MAGNUM

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Holladay, Utah 84121
520-429-6662

www.westernenergyhub.com

March 12, 2021

Dan Hall
Utah Department of Environmental Quality
Division of Water Quality
195 North 1950 West
Salt Lake City, UT 84116

Re: Revised Groundwater Discharge Permit Application and Design Report Per Agency Comments for Magnum Solution Mining, LLC – Brine Pond 4

Dear Mr. Hall,

Magnum Solution Mining, LLC (Magnum) has enclosed the revised application for the Brine Pond 4 Groundwater Discharge Permit (GWDP) at the Magnum site. The revised application includes a number of minor changes in the text, figures and final design report drawings to incorporate comments made by Brian Hamos on February 26, 2021. The comments that were incorporated were not to actual pond design, rather it was a correction in the calculation of the potential leakage rate and the addition of two more monitoring wells on the west side of the pond. While the changes were not substantive to the design, the number of replacement pages to show the additional monitoring wells required a full replacement of the application. If you have any questions, please feel free to contact me as Magnum's representative for this permit process.

Thank you,

Tiffany James
801.71.9.9131 mobile
tjames@magnumdev.com

Groundwater Discharge Permit Application Package Checklist
Magnum Solution Mining, LLC Brine Pond 4

Item		Part A - General Facility	Item Location
X	1	Administrative Information	*Utah Groundwater Discharge Permit Application* form, Section 1 and Figure 1-1 of the *Groundwater Discharge Permit Application Attachment*
X	2	Owner/Operator Information	*Utah Groundwater Discharge Permit Application* form
X	3	Facility Classification	*Utah Groundwater Discharge Permit Application* form
X	4	Type of Facility	*Utah Groundwater Discharge Permit Application* form
X	5	SIC/NAICS Codes	*Utah Groundwater Discharge Permit Application* form
X	6	Projected Facility Life	*Utah Groundwater Discharge Permit Application* form
X	7	*Principal Processes Used*	*Utah Groundwater Discharge Permit Application form and the Groundwater Discharge Permit Application Attachment*
X	8	Existing Permits	*Utah Groundwater Discharge Permit Application* form and Section 1.2 of the *Groundwater Discharge Permit Application Attachment*
X	9	Well Locations / UAC 309-600 Regs.	Section 2.1, Appendix A, and Appendix C of the *Groundwater Discharge Permit Application Attachment*
Item #		**Part B - General Discharge**	**Item Location**
X	1	Location	*Utah Groundwater Discharge Permit Application* form
X	2	Type of Fluid to be Discharged	*Utah Groundwater Discharge Permit Application* form
X	3	Discharge Volumes	*Utah Groundwater Discharge Permit Application* form and Section 2.6 of the *Groundwater Discharge Permit Application Attachment*
X	4	Potential Discharge Volumes	*Utah Groundwater Discharge Permit Application* form and Section 2.6 and Appendix C of the *Groundwater Discharge Permit Application Attachment*
X	5	Means of Discharge	*Utah Groundwater Discharge Permit Application* form
X	6	Flows, Sources of Pollution, and Treatment Technologies	Section 2.2 and Figure 2-1 of the *Groundwater Discharge Permit Application Attachment*
X	7	Discharge Effluent Characteristics	Section 2.3 of the *Groundwater Discharge Permit Application Attachment*
X	8	Hydrogeologic Reports	Section 2.4 of the *Groundwater Discharge Permit Application Attachment*
X	9	Groundwater Discharge Control Plan	Section 2.6 of the *Groundwater Discharge Permit Application Attachment*
X	10	Compliance Monitoring Plan	Section 2.7 and Appendix D. Groundwater Monitoring Plan of the *Groundwater Discharge Permit Application Attachment*
X	11	Closure and Post Closure Plan	Section 2.7.4 of the *Groundwater Discharge Permit Application Attachment*
X	12	Contingency and Corrective Action Plans	Section 2.7.5 of the *Groundwater Discharge Permit Application Attachment*

MAIL TO:
Division of Water Quality
Utah Department of Environmental Quality
Salt Lake City, Utah 84114-4870

Application No.:______________________
Date Received:______________________
(leave both lines blank)

UTAH GROUND WATER DISCHARGE PERMIT APPLICATION

Part A - General Facility Information

Please read and follow carefully the instructions on this application form. Please type or print, except for signatures. This application is to be submitted by the owner or operator of a facility having one or more discharges to groundwater. The application must be signed by an official facility representative who is: the owner, sole proprietor for a sole proprietorship, a general partner, an executive officer of at least the level of vice president for a corporation, or an authorized representative of such executive officer having overall responsibility for the operation of the facility.

1. **Administrative Information.** Enter the information requested in the space provided below, including the name, title and telephone number of an agent at the facility who can answer questions regarding this application.

Facility Name: Magnum Solution Mining, LLC – Brine Pond 4

Mail Address: 3165 East Millrock Drive, Suite 330 Holladay, UT 84121
(Number & Street, Box and/or Route, City, State, Zip Code)

Facility Legal Location*

County: Millard

Township	**Range**	**Section**	**Allotment**
15 South	7 West	25	in South 1/2

Lat: 39° 29’ 0.54” N

Long: -112° 35’ 12.19 ”W

*Note: Figure 1-1 of the *Groundwater Discharge Permit Application Attachment* shows the location of the facility on a detailed aerial photograph.

Contact’s Name: Michael J. Ducker

Phone No.:(801) 748-5566

Title: COO of ACES Delta, LLC (Magnum Solution Mining, LLC Sole Member)

2. **Owner/Operator Information.** Enter the information requested below, including the name, title, and phone number of the official representative signing the application.

Owner

Name: Magnum Solution Mining, LLC

Phone No.:(801) 993-7001

Mail Address: 3165 East Millrock Drive, Suite 330 Holladay, UT 84121
(Number & Street, Box and/or Route, City, State, Zip Code)

Operator

Name: Same as Owner
(If different than Owner’s above)

Phone No.:(____) n/a

Mail Address: n/a
(Number & Street, Box and/or Route, City, State, Zip Code)

Official Representative

Name: Tiffany James Phone No.:(801) 719-9131

Title: Executive Consultant

3. Facility Classification (check one)

[x] New Facility
[ ] Existing Facility
[ ] Modification of Existing Facility

4. Type of Facility (check one)

[ ] Industrial
[x] Mining
[ ] Municipal
[ ] Agricultural Operation
[x] Other, please describe: Hydrogen production and subsurface storage facility

5. SIC/NAICS Codes: 2123 - Nonmetallic mineral mining and quarrying
Enter Principal 3 Digit Code Numbers Used in Census & Other Government Reports

6. Projected Facility Life: minimum of 25 years

7. Identify principal processes used, or services performed by the facility. Include the principal products produced, and raw materials used by the facility:

The hydrogen production and storage facility will store hydrogen in solution-mined caverns within a subsurface salt deposit. The attached *Groundwater Discharge Permit Application Attachment* contains additional information.

8. List all existing or pending Federal, State, and Local government environmental permits:

		Permit Number
[ ]	NPDES or UPDES (discharges to surface water)	
[ ]	CAFO (concentrated animal feeding operation)	
[X]	UIC (underground injection of fluids)	UTU-27-AP-718D759
[ ]	RCRA (hazardous waste)	
[ ]	PDS (air emissions from proposed sources)	
[]	Construction Permit (wastewater treatment)	
[ ]	Solid Waste Permit (sanitary landfills, incinerators)	
[ ]	Septic Tank/Drainfield	
[X]	Other, specify___________________	

Section 1.2 of the attached Groundwater Discharge Permit Application Attachment provides additional detail.

9. Name, location (Lat._____ ______ _______ N,Long. ______ ______ ______ W) and description of: each well/spring (existing, abandoned, or proposed), water usage(past, present, or future); water bodies; drainages; well-head protection areas; drinking water source protection zones according to UAC 309-600; topography; and man-made structures within one mile radius of the point(s) of discharge site. Provide existing well logs (include total depth and variations in water depths).

Name	Location	Description	Status	Usage

Section 2.1 and Appendix A, of the attached Groundwater Discharge Permit Application Attachment provides a more detailed discussion, table, and map to satisfy the requirements set forth in UAC 309-600.

The above information must be included on a plat map and attached to the application.

Part B - General Discharge Information

Complete the following information for each point of discharge to ground water. If more than one discharge point exists, photocopy and complete this Part B form for each discharge point.

1. **Location** (if different than Facility Location in Part A):

Facility location is as described in Part A of this application.

T.__________, R.__________, Sec.__________, __________1/4 of __________1/4,
Lat.__________°__________'__________"N.Long.__________°__________'__________"W

2. **Type of fluid to be Discharged or Potentially Discharged**
(check as applicable)

Discharges (fluids discharged to the ground)

[ ] Sanitary Wastewater: wastewater from restrooms, toilets, showers and the like
[ ] Cooling Water: non-contact cooling water, non contact of raw materials, intermediate, final, or waste products
[ ] Process Wastewater: wastewater used in or generated by an industrial process
[ ] Mine Water: water from dewatering operations at mines
[X] Other, specify: brine (sodium chloride) from solution mining operations associated with the development of subsurface salt storage caverns

Potential Discharges (leachates or other fluids that may discharge to the ground)

[ ] Solid Waste Leachates: leachates from solid waste impoundments or landfills
[ ] Milling/Mining Leachates: tailings impoundments, mine leaching operations, etc.
[ ] Storage Pile Leachates: leachates from storage piles of raw materials, product, or wastes
[ ] Potential Underground Tank Leakage: tanks not regulated by UST or RCRA only
[X] Other, specify: Same as discharges listed above

3. **Discharge Volumes**

For each type of discharge checked in #2 above, list the volumes of wastewater discharged to the ground or ground water. Volumes of wastewater should be measured or calculated from water usage. If it is necessary to estimate volumes, enclose the number in parentheses. Average daily volume means the average per operating day: ex. For a discharge of 1,000,000 gallons per year from a facility operating 200 days, the average daily volume is 5,000 gallons.

Discharge Type:	Daily Discharge Volume	all in units of
Brine associated with solution mining	0	gallons

Part B - General Discharge Information

4. Potential Discharge Volumes

For each type of potential discharge checked in #2 above, list the maximum volume of fluid that could be discharged to the ground considering such factors as: liner hydraulic conductivity and operating head conditions, leak detection system sensitivity, leachate collection system efficiency, etc. Attach calculation and raw data used to determine said potential discharge.

