Explanation of Significant Differences
Gilt Edge Mine Superfund Site
Operable Unit 1

EPA ID: SD987673985
Lead, SD

September, 2014

U.S. Environmental Protection Agency
Region 8
Denver, Colorado

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EXPLANATION OF SIGNIFICANT DIFFERENCES
to the Record of Decision for Gilt Edge Mine Site Operable Unit 1

1.0 INTRODUCTION AND STATEMENT OF PURPOSE

1.1 Site Name and Location

Site Name: Gilt Edge Mine Superfund Site
Site Location: Lawrence County, South Dakota
Site ID: DSS987673985

1.2 Lead and Support Agencies

The United States Environmental Protection Agency (EPA) is the lead agency for the Gilt Edge Mine Site (Site). South Dakota Department of the Environment and Natural Resources (SD DENR) is the support agency.

1.3 Legal Authority for Explanation of Significant Differences

This explanation of significant differences (ESD) is issued in accordance with section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, (CERCLA), 42 U.S.C. 9617(c) and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) section 300.435(c)(2)(i). The modifications described in this ESD significantly change, but do not fundamentally alter the original remedy selected in the Record of Decision (ROD) for operable unit 1 (OU1) issued by EPA in September 2008, with respect to scope, performance, or cost.

1.4 Summary of Purpose

EPA has organized the Site into three operable units as follows:

- OU1 - Primary Mine Disturbance Area. This operable unit addresses existing contaminant sources within the primary mine disturbance area such as acid generating waste rock and fills, spent ore, exposed acid generating bedrock, and sludge.
- OU2 - Water Treatment, Groundwater, and Lower Strawberry Creek. This operable unit addresses (1) acid rock drainage (ARD) management including ARD collection systems, pumping stations, pipelines, water treatment, and the future generation of ARD treatment sludge; (2) groundwater contamination associated with the Site; and (3) contaminant sources, surface water and sediments in the lower Strawberry Creek area.
- OU3 - Ruby Gulch Waste Rock Dump. This operable unit addresses contaminant sources located within the Ruby Gulch waste rock dump.

EPA issued the OU1 ROD for OU1 on September 29, 2008, selecting a remedy focused upon containment of contaminant sources (acid generating waste rock and fills, exposed acid generating bedrock, and sludge) within the primary mine disturbance area to prevent direct exposure to metals containing materials and to reduce the generation of ARD and subsequent contamination to surface and ground water. During the remedial design process several possible modifications to the selected remedy were determined to be feasible. These modifications are expected to further reduce the volume of ARD generated at the Site after implementation of the OU1 remedy. This enhanced reduction of ARD generation is anticipated to reduce long term operations and maintenance (O&M) complexity and costs required for collecting and treating contaminated water at the Site. Water management and treatment are conducted under an interim ROD for OU2. A final ROD for OU2 will be selected after the OU1 remedial action's effect on ARD generation is verified.

The selected modifications to the OU1 ROD, while significant, do not fundamentally change the selected remedy with respect to scope, performance and costs. The remedy still employs source control and containment of contaminants. Hazards from direct contact with metals containing materials will continue to be addressed by consolidation and capping. Hazards from generation and release of ARD will continue to be addressed by consolidation and capping of acid-generating materials and implementation of clean water control structures to prevent clean water from contacting the acid generating waste. Design changes to the selected remedy, described in this ESD, increase the extent to which ARD generation will be prevented in the future and reduce the threat of release of ARD water from the Site. Information and rationale for these changes are presented in Section 3.

1.5 Administrative Record

This ESD and its supporting documentation will be incorporated into the administrative record as directed in Section 300.825(a)(2) of the NCP. The administrative record file is available for public review at the following locations:

U.S. EPA, Region 8, Superfund Records Center
1595 Wynkoop Street
Denver, CO 80202-1120
303.312.6473 or toll free 800.227.8917
Viewing hours by appointment; call 303-312-6312 or 800-227-8917

Hearst Public Library
315 Main Street
Lead, SD 57754
(605) 584-2013

As required by NCP section 300.435(c)(2)(i) a brief summary of the action will be published in a local newspaper, *The Rapid City Journal*, indicating the availability and location of this ESD.

2.0 SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

The topography of the Gilt Edge Mine Site is rugged and mountainous and the elevation ranges from approximately 5,320 to 5,520 feet above mean sea level. The Site straddles the headwaters of Strawberry Creek and Ruby Gulch, which are tributaries to Bear Butte Creek. Strawberry Creek and Bear Butte Creek are perennial streams classified by South Dakota surface water quality standards as coldwater marginal fish life propagation waters and coldwater permanent fish life propagation waters, respectively. Ruby Gulch ranges from an ephemeral to intermittent stream where surface water is present during the spring and after large precipitation events. South Dakota surface water quality standards classify all streams including Ruby Gulch, Strawberry Creek, and Bear Butte Creek as irrigation, fish and wildlife propagation, recreation, and stock watering waters.

Major features of the Site include the 31-acre Sunday Pit and the 14-acre Dakota Maid Pit, both of which are underlain by extensive underground workings and a relic tailings repository, and the 28-acre Anchor Hill Pit. The Langley Pits are two smaller pits that have been partially backfilled and do not contain water. The heap leach pad (HLP) covers 37 acres with waste material reaching 150 feet in height. The Ruby Repository was constructed to cover the Ruby Gulch Waste Rock Dump; it is approximately 75 acres in size, and contains approximately 20 million tons of waste rock and spent ore. Figure 1 shows the main Site features.

The following sections describe the Site history, contamination and selected remedy.

2.1 Site History

Mining began at the Site in 1876 when the Gilt Edge and Dakota Maid mining claims were located. Sporadic mining by numerous operators were conducted at the Site until the early 1920s. Early gold miners developed extensive underground workings that wind through the central portion of the Site. From 1935 to 1941, the mines at the Site were in steady production and the underground workings were expanded.

