Grants Reclamation Project Design Work Plan for Re-lining EP-1

Evaporation Pond 1 (EP-1)
Cibola County, NM
Design Work Plan

July 30, 2018

Prepared for:

HOMESTAKE
Doing it right... ...Right to the end.
Grants Reclamation Project

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Revision Tracking

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

Executive Summary

This work plan describes the proposed design methods, analysis, design basis, and criteria that will be used during the design of re-lining evaporation pond 1 (EP-1) at the Grants Reclamation Project (GRP) site in Grants, New Mexico. The existing liner in EP-1 has exceeded its lifespan and must be replaced for EP-1 to remain in operation. The hazard potential classification for EP-1 was also recently changed from low hazard to significant hazard by the New Mexico Office of the State Engineer (NMOSE). The final design report will address the proposed change to the liner within the dam in accordance with the requirements of Subsection C of 19.25.12.11 NMAC and 20.6.7.17 NMAC, as well as address any existing conditions that do not meet the requirements of NMAC 19.25.12. The work plan describes design criteria and regulatory guidance that will be used to guide the design, describes the analysis methods and design approach, and outlines sections and information that will be included in the design report.

Abbreviations

AACE	Association for the Advancement of Cost Engineering
ALR	Action Leakage Rate
amsl	above mean sea level
ASTM	American Society for Testing and Materials
COC	contaminant of concern
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
CQC	Construction Quality Control
CSI	Construction Specifications Institute
CY	cubic yard
EAP	Emergency Action Plan
EP-1	Evaporation Pond 1
EP-2	Evaporation Pond 2
EP-3	Evaporation Pond 3
FEMA	Federal Emergency Management Agency
FOS	Factor of Safety
gpm	gallons per minute
GWQB	Groundwater Quality Board
HMC	Homestake Mining Company of California
IFC	Issued for Construction
IFR	Issued for Review
LDRS	Leak Detection and Removal System
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environmental Department
NMOSE	New Mexico Office of the State Engineer
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSHM	National Seismic Hazard Model
O & M	Operation and Maintenance
PFS	Prefeasibility Study
PGA	peak ground acceleration
PMF	probable maximum flood
PMP	probable maximum precipitation
RO	reverse osmosis
STP	Small Tailings Pile
UMTRCA	Uranium Mill Tailings Radiation Control Act (1978)
USCS	Unified Soil Classification System
USDOE	US Department of Energy
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
USNRC	US Nuclear Regulatory Commission

July 30, 2018

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

This Design Work Plan was prepared on behalf of Homestake Mining Company of California (HMC) to describe the organization, objectives, methods, and processes that will be used to design the re-lining of Evaporation Pond 1 (EP-1) at the GRP site. Because the EP-1 liner exceeded its design lifespan, the liner must be replaced if EP-1 is to continue to be used effectively and avoid further environmental impacts. Specific objectives of this Design Work Plan are:

- Describe the design criteria and regulatory guidance that will be used to guide the design
- Describe the analysis methods and design approach to be used for each design element
- Outline the sections to be included in the design report

The hazard potential classification for EP-1 was changed from low hazard to significant hazard on March 1, 2018 by the Office of the State Engineer (NMOSE). The final design report will address the proposed change to the liner within the dam in accordance with the requirements of Subsection C of 19.25.12.11 New Mexico Administrative Code (NMAC) and Section 20.6.7.17 NMAC. The design report will also address whether the existing dam condition complies with the design requirements and, where the existing condition is not in compliance, will propose changes to address compliance issues or request a waiver from NMOSE if the deficiency is not critical to dam safety.

1.2 PROJECT LOCATION AND DESCRIPTION

The GRP site is located approximately 4.5 miles north of the Village of Milan, Cibola County, New Mexico. Major land uses south and southwest of the site include residential, commercial, and agricultural. The site is on the alluvial flats of San Mateo Creek, a tributary of the Rio San Jose. Mount Taylor is located to the east and the El Malpais Lava Flow and the Zuni Mountains are located to the west-southwest and southeast, respectively. New Mexico State Highway (NM) 605 is east of the site and State Route 66 is to the south-southwest. The main area of the site falls within Sections 22, 23, and 26 of Township 12 North, Range 10 West. HMC owns approximately 14,000 acres over 22 Township Sections (over 22 square miles), which includes the Grants Reclamation Project site and surrounding areas.

HMC owns and operates the GRP site. The GRP is a Title II Uranium Mill Tailings Radiation Control Act (UMTRCA) site licensed by the United States Nuclear Regulatory Commission (USNRC) (USNRC Licensed SUA-1471). The site also has a Discharge Permit (DP-200) with the State of New Mexico Environment Department (NMED) and is a Federal Superfund site on the National Priority List (NPL) with the United States Environmental Protection Agency (USEPA). There are two uranium mill tailings piles on the site, as well as three evaporation ponds (EP-1, EP-2, and EP-3) and two collection ponds (East and West Collection Ponds).

Groundwater reclamation at the site involves two zeolite treatment systems and a reverse osmosis (RO) treatment plant. Treatment residuals are managed in the three evaporation ponds, which remove water and leave behind contaminants of concern (COCs) as salts in the bottom of the ponds. The existing ponds may not provide sufficient evaporation through closure and EP-1 requires maintenance with the exceedance of the pond liner design lifespan.

EP-1 is located on the Small Tailings Pile (STP) at 35° 14' N latitude and 107° 52' W longitude with a nominal site elevation of 6,583 feet above mean sea level (amsl). EP-1 was designed and constructed in 1990 (NMOSE Dam

Permit Number 3700). It was constructed on top of the STP, which was constructed above the surrounding natural grade. The pond is lined with a composite liner consisting of 50 mil polyester fabric sheets coated with Deery Oil No. 6 asphaltic emulsion. EP-1 has no internal leak detection system. Localized sloughing of some of the internal pond slopes has been observed in recent years.