Discharge Type:	Daily Discharge Volume	all in units of
Brine associated with solution mining	up to 632,160	gallons

Potential Discharge Volume (PDV) is the estimated maximum leakage rate from the primary liner: Brine Pond 4, 439 gpm (632,160 GPD). Leakage is estimated using an engineering model of primary liner leakage. The reported PDV assumes brine leakage through the liner up to the maximum estimate and complete failure of the Leak Collection and Recovery System.

5. Means of Discharge or Potential Discharge (check one or more as applicable)

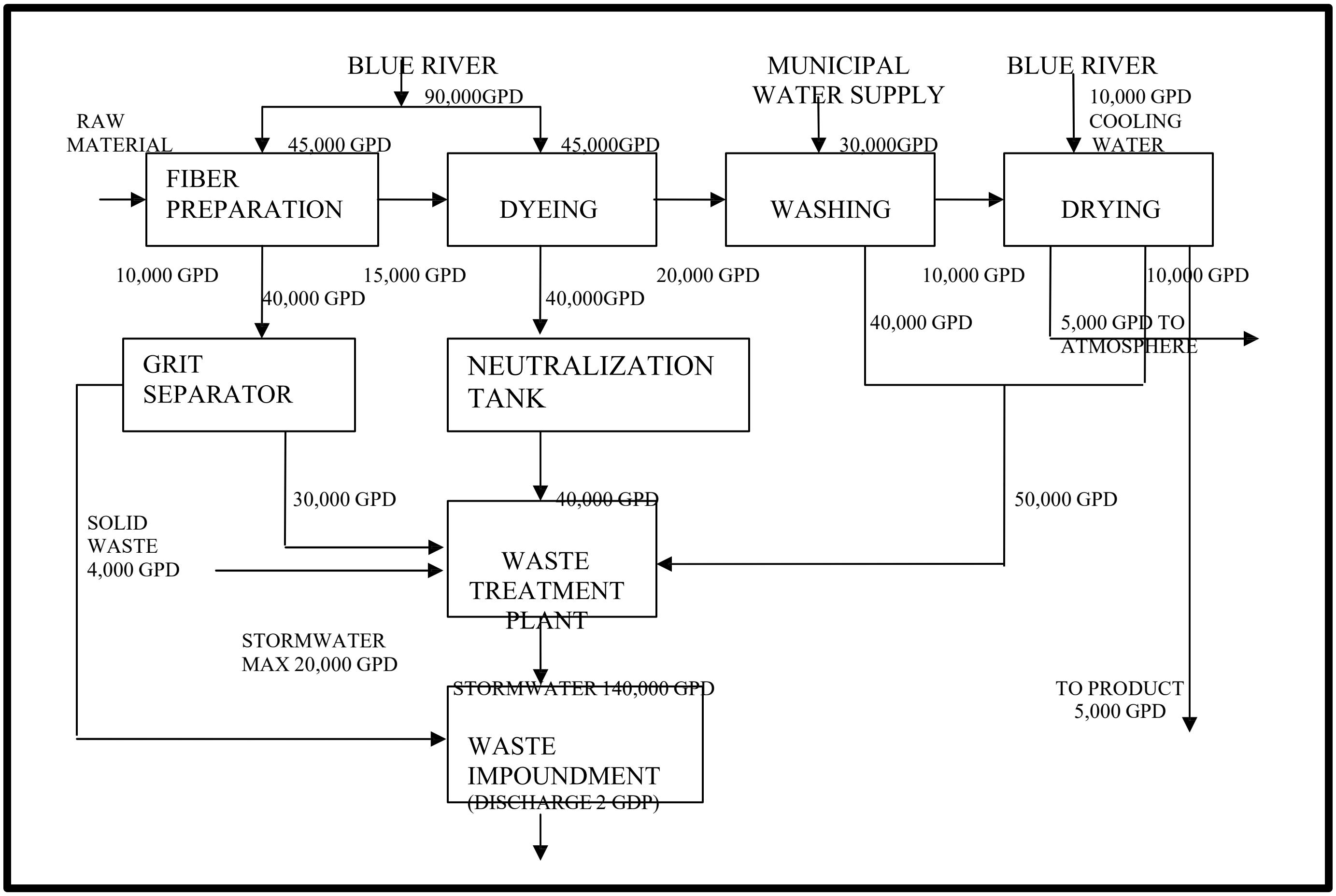
[ ] lagoon, pit, or surface impoundment (fluids)
[ ] land application or land treatment
[ ] discharge to an ephemeral drainage (dry wash, etc.)
[ ] storage pile
[ ] landfill (industrial or solid wastes)
[ ] industrial drainfield
[ ] underground storage tank
[ ] percolation/infiltration basin
[ ] mine heap or dump leach
[ ] mine tailings pond

[X] other, specify Brine evaporation pond

Part B - General Discharge Information

6. Flows, Sources of Pollution, and Treatment Technologies

Flows. Attach a line drawing showing: 1) water flow through the facility to the ground water discharge point, and 2) sources of fluids, wastes, or solids which accumulate at the potential ground water discharge point. Indicate sources of intake materials or water, operations contributing wastes or wastewater to the effluent, and wastewater treatment units. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and wastewater outfalls. If a water balance cannot be determined, provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures. See the following example.



7. Discharge Effluent Characteristics

Established and Proposed Ground Water Quality Standards - Identify wastewater or leachate characteristics by providing the type, source, chemical, physical, radiological, and toxic characteristics of wastewater or leachate to be discharged or potentially discharged to ground water (with lab analytical data if possible). This should include the discharge rate or combination of discharges, and the expected concentrations of any pollutant (mg/l). If more than one discharge point is used, information for each point must be provided.

Hazardous Substances - Review the present hazardous substances found in the Clean Water Act, if applicable. List those substances found or believed present in the discharge or potential discharge.

Part C - Accompanying Reports and Plans

The following reports and plans should be prepared by or under the direction of a professional engineer or other ground water professional. Since ground water permits cover a large variety of discharge activities, the appropriate details and requirements of the following reports and plans will be covered in the pre-design meeting(s). For further instruction refer to the Ground Water Permit Application Guidance Document.

8. Hydrogeologic Report

Provide a Geologic Description, with references used, that includes as appropriate:

Structural Geology – regional and local, particularly faults, fractures, joints and bedding plane joints;
Stratigraphy – geologic formations and thickness, soil types and thickness, depth to bedrock;
Topography – provide a USGS MAP (7 ½ minute series) which clearly identifies legal site location boundaries, indicated 100 year flood plain area and applicable flood control or drainage barriers and surrounding land uses.

Provide a Hydrologic Description, with references used, that includes:
Ground water – depths, flow directions and gradients. Well logs should be included if available. Include name of aquifer, saturated thickness, flow directions, porosity, hydraulic conductivity, and other flow characteristics, hydraulic connection with other aquifers or surface sources, recharge information, water in storage, usage, and the projected aerial extent of the aquifer. Should include projected ground water area of influence affected by the discharge. Provide hydraulic gradient map indicating equal potential head contours and ground water flow lines. Obtain water elevations of nearby wells at the time of the hydrologic investigation. Collect and analyze ground water samples from the uppermost aquifer which underlies the discharge point(s). Historic data can be used if the applicant can demonstrate it meets the requirements contained within this section. Collection points should be hydraulically up and downgradient and within a one-mile radius of the discharge point(s). Ground water analysis should include each element listed in Ground Water Discharge Permit Application, Part B7.
NOTE Failure to analyze for background concentrations of any contaminant of concern in the discharge or potential discharge may result in the Executive Secretary's presumptive determination that zero concentration exist in the background ground water quality.
Sample Collection and Analysis Quality assurance – sample collection and Preservation must meet the requirements of the EPA RCRA Technical Enforcement Guidance Document, OSWER-9959.1, 1986 [UAC R317-6-6.3(I,6)]. Sample analysis must be performed by State of Utah certified laboratories and be certified for each of the parameters of concern. Analytical methods should be selected from the following sources [UAC R317-6-6.3L]: (Standard Methods for the Examination of Water and Wastewater, 20th Ed.,1998; EPA, Methods for Chemical Analysis of Water and Wastes, 1983; Techniques of Water Resources Investigation of the U.S. Geological Survey, 1998, Book 9; EPA Methods published pursuant to 40 CFR Parts 141, 142, 264 (including Appendix IX), and 270. Analytical methods selected should also include minimum detection limits below both the Ground Water Quality Standards and the anticipated ground water protection levels. Data shall be presented in accordance of accepted hydrogeolgic standards and practice.

Provide Agricultural Description, with references used, that includes:
If agricultural crops are grown within legal boundaries of the site the discussion must include: types of crops produced; soil types present; irrigation system; location of livestock confinement areas (existing or abandoned).

Note on Protection Levels:

After the applicant has defined the quality of the fluid to be discharged (Ground Water Discharge Permit Application, Part B), characterized by the local hydrogeologic conditions and determined background ground water quality (Hydrogeologic Report), the Executive Secretary will determine the applicable ground water class, based on: 1) the location of the discharge point within an area of formally classified ground water, or the background value of total dissolved solids. Accordingly, the Executive Secretary will determine applicable protection levels for each pollutant of concern, based on background concentrations and in accordance with UAC R317-6-4.

9. **Ground Water Discharge Control Plan:**
Select a compliance monitoring method and demonstrate an adequate discharge control system. Listed are some of the Discharge Control Options available.

No Discharge – prevent any discharge of fluids to the ground water by lining the discharge point with multiple synthetic and clay liners. Such a system would be designed, constructed, and operated to prevent any release of fluids during both the active life and any post-closure period required.

Earthen Liner – control the volume and rate of effluent seepage by lining the discharge point with a low permeability earthen liner (e.g. clay). Then demonstrate that the receiving ground water, at a point as close as practical to the discharge point, does not or will not exceed the applicable class TDS limits and protection levels* set by the Executive Secretary. This demonstration should also be based on numerical or analytical saturated or unsaturated ground water flow and contaminant transport simulations.

Effluent Pretreatment – demonstrate that the quality of the raw or treated effluent at the point of discharge or potential discharge does not or will not exceed the applicable ground water class TDS limits and protection levels* set by the Executive Secretary.