Beginning in the 1970’s, an extensive mine development program at the Site was initiated to investigate potential production gold or other minerals. Mine operators engaged in extensive exploration activities including both surface and underground exploration.

In 1986, Brohm Mining Company (BMC) commenced development of a large scale open pit, cyanide heap leach gold mine operation. Mining activities generated ARD and the mining permit required BMC to collect and treat ARD water from the Site. In 1999, BMC abandoned the Site and the water treatment responsibilities. The State of South Dakota immediately responded and took responsibility for collecting and treating ARD. At the request of the State, EPA listed the Site on the National Priorities List (NPL) in 2000.

EPA issued an Early Action Interim Record of Decision for OU2 in April 2001 to continue water treatment activities previously assumed by the State, followed by an Interim Record of Decision for OU2 in November 2001. The interim OU2 remedy included the diversion of ARD from various seeps and mine pits, and conversion of the existing water treatment plant (WTP) to a lime precipitation or a metals-coordination precipitation system. Construction of the WTP conversion was completed in August 2003, and water treatment activities are ongoing. Contaminated water is collected at various facilities at the Site and stored until it is treated and discharged to Strawberry Creek through an effluent discharge line. In addition, during the past several years of operation EPA and SD DENR constructed several water diversion structures to keep uncontaminated runoff from entering the water treatment conveyance system. The Site currently generates an average of 95 million gallons of ARD per year (ranging from 49 to 125 million gallons), which is collected and treated before discharge into Strawberry Creek.

EPA issued the Interim Record of Decision for OU3 in August 2001 to address contamination associated with the largest ARD source on the Site, the Ruby Gulch Waste Rock Dump. This remedy created the Ruby Repository by regrading waste rock that was previously deposited in the upper Ruby Gulch drainage and constructing a composite cap consisting of geomembrane liner covered by soil and vegetation. Lateral drainage structures (diversion ditches) were also installed to divert surface water runoff around and off of the cap system. The planned repository construction was completed in 2006. However, additional work was performed from 2009 through 2011 to reduce leaking of the diversion ditches into the Ruby Repository. Additional leakage areas were identified in 2012 and will be addressed in a final record of decision for OU3.

EPA issued the OU1 ROD in September 2008, selecting a remedy focused upon containment of contaminant sources (acid generating waste rock and fills, exposed acid generating bedrock, and sludge) within the primary mine disturbance area to prevent direct exposure to metals containing materials and to reduce the generation of ARD and subsequent contamination to surface and ground water.

2.2 Contamination Sources

ARD is acidic metal laden water that is formed when iron sulfide minerals (such as pyrite) are exposed to oxygen and water. This scenario frequently occurs at mine sites. Mining activities disturb the buried mineralized rock and introduce pathways for contact with oxygen (atmospheric air) and water (precipitation or groundwater). As oxygen and water flow over the iron sulfide minerals the minerals are oxidized and form sulfuric acid which then leaches other metals from the mineralized rock. The surrounding water becomes contaminated with the acid, sulfate, and metals. ARD is contaminated water that can contain iron, copper, cadmium, zinc, nickel, lead, arsenic and many other metals in various concentrations depending on the source rock. ARD can be slightly acidic, at pH 5 or 6, to very acidic, with pH 2 or below. When ARD is generated from a source material it often flows into surrounding ground and surface water and contaminates those waters as well.

At the Gilt Edge Mine Site, ARD is generated by numerous source materials both above and below ground. These sources include fill materials, HLP spent ore, exposed pit highwalls, amended tailings, sludge and underground mine workings and boreholes.

Fill materials were generated during previous mining related activities and had been used to build features such as roads and flat surfaces for building areas. These fills are acid generating.

The HLP contains a large volume of acid generating spent ore. This rock was processed during mining operations with cyanide to extract gold. The spent ore was left in place on the HLP liner system. ARD that is generated by the HLP is collected and transferred to the Site water treatment circuit.

Exposed pit highwalls have a high potential to continue to generate ARD. Pit highwalls encompass large areas of exposed mineralized rock that include unconsolidated rock that has sloughed from the highwalls onto the safety capture benches.

Amended tailings are acid-generating tailings that were mitigated by BMC with the addition of alkaline fly ash. The amended tailings were placed in two repositories, capped with a low permeability clay cover, and revegetated. The amended tailings repositories are located on the north highwall of Dakota Maid Pit and the east highwall of Sunday Pit.

Sludge was generated by water management and treatment activities and can be a source of contamination, because it contains toxic metals removed from the ARD including arsenic, cadmium, chromium, copper, lead, nickel, and zinc. Sludge is currently located in Anchor Hill Pit, Sunday Pit, Dakota Maid Pit, constructed ponds, and the sludge storage cell.

The underground mine workings produce ARD that contaminates the groundwater. The groundwater then seeps out of the ground in certain areas of the Site causing contamination of the surface water. A complex network of shafts, exploratory boreholes, adits, and stopes are present in the central portion of the Site. These underground mine workings were developed prior to open pit mining. Some of these workings have been intersected during construction of the mine pits. The lower level King workings (under the Dakota Maid Pit) and the Rattlesnake workings (under Sunday Pit) are a continuous source of ARD generation causing an impacted groundwater plume. In addition, the Langley adit is a mine portal that discharges ARD conveyed through the Langley mine workings to the Strawberry Creek drainage within the mine disturbance area on an intermittent basis.

2.3 Summary of the OU1 ROD Selected Remedy

In September 2008, EPA issued the OU1 ROD to implement a remedial strategy that emphasizes consolidation and containment of contaminant sources throughout the Site to reduce exposure to hazardous substances and reduce the volume of acid rock drainage generated. The primary objective of this remedy is to reduce the amount of ARD generated on Site by preventing surface water from interacting with acid-generating materials. Acid-generating mine wastes will be consolidated and covered to the extent practicable. Cover systems will be employed to limit infiltration of precipitation and subsequent generation of ARD.

The remedial action objectives (RAOs), listed below are unchanged from the OU1 ROD:

- 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 $1x\ 10^{-4}$ chance of contracting cancer from ingestion and inhalation of Site soils
- Ensure that low intensity recreational Site users and commercial workers are protected against non-cancer effects through inhalation and ingestion of surface soils for contaminants that exceed a hazard index of greater than or equal to one
- 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 ROD designates Anchor Hill Pit as the primary storage location for ARD prior to treatment at the WTP. The OU1 ROD also specifies covering the Upper South Ruby area to complete the Ruby Repository cover, constructed as the OU3 Interim ROD remedy, and allows for upgrades as necessary to the WTP that is operated under the OU2 Interim ROD.

The OU1 ROD selected remedy includes the following:

- Removal, consolidation, and containment of acid-generating waste materials and fills within mine pits and creation of clean water corridors within the Upper Strawberry Creek and Hoodoo Gulch drainages.
- All mine waste with arsenic concentrations above 1,125 mg/kg and/or thallium concentrations above 200 mg/kg will be managed through containment using covers or through engineered controls.
- Excavated materials will be placed primarily in Dakota Maid and Sunday Pits and covered.
- Waste rock and fill will also be consolidated and covered in the Langley Benches/pits and Upper South Ruby remediation subareas.
- Remove the majority of the spent ore from the HLP. Some spent ore would be left in place to protect the existing liner system. The remaining spent ore will be contained with a liner to reduce ARD generation and facilitate disposal of sludge as part of OU2.
- The surface of the entire HLP and extension will be available for future sludge generation from the WTP. WTP sludge would be disposed of at this location in disposal cells constructed as part of OU2.
- Sequence the placement of waste materials in the pits so that materials with the lowest ARD generating potential are placed at the lowest levels in the pits where groundwater may interact with placed materials. Waste materials with higher ARD generating potential will be placed at higher levels in the pits above the groundwater level to prevent interaction with groundwater. This is expected to reduce future groundwater contamination.
- Implementation of cover systems at contaminant source consolidation locations to limit infiltration of precipitation and subsequent ARD generation. Wastes consolidated in Dakota Maid and Sunday pits will be covered. Langley Benches and the Upper South Ruby area will be covered.
- Exposed acid-generating bedrock in the lower highwalls of the Dakota Maid Pit and Sunday Pit and surficial sludge within these pits will be addressed incidental to the backfilling and covering of the pits.
- Soil stockpiles now stored in the HLP extension will be used for reclamation or cover construction. Removal of soil stockpiles from the HLP extension will provide additional area for sludge disposal cells constructed as part of WTP operations under OU2.
- Topsoil and subsoil resources remaining after cover construction will be used to cover and revegetate (reclaim) parent ground and fill zones exposed during contaminant source removal.
- Sludge in the bottom of Dakota Maid Pit, Sunday Pit, and the Stormwater Pond will be removed and placed on the HLP adjacent to the WTP sludge currently stored at the HLP extension. Sludge removal from the pits is expected to reduce a source of high contaminant mass loading which would be in contact with the groundwater in the lowest portions of the pits. Removal of sludge is also expected to improve the implementability of backfilling the pits with other waste materials as the sludge obscures the underground workings within the bottom of the pits and the sludge is not dense enough to allow the use of heavy equipment operation on top of the sludge. These issues cause safety concerns.

- Anchor Hill Pit will be designated as the primary ARD storage location at the Site for future water management activities.
- Collection and treatment of contaminated water in the mine disturbance area and treated water discharge into lower Strawberry Creek will continue using current discharge waivers for selenium (Se) and total dissolved solids (TDS). The waivers and the management of water are covered in the OU2 interim remedy until a final remedy for OU2 is selected.
- Removal of the Surge and Stormwater ponds is part of the source removal in the Upper Strawberry Creek corridor.
- Collection systems will be installed at the base of Dakota Maid and Sunday pit covers in order to maintain acceptable ARD levels in the submerged portions of the pits.
- ARD collection systems will also be placed along the east perimeter of the Process Plant remediation subarea and the west berm of the HLP remediation subarea to collect and transfer ARD from contaminants sources left in place at those locations.
- The ARD capture and pumping systems at Strawberry Pond (also called Pond E) and Hoodoo Gulch will be phased out over time as surface water quality within the Upper Strawberry Creek and Hoodoo Gulch drainages improves due to contaminant source removal within these drainages.
- Upgrade the WTP, as needed, to allow treatment of higher concentrations of sulfate from ARD stored in mine pits and ponds, and to address potentially higher concentrations of sulfate in ARD from future discharges from pit backfills to the collection systems.
- Land use controls, including both institutional controls and engineered controls, will be implemented as needed to address risks posed to human receptors from unaddressed contaminant sources and to protect engineered elements of the remedy.

3.0 BASIS FOR THE ESD

The modifications to the OU1 ROD are anticipated to further reduce the volume of contaminated water that requires collection and treatment. These changes involve the Anchor Hill Pit, the HLP, Hoodoo Gulch, Union Hill, process plant area, rinsate water collection and parent ground amendments, water treatment plant modifications, and anticipated remedial action costs.

Anchor Hill Pit

The OU1 ROD provides for the use of Anchor Hill Pit as the primary ARD storage location for the Site. However, significant issues have been identified regarding the use of Anchor Hill Pit for long-term ARD storage. The large watershed (20.2 acres) draining to the Anchor Hill Pit contributes runoff into this pit lake, which mixes with stored ARD and increases the volume of water becoming ARD and requiring treatment. This area includes the highwalls of the Anchor Hill Pit and other areas where runoff cannot be adequately diverted away from the stored ARD. Further evaluation of post-remedy estimates, developed in Appendix G of the OU1 Feasibility Study (FS) for the OU1 ROD remedy (Alternative 5 of the FS), suggests that the Anchor Hill watershed increases the volume of water requiring treatment by approximately 6 to 8 million gallons in an average water year. The additional volume of water requiring treatment increases long-term O&M costs.