1.3 PROPOSED DESIGN

The GRP Water Management Prefeasibility Study (PFS; CH2M, 2018) consisted of evaluating the feasibility of re-lining pond EP-1 (Option 1) or replacing EP-1 by constructing a new evaporation pond 4 (Option 2) near EP-3. CH2M also included four options for salt management to re-line EP-1 (Options 1A through 1D). These four options included:

- staged liner replacement/mechanical salt removal (1A),
- one phase liner replacement/mechanical salt removal (1B),
- one phase liner replacement/hydraulic salt removal (1C), and
- one phase liner replacement/stabilized salt (1D).

Based on the costs, permitting, preliminary engineering, and top risks, the preferred option selected by CH2M was to re-line EP-1 in one phase with salt stabilization (Option 1D). Stantec reviewed the PFS and concurs that Option 1D is the preferred option. The advantages of this option include avoiding double-handling of material, limiting personnel exposure, avoiding equipment traffic on top of the new liner, and relative ease of permitting; as compared to the other options.

2.0 DESIGN APPROACH

2.1 DESIGN CRITERIA AND REGULATORY GUIDANCE

Design criteria are the specific metrics and conditions used to determine adequacy of a design element. Design criteria do not include the methods by which the analyses are performed, the design approach, or the conceptual models used to develop the design analyses. Design criteria are conditions used to guide the design including minimum factors of safety, design storm events, and the recurrence interval of the design seismic event. The design criteria that will be used to guide the design are described in Section 3. The design criteria are based on current assumptions regarding the design and represent the best-estimate of the criteria to be used. Additional design criteria may be identified during the design process and will be documented in the Design Report.

Regulatory guidance documents are issued by a regulating agency. The documents describe, and make available to the public, methods that agency staff (e.g., USNRC, NMED) consider acceptable for use when implementing specific parts of the agency's regulations, techniques that the staff use to evaluate specific problems or postulated accidents, and data that staff need when reviewing applications for permits and licenses. Regulatory guidance documents are not substitutes for regulations, and compliance with guidance is not required. Design methods and solutions that differ from those set forth in regulatory guidance documents are acceptable if the designer provides an adequate basis for their use. Analyses performed as part of the design (described in Section 3) will conform to the guidelines presented in the regulatory guidance documents identified in this report. Guidance documents developed by the USNRC, USEPA, US Department of Energy (USDOE), NMOSE, and NMED will be used as the basis for supporting design analyses, work plans, and other plans associated with the design.

2.2 ANALYSIS METHODS

Analysis methods are systematic methods by which analyses are performed to yield quantitative results. Analysis results can be evaluated against specific design criteria to determine the adequacy of a design element. Analysis methods do not define criteria of acceptability, the design approach, input parameters, or assumptions used in the analysis. Examples of analysis methods include limit-equilibrium slope stability analysis, Terzaghi bearing capacity equation, required freeboard calculations and liner anchor pullout calculations. Anticipated methods of analysis have been identified from regulatory guidance and technical documents and are presented in Section 3. All analysis methods used during the design will be documented in the Design Report.

2.3 DESIGN APPROACH

The design approach is the broad strategy for designing a facility or element with the goal of satisfying the design criteria or performance standards. A design approach includes a series of steps to complete the design element, including: (1) selection of appropriate analysis, (2) performing the analysis, and (3) incorporating the analysis results or revising the design to meet performance standards.

2.4 INPUT PARAMETERS

Input parameters are specific values and conditions used to perform the design analyses. Input parameters are often determined using site-specific information and operational requirements, design features, assumptions, conceptual models of existing systems, and recommendations from professional or regulatory guidance documents. Examples of input parameters include site topography, construction material strengths, rainfall distributions, repository grading, and subsurface stratigraphy. Input parameters will be selected based on historical site data, data from previous studies and reports, and the specific needs for the completed design.

3.0 DESIGN ANALYSES

Design analyses will demonstrate the ability of the design elements to meet the design criteria and regulatory requirements. Table 1 summarizes each design element and its criteria, approach and methods, and regulatory guidance. Analyses will be performed according to regulatory guidance documents, standard engineering practices, peer-reviewed technical documents, and Barrick's Tailings and Heap Leach Management Standard (Barrick, 2016). Design analysis results will be used to develop plans and specifications. Cost-benefit analyses will be performed, as appropriate, to evaluate the benefits associated with specific design approaches and construction materials.