Contaminant Transport/Attenuation – demonstrate that due to subsurface contaminant transport mechanisms at the site, raw or treated effluent does not or will not cause the receiving ground water, at a point as close as possible to the discharge point, to exceed the applicable class TDS limits and protection levels* set by the Executive Secretary.

Other Methods – demonstrate by some other method, acceptable to the Executive Secretary, that the ground water class TDS limits and protection levels* will be met by the receiving ground water at a point as close as practical to the discharge point.

*If the applicant has or will apply for an alternate concentration limit (ACL), the ACL may apply instead of the class TDS limits and protection levels.

Submit a complete set of engineering plans and specifications relating to the construction, modification, and operation of the discharge point or system. Construction Permits for the following types of facilities will satisfy these requirements. They include: municipal waste lagoons; municipal sludge storage and on-site sludge disposal; land application of wastewater effluent; heap leach facilities; other process wastewater treatment equipment or systems.

Facilities such as storage piles, surface impoundments and landfills must submit engineering plans and specifications for the initial construction or any modification of the facility. This will include the design data and description of the leachate detection, collection and removal system design and construction. Provide provisions for run on and run-off control.

10. **Compliance Monitoring Plan:**

The applicant should demonstrate that the method of compliance monitoring selected meets the following requirements:

Ground Water Monitoring – that the monitoring wells, springs, drains, etc., meet all of the following criteria: is completed exclusively in the same uppermost aquifer that underlies the discharge point(s) and is intercepted by the upgradient background monitoring well; is located hydrologically downgradient of the discharge point(s); designed, constructed, and operated for optimal detection (this will require a hydrogeologic characterization of the area circumscribed by the background sampling point, discharge point and compliance monitoring points); is not located within the radius of influence of any beneficial use public or private water supply; sampling parameters, collection, preservation, and analysis should be the same as background sampling point; ground water flow direction and gradient, background quality at the site, and the quality of the ground water at the compliance monitoring point.

Source Monitoring – must provide early warning of a potential violation of ground water protection levels, and/or class TDS limits and be as or more reliable, effective, and determinate than a viable ground water monitoring network.

Vadose Zone Monitoring Requirements – Should be: used in conjunction with source monitoring; include sampling for all the parameters required for background ground water quality monitoring; the application, design, construction, operation, and maintenance of the monitoring system should conform with the guidelines found in: Vadose Zone Monitoring for Hazardous Waste Sites; June 1983, KT-82-018(R).

Leak Detection Monitoring Requirements – Should not allow any leakage to escape undetected that may cause the receiving ground water the exceed applicable ground water protection levels during the active life and any required post-closure care period of the discharge point. This demonstration may be accomplished through the use of numeric or analytic, saturated or unsaturated, ground water flow or contaminant transport simulations, using actual filed data or conservative assumptions. Provide plans for daily observation or continuous monitoring of the observation sump or other monitoring point and for the reporting of any fluid detected and chemical analysis thereof.

Specific Requirements for Other Methods – Demonstrate that: the method is as or more reliable, effective, and determinate than a viable ground water monitoring well network at detecting any violation of ground water protection levels or class TDS limits, that may be caused by the discharge or potential discharge; the method will provide early warning of a potential violation of ground water protection levels or class TDS limits and meets or exceeds the requirements for vadose zone or leak detection monitoring.

Monitoring well construction and ground water sampling should conform to A Guide to the Selection of Materials for Monitoring Well Construction. Sample collection and preservation, should conform to the EPA RCRA Technical Enforcement Guidance Document, OSWER-9950.1, September, 1986. Sample analysis must be performed by State-certified laboratories by methods outlined in UAC R317-6-6.3L. Analytical methods used should have minimum detection levels which meet or are less than both the ground water quality standards and the anticipated protection levels.

11. **Closure and Post Closure Plan:** The purpose of this plan is to prevent ground water contamination after cessation of the discharge or potential discharge and to monitor the discharge or potential discharge point after closure, as necessary. This plan has to include discussion on: liquids or products, soils and sludges; remediation process; the monitoring of the discharge or potential discharge point(s) after closure of the activity.

12. **Contingency and Corrective Action Plans:** The purpose of this Contingency plan is to outline definitive actions to bring a discharge or potential discharge facility into compliance with the regulations or the permit, should a violation occur. This applies to both new and existing facilities. For existing facilities that may have caused any violations of the Ground Water Quality Standards or class TDS limits as a result of discharges prior to the issuance of the permit, a plan to correct or remedy any contaminated ground water must be included.

    <u>Contingency Plan</u> – This plan should address: cessation of discharge until the cause of the violation can be repaired or corrected; facility remediation to correct the discharge or violation.

    <u>Corrective Action Plan</u> – for existing facilities that have already violated Ground Water Quality Standards, this plan should include: a characterization of contaminated ground water; facility remediation proposed or ongoing including timetable for work completion; ground water remediation.

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

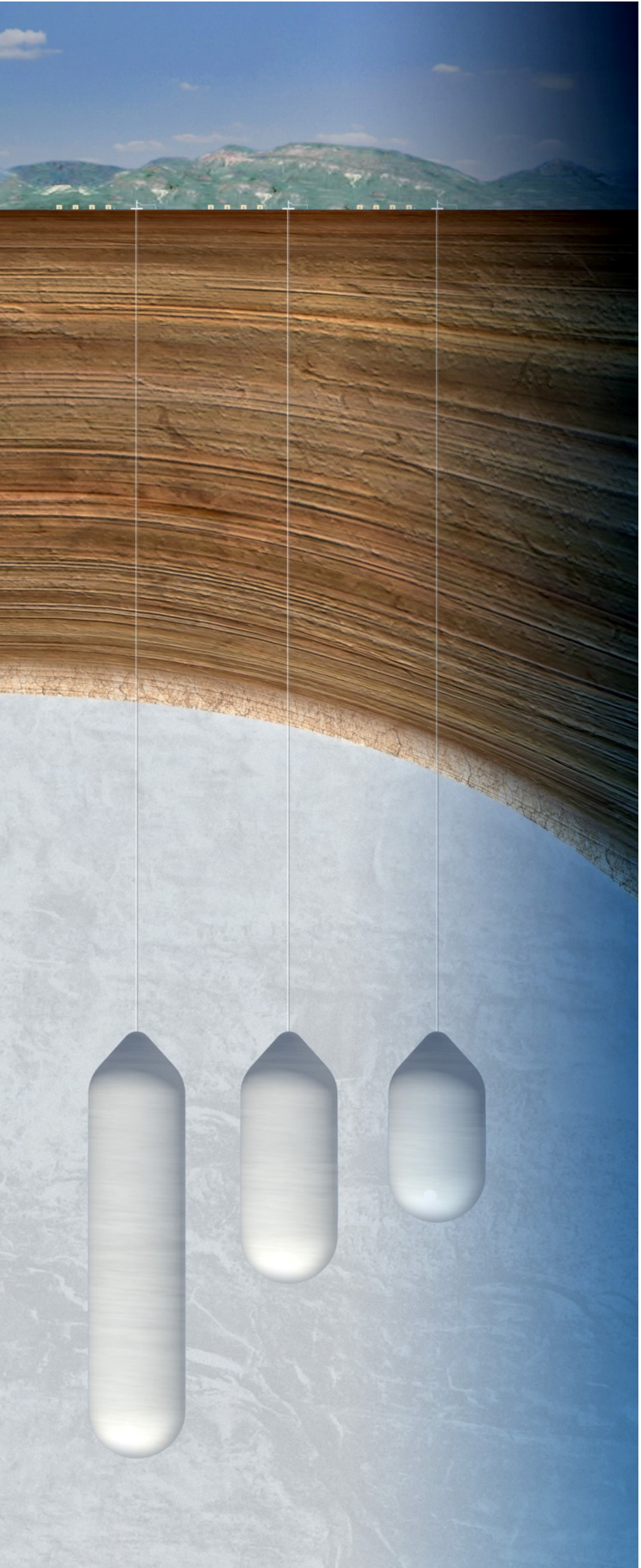
Michael J. Ducker, COO of ACES Delta, LLC
(Magnum Solution Mining, LLC Sole Member)
NAME & OFFICIAL TITLE (type or print)

801-748-5566
PHONE NO. (area code & no.)

Michael J. Ducker
SIGNATURE

March 12, 2021
DATE SIGNED

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
03/12/2021
STATE OF UTAH



Groundwater Discharge Permit Application Attachment

Magnum Solution Mining, LLC – Brine Pond 4

MAGNUM

Groundwater Discharge Permit Application Attachment

Magnum Solution Mining, LLC – Brine Pond 4

March 12, 2021

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
03/12/2021
STATE OF UTAH

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Appended Tables

Appendices

Section 1

Introduction

Magnum Solution Mining, LLC (Company) is constructing a hydrogen production and storage facility (Project) in Millard County, Utah approximately 10 miles north of Delta. The Project entails solution mining storage caverns in a subsurface salt deposit for the purpose of storing hydrogen. The resulting brine from the solution mining process will be stored in Brine Pond 4. This pond is an above-ground earthen pond and supports an operating volume of approximately 6,500 acre-feet. The pond occupies an approximately 168-acres (as measured from the outside toe of the pond) site located on Utah School and Institutional Trust Lands Administration (SITLA) lands (Figure 1-1). Table 1-1 provides the legal location of the pond.

Table 1-1: Legal Locations of Brine Pond 4

Township	Range	Section	Allotment
15 South	7 West	25	in South 1/2

1.1 Brine Pond 4 Description

As a component of the Project, the Company plans to construct a pond along the southwestern corner of Section 25, Township 15 South, Range 7 West. This application pertains to Brine Pond 4. Figures 1-1 through 1-4 depict the pond layout and design. The Division of Water Quality (DWQ) has previously approved groundwater discharge permits for Brine Ponds 1, 2, and 3 (permit nos. UGW270008 and UGW270010). A previous design for Brine Pond 4 was also approved under permit no. UGW270010 but has been redesigned as part of this application to be a standalone facility with a separate permit from the Project that still holds permit UGW270010 authorizing the construction and operation of Pond 3. All four ponds are of a similar design. Brine Ponds 1 and 2 have been constructed and are currently in operation under the ownership of Sawtooth Caverns, LLC. Pond 3 has not yet been constructed and is not part of the current Project. The locations of Brine Pond 4 and the two existing ponds are depicted in Figure 1-1.

Brine Pond 4 has a disturbance area of approximately 168 acres. The pond will be constructed using a combination of excavation into the ground surface and the construction of elevated earthen berms. The Brine Pond 4 depth varies from 40 to 68 feet and the maximum embankment height is approximately 58 feet. Berms would be constructed with 2H:1V exterior slopes, 2.5H:1V interior slopes, and a 22-foot wide platform (crest width) on top to allow berm/pond inspection and maintenance. During operation, a minimum of 3 feet of freeboard would be maintained in the pond to allow adequate storage area for incidental precipitation. The interior surface of the pond would be constructed with a compacted subgrade and double geomembrane lining system with a proactive leak detection system to ensure adequate protection of the groundwater and the environment. A full description of the leak detection system is provided in Section 2.6.

Brine Pond 4 will have a composite liner system that includes both a Leak Collection and Recovery System (LCRS) and Process Component Monitoring System (PCMS). The system design consists of a primary liner of 80-mil high density polyethylene (HDPE) single-sided textured geomembrane and a secondary 60-mil HDPE geomembrane liner. The liners will be separated by a drainage layer using either

130-mil drainage studs fabricated with the secondary liner and installed face up against the primary liner, or 250-mil geonet. The double liner system will cover the pond basin and interior embankment slopes. The liners will be hot wedge welded to ensure continuous uninterrupted watertight containment.

The secondary liner will consist of a geomembrane drain liner with raised studs or geonet supporting the primary liner. The studs/geonet create an unpressurized drainage space between the liners. The drainage gap allows fluid to flow freely to a collection sump where it can be removed and pumped back into the pond. Figures 1-2, 1-3, and 1-4 provide pond location and general details. Full engineering design details are included in the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report (NewFields 2021) in Appendix C.

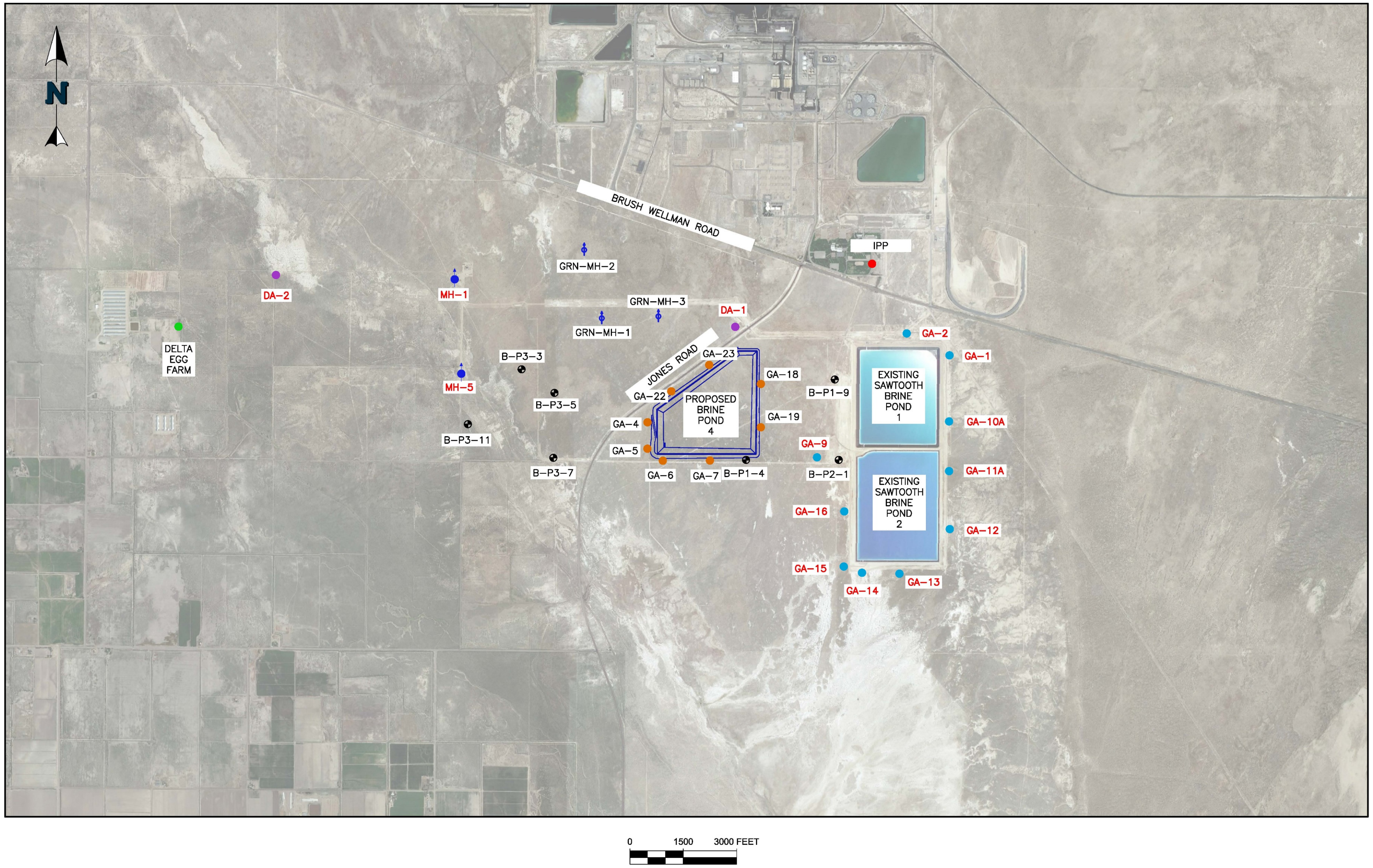
As stated, the engineering plans and specifications for Brine Pond 4 are similar to the previously approved ponds, with improvements based on construction and operational experience with Brine Ponds 1 and 2. At this time, the plans and specifications for Brine Pond 4 are currently under review by DWQ and Utah Division of Water Rights (UDWRi). Refer to Section 1.2 below for a listing of pertinent permits.

1.2 Existing Environmental Permits

The Company has received all necessary environmental clearances and the primary construction and operations permits for this Project. The Company is also in the process of obtaining the remaining necessary permits to begin operations.

The Company has received the following approvals for this Project:

a) United States Army Corps of Engineers Section 404 Wetlands and Waters of the U.S. Jurisdictional Severance
b) United States Fish and Wildlife Service Listed Species Clearance
c) Utah Division of Wildlife State-Listed Species Clearance
d) Utah State Historic Preservation Office Cultural Resources Clearance
e) Division of Water Quality (DWQ) Underground Injection Control Permit (UIC) UTU-27-AP-718D759
f) Millard County Conditional Use Permit Z-2017-033



LEGEND:

—	PROPOSED BRINE POND
● GA–4	PROPOSED WATER TABLE AQUIFER MONITORING WELL
ɸ GRN–MH4	PROPOSED DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL

EXISTING SAWTOOTH WELLS:

● GA–1	WATER TABLE AQUIFER MONITORING WELL
● MH–1	BASEMENT AQUIFER WATER PRODUCTION WELL
● DA–2	MULTI–AQUIFER MONITORING WELL

OTHER WELLS:

● DELTA EGG FARM	SHALLOW ARTESIAN AQUIFER WATER PRODUCTION WELL
● IPP	DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL
⊕ B–P1–4	MAGNUM WATER TABLE AQUIFER MONITORING WELL

NOTES:

1. AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND IS DATED AUGUST 19, 2019

NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
BRINE POND 4 LAYOUT

FILENAME
475.0093.020.GWDP.1–1

FIGURE NO.
1–1

REVISION
B

Figure 1-1: Brine Pond 4 Layout

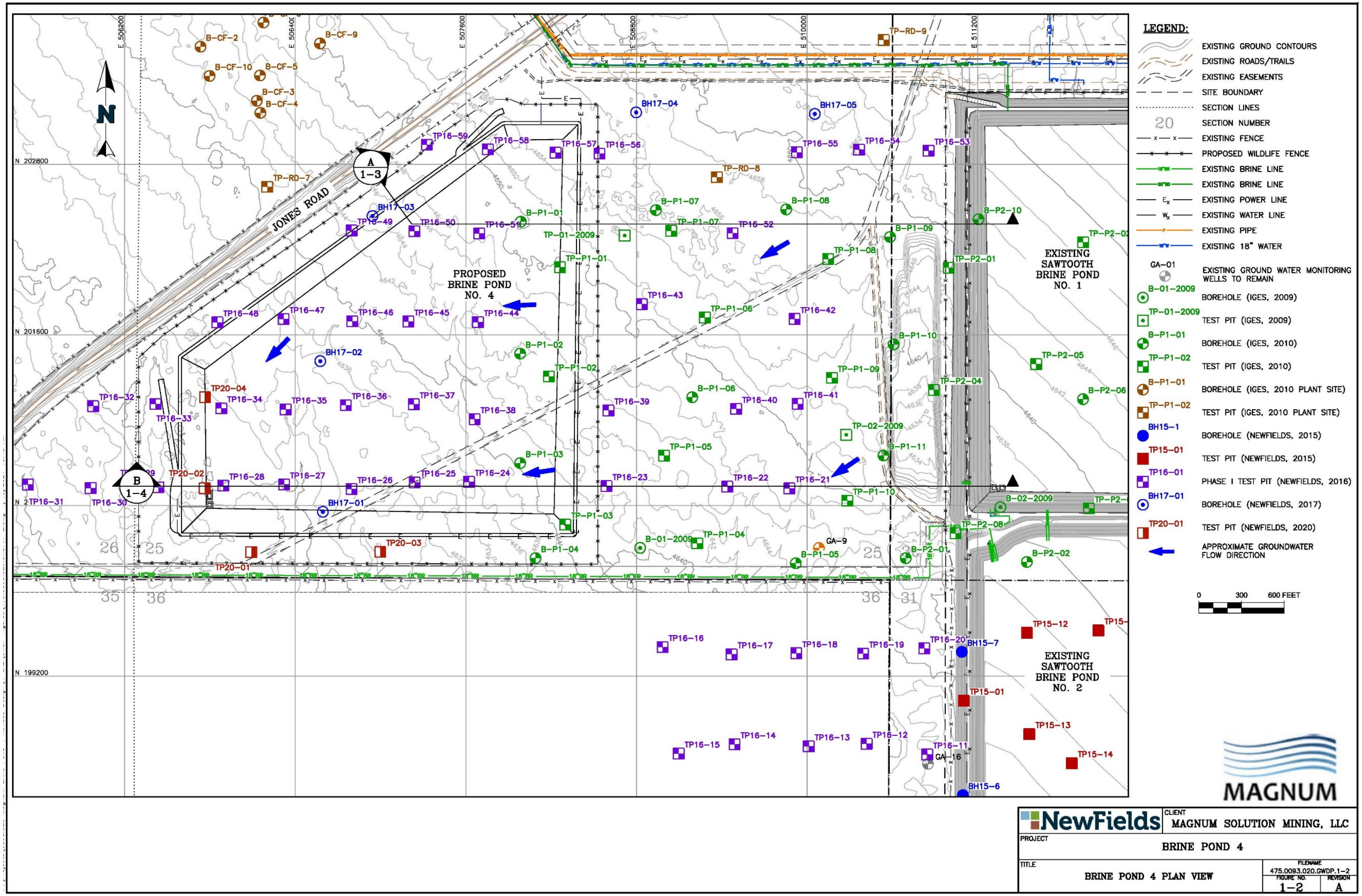
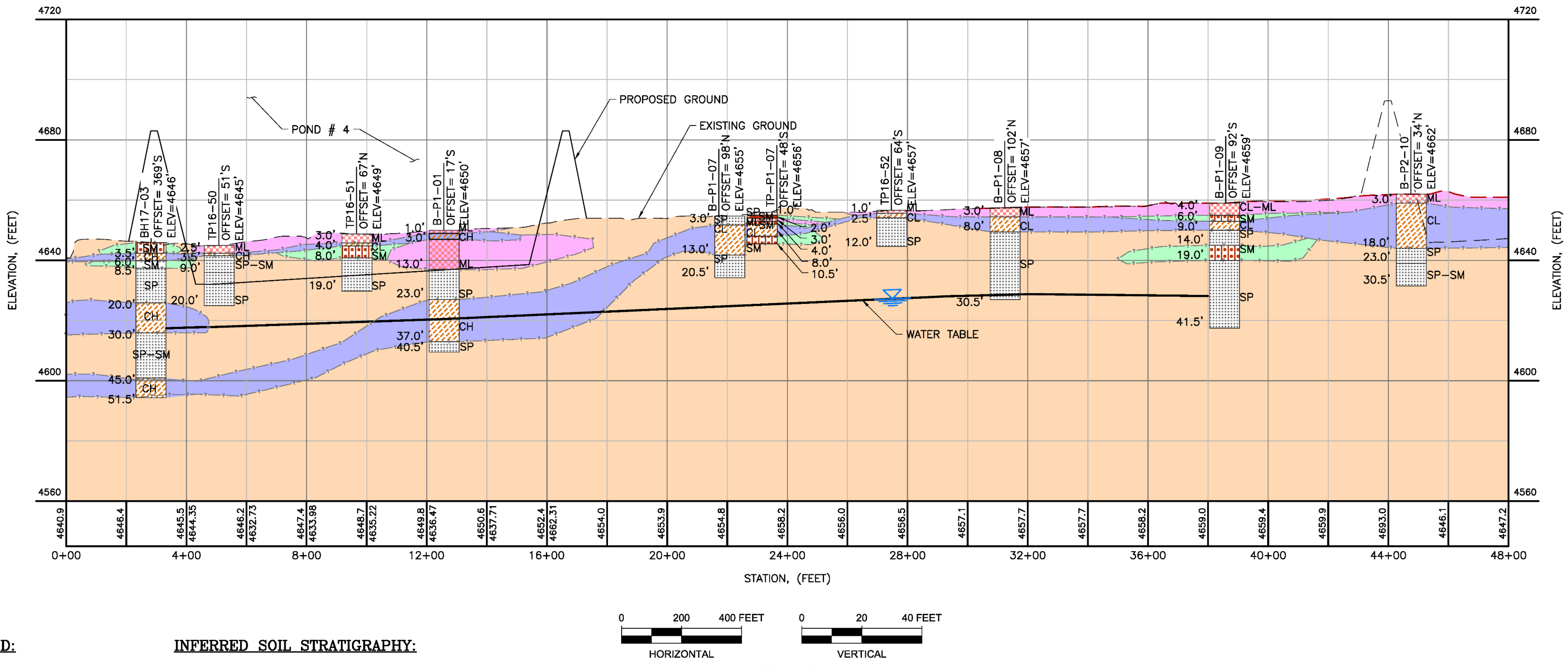


Figure 1-2: Brine Pond 4 Plan View



BORING LEGEND:

▨	CLAY (CL/CH)
▨	SILT (ML)
▨	POORLY GRADED SAND (SP)
▨	SILTY SAND (SM)
▨	CLAYEY SAND (SC)

INFERRED SOIL STRATIGRAPHY:

🟦	CLAY DOMINATED
🟪	SILT DOMINATED
🟧	SAND DOMINATED
🟩	SANDY SILT/ SILTY SAND

NOTES:

1. COLORED SHADING HAS NOT BEEN VERIFIED AND ONLY REPRESENTS MAJOR SOIL CLASSIFICATION INFERRED BY NEWFIELDS BASED ON BOREHOLE LOGS.

NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

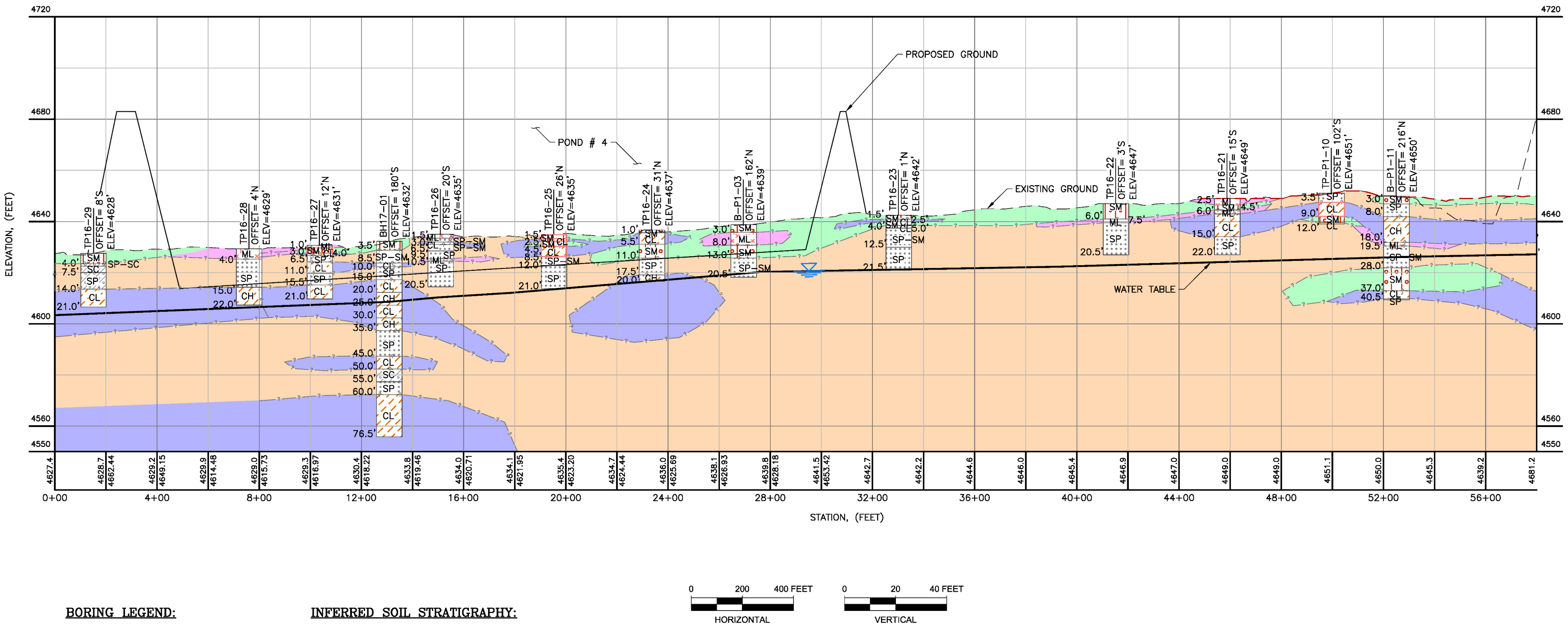
TITLE
BRINE POND 4 SECTION A

FILENAME
475.0093.020.GWDP.1-3

FIGURE NO.
1-3

REVISION
A

Figure 1-3: Brine Pond 4 Section A



BORING LEGEND:

▨	CLAY (CL/CH)
▨	SILT (ML)
▨	POORLY GRADED SAND (SP)
▨	SILTY SAND (SM)
▨	CLAYEY SAND (SC)

INFERRED SOIL STRATIGRAPHY:

🟦	CLAY DOMINATED
🟪	SILT DOMINATED
🟧	SAND DOMINATED
🟩	SANDY SILT/ SILTY SAND

NOTES:

1. COLORED SHADING HAS NOT BEEN VERIFIED AND ONLY REPRESENTS MAJOR SOIL CLASSIFICATION INFERRED BY NEWFIELDS BASED ON BOREHOLE LOGS.

NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
BRINE POND 4 SECTION B

FILENAME
475.0093.020.GWDP.1-4

FIGURE NO.
1-4

REVISION
A

Figure 1-4: Brine Pond 4 Section B

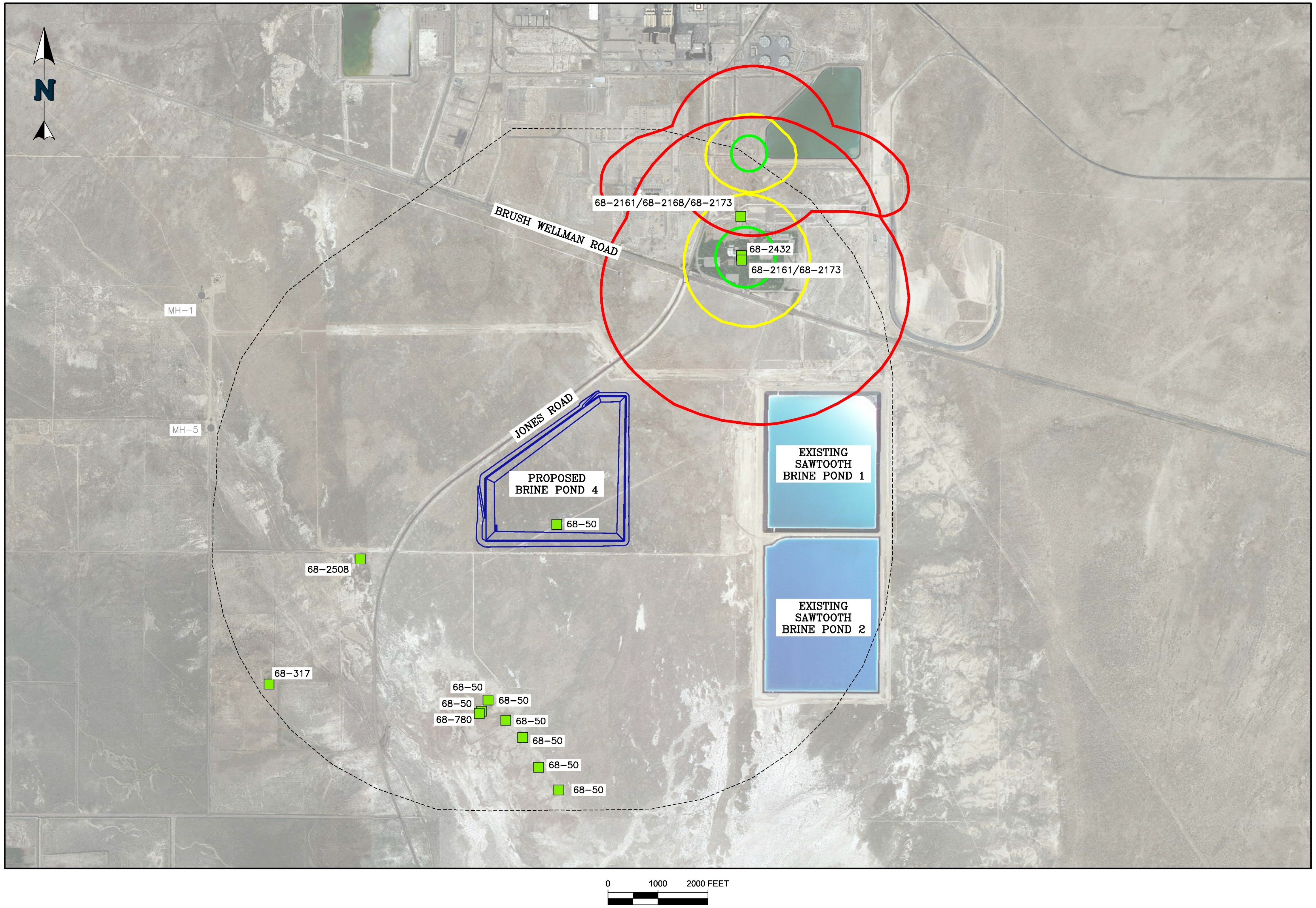
Section 2

Application Requirements

2.1 Water Rights, Surface Water and Wells

The UDWRi database was searched for descriptions of each well/spring within one mile of the brine pond (UDWRi 2020). Figure 2-1 depicts the location of wells and water source protection zones within one mile of the brine pond. Only production wells are shown, together with the associated water right number; there are no springs. Shallow artesian aquifer monitoring wells are not shown. Appendix A provides a figure and table detailing the UDWRi documented water wells and rights within one mile of the brine pond (UDWRi 2020). Wells within the one-mile review area have historically been used for agricultural and industrial uses. The brine pond and one-mile review area are situated entirely on an arid upland environment and contain no surface waters, springs, waterbodies, or drainages (Cardno 2017).

Wells specific to the Company's planned monitoring of the quality and behavior of the aquifers – in particular, the water table aquifer – underlying the Project site, and to the development of water production for Project use, are displayed on Figure 1-1. Borehole logs specific to the geotechnical investigation, including of the water table aquifer, associated with design of Brine Pond 4 are included in the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report (NewFields 2020) in Appendix C.



NOTES:

1. AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND IS DATED AUGUST 19, 2019
2. ZONES 1–4 BOUNDARIES WERE EXTRACTED FROM FIGURE 2–1 WITHIN THE FOLLOWING REPORT:

   "Groundwater Discharge Permit Application Attachment

   Magnum Gas Storage Project – Brine Ponds 3 and 4"

   DATED NOVEMBER 17, 2017

NewFields	CLIENT MAGNUM SOLUTION MINING, LLC
PROJECT	BRINE POND 4
TITLE WATER RIGHT WELL LOCATIONS WITHIN ONE MILE OF BRINE POND 4	FILENAME 475.0093.020.GWDP.2–1 FIGURE NO. 2–1 REVISION A

Figure 2-1: Wells and Water Source Protection Zones within One-mile Radius

2.2 Flows, Sources of Pollution, and Treatment Technologies

Flow to the brine pond will come from solution mining of underground storage caverns within a subsurface, homogeneous salt deposit that is approximately one mile thick. The brine pond is designed with a zero-discharge dual geomembrane liner system and leak detection system that is described in Sections 1.1, and in the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report in Appendix C. Pollution entering the groundwater is not anticipated, so treatment technologies are not necessary. Figure 2-2 shows the water balance of the facility and brine flow through the brine pond and LCRS and PCMS brine recovery systems. Brine return from the LCRS and PCMS sumps back into the brine pond will be variable over the life of the facility, depending on the volume of water stored in the pond. Sump pump design would include installation of a combination of pumps capable of returning the maximum leakage flow rate back to the brine pond. Table 2-1 describes pond characteristics and design volumes.

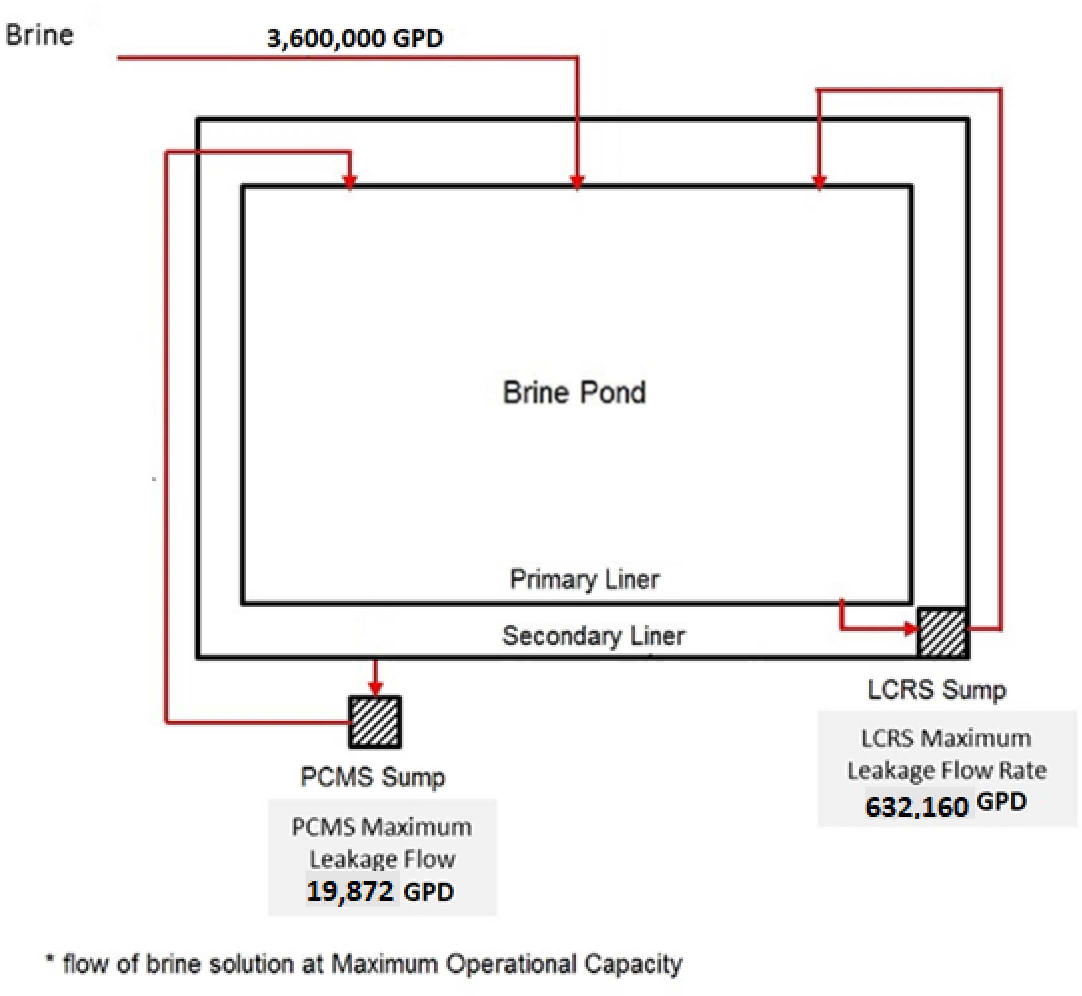


Figure 2-2: Water Balance of Brine Flow through Brine Pond, Liners, and Sumps

Table 2-1: Brine Pond Design Specifications and Predicted Brine Volume

Brine Pond 4 Design Specifications	
Construction Specifications	
Length (at top of berm)	10,252 ft.
Total area (at freeboard: 3 feet below crest)	139 acres
Pond depth	40 to 68 ft.
Interior Slope	2.5H:1V
Exterior Slope	2H:1V
Pond top berm elevation	58 ft. (4,683 ft. AMSL)
Total area of pond (exterior bottom of berm)	168 acres
Total area at pond floor	109 acres
Brine Pond 4 Volumetric Calculations	
Minimum storage volume	6,500 ac-ft.
Total volume of pond at maximum water surface elevation (4,680 ft. amsl[1])	6,571 ac-ft.
(NewFields 2020)	

[1] Allows for 3-ft. of freeboard

2.3 Discharge Effluent Characteristics

The brine pond will contain highly saturated brines that are a by-product of the solution mining process. Saturated brines will be approximately 98% sodium chloride. The pond has been designed as a zero-discharge system; no discharges are anticipated from the brine pond.

2.4 Environmental Setting

The environmental setting of the Company’s brine pond is described in the following sections.

2.4.1 Geologic Description

The Project is in the central Sevier Desert within the Basin and Range physiographic province. The Sevier Desert is bounded on the north by Desert Mountain and the West Tintic, Sheeprock, and Keg Mountains; on the east by the East Tintic, Gilson, and Canyon Mountains; on the southeast by Pavant Valley and the Black Rock Desert; on the south by the Wah Valley; and on the west by the Drum Mountains, Topaz Mountain, and House Range (Mower and Feltis, 1968; Holmes, 1984; Hintze and Davis, 2003).

The mountains surrounding the basin of the Sevier Desert contain rocks of Precambrian to Tertiary age, composed of a variety of consolidated sedimentary, metamorphic, and igneous rock (Mower and Feltis, 1968; Hintze and Davis, 2003).

The basin is filled with deposits that consist primarily of semi-consolidated and unconsolidated sediments of Tertiary and Quaternary age (Hintze and Davis, 2003). The basin fill includes sand, silt, clay, and gravel deposited as alluvial fans, stream alluvium, mudflows, lacustrine (lake) sediments, and deltas. The basin fill also contains scattered basalt flows and tuffs of late Tertiary and Quaternary age. Tertiary and Quaternary basin-fill deposits are over 7,000 feet thick.

Oligocene and Miocene basin-fill sediments contain evaporite deposits in some parts of the basin, which, through time, have flowed to form a salt dome beneath the site.

The brine pond is near the center of Sevier Desert in an area of relatively flat topography. A thick (>7,000 feet) column of unconsolidated basin fill, including the previously mentioned evaporite deposits, lies beneath the brine pond. The basin fill lies unconformably on Cambrian limestone and dolomite bedrock (Hintze and Davis, 2003). Appendix B is a geologic map with unit descriptions of the Project area.

2.4.2 Hydrology

The principal regional groundwater system is the unconsolidated basin-fill deposits derived from erosion of the surrounding mountains, laid down by streams, lakes, and mudflows. These regional deposits consist of interbedded and lenticular deposits of clay, silt, sand, gravel, and boulders. The regional depositional processes created alternating and interfingering layers and lenses with regional horizontal and vertical heterogeneity. Differences in sorting and grain size influence local permeability and storage capacity, which can vary greatly depending on the nature of local depositional processes. Sediments are generally coarser near the mountain front and grade finer toward the basin center. Stream channel deposits are coarser and better sorted than alluvial fan and mudflow deposits that generally occur at the base of steep drainages. Regional-scale lakes that occupied the valleys many thousands of years ago deposited interbedded clay and fine-grained sands. Rivers flowing into these lakes formed coarse-grained delta deposits near the ancient lake shore, such as near the mouth of Leamington Canyon.

Aquifers underlying the hydrogen storage site have been clearly defined using published technical literature (Mower and Feltis, 1968; Holmes, 1984); information from the UDWRi online database (https://maps.waterrights.utah.gov/EsriMap/map.asp?layersToAdd=wellsearch); and data from multiple wells on the Company's site. These wells include two water production wells, MH-1 (first drilled as an exploration well to a depth of 6,422 feet, then completed as a water well to a depth of 3,011 feet) and MH-5 (total depth of 2,385 feet), and two deep artesian aquifer observation wells, DA-1 (total depth of 1,590 feet) and DA-2 (total depth of 1,670 feet), all of which are owned and operated by Sawtooth. The Company constructed each of these wells. The aquifers depths have been refined utilizing a geologic model constructed based on drilling data from available wells adjacent to and on site. The four aquifers that have been defined and revised depths for each are as follows:

- the water table aquifer, in the upper 250 feet of the basin fill;
- the shallow artesian aquifer between about 300 to 600 feet below ground surface (bgs);
- the deep artesian aquifer between about 700 to 1,400 feet bgs; and
- the basement aquifer at depths greater than about 1,650 feet bgs.

Thick (>100 feet) sequences of low-permeability clays separate the various aquifers. Figure 2-3 is a simplified illustration of this hydrostratigraphy. The brine storage pond is situated immediately above the water table aquifer. Figures 1-3 and 1-4, together with figures and boring log information in the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report in Appendix C, document the position of the water table aquifer defined during the geotechnical investigations for brine pond design. These data show that the water table aquifer is the pertinent aquifer for the purposes of the groundwater discharge permit. The production wells owned and operated by Sawtooth (MH-1 and MH-5) withdraw water from the basement aquifer, from intervals >1,400 feet bgs, intervals separated from the water table aquifer by thick layers of low-permeability sediments. While the top of the basement aquifer varies, the permeable zones are generally 1,650 ft bgs, separated by about 250 ft of confining layers from the deep artesian aquifer.

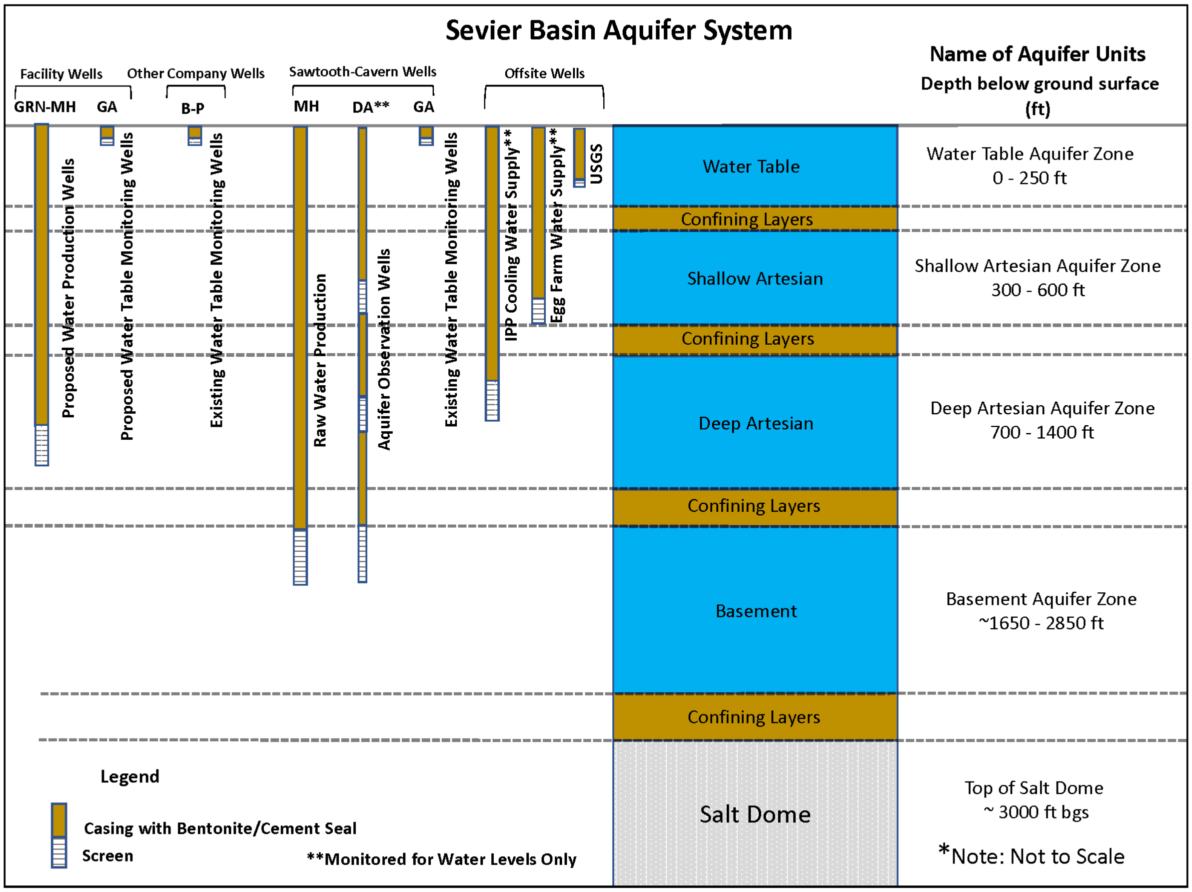


Figure 2-3: Hydrostratigraphic Framework of the Project Area

2.4.2.1 *Recharge, Discharge and Groundwater Flow Direction*

Recharge to the principal groundwater aquifer system (basin-fill deposits) in the Sevier Desert occurs by stream infiltration along mountain fronts, subsurface inflow from consolidated rocks of mountain areas, subsurface inflow from adjoining basins, precipitation on basalt outcrops, and seepage from rivers, canals, reservoirs and unconsumed irrigation (Mower and Feltis, 1968; Holmes, 1984). Prime recharge areas for the water table aquifer occur mostly near the mountain fronts in the Project region. Some of the water that recharges the water table aquifer flows downward and provides recharge to the underlying artesian aquifers. Figure 2-4 is a schematic block diagram representative of the basin-fill groundwater system in the Sevier Desert and similar systems throughout the Basin and Range physiographic province.

Groundwater in the water table, shallow artesian, and deep artesian aquifers generally flows from recharge areas near the mountains on the northeast and east of the Sevier Desert toward discharge areas in the central and western parts of the basin. Groundwater flow direction is perpendicular to the potentiometric contours and is shown on the Regional Geology Maps in Appendix B for the water table, shallow artesian, and deep artesian aquifers. Near the brine pond, the calculated hydraulic gradient (using the three-point method (Domenico and Schwartz, 1990)) in the water table aquifer is approximately 0.0025 feet/feet in a direction S56ºW. This calculation is based on six measurements of groundwater elevation in three monitoring wells, (B-P1-4, B-P1-9 and B-P2-1, see Figure 1-2 and Figure 2-5) installed by the Company in 2010 for geotechnical investigation and for pre-construction monitoring of water levels and water quality. During the period from March 2010 to September 2017, when the water level measurements were taken, both the magnitude and the direction of the gradient have been nearly constant.

Groundwater discharge occurs by evapotranspiration, subsurface outflow to adjoining basins, discharge to springs (largely to Clear Lake Springs, located about 20 miles south of Delta, Utah), and to wells.

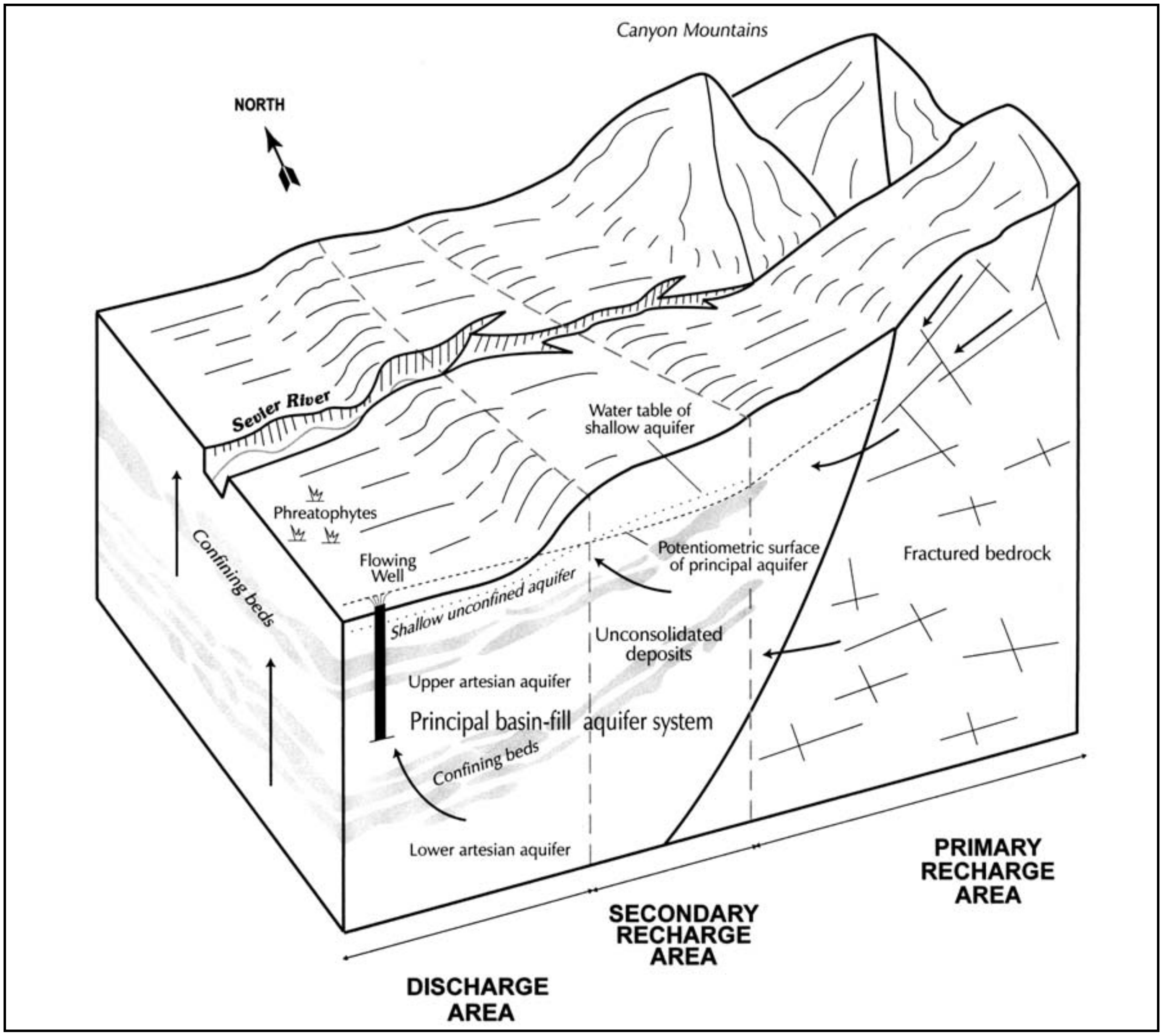


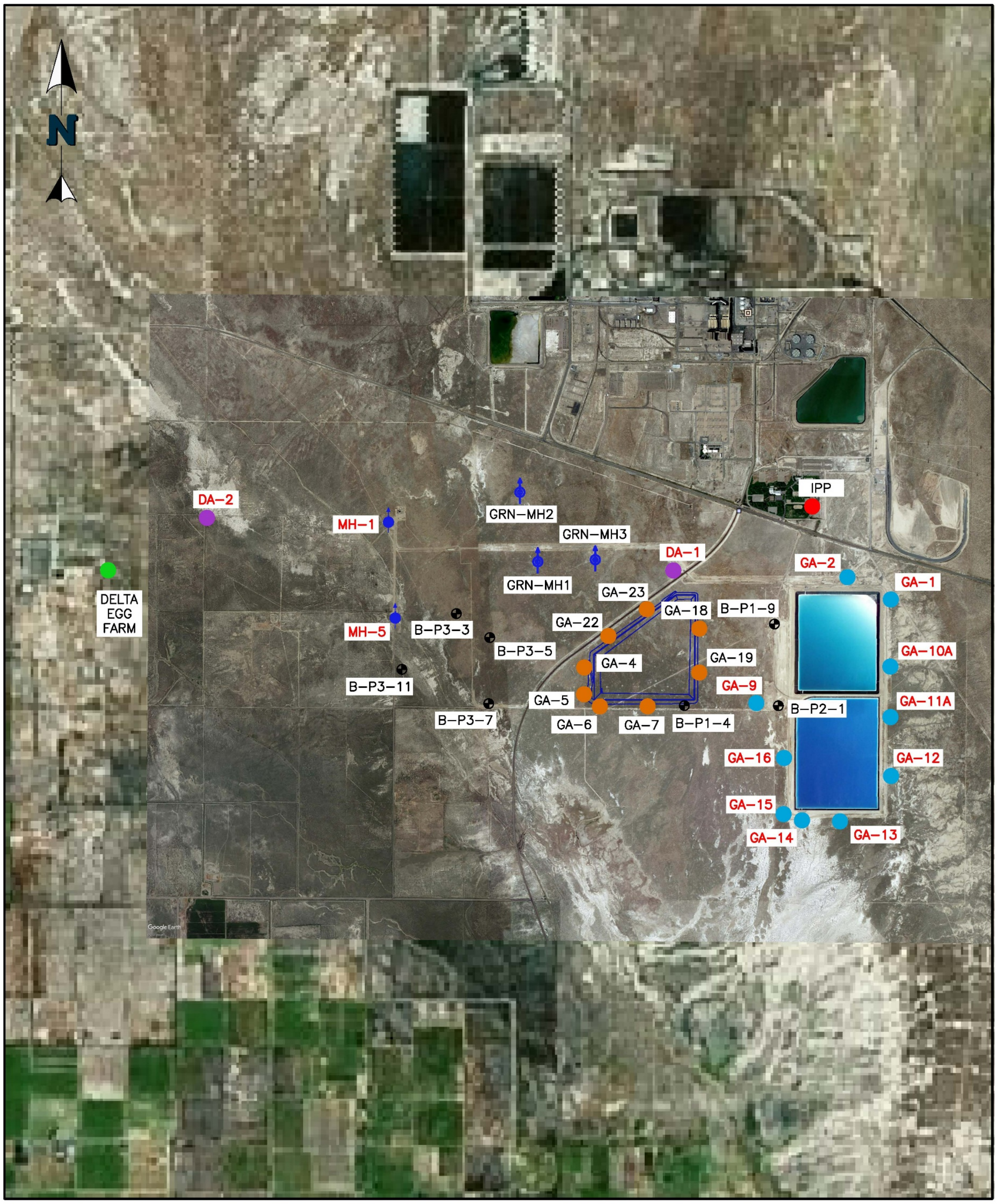
Figure 2-4: Basin-Fill Groundwater System in the Sevier Desert (from Snyder 1998)

2.4.2.2 *Surface and Groundwater Quality*

Surface water quality measurements are not available because there are no natural surface water features near the pond. Despite the lack of surface water, groundwater quality has been measured extensively. The UDWRi does not currently differentiate between the shallow artesian, deep artesian, or basement aquifers for permitting purposes. Measurements of water quality in the water table aquifer have been collected by the Company from non-jurisdictional monitoring wells B-P1-4, B-P1-9, B-P2-1, B-P3-3, B-P3-5, B-P3-7 and B-P3-11, in addition to the water levels used to estimate hydraulic gradient (see Figure 1-1 and 2-5). Fifteen measurements have been taken in each well, the first in March 2010, followed by measurements in 2011; nearly six years elapsed until the next measurement was taken in June 2017, followed by measurements in 2018, 2019, and most recently in 2020.

The majority of the results, listed in appended Table 2-2, exhibit some variability with concentration spikes settling to average levels during the ten years of measurements. However, there have been two documented discharges at Brine Ponds 1 and 2, related to operational issues. Field characterization of shallow artesian aquifer groundwater conditions was completed by Sawtooth NGL Caverns (Sawtooth), followed by design and successful implementation of remedial measures (GHD, 2020). The Company is an affected party as landowner/lessee of lands adjacent to those ponds. The areas of affected groundwater are well upgradient of Brine Pond 4 and is not anticipated to be within the footprint of this pond due to low groundwater gradients and velocities.

Review of the wells located further away from the existing brine ponds appear to demonstrate natural increases (i.e., B-P3-5) and decreases (i.e., B-P3-7) in TDS over time. Considered together with the near-constant hydraulic gradient discussed in Section 2.4.2.1, the water quality measurements show that the water table aquifer displays some variability in water quality, but in general can be considered a stable system over the timeframe of several years.



0 2000 4000 FEET

LEGEND:

―	PROPOSED BRINE POND
● GA–4	PROPOSED WATER TABLE AQUIFER MONITORING WELL
GRN–MH4	PROPOSED DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL

EXISTING SAWTOOTH WELLS:

● GA–1	WATER TABLE AQUIFER MONITORING WELL
MH–1	BASEMENT AQUIFER WATER PRODUCTION WELL
● DA–2	MULTI–AQUIFER MONITORING WELL

OTHER WELLS:

● DELTA EGG FARM	SHALLOW ARTESIAN AQUIFER WATER PRODUCTION WELL
● IPP	DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL
● B–P1–4	MAGNUM WATER TABLE AQUIFER MONITORING WELL

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
GROUNDWATER MONITORING LOCