THIRD FIVE-YEAR REVIEW REPORT FOR GILT EDGE MINE SUPERFUND SITE LAWRENCE COUNTY, SOUTH DAKOTA

JUNE 2017

Prepared by

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6/20/17
Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
ARD	Acid Rock Drainage
BMC	Brohm Mining Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
IC	Institutional Control
MCL	Maximum Contaminant Level
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
RAO	Remedial Action Objective
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Level
SCADA	Supervisory Control and Data Acquisition
SD DENR	South Dakota Department of Environment & Natural Resources
SWQS	Surface Water Quality Standards
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UU/UE	Unlimited Use and Unrestricted Exposure
WTP	Water Treatment Plant

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the third FYR for the Gilt Edge Mine Superfund Site (the Site). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared due to the fact that hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

To manage Site investigations and cleanup, EPA designated three operable units (OUs) at the Site. All three OUs are addressed in this FYR.

- OU1 addresses the primary mine disturbance area, including acid-generating waste rock and fills, spent ore, exposed acid-generating bedrock and sludge.
- OU2 addresses water treatment, groundwater and Lower Strawberry Creek.
- OU3 addresses contaminant sources within Ruby Gulch Waste Rock Dump.

Interim remedies are in place for OU2 and OU3. A final OU1 remedy has been determined, but not yet been fully implemented. The FYR was led by EPA remedial project manager Joy Jenkins. Participants included Mark Lawrensen from the South Dakota Department of Environment & Natural Resources (SD DENR), and Kirby Webster from EPA contractor Skeo. The review began on 6/6/2016. Appendix A includes documents reviewed as part of this FYR.

EPA is the lead agency for developing and implementing the remedy for the Superfund-financed cleanup at the Site. SD DENR, as the support agency representing the State of South Dakota, has reviewed all supporting documentation and provided input to EPA during the FYR process.

Site Background

The 360-acre Site is located in a rural area of the Black Hills in Lawrence County, South Dakota, about 6 miles south-southeast of the towns of Lead and Deadwood on county road FDR170 (Figure C-1 and C-2). The Site is located in mountainous terrain adjacent to the upper reaches of Strawberry Creek. It is in the headwaters of three tributaries (Strawberry Creek, Terrible Gulch and Ruby Gulch) that drain into Bear Butte Creek. Tributary drainages contribute flow to Strawberry Creek. These tributaries include Hoodoo Gulch, Boomer Gulch, Cabin Creek and several ephemeral drainages. Site aquifers include bedrock and alluvial aquifers. The alluvial aquifers are often perched above the deeper aquifers at the Site, with a zone of unsaturated rock in between.

Since the late 1800s, the Site has been used extensively for mining and mineral processing operations, including a heap leach gold mining operation. Many features associated with mining remain. These include open pits, underground mine workings, and rotary and core holes drilled across the surface of the mine. The most recent operator, Brohm Mining Company (BMC), abandoned the mine in July 1999. EPA listed the Site on the Superfund program's National Priorities List (NPL) in December 2000. Appendix B includes a Site chronology. Current Site uses are restricted to EPA-controlled Superfund activities related to Site maintenance and remediation.

Wastes associated with mining activities included waste rock, tailings and spent ores. These wastes are contaminated with a wide array of metals. Mine waste rock is found in many areas of the Site. Major Site features include the 31-acre Sunday Pit, the 14-acre Dakota Maid Pit and the 28-acre Anchor Hill Pit. The heap leach pad covers 37 acres; waste material there reaches 150 feet in height. The Ruby Repository was constructed to cover the Ruby Gulch Waste Rock Dump; it is about 75 acres in size and contains approximately 20 million tons of waste rock and spent ore.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Gilt Edge Mine		
EPA ID: SDD987673985		
Region: 8	**State:** SD	**City/County:** Lead/Lawrence
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA		
Author name: Joy Jenkins and Kirby Webster		
Author affiliation: EPA Region 8 and Skeo		
Review period: 6/6/2016 – 6/21/2017		
Date of site inspection: 8/30/2016		
Type of review: Statutory		
Review number: 3		
Triggering action date: 6/21/2012		
Due date *(five years after triggering action date)*: 6/21/2017		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The most significant threat to human health and the environment at the Site stems from the potential for releases of metals-contaminated acid rock drainage (ARD) to downstream fisheries and residential and municipal water users. In addition, contaminated surface soil may pose risks to human health and the environment. Table 1 shows Site contaminants of concern (COCs) by soil, surface water and groundwater as identified in baseline human health and ecological risk assessments.

Table 1: Contaminants of Concern

COC	Media		
	Surface Soil[a]	Surface Water[b]	Groundwater[a]
Aluminum			X
Antimony			X
Arsenic	X	X	X
Cadmium		X	X
Chromium		X	X
Copper		X	X
Cyanide		X	
Iron			X
Lead		X	X
Mercury		X	
Manganese			X
Nickel		X	
Selenium		X	
Silver		X	
Thallium	X		X
Zinc		X	X

Notes:

a. Information obtained from Exhibit 7.1 of the 2008 OU1 Record of Decision (ROD) based on human health risks.

b. Obtained from Table 2 of the April 2001 OU2 Interim ROD.

Response Actions

After BMC abandoned the mine in 1999, the State assumed Site maintenance and water treatment activities using the South Dakota Regulated Substance Response Fund. In August 2000, EPA took over emergency response activities from the State of South Dakota. EPA completed interim remedial actions at OU2 and OU3 to address the immediate threat to human health and the environment at the Site from the potential for releases of metals-contaminated ARD. EPA is currently implementing remedial actions at OU1 to remediate source areas. A summary of interim and final response actions for each OU is provided below. The OU2 remedial investigation and feasibility study (RI/FS) will follow once the OU1 remedy is in place.

OU1 – Primary Mine Disturbance Area

(existing contaminant sources in the primary mine disturbance area such as acid-generating waste rock and fills, spent ore, exposed acid generating bedrock and sludge)

The Site's OU1 2008 Record of Decision (ROD) defined the following remedial action objectives (RAOs):

- Manage ARD source materials to reduce the volume of ARD that requires on-Site treatment.
- Reduce or eliminate the risk of an uncontrolled release of ARD from the Site as a result of a 100-year, 24-hour storm event.
- Ensure that low-intensity recreational Site users and commercial workers have no more than a 1×10^{-4} chance of contracting cancer from ingestion and inhalation of on-Site soils.
- Ensure that low-intensity recreational Site users and commercial workers are protected against noncancer effects through inhalation and ingestion of surface soil for contaminants that exceed a hazard index of greater than or equal to 1.
- Reduce risks to terrestrial ecological receptors through control of mine waste.
- Implement institutional controls to prevent the unacceptable uses of groundwater that pose human or ecological risks.
- Implement institutional controls that limit residential and off-road motorized vehicle rider use and allow only low-intensity recreational Site users and commercial workers.
- Ensure the remedy is compatible with existing and future RODs for the Site.

The OU1 remedy was selected in the Site's 2008 ROD and modified by a 2014 Explanation of Significant Differences (ESD) summarized in Table 2.

Table 2: OU1 Remedy from the 2014 ESD

Area	OU1 ROD Remedy	2014 ESD Remedy	Goal
Anchor Hill Pit	Anchor Hill Pit for ARD Storage	Backfill and cover to reduce infiltration to groundwater through the pit and reduce volume of ARD generated.	ARD source reduction and groundwater protection
Heap Leach Pad	Heap Leach Pad configured for sludge disposal	Construct new impoundments at the Heap Leach Pad for ARD storage and management as well as sludge disposal.	ARD water storage and management
Hoodoo Fills	ROD implied removal of Hoodoo Fills, but was not specific	Hoodoo fills will be partially excavated and consolidated into the pits; remaining contaminated materials will be covered in place to reduce ARD generation. Clean water diversions will be implemented to prevent infiltration (not a significant change/clarification only).	ARD source reduction and groundwater protection
Process Plant	Remain in place with contaminated materials surrounding the building	The process plant will be demolished and contaminated fills underneath the plant will be excavated and consolidated into the pits to reduce ARD generation. Need for collection system in this area eliminated. New	ARD source reduction and groundwater protection

Area	OU1 ROD Remedy	2014 ESD Remedy	Goal
		maintenance building to be constructed in the future.	
Union Hill	A significant portion of the Dakota Maid and Sunday pits acid-generating highwalls would remain exposed.	A portion of Union Hill will be removed to allow creation of a contiguous cap over Dakota Maid and Sunday pits to the Ruby Waste Rock Dump cap and coverage of the highwalls, resulting in reduction of ARD generation and elimination of spalling of acid generating rock on to the clean cap.	ARD source reduction and groundwater protection
Rinsate Water	Collect, transfer and treat through existing water treatment plant (WTP)	Newly exposed parent ground will be amended with a neutralizing agent (lime) and clean fill to prevent or reduce the generation of impacted rinsate. As a precaution, rinsate collection basins will allow for flexibility to manage impacted rinsate water in the WTP, or in semi-passive localized treatment systems tested in the OU2 RI/FS or released to the stream if water quality is suitable.	Surface water protection (reduce or eliminate generation of impacted rinsate water)
Capability for Future Pit Water Level Management	Collection systems will be installed at the base of Dakota Maid and Sunday pits covers to maintain acceptable ARD levels in submerged portions of the pits.	Remedy was modified to include wells in each pit backfill that can be used for water extraction. A single, free-draining collection feature at the bottom of Dakota Maid Pit will drain both Sunday and Dakota Maid pits.	Compatibility with OU2 water collection and management
WTP Upgrades	WTP upgrades to treat high sulfate water; a second reactor tank, a second clarifier and building expansion was anticipated	WTP modifications to treat high sulfate water will be delayed until water quality and quantity changes resulting from OU1 remedial action implementation are determined and required discharge quality is determined. Modifications will be evaluated in the OU2 RI/FS. High sulfate water that is generated on Site currently is expected to be treated in current WTP at low flow rate or other temporary treatment employed.	Compatibility with OU2 water collection and management
Note: Table 3 of the 2014 ESD			

Table 3 lists OU1 surface soil cleanup goals.

Table 3: OU1 Surface Soil Cleanup Goals

Medium	Chemical	Remedial Goal[b]	Remedial Action Level[c]
Surface Soil[a]	Arsenic	596 mg/kg	1,125 mg/kg
	Thallium	134 mg/kg	200 mg/kg

Notes:

a. From Exhibit 8-1 in the 2008 OU1 ROD. Cleanup goals are based on results of the Baseline Human Health Risk Assessment for low-intensity recreational hikers and commercial workers. Ecological remedial cleanup levels were not developed at the time of the 2008 ROD. Cleanup goals were not reevaluated in the 2014 ESD.

b. Remedial goal, defined as average concentration of a chemical in an exposure unit associated with a target risk level such that concentrations at or below the remedial goal do not pose unacceptable risk greater than 1×10^{-4} or noncancer hazard index greater than 1.0.

c. Remedial action level, defined as the maximum concentration of a contaminant that can be left in place such that the average is at or below the remedial goal.

mg/kg = milligrams per kilogram

OU2 – Water Treatment, Groundwater and Lower Strawberry Creek
(ARD management, including collection systems, pipelines, water treatment and future generation of ARD treatment sludge; groundwater contamination associated with the Site; and contaminant sources, surface water and sediments in the lower Strawberry Creek area)

In 2001, EPA prepared an OU2 Early Action Interim ROD and an Interim ROD. The response action selected in these decision documents was necessary to protect public health and the environment from actual or threatened releases of hazardous substances. OU2 RAOs were defined in these Interim RODs:

- Maintain Site control and operational infrastructures.
- Capture source water and ARD.
- Treat source water and ARD on Site to reduce the toxicity of the water prior to discharge.
- If possible, treat sufficient ARD volumes to gain storage and/or dewater the Site during low precipitation cycles.
- Meet surface water discharge quality goals at the compliance point in Strawberry Creek.
- Prevent direct exposure of human and environmental receptors to elevated concentrations of contaminants in surface water drainage from the Site.
- Reduce or eliminate ARD water flow into Ruby Gulch and Strawberry and Bear Butte Creeks.
- Achieve compliance, to the extent possible and practicable for the interim, with currently applicable water quality standards.
- Minimize waste and disposal requirements.
- Integrate water treatment with overall Site closure and reclamation activities.
- Maintain compatibility with Site-wide RAOs and final treatment remedial action.
- Minimize expenditures for water treatment at the Site during closure activities (determine a preliminary minimum cost to Site closure comparison between recommended alternatives, based on present worth analysis).