Table 1. Summary of Design Criteria, Approach, Methods, and Guidance Documents

Design Element	Design Condition	Design Criteria	Method of Analysis	Design Approach	Design Guidance
Seismic Design	2,500-year design earthquake Site Class D	The design seismic event corresponds to a 2 percent probability of exceedance in 50 years.	Evaluation of available regional geologic and seismologic data to determine the characteristics of the design seismic event.	Stantec reviewed the design seismic event and seismic hazard study presented in the Prefeasibility Study (CH2M, 2018), and the fault study review (Jacobs, 2018b).	• NUREG 1620, Sections 1.2 and 1.4 (USNRC, 2003) • Prefeasibility Study (CH2M, 2018) • Fault Study Review (Jacobs, 2018b) • NMAC 19.25.12.11 (NMAC, 2005) • Barrick (2016)
Slope Stability	Static Condition	Long-term minimum FOS = 1.5 End of construction FOS = 1.3	Limit equilibrium using GeoStudio software Slope/W	Evaluate material properties based on field investigations results and laboratory analyses. Assess stability for static and seismic conditions at multiple locations, as determined by maximum slope steepness, maximum slope height, conditions at toe of slope.	• NUREG 1620, Section 2.2 (USNRC, 2003) • USNRC Regulatory Guide 3.11, Section C (USNRC, 2008) • NMAC 19.25.12.11 (NMAC, 2005) • Barrick (2016)
	Seismic Condition	Minimum FOS = 1.1 Design seismic coeff. = 67% of PGA or 0.1 g (whichever is greater)	Pseudo-static limit equilibrium using GeoStudio software Slope/W		
Pond Subgrade	Stabilize existing salts for equipment access – assumed properties of sediments following water removal based on lab data collected from pond bottom.	Bearing capacity for ground pressure of equipment.	Terzaghi bearing capacity evaluation.	Evaluate strength properties of salt sediments post-water removal. Estimate bearing capacity in current condition to determine if equipment can operate on the surface to place soil, or incorporate tensile strength reinforcing to allow for fill placement.	• Das (2007)
Liner Design	Maintain similar footprint to existing pond. Double-lined with leak detection system. Target storage volume = 205 acre-feet	• Optimize storage capacity of pond. • Maintain equipment access to pond. • Minimize excavation into tailings • Minimize head on secondary liner	Evaluate liner and determine components of leak detection and removal system (LDRS)	Evaluate liner availability, permeability, durability, and resistance to chemical and mechanical breakdown, constructability, and cost. Return liquid from LDRS to impoundment or system.	• NMAC 19.25.12.11.C.17 (NMAC, 2005) • NMAC 20.6.7.17 (NMAC, 2013) • 40 CFR 264.211 • Barrick (2016)

Design Element	Design Condition	Design Criteria	Method of Analysis	Design Approach	Design Guidance
Freeboard	Wave runup for site-specific maximum wind speed and direction. 100-yr, 24-hr storm event.	Minimum freeboard to prevent overtopping.	Calculate required freeboard based on NMAC guidance	Sufficient to prevent overtopping by flood inflows and wind-generated waves, normal/abnormal operations, overfilling, and run-on	• NMAC 19.25.19.11.C(15) (NMAC, 2005) • NUREG-1623 (USNRC, 2002) • Regulatory Guide 3.11 (USNRC, 2008) • Barrick, 2016
Stormwater Controls	Long-term	Drain EP-1	AFT Fathom model	Drain EP1 using mechanical evaporators and excess capacity in EP-2 and EP-3 using system of pipes and pumps.	• NMAC 19.25.12.11 (NMAC, 2005)
Water Balance	Maintain volume of EP-2 and EP-3 below established limits when EP-1 is offline; maintain volume of EP-1, EP-2, and EP-3 below required volume limits post-construction.	Base maximum volume on applicable freeboard requirements and recent bathymetric survey of settled solids in the ponds	Utilize current CH2M GoldSim water management model	Evaluate the number of mechanical evaporators required to maintain pond volumes within established criteria under various construction, climate, and management scenarios	• see freeboard requirements
Restoration of Borrow Areas	After completion of EP-1 construction	Restore positive drainage; 2:1 (H:V) maximum slopes. Revegetate disturbed areas with native sustainable species.	-	Develop post-borrow grading plans. Develop plans and specifications for regrading and revegetating.	• NMAC 19.8.20.2003 (NMAC, 1997)

FOS = factor of safety, PGA = peak ground acceleration

3.1 FAULT STUDY REVIEW

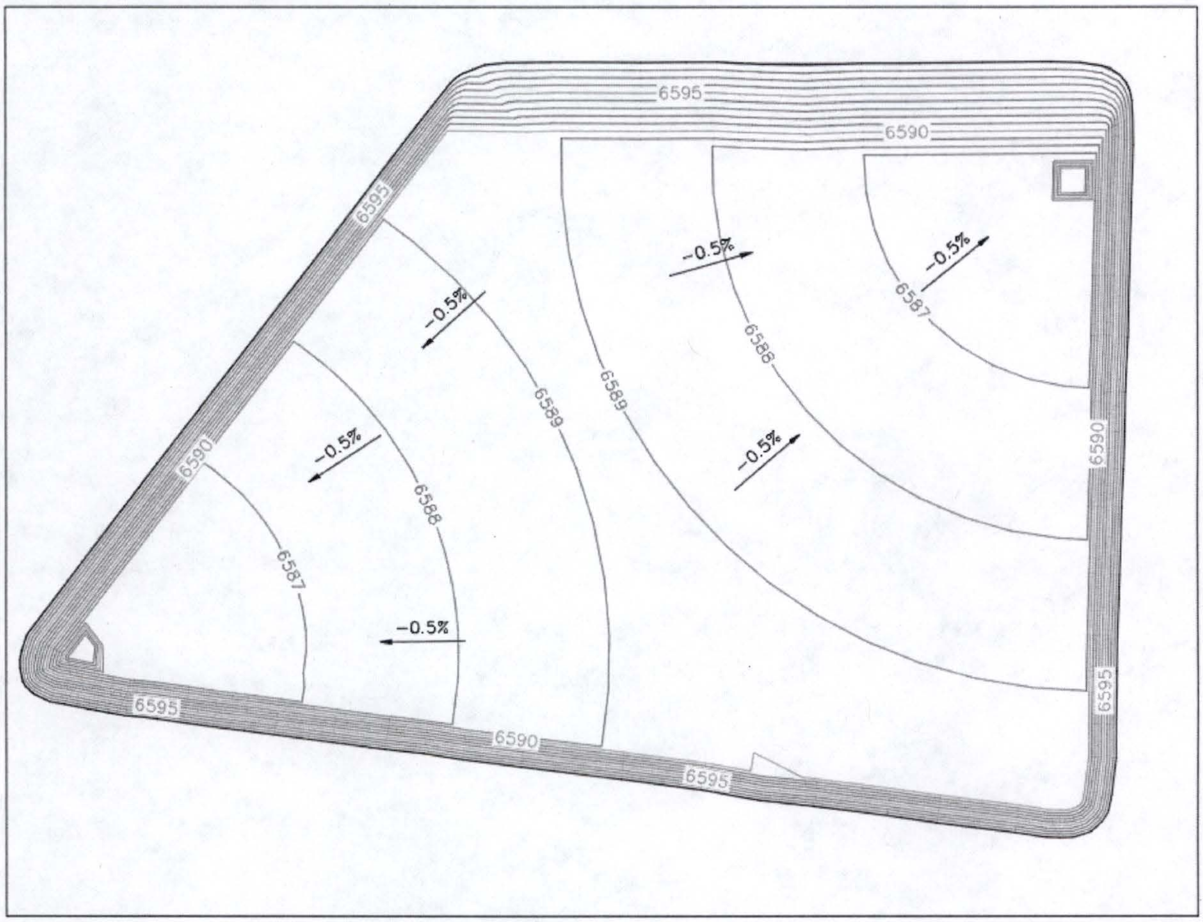
Stantec reviewed the fault study (Jacobs, 2018b), which summarized the regional seismicity, regional Quaternary faults, and the results of a site-specific seismic hazard study. According to the study, the rate of earthquake activity in NM can be characterized as low to moderate. Seismic hazard curves were obtained for the project site using the 2008 and 2014 US seismic hazard maps developed by US Geological Survey (USGS). The 2,475-year Peak Ground Acceleration (PGA) for rock conditions was predicted to be 0.140 g and 0.128 g using the 2008 and 2014 USGS Seismic Hazard studies, respectively. Site Class B/C was selected based on a near-surface shear wave velocity of 760 meters per second (m/s). The mean magnitude and distance combination from all sources for the 2008 USGS study is a M 5.9 event at 22.18 km, and a M 5.98 at 23.22 km distance for the 2014 study. Results of the fault study will be used in the geotechnical design basis for the detail design of the EP-1 Pond Re-lining Project.

Stantec selected the value from the 2014 National Seismic Hazard Model (NSHM) of 0.128 g as the predicted PGA to be used for the geotechnical design basis. Stantec adjusted the PGA for site class D based on the tailings located beneath the pond. The predicted PGA value was converted from Site Class B/C to Site Class D using Table 11.8-1 from ASCE (2010). Given a PGA value of 0.128 g, interpolation within the ASCE table results in a F_{PGA} of 1.54. The resulting Site Class D PGA to be used in the geotechnical design is 0.20 g (=1.54*0.128). The pseudo-static coefficient to be used in the pseudo-static stability analysis is two-thirds of the predicted PGA, or 0.13 g (=0.20*2/3).

3.2 GRADING PLANS

Stantec anticipates designing the EP-1 Pond with a floor grade of 0.5 percent draining to one of two leakage collection sumps in the NE and SW corners of the Pond. A ridge running NW-SE will separate leakage flows between the two sumps. The design will maintain the current interior slope grades (10H:1V on the northern interior slope, with 5H:1V elsewhere) as they currently exist. Minor slope reshaping may be required during construction to repair sloughing areas. Access to the pond bottom from the northern 10H:1V slope will also remain as it currently exists. No design change will be required for the exterior pond slopes. Figure 1 provides a conceptual plan for the EP-1 pond interior grading.

Figure 1. EP-1 Conceptual Interior Top of Pond Liner Grading



3.3 BORROW STUDY

Based on the pre-feasibility study to evaluate borrow source options (Jacobs, 2018a), available borrow material volumes and material types are being evaluated for construction of the pond. The proposed borrow source is directly west and southwest of EP-3, on HMC-owned property approximately 1.8 miles from EP-1 (Jacobs, 2018a). Based on test pit logs D1 through D28 (Alan Kuhn Associates, 2017), Stantec estimated the volume of material in the borrow source is approximately 139,000 cubic yards (CY) of material, consisting of predominantly clayey sands or low plasticity clays (SC or CL) and silty sands (SM). The estimated volume is based on the total excavated depths of the test pits, which ranged from 1 foot to 7 feet below ground surface. Several test pits reported sand or clay material at the bottom of the test pit and the borrow area could potentially be excavated deeper than the test pits, if necessary.

Stantec will review existing laboratory data from the test pit logs, as well as data from EP-3 construction (Kleinfelder, 2006), to determine material types and if they are suitable for construction use. Laboratory data from test pits D23 through D28 included four sieve analyses, which reported the USCS classification of three samples as either SC or CL (one sample was undetermined). The average maximum dry density and optimum moisture contents determined by standard Proctor testing of six samples (one from each test pit location D23 through D28) were 111.0 pcf and 14.4 percent, respectively. The overall volume and volume of each material type available will be refined using AutoCAD based on the information from the test pits and the laboratory data.

Jacobs (2018a) estimated that the approximate soil volume needed to stabilize salts and grading the pond bottom to be 119,300 compacted cubic yards. Based on review of the borrow information available and the PFS design (CH2M, 2018), the volume and materials available in the proposed borrow source will be adequate; however, the proposed borrow source provides only a limited contingency borrow volume. Additional borrow source investigations are not anticipated at this time. An excavation plan and a reclaimed grading plan for the proposed borrow area will be developed for the proposed borrow area as part of the detailed design. Stantec will contact relevant contractors to identify estimated costs for earthworks, with these costs included in the feasibility cost estimate deliverable.

3.4 EVALUATION OF SALT SUBGRADE

Stantec reviewed data from applicable reports, including the PFS Salt Investigation Sampling Plan and Salt Handling and Stabilization memorandums. Stantec will also review additional laboratory data when available (July 2018) and will use the new information to recommend subgrade bearing capacity and stabilization for construction equipment and for liner installation preparation. Stantec will evaluate the strength properties of salt sediments post-water removal. Soft or unstable areas identified during that evaluation can be over-excavated and/or stabilized as fill is being placed to construct the bottom of the pond. Subgrade materials (salts and sediments) will not be removed but may be moved within the pond to adjust grades for the bottom of the pond. The allowable bearing capacity for equipment loading will be calculated using the Terzaghi bearing capacity equation, based on the known material properties of the salts and borrow materials. Stantec will use the estimated bearing capacity to determine if equipment can operate on the surface to place soil, or if incorporating tensile strength reinforcement is necessary to allow for fill placement. The geotechnical recommendations may be amended during construction based on the observations made after dewatering the pond to stabilize the salt subgrade for the new pond lining.

