R. J. BAYER PROFESSIONAL GEOLOGIST, LC

December 19, 2016

RECEIVED
DEC 2 9 2016
Utah Division of Water Quality

Mr. Dan Hall
Mr. Mark Novak
Utah Division of Water Quality
P.O. Box 144870
Salt Lake City, Utah
84114-4870

Re: Amended Groundwater Discharge Permit Application for CS Mining LLC (UGW010014)

Gentlemen:

On behalf of Mr. David McMullin, CS Mining's CEO, I am submitting the subject document, which is intended to respond to the Division's letter from Mr. Hall of June 13, 2016 and Mr. Novak's letter of August 19, 2016 and his accompanying memo. Attached please find revised GWDPA text and supplemental information in appendices for CS Mining LLC's Ground Water Discharge Permit. The revised text of the GWDPA is complete with both original wording and revised text. The new text is in red font and deleted text is stricken. Items have been added to Appendix A and D and a new Appendix H has been added. The remainder of the appendices as well as the figures that followed the text in the currently approved GWDPA have not been changed and are not duplicated in this submittal. The pages of this submittal are three-hole punched to allow them to be placed in the binder containing the original GWDPA.

On behalf of CSM I am looking forward to working closely with Division staff to answer questions and provide additional information that may be required regarding the subject application.

Sincerely,

Robert J. Bayer, P.G.

DWQ-2016-016683

Copy: David McMullin, CSM (w/ attachment) via email

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GROUND WATER DISCHARGE PERMIT APPLICATION

for

CS Mining, LLC

Solution Ponds and Intermediate Tailings Disposal Facility Project

~~January 30, 2014~~

UGWRevised December 15, 2016

RECEIVED
DEC 29 2016
Utah Division of Water Quality

Prepared for

CS MINING, LLC
1208 S. 200 W., P.O. Box 608
Milford, UT 84751

Prepared by

R.J. Bayer Professional Geologist, LC
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1. Introduction

CS Mining LLC is expanding its copper mining and beneficiation operation in Beaver County, Utah. This expansion includes new plant facilities that will be supported by solution ponds and a new tailings impoundment that require a Utah Ground Water Discharge Permit in accordance with the Rule R317-6, Ground Water Quality Protection. This document is intended to meet the requirements for a Ground Water Discharge Permit Application under Rule R-317-6-6.

2. Background Information

In 2008, a predecessor to CS Mining acquired approximately 11,440 acres of mixed private, Federal, and State lands located approximately seven miles northwest of Milford, Beaver County, Utah. This land encompasses various current and historic copper-bearing open pit copper mines and underground mine workings (DOGM Notice of Intention to Commence Large Mine Operations M/001/0067). CS Mining proposes to increase economic viability of its mining operations by continuing to expand its mining activities and constructing an acid-leach and counter-current decantation (CCD) plant along with a solvent extraction and electrowinning (SX/EW) plant. These additional facilities will enable CS Mining to produce copper cathode as well as copper concentrates; the latter will continue to be sold to a toll smelter. The tailings residue will be placed in a lined tailings facility (the Intermediate Tailings Disposal Facility or ITDF) to be located east of the existing mill site. The acid-leach and SX/EW plants will require up to 3 solution storage ponds, which will be lined and have leak detections systems. A Utah Ground Water Discharge Permit (GWDP) is sought for the ITDF and the 3 solution ponds.

3. Administrative Information

3.1. Applicant Name and Address

CS Mining, LLC
1208 S. 200 W., P.O. Box 608
Milford, UT 84751

3.2. Contact Information

Phone: (435) 378-5053
Fax: (435) 387-5088
Attn: David McMullin, VP and General Manager

3.3. Authorized Company Representative

David McMullin, Vice President and General Manager, is duly authorized to represent CS Mining, LLC, with regard to this application for a groundwater discharge permit for the Intermediate Tailings Disposal Facility (ITDF).

3.4. Facility Legal Location

The proposed tailings facility will be located in the SW ¼ of Section 5, SE ¼ of Section 6, NE ¼ of Section 7, and NW ¼ of Section 8, Township 27 South, Range 11 West, Salt Lake Base & Meridian. The 3 solution storage ponds will be located in the NW ¼ of Section 7 in the same township. All sections are located in Beaver County, Utah. The Universal Transverse Mercator Geographic Coordinate System (UTM) coordinates for the facility are: Zone 12 Northing 4261885, Easting 314950. Figure 1 is a project and general facilities location map.

4. General Information

4.1. Owner and Operator Information

The owner and operator information is the same as the applicant information: CS Mining, LLC is the owner and operator for this facility.

4.2. Facility Information

Solution Ponds and Intermediate Tailings Disposal Facility (ITDF)
CS Mining, LLC
Milford, UT

4.3. Contact Information

The Contact information is the same as listed in Section 3.2 above.

5. Facility Location, Type, and Classification

The ITDF will be used to store reject material from CS Mining's copper processing facility, which is described in detail in Section 6, Mine Operation and Processing Description. The proposed tailings pond will be located on privately owned land approximately nine miles northwest of Milford, Beaver County, Utah (Figure 1), and is located as described in section 3.4. The ITDF footprint is approximately 80 acres.

5.1. Facility Classification

The ITDF and the 3 solution ponds will be new, to-be-constructed facilities.

5.2. Type of Facility

The new facilities for which a Ground Water Discharge Permit is sought will be the 3 solution storage ponds and a new tailings pond. The facilities will store solutions and tailings as part of CS Mining's new copper cathode production facilities. Production of cathode copper begins following crushing and grinding with separation of acid-leachable ore from sulfide ore through the flotation process. The floatable ore, primarily sulfides, are dried and sold as concentrates. The ore that does not float, the underflow from the flotation tanks, contains non-sulfide (oxide) copper minerals that are acid soluble. Acid leaching produces a pregnant leach solution (PLS), which is stored in the PLS pond prior to processing with solvent extraction. Following solvent

extraction, the dissolved copper-bearing liquids are processed in the electrowinning circuit, in which copper cathodes are produced. The liquid remaining after solvent extraction is called raffinate and is stored in the raffinate pond to be recycled for reuse in the acid leach process.

A third solution pond ~~will~~ may also be constructed. It will be used for additional raffinate storage to accommodate future production increases and, if constructed prior to plant expansion, will provide added solution storage capacity in the event that repairs to one of the two primary ponds require it be taken out of service. The third pond may not be constructed immediately; however, it is the intent that this application includes a third pond to be located adjacent to the two currently proposed ponds, as described in sections 6.3 and 10.1.

5.3. SIC/NAICS Codes

The Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes that describe the proposed facility are 1021 (SIC) and 212234 (NAICS) for *copper ores mining and/or beneficiating.*

5.4. Project Facility Life

The expected life of the ITDF is 4 to 8 years. The solution ponds are anticipated to be used for a longer time period, up to 20 years, as ore reserves are increased and additional future tailings storage capacity is established. A larger tailings facility will be designed and constructed in the future; however, that facility is not part of this application.

6. Issued and Pending Permits

6.1. Permit History

Division of Water Quality Permits

CS Mining's predecessors, Western Utah Copper Company (WUCC) obtained a Permit by Rule from the Division of Water Quality (DWQ) on October 5, 2009 for the Flotation Tailings Pond (FTP) located south of the existing Mill Facility. On June 7, 2012, CS Mining received approval from the DWQ to use the FTP. The letter, dated June 7, 2012 from Woodrow Campbell to Ron Wunderlich, gives a chronological summary of events for the review and approval process. This letter can be found online in the Division's database. DWQ recently approved, in a letter dated September 30, 2013 from DWQ Director Walt Baker to Mr. Ron Wunderlich of CSM, a construction permit for expansion of the flotation tailings pond. This permit was issued under the existing Permit-by-Rule for the pond.

DOGM Permits

CSM currently has a permit for Large Mining Operations (LMO) with the Division of Oil, Gas and Mining (DOGM), M/001/067. The permit includes mining copper ore with open-pit mining methods, beneficiation via flotation to produce copper concentrate, and the flotation tailings pond. Two amendments to the LMO have been approved by DOGM in late 2013 to include the Sunrise mine pit, waste dump, and haul road.

CSM has several exploration permits with DOGM in and surrounding the Project area:

E/001/0159	Copper Ranch Exploration Project
E/001/0172	Bawana/Sunrise Exploration Project
E/001/0177	Maria Pit Exploration Project
E/001/0178	Candy B Exploration Project
E/001/0180	OK Mine Exploration Project

DOGM also has had one Small Mine Permit, S/001/0076, for the Bawana Low Grade Ore Piles; however, it will "rolled into" the LMO, M/001/067.

Air Quality Permits

Air Quality Approval Order (AO) DAQE-AN142190002-12 was approved on August 2, 2012.

BLM

BLM has approved a revised Plan of Operations for the Sunrise mine area and as part of that process prepared an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA). The EA did not address the effects of the current or planned tailings management or beneficiation operations because those existing and proposed facilities are not and will not be located on federal land.

To date, there have been six EAs prepared by the BLM for projects related to CSM's operations in this area. The EAs are:

DOI-BLM-UT-C010-2013-0053-EA December 2013 – Hidden Treasure Mine – Amendment 3

DOI-BLM-UT-C010-2012-0020-EA September 2012 - Hidden Treasure Mine

DOI-BLM-UT-C010-2009-0054-EA September 2009 - Sunrise Exploration Project

DOI-BLM-UT-C010-2009-0061-EA August 2009 - Bawana Stockpile Removal

DOI-BLM-UT-C010-2009-0027 January 2009 - Copper Ranch Exploration

EA UT-040-06-34 September 2008 - Candy B Exploration

6.2. Pending Permits

CS Mining is currently in the process of revising its Notice of Intent (NOI) for Large Mine Operations (LMO) with DOGM (M/001/067). Amendments to this NOI have recently been approved by DOGM, as noted above. The pending revision will address those proposed facilities described in this application document, including the proposed new plant facilities, process ponds and the tailings impoundment. Once approved by DOGM, this document will be placed on the DOGM online database.

A Notice of Intent Modification Application has been prepared and was submitted to the Division of Air Quality (DAQ) in December 2013. This modification addresses the operations set forth in

application as well as new or expanding mine facilities and haul roads. The application is currently under review by the DAQ.

7. Mine Operation and Beneficiation Description

7.1. Mining

CSM currently mines copper and magnetite ore in 3 open pits, the Hidden Treasure, Bawana, and Sunrise (Figure 1). The sequence in which they are mined is based upon the copper grade requirements of the mill; mining may occur in more than 1 pit at a time in order to meet mill feed requirements. Additional mineral deposits in the project area are anticipated to be developed in the near future. Ore produced from these pits will be milled and further beneficiated in the existing and proposed plant facilities and disposed in the ITDF. Waste rock removed from the pits is placed in adjacent waste dumps. Ore from the pits is trucked to the milling facility.

7.2. Mill/Concentrator

The mill facility consists of a crushing and grinding area with a dirt/gravel floor, and a flotation mill and recovery section, with a concrete floor. The entire facility has underlying concrete footings. The facility also includes chemical storage and conditioning tanks.

The concentrating activities are crushing, grinding, flotation, and filtration, which results in a copper concentrate, magnetite concentrate and tailings. The mill is capable of operating 24 hours per day, 7 days per week.

The primary crusher is a jaw crusher which crushes the rock to ¾-inch minus. The secondary crushing circuit consists of a series of 2 cone crushers which take the rock to minus 10 mesh. The minus 10 mesh to plus 60 mesh goes to the ball mill to be ground to 150-200 mesh. The minus 60 mesh from the secondary crusher will go directly to flotation. The capacity of the primary and secondary crushing circuits will be 3500 tons per day initially and shortly increased to 7000 tons per day. The ball mill capacity will be expanded to match the capacity of the crushers.

After the ore is ground in the ball mill, it goes to magnetic separation. The magnetite is stockpiled in anticipation of its sale to an end user. If it is not sold, the magnetite concentrate will be processed through the acid leach circuit for copper recovery.

The non-magnetic material moves to the conditioning, reagent, and mixing circuit, where it flows by gravity tank-to-tank, and then into the flotation and thickening circuit. The concentrate is then skimmed off and filtered before being shipped via truck as a concentrate to offsite facilities for further processing.

Flotation agents are added to the ground ore in the flotation circuit in an aerated water suspension. The flotation process uses two general types of froth flotation reagents: frothers, which aid in stabilizing the bubbles that form the froth, and "promoters" (also termed "collectors"), which enhance the effectiveness of flotation of specific minerals. The formulation of the flotation reagents used depends upon the specific mineralogy of the ore being processed.