Post-ROD analysis of data from ongoing groundwater and pit lake monitoring at Anchor Hill Pit indicates that the pit lake is in communication with groundwater and that a gradient is commonly present that causes water to move southeast from the pit lake into groundwater. In addition, groundwater quality data indicate that groundwater down gradient from the pit lake is strongly affected by ARD, which suggests that ARD may have migrated from the pit lake into groundwater in previous years. One groundwater monitoring well, GE-MW-08, is present on the downgradient (southeast) side of the Anchor Hill Pit. The well is affected by ARD as indicated by a pH of approximately 3 standard units.

As described in the technical memorandum prepared for EPA by CDM (January 11, 2011), an equivalent porous model approach using Darcy's Law[1] was applied to provide an estimate of the potential magnitude of leakage from the pit lake. The bedrock aquifer is a fracture-controlled groundwater system rather than a porous media. However, an equivalent porous model approach is often used to evaluate fracture flow systems, particularly when detailed groundwater data necessary to evaluate fracture flows are not available. Previous evaluations of the bedrock groundwater system at the Site indicate that transmissivity of the aquifer is variable, and visual evaluations of fractures on the southeast highwall of Anchor Hill Pit indicate that fracture distribution also varies spatially. Therefore, the estimate of the potential leakage rate based on existing data should be understood as an "order of magnitude" value and is estimated at approximately 25 gpm. This flow has the potential to contribute to groundwater degradation over time. In addition, the leakage could potentially increase long-term O&M costs if ARD leaking into groundwater from the Anchor Hill pit lake storage vessel is collected at a downgradient ARD collection facility.

[1] Darcy's Law is a mathematical expression that describes laminar flow of water through a porous media. Darcy's law states that the discharge is equal to the product of the hydraulic conductivity, the hydraulic gradient and the cross-sectional area of the aquifer.

EPA and SD DENR have agreed to modify the OU1 ROD remedy to include backfill and cover of Anchor Hill Pit. This modification will include placement of excavated contaminant source fills within Anchor Hill Pit and installation of a geosynthetic multi-layer cover similar to that proposed for the backfilled Dakota Maid and Sunday pits. The cover would eliminate exposure of the contaminated materials at the surface, and reduce the infiltration of precipitation and subsequent ARD generation in the contaminated backfill. This modification to the OU1 ROD is anticipated to reduce the volume of ARD generated from this area by 6 to 8 million gallons, but will also eliminate the use of Anchor Hill Pit for long term ARD storage and management.

At the time the OU1 ROD was issued, it was thought that there would be insufficient material available to fill and cover Anchor Hill Pit and a reasonable alternative for water storage was needed. Since that time, information gained during the design process indicated that there are more contaminated fills on Site available for consolidation and an alternative for water storage was identified as described below.

Heap Leach Pad

Due to the elimination of Anchor Hill Pit as the long-term ARD/contaminated water storage and management facility, selection of an alternative location became necessary. The HLP was identified as the most feasible location for future water storage and management. This location is upgradient from the current and future seeps, however, other downgradient locations in the vicinity of the Site are spatially limited by topography and/or private property.

The HLP area offers some advantages. A liner system is already in place at the HLP, construction cost savings were identified by removing additional mass of spent ore and utilizing the remaining spent ore to form bermed cells that will be lined for the future storage and management of contaminated water as well as WTP generated sludge repositories. An evaluation of future storage capacity needed is described in Section 3.1.2. Additionally, it was determined that the west berm of the HLP can be covered and water diversion structures can be installed such that a collection area for seepage through this area is not required.

Hoodoo Gulch

Although not specifically addressed in the OU1 ROD, the selected remedy description implies the excavation or covering of waste materials in the Hoodoo Gulch area to reduce the quantity and improve the quality of contaminated surface water that is generated in this location. Acid-generating materials will be excavated to the extent practicable and remaining materials will be capped in place. This is not a significant change from the OU1 ROD but is described here for clarity and to include the projected costs associated with addressing this material.

Process Plant Area

The fills currently under the process plant area have previously been identified as a source of ARD. In the OU1 ROD remedy, the process plant was selected to remain in place to preserve the use of the building for Site maintenance and office needs. Post-ROD considerations of the process plant building have indicated that the building is not well suited for sustainable use in the winter months and is not well suited for the intended purpose. Since the material under the process plant is suspected to be a significant contributor to water contamination in the Strawberry Creek corridor, the demolition of the structure and the removal of the underlying waste material is selected as a modification to the OU1 ROD remedy. Additionally, this modification eliminates the need for a subsurface collection area along the east perimeter of the process plant area as described in the OU1 ROD. A more suitable office and maintenance building will be constructed at a location to be determined.

Union Hill

The original concept laid out in the OU1 ROD for the cap of Dakota Maid and Sunday pits would leave a significant extent of highwalls exposed. These highwalls are acid generating and rocks fall or spall freely. The spalling and ARD generation would contribute significantly to future maintenance costs and complexity. Water capture structures would need to be installed to prevent acid water from contaminating the clean cap and this water would need to be treated prior to discharge. The spalling of acid generating rock material from the highwalls onto the clean cap would be challenging to manage into the future.

In the post-ROD design process EPA and SD DENR determined that removing a portion of the Union Hill will allow for a contiguous cap to be installed over both pits resulting in coverage of these highwalls. This will reduce the volume of water requiring treatment, eliminate the challenge of safely removing the spalled material, and preserve the integrity of the clean cap material.