3.5 LINER STUDY

EP-1 will be re-lined utilizing a geomembrane liner system with a leak detection component. Stantec anticipates that the liner system will consist of a dual geomembrane liner system with leak detection layer and collection sumps. Stantec will complete a liner study to identify the preferred geomembrane liner material(s), taking into account regulatory requirements and standards, specifically NMAC 19.25.12.11.C.17 and NRC Regulatory Guide 3.11 (USNRC, 2008), liner availability, permeability, durability and resistance to chemical and mechanical breakdown, constructability, as well as price for material supply and installation. As part of this study, Stantec will assess the chemical qualities of the influent water entering the pond to determine potential impacts on the liner. The liner study will also determine the number and design of pipe penetration leak protection (i.e. pipe boots, collars, etc.), liner pullout and tearing calculations, as well as anchor trench design.

The liner study will also include LDRS. Specifically, the study will evaluate and determine the preferred components of the LDRS and verify conformance to the requirements given in NRC Regulatory Guide 3.11. The LDRS components are anticipated to include:

- High permeability layer (geo-grid or similar), located beneath a primary liner used to convey any leakage through the liner to a collection and removal sump.
- Leak location system, consisting of a stainless-steel wire grid, lying directly below the geonet (and above the secondary liner). This grid is used to assist in identifying the location of a liner leak by passing electrical

current through the grid and identifying location within the pond where current is observed by electrical probe, as described in American Society for Testing and Materials (ASTM) D7007.

- Leakage collection and removal sumps – anticipating two sumps (two compartments) to allow pond operations during liner repair.
- Leakage removal pump access – perforated and non-perforated piping from sump to pond crest. Liquid accumulation will be pumped back into the impoundment, or process water system with the pumps to minimize the hydraulic head on the secondary liner. The interstitial space between the liners will not be allowed to become saturated.
- Calculation of Action Leakage Rate (ALR), based on anticipated defect rates, hydraulic conditions on the liner system, and operation considerations. This ALR will serve as the threshold for commencement of repairs on the pond liner.
- Liner pipe boots for all liner penetrations.

Stantec will include the results and supporting information of the study as well as present the preferred geomembrane liner material for approval as part of the draft design deliverable. Upon approval by HMC, the preferred liner and leak detection and removal system design will be further developed and included in the final design documents.

Stantec will contact relevant liner suppliers and installation professionals to identify estimated costs for materials and installation for the preferred liner system components, with these costs included in the feasibility cost estimate deliverable.

3.6 STABILITY EVALUATION FOR POND BANKS

Stantec will evaluate stability of the pond embankments as part of the analyses based on the design grading plans. GeoStudio software SLOPE/W (GeoSlope International, 2016) software will be used to conduct static and pseudo-static slope stability analyses using limit equilibrium methods. Stantec will select critical cross-sections to represent the maximum loading conditions and critical slope geometry. The loading conditions to be evaluated in embankment stability analyses and corresponding minimum factors of safety (FOS) are summarized in Table 2 and were adopted from applicable guidance documents, including:

- NUREG 1620, Section 2.2 (USNRC, 2003)
- USNRC Regulatory Guide 3.11, Section C (USNRC, 2008)
- NMAC 19.25.12.11.C (NMAC, 2005)
- Tailings and Heap Leach Management Standard (Barrick, 2016)

Table 2. Slope Stability Design Criteria

Loading Condition	Minimum FOS
Steady-state, long-term static	1.5
End of Construction	1.3
Earthquake (pseudo-static analysis)	1.1

3.7 HYDRAULICS FOR THE INTERIM CONSTRUCTION PERIOD

The strategy for managing water levels during the interim construction period is to drain EP-1 and then manage all site wastewater in only EP-2 and EP-3. Prior to construction, EP-1 will be drained using a combination of mechanical evaporators and transfer of water to EP-2 and EP-3. The PFS (CH2M, 2018) demonstrated conceptually that this dewatering strategy could be accomplished using between 6 and 24 mechanical evaporators (depending on the time of year) and the existing pump in EP-1, a constant-speed centrifugal pump rated at 4,000 gallons per minute (gpm). During construction, wastewater will continue to be sent to EP-2, and a valved pipeline will be installed connecting EP-2 to the line running from EP-1 to EP-3 that will allow water to be pumped from EP-2 to EP-3. Two of the three pumps in EP-2 (constant-speed centrifugal pumps, each rated at 3,250 gpm) are currently not operating, and these pumps will be connected to the new pipeline and operated to manage water levels in EP-2 and EP-3 during the construction period. Homestake has already began the process of installing the new pipeline.

As part of the EP-1 re-lining design, Stantec will perform the following checks and calculations related to the hydraulics for the interim construction period:

- Confirm the make, model, and test the serviceability of the existing pumps in EP-1 and EP-2
- Visually check the material types, diameters, and conditions of the existing pipes
- Confirm existing types of valve and visually inspect the conditions of existing valves
- Check the pump discharge versus operating head and calculate the actual pump curves and operating points
- Measure the head loss in the existing pipelines at a range of operating discharges and calculate the systems curves for the existing and construction conditions
- Calculate the expected pressure heads in pipelines and compare these to the allowable pressure heads under the construction flows for the current condition of the pipelines.