Reagents are used in concentrations generally less than 1 percent by volume, with typical concentrations estimated to be 0.5 percent. The flotation reagents, by design, preferentially accumulate ore minerals and as a result are removed with the froth that contains the copper minerals and, therefore, accumulate with the concentrate following the flotation process. Thickened concentrates are dewatered through filtration and dried prior to shipping to an offsite smelter. The filtrate solution, including most of the flotation reagents, is recovered and returned to the mill circuit. Only minor amounts of reagents remain in the concentrates and tailings. Table 1 is a list of reagents used in the mill facility.

Table 1. List of Reagents used in Ore Beneficiation

Common Name	Industry Name	Circuit	Notes
Bentonite clay		Solvent Extraction	Crud treatment and clean up of organic phase
AERO® MX 935 Promoter	Modified dithiophosphate mixture	Flotation	Mineral promoter/collector
FLOMINC 4343	Sodium alkyl monothiophosphate	Flotation	Mineral collector
FLOMIN F 500 Frother	Methyl Isobutyl Carbinol (MIBC)	Flotation	Frother
TPH C40A	Polydiallydimethylammonium chloride	Flotation	Coagulant
Sodium hydrosulfide solution	Same	Flotation	Collector
Orform R (PAX)	Potassium Amyl Xanthate	Flotation	Collector
TPH A940	Anionic Emulsion Co-polymer	Flotation	Flocculent
CS Mining Copper Concentrate	Copper Concentrate	N/A	Product
Sulfuric acid (90-98%)	Same	Acid Leach	Acid
SuperFloc□ A-1883RS	Anionic polyacrylamide in water-in-oil emulsion	Acid Leach	Flocculent
3M Acid Mist Suppressor FC-1100	Fluroalkyl Acrylate Adduct	Solvent Extraction	Suppressor
ACORGA M5640X Solvent Extraction Reagent	Salicylaldoxime derivative	Solvent extraction	Extractant
Calumet 400-500 Solvent	Hydrotreated light petroleum distillate	Solvent Extraction	Solvent
Penreco® 170ES	Hydrotreated light petroleum distillate	Solvent Extraction	Solvent
Anionic polyacrylimide, PAM	Hydrotreated Distillate, Light C9-16	Solvent Extraction	Solvent
ShellSol D70	Same	Solvent Extraction	Organic diluents for extractant

7.3. Acid Leach and Solvent Extraction/Electrowinning

After the acid leach circuit and related facilities are built, the tailings from the flotation circuit will be transported via pipeline to the proposed acid-leach/counter-current decantation (CCD) circuit where it will undergo leaching with a sulfuric acid solution. The resultant copper-bearing pregnant leach solution (PLS) will be stored in the PLS pond before being processed in the adjacent SX/EW circuit. Solvent extraction is a process that reacts the copper-bearing weak acid solution with an organic solvent similar to kerosene. The reaction process effectively replaces the copper in the acid solution with hydrogen ion from the organic solvent. In turn, the copper is complexed with the organic solvent. When the extraction to organic solution is completed, the copper is then extracted from the organic solvent using a concentrated sulfuric acid solution, resulting in dissolved copper sulfate. This acid solution is processed electrochemically, in a process known as electrowinning, which results in electroplating to produce copper metal cathodes. The cathodes will be shipped and sold to metal brokers or other end users.

Design drawings for the acid leach and SX/EW circuits are contained in Appendix A. The drawings shown in the appendix are proprietary and marked business confidential. Drawing 00-GA-01 is a general arrangement and site plan for the acid leach and SX/EW facilities. As the drawing shows, the new facilities will be installed immediately to the west of the existing flotation mill. The acid-leach feed thickeners will be located adjacent to the mill. All of the facilities will be located on patented mining claims (fee land). From east to west, the major facility components are: the acid leach feed thickeners, the acid leach circuit and adjacent acid storage tanks, the CCD circuit, the SX circuit and the adjacent tank farm where solvents for the solvent extraction process are stored, and the electrowinning circuit and cathode handling facility. Initially a single train of 7 leach tanks will be installed for the acid-leach circuit; however, a second train may be added in the future. Similarly the initial CCD circuit will have a single 4-tank train with the addition of a second train planned in the future. Either 2 or 3 lined solution storage ponds will be constructed, as shown on Drawing 00-GA-01. One pond will contain PLS and 1 or 2 ponds will contain raffinate. Initially a single raffinate pond will be constructed. A second pond may be constructed if necessary in the future. Each pond is approximately 2.2 acres in area.

Process flowsheets for the leach/CCD, SX and electrowinning circuits are provided on drawings 60-FS-01, 30-FS-01, and 40-FS-O1, respectively (Appendix A). The leach process begins with the delivery of thickened acid leach feed from the thickeners to the leach circuit along with raffinate (recycled leach solution depleted of metals in the SX circuit) and sulfuric acid to adjust the pH in the first leach tank. Leaching of flotation tailings takes place as they flow through a series of 7 agitated leach tanks at progressively lower rates with addition of acid at each tank to maintain proper pH before flowing to the CCD tanks where pregnant (metal-bearing) solution is progressively separated from the solids by counter-current decantation, and sent to the PLS pond. The solids, tailings, from the CCD circuit are then pumped to the ITDF. From the PLS, pregnant solution is pumped through the SX circuit. The metal laden solvent is then reacted with concentrated sulfuric acid (in the tank farm area) where metal is separated from the solvent

after which the acid solution is pumped to the electrowinning circuit where copper cathodes are produced.

The following drawings for the principal facilities discussed above are provided in Appendix A:

62-GA-01 Acid Storage Tank Layout

60-GA-01 Leach Circuit Tanks Layout

61-GA-01 CCD Thickeners Circuit Layout

61-GA-01 CCD Thickener Circuit Section

30-GA-01 Solvent Extraction Unit Layout

40-GA-01 Electrowinning Unit Layout

50-GA-01 Tank Farm Unit Layout

Both the acid solutions and the organic solutions are recycled.

Tailings are separated from the PLS in the CCD circuit (see drawing 60-FS-01 in Appendix A). Tailings are estimated to be generated at a rate of approximately 350 gpm and contain 54% solids. No other waste streams will be sent to tailings.

A material termed crud remains following solvent extraction. Crud is the term used for the solid stabilized emulsion which collects in the settlers of solvent extraction (SX) facilities. The crud phase contains fine suspended solids, recoverable organic solvent, trapped air, gypsum, and debris that enters the open SX tanks. The crud is treated for recovery of the organic contents for re-use in the solvent extraction process. The final treatment step is filtration using either diatomaceous earth or a clay material (see flow sheet on Drawing 30-FS-01 in Appendix A). Following this step recovered solvent is returned to the solvent extraction circuit and the solids remaining after filtration are disposed offsite in accordance with its waste characteristics.

The concrete foundations for all proposed new structures are designed to contain 110 percent of the volume of the largest tank in the event of a spill. Any spills will be returned to the process circuit from which they were released or discharged to the raffinate pond.

The PLS and raffinate pond designs are depicted in a series of drawings included in Appendix B:

80-GA-01 PLS and Raffinate Pond Layout

80-GA-02 Ponds Sections and Details

80-GA-03 Solution/Leak Recovery Sections and Details

80-GA-04 Solution/Leak Recovery Plan and Notes

80-GA-05 Solution/Leak Recovery Sections and Details

The ponds will be designed to contain the designated solution quantities as well as the appropriate design direct precipitation component. The ponds will be bermed and will collect no runoff from the surrounding area. The solution ponds will contain a primary and secondary (composite) liner with a leak detection system.

Further details of the pond liners and leak detection systems are described in Section 10, Design Report.

7.4. Tailings Management and Tailings Characteristics

Currently flotation tailings are sent to the existing tailings pond located approximately 800 feet south of the mill. The proposed ITDF will be located to the east of the beneficiation facilities in two small drainages. The location of the ITDF is shown of Figure 1.

7.4.1 Flotation Tailings

The 25.80-acre flotation mill tailings pond was constructed at the location of a dry tailings disposal facility that was permitted by rule on October 5, 2009 under Utah's Ground Water Quality Protection Rules. CSM received a construction permit for this facility from the Division on October 11, 2011, and it was subsequently reissued on November 11, 2011. Most recently, a construction permit for expansion of the Flotation Tailings Pond was issued (September 30, 2013) for a 10 raise of the tailings dike to provide increased in capacity using upstream construction methods to allow for additional storage capacity while the acid leach circuit and associated tailings pond are constructed. Once the acid leach circuit is completed, the flotation tails will be extracted from the existing tailings pond and sent through the leach/SX/EW circuit and then to the ITDF.

Flotation tailings characteristics have been described in past data submittals that supported the current Permit-by-Rule for the Flotation Tailings Pond. No approvals relative to the Flotation Tailings Pond are being sought by CSM as part of this Application.

7.4.2 Intermediate Tailings Disposal Facility

The proposed tailings pond (or ITDF) for the acid-leach and SX/EW operation will be located in two small canyons east of the current milling operations (Figures 1, 2). The tailings pond will have two dams and a capacity of approximately 3 million cubic yards. Design information for the 2 ponds is provided in Appendix B. ~~Dam construction borrow will come from unconsolidated alluvium and weathered bedrock in both drainages and from the bedrock ridge located between the drainages. Weathering and fracturing of the granitic bedrock will allow this material to be ripped and no blasting is contemplated. Construction will commence with the eastern dam with much of the borrow material derived from the intervening ridge. Construction of the southeastern pond is scheduled to begin in mid Q2 of 2014.~~ These ponds are anticipated to have a life of 4 to 8 years and will allow ongoing production while design and permitting of a larger tailings impoundment is carried out.

Both dams will have a final crest elevation of 5,860 feet AMSL. The eastern dam will have a maximum downstream toe-to-crest height of approximately 160 feet. The western dam will have a maximum downstream toe-to-crest height of approximately 80 Feet.

As tailings begin to fill the eastern part of the ITDF, construction of the western starter dam will commence. Construction will proceed sequentially between the two dams as the containment capacity is increased over the life of the impoundment. Following construction of starter dams,

the dams will be raised in 10-foot increments. ~~r~~Raises will be constructed with borrowed filled ~~(from within the impoundment's ultimate footprint)~~ using upstream methods, building upon tailings beaches formed by selective tailings deposition along the dams' upstream sides. In order to ensure a stable foundation on which to place the raise fills, a geofabric will be placed over the tailings beach prior to fill placement. Earthen fill for construction of the starter dams will be borrowed from within the ultimate footprint of the ITDF to the extent fill is available. Supplemental starter dam or lift construction material will be borrowed from one or more sources yet to be selected, which may include waste rock dumps, or new borrow pits in alluvial deposits. Borrow sites and characteristics of fill materials will be provided with future Construction Permit applications.

Containment of tailings liquids will be enhanced by installation of a liner system. A 40-mil HDPE liner ~~will be~~was installed beneath the entire initial east starter dam impoundment and on the face of the dam.~~over the drainage bottoms and in those parts of the impoundment where water separated from the tailings will pond~~For the west starter dam and impoundment, as well as on the faces of the dams after lifts are installed, and on all subsequent pond margins as lifts on the dams are installed 60-mil HDPE will be used. A geocomposite liner (GCL) ~~will cover~~ may be used on parts of the upper margins of the impoundment if its performance and local conditions (e.g., steep walls with rock outcrops) indicate it would be preferable to HDPE or similar synthetic liner. If GCL is proposed for use it will be called out in the Construction Permit application for the individual lift being designed and will only be used if the Division approves the design and specifications presented. ~~Upon completion of ITDF construction, approximately 80 percent of the impoundment will be lined with HDPE.~~

The ITDF will not have a leak detection system.

Complete ITDF design details have been submitted to the Division under separate cover.

7.4.3 ITDF Ground Water Monitoring

As discussed in Section 9.0, ground water in the form of a water table aquifer is not known to be present beneath the ITDF site. Instead it is believed to occur in fractures with surface definitions in the form eroded drainage channels. The relatively localized granitic bedrock, small watershed area, and low precipitation rate combine to suggest this is may be the case. A 200-foot drill hole adjacent to the southeastern damp outslope location encountered fractured granodiorite (refer to Section 9.0). Nevertheless, a monitor well will be installed adjacent to the toe of each dam.

These wells will be 8-inches in diameter, 500 feet in depth and completed with 4-inch casing and well screen for monitoring and pumping purposes. Whether or not ground water is encountered, the wells be equipped with a dedicated pump and equipped with an electronic pressure transducer to enable sampling and to measure the hydrostatic head in the well, respectively. The monitor well below the eastern starter dam will be installed as soon as practicable following beginning of dam construction. The well will be completed and sampled

before tailings are place in the ITDF. The same approach will be taken with the monitor well to be installed below the western starter dam.