Capability for Future Pit Water Level Management

The OU1 ROD provides that collection systems will be installed at the base of Dakota Maid and Sunday pit covers. The intention is to maintain constant water levels to prevent wetting and drying cycles of the acid-generating materials surrounding the pit areas, which can increase the generation of ARD. One free drain near the bottom of Dakota Maid Pit was determined to be sufficient to maintain consistent water levels in both Dakota Maid and Sunday pits, rather than a drain system in each pit. Additionally, a well will be installed in each pit, including Anchor Hill Pit, that can be used in the future as an extraction well should pumping of water be required to sustain constant water levels in the pit backfills. These wells can also be used for monitoring wells.

Rinsate Water Collection and Parent Ground Amendment

The remedy specifies the removal of mine wastes (general fills) that were laid on top of parent ground during mining of the Site. Contaminants are anticipated to have mobilized from the general fills into the parent ground to some degree over the past many years. It is anticipated that after removal of the general fills or other contaminate source materials, there may be a finite rinsate period where metals, acidity and sulfate are flushed from the newly exposed parent ground material. Over time it is anticipated that this rinsate water quality will improve and may not need treatment. The rinsate water phenomena is explained further in the technical memorandum prepared by CDM (January 11, 2011). Although rinsate water collection is not specifically named in the OU1 ROD, the phenomena of rinsate water is implied in the remedy provision that directs collection facilities at Strawberry Pond and Hoodoo Gulch to be phased out as surface water quality within the Upper Strawberry Creek and Hoodoo Gulch drainages improve from removing contaminant sources within these drainages. Additionally, this rinsate water and the projected volume were evaluated in the OU1 FS.

The potential rinsate will be addressed in two ways. Soil amendments including lime (or equivalent) and clean fill will be added to newly exposed parent ground to prevent or reduce the production of poor quality rinsate water. Amending the soil in place is expected to prevent or minimize the production of impacted rinsate water. However, since the concentration of contaminants deposited into the parent ground have spatial variability, it is difficult to precisely predict the anticipated water quality of the rinsate after any given storm size. Therefore, the modified remedy provides for the collection of impacted rinsate water into capture basins. A capture basin will be located in the lower portion of the Strawberry Creek corridor and in the Hoodoo Gulch area. Including collection basins in the OU1 earthwork allows capture and detention of the rinsate so that water quality can be assessed and a determination made if rinsate requires ongoing capture and treatment or if it is suitable to be discharged.

Temporary pumping systems will be utilized in OU2 operations while water quality and quantity and long term management needs are assessed. Water not meeting discharge standards, including in-place waivers for TDS and Se, will be pumped to the contaminated water storage and management facility (HLP area) and treated as necessary.

Concurrently, semi-passive treatment treatability studies are planned during the remedial investigation/feasibility study (RI/FS) for OU2 if rinsate water quality prevents direct discharge to Strawberry Creek. If rinsate water requires treatment, semi-passive treatment will be utilized, if applicable, to reduce costs for long term pumping and treating of this rinsate water in the WTP. The installation of the semi-passive treatment systems can be phased in as the OU1 remedial action progresses, but will require an assessment of the rinsate water quality resulting from the parent ground excavations and implementation of the soil amendments in order to design an appropriate system. Empirical data from the rinsed areas, including variations in both water chemistry and flow rates, are necessary before final design of a semi-passive treatment system is developed. Until the localized semi-passive systems have been installed, impacted rinsate water collected in the sedimentation/capture basins will be pumped with temporary pumping systems and treated in the existing WTP. Therefore, the modified remedy will not allow release of poor quality rinsate water into Strawberry Creek or Bear Butte Creek.

Several different types of passive/semi-passive treatment technologies may be evaluated for use in the OU2 RI/FS, including Reducing and Alkalinity Producing Systems (RAPS), anaerobic wetlands, sulfate-reducing bioreactors, and aerobic wetlands.

Water Treatment Plant Modifications

The OU1 ROD specifies upgrades to the WTP, as needed, to allow treatment of higher concentrations of sulfate from ARD stored in mine pits and ponds to allow OU1 construction to proceed, and to address potentially higher concentrations of sulfate in ARD from future Site sources to the collection systems. The OU1 ROD indicated that the exact components and configuration of the WTP upgrade would be determined during the design and implementation of the remedy. However, the OU1 ROD indicated that a second reactor tank, a second clarifier and building expansion would likely be required. In 2013, the OU2 Site operators have tested high sulfate water treatment at slower flow rates through the existing WTP. Initial experiments have shown good potential to utilize this method to address the high sulfate water stored in the Sunday and Dakota Maid pits. Additionally, an optimization study conducted by EPA (Tetra Tech, December 2012) indicated that in-pit treatment for sulfate may be more cost effective than the proposed modifications to the WTP. Furthermore, designing and implementing WTP modifications without an accurate understanding of future water quality and applicable discharge standards, including TDS and Se, is likely to result in a treatment system that may not function optimally, requiring future expenditures for further modifications. Therefore, the remedy will be modified to delay WTP modifications and address necessary modifications and potential relocation in the OU2 RI/FS.

Remedial Action Cost Estimate

The OU1 ROD anticipated the remedial action costs at $57,987,000. Costs presented in a ROD are generated during the feasibility study and have an accuracy range of minus 30% to plus 50% giving a probable range of $40,591,000 to $86,981,000. The costs are expected to increase significantly from the OU1 ROD for several reasons. Costs were revised during the design process as additional information on the depth of mine wastes were gathered and feasibility level assumptions were revised. Modifications to the selected remedy described in this ESD are expected to enhance achievement of the remedial action objectives over the life of the project and are anticipated to reduce long term O&M complexity and costs allowing long term fiscally sustainable management of the Site. However, these modifications have increased the capital costs for the remedial action. Additionally, inflation since the feasibility study cost evaluation has contributed to the increase in costs. Costs are discussed in further detail in Section 4.3.

3.1 Analysis of Future ARD Generation and Storage Requirements

The modified remedy components were selected to reduce the quantity of ARD and poor quality rinsate generated at the Site in order to reduce the management effort and associated costs required to collect, convey and treat impacted water over the long-term. Since the modified remedy includes a reduction in future water storage capacity at the Site by changing from utilizing the Anchor Hill Pit with 160 million gallons of storage capacity, to a smaller constructed water storage and management facility at the HLP location, an evaluation of needed storage capacity has been performed and is discussed below.

3.1.1 Volume of ARD Requiring Collection and Treatment

Appendix G of the OU1 FS provides normalized estimates of the ARD yield, including the rinsate phase and post-rinsate phase, which are expected from implementation of the OU1 ROD (Alternative 5 of the FS as originally presented). This estimate is based on a water balance approach that considers the drainage basin areas, precipitation, evapotranspiration, pit lake evaporation, groundwater inflows, and groundwater discharge including that required to maintain a constant water level in the pits (identified as base flows in the FS and the January 2011 memorandum). While soil amendments are planned in the modified remedy to reduce or eliminate the generation of contaminated rinsate, the calculated rinsate volume was still included in the analysis of future ARD generation and storage requirements to be conservative in the event that spatial variability in contaminant distribution is not adequately addressed in applying the soil amendments.

To estimate the ARD yield expected from the modified remedy, estimates provided in the OU1 FS were adapted to evaluate the effect of backfilling and capping the Anchor Hill Pit. This estimate assumed that a low permeability cover system would be installed over the backfilled source materials, and that precipitation (rain and snow melt) within the Anchor Hill watershed would be intercepted by the cover system and diverted as clean water into the Strawberry Creek corridor.

In estimating the future ARD yield from the Ruby Repository, the yield reduction resulting from completing the cap of the upper Ruby Repository was calculated. However, additional reductions from the Ruby Repository clean water diversion ditch repairs was not included in this analysis. Due to the difficulty in accurately measuring the reduction in ARD volume from complete coverage of the Dakota Maid and Sunday pit highwalls, by the reduction of Union Hill, this volume reduction was not included in the analysis either. Because this additional work will reduce ARD generation by some volume, the following analysis of future ARD generation and storage requirements are conservative.

Table 1 includes a summary of the estimated volume of ARD that would be generated at the Site under the OU1 ROD remedy and the modified remedy.

Table 1. Estimated Volume of ARD Generated at Site

Remedy and Rinse Phase[1]	**Normalized ARD Yield (million gallons produced per inch of precipitation)**	**Average annual ARD yield**[2] **(million gallons)**	**Annual ARD yield in 95th percentile wet year**[3] **(million gallons)**
Current condition	3.4	97	125.8
OU1 ROD remedy: Parent ground rinsing phase	2.2	64	83
OU1 ROD remedy: Post-parent ground rinsing phase	1.0	29	38
Modified remedy: *Parent ground rinsing phase*[4]	***2.0***	***57***	***75***
Modified remedy: Post-parent ground rinsing phase	0.8	22	30

1. Data presented in appendix A of the Technical Memorandum *Reissue- Revision 2- Draft Final Potential 2008 Record of Decision Remedy Modifications to Improve Effectiveness and Decrease Long Term O&M costs, Gilt Edge Superfund Site, Operable Unit 1 Remedial Design*, prepared by CDM January 11, 2011.
2. Average annual precipitation is 28.65 inches.
3. Ninety-fifth percentile wet year is 37 inches.
4. The soil amendments are anticipated to eliminate or greatly reduce the generation of contaminated rinsate water. Parent ground rinsing in the modified remedy is included as a worst case scenario and is considered a conservative scenario.

3.1.2 Required ARD Storage Capacity

To evaluate if suitable storage capacity can be made available onsite without the use of Anchor Hill Pit, the required storage volume for the modified remedy and the OU1 ROD was calculated using a Monte Carlo simulation[2] method to account for uncertainty in future precipitation, ARD yield and other factors. Important assumptions of this estimate include the following:

- Parent ground rinsing and post-parent ground rinsing periods were calculated.
- Water treatment was assumed to operate year round, requiring a variable flow rate ranging from 50 gpm to 325 gpm. Additional considerations included the storage of precipitation as snow during winter months and snow melt during late March and April.
- Stochastic estimates of future precipitation were based on the historical record of 1948 to 2006.
- The model was run in monthly time steps for one water year (October 1 to September 30).
- A Monte Carlo simulation was run 10,000 times with varying input data, and estimates included average storage volume and storage volume that would be exceeded no more than once in 25 years (on average).

[2] Monte Carlo simulation is an estimation method that can be applied to predictive models. Input data for the model are defined as probability distributions. Random values are selected from the defined probability distributions, and the predictive model is solved. This process is repeated thousands of times to develop statistical estimates of likely outcomes of the predictive model.

The model did not consider campaigned treatment where all ARD would be treated during the summer and no treatment would be conducted during other months of the year. However, in the model, treatment flow rates were sufficiently small during the winter months that the ability to do campaign treatment during part of the year is feasible with the predicted storage requirements. If campaign treatment is utilized, the length of the treatment season may vary year to year based on the precipitation. The results of the analysis are presented in Table 2.

Table 2. Required ARD Storage Capacity

Remedy and rinse phase	Required storage capacity average year (million gal)	Storage capacity exceeded no more than once in 25 years, on average (million gal)
Current condition	21	54
OU1 ROD remedy: Parent ground rinsing phase	13	28
OU1 ROD remedy: Post- parent ground rinsing phase	6	11
Modified remedy: *Parent ground rinsing phase*[1]	*12*	*25*
Modified remedy: Post-parent ground rinsing phase	5	8

1. Parent ground rinsing phase is shown in the modified remedy as a worst case scenario. The planned soil amendments are anticipated to eliminate or greatly reduce the generation of contaminated rinsate water. This is included as a conservative scenario.

As shown in Table 2, in the modified remedy, the required storage capacity for ARD, not including collection of rinsate, is estimated to be eight million gallons. If rinsate water is of poor quality and needs to be collected, the required storage capacity is 25 million gallons. The required storage capacity for the modified remedy, assuming impacted rinsate, is over eighty percent less than the 160 million gallon capacity of Anchor Hill Pit. Even in current conditions if water is managed and treated on a regular basis the 160 million gallon storage capacity of Anchor Hill Pit is not necessary.

The converted HLP is designed to have 32 million gallons of storage capacity in addition to a 1.7 million gallon mixing cell. The planned water management facility will have more than 7 million gallons of capacity over what was predicted to be needed in the event rinsate water requires capture and treatment. This excess planned volume offers a measure of safety if future flows are greater than anticipated. Overtime, excess volume in the water storage facility can be used as a repository for treatment generated sludge.

4.0 DESCRIPTION OF DIFFERENCES BETWEEN THE OU1 ROD REMEDY AND THE MODIFIED REMEDY

This section presents an overall summary of the differences in the OU1 ROD remedy and the modified remedy. The differences are presented in comparative summaries for remedy scope, remedy performance, and cost.

4.1 Remedy Scope

The significant differences in remedy scope between the OU1 ROD remedy and the modified remedy are summarized by component in Table 3.

Table 3. Description of the significant differences by remedy component.

Component	OU1 ROD Remedy	Modified Remedy	Goal
Anchor Hill Pit	Anchor Hill Pit for ARD storage.	Backfill and cover Anchor Hill Pit to reduce infiltration to groundwater through the pit and reduce volume of ARD generated.	**ARD Source Reduction & Ground Water Protection**
Heap Leach Pad	HLP configured for sludge disposal.	Construct new impoundments at the HLP for ARD storage & management as well as sludge disposal.	**ARD Water Storage & 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 & Ground Water Protection**
Process Plant	Process plant to 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 maintenance building to be constructed in the future.	**ARD Source Reduction & Ground Water Protection**
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 & Ground Water Protection**
Rinsate Water	Collect, transfer, and treat through existing 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 the Generation of Impacted Rinsate Water)**
Capability for Future Pit Water Level Management	Collection systems will be installed at the base of Dakota Maid & Sunday pits covers in order to maintain acceptable ARD levels in the 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 RA 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**

4.2 Performance

The key differences in performance between the OU1 ROD remedy and the modified remedy are summarized in Table 4.

Table 4. Remedy Performance Comparison

Goal	OU1 ROD Remedy	Modified Remedy
ARD Storage & Management	ARD stored in Anchor Hill Pit - 160 million gallons of capacity contributing 8 million gallons in ARD production to the Site water balance annually.	ARD stored on Heap Leach Pad. New impoundment, 32 million gallon total capacity. No passive discharge to the groundwater. Ability to mix low and high sulfate concentration water in mix cell to facilitate treatment. The converted HLP facility will provide a WTP sludge disposal area as well.
ARD Source Reduction	64 million gallons during parent ground rinsing/29 million gallons after parent ground rinsing.	57 million gallons during parent ground rinsing/22 million gallons after parent ground rinsing.
Surface Water Quality	Protects surface water through collection of ARD and rinsate water for treatment in the WTP.	Reduction in volume of ARD generated and amending soils to reduce or prevent contaminated rinsate water, facilitates contaminated water management and reduces risk of release to surface water.
Groundwater Quality	Use of Anchor Hill Pit for storage is a potential source of groundwater contamination. The Process Plant, Hoodoo fills and highwalls associated with Union Hill all are potential ARD producing areas.	Backfill and cover Anchor Hill Pit to eliminate potential source of groundwater contamination. Remove and/or cover ARD generating fills under the process plant, in the exposed highwalls creating Union Hill and the Hoodoo fill area to control ARD sources that contribute to groundwater contamination.
Compatibility with OU2 Water Collection and Management	Collection of pit water was provided to maintain water levels in pits and minimize ARD generated in the pits. WTP modifications were selected to treat high sulfate water to drain the Dakota Maid and Sunday pits prior to construction, however, these costly upgrades may not be suitable to treat future water quality or meet future water quality goals for TDS and Se.	The ability to collect pit water is retained and modified to include a pumping option if needed. Treating current high sulfate water in cost effective temporary manner so that future water quality and water quality goals can be determined before costly WTP process changes are implemented

ARD generating mine sites can produce ARD into perpetuity, requiring treatment for long after the foreseeable future. The modified remedy improves the ability to meet the RAOs over the long life of this ARD generating Site. Specifically, the remedy modifications further the management of ARD source materials to reduce the volume of ARD, further reduce the risks of uncontrolled release of ARD in a 100-year flood event by reducing the volume of ARD that requires management, increase the coverage of mine waste to enhance the reduction of exposure risks to terrestrial ecological receptors, reduce the contaminant migration to groundwater, and reduce the complexity required to maintain any long term OU2 remedy.

The overall strategy and remedy technologies selected for this modified remedy are the same as those in the OU1 ROD. Therefore the ARARs have not changed.

4.3 Cost

The key differences in capital and O&M costs between the OU1 ROD and the modified remedy are presented in Table 6. The costs presented are feasibility level costs with an accuracy range of minus 30% to plus 50%. The O&M costs for the water treatment plant and overall Site management are difficult to predict accurately. Anticipated automation of the WTP, and collection and conveyance facilities will allow reduced site labor, however, removal of the current waiver for TDS and Se are expected to require different treatment technologies which are likely to increase costs from those estimated here.

Certain enhancements, such as the prevention of spalling from the Dakota Maid and Sunday pits highwalls are very difficult to accurately quantify as cost reductions since it is difficult to predict the frequency that the material would have had to be removed. Accordingly, cost assumptions have a high degree of uncertainty, but the reduction in complexity and the protection of the clean cap are considered important for the long term sustainability of Site operations and maintenance and protectiveness of the remedy.

Table 6. Cost Comparison between the OU1 ROD Remedy and Modified Remedy Components.

Remedy Component	OU1 ROD Remedy 2008		OU1 ROD Remedy 2011 Revised Costs		Modified Remedy	
	Capital Cost	**Annual O&M Cost**	**Capital Cost**	**Annual O&M Cost**	**Capital Cost**	**Annual O&M Cost**
WTP Modifications	$553,000	NA	$678,000	NA	NA	NA
Earthwork and Capping	$57,434,000	NA	$63,475,000	NA	$60,021,000	NA
Anchor Hill Pit- Backfilling and Cover System Construction	NA	NA	NA	NA	$5,858,000	NA
Alternate ARD Storage (Impoundment at HLP)	NA	NA	NA	NA	$2,524,000	NA
Union Hill/Coverage of Dakota Maid and Sunday highwalls	NA	NA	NA	NA	$13,079,000	NA
Parent Ground Amendment	NA	NA	NA	NA	$235,000	NA
Rinsate Water Collection Basins (versatility for rinsate capture or localized treatment)	NA	NA	NA	NA	$6,129,000	
O&M for OU1	NA	$43,000		$80,000	NA	$50,000
WTP O&M -OU2	NA	Not Calculated in ROD	NA	$236,000	NA	$174,000
Site Management O&M -OU2	NA	Not Calculated in ROD	NA	$304,000	NA	$218,000
Onsite Labor/Staff Support -OU2	NA	Not Calculated in ROD	NA	$970,000	NA	$592,000
Maintenance Supplies -OU2	NA	Not Calculated in ROD	NA	$71,000	NA	$54,000
Total Costs	**$57,987,000**	**$43,000**	**$64,153,000**	**$1,661,000**	**$87,846,000**	**$1,088,000**

Notes:

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons for evaluation purposes and do not necessarily represent annual appropriations or total budgetary expenditures required.

Total capital and annual O&M costs are rounded to nearest $1,000. OU2 Annual O&M costs exclude periodic replacement of major remedy components that may be necessary over time.

OU1 O&M costs were averaged from periodic costs presented in the OU1 ROD; 2011 OU1 O&M costs includes averaged estimate for highwall spalled material removal, Modified remedy OU1 O&M costs are adjusted for inflation from 2008 ROD.

Costs were revised during the design process in 2011 based on additional information that was gathered during the design work.

Costs developed in past years are not adjusted reflect inflation to 2014 dollars.

The scope of earthwork components for the OU1 ROD Remedy is based on the descriptions presented in the ROD.

The scope of earthwork components for the Modified Remedy includes additional sources of contaminated backfill is based on the descriptions presented in this ESD.

Reductions of O&M costs presented for the modified remedy include the expectation that generation of impacted rinsate water will be prevented.

NA - Not Applicable

5.0 SUPPORT AGENCY COMMENTS

The State of South Dakota Department of Environment and Natural Resources (SD DENR) has provided comments on this ESD and has participated in Region 8's ESD review meeting. The incorporation of their comments is documented in the administrative record. SD DENR agrees with the modified remedy as described in this ESD.

6.0 STATUTORY DETERMINATIONS

In accordance with CERCLA section 121, 42 U.S.C. § 9621, EPA has determined that this action is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements (ARARs) to the remedial action, are cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The ARARs have not changed from those in the OU1 ROD. In accordance with NCP Section 300.430(a)(iii), the remedy meets the expectations to utilize containment of high volumes of low level threat waste.

7.0 PUBLIC PARTICIPATION REQUIREMENTS

In accordance with requirements of CERCLA section 117 and NCP section 300.435(c)(2)(i) EPA is issuing this ESD as the modifications to the OU1 ROD, while significant, do not fundamentally alter the original remedy selected in the OU1 ROD with respect to scope, performance, or cost. This ESD and the supporting information shall be available to the public at the information repository located at the Hearst Public Library, 315 Main Street, Lead, South Dakota 57754, (605) 584-2013 and, by appointment, at the Region 8 EPA records center at 1595 Wynkoop St, Denver, Colorado 80202. EPA shall publish a notice in the Rapid City Journal indicating the availability and location of this ESD.

8.0 REFERENCES

CDM, 2011, Technical Memorandum "Reissue- Revision 2- Draft Final Potential 2008 Record of Decision Remedy Modifications to Improve Effectiveness and Decrease Long Term O&M costs, Gilt Edge Superfund Site, Operable Unit 1 Remedial Design" To Kathy Hernandez, EPA. From Karen Taylor, CDM. January 11, 2011.

Tetra Tech, Inc. 2012. Optimization Evaluation: Gilt Edge Mine Superfund Site Water Treatment Plant, Lawrence County, South Dakota (EPA 542-R-13-002). http://clu-in.org/techdirect/techpubs.cfm, December 14, 2014.

9.0 AUTHORIZING SIGNATURES

Federal

This Explanation of Significant Differences (ESD) documents modifications to the remedy previously selected by the United States Environmental Protection Agency for the Gilt Edge Mine Site (SD987673985), Operable Unit 1, in the Record of Decision.

The following authorized official at EPA Region 8 approves the modified remedy as described in this ESD.

Martin Hestmark
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

9/30/14
Date

State of South Dakota

This Explanation of Significant Differences (ESD) documents modifications to the remedy previously selected by the United States Environmental Protection Agency for the Gilt Edge Mine Site (SD987673985), Operable Unit 1, in the Record of Decision.

The following authorized official at the South Dakota Department of Environment and Natural Resources approves the modified remedy as described in this ESD.

Steven M. Pirner
Secretary, South Dakota Department of Environment and Natural Resources

10/15/14
Date

FIGURE 1: GILT EDGE SITE LEAD, SD