To support the re-line EP-1 design, Stantec will model the construction-phase modifications to the site piping and pumping systems. Stantec will review the existing pump system, including pump curves, pipe dimensions, and information on valves and junctions relevant to the pumping capacity. To support the calculations, Stantec will construct a pump systems model using the AFT Fathom model (or equivalent software) to determine the adequacy of using the existing pumping system for draining EP-1 and operations during the EP-1 re-lining. The model will include the proposed construction phase alternative where a new pipe will be installed from the existing EP-2 pump station to connect with the EP-1 to EP-3 pipeline. The model will aid in confirming the feasibility of the alternative as well as determining the appropriate piping and valve sizes and materials for the new pipeline. Inspection and calculation results will be documented in a technical brief and Stantec will prepare detailed drawings and specifications for the proposed pumping system modifications to be included in the overall design. The calculation results will also inform the water balance on the expected pumping rates. Stantec will determine requirements for the mechanical evaporators as part of the water balance task. Stantec will contact relevant contractors to identify methods and estimated costs for dewatering salt sediments, with these costs included in the feasibility cost estimate deliverable.

Stantec will calculate the freeboard requirements for EP-1 as part of the design, in accordance with the Tailings and Heap Leach Management Standard (Barrick, 2016), USNRC Regulatory Guide 3.11 (NRC, 2008) and NMAC 19.25.12.11.C(15) (NMAC, 2005). Freeboard will be sufficient to prevent overtopping by flood inflows and wind-generated waves, normal or abnormal operations, overfilling, and run-on. The design will be based on the 100-year,

24-hour storm event (CH2M, 2018). The calculated freeboard requirement will be discussed with the NMOSE, and a waiver may be requested if the calculated required freeboard is less than 4 feet.

3.8 WATER BALANCE

As a zero-liquid discharge facility, the site relies on storage and seasonal evaporation from EP-1, EP-2, and EP-3 to manage flows of reverse osmosis plant brine and zeolite plant backwash that originate from the remediation process. These flows are initially discharged to EP-2. Some water is pumped from EP-2 to EP-1 and from EP-1 to EP-3 to manage storage volumes. Consideration of seasonal storage capacity is especially important because evaporative losses are minimal during winter months and water is not moved between ponds during the winter due to the potential for freezing in the pipes.

During the period when EP-1 is taken offline for draining and re-lining activities, flows of reverse osmosis plant brine and zeolite plant backwash are managed through a combination of storage and evaporation at EP-2 and EP-3. The evaporative capacity of EP-2 and EP-3 will be increased by installing additional mechanical evaporators. The re-lining process will result in the permanent loss of storage volume in EP-1 due to the placement of the new liner system above the existing liner and accumulated salts. Additional loss of storage volume could occur at EP-1, EP-2, and EP-3, if a more stringent freeboard criteria is applied.

CH2M (2018) conducted an evaluation of water management during the EP-1 re-lining process as part of the project PFS. The PFS evaluated the number of additional mechanical evaporators required during the re-lining process for expected, worst, and best-case scenarios. Due to winter storage considerations, the number of additional evaporators varied based on the starting month of the project and the project duration. This PFS estimated that if re-lining construction activities begin in September and persist for one year, 221 million gallons of water would need to be removed via mechanical evaporators. The number of additional mechanical evaporators (beyond the existing six listed in the PFS) was estimated to range from 5 (11 total) to more than 18 (more than 24 total) for the expected scenario and from 14 (20 total) to more than 18 (more than 24 total) for the worst case depending on project duration and starting date.

The PFS found that for the expected scenario, the loss of pond volume in EP-1 after re-lining could be offset through the addition of an unspecified number of additional evaporators. CH2M suggested conducting additional analysis after completion of a more detailed water balance model (which was under development at the time). This updated water balance model is now available. The water balance conclusions in the PFS were performed using Excel-based spreadsheets, not the recently developed model.

The PFS identifies several critical assumptions and recommends these assumptions receive additional analysis and verification in the feasibility study:

- The mechanical evaporators will produce the evaporative rates specified by the vendor
- Potential reduction in overall evaporation rates due to the impact of evaporator-to-evaporator interference and localized high humidity is aligned with actual field performance
- Treatment system inflows to the ponds during construction and future operation will be constant and equal to, or lower than, values used in the analysis
- Salinity in the ponds will not significantly increase resulting in decreased evaporation rates
- Adjustments made to assumed natural surface and mechanical evaporation rates due to elevated salinity concentrations are realistic and align with actual field performance

In a listing of top engineering risks to the project, the PFS ranks the possibility that mechanical evaporators may not achieve the specified performance criteria as a high risk. The performance of the mechanical evaporators assumed for the PFS was based on manufacturer estimates and not calibrated field data. Documentation of the manufacturer-supplied estimates of mechanical evaporator performance was not included as part of the PFS. Potential causes of reduced performance by the mechanical evaporators include differences between assumed and actual climatic conditions, differences in operating schedules and unit uptime, and higher salinity levels in the ponds. Section 5.4.1 of the PFS lists possible mitigation actions and controls for managing this risk.

Due to the risk ranking and critical assumptions used in the PFS, the EP-1 re-lining project feasibility study requires careful analysis of the risks associated with the following issues:

- Temporary loss of evaporative capacity and storage volume at EP-1 during construction
- Permanent loss of system storage capacity at EP-1 due to the re-lining process
- Permanent loss of system storage capacity at EP-1, EP-2, and EP-3 due to increased freeboard requirements
- Uncertainty in the estimated evaporative potential of the mechanical evaporators during the construction process when EP-1 is taken offline
- Uncertainty in the estimated evaporative potential of the mechanical evaporators during the post-construction period which will have reduced total system storage capacity which is relied upon during the winter
- Significant changes in operations of the treatment systems and the associated waste streams into the evaporation ponds

CH2M recently developed a more detailed site-wide water balance simulation model for the Grants Reclamation Project. This model was developed using a dynamic simulation software package called GoldSim. Because this model was not used to produce the predictions used in the PFS, CH2M will provide documentation which verifies that the new GoldSim-based water balance model properly re-creates the predictions of the PFS spreadsheet model.