The elevation of the potentiometric surface in the well would be measured and recorded weekly. If water is present in the well, baseline water quality samples would be collected. Wells would be appropriately purged before sampling, samples would then be collected, preserved in appropriate sample containers and stored on ice or in refrigeration until delivery, under chain of custody to a Utah-certified analytical laboratory. The samples would be analyzed for the following parameters: pH and electrical conductivity (both in the field and in the lab); total dissolve solids (TDS); alkalinity; major ions (calcium, magnesium, sodium, potassium, sulfate, nitrate and nitrite, chloride); trace metals (for which Utah has established standards); and radionuclides (radium 226 and 228, gross alpha). Samples would be collected at the same time from water supply well WW-6 located approximately one-half mile south of the ITDF. Samples from the monitor well(s) and WW-6 will be collected quarterly for 2 quarters after which the baseline water quality for the well(s) would be reported to the Division. Thereafter, monitoring would continue on a quarterly basis with results reported to the Division quarterly.

Because the quality of tailings water is very similar to that of some ground water in the area, determining whether or not there has been an impact from leakage from the tailings pond may be difficult. CSM will work closely with the Division to assess whether or not the quality of any water beneath the pond has been impacted by a release of water from the ITDF. If it is determined that ground water quality is being affected by release of water from the tailings pond, the 4-inch well(s) will be used as recovery wells and water will be returned to the tailings pond. If it is determined that the capacity of a single 4-inch well cannot recover sufficient water to offset the rate of release, an additional well or a larger diameter well or both would be installed to enable water released from the ITDF to be pumped back to the pond.

Depending on the depth of water in the well, the submersible pump may or may not be able to lift the water from the water table to the tailings pond. If that is the case, either a larger capacity pump and well would be installed or an intermediate pump station would be installed at the toe of the dam to transfer water from the well head to the pond, which will require lifting against a head of 120 feet.

The combination of the liner system, placement of tailings in the ITDF which will retard water from reaching the liner, and the relatively short facility life (4 to 8 years) combine to create a very low potential for a leak escaping the pond to reach any water table under the largely unsaturated flow conditions that will exist beneath the ITDF.

7.4.4 Acid-leach/SX Tailings Characteristics

Bench-scale acid leach and solvent extraction testing was carried out by McClelland Laboratories in Reno, Nevada during 2013. A composite bulk sample was collected from the flotation tailings pond. Because flotations tailings will feed the acid-leach/SX/EW plant, the bulk sample is representative of the feed to the new plant.

The test replicated expected operating conditions with continuous acid addition and a 3-hour leach cycle at ambient temperature. Figure 3 is a flow diagram for the bench-scale test. Testing begins with the addition of tailings (T1) and sulfuric acid (A1) to the first of the 6 agitated leach tanks. Tailings move sequentially through the agitated leach tanks with acid added in each tank to maintain the necessary pH. Following leaching the liquids and solids from the leach circuit (T7) are separated in the CCD thickener train with the PLS going to solvent extraction (OF4) and the solids representing the tailings (UF 4) that would be pumped to the ITDF. Note that the flow from the SX cell does not segregate PLS and raffinate since electrowinning is not part of the bench test; therefore, no environmental analyses were performed on the discharge from the SX vessel (OF5). The tailings collected from the bench test (UF4) were sampled for characterization in terms of chemistry and mineralogy.

Characterization of the acid leach and SX/EW tailings has been completed using residue from the bench-scale testing conducted at McClelland Laboratories. Samples were analyzed using several test methodologies: total concentrations of 48 elements using inductively coupled plasma/mass spectroscopy (ICP/MS) analysis; elemental and ionic analysis of extracts from the Meteoric Water Mobility Procedure (MWMP) and the Synthetic Precipitate Leach Procedure (SPLP); acid-base accounting (ABA) using the modified Sobek Method, and mineralogical and modal analyses. This information is summarized here and provided in full in Appendix C.

Table 2 provides a summary of the tailings characterization testing. As these data indicate, the MWMP results showed an exceedance of a single Utah Ground Water Quality Standard (antimony @ 0.019 mg/l) and had total dissolved solids (TDS) concentration of 2400 mg/l; no other Ground Water Quality Standards or Class designations were exceeded in the MWMP extract. The SPLP results found no detectable concentrations of any metals of concern (Appendix C). As the water quality data in water supply well #6 indicate (Appendix D), TDS in ground water in the area is relatively high, 1760 mg/l. Well #6 was the closest well to the ITDF prior to construction of the east starter dam and is approximately one-half mile downgradient (south) from the toe of ~~the planned TDF~~that dam.

ABA tests on the tailings sample indicated a relatively high net neutralizing potential (NNP) and a paste pH test of the sample had a pH just above neutral.

~~No changes in processing methodology would take place that could affect the tailings character significantly.~~ The primary variable in the process occurs in the leaching circuit where acid consumption by the ground ore (chiefly due to carbonate content) and the amount of acid needed to leach the copper without excessive acid consumption are balanced. To be economically effective the leaching process must optimize copper recovery and acid consumption; therefore, a relatively uniform pH is maintained in the acid plant.

Tailings characterization will continue during operations; however, the methods for doing so will be different; it will not be practicable to collect representative tailings samples and analyze them using ABA and MWMP methods. Instead, the quality of tailings water will be analyzed. Tailings water samples will be collected daily from the tailings water return line at the plant terminus of that line. The daily samples will be analyzed for pH and electrical conductivity. Following plant start-up and "shake-down" or after one month of operations, whichever comes first, a return-water sample will be collected and analyzed by a Utah-certified laboratory for the following parameters: pH and electrical conductivity; total dissolve solids (TDS); alkalinity; major ions (calcium, magnesium, sodium, potassium, sulfate, nitrate and nitrite, chloride); trace metals and metalloids (for which Utah has established standards); and radionuclides (radium 226 and 228, gross alpha). Thereafter, sampling and analysis will be done at monthly intervals for 90 days, after which analysis will be done quarterly. Results of the return water analyses will be included with CS Mining's annual report to the Division.

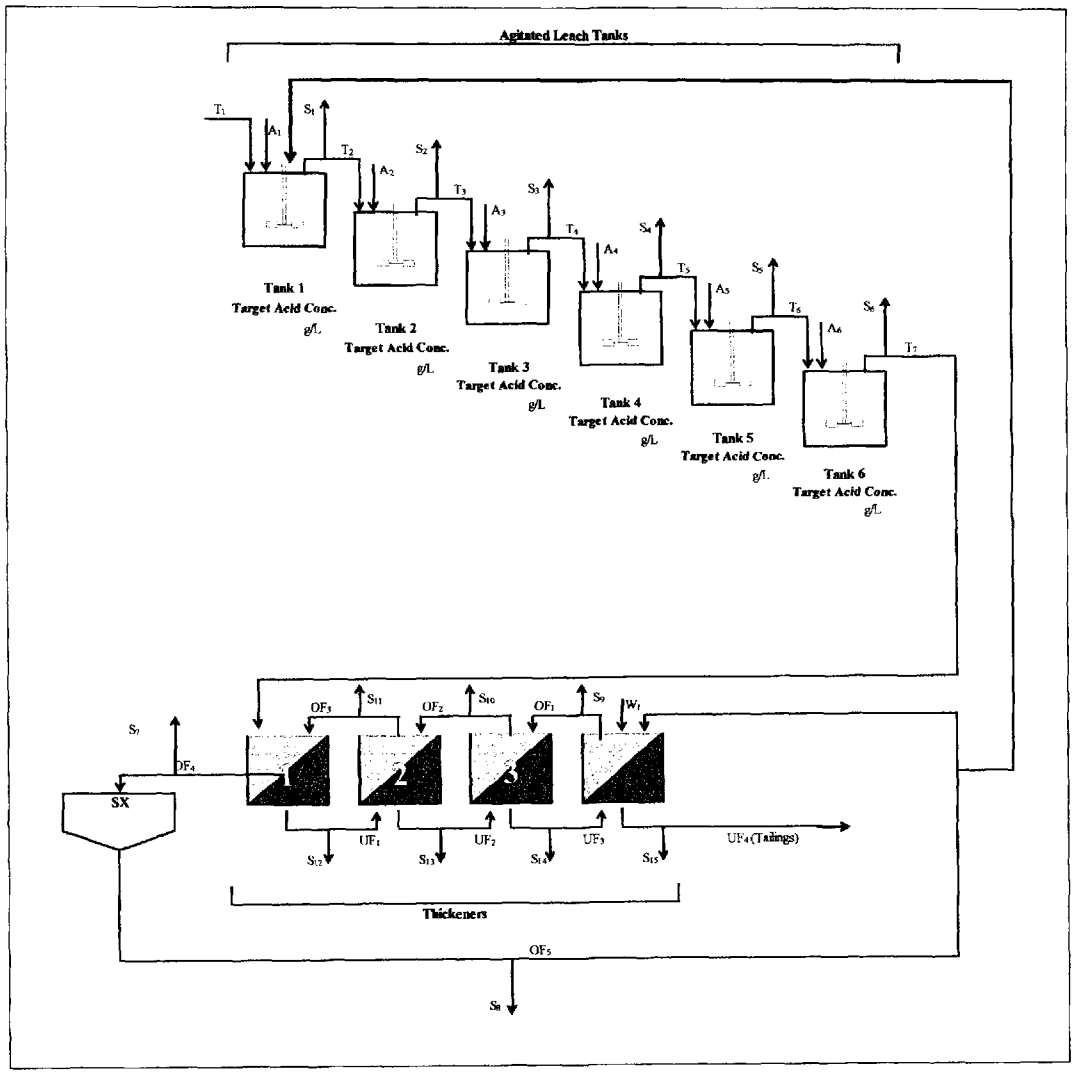

Figure 3. Acid-leach/Solvent Extraction Bench Test Flow Diagram

After commissioning of the acid leach-SX/EW plant in the winter of 2016, tailings pH was found to be much lower than pre-production testing had predicted. Instead of processing a blend of ores from different deposits, which was the basis for the pre-production tests, the newly developed Copper Ranch deposit was developed and mined. Although Copper ranch ore samples were included with the bulk composites used in pre-production testing, the absence of significant acid consumers in the gangue was not anticipated. Much less acid was needed to liberate copper in the acid leach than had been estimated and efforts to maximize percent recovery of copper resulted in excess acid being used in the acid leach step. This occurred during the period of plant commissioning and the follow-on "shake-down" period during which process optimization was to occur. However, within only a few months of start-up, business conditions led to cessation of mining operations and the layoff of most mine staff. Soon thereafter CSM was placed into involuntary Chapter 11 bankruptcy by a group of unsecured creditors. As as result of these business-related events, the planned process optimization was not carried out. Instead, a component of the the optimization plan, a tailings neutralization circuit, was designed and tested.

Mineralogical analyses were accomplished using x-ray diffraction and scanning electron microscopy (QEMSCAN). Results of these analyses are provided in Appendix C. These results indicate that the mineralogy of the tailings sample is dominated by silicate and oxide minerals and low sulfide and carbonate concentrations. Neutralization of the tailings had been anticipated to occur~~s~~ in the CCD circuit where hydrogen ions ~~are~~ would be consumed by calcium carbonate minerals, resulting in their dissolution and then the eventual precipitation of calcium as the sulfate gypsum. Ferrous iron compounds may also neutralize acidity in the tailings.

As discussed above, the initial ore processed in the acid leach system was very low in carbonate content. Going forward, rather than relying in any way upon the neutralizing potential of the gangue minerals in the tailings, CSM has elected to install the neutralizing circuit. When and if production of copper resumes, the optimization of the leaching and CCD circuits will be carried out and it is expected that less acid will be consumed during copper leaching operations. With less acid use, tailings pH may be closer to that originally anticipated during ore testing and plant design. Nevertheless, the neutralization circuit will be operated continuously with the rate of slaked lime production dependent on the quantity necessary to achieve a tailings decantate pH suitable for recirculation and use in milling and leaching.

Table 2. Summary of Acid-Leach/SX-EW Tailings Characteristics
(complete analytical reports in Appendix C)

Data Type	Lab	Data			
Acid/Base Accounting	SVL Analytical	pH	Acid Generating Potential (AGP) – Tons $CaCO_3$	Acid Neutralizing Potential (ANP) – Tons $CaCO_3$	NNP– Tons $CaCO_3$
		7.75	<0.3	48.5	48.5
MWMP	Wet Labs	Notable Results (mg/L)			
		pH = 7.37	TDS = 2400	Sb = 0.019 (exceeds UT GWQ std. of 0.006)	Other Trace Metals - Non-detectable
		Ca = 550	SO_4 = 1,500		
SPLP	Wet Labs	Notable Results (mg/L)			
		Ca = 580	SO_4 = 4,000 mg/kg – note units		
		Trace Metals - Non detectable			
ICP/MS	ALS Minerals	Refer to Appendix C for Results			
Mineralogy (XRD)	ALS Metallurgy	Results (percent)			
		Sulfides	Iron Oxides	Silicates	Sulfate (gypsum)
		0.6	22.0	68.0	5.4
		Carbonates	Others		
		0.6	3.4		

7.4.5 Tailings and Decantate Neutralization Plans

CSM carried out a plant-scale neutralization test following the laboratory bench testing described above. A neutralization circuit comprised of 3 key components was designed: a lime slaking tank (unused, new acid leach tank), a thickener operated as a clarifier, and the existing booster station. Two neutralization circuit flow sheets accompany this notice: a flow sheet for tailings decantate neutralization and a flow sheet for tailings neutralization in the event that production were to resume. The flow sheets immediately follow the text.