The OU2 interim remedy includes:

- Collect water with enhanced metals reduction treatment and improved sludge management.
- Collect and convey ARD seep flows from Hoodoo Gulch and Pond C to the WTP.
- Modify the existing sodium hydroxide-based WTP to convert to either (1) lime-based neutralization/precipitation process, including, if necessary, a circular clarifier and/or filtration equipment for post sedimentation effluent polishing; or (2) construct a new optimized chemical precipitation WTP using a proprietary metals-coordination process with microfiltration and pH adjustment.
- If necessary, dewater solids produced with a filter press and contain de-watered sludge on Site.

Although numeric cleanup levels for surface water were not specified in the Interim ROD, South Dakota Surface Water Quality Standards (SWQS) were identified as applicable or relevant and appropriate requirements (ARARs) in the August 2001 OU2 Feasibility Study (Table 4 below). EPA adopted a waiver for the total dissolved solids (TDS) and selenium ARARs for interim water treatment. At the time of the OU2 interim remedy selection, the ability of the water treatment process to consistently meet TDS and selenium water quality standards was uncertain. The SWQS are anticipated to be met as a part of the final remedy.

Table 4: OU2 Feasibility Study Summary of ARAR SWQS

Constituent	Standard	Unit
Arsenic	190	µg/L
Cadmium	2.87[a]	µg/L
Chromium (III)	554[a]	µg/L
Chromium (VI)	10	µg/L
Copper	37.11[a]	µg/L
Lead	10.94[a]	µg/L
Mercury	0.012[b]	µg/L
Nickel	507.89[a]	µg/L
Selenium	5	µg/L
Silver	37.4[a]	µg/L
Zinc	338.28[a]	µg/L
Cyanide (weak acid dissociable)	5.2	µg/L
Nitrate as N	≤ 50	mg/L
TDS	≤ 2,500	mg/L
pH	6.6 - 8.6	standard units
Total suspended solids (TSS)	≤ 90	mg/L

Notes:

a. Hardness dependent criteria in micrograms per liter (µg/L). Value given is based on a calcium carbonate hardness of 400 milligrams per liter (mg/L). Criteria for other hardness values must be calculated using the equations taken from Quality Criteria for Water 1986 (Gold Book).

b. Criteria based on total recoverable fraction of the metal.

From Table 3-1 of the Site's 2001 OU2 FS.

Constituent	Standard	Unit
µg/L = micrograms per liter mg/L = milligrams per liter		

OU3 – Ruby Gulch Waste Rock Dump
(contaminant sources within Ruby Gulch Waste Rock Dump)

In 2001, EPA selected an interim remedy for OU3 to protect the public health and the environment from actual or threatened releases of hazardous substances. The purpose of the Interim ROD for OU3 was to:

- Control erosion of mine waste contaminants into Ruby Gulch and Bear Butte Creek.
- Reduce formation and volume of ARD.
- Reduce leaching and migration of contaminants from mine waste into surface water.
- Reduce leaching and migration of contaminants from mine waste that may enter groundwater.

The OU3 interim remedy includes:

- Regrading of waste rock, including placement of waste rock in the upper Ruby Gulch drainage.
- Construction of a composite cap using a geomembrane liner.
- Installation of lateral drainage structures to limit erosion and convey runoff.
- Construction of a protective layer of the liner and surface water controls.
- Construction of surface water run-on diversion channels.

Status of Implementation

OU1 - Primary Mine Disturbance Area
EPA began the remedial design for OU1 in 2008 and completed it in 2014. The construction began in March 2017. It is expected to take eight to ten years to complete the remedial action. The OU1 remedial action builds on the interim OU2 and OU3 remedies implemented at the Site and is expected to significantly reduce the volume of ARD generated at the Site in response to meteoric precipitation. Once the OU1 remedy is implemented and the effectiveness of the remedy is determined, a final remedy for surface water and groundwater will be identified and implemented under OU2. The cover system of Dakota Maid pit in OU1 will tie into the cover system of the Ruby Repository, OU3, completing the repository cap. EPA will issue final RODs for OU2 and OU3 upon completion of the OU1 remedy.

OU2 – Water Treatment, Groundwater and Lower Strawberry Creek
The OU2 remedial action for the interim remedy began in July 2001, and finished in October 2003. Under this interim remedial action, an ARD collection and conveyance system was constructed for Hoodoo Gulch and Pond C and the existing sodium hydroxide water treatment process was converted to a lime-based high-density sludge process. The treatment generated sludge is disposed of on Site on the Heap Leach Pad Extension.

At the time of the OU2 interim remedy selection, the ability of a lime-based high-density sludge water treatment process to consistently meet TDS and selenium water quality standards was uncertain. Because of this, EPA waived these standards for the interim ROD. EPA intends to select a final remedy for OU2 that will achieve current federal and state surface water standards once the OU1 remedy is implemented.

Water samples were collected weekly through 2012 and are now collected monthly from the WTP effluent and at two downstream surface water compliance points (Figure C-3 and C-4):

- CP-001 – in Strawberry Creek, 10 yards downstream from the confluence of Strawberry Creek and Boomer Creek.

- CP-003 (replaced former CP-002) – in Ruby Gulch downstream of Ruby Waste Rock Dump and the final sedimentation pond.

Surface water samples are analyzed for a suite of metals, alkalinity, cyanide and physical parameters and compared to state SWQS.

OU3 – Ruby Gulch Waste Rock Dump

Construction of Ruby Repository finished in September 2003. Under the interim OU3 ROD, waste rock was regraded and placed in the upper Ruby Gulch drainage. A composite cap was constructed with a geomembrane liner, protective fill and soil layers, and vegetated. Lateral drainage structures and surface water controls and diversion channels were constructed to reduce surface water infiltration. Rock, fill and soil material were sourced from excess rock and soils from the Highway 385 project and from on-Site sources.

In 2009, $3.5 million in American Recovery and Reinvestment Act funds were used to implement the ditch grouting and lining work for OU3. Approximately 1,000 linear feet of the ditches were cleaned of rock, riprap and other loose debris, drilled to an average depth of 20 feet and pressure grouted, which involves injecting concrete to seal joints, cracks and fractures. In 2010 and 2011, drilling and pressure grouting continued. Some ditches were also lined with an impermeable geomembrane to reduce infiltration. Approximately 3,200 linear feet of ditch were grouted and approximately 660 linear feet of ditch were lined with geomembrane to reduce or eliminate surface water infiltration into the Ruby Repository.

Institutional Control (IC) Summary

Table 5 lists the current status of institutional controls at the Site. There are currently no completed exposure pathways to contamination that remain on Site. Current Site activities include interim remedial activities. The specific institutional control instruments to restrict future use on the Site will be determined once final remedies are completed.

Table 5: Summary of Planned Institutional Controls (ICs)

Media, Engineered Controls and Areas that Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
OU1 – Caps and Repository	Yes	Yes	Caps and Repository	Limit residential and off-road motorized vehicle rider use and allow only low-intensity recreational Site users and commercial workers.	Planned
OU1 – Caps and Repository	Yes	No	Caps and Repository	Restrict other activities that could disturb the caps and waste remaining in place.	To be determined and documented in a future institutional control instrument

Media, Engineered Controls and Areas that Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
OU3 – Caps and Repository	Yes	No	Ruby Repository	Restrict disturbance of caps and waste remaining in place.	Planned to be addressed in Final OU3 ROD
OU2 - Groundwater	Yes	Yes, in OU1 ROD	Groundwater Plume	Prevent the unacceptable uses of groundwater that pose human or ecological risks.	Planned to be addressed in the Final OU2 ROD

Systems Operations/Operation & Maintenance (O&M)

The Site is not currently in the O&M phase.

Interim remedy activities include ongoing water collection, conveyance and treatment as well as Site water quality monitoring by EPA contractors. Performance monitoring activities are described in detail in the 2014 Performance Work Statement. There are many ARD collection and conveyance facilities at the Site. Generally, ARD is collected from seeps or drainages on Site and pumped to the mine pits for storage prior to treatment. Specifically, ARD is collected and then transferred using pumping systems at Ruby Repository, Hoodoo Gulch and Pond E. The ARD is pumped from these locations to the Sunday Pit, or Anchor Hill Pit for storage. The pumping system at Pond E delivers water to the WTP. Water treatment needs are driven by precipitation. In November 2013, a new heated tipping-bucket gauge was installed at the Ruby Repository pump house to improve accuracy in measuring precipitation. Precipitation varies greatly over small distances because of the area's topography.

Activities also include general Site maintenance of roads and facilities and Site security. Site staffing has recently been reduced from 10 to six full-time staff members due to the automation upgrades. New fencing has been installed to further protect potential trespassers from potential exposure or physical hazards associated with the Site.

The 2014 OU1 ESD estimates the OU1 remedy to cost $87.8 million and annual operations to cost $1.1 million. Annual costs for the interim OU2 remedy were estimated at approximately $3 million per year. Actual operating costs have been approximately $2 to $2.3 million per year for OU2. OU2 operating costs include collection, conveyance, and treatment of impacted water at the Site from several sources including water collected at the toe of the Ruby Repository (OU3). A reduction in costs occurred in 2016, due to the installation of an automation system for the collection and conveyances systems including upgrades to the supervisory control and data acquisition (SCADA) system. These upgrades have reduced labor costs associated with ensuring the continued operation of the water collection and conveyance systems. 2016 costs were $1.5 million. Annual costs for the interim OU3 remedy were estimated at $31,100 per year. Actual OU3 costs have been approximately $15,000 per year. Operating costs include inspection of the cover for erosion or other damage, noxious weed spraying and removal of saplings.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 6: Protectiveness Determinations/Statements from the 2012 FYR

OU #	Protectiveness Determination	Protectiveness Statement
2	Not Protective	Although no unacceptable risks to human health are present at OU2, the interim remedy at OU2 is not protective because of the following issue: the current chronic cadmium South Dakota Surface Water Standard is regularly exceeded at the instream monitoring points. The source of the instream cadmium concentrations appears to be from dispersed mine waste material or sources that are not addressed in the interim remedy. The planned remedy at OU1 is anticipated to further reduce stream contamination from dispersed sources at the Site. In addition, the following actions need to be taken: evaluate sources of this contaminant in the pending OU2 remedial investigation and feasibility study (RI/FS). The RI/FS will be completed after the OU1 remedy is in place.
3	Protective	The interim remedy at OU3 is protective of human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Table 7: Status of Recommendations from the 2012 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
2	The current chronic cadmium standard is regularly exceeded at specific instream monitoring points.	Evaluate sources of this contaminant in the pending OU2 RI/FS.	Ongoing	The chronic cadmium standard continues to be exceeded. Monitoring will continue to determine if implementation of the OU1 remedy reduces cadmium exceedances. The OU2 RI/FS has not yet been completed and is dependent on the implementation of the OU1 remedial action.	NA
2	Alkalinity, conductivity, chromium VI, arsenic and mercury are not regularly monitored at surface water compliance points and alkalinity, chromium VI and mercury are not regularly monitored in treatment plant effluent as recommended from the last FYR.	Review the monitoring plan. Determine if further changes are necessary.	Completed	The 2014 Performance Work Statement indicates required monitoring is occurring.	8/26/2014

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement and Site Interviews

A public notice was made available on the website[1] in August 2016, stating EPA was beginning the FYR process. The invitation for the public to submit any comments to EPA was posted in February 2017. Additionally, local town and county officials were contacted in August of 2016 informing them of the Five-Year Review and asking for interviews. The results of the review and the report will be made available at the Site's information repository, located at Phoebe Apperson Hearst Public Library, located at 315 Main Street, Lead, South Dakota 57754.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date**.** The results of these interviews are summarized below. Completed interview forms are included in Appendix E.

Most interview participants felt well-informed about where to find Site information and did not have any concerns with cleanup or maintenance activities at the Site. The Site's manager Paul Hight stated that the community is satisfied with EPA's leadership at the Site, and had no comments, suggestions or recommendations regarding long-term Site management. Allen Bonnema from the Lawrence County Transportation Department indicated some concern with keeping the surrounding off-Site public roads maintained, and dust, traffic and light pollution potentially affecting people living near the Site during the upcoming OU1 remedial action activities. Mayor Ron Everett feels that cleanup actions to date have been too costly and believes the Site's long-term management should include active mining. Lead City Administrator Mark Stahl is unaware of any Site concerns and feels there have been no impacts on the local community. Mark Lawrensen of SD DENR concurs with the Site's current schedule and construction plans. Daryl Johnson, Lawrence County Board of Commissioner's Chair, suggested communicating with people in the near vicinity of the Site by stopping in to talk with them instead of just sending letters.

Data Review

Current data collections are mainly associated with OU2. Data collected at the Site are used to evaluate the effectiveness of the ARD collection facilities and treatment operations. Data collected also provide information about the effectiveness of the current OU3 and future OU1 remedies.