Stantec will use the GoldSim-based water balance model developed by CH2M to further evaluate the water management scenarios for the PFS's preferred alternative for the following two periods: 1) during the EP-1 re-lining construction process, and 2) the period between the end of the EP-1 re-lining process and site closure. These scenarios will be evaluated with regard to the project risks identified above. Stantec will evaluate the expected case and realistic worst-case scenarios to help understand the range of potential system demands during these periods. When possible, Stantec will evaluate the range of uncertainty in key model inputs and assumptions to provide bounds for model results.

Stantec will rely on the most recent CH2M GoldSim model to perform the proposed project scenario analyses for the feasibility study. To help address some of the project risks listed above, Stantec will provide review and validation of the GoldSim model and the underlying inputs, calculations and assumptions used in both the PFS analysis and the GoldSim model.

4.0 PERMITTING

Stantec will develop a comprehensive plan for obtaining the necessary permits and approvals. The approvals schedule will be incorporated into the construction and commissioning schedule. A preliminary list of regulatory agencies and associated permits being evaluated are listed in Table 3.

Stantec will further evaluate permit and approval requirements for design, construction, and operation of EP-1, as well as facilitating discussions with pertinent regulatory agencies to confirm permitting requirements are met. The USNRC, NMED Groundwater Quality Board (GWQB) and the NMOSE have been identified as the primary agencies involved in approval of the design concept. The Preliminary Feasibility Study for the Re-lining of EP-1, and the preferred alternative, have already been presented to these agencies. As the design progresses, HMC will discuss any significant changes to the design concept to these agencies to avoid delays.

NRC license SUA-1471 allows HMC to make changes to the facility without prior NRC approval and an associated license amendment via the Safety and Environmental Review Panel (SERP) process. The regulatory basis for conducting a SERP is found in Conditions 16 and 43 of HMC's NRC-issued material license (SUA-1471):

"16 Before engaging in any activity not previously assessed by the NRC, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of such activities and obtain prior approval of the NRC in the form of a license amendment."

"43 Before engaging in any developmental activity not previously assessed by the NRC, the licensee shall administer a cultural resource inventory. In order to ensure that no unapproved disturbance of cultural resources occurs, any work resulting in the discovery of previously unknown cultural artifacts shall cease."

A cultural resources inventory and environmental review has been completed as part of the SERP process, and the results will be summarized in the design report. HMC is in the process of completing the SERP for the proposed EP-1 relining work, the results of which indicate that a NRC license amendment will not be required. Findings of the SERP process are compiled in 'SERP Reports' and will be available on-site for review by NRC during subsequent site visits.

EP-1 is classified as a significant hazard dam by NMOSE, and as such an evaluation of current conditions is required prior to implementing changes at EP-1 (NMAC 19.25.12.19) to ensure EP-1 is in compliance with design requirements presented in Subsection C of NMAC 19.25.12.11. Stantec will coordinate with HMC and NMOSE to determine the requirements of the current conditions evaluation. HMC and Stantec will implement the evaluation following confirmation of requirements and present the results as part of the design report. Any deficiencies identified in the evaluation will be documented and plans to address the deficiencies will be included as part of the design report.

Expansion of the footprint of EP-1 is not expected currently, and therefore no changes to floodplain maps are required. However, if the final design includes expansion of EP-1 footprint, Stantec will begin the process of submitting a 'Conditional Letter of Map Revisions' to the Federal Emergency Management Agency (FEMA).

Table 3. Preliminary Permitting List

Agency	Permit Documentation	Anticipated Agency Review Time	Relevant Phase
USNRC	Conduct a Safety and Environmental Review Panel (SERP) per SUA-1471	1 year	Design through Construction
NMED GWQB	Design and Siting Document/Discharge Permit 200	1 year	Design through Construction
NMOSE	Dam permit revisions	6 months	Design through Construction
USNRC	Radioactive Work Permit	1 month	Construction
USEPA	National Pollutant Discharge Elimination System (NPDES) Construction General Permit	2 months	Construction
USFWS	Migratory Bird Treaty Act	Prior to construction	Construction
FEMA	FEMA Conditional Letter of Map Revisions and Letter of Map Revisions	1 year	Contingent Upon Final Design*
Cibola County	Floodplain Development Permit	3 Months	Contingent Upon Final Design*

*No changes to flood permits/maps are required if the footprint of EP-1 is not expanded.

5.0 DRAWINGS

Stantec will develop Issued for Construction (IFC) drawings as part of the detailed design for each pond design component following the requirements in NMAC 19.25.12.11.D. Table 4 provides an anticipated drawing list.

Table 4. EP-1 Issued for Construction (IFC) Preliminary Drawing List

Drawing Title	Anticipated Number of Sheets
Title Page with Location Map, Key Plan, and Drawing Index	1
Existing Conditions and Geotechnical Boring Locations	1
Overall Site Plot Plan	1
Pond Embankment Design (including earthworks set-out points and table)	1
Pond Long Section at Crest Centerline	1
Typical Pond Embankment Cross Sections	2
EP-1 Stage Storage Curve	1
Pond Liner Connection Details	1
Embankment Details	1
Leak Detection and Removal System Details	2
Miscellaneous Civil Details (if required)	1
General Notes (if required)	1

The construction drawings will contain the information provided in NMAC 19.25.11.D and will be submitted in accordance with HMC requirements, in a form acceptable to the NMOSE and the other regulatory agencies involved with the project. Jason Cumbers PE, a Stantec professional engineer licensed in the state of New Mexico, will oversee the production of, and provide certification for, the IFC drawings.