Initial lab and plant-scale testing was done with lime kiln dust sourced from Graymont Western's Cricket Mountain lime plant. Since beginning neutralization of the tailings decantate on September 12, CSM has discovered that the LKD used to produce an "off-spec" hydrated lime is more variable in its lime content than originally anticipated. CSM has decided to begin using quick lime as the neutralization agent. Although more expensive than LKD, quick lime is a

standard agent used to neutralize acids. Although CSM is optimistic that neutralization with quick lime will be effective, the company may make other changes to the process to improve neutralization efficiency or reduce costs.

CSM has recently tested quick lime (CaO) for neutralization of tailings decantate in its laboratory. The test was used to estimate the quantity of quick lime necessary to raise the tailings decantate pH to 5.5:, a pH that would enable the decantate to be recycled for ongoing production. The test was run three times and the results averaged. The tests found that approximately 3.58 grams of CaO would be required to neutralize 1 liter of tailings decantate. Assuming there are 50,000,000 gallons (189,270,600 liters) to be neutralized, then 677,600 kilograms or 747 short tons would be required to raise the pH to 5.5 so that tailings can be re-used in the plant. The laboratory test results likely reflect a rough estimate of the quantity of lime required to reach the decantate pH goal. Plant-scale neutralization involves many variables that cannot be tested in the lab: rate of CaO hydration and slaked lime production in the slaking tank; and addition to the tailings line; efficiency of mixing in the tailings pipeline; effectiveness of distribution of the hydrated lime in the ITDF. Like LKD, quick lime is purchased from Graymont Western's Cricket Mountain Lime Plant. A safety data sheet (SDS) is available at: http://www.graymont.com/sites/default/files/pdf/msds/sds-high_calcium_quicklime-april_2015_2.pdf.

Neutralization using LKD began on September 6, 2016. Neutralization using quick lime began on November 1, 2016. During the time LKD was used the average decantate pH in the ITDF increased from 1.3 to 1.7. Since the use of quick lime began, pH has continued to rise. Quick lime is much more expensive than LKD. CSM's current debtor-in-possession budget allows delivery of one 42-ton truckload per week.

As of now steps in the decantate neutralization process using quick lime are:

1. LKD Quick lime is delivered by truck in 42-ton loads and the driver discharges the LKD into the slaking tank, which is an acid leach tank (leach tank #3) that was not put into service as part of the leaching circuit.
2. Quick lime is loaded from the tanker truck through a pipe under air pressure to a cyclone installed at the top of the leach tank #3. There tailings decantate solution is also added to the tank via the cyclone. A single truckload of CaO supplies the lime source for operation of the neutralization system for approximately 2 to 3 days, including time for mixing in the slaking tank prior to discharge to the tailings line.
3. In effect, the quick lime is added as in a batch treatment process. It is stirred/mixed for a period of time and then, incoming water from the ITDF mixes with the lime in the tank and a milk of lime mixture comprised of about 20 percent CaO is sent to the ITDF via the booster station where it is added to the continuously circulating decantate.

Plans have been made for neutralization of acid leach -SX/EW tailings when and if copper production were to resume. The plan for tailings neutralization is as follows:

1. Quick lime or possibly a mixture of quick lime and LKD would be mixed with tailing decantate in the slaking tank as it is now; however, the resulting low density slurry (20 to 24% solids) would then be pumped to the south thickener at the mill.
2. The south thickener at the mill will be operated as a clarifier for the neutralized, milk-of-lime-containing return water produced in the slaking tank. Neutralized, clarified water (overflow) will be pumped to the reclaim water tank. The water in the reclaim water tank will be added to the acid leach system along with raffinate and sulfuric acid.
3. Underflow from the south thickener would be blended with tailings from CCD-4 and pumped to the ITDF via the booster station and tailings discharge pipeline. The density of this mixture is anticipated to be approximately 50%; well below the density where sanding may occur.

Supplemental Information: Decantate Chemistry - Fall 2016

Samples of decantate were collected on June 24, 2016 and on October 18, 2016 and submitted to AWAL for analysis of standard water quality parameters analyzed in ground water samples. Neutralization with LKD had begun on September 30 and there was no significant change in decantate pH between that date and the subsequent sample date. Copies of the analytical reports are included in Appendix E. As would be expected in the low pH decantate (less than pH 1.5) at the time the sample was collected, solutes concentration were highly elevated. Some of the high-concentration cations and anions are shown below in Table 2A.

Total Dissolved Solids (TDS) concentrations in these samples were 21,300 mg/l for the June 24 sample and 20,500 for the October 18 sample. Three cations (aluminum, iron and manganese) and one cation (fluoride) were added to the suite of parameters analyzed in the October 18 sample. Sulfate makes up 68% of the TDS in both samples. Other anions comprise just over 3 percent of the total anions analyzed in both samples. Measured cation concentrations in the October 18 sample from Table 2A are approximately 4,430 mg/l and measured anion concentrations shown in the table are approximately 14,500 mg/l) Together, measured cation and anion concentrations comprise 92 percent of the measured TDS of 20,500 mg/l. The difference between the sum of measured individual ions and TDS can be ascribed to some or all of the following factors: un-analyzed cations, ionic complexes, and the effects of extremely low pH. The lack of a measured cation-anion balance is demonstrated by the ratio of measured cations to measured anions to cations, which is greater than 3:1. At very low pH, the elevated hydrogen ion (H^+) content enables "excessive" anions to stay in solution.

Neutralization with hydrated quick lime (CaOH) will raise the currently low calcium concentration measured in the two above-referenced samples. At the same time, decantate pH will increase as the hydrogen ions react with the hydrated quick lime to form water (H_2O) and Ca^{+2}. The calcium ions will react with the dissolved sulfate (SO_4^{-2}) to form $CaSO_4 \cdot 2H_2O$, gypsum, which will precipitate from solution. Reduction-oxidation potential or Eh, pH and chemical equilibria affect solubility. Included in Appendix D is a copy of an Eh-pH diagram for the system calcium-carbon-oxygen-hydrogen-sulfur (Brookins, 1987). No Eh-pH diagram can represent a complex natural/man-made solution; however, this diagram reveals the following: assuming oxidizing

conditions, gypsum will precipitate beginning at a pH of just below 4.0 in oxidizing condtions. Oxidizing conditions are assured because dissolved oxygen would be added to the tailings in the CCD circuit, in the tailing discharge pipeline, as tailings are discharged over the tailings beach, and during rainfall events. Therefore, as decantate pH is raised to a pH approaching 4.0. and as the decantate becomes saturated in both calcium and sulfate by the addition of slaked lime, gypsum precipitation will occur resulting in a reduction of the primary dissolved constituent, sulfate, in the decantate.

Table 3 Decantate Selected Major Ion Concentrations

June 24, 2016 Sample			
Cations		Anions	
Ion	Concentration (mg/l)	Ion	Concentration (mg/l)
Aluminum	N/A	Alkalinity	< 10
Calcium	540	Carbonate	< 10
Copper	337	Chloride	331
Iron	N/A	Fluoride	N/A
Magnesium	1,850	Sulfate	14,600
Manganese	N/A		
Potassium	66.3		
Sodium	272		
Zinc	37.9		

October 18, 2016			
Cations		Anions	
Ion	Concentration (mg/l)	Ion	Concentration (mg/l)
Aluminum	180	Alkalinity	< 10
Calcium	687	Carbonate	< 10
Copper	72.6	Chloride	428
Iron	455	Fluoride	70.5
Magnesium	2,230	Sulfate	14,600
Manganese	392		
Potassium	76.4		
Sodium	299		
Zinc	38.6		

8.Water Information

8.1. Climate

The entire Great Basin has an arid climate. Information on temperature and precipitation for the Milford area, as compiled by the Western Regional Climate Center is shown in Table 3.

8.2. Area Surface Water

The facility is located in the Beaver River drainage basin, which drains into the Sevier River. There are no single main channels through the area; instead, the runoff is dispersed and distributary. There are five springs in the Beaver Lake Mountains, all located to the north of the ITDF. The nearest mapped spring or seep is approximately 2 miles north of the ITDF (Bogley 2013). There are no Drinking Water Protection Zones or wellhead protection areas in the state database for Beaver County (Utah DDW 2013). The nearest perennial stream is a section of The Big Wash, 3.3 miles south of the of common section corner of sections 5, 6, 7, and 8; the Beaver River is 5.8 miles east of the same common section corner (USGS 2013).

Table 4. Milford, Utah Monthly Climate Summary

Period of Record : 11/1/1906 to 3/31/2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	39.1	45.5	54.6	63.9	73.8	84.5	92.1	89.7	80.7	67.8	52.5	41.3	65.5
Average Min. Temperature (F)	13.5	19.6	25.4	31.6	39.3	46.9	55.8	54.1	43.8	32.6	22.2	14.9	33.3
Average Total Precipitation (in.)	0.65	0.79	1.03	0.86	0.73	0.46	0.72	0.84	0.68	0.92	0.64	0.77	9.09
Average Total Snow Fall (in.)	6.7	5.7	6.6	3.1	0.9	0	0	0	0.1	1.1	3.5	6.3	34.1
Average Snow Depth (in.)	2	1	0	0	0	0	0	0	0	0	0	1	0

Percent of possible observations for period of record.
Max. Temp.: 94.9% Min. Temp.: 94.9% Precipitation: 80.9% Snowfall: 78.4% Snow Depth: 76.7%

Source: Western Regional Climate Center, 2013 (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ut5654)

8.3. Well and Spring Identification

Wells

There are eight water rights associated with CS Mining; all for underground water wells. Table 4 lists the water right information for water rights associated with CS Mining.

Associated with these water rights are three wells; Well #3 (71-4396, 71-4773, 71-5052, 71-5327), Well #6 (71-4783), and the Truck Shop well (71-4396, 71-5111). Additionally there are four former monitor wells near the facilities area (USGS 2013, UDWR 2013). Well locations are shown on Figure 1.

Table 5. Water Right Information for Water Rights associated with CS Mining

Water Rights Number	Source	Point of Diversion Location	Acre feet
71-4396	Underground Water Well	N 380 ft E 1090 ft from SW cor, Sec 31, T 26S, R 11W; S 100 ft W 650 ft from NE cor, Sec 7, T 27S, R 11W; N 943 ft E 1438 ft from SW cor, Sec 8, T 27S, R 11W; S 1600 ft W 300 ft from NE cor, Sec 20, T 27S, R 11W; N 2010 ft W 945 ft from SE cor, Sec 34, T 27S, R 11W; S 1650 ft W 2300 ft from NE cor, Sec 34, T 27S, R 11W	546.23
71-4763	Underground Water Well	N 460 ft W 4435 ft from SE cor, Sec 6, T 27S, R 11W; N 943 ft E 1438 ft from SW cor, Sec 8, T 27S, R 11W; S 924 ft W 628 ft from N4 cor, Sec 16, T 27 S, R 11W; N 510 ft W 472 ft from SE cor, Sec 20, T 27S, R 11W; N 1085 ft E 603 ft from SW cor, Sec 20, T 27S, R 11W; S 379 ft E 4187 ft from NW cor, Sec 20, T 27S, R 11W; S 1681 ft W 698 ft from N4 cor, Sec 21, T 27S, R 11W; S 148 ft E 380 ft from NW cor, Sec 22, T 27S, R 11W	50.00
71-4772	Underground Water Well	S 450 ft E 1140 ft from N4 cor, Sec 9, T 27S, R 13W	217.33
71-4773	Underground Water Well	S 450 ft E 1140 ft from N4 cor, Sec 9, T 27S, R 13W	1.73
71-4783	Underground Water Well	S 100 ft W 650 ft from NE cor, Sec 7, T 27S, R 11W; S 2585 ft W 3353 ft from NE cor, Sec 7, T 27S, R 11W; S 1220 ft E 750 ft from NW cor, Sec 8, T 27S, R 11W	253.56
71-5052	Underground Water Well	N 490 ft W 4435 ft from SE cor, Sec 6, T 27S, R 11W	50.00
71-5111	Underground Water Well	S 40 ft E 1320 ft from N4 cor, Sec 12, T 28S, R 11W; S 50 ft E 70 ft from N4 cor, Sec 12, T 28S, R 11W; S 2600 ft W 1330 ft from NE cor, Sec 12, T 28S, R 11W	3.00
71-5327	Underground Water Well	N 943 ft E 1438 ft from SW cor, Sec 8, T 27S, R 11W; S 100 ft W 650 ft from NE cor, Sec 7, T 27S, R 11W; N 380 ft E 1090 ft from SW cor, Sec 31, T 26S, R 11W; S 450 ft E 1140 ft from N4 Sec 9, T 27S, R 11W	50.00

Springs

There are five springs located in the Beaver Lake Mountains and none in the Rocky Range. They are located in Table 8.1-1(Bogley 2013). The spring closest to the CSM operation is Brownfield Canyon Spring, located in Brownfield Canyon approximately 3 miles north of the ITDF and would not be influenced by the proposed facilities. All of the other springs listed in Table 5 are located further to the north of the proposed facilities, as the latitudinal information in the table demonstrates.