ARD Treatment monitoring (monthly) samples are used to monitor the performance of the water treatment system and collection facilities. ARD Collection Monitoring (quarterly sampling) of surface and groundwater consists of sampling locations throughout the Site and at off-Site locations downstream. Quarterly sampling is performed to further evaluate the effectiveness of ARD collection systems, monitor the groundwater plume, and assess the effectiveness of the OU3 interim remedy. Quarterly sampling also will provide a baseline comparison point for data that will be collected during and after construction of the OU1 remedy. The quarterly monitoring data will inform the future final remedy selection for OU2.

ARD Treatment Monitoring

Water quality monitoring within the treatment system and of system influent sources is used to evaluate the performance of the WTP. Two locations downstream of the collection facilities are used to evaluate the performance of the collection facilities. Monitoring locations include:

- WTP influent and effluent.
- Hoodoo Gulch Collection and Pump Back System.
- Ruby Repository Toe and Ruby Repository Wet Well.

[1] Available at: www.epa.gov/superfund/gilt-edge

- Pond C to Pond D ARD Conveyance.
- Strawberry Creek (CP-001) (downstream of the Hoodoo Gulch and Strawberry Pond collection facilities).
- Ruby Gulch (CP-003) (downstream of the OU3 remedy).

This data section discusses performance monitoring data collected from 2012 through 2015 from the WTP effluent and the two surface water compliance points (CP-001 and CP-003) in detail (see Figures C-3 and C-4 in Appendix C for locations). Results at these locations will be compared for compliance with the current Site specific water quality standards.

WTP effluent samples were collected weekly through 2012 and have been collected monthly since January 2013. Samples are collected from the end of the pipe immediately prior to discharge into Strawberry Creek. Data are compared to the applicable South Dakota SWQS for acute and chronic exposure. There were no acute exceedances of the SWQS in 2015. Dissolved cadmium has periodically exceeded the numeric value of the chronic SWQS during this FYR period, usually in the winter months. Dissolved selenium concentrations have also exceeded the chronic SWQS. An ARAR waiver is in place for selenium. Figures H-2 and H-3 in Appendix H show the dissolved cadmium and selenium concentrations, respectively. In addition to dissolved selenium and cadmium, the following constituents have exceeded either the acute or chronic SWQS during this FYR period:

- Dissolved copper has periodically exceeded both the acute and chronic SWQS. The last exceedance was in 2012.
- Conductivity has periodically exceeded the chronic SWQS. The last exceedance was in 2013.
- TDS has exceeded the chronic SWQS only once, in March 2013. An ARAR waiver is in place for TDS.
- Total suspended solids (TSS) have exceeded both the acute and chronic standards periodically in 2010, 2012 and 2014.

Surface water compliance sampling locations have been sampled weekly since 1993; in January 2013, sampling frequency was changed to monthly. Sampling location CP-001 is located about 1.25 miles downstream from the WTP discharge. Water sampled at CP-001 includes inflows from several tributary drainages and groundwater. During dry periods, the WTP discharge is a major component of flow at CP-001. There were no acute SWQS exceedances in 2015. However, the calculated numeric value for chronic SWQS for dissolved cadmium was exceeded each month in 2015 and frequently during this FYR period (Figure H-4 in Appendix H), when compared to the result of the monthly grab sample. This is a conservative approach to looking at the chronic standard without taking chronic samples. The cadmium concentrations in the WTP discharge and at CP-001 are compared in Figure H-5 in Appendix H. Cadmium concentrations at CP-001 are typically higher than the WTP discharge, indicating that a downstream source located between the discharge pipe and CP-001 is contributing cadmium to the stream. The chronic standards are based on the average result of multiple discrete samples collected within 30 days. However, since the Site is well characterized and a potential source of the chronic exceedance of cadmium is expected to be mitigated by the OU1 remedy, the sampling frequency was reduced from weekly to monthly in 2013. Any sources remaining after the OU1 remedy implementation, will be investigated further in the OU2 RI/FS.

The Ruby Gulch sampling location (CP-003) is located about 500 feet downstream of the ARD collection facilities at Ruby Repository. Water at CP-003 is essentially a groundwater-fed spring where the Ruby Gulch alluvial aquifer discharges at the surface. Site CP-003 measures the performance of the primary and secondary ARD collection systems at Ruby Gulch. Since 2012, there have been no exceedances of the acute or chronic SWQS for dissolved metals at CP-003.

ARD Storage

Monitoring of ARD storage is conducted to maintain the Site's water balance and includes routine surveys of stored ARD volumes, climate monitoring and monitoring of inflow rates from various ARD sources. Water levels in wells surrounding the pit lakes are also monitored to assess hydraulic communication between stored ARD in the pits and groundwater. ARD volumes are calculated monthly and inflow rate monitoring is conducted daily. Since 2012, the peak volume of ARD stored at the Site has increased slightly as a result of increased precipitation. Despite these increases, the peak stored ARD volume at the Site in 2013 and 2014 is approximately half the volume stored in 2006-2007 at its peak. The normalized ARD yield (total inflow divided by total precipitation) at the Site in 2015 was 3.9 million gallons per inch of precipitation based on the recently installed on-Site rain gauge. Previous measurements were based on the Lead weather station. Since measurements began in 2000, 2015 had the second highest net inflow and precipitation.

ARD Collection Monitoring

Surface Water Monitoring

The general purposes of the surface water sampling program are:

- To evaluate the performance of interim remedial actions including the ARD collection and treatment in reducing effects to surface water in Bear Butte Creek.
- To evaluate potential effects on Strawberry Creek water quality caused by ARD-affected groundwater seeps.

Monitoring locations have been sampled quarterly since 2005 and include the following seven locations (see Figure C-3 and C-4 in Appendix C for map depicting locations):

- Bear Butte Creek Water Quality
    - SWCDM33: Bear Butte Creek upstream of Strawberry Creek confluence (background)
    - SW3: Bear Butte Creek downstream from Strawberry Creek confluence
    - SWCDM38: Bear Butte Creek downstream from Ruby Gulch confluence
- Tributaries to Bear Butte Creek
    - SWCDM35: Terrible Gulch just upstream from confluence with Bear Butte Creek
    - SWCDM37: Ruby Gulch just upstream from confluence with Bear Butte Creek
- Strawberry Creek:
    - OPCDMSC: Strawberry Creek upstream of confluence with Hoodoo Gulch
    - GESW7: Strawberry Creek upstream from the confluence of Boomer Gulch

Surface water sampling results are provided in the 2015 Annual Summary Report. There were no exceedances of the acute SWQS in 2015 in any of the quarterly surface water sampling locations. Cadmium exceeded the numeric value of the chronic SWQS at both surface water sampling locations on Strawberry Creek and at SWCDM 38 on Bear Butte Creek in December 2015.

Groundwater Monitoring

Groundwater monitoring has been conducted since 2005 to evaluate:

- The performance of the alluvial groundwater collection systems in Strawberry Gulch, Hoodoo Gulch and Ruby Gulch in reducing discharge of ARD-related contaminants via the alluvial groundwater system.
- The extent of the contaminant plume in the bedrock aquifer.
- The rate and extent of contaminant migration from the pit lakes.

The alluvial aquifers in Strawberry Gulch, Hoodoo Gulch and Ruby Gulch are affected by ARD. However, ARD-affected alluvial groundwater is collected to the extent practical where it daylights through seeps and at subsurface collection points, where it is pumped into the ARD treatment circuit. In the lower portions of the gulches, the alluvial aquifers are in direct communication with surface water. There are currently 23 monitoring wells in the quarterly groundwater sampling program – three alluvial monitoring wells and 20 bedrock wells.

There is currently no groundwater remedy in place. The OU1 remedy implementation is expected to mitigate sources that migrate to the groundwater. A final remedy will address groundwater. The extent of groundwater in the bedrock aquifer that exceeds applicable South Dakota site-specific groundwater quality standards is presented in Appendix H, Figure H-1. Compounds exceeding state standards in 2015 include:

- Metals: aluminum, arsenic, beryllium, cadmium, copper, lead, manganese, molybdenum, nickel and zinc.
- Fluoride, sulfate, TDS and pH.

These exceedances are contained within the Site boundary.

Site Inspection

The Site inspection took place on 8/30/2016. In attendance were EPA remedial project manager Joy Jenkins, Mark Lawrensen from SD DENR and Kirby Webster from EPA contractor Skeo. The purpose of the inspection was to assess the protectiveness of the remedy. The Site inspection checklist is in Appendix D. Site inspection photos are in Appendix F.

Site inspection participants met in the Site building for a health and safety briefing with Site manager Paul Hight. Site inspection participants toured the Site. The Site has fencing, and gated vehicle entrances, which are locked at all times. Signs clearly indicate the boundaries of the Site and "no trespassing" signs were visible. A three-strand barbed wire has been added to the Site to inhibit public access to physical hazards at the Site.

Site inspection participants toured Site features, including the Heap Leach Pad, Anchor Hill Pit, Union Hill, Dakota Maid Pit, the Stormwater Pond, the WTP, Ruby Repository and the treatment plant sludge storage area. All Site roads and remedy components are in good condition. The WTP was not operating at the time of the Site inspection because of the low water levels in the storage ponds. The vegetative cover on Ruby Repository is well established. No trees or deep growing plants that would impact cover integrity were observed. The WTP outflow had no discharge because the treatment plant was not active and Strawberry Creek in the vicinity of the WTP outflow was dry.

Skeo visited the Site information repository, Phoebe Apperson Hearst Public Library, located at 315 Main Street, Lead, South Dakota 57754. The repository had the complete administrative record with some documents in hard copy and some on CD.

V. TECHNICAL ASSESSMENT

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

Question A Summary:

The OU1 remedial action builds on the interim OU2 and OU3 remedies implemented at the Site. Construction of the remedy is starting in the spring of 2017. Therefore, it is premature to determine if the remedy is functioning as intended by decision documents. Once the OU1 remedy is implemented and the effectiveness of the remedy is determined, a final remedy for surface water and groundwater, will be identified and implemented under OU2. Final RODs will be issued at that time.

No, the interim OU2 remedy is not fully functioning as intended by the interim decision documents. The OU2 interim action has resulted in reduced migration of metal contaminants and acid water in surface water discharge to Strawberry Creek. Contamination in WTP effluent and surface water compliance points has declined and is generally in compliance with the relevant surface water standards. However, the numeric value for the current chronic cadmium standard is periodically exceeded at WTP effluent and surface water sampling location CP-001 on Strawberry Creek. A conservative approach assumes exceedances of the chronic water quality standard for cadmium indicates that the interim remedy is not protective for aquatic life exposure. As discussed in the data analysis section, results indicate that the WTP effluent is not responsible for the elevated cadmium concentrations in Strawberry Creek. The periodic exceedances in the WTP effluent primarily occur during the winter months. It is hypothesized that other sources and contaminant transport pathways are contributing to the cadmium concentrations in Strawberry Creek. The planned final remedy for OU1 is anticipated to further reduce stream contamination from dispersed sources at the Site. Remaining contaminant sources will be evaluated in the OU2 RI/FS.

Yes, the OU3 remedy is functioning as intended by the interim decision documents. The OU3 interim action has controlled erosion of mine waste into local water courses and controlled formation of ARD and leaching and migration of contaminants from mine waste into surface water and local groundwater. There have been no exceedances at the Ruby Gulch surface water sampling point, CP-003, indicating that the two ARD collection systems at Ruby Repository are effective in collecting ARD from the alluvial aquifer in this area.

A Site-wide Performance Monitoring Plan has been implemented at the Site to monitor ARD collection, water treatment and storage, and changes in Site conditions. The Site is currently fenced and public access is restricted. Groundwater contamination is localized on Site and groundwater is not used for drinking water. The final Site remedy will include land use controls to prevent the unacceptable uses of groundwater that pose human or ecological risk, limit residential and off-road motorized vehicle rider uses, and allow only low-intensity recreational users and commercial workers. The land use controls will consist of a combination of institutional controls, which may include community awareness programs and land-use restrictions, and engineered controls. In the interim, exposure pathways are controlled through access restrictions, worker safety measures, and treatment of contaminated surface water prior to discharge to Strawberry Creek. Restrictions will be needed to protect caps and covers for contamination left in place as part of the OU1 and OU3 remedies.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:

Yes, RAOs used at the time of remedy selection are still valid. Comparisons of remedial cleanup levels established in the OU1 ROD and the OU2 and OU3 early and interim remedies result in the following observations.

The 2008 OU1 ROD established surface soil remedial goals for arsenic and thallium based on recreational hiker and commercial worker exposures. Appendix G compares 2008 remedial goals to current toxicity values. These results indicate that the recreational-based remedial goals presented in the 2008 OU1 ROD for arsenic and thallium may need to be reevaluated to determine if the exposure factors in the 2006 Memorandum remain valid with anticipated Site use. The OU1 planned remedy is anticipated to be protective even with the updated toxicity values because waste left in place will be covered with clean soils.