6.0 TECHNICAL SPECIFICATIONS

Stantec will develop technical specifications, as part of the detailed design in accordance with NMAC 19.25.12.11.E, in the standard three-part Construction Specifications Institute (CSI) format. Technical specifications will be provided in their entirety for the following construction tasks:

- General Conditions
- Survey
- Earthworks
- Liner and Leak Detection System Installation
- Pipe Installation
- Revegetation

The specifications will include detailed methods of construction, qualities and sizes of materials, methods and frequency of testing and quality control, lines and grading tolerances, construction supervision and frequency of inspection, as well as progress and as-built records and survey requirements. Individual specifications sections will typically be organized as follows:

Section 1: General

- Summary of requirements
- Reference standards
- Related specification sections
- Related compliance plans
- Submittals (work plans, surveys, product information, samples)
- Quality assurance/quality control general provisions

Section 2: Products

- Material and product requirements

Section 3: Execution

- Performance requirements for execution of the work
- Quality control inspection and testing specifics
- Quality assurance inspection and testing specifics

Stantec will submit the specifications to HMC for review (IFR) as part of the draft design deliverables. The reviewed and accepted specifications will then be revised to IFC level and provided to HMC as part of the final design deliverables. These IFC specifications will be used in conjunction with the IFC drawings to direct and confirm that the constructed works are completed in accordance with design engineer's design intentions. Neither the construction drawings nor the specifications can be materially changed without the prior written approval of the state engineer, except for field design changes submitted during construction, which may be approved by the Stantec engineer, Jason Cumbers, PE.

7.0 OPERATION AND MAINTENANCE MANUAL

Stantec will develop an operation and maintenance (O&M) manual for EP-1 in accordance with requirements in 19.25.12.17 NMAC. The O&M Manual will include, but is not limited to, the following:

- Reservoir operation instructions
- Emergency reservoir evacuation procedures
- Outlet works operations
- Operator safety
- Instrumentation installation, maintenance, reading schedule and data reduction
- Site security measures
- Inspection requirements
- Maintenance requirements

Design reports for dams classified as high or significant hazard potential are required to address security. The O&M Manual for EP-1 will address security at the dam (structure) to prevent unauthorized operation or access, as required by Section G of 19.25.12.11 NMAC. Stantec will develop an instrumentation plan, as required by Section H of 19.25.12.11 NMAC, for inclusion in the O&M Manual. The instrumentation plan will provide guidance to monitor and evaluate the performance of the pond liner system. Instrumentation details will be included on construction drawings and in the specifications. At a minimum, the instrumentation plan will include: description and purpose; detailed description of installations; calibration and maintenance schedule and instructions; reading schedule and instructions; data reduction and interpretation instructions; and identification of critical readings.

Stantec is developing an emergency action plan (EAP) separately for EP-1. The plan will include a dam break analysis for the STP as required by NMOSE.

8.0 COST ESTIMATE AND CONSTRUCTION SCHEDULE

Stantec will develop a Level 2 Association for the Advancement of Cost Engineering (AACE) capital cost estimate to an accuracy of +10 percent to +15 percent for the selected design option and will provide a basis of estimate for the project cost. Stantec will develop the Level 2 cost estimate using the information in the existing Level 3 cost estimate for reference. Stantec will contact vendors to obtain detailed quotes for the project components. The basis of estimate will include:

- Basis and rationale for any assumptions made
- Statement of any exclusions from cost estimate
- Detailed summary of capital costs with reference to direct, indirect and owner's costs
- Base date of the capital cost estimate

The capital cost estimate will provide unit rates and quantities for each estimate item and will be output using Excel spreadsheets in a format that can input directly into HMC's Financial Model.

Stantec will develop a construction and commissioning schedule as part of the design. The schedule will identify and describe critical paths of the study, permitting, construction, and key milestones, as well as outlining any sensitivity to decision making or critical delays which might occur.

9.0 CONSTRUCTION QA MANUAL

The Construction Quality Assurance Plan (CQAP) discusses the proposed organizational structure for implementation of construction quality assurance (CQA) during the re-lining of EP-1 at the Grants Reclamation Project. The CQAP will outline processes to be implemented to demonstrate and document that construction work elements comply with the Drawings, Technical Specifications, and regulatory requirements. The final approved CQAP would be updated as necessary to incorporate major changes to the project team or CQA procedures. Stantec will develop this CQAP using the following guidance documents:

- Technical Guidance Document – Construction Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182 (USEPA, 1993).
- Technical Guidance Document – Construction Quality Management for Remedial Action and Remedial Design Waste Containment Systems, EPA/540/R-92/073 (USEPA, 1992).

The CQAP will include the following information:

- Responsibility and authority – The responsibility and authority of organizations and key personnel involved in the design and construction.
- CQA Processes including:
    - Meetings
    - Inspection and verification
    - Corrective action and work stoppage
    - Documentation
    - Change management

This CQAP is supplemented with task-specific inspection and testing requirements included in the Technical Specifications.

CQA and construction quality control (CQC) are two related, but independent, processes associated with the construction quality program, defined as follows:

- **Construction Quality Assurance (CQA)** – A planned system of activities that document that the project is constructed as specified, and that the materials used in construction are procured or manufactured according to specifications. CQA includes inspections and audits of materials and workmanship necessary to determine the quality of the construction and compliance with the design.
- **Construction Quality Control (CQC)** – The process of a planned system of inspections and testing used directly to monitor and control work quality. CQC includes surveying, sampling, and testing to directly monitor the quality of furnished, constructed, and installed components. CQC activities are the responsibility of the Construction Contractor to demonstrate and document that the work product complies with the design. The selected Construction contractor will prepare the CQC processes and these processes will be an addendum to the CQAP.

10.0 REFERENCES

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