Table 6. Springs in the Beaver Lake Mountains

Spring Name	ID Name (USGS)	Location (Lat/Long)	Flow
West Spring	NA	38.533890, -113.127220	NA
Douglas Spring	NA	38.531110 -113.110830	NA
Bardsley Spring	NA	38.527500 -113.109720	NA
Smith Spring	NA	38.526110 -113.103890	NA
Brownfield Tunnel Spring	NA	38.516110 -113.116390	NA

(Bogley 2013)

8.4.Surface Water Body Identification

There are no Surface Water Bodies located within two miles of the Medium Tailings Facility (USGS 2013).

8.5.Drainage Identification

Numerous, unnamed, intermittent drainages have been located within two miles of the ITDF. These drainages are shown on Figure 1.

8.6.Well-head Protection Area Identification

There are no Well head Protection Areas located within five miles of the ITDF or the solution ponds locations (UDDW 2013).

8.7. Drinking Water Source Identification

There are no Drinking Water Sources located within five miles of the ITDF or the solution ponds locations (UDDW 2013).

8.8.Well Logs

Drillers' ~~W~~well logs for WW #3, WW #6, and the Truck Shop well are located in Appendix E. According to the well logs, WW #3 was drilled to a depth of 680 feet, and encountered water at 186 feet below the surface; WW #6 was drilled to a depth of 560 feet, and encountered water at 96 feet below the surface; the Truck Shop well was drilled to a depth of 875 feet, and encountered water at 295 feet below the surface. Further information on ground water is provided in section

9.General Discharge Identification

Neither the solution storage ponds nor the ITDF are designed to discharge; they are designed as zero-discharge facilities.

The solution ponds are designed to be constructed above the natural grade of the surrounding terrain with a berm of approximately 6 feet (refer also to section 6.3). Diversion berms channeling upland flow to the west and east of the plant and pond areas will be included in the final design drawings and shown on the SWPPP that is in draft now. However, the containment systems for the ponds (elevated berms) and the concrete containment walls for each of the new beneficiation plant components will provide back-up capability for preventing runoff from impacting any of the proposed facilities. The solutions ponds will be double lined with a leak detection layer beneath the entire upper liner, as described in section 6.3. Any significant leaks will be identified in a timely manner and repaired. As a result, there are no planned or reasonably potential discharges from the solution ponds.

The ITDF will be lined and no tailings discharge is planned or anticipated. Should tailings liquids escape the liner, the monitor wells below the tailings dams will identify any significant quantity of water. The monitor wells are described in section 6.4.3.

If tailings water were to be released due to a leak in the tailings pond liner, the water would, with a neutralization circuit in operation, have characteristics similar to those of the bench-scale test results described in section 6.4.3.

10. Geology and Hydrogeology

10.1. Regional Geology and Landform

The project area is located within the Basin and Range Physiographic Province in west-central Utah. This province owes its name to the general geologic history common to this part of the country that has given rise to the present-day landscape of alternating generally north-south trending fault-block mountains and intervening valleys or basins. Prior to development of the basins and ranges igneous rocks of latest Mesozoic to Tertiary age intruded the early Mesozoic and Paleozoic sedimentary rocks that had been folded and faulted during the Cretaceous Sevier Orogeny. Volcanic rocks were deposited over much of the region during the mid-to late Tertiary age.

10.2. Project Area and Local Geology

The geology in the project area is dominated by both intrusive and extrusive igneous rocks. Late Paleozoic rocks (Permian) are exposed in limited areas except in the vicinity of the ore deposits currently being mined or to be mined in the near future. A geologic map of the CSM Operations Area is provided on Figure 4.

Ore Deposit Geology

The ore deposits in the Rocky Range occur as skarns, metasomatically altered sedimentary rocks with replacement silicate minerals, abundant marble, and local vein-like concentrations of copper oxide and lesser sulfide minerals. In 2012, metallurgical and mineralogical tests were performed on samples taken from the Hidden Treasure, Bawana, and Sunrise deposits. The results of these tests reaffirmed historical reports of low to non-existent amounts of pyrite (D. Hartshorn, 2013). Copper in all three deposits is primarily found in the oxide minerals malachite/azurite, cuprite, chrysocolla, and various copper-calcium silicates. Copper sulfide minerals, chalcopyrite, chalcocite, and bornite, occur in lesser quantities. The geology and mineralization in the Rocky Range is described by Whelan (1982). Currently all of CSM's proposed mining activity is planned to occur from deposits in the Rocky Range and in nearby skarn deposits beneath the adjacent pediment.

The OK mine area is located on the southern end of the Beaver Lake Mountains. This part of the range is comprised of tertiary volcanic and the granodiorite intrusive that hosts the OK copper deposit, which occurs in a mineralized breccia pipe (Taylor, 1987) and has been mined out. CSM will process the ore in a low-grade stockpile remaining from OK mine production.

Geology of the Proposed Plant Area and the ITDF

Geologic mapping by the USGS of the Milford 15-minute quadrangle is available as an Open-File Report (Lemmon and Morris, 1979). A geologic map of the entire project area is shown on Figure 4 and a geologic map of the greater plant area and the ITDF area is shown on Figure 5. No faults have been recognized in the area of the ponds or the ITDF. As the geologic map on Figure 5 shows, the solution ponds and the ITDF will be constructed in an area underlain by Quaternary alluvium and the unnamed Tertiary granodiorite. Surface geologic mapping, and limited subsurface data from drilling suggest that the area in and around the ponds and the ITDF is underlain by granodiorite bedrock. Subsurface geologic information comes from general knowledge of subsurface geology compiled by successive operators of the current CSM mines, drillers logs from water production wells, a geologic log of a monitor well boring adjacent to the lab facility as well as some recent subsurface investigations associate with ITDF design. Despite probable erroneous labeling of rock type as "dolomite" in the driller's logs for 2 of the production wells, it seems clear that the ground water in the vicinity of the proposed facilities occur in relatively intensely fractured granodiorite. It is reasonable to conclude that wells completed in fractured granodiorite are the source of the water used by CSM in its mining and beneficiation operations.

No exploration drill holes for which geologic logs are available are known in the vicinity of the proposed new facilities. Driller's logs, but no geologic logs are available for the water supply wells. A geologic log of one of the former monitor well (MW-1) is also available. This log and the drillers logs are provided in Appendix E.

As part of the pre-dam design geological and geotechnical investigations, test pits, 3 shallow core holes, and a deeper, 200-foot core hole were drilled. Figure 6 shows the location of test pits and core holes relative to the toe of the ITDF dam. In addition, seismic investigations were performed to assess the extent of fracturing in the subsurface in the granodiorite.

Test pits encountered the following typical profiles:

- 0 to 1.0 feet of topsoil
- 2.0 to 8.5 feet of unconsolidated alluvium often grading to a residuum of highly weathered, texture-less granodiorite
- Up to 2.5 feet of weathered, friable granodiorite with the texture preserved
- Hard, slightly weathered granite was encountered at a depth of approximately 2 feet in 1 test pit

Logs of representative test pits are provided in Appendix F and their locations are shown on Figure 6.

A single shallow core hole (B-3) was drilled in the drainage at the eastern dam site encountered unconsolidated sediments and weathered granodiorite over highly fractured granite to a depth of approximately 50 feet. The other core holes, B-1 and B-2, were drilled on the ridge dividing the two subdrainages in which the ITDF will be constructed (Figure 6).

Two seismic surveys were carried out. The objective of the surveys was to assess changes in the relative intensity of fracturing in the granodiorite using the seismic refraction method. Measuring the return velocities of compression waves (p waves) allows the depth to refracting horizons along with the thickness and velocities of overlying horizons to be estimated.

One of the surveys was used in combination with several shallow core holes to assess the condition of the bedrock forming the ridge between the 2 adjoining drainages that will form the ITDF. The combination of the drilling and seismic work demonstrated that the bedrock forming the ridge is weathered and fractured to sufficient depth to enable it to be used as construction material for the starter dam in the east drainage. The design engineers estimate that this borrow material will be susceptible to ripping with large dozers and that little or no blasting will be required. The results of this survey are not described further herein.

The second seismic survey was conducted in the location of the eastern starter dam. The report in this seismic survey is provided in Appendix G. The survey was conducted along the ephemeral drainage beneath the location of the eastern tailings starter dam. A 700-foot-long line was run adjacent to a road that roughly parallels the drainage channel. Three lines slightly less than 400 feet long were run perpendicular to the longer line. All of the lines indicate increasing seismic velocity with depth. The three shorter lines indicate shallower low-velocity surficial cover

on their eastern ends, which reflects the thinner cover on the steeper eastern slope. In all of the seismic profiles the lowest velocity layer (green in color) has an estimated thickness of 20 to 30 feet, which is approximately the thickness of surficial alluvium and highly weathered granodiorite observed in core holes drilled in the footprint of the eastern tailings dam, as discussed below. Although the seismic survey results showed increasing velocity with depth, the maximum estimated depth observed was approximately 100 feet (Appendix G). Increasing velocity in the granodiorite reflects less fracturing and in turn decreasing secondary porosity.

The 200-foot boring (ITDF Test Boring) is located approximately at the intersection of seismic lines 1 and 3 (map on page 2 of the seismic survey report in Appendix G near the planned location of the ITDF eastern starter dam toe (Figure 6). The core hole was drilled in order to characterize the nature of the bedrock, including rock type, hydrothermal alteration, fracturing, rock quality data (RQD) and evidence of faulting. A geologic and geotechnical log of the core hole is included in Appendix F. A summary of the gross lithology, fracture density and RQD for ITDF-0 is shown on Figure 7. The RQD for the interval 130 to 200 feet indicates poorer rock quality than is depicted in the upper 130 feet. Similarly, fracture density is greater in the interval from 130 to 200 feet than it is in the upper 130 feet. Because the fracture density did not diminish with depth, it is reasonable to assume that intense fracturing is likely to continue for an unknown distance below the depth of 200 feet. This observation is reflected in the proposed monitor well depth discussed in section 6.4.3.

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A ground water monitor well, ITDF-1, was installed in late 2015. The hole is located approximately 400 feet south of the center of the toe of the ITDF dam outslope in the location planned at the time the initial GWDPA was submitted to DWQ. A detailed geologic log of the well is provided in Appendix H. Note that while logging forms developed by IGES, Inc., the geologic logging was done by CSM geologists. The well was drilled to a depth of 410 feet. Two attempts to install this well were made. Intense fracturing in the first well resulted in loss of the hole and it was plugged and abandoned; however, ground water was encountered at the bottom of that hole. The first hole was very unstable. Several attempts to install casing in the hole failed. After each attempt large quantities of broken rock fragments, not drill cuttings, from the borehole wall were air-lifted to the surface. With each attempt to case the hole, casing was advanced to a shallower depth. The second attempt, using ODEX (triple wall) equipment enabled to well to be screened, cased and completed. Water was encountered at a depth of approximately 290 feet. The borehole collared in alluvium and almost immediately entered weathered granitic rock. Fractured conditions were first identified at a depth of 50 feet and continued to be present throughout the borehole both above and below the potentiometric surface. Evidence of oxidation (iron-staining) was observed on cuttings intermittently on samples containing fractured rock throughout the drill hole.

Three holes (one core hole and two rotary well borings) were drilled along the axis of the canyon floor that was dammed during ITDF construction. Each hole encountered increasing fracturing with depth. Both holes drilled while attempting to install ITDF-1 encountered visual evidence of open fracturing in the cuttings. Many of the cuttings representing fracture zones

were "iron stained," coated with thin veneers of goethite or supergene hematite. The presence of wide-spread hydrated iron oxide (goethite) and/or iron oxide (hematite) are evidence of ground water movement through the fractured granitic bedrock.