Some South Dakota SWQS have become more stringent than at the time of the development of the Interim ROD for OU2 (see Table G-3, Appendix G). Water treatment discharge and surface water quality are sampled regularly and compared to the current, applicable South Dakota surface water standards. State SWQS for TDS and selenium were waived with the understanding that they will be part of the final remedy.

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

No new information has come to light to call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues and Recommendations Identified in the FYR:

OU: 1	**Issue Category: Remedy Performance**			
	Issue: A screening level risk evaluation indicates surface soil remedial goals for arsenic and thallium may no longer be valid for recreational and commercial worker use.			
	Recommendation: Reevaluate OU1 remedial goals for arsenic and thallium to determine if changes are needed. Document these changes as appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	8/31/2018

OU: 2	**Issue Category: Remedy Performance**			
	Issue: Some surface water locations exceed the calculated numeric value for the chronic cadmium standard.			
	Recommendation: The OU1 Final Remedy is anticipated to address sources of cadmium in Strawberry Creek. Evaluate the cause of the exceedances and potential solutions upon completion of the OU1 remedy, during the OU2 RI/FS.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA	EPA	4/3/2022

OUs: 3	**Issue Category: Institutional Controls**			
	Issue: No land use restrictions are in place for waste remaining on Site and they are not called for in a decision document.			
	Recommendation: Determine appropriate restrictions for waste remaining on Site and formalize this decision in the final OU3 ROD.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	4/3/2022

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement	
Operable Unit:1	*Protectiveness Determination:* Will be Protective
Protectiveness Statement: The remedy at OU1 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.	

Protectiveness Statement	
Operable Unit:2	*Protectiveness Determination:* Not Protective
Protectiveness Statement: The interim remedy at OU2 is not protective because of the following issue: the numeric value for the chronic cadmium standard for aquatic life is periodically exceeded in surface water. The following actions need to be taken: evaluate this issue during the OU2 RI/FS, after the OU1 remedy has been implemented to ensure protectiveness.	

Protectiveness Statement	
Operable Unit:3	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The interim remedy at OU3 currently protects human health and the environment because there are currently no completed exposure pathways. However, in order for the remedy to be protective in the long term, the following actions need to be taken: Ruby Repository needs land use restrictions formalized in a decision document and implemented to ensure protectiveness.	

VIII. NEXT REVIEW

The next FYR Report for the Gilt Edge Mine Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

2001. CDM Federal Programs Corporation. Final Focused Feasibility Study for Gilt Edge Mine Interim Water Treatment Operations Operable Unit 2 (OU2) Lawrence County, South Dakota. August 2001.

2001. U.S. Environmental Protection Agency. Early Action – Interim Record of Decision. Operable Unit 2 Water Treatment Operations. Gilt Edge Mine NPL Site, Lawrence County, South Dakota. April 2001.

2001. U.S. Environmental Protection Agency. Interim Record of Decision. Operable Unit 3. Ruby Gulch Waste Rock Dump. Gilt Edge Mine NPL Site. Lawrence County, South Dakota. August 2001.

2001. U.S. Environmental Protection Agency. Interim Record of Decision. Operable Unit 2. Interim Water Treatment Operations. Gilt Edge Mine NPL Site. Lawrence County, South Dakota. November 2001.

2006. Syracuse Research Corporation. Memorandum. Human Health Preliminary Remediation Goals and Remedial Action Levels for Recreational Visitors and Residents at the Gilt Edge Mine Site. December 13, 2006.

2007. Syracuse Research Corporation. Final Baseline Human Health Risk Assessment for the Gilt Edge Mine. Lawrence County, South Dakota. November 2007.

2008. U.S. Environmental Protection Agency. Record of Decision for Gilt Edge Mine Superfund Site. Operable Unit 1. Lawrence County, South Dakota. September 2008.

2012. U.S. Environmental Protection Agency, Region 8. Second Five-Year Review Report for Gilt Edge Mine Superfund Site. Lawrence County. Denver, Colorado. June 21, 2012.

2014. U.S. Army Corps of Engineers. Performance Work Statement for Performance-Based Contract. Interim Remedial Action. Site-Wide Operation & Maintenance (O&M) and Performance Monitoring Activities. Gilt Edge Mine Site Operable Unit 2 (OU2). August 26, 2014.

2014. U.S. Environmental Protection Agency. Explanation of Significant Differences. Gilt Edge Mine Superfund Site Operable Unit 1. September 2014.

2015. CDM Smith. Surface Water and Groundwater Summary Report – December 2014 Update. October 16, 2015.

2016. U.S. Army Corps of Engineers. Final 2015 Annual Summary Report Interim Remedial Action Site-Wide Operation and Maintenance and Performance Monitoring Activities. Gilt Edge Mine Superfund Site. Operable Unit 2. Lawrence County, South Dakota. November 2016.

APPENDIX B – SITE CHRONOLOGY

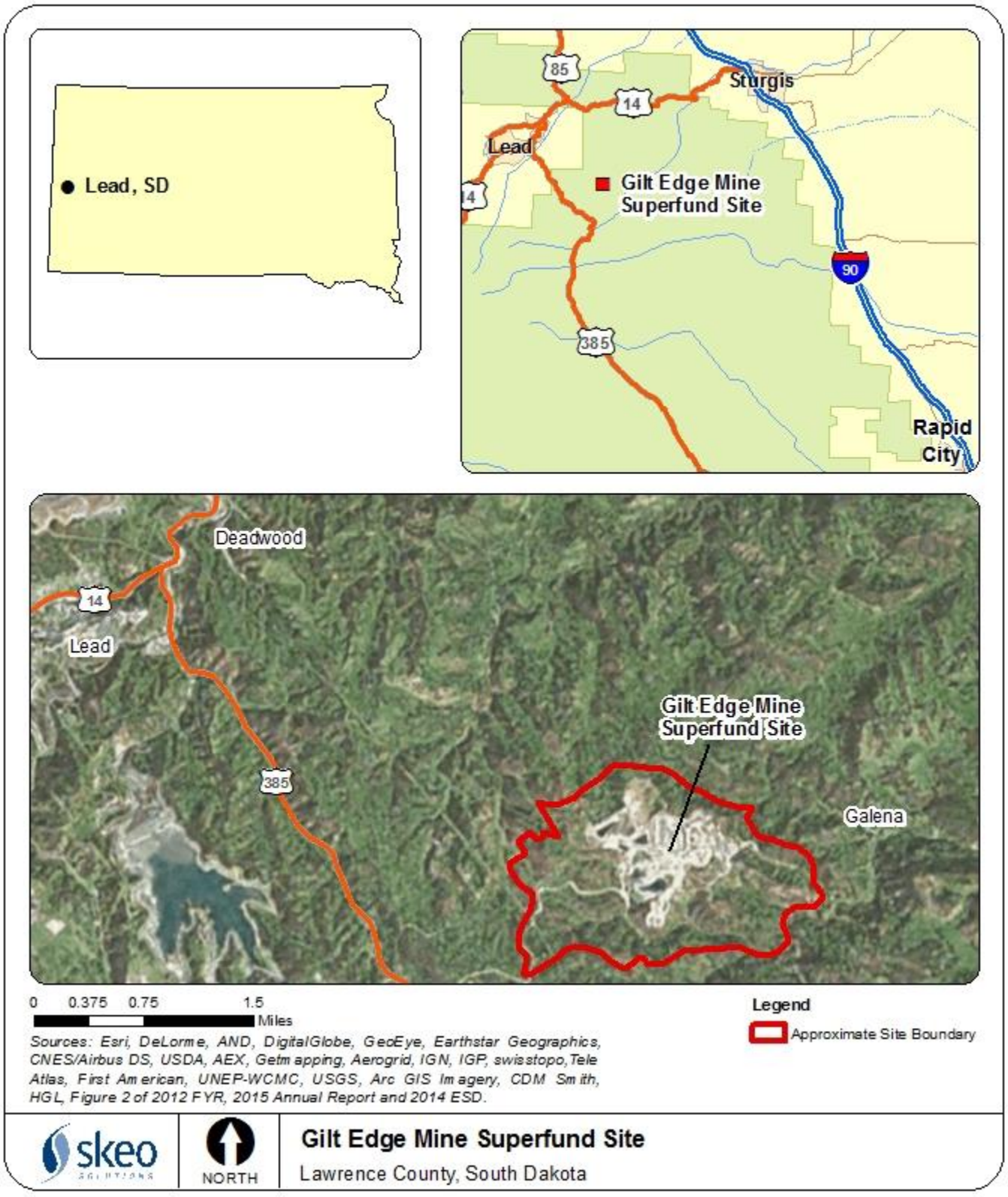
Table B-1: Site Chronology

Event	Date
Mining activity began	1876
Intermittent gold, silver, copper, lead and zinc mining	1887-1941
Mine development program	1975-1986
Permit issued to Brohm Mining Company (BMC) for cyanide heap leach operation	1986
SD DENR prepared preliminary Site assessment	1991
Cyanide solution released into local drainages	June 21, 1991
Acid waters and metals discharged without permits	May 1992
National Pollutant Discharge Elimination System (NPDES) permit issued to BMC to address cyanide and metal releases	September 14, 1993
BMC removed 150,000 tons of tailings from Strawberry Creek drainage as required by a legal settlement agreement.	1993-1994
BMC reported intent to abandon the Site by May 29, 1998	1998
State of South Dakota obtained a restraining order issued to BMC against Site abandonment	May 29, 1998
SD DENR assumed water treatment operations	1999
BMC's parent company, Dakota Mining Corp., filed for bankruptcy	July 1999
OU1 remedial investigation/feasibility study (RI/FS) initiated	September 27, 1999
EPA proposed the Site for listing on the NPL	May 10, 2000
OU2 and OU3 RI/FS initiated	September 25, 2000
EPA listed the Site on the NPL	December 1, 2000
Early Action Interim ROD for OU2 (water treatment) transferred interim water treatment operations from SD DENR to EPA Region 8 Emergency Response Program	April 23, 2001
OU2 remedial action initiated	July 17, 2001
OU3 RI/FS completed Interim ROD for OU3 (Ruby Gulch Waste Rock Mind Dump) signed	August 30, 2001
OU3 remedial action initiated Ruby Gulch Waste Rock Dump grading	September 24, 2001
OU2 RI/FS completed Interim ROD for OU2 signed, requiring conversion of the existing sodium hydroxide treatment plant to a lime-based treatment process	November 30, 2001
OU3 remedial action initiated Capping of the Ruby Waste Rock Dump	March 27, 2002
OU2 remedial action initiated Interim WTP modifications and ongoing interim water treatment	April 18, 2002
OU3 remedial construction completed Ruby Gulch Waste Rock Dump grading	June 30, 2002
OU2 remedial construction completed Early Action ROD activities	October 17, 2002
OU3 remedial action initiated Ruby Repository Ditch modifications	April 4, 2008
OU3 remedial construction completed Capping of the Ruby Gulch Waste Rock Dump	December 31, 2003
OU3 Long Term Response Action at Ruby Toe initiated	February 20, 2004
OU3 Long Term Response Action at Ruby Toe completed	September 21, 2006
EPA completed Site's first FYR	April 10, 2007
OU1 human health and ecological risk assessment completed	November 27, 2007

Event	Date
OU1 RI/FS completed EPA signed OU1 ROD	 September 29, 2008
OU1 remedial design initiated	December 15, 2008
EPA began combined RI/FS for OU2	April 26, 2012
EPA completed Site's second FYR	June 21, 2012
OU3 remedial action Ditch Modifications Ceased	August 23, 2012
OU1 remedial design completed	September 26, 2014
EPA began OU1 remedial action (contract acquisition began)	February 10, 2015
EPA will begin the OU1 onsite remedial action construction	Spring 2017

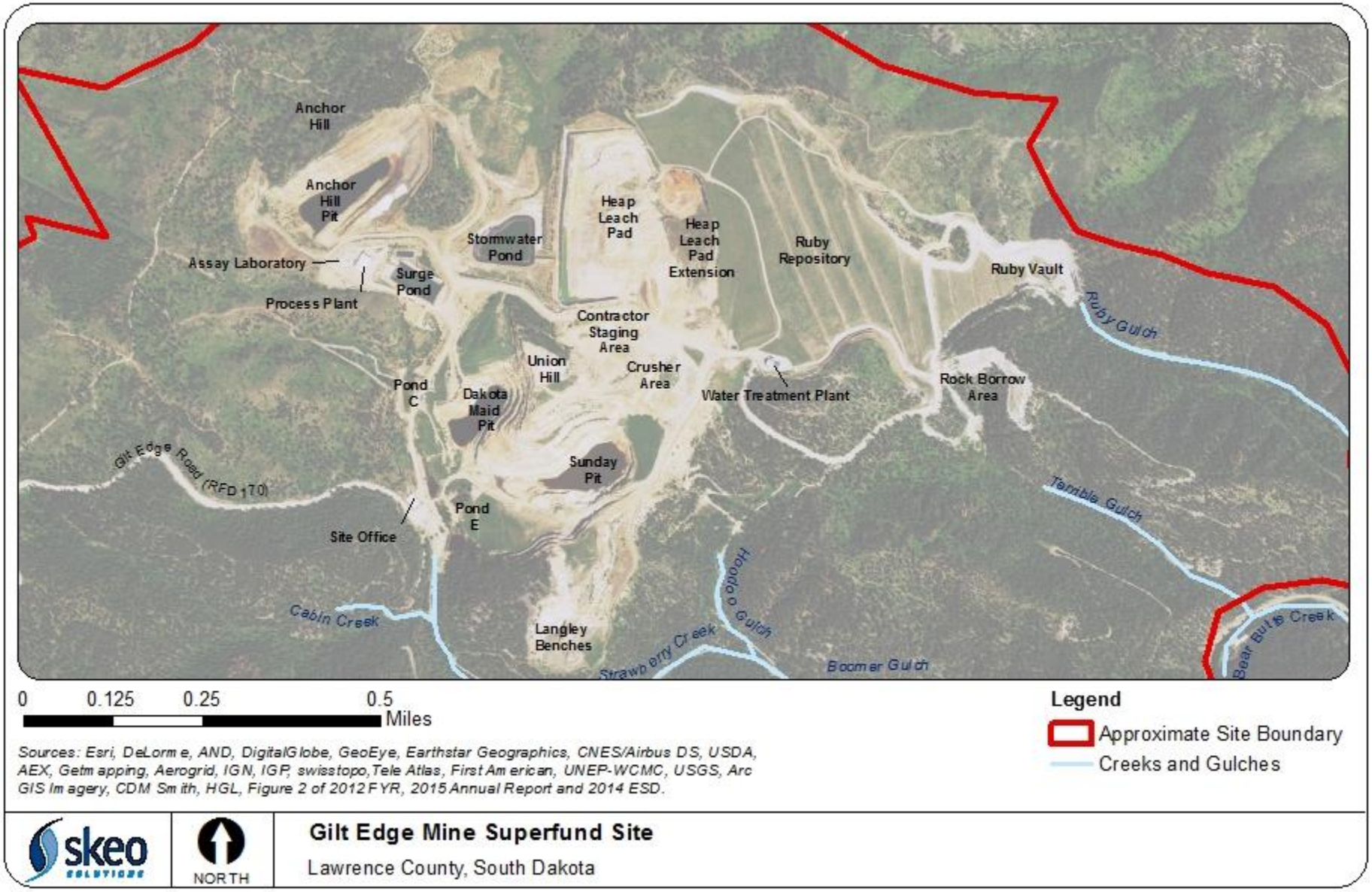
APPENDIX C – SITE MAPS

Figure C-1: Site Vicinity Map



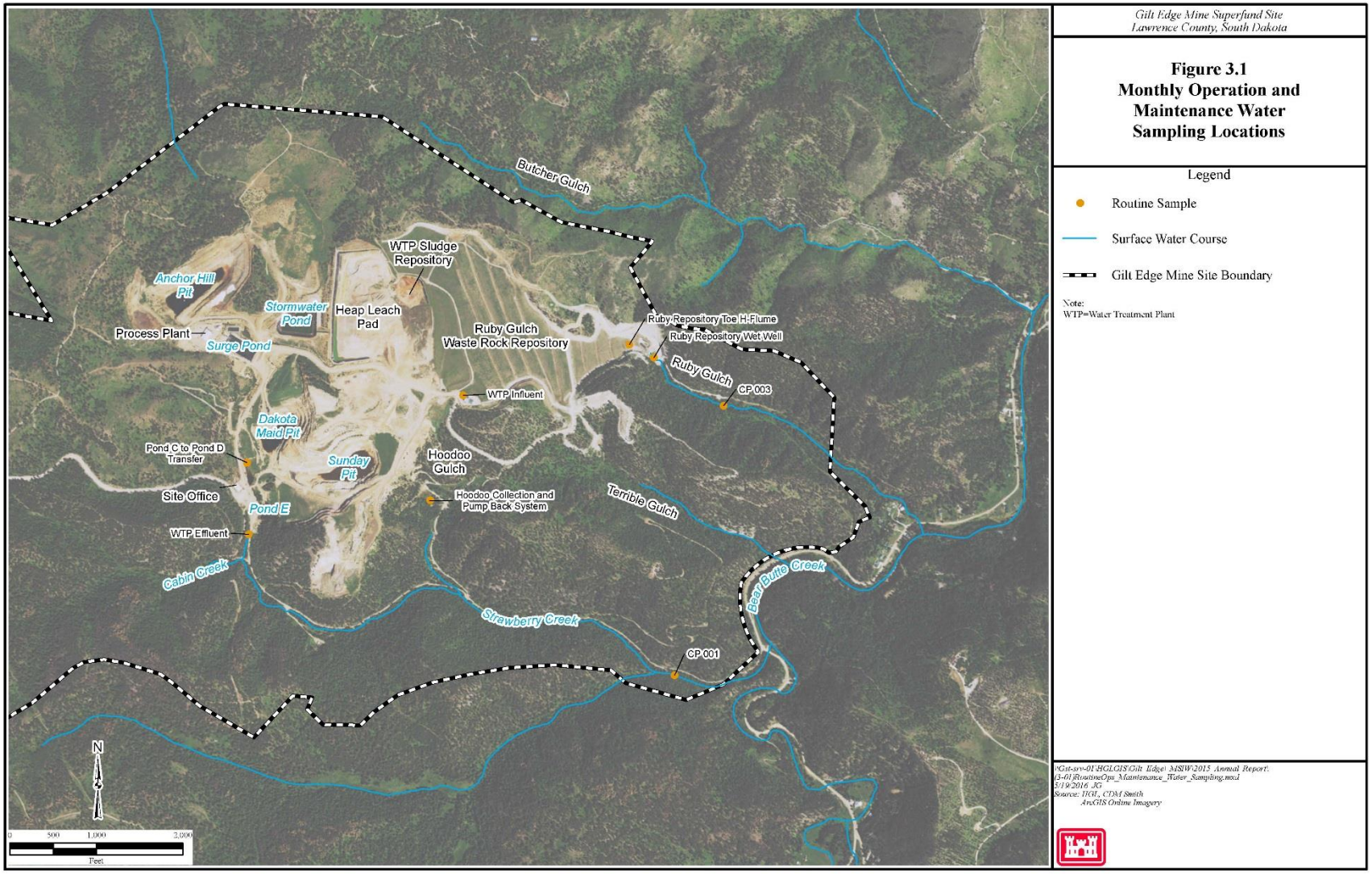
Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure C-2: Detailed Site Map



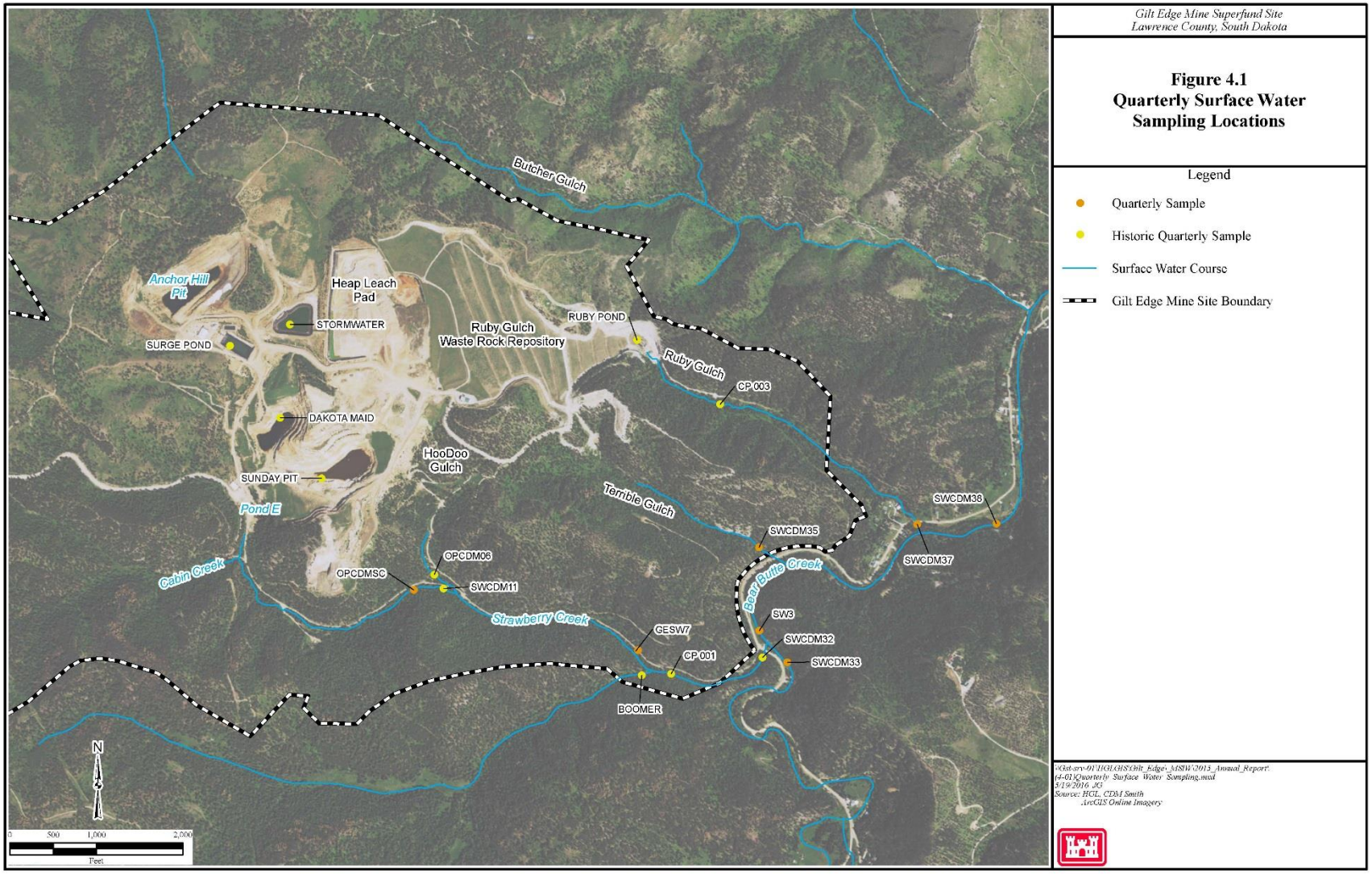
Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure C-3: Monthly Operation and Maintenance Water Sampling Locations[2]



[2] Figure 3.1 from the 2015 Annual Summary Report, November 2016

Figure C-4: Surface Water Monitoring Locations[3]



[3] Figure 4.1 from the 2015 Annual Summary Report, November 2016

APPENDIX D – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Gilt Edge Mine	**Date of Inspection:** 08/30/2016
Location and Region: Lead, South Dakota; Region 8	**EPA ID:** SDD987673985
Agency, Office or Company Leading the Five-Year Review: EPA	**Weather/Temperature:** Sunny; 70's

Remedy Includes: (Check all that apply)

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

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **Site Manager** Paul Hight (Name) Manager (Title) _____ (Date)
   Interviewed ☐ at site ☒ at office ☐ by phone Phone: _____
   Problems, suggestions ☐ Report attached: _____

2. **Staff** _____ (Name) _____ (Title) _____ (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 _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

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

Mayor Ron Everett, City Administrator Mark Stahl, SD DENR Mark Lawrensen, Lawrence County Commissioner Chair Daryl Johnson, Lawrence County Transportation Department Allen Bonnema

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: _____

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: _____			
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: _____			
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.	**Groundwater 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 EPA
	☐ 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: _____ ☐ Breakdown attached	
	Total annual cost by year for review period if available	

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs during Review Period**
Describe costs and reasons: _____

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

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks: No fencing damage.

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A
Remarks: Signage includes no trespassing signs, a do not enter sign and a Superfund Site designation sign.

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 _____ _____ _____ _____
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: Not yet implemented.

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: _____

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: Well vegetated and no trees present.

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths: _____ Widths: _____ Depths: _____
Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent: _____ Depth: _____
Remarks: _____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Arial extent: _____ Depth: _____
Remarks: _____

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established
☐ No signs of stress ☐ 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
Areal extent: _____ Height: _____
Remarks: _____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent: _____

☐ Ponding ☐ Location shown on site map Areal extent: _____

☐ Seeps ☐ Location shown on site map Areal extent: _____

☐ Soft subgrade ☐ Location shown on site map Areal extent: _____

Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map

☒ No evidence of slope instability

Areal 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

Areal extent: _____ Depth: _____

Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☒ No evidence of degradation

Material type:_____ Areal extent: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ No evidence of erosion

Areal extent: _____ Depth: _____

Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☒ No evidence of undercutting

Areal extent: _____ Depth: _____

Remarks: _____

5. **Obstructions** Type: _____ ☒ No obstructions

☐ Location shown on site map Areal 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 Areal extent: _____

Remarks: _____

D. Cover Penetrations ☐ Applicable ☒ N/A

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

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: Functioning as intended.

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: No degradation.

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

☒ Vegetation 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

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

A. Groundwater 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 provided

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: Sand filters.

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☒ Good condition ☐ Needs maintenance

☒ Sampling ports properly marked and functional

☒ Sampling/maintenance log displayed and up to date

☒ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☒ Quantity of surface water treated annually: 160,000 gallons in 2015

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:**

☐ Groundwater 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 Site is divided into three operable units (OUs). The final remedy for OU1 has not been implemented yet; it is designed to address existing contaminant sources within the primary mine disturbance area. The OU2 interim remedy is designed to address acid rock drainage (ARD) generated at the Site as well as groundwater contamination and surface water contamination and includes an existing water treatment facility to treat ARD. The OU3 interim remedy is designed to address contaminant sources within Ruby Gulch Waste Rock Dump and includes a synthetic cap over the waste rock dump, clean water diversions and an ARD collection gallery. Final repair of Ditch 1a and 5 on the Ruby Repository will be completed in conjunction with the OU1 remedial action. The OU3 remedy is otherwise functioning as intended. The OU2 remedy is currently not protective of human health and the environment
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. Interim remedial activities occur as specified in the decision documents. A full-time staff of six employees ensures that this happens. No problems or issues were noted during the Site inspection.
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. There are none.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. In the past five years, a SCADA system was installed that helped to automate the overnight functions of the current treatment systems in place. This reduced the number of full-time employees from ten to six. Tetratech also completed an optimization report in the past five years as well.

APPENDIX E – INTERVIEW FORMS

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Paul Hight – Site Manager

Date: 08/30/2016

Interviewer: Joy Jenkins

1. Are you aware of any community concerns about the Site or its cleanup operations? If so, please detail.

I don't think anything that you aren't already aware of. The community is happy EPA is in charge.

2. Is there anyone you think we should talk to?

I can't think of anyone.

3. Do you have any comments, suggestions or recommendations regarding the Site's long-term management?

No. The way we run the Site changed earlier this year to SCADA. We're trying to make sure we are all on the same page about that. I wouldn't say it is a problem.

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Allan Bonnema – Lawrence County Transportation Department

Date: 08/30/2016

Interviewer: Joy Jenkins

1. Are you aware of any community concerns about the Site or its cleanup operations? If so, please detail.

The only thing I deal with or get worried with are the people living near the mine who are concerned about what will happen with keeping the road in shape, dust, traffic, people and light pollution. I haven't fielded a lot of calls.

2. Do you know where to find site-related information or who to contact? Do you feel that more information to the community would be valuable?

Not really. Once we get started, it will be more valuable. I have your business cards. The best way to get information about the Site for me is by email. For residents, it will be to publish a notice in the Rapid City Journal or the Black Hills Pioneer.

3. What is your overall impression of the Site and cleanup actions to date?

I've only been to the Site a handful of times. I don't know one pit from another pit. Some people say it's a mess out there. Pollution wise, I wouldn't know if it's polluted or not. There is a concern that this mine needs to be cleaned up because of the scar it has left on the beautiful black hills. They go to the top of Terry Peak. I don't know if you can see it or not, but you can see the gold mine needs work, but the State and EPA are helping. The public would like to get it cleaned up. I don't think they know how much it is going to cost, so visible progress would be good. On the north side, there are a few houses; people living there have questions about Last Chance Ridge Road. Are you going to be utilizing that for the cleanup? Some people think it's a county road – some ask if it's going to be improved. The county doesn't plan to improve it.

4. Has the presence of the Site had any impact on the local community?

What happens when this project is done?

5. Do you have any comments, suggestions or recommendations regarding the Site's long-term management?

I am curious to see how long EPA estimates the cleanup will take.

6. Do you consent to have your name included along with your responses to this questionnaire in the FYR Report?

Yes.

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Mayor Ron Everett – City of Lead

Date: 08/30/2016

Interviewer: Joy Jenkins

1. Are you aware of any community concerns about the Site or its cleanup operations? If so, please detail.

No.

2. Do you know where to find site-related information or who to contact? Do you feel that more information to the community would be valuable?

Yes. Probably not, it's been long enough that it's been forgotten by the community.

3. What is your overall impression of the Site and the cleanup actions performed to date?

It cost too much. A private entity could have done it cheaper than the government.

4. Has the presence of the Site had any impact on the local community?

I don't think so, at least not as an EPA site. I don't know that it has been damaging or positive.

5. Do you have any comments, suggestions or recommendations regarding the Site's long-term management?

Let someone mine it. I think there was a plan for Wharf to mine it.

6. Do you consent to have your name included along with your responses to this questionnaire in the FYR Report?

Yes.

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Mike Stahl – City Administrator, City of Lead

Date 8/30/2016

Interviewer Joy Jenkins

1. Are you aware of any community concerns about the Site or its cleanup operations? If so, please detail.

No.

2. Do you know where to find site-related information or who to contact? Do you feel that more information to the community would be valuable?

Yes. It came up about a year ago when one of the options for the facility was to move some of the fill to Gilt Edge. It was too risky.

3. Has the presence of the Site had any impact on the local community?

No.

4. Do you have any comments, suggestions or recommendations regarding the Site's long-term management?

No.

5. Do you consent to have your name included along with your responses to this questionnaire in the FYR Report?

Yes.

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Mark Lawrensen, SD DENR

Email

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

The site contractor is collecting and treating mine impacted water and remedial action plans have been developed to move the site toward closure. Future reuse activities will need to be compatible with the constructed site remedy. There are no significant issues with the current site schedule or construction plans.

2. What is your assessment of the current performance of the remedy in place at the Site?

The current OU2 and OU3 remedies in place are functional and will be upgraded and finished during and after OU1 construction.

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.

SD DENR is a support agency to EPA Region 8 and is involved in the Superfund site cleanup process.

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?

Institutional controls at the Site have not been finalized.

7. Are you aware of any changes in projected land use(s) at the Site?

No.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

No.

9. Do you consent to have your name included along with your responses to this questionnaire in the FYR Report?

Yes.

Gilt Edge Mine Five-Year Review Questionnaire

Interview Contact: Mr. Daryl Johnson – Lawrence County Commissioner Chair

Date: 08/31/2016

Interviewer: Joy Jenkins

1. Are you aware of any community concerns about the Site or its cleanup operations? If so, please detail.

No community concerns have been brought to my attention.

2. Do you know where to find site-related information or who to contact? Do you feel that more information to the community would be valuable?

I do not know where to look but believe that others with the County and City do. Since the Site has not been in the news, I have not heard much about it.

3. What is your overall impression of the Site and cleanup actions to date?

I do not know much about the Site, so my impression is that things are going ok since there have been no red flags recently.

4. Has the presence of the Site had any impact on the local community?

I do not think there has been an impact on the local community. When there was discussion about transporting rocks from the Sanford Lab Expansion to Gilt Edge Site there was a lot of concerns and questions about that potential truck traffic. Now that this transport is not planned it is not of concern any more.

5. Do you have any comments, suggestions or recommendations regarding the Site's long-term management?

I suggest communicating with the people in the near vicinity of the Site by stopping in and talking with them directly to explain the activities, rather than just sending letters. I do not think additional information is necessary as long as the Site operations are under control.

6. Do you consent to have your name included along with your responses to this questionnaire in the FYR Report?

Yes.

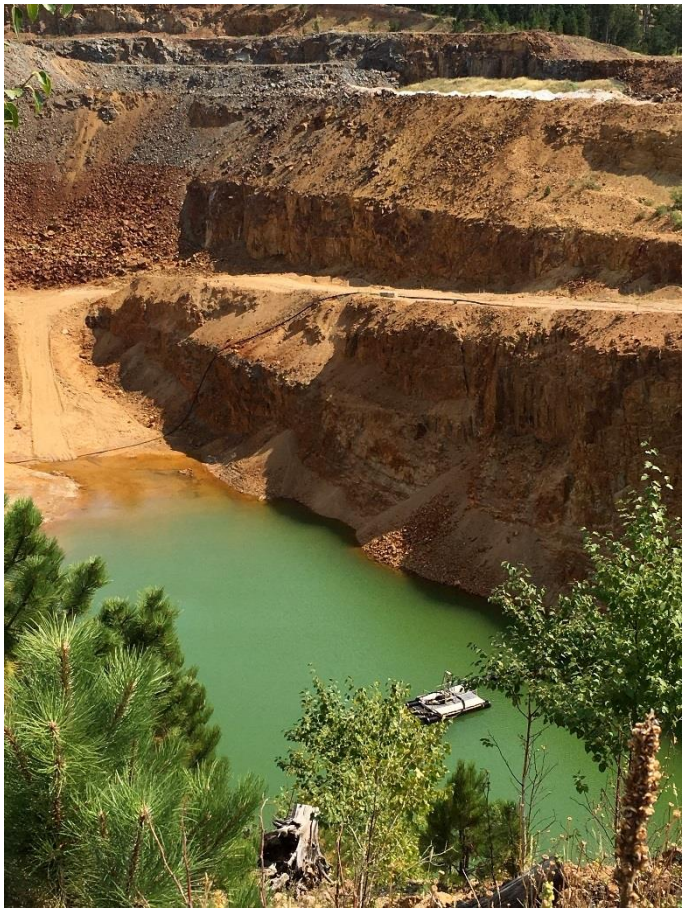
APPENDIX F – SITE INSPECTION PHOTOS

Entrance sign

Fence signage

Groundwater monitoring well

Heap Leach Pad with pipe storage in foreground



Anchor Hill Pit with barge pump

Ruby Repository

Water treatment plant

Inside the water treatment plant

Location of treatment plant outflow (treatment plant not running when photo taken)

APPENDIX G –ARARs AND SCREENING-LEVEL RISK REVIEW

This section provides an ARARs and screening-level risk review of soil remedial levels and surface water standards.

OU1 (primary mine disturbance area such as acid-generating waste rock and fills, spent ore, exposed acid-generating bedrock and sludge)

The 2008 OU1 ROD surface soil remedial goals for arsenic and thallium were reviewed to determine if the remedial cleanup levels remain valid based on current toxicity information. According to Exhibit 8-1 of the 2008 OU1 ROD, the remedial goals for arsenic and thallium were established to be protective of a recreational hiker and commercial worker. This FYR identified the exposure assumptions used as the basis for the 2008 remedial goals in order to make a direct comparison of these remedial goals to similar levels based on current toxicity information. According to Table 3 in the 2006 memorandum entitled "*Human Health Preliminary Remediation Goals and Remedial Action Levels for Recreational Visitors and Residents at the Gilt Edge Mine Site*" (2006 Memorandum) the remedial goals listed in the ROD are based on a recreational hiker. Attachment 1 of the 2006 Memorandum indicates that the remedial goals are based on an exposure frequency of 100 days per year for a 70 kilogram adult for 24 years and a 15 kilogram child for 6 years; these exposure assumptions are consistent with what is presented in Table 3-4 of the 2007 Final Baseline Human Health Risk Assessment. The 2006 Memorandum also indicated that the primary exposure route driving risk was ingestion, therefore, the remedial goals were based only on ingestion using adult and child ingestion rates of 50 mg/day and 100 mg/day, respectively. Using these exposure assumptions and toxicity information available in 2008 for arsenic and thallium, the 2006 Memorandum developed a remedial goal of 596 milligrams per kilogram (mg/kg) for arsenic based on a cancer risk of 1×10^{-4} and a RG of 134 mg/kg for thallium based on a noncancer hazard quotient of 1.0.

To determine if current toxicity data significantly changes these goals, the FYR compares the OU1 ROD remedial goals to current recreational-based remedial levels calculated using EPA's Regional Screening Level (RSL) calculator (Table G-2), applying exposure assumptions described in the 2006 Memorandum. Table G-1 summarizes the calculator outputs.

Table G-1: Summary of Remedial Goal Evaluation

COC	2008 OU1 ROD Remedial Goal (mg/kg)	Recreational Hiker Remedial Goal[a] (mg/kg)		
		Cancer Risk ($1x10^{-4}$)	Hazard Quotient=1.0	
			Adult	Child
Arsenic	596	628	3,070	329
Thallium	134	--	51	5.5

Notes:

a. Calculated using 2006 Memorandum exposure assumptions in EPA's RSL Calculator, dated May 2016, are available at http://www2.epa.gov/risk/risk-based-screening-table-generic-tables (accessed 11/21/2016).

-- = cancer risk not be calculated; COC not a classified as a carcinogen.

These results indicate that the recreational-based RGs presented in the 2008 OU1 ROD may need to be reevaluated to determine if the exposure factors in the 2006 Memorandum remain valid with anticipate Site use.

Table G-2: Recreational RSL Using 2006 Risk Assessment Exposure Assumptions[a]

Site-specific

Recreator Screening Levels (RSL) for Soil

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL),
ca** (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat,
Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide),
Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF (mg/kg-day)$^{-1}$	SFO Ref	Inhalation Unit Risk (ug/m^3)$^{-1}$	IUR Ref	Chronic RfD (mg/kg-day)	Chronic RfD Ref	Chronic RfC (mg/m^3)	Chronic RfC Ref	GIABS	ABS
Arsenic, Inorganic	7440-38-2	No	No	1.50E+00	U	-		3.00E-04	U	-		1	-
Thallium (Soluble Salts)	7440-28-0	No	No	-		-		1.00E-05	U	-		1	-

Chemical	RBA	Volatilization Factor (m^3/kg)	Henry's Law Constant (atm-m^3/mol)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR=1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)
Arsenic, Inorganic	0.5	-	-	-	1.36E+09	6.28E+00	-	-	6.28E+00
Thallium (Soluble Salts)	1	-	-	-	1.36E+09	-	-	-	-

Chemical	Ingestion SL Child THQ=1 (mg/kg)	Dermal SL Child THQ=1 (mg/kg)	Inhalation SL Child THQ=1 (mg/kg)	Noncarcinogenic SL Child THI=1 (mg/kg)	Ingestion SL Adult THQ=1 (mg/kg)	Dermal SL Adult THQ=1 (mg/kg)	Inhalation SL Adult THQ=1 (mg/kg)	Noncarcinogenic SL Adult THI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	3.29E+02	-	-	3.29E+02	3.07E+03	-	-	3.07E+03	6.28E+00 ca*
Thallium (Soluble Salts)	5.48E+00	-	-	5.48E+00	5.11E+01	-	-	5.11E+01	5.48E+00 nc

Notes:

a. Values calculated using EPA's RSL Calculator located at https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
With the following exposure assumptions for ingestion exposure from the 2006 Memorandum:
Adult body weight of 70 kilograms, soil ingestion rate of 50 mg/day, exposure frequency of 100 days per yr, exposure duration of 24 years
Child body weight of 15 kilograms, soil ingestion rate of 100 mg/day, exposure frequency of 100 days per year, exposure duration of 6 years
Relative bioavailability for arsenic of 0.5 and 1 for thallium.

OU2 (water treatment, groundwater and Lower Strawberry Creek)

South Dakota Administrative Rules – Chapter 74:51:01, Surface Water Quality Standards for protection of aquatic life are considered ARARs for surface water. Specifically, the RAOs state that the remedy will "achieve compliance, to the extent possible and practicable for the interim, with currently applicable water quality standards." The Interim ROD does not specify numeric standards and the standards listed in the 2001 FS do not discuss the basis of the metals standards. In addition, the final Site remedy is anticipated to comply with current standards. The current state and federal standards are included in Table G-3. Current surface water quality was evaluated using the current State standards. State SWQS for TDS and selenium are waived in the short term.

Table G-3: Review of Interim Surface Quality Standards

COC	Units	2001 FS Surface Water Quality Standard[m]	2016 EPA Surface Water Standard[a,e]		Current State Surface Water Quality Standard [b,k]	
			Acute	Chronic	Acute	Chronic
Arsenic	µg/L	190	340	150	340	150
Cadmium [c]	µg/L	2.87[b]	6.5	2.03	7.7	0.64
Chromium (III) [c]	µg/L	554[b]	1,773	231	1,773	231

Chromium (VI)	µg/L	10	16	11	16	11
Copper [c]	µg/L	37.11[b]	50	29	50	29
Lead [c]	µg/L	10.94[b]	281	11	281	11
Mercury	µg/L	0.012[c]	1.4	0.77	1.4	0.77[d]
Nickel [c]	µg/L	507.89[b]	1,513	168	1,513	168
Selenium	µg/L	5	--[f,g]	3.1[f,h]	--[l]	5.0[d]
Silver [c]	µg/L	37.4[b]	35	--	35	--
Zinc [c]	µg/L	338.28[b]	380	380	380	380
Cyanide (weak acid dissociable)	µg/L	5.2	22[i]	5.2[i]	22	5.2
Nitrate as N	mg/L	≤50	--[j]	--[j]	<88	<50
TDS	mg/L	≤2,500	--[j]	--[j]	≤ 4,375	<2,500
pH	Standard units	6.6-8.6	--	6.5 - 9	6.5 – 8.8	6.5 – 8.8
TSS	mg/L	≤90	--[j]	--[j]	≤ 17.5	<10

Notes:

a. National Recommended Water Quality Criteria – Aquatic Life – https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table (accessed 10/04/2016).

b. South Dakota Surface Water Standards – http://sdlegislature.gov/rules/DisplayRule.aspx?Rule=74:51:01 (accessed 08/11/2016).

c. Hardness dependent criteria in µg/L. Value given is based on a calcium carbonate hardness of 400 mg/L.

d. Criteria based on total recoverable fraction of the metal.

e. Hardness-based criteria calculated using Appendix A and Appendix B, National Recommended Water Quality Criteria – Aquatic Life Criteria Table.

f. 2016 National Selenium Criteria – https://www.epa.gov/sites/production/files/2016-07/documents/aquatic_life_awqc_for_selenium_-_freshwater_2016.pdf.

g. Calculation based on 30-day average and average background concentration. Has not been calculated for the Site.

h. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data.

i. Expressed as µg free cyanide per liter.

j. Narrative Criteria (available in Gold Book: Quality Criteria for Water, 1986).

k. Hardness-based criteria calculated using Appendix B Toxic Pollutant Criteria, South Dakota Administrative Rule 74:51:01:55. Criteria for toxic pollutants.

l. The (0.996)CMC = 1/[fl/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/L and 12.82 µg/L, respectively.

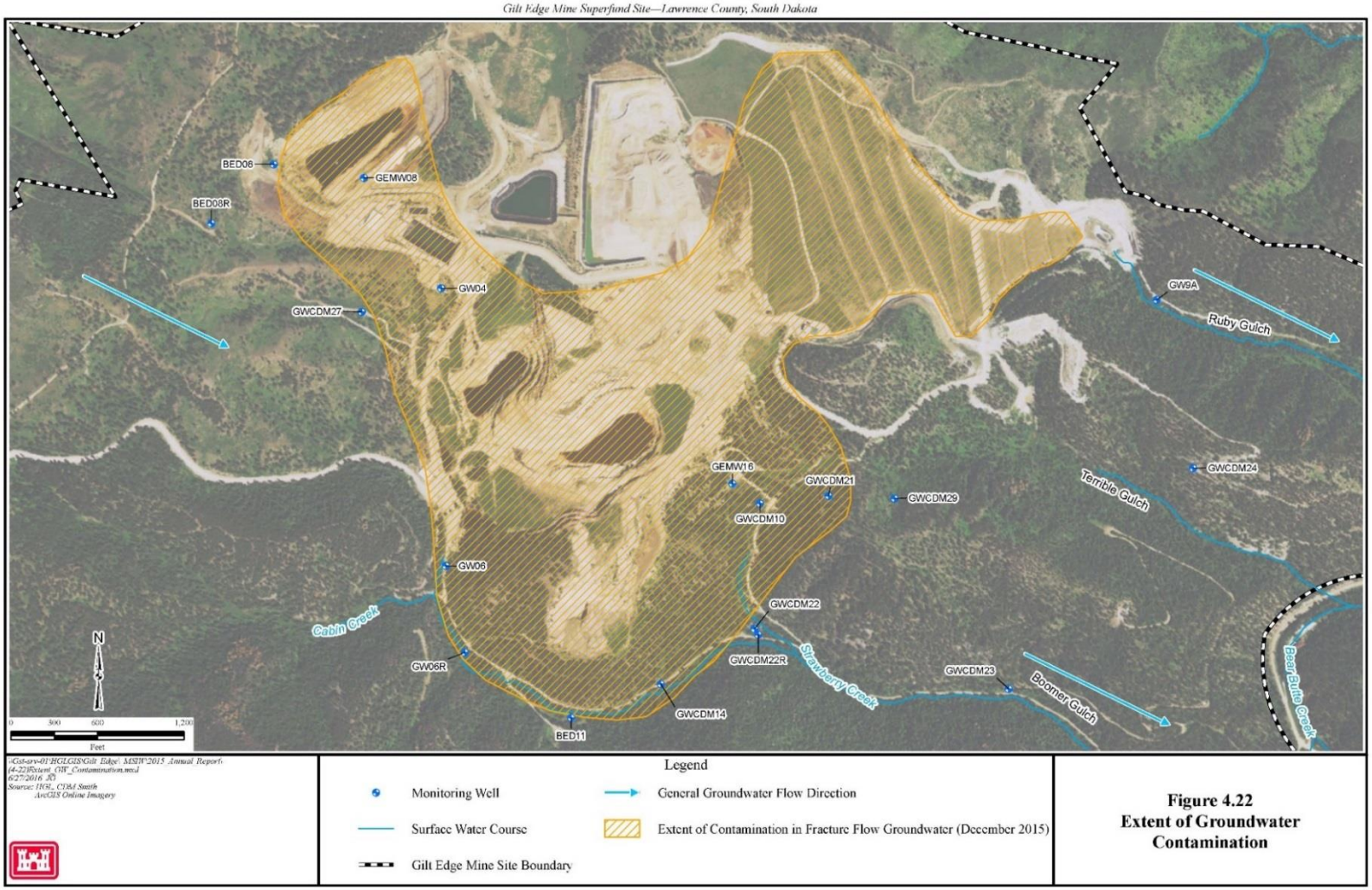
m. Based on beneficial use of the surface water body, values shown for Water Treatment Plant Effluent, Table 3-2 of the 2001 FS.

µg/L = micrograms per liter
mg/L = milligrams per liter

The OU3 Interim ROD considers the Safe Drinking Water Act maximum contaminant levels (MCLs) relevant and appropriate because the aquifers downgradient of OU3 and the Site are a public water supply source. However, OU3 does not directly address groundwater contamination. Specific MCLs and groundwater remedial cleanup levels were not included in the interim RODs. The final Site remedy is anticipated to include groundwater remedial action goals.

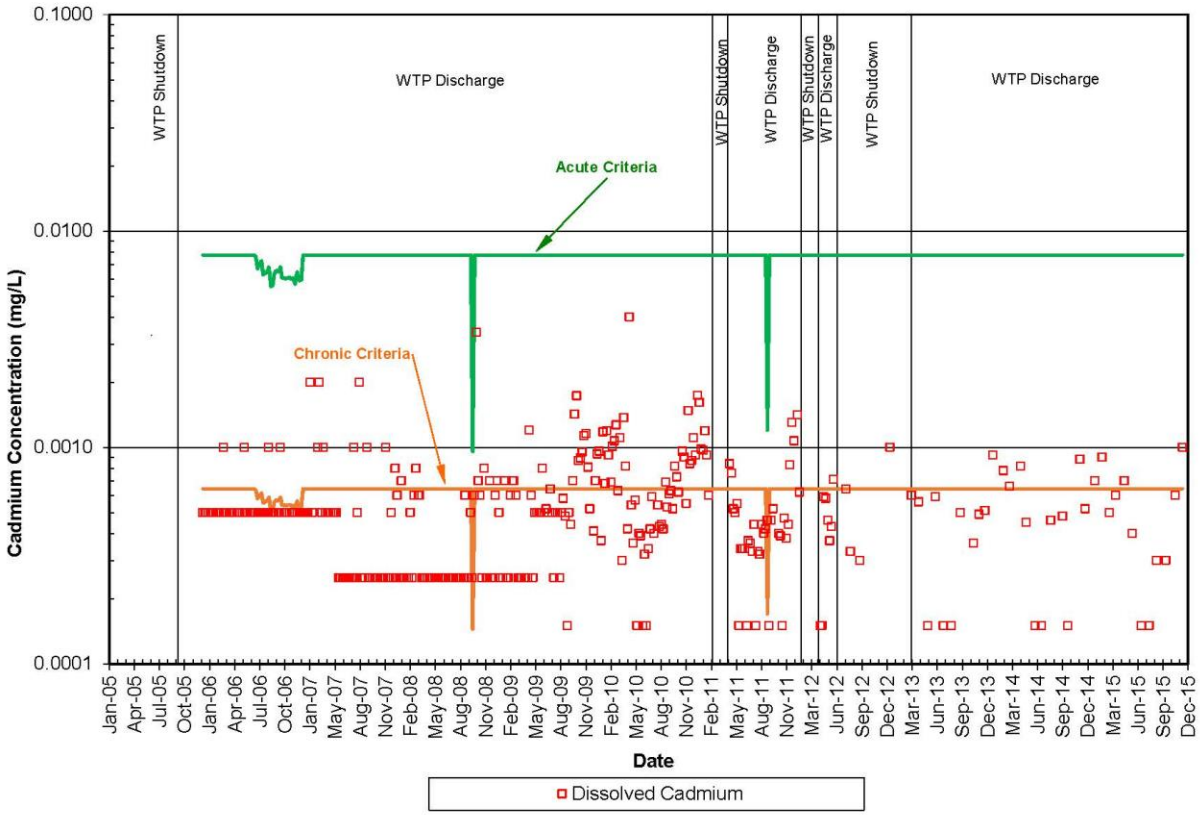
APPENDIX H – DATA ANALYSIS FIGURES

Figure H-1. Extent of Groundwater Exceeding Applicable SD Site Specific Groundwater Quality Standards[4]



[4] Figure 4.22 from the 2015 Annual Summary Report, November 2016

Figure H-2. Cadmium Concentrations – Water Treatment Plant Effluent[5]



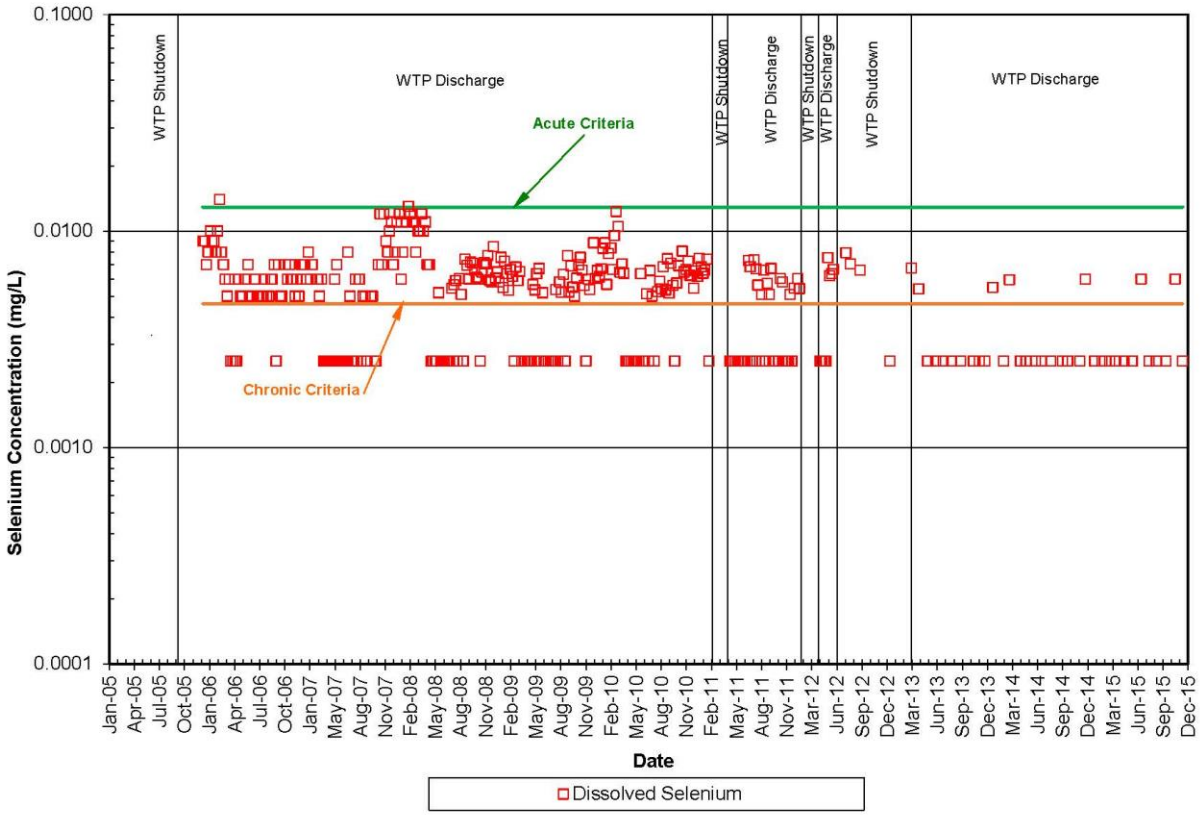
Notes: Nondetect concentrations were graphed as 1/2 the reporting limit.

Notes: mg/L = milligrams per liter.

Figure 3.3
Dissolved Cadmium Trends - Water Treatment Plant Effluent (End of Pipe)
Gilt Edge Mine Superfund Site, Lawrence County, South Dakota

[5] Figure 3.3 from the 2015 Annual Summary Report, November 2016

Figure H-3: Selenium Concentrations – Water Treatment Plant Effluent[6]

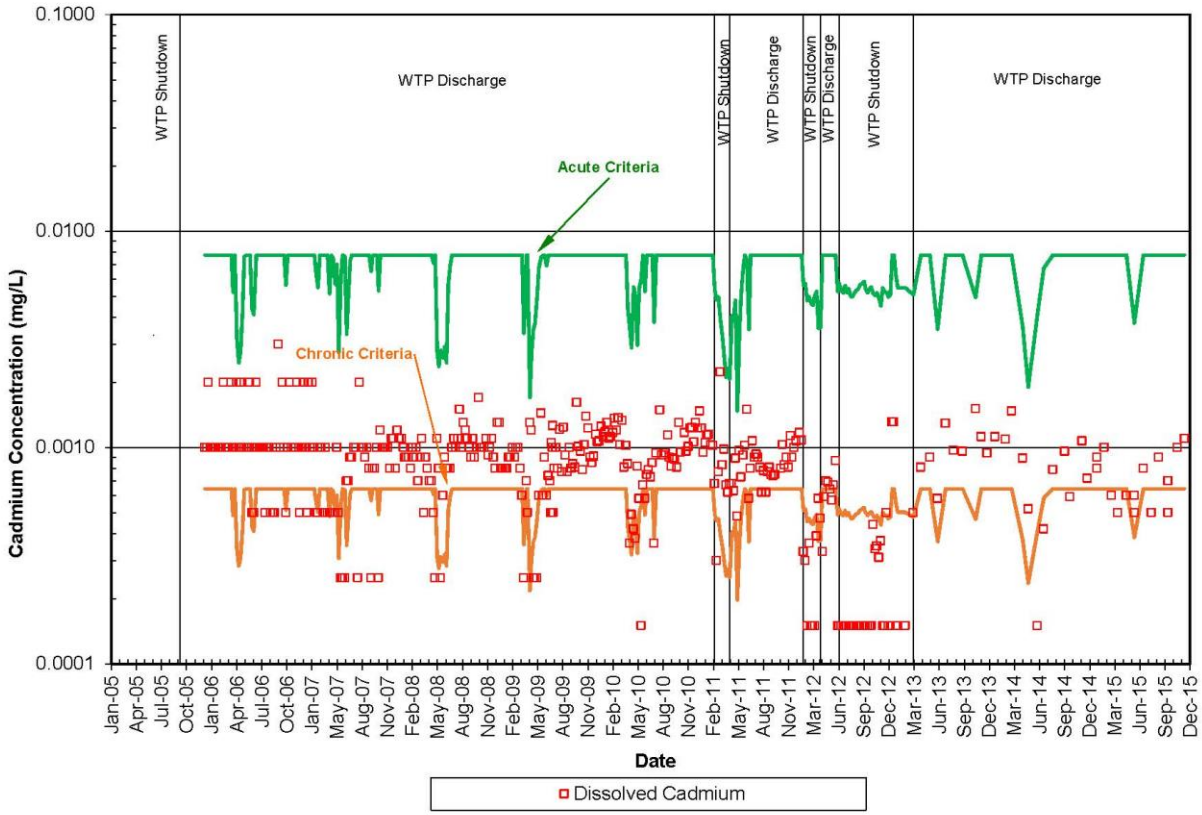


Notes: Nondetect concentrations were graphed as 1/2 the reporting limit. Notes: mg/L = milligrams per liter.

Figure 3.4
Dissolved Selenium Trends - Water Treatment Plant Effluent (End of Pipe)
Gilt Edge Mine Superfund Site, Lawrence County, South Dakota

[6] Figure 3.4 from the 2015 Annual Summary Report, November 2016

Figure H-4: Cadmium Concentrations – Strawberry Creek[7]



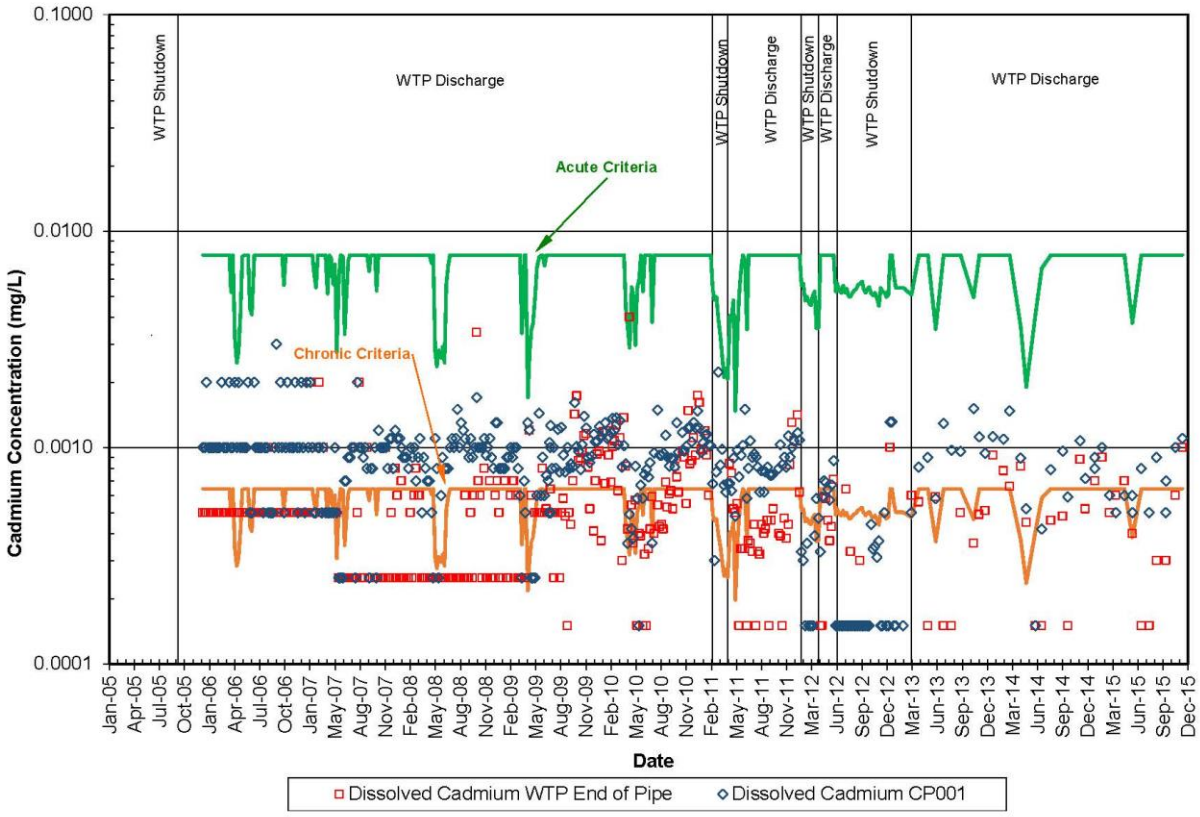
Notes: Nondetect concentrations were graphed as 1/2 the reporting limit.

Notes: mg/L = milligrams per liter.

Figure 3.5
Dissolved Cadmium Trends - CP001 (Strawberry Creek)
Gilt Edge Mine Superfund Site, Lawrence County, South Dakota

[7] Figure 3.5 from the 2015 Annual Summary Report, November 2016

Figure H-5: Cadmium Concentrations – Strawberry Creek and Water Treatment Plant Effluent[8]



Notes: Nondetect concentrations were graphed as 1/2 the reporting limit. mg/L = milligrams per liter

The acute and chronic standards shown are calculated based on the hardness of the CP001 sample.

Figure 3.7
Dissolved Cadmium Trends - Water Treatment Plant Effluent and CP001
Gilt Edge Mine Superfund Site, Lawrence County, South Dakota

[8] Figure 3.7 from the 2015 Annual Summary Report, November 2016