The extensive and intense fracturing observed in the three drill holes suggest that the initial hypothesis that the weathering and erosion that created the canyon was focused by a fracture zone in the granitic bedrock was correct. In addition the extensive fracturing demonstrates that a conduit for ground water flow exists in that fracture zone. it is a fundamental geomorphic principle that structural features control erosion patterns.

A past mining claim holder in the area (Bear Creek Mining Company) prepared geologic and fracture maps as part of their examination of the OK Deposit and surrounding area. The fracture map covers a broad area of granodiorite including what is now the location of the ITDF. Copies of the geologic and fracture map are included as Figures 7B and 7C. The fractures mapped have strikes that differ subtly in the weakly mineralized area north of the ITDF from the orientation of the fractures in the granodiorite to the south in the ITDF area. In the northern part of the mapped area, fractures have a dominant orientation striking northwest; the fractures in the granodiorite in the vicinity of the ITDF have a more east-west strike. Fractures in the granodiorite observed during the siting study for the ITDF were tight and some were silica-filled. None of the fracture orientations suggest any relationship between the observed tight fractures in the exposed granodiorite bedrock and the fracture zone believed to be present beneath the canyon floor. Furthermore, there are no other linear features that suggest fracture flow in any direction other than down-gradient to the south of the ITDF.

The second proposed ITDF monitor well is planned to be located in the broader, less well-defined canyon just below the planned west starter dam. The drainage pattern in the west ITDF drainage lacks the relief and exposed outcrop present in the canyon to the east where the east starter dam was constructed. Alluvial fill is extensive in the broad west drainage area and is locally very deep, as observed during soil test pit installation prior to the ITDF design. Geomorphically indicated fracture patterns may thus be hidden. Nevertheless, based on what has been observed in the east drainage area, the drainage pattern in the west part of the ITDF location is likely to be the best indicator of fracturing in the underlying bedrock.

The two currently planned monitor well locations are considered to be appropriate in terms of detecting ground water contamination, should it occur, due to a release of water from the ITDF. The granodiorite is fractured; however, weathering and erosion have not acted on the east-west and northwest-striking fractures observed and mapped in the ITDF vicinity by Bear Creek. Nothing in the surface bedrock geology suggests an expression of a pathway for ground water flow. On the other hand, the geomorphic features and highly fractured granodiorite encountered in three separate drill holes aligned with the canyon stream channel impounded by the ITDF define what is likely to be a surface flow path aligned with a zone of highly fractured bedrock that is a groundwater conduit.

During development of ITDF-1 and in purging prior to monthly sampling, very rapid drawdown followed by very slow recharge has occured in every event. These characteristics suggest low

head that would be expected given a small recharge area and low gradient. The recharge area for ITDF 1 is almost certainly coincident with the upgradient watershed area for the ITDF. This very small area was measured at 96 acres by IGES (2014) during it's preparation of the ITDF design report. Perhaps 20 percent of the 96 acres is currently prevented from recharging groundwater by the liner beneath the east TDF.

Robson and Banta (1995), in the USGS' Ground Water Atlas of the United States, Segment 2 Arizona, Coloroado, Nevada, Utah, state the following with regard to the permeability of igneous rocks in the ranges within the Basin and Range:

> *Bedrock is present in the uplifted blocks of the mountain ranges and beneath the basin fill in the valleys. Bedrock consists of consolidated carbonate rocks or metamorphic, igneous, and clastic rocks that are relatively impermeable unless extensively fractured* - and go on to say
>
> *Although extrusive igneous rocks (primarily basalt) can be permeable in local areas, most other types of consolidated rock are not sufficiently permeable to transmit large volumes of water, and bedrock generally forms a relatively impermeable boundary to the Basin and Range aquifers.*

The current ITDF monitor well located immediately downgradient from the east ITDF dam and WW-6 further down gradient are adequate to detect ground water contamination in the event of a release from the ITDF as currently built out.

10.3.-Project Area Hydrogeology

Limited ground water data is available for the CS Mining project area as a whole. Figures 1 and 4 show the water supply wells used by CSM. Data available for these wells include drillers logs for the water supply wells (WW-3, WW-6, Truch Shop Well); however, they are not available for the monitor wells located immediately south of the flotation tailings pond and adjacent to the CSM laboratory. Geologic logs are not available for the water supply wells; however a geologic log is available for one of the monitor wells. Logs are provided in Appendix E.

According to records from previous site operators now in the possession of CSM, monitor wells that were installed downgradient of the formerly proposed heap leach pad and what is now the flotation tailings pond had an average depth to ground water of approximately 167 feet when they were drilled and they were completed in granodiorite/quartz monzonite. The rock type is confirmed in the geologic log of MW-1 in Appendix E.

Knowing what we do about the project area geology and the occurrences of water, we know that ground water in the project area is unconfined. From the driller's logs we know the depth of water in the wells and the static water level in the well bore when the wells were drilled. However, wells are too widely separated to use water levels in these wells to determine the hydraulic gradient over the greater project area. In fact, there is no evidence of hydraulic connectivity among the wells, although it is likely that the aquifers encountered in WW-6, the lab area monitor wells and the Truck Shop Well are connected to some degree. Nevertheless, it is very probable that the ground water ~~table~~ gradient in the vicinity of the solution ponds and ITDF sites is to the south reflecting the surface topography.

Recent historic water level data is available for WW-6; however, this data for WW-3 appears corrupted. Table 6 summarizes the available water level information from the 3 water supply wells.

Table 7. Water Level Information – Water Supply Wells

Well Designation	Collar Elevation	Total Depth	Static Water Level on Completion		Static Water Level – Fall 2013	
	(Feet AMSL)	(Feet)	Depth (Feet)	Elevation (Feet AMSL)	Depth (Feet)	Elevation (Feet AMSL)
WW-3	6341	680	186	6155	No data	No data
WW-6	5590	560	96	5494	314	5276
Truck Shop Well	5230	875	295	4935	No data	No data

Well WW-6 was completed in September 2008 per the driller's log (Appendix E) and in Fall 2013 production from the well had lowered the water level in the well approximately 218 feet from the static level at completion.

Drawdown in WW-6 would result in an increased hydraulic gradient between any ground water beneath the ITDF and this water supply well. Ongoing production from WW-6 will have the effect of causing ground water in the surrounding area to flow toward that well instead of flowing along the presumed water table gradient to the south.

The United States Geological Survey has compiled and interpreted available ground water data for the Milford area (Mason, 1998). Figure 8 is excerpted from that professional paper. As the map on that figure shows, the CSM project area is more than 5 miles from the nearest production well used in the USGS study. The geological and hydrogeological data for the project area described above clearly demonstrate that the project area is not located on basin fill, unlike the wells used as part of the USGS study.

10.4.Surface and Ground Water Quality

There is no surface water in or around the project area.

Ground water quality data for production wells WW-3 and WW-6 are shown in Table 7. TDS concentrations are 1410 and 1760 mg/L, respectively for the 2 wells. As such the ground water would be classified as Class II under the Utah Ground Water Protection Rules. Otherwise, ground water quality is unremarkable with pH near neutral and background trace metal content low, with most analytical results being at or near the lab detection limit.

Table 8. Ground Water Quality Data Summary

SUU Water Lab Data					
	Well #3		MRL*	Well #6	
Parameter	Result	Units		Result	Units
pH	6.72	SU	4	7.36	SU
Arsenic	<5	µg/L	10	<5	µg/L
Barium	0.014	mg/L	0.005	0.029	mg/L
Beryllium	ND	mg/L	0.001	ND	mg/L
Cadmium	<1	µg/L	1	<1	µg/L
Chromium	ND	mg/L	0.005	ND	mg/L
Copper	<50	µg/L	50	<50	µg/L
Lead	5.66	µg/L	5	<5	µg/L
Mercury	ND	mg/L	0.0002	ND	mg/L
Nickel	<10	µg/L	5	<10	µg/L
Selenium	<5	µg/L	5	<5	µg/L
Thallium	ND	µg/L	2	ND	µg/L
Fluoride	<0.4	mg/L	0.4	0.435	mg/L
Sodium	65.8	mg/L	5	81	mg/L
Sulfate	700	mg/L	5	798	mg/L
Nitrate	0.313	mg/L	0.1	<0.1	mg/L
Nitrate+ Nitrite Total	0.313	mg/L	0.1	<0.1	mg/L
Nitrite	<0.1	mg/L	0.1	<0.1	mg/L
Total Dissolved	1410	mg/L	20	1760	mg/L

GE Water & Process Technology Data			
	Well #3	Units	Well #6
Parameter	Result		Result
Specific Conductance	2220	µmhos	2560
Alkalinity as $CaCO_3$	297	ppm	84
Sulfur	528	ppm	697
Chloride	236	ppm	364
Hardness, Total as CaCO3	1090	ppm	1260
Calcium Hardness	810	ppm	893
Magnesium Hardness	279	µg/L	364
Copper	<0.05	ppm	<0.05
Iron	<0.05	ppm	<0.05
Sodium	68	ppm	89
Potassium	2	8.4	798
Phosphate, Total, as PO_4	<0.4	ppm	<0.4
Phosphate, Ortho, as PO4	0.2	ppm	0.2
Silica, as SiO_2	19.6	ppm	25

11. Solution Pond and ITDF Design Report

Detail design and construction permit application materials are nearly complete and Construction Permit applications for both the solution ponds and the ITDF will be submitted to the Division very soon. Therefore, the information provided below is summary in nature.

11.1. Solution Pond Design Summary

The raffinate and PLS ponds have the same design and will be the same size. The ponds will have a primary liner of 80-mil HDPE over a geogrid leak detection layer, which will in turn be *underlain by a composite liner made up of 60-mil HDPE over compacted clay. The secondary* composite liner will be placed on a prepared (graded, scarified, moisture conditioned and compacted) native-earth foundation. The lower part of the composite liner will consist of a 6-inch–thick layer of clay prepared and compacted at optimum moisture content and density to have a hydraulic conductivity of 10 x 10-7 cm/sec or less. A 60-mil HDPE flexible membrane liner will be installed directly on top of the clay layer. A geogrid will provide the leak detection layer and will be placed directly on the secondary liner. The primary liner will be 80-mil HDPE and will be installed on top of the geogrid. The ponds will slope to the northeast corner then continue along the path of the solution recovery pipe (drawing 80-GA-05 in Appendix B) to the leak detection sump located beneath the adjacent pump station (see drawings 80-GA-04 and 05 in Appendix B). The sump will be gravel-filled and will have a capacity of approximately 600 gallons. The dedicated leak recovery pump will engage automatically when water reaches the top of the well screen (Section B, drawing 80-GA-03 in Appendix B. Water recovered from the sump will flow through a totalizer prior to being discharge back to the pond from which it origninated. Totalizer readings will be recorded daily during scheduled inspections and the volume of water recovered for each day will be recorded. The volume of water removed will be measured and recorded on a daily basis. Each 2.2-acre pond must not leak more than 440 gallons per day in order to remain in compliance with the Division's required maximum daily leakage rate of 200 gallon/acre/day. Leakage rates in excess of this daily limit would be reported to the Division with 24 hours and immediate steps would be taken to reduce the leakage rate, identify the source of the leak, and repair it.

The ponds are designed to contain all un-diverted upland runoff from an appropriate precipitation return event. Berms will surround the ponds to prevent run-on from overland flow from the north and to provide access for operations and maintenance (Pond Section A, drawing 80-GA-01 and 80-GA-02, Appendix B). Average up-gradient berm height will be approximately 6 feet from surrounding natural terrain to the top of the pond berms.

11.2. ITDF Design Summary

Detailed, final design will be done only for the eastern starter dam at this time. The resulting detailed design package will serve as the Construction Permit application for the ITDF as well as the application for a Dam Safety Permit from the Division of Water Rights.

Construction will begin with the eastern starter dam, which will have an elevation of 5820 feet AMSL and a toe-to-crest height of 120 feet (Figure 9). When constructed, the western starter dam will have an elevation of 5830 feet AMSL. The eastern dam will have an ultimate toe to crest height of 160 feet and a final elevation of 5860 feet AMSL. The final western dam will have a lower toe to crest height, but the final elevation will be the same as that of the eastern dam, 5860 feet AMSL. Estimated demand for construction material for the eastern and western starter dams is 403,000 yd3 and 151,000 yd3, respectively. Final dam volumes are estimated to be 457,000 yd3 and 204,000 yd3 for the eastern and western dams, respectively.

The starter dams will have slopes of 3H:1V on the upstream sides and 2H:1V on the downstream side. Raises will have slopes of 2.5H:1V on the downstream sides and 1.5H:1V on the upstream sides. The dams will have crest widths of 20 feet and 2 feet of freeboard will be provided.

The ITDF will have an ultimate capacity to contain 2,564,500 yd^3 of tailings. Tailings will initially be produced at 1500 tons per day (tpd), ramping up to 3000 tpd.

Borrow for the dams will come from unconsolidated alluvial fill and weathered and fractured bedrock within the footprint of the ITDF. In addition, the upper part of the ridge dividing the east and west drainages that will make up the ITDF will be excavated and reduced in elevation to 5815 feet AMSL. The material removed will provide approximately 161,000 yd^3 or about 40 percent of the construction material for the east starter dam. As stated in section 9.5.2, the results of a seismic survey and 2 shallow core holes indicated that the material comprising the upper parts of the ridge can be ripped with a large dozer equipped with ripper teeth.

Borrow is expected to be ripped and then crushed by dozer tracks prior to excavation loading and transport to the dam site. The dam construction material is expected to be 3-inch minus in size. Borrow will be hauled to the dam site in trucks or scrapers and spread with dozers in 12 inch lifts, which will be roller compacted after moisture conditioning.

Subgrade for the lined parts of the impoundment will be graded, moisture conditioned, scarified, and compacted. One-inch minus material will be used as bedding material for the flexible membrane liner, which will be ~~40~~60-mil HDPE with smooth surface texture. The HDPE will be placed in accordance with manufacturer's specifications. Originally, ~~approximately 1,100,000 ft^2 of the eastern part of the impoundment will be lined with HDPE following completion of the starter dam. Approximately 400,000 ft^2 of the western part of the impoundment will be lined with HDPE after the starter dam is completed. When the dams are completed to their final design height, an additional 900,000 ft^2 of the impoundment will have been lined with HDPE, bringing the total lined area to approximately 2,400,000 ft^2 or~~ 80 percent of the 60 acre impounded area was to be HDPE lined; however, CSM now intends to line the entire impoundment with 60 mil HDPE if slope conditions allow its installation.

Because of the steep slopes ~~T~~the remaining 20 percent of the impoundment was originally intended to ~~will~~ be lined with GCL, Bentomat ST or the equivalent. The GCL ~~will~~ would be installed in accordance with manufacturer's recommendation. HDPE and GCL ~~will~~ would be joined by overlapping them in the HDPE anchor trench or placing powdered bentonite when

joining the 2 materials in an anchor trench is not possible. CSM will justify the localized use of GCL, if determined to be necessary by the design engineer, as part of the revised liner design that will be submitted with in the Construction Permit Application submitted for future lifts of the ITDF dams after both starter dams have been constructed.

12. Construction Quality Control Plan

Construction quality control plans will be included in the final design packages that will accompany the Construction Permit Application for the solution ponds and ITDF. In general industry standard quality control measures will be taken for each step of construction: grading and foundation preparation; installation of the clay portion of the secondary liner for the solution ponds, installation of flexible membrane liners for both the solution ponds and the ITDF, and all concrete installations, including those intended to contain spills, direct precipitation, or, for the solution ponds, the leak detection sumps.

13. Groundwater Discharge Control and Contingency Plan

Groundwater discharge will be prevented from occurring from the solution ponds by the liner and leak detection system, making repairs when and if necessary, as determined by the rate at which any leakage reaches the leak detection sumps. CSM believes that the solution pond design is appropriate and that it meets industry standards.

Groundwater discharge from the ITDF is anticipated to be controlled by the liner system and the relatively short facility life for the ITDF (4 to 8 years). The monitor wells will detect any recognizable leakage from the ITDF and will be converted to pump back wells to recover any water released from the ITDF and return it to the adjacent tailings pond. Additional pump-back capacity in the form of more or larger diameter wells will be added if necessary. In this way, should there be a release from the pond, the pump-back wells will in effect serve the purpose of recovering water from secondary containment.

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The current ITDF monitor well was completed in the fall of 2015. A completion description of the well, a driller's log, and a geologic log of the well cuttings are included in Appendix E. A 3 horsepower pump with a capacity to pump at a rate of 18 gallons per minute was installed in the well at a depth of 350 feet, 10 feet above the top of the 40 feet of well screen. A control box and necessary valving, etc for sampling is installed on the well head. A portable generator is used to power the pump. From a static water level of about 179 feet, the pump, which is not variable speed, drew the well down to just above the pump level in less than five minutes. Recovery time was not measured precisely; however, at least 12 hours was required for full recovery. Supplemental sampling events have confirmed that the recovery time after purging is very

lengthy. During the first sampling event after well development, 220 gallons of water were removed until the well was drawn down to the pump level.

Should pump-back of contaminated ground water be required, a smaller capacity pump may be required to lift water to a tank that would be installed adjacent to the wellhead. The water would either be placed in a stationary tank from which it would be pumped to the ITDF or into a water truck which would return the water to the ITDF. The currently installed pump was selected and purchased prior to well installation. A relatively high velocity pump was selected to ensure that there would be adequate capacity to handle the pump-back requirements if necessary.

14. Reclamation and Closure Evaluation

All topsoil from the proposed ITDF location will be gathered to a depth of 12 inches where available and placed in a topsoil stockpile to be located south of the western ITDF dam. Approximately, 145,000 cubic yards of topsoil are proposed to be taken from this area and placed in the existing topsoil stockpile for use during reclamation.

Reclamation of the ITDF will begin on the tailings beach. If necessary a geotextile will be first placed on the beach surface as needed for foundation stability on the partially dried tailings surface prior to replacement of topsoil. Approximately one foot of topsoil will be placed on the tailings surface after applying the geotextile when needed. The topsoil will be scarified after placement and reseeded by broadcast methods using the DOGM-approved seed mix.

Solution ponds will be reclaimed by first folding the liners from the pond side walls onto the pond bottoms and then backfilling the ponds with the fill used to create the graded fill on which the ponds were constructed. Approximately one foot of topsoil will be placed on the backfilled ponds. The topsoil will be scarified after placement and reseeded by broadcast methods using the DOGM-approved seed mix.

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CSM believes that the current reclamation plan, as written, provides for the adequate and environmentally safe closure that was originally, and is still, approved by the Division of Oil Gas and Mining. Upon drying of the tailings and covering them with topsoil and revegetating with a native seed mix, the tailings will be confined on all sides and, given the local, dry, windy, and often hot local climate, evapotranspiration will prevent significant infiltration of meteoric water. Most of the small upland watershed (less than 35 acres) above the ITDF has been isolated from the ITDF by fill placed during construction of the peripheral road (refer to Sheet 8 in the design drawing set that accompanied the Construction Permit application prepared by IGES). The roadfill will remain in place following reclamation so that most upland runoff will continue to be prevented from reaching the former ITDF, leaving only direct precipitation to reach the reclaimed 60-acre surface.

15. Compliance Monitoring Plan

The solution pond leak detection systems will be regularly monitored and maintained as described in section 10.1. Both the solution ponds and exposed liner in the ITDF will be inspected no less than weekly, damage reported and necessary repairs scheduled for timely completion.

The monitor wells below the ITDF dams will be operated as described in section 6.4.3 and if appropriate will trigger initiation of ground water recovery using the monitor wells (or larger replacement wells as needed) as recovery or pump-back wells to return ground water adversely impacted by release from the tailings pond to the ITDF.

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FIGURES

APPENDICES

Appendix A
Acid Leach and SX/EW Plant
Design Drawings

(with Tailings Decantate Analyses from 2016)

INORGANIC ANALYTICAL REPORT

Client: CS Mining **Contact:** John Moyo
Project: ITDF Neutralization
Lab Sample ID: 1610434-002
Client Sample ID: ITDF Recirculation Line
Collection Date: 10/18/2016 830h
Received Date: 10/21/2016 1042h

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/24/2016 1002h	SM2320B	10.0	< 10.0	
Bicarbonate (as CaCO3)	mg/L		10/24/2016 1002h	SM2320B	10.0	< 10.0	
Carbon Dioxide	mg/L		10/28/2016 1733h	SM4500-CO2-D	5.00	< 5.00	
Carbonate (as CaCO3)	mg/L		10/24/2016 1002h	SM2320B	10.0	< 10.0	
Chloride	mg/L		11/4/2016 652h	E300.0	10.0	**428**	
Fluoride	mg/L		11/4/2016 652h	E300.0	10.0	**70.5**	
Hydroxide (as CaCO3)	mg/L		10/24/2016 1002h	SM2320B	10.0	< 10.0	
Nitrate (as N)	mg/L		10/21/2016 1916h	E353.2	0.100	**3.64**	H
Nitrite (as N)	mg/L		10/21/2016 1845h	E353.2	0.0100	< 0.0100	H[1]
pH @ 25° C	pH Units		10/21/2016 1526h	SM4500-H+B	1.00	**1.65**	H
Sulfate	mg/L		11/4/2016 709h	E300.0	750	**14,000**	
Total Dissolved Solids	mg/L		10/21/2016 1740h	SM2540C	100	**20,500**	

[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

Client: CS Mining **Contact:** John Moyo
Project: ITDF Neutralization
Lab Sample ID: 1610434-001
Client Sample ID: ITDF Recirculation Line
Collection Date: 10/4/2016 830h
Received Date: 10/21/2016 1042h

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Salt Lake City, UT 84119

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QA Officer

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	10/24/2016 1142h	10/27/2016 1359h	E200.7	1.00	**180**	
Antimony	mg/L	10/24/2016 1142h	10/26/2016 1020h	E200.8	0.0100	**0.0440**	
Arsenic	mg/L	10/24/2016 1142h	10/26/2016 1020h	E200.8	0.0100	**5.09**	
Barium	mg/L	10/24/2016 1142h	10/26/2016 958h	E200.8	0.00200	**0.161**	
Beryllium	mg/L	10/24/2016 1142h	10/27/2016 1522h	E200.8	0.0200	**0.0412**	
Cadmium	mg/L	10/24/2016 1142h	10/26/2016 1020h	E200.8	0.00250	**0.444**	
Calcium	mg/L	10/24/2016 1142h	10/27/2016 1410h	E200.7	100	**687**	
Chromium	mg/L	10/24/2016 1142h	10/26/2016 958h	E200.8	0.00200	**0.775**	B§
Copper	mg/L	10/24/2016 1142h	10/27/2016 1356h	E200.8	0.100	**72.6**	
Iron	mg/L	10/24/2016 1142h	10/27/2016 1408h	E200.7	2.00	**455**	
Lead	mg/L	10/24/2016 1142h	10/26/2016 958h	E200.8	0.00200	**0.664**	
Magnesium	mg/L	10/24/2016 1142h	10/27/2016 1410h	E200.7	100	**2,230**	
Manganese	mg/L	10/24/2016 1142h	10/27/2016 1353h	E200.8	1.00	**392**	
Mercury	mg/L	10/26/2016 1540h	10/27/2016 921h	E245.1	0.000150	< 0.000150	
Potassium	mg/L	10/24/2016 1142h	10/27/2016 1359h	E200.7	10.0	**76.4**	
Selenium	mg/L	10/24/2016 1142h	10/26/2016 1011h	E200.8	0.00200	**0.0257**	
Silver	mg/L	10/24/2016 1142h	10/26/2016 1020h	E200.8	0.0100	< 0.0100	*
Sodium	mg/L	10/24/2016 1142h	10/27/2016 1408h	E200.7	20.0	**299**	
Thallium	mg/L	10/24/2016 1142h	10/26/2016 958h	E200.8	0.00200	**0.00936**	
Zinc	mg/L	10/24/2016 1142h	10/27/2016 1356h	E200.8	0.250	**38.6**	

** - The reporting limits were raised due to sample matrix interferences.*
§ - The method blank was acceptable, as the method blank result is less than 10% of the sample concentration.

INORGANIC ANALYTICAL REPORT

Client: CS Mining
Project: ITDF
Lab Sample ID: 1606554-001
Client Sample ID: ITDF
Collection Date: 6/24/2016 1216h
Received Date: 6/24/2016 1701h

Contact: Lendl Ah-Fook

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		6/27/2016 530h	SM2320B	10.0	< 10.0	^
Bicarbonate (as CaCO3)	mg/L		6/27/2016 530h	SM2320B	10.0	< 10.0	
Carbon Dioxide	mg/L		6/27/2016 1603h	SM4500-CO2-D	5.00	< 5.00	
Carbonate (as CaCO3)	mg/L		6/27/2016 530h	SM2320B	10.0	< 10.0	
Chloride	mg/L		7/6/2016 1313h	E300.0	10.0	**331**	
Hydroxide (as CaCO3)	mg/L		6/27/2016 530h	SM2320B	10.0	< 10.0	
Nitrate (as N)	mg/L		6/24/2016 1839h	E353.2	0.100	**2.88**	
Nitrite (as N)	mg/L		6/24/2016 1839h	E353.2	0.100	**0.140**	
pH @ 25° C	pH Units		6/24/2016 1732h	SM4500-H+B	1.00	**1.65**	
Sulfate	mg/L		7/6/2016 1330h	E300.0	750	**14,600**	
Total Dissolved Solids	mg/L		6/27/2016 1300h	SM2540C	100	**21,300**	

^ - *Insufficient sample volume to perform MS/MSD analysis. An LCSD was added to provide precision data.*

American West

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: CS Mining
Project: ITDF
Lab Sample ID: 1606554-001
Client Sample ID: ITDF
Collection Date: 6/24/2016 1216h
Received Date: 6/24/2016 1701h

Contact: Lendl Ah-Fook

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	6/27/2016 1226h	6/30/2016 1519h	SW6020A	0.0100	**0.0411**	
Arsenic	mg/L	6/27/2016 1226h	6/30/2016 1519h	SW6020A	0.0100	**5.34**	
Barium	mg/L	6/27/2016 1226h	6/28/2016 1428h	SW6020A	0.00200	**0.0858**	
Beryllium	mg/L	6/27/2016 1226h	7/1/2016 1622h	SW6020A	0.0500	< 0.0500	*
Cadmium	mg/L	6/27/2016 1226h	6/30/2016 1519h	SW6020A	0.00250	**0.404**	
Calcium	mg/L	6/27/2016 1226h	6/28/2016 800h	SW6010C	100	**540**	
Chromium	mg/L	6/27/2016 1226h	6/28/2016 1428h	SW6020A	0.00200	**0.664**	
Copper	mg/L	6/27/2016 1226h	6/30/2016 1423h	SW6020A	1.00	**337**	
Lead	mg/L	6/27/2016 1226h	6/28/2016 1428h	SW6020A	0.00200	**0.691**	
Magnesium	mg/L	6/27/2016 1226h	6/28/2016 800h	SW6010C	100	**1,850**	
Mercury	mg/L	7/5/2016 1409h	7/6/2016 851h	SW7470A	0.000150	< 0.000150	
Potassium	mg/L	6/27/2016 1226h	6/28/2016 820h	SW6010C	10.0	**66.3**	
Selenium	mg/L	6/27/2016 1226h	6/30/2016 1519h	SW6020A	0.0100	**0.0236**	
Silver	mg/L	6/27/2016 1226h	6/30/2016 1519h	SW6020A	0.0100	< 0.0100	*
Sodium	mg/L	6/27/2016 1226h	6/28/2016 820h	SW6010C	10.0	**272**	
Thallium	mg/L	6/27/2016 1226h	6/28/2016 1428h	SW6020A	0.00200	**0.00845**	
Zinc	mg/L	6/27/2016 1226h	6/30/2016 1423h	SW6020A	2.50	**37.9**	

** - The reporting limits were raised due to sample matrix interferences.*

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Appendix B
Solution Pond Design Drawings

Appendix C
Tailings Analysis Results for Metallurgical Bench Test Sample

Appendix D
Water Quality Data

(with Eh-pH Diagram for System: Ca-C-O-H-S added in 12/2016)

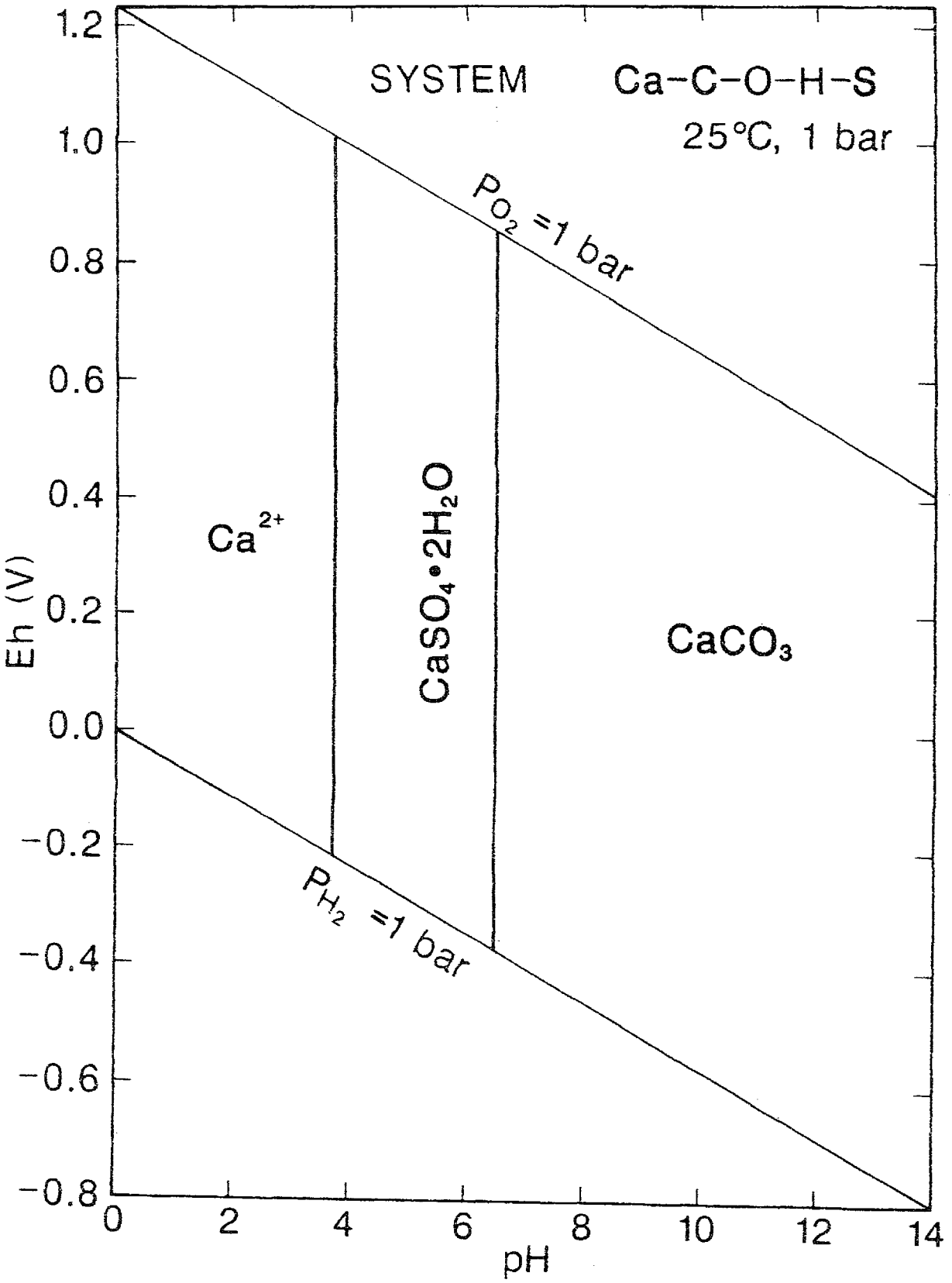

Fig. 95. Eh-pH diagram for part of the system Ca-C-O-H-S. Assumed activities for dissolved species are: Ca = $10^{-2.5}$, S = 10^{-3}, C = 10^{-3}. See text for discussion

From Brookins, 1987. page 165
(Appendix D, CSM GWDPA

Appendix E
Drillers Logs: WW-3, WW-6
Truck Shop Well and
Geologic Log of MW-1

Appendix F
ITDF Test Pit and Core Logs

Appendix G
Seismic Survey Report
Dam Location

Appendix H

Ground Water Monitor Well Geologic Log

DATE		Geotechnical Investigation		
	STARTED 9/28/2015	CS Mining	Drill Rig: Schramm	Boring No.
	COMPLETED 10/07/2015	Stagecoach Resort Development	Boring Loc:	
	RECORDED 10/16/2015	Milford, UT	Project Number:	

LOCATION: NORTHING 6494837.05 EASTING [illegible] ELEVATION 5696.85

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N* Blows/6in	Dry Density (pcf)	Moisture Content %	Percent passing #200	Liquid Limit	Plasticity Index
									14" casing with [illegible] cement						
									8' cement 0-8'						
	10									20					
									Granodiorite						
	20														
	30														
	40								14" casing 40 ft						
									10 5/8" casing	30					
	50														
	60														

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY

0-25%	Very Poor (VP)
25-50%	Poor (P)
50-75%	Fair (F)
75-90%	Good (G)
90-100%	Excellent (E)

WATER LEVEL
- MEASURED - ESTIMATED

Plate

DATE: STARTED 9/28/2015 COMPLETED 10/07/2015 REVIEWED 10/10/2015

Geotechnical Investigation
CS Mining
Supplemental Geotechnical
Milford, UT

Schramm Mayor - RC

METERS	FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N Rock*	Dry Density pcf	Moisture Content %	Percent Passing 200	Liquid Limit	Plasticity Index
	70								Conglomerate - Biotite - Plagioclase - Quartz - Hornblende * small crystal size fairly uniform throughout	20					
	80														
	90								10 3/4" casing 10" casing 90'	18					
	100								fracture density 80% 100-110 no oxidation	25					
	110								fracture density 10-20% 110-115 oxidation						
	120									10					

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

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- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
- MEASURED ▽ - ESTIMATED

Plate

DATE	STARTED 9/26/2016	Geotechnical Investigation	BORING ID
	COMPLETED 10/7/2015	CS Mining	
		Stephanie [illegible]	
		Milford, UT	

METERS	FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent passing 200	Liquid Limit	Plasticity Index
	130								Granodiorite						
									130-133' fractured 50% 5-10% oxidation	10					
	140														
	150									10					
	160								Fractured from 165-170' 30-40% oxidation 10%						
	170														
	180								185-190' fractured 30% oxidation 5-10%	10					
	190														

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

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- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

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- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
- MEASURED
- ESTIMATED

Plate

DATE			
	STARTED 9/28/2015	Geotechnical Investigation	
	COMPLETED 10/7/2015	CS Mining	
	REVIEWED 10/16/2015	Diamond Decline Project	
		Milford, UT	

HOLE Dip	5 Minute
Bearing	Schwarz
Bearing Line	Sationary
Project Sample	

BORE 0

Page 22

METERS	FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY	GRAPHICAL LOG	MATERIAL CLASSIFICATION	LOCATION: SOUTHING	LOCATION: EASTING	LOCATION: ELEVATION	N Rate ft/min	Dry Density (pcf)	Moisture Content %	Percent passing 200	Liquid Limit / Plasticity Index
	200															
	210															
	220															
	230															
	240															
	250															

MATERIAL DESCRIPTION

190-197' fractured 20-30%
no oxidation

Granodiorite

10

Fracture zone 40% no oxidation

Fracture zone 30%
no oxidation in and out of fractures

12

Chipseal fill 5-298'

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

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- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY

0-25%	Very Poor (V P)
25-50%	Poor (P)
50-75%	Fair (F)
75-90%	Good (G)
90-100%	Excellent (E)

WATER LEVEL
- MEASURED - ESTIMATED

Plate

Geotechnical Investigation
CS Mining
Milford, UT

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATIONS	MATERIAL DESCRIPTION	* N	Dry Density (pcf)	Moisture Content (%)	Percent Fines (%)	Liquid Limit	Plasticity Index
	250								40% Fracture zone Granodiorite	12					
	270									13					
	280								Large Fracture zone 40% No oxidation Larger chipstone dimesize						
	290								Chipseal S-298'						
	300								298' Sand Pack well	13					
	310								Fracture zone 20-40% Oxidation in fractures						

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

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- 90-100% Excellent (E)

WATER LEVEL
- MEASURED
- ESTIMATED

Plate

Geotechnical Investigation
CS Mining
Milford, CT

METERS	DEPTH	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	RQD %	Dry Density	Moisture Content	Percent Passing 200	Liquid Limit	Plasticity Index
	32'								Granodiorite.	13					
	280									5					
	340								345' damp however just a drip or two on seams						
	350								In fracture @ 350' calcite	4					
	360								→ 365-370' Large [illegible]						
	370									8					
	380								• Sand Pack well 378-410'						

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

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- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

Geochemical Exploration
FCS Mining

ELEV.	DEPTH	SAMPLE TYPE	WATER LEVEL RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK COMPOSITION	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	# Rate 4/5/07	Dry Density (pcf)	Moisture Content (%)	Percent Passing 200	Liquid Limit	Plasticity Index
	390							Granodiorite Fracture zone 30-40% no oxidation	8					
	400							Clay 390 - 400' weathered granodiorite Slightly fractured 400-410' 20% Sand pack well End of well 410ft	15					
	410													
	420													
	430													
	440													

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES

SAMPLE TYPE
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75-90%	Good (G)
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WATER LEVEL
MEASURED ▽ ESTIMATED

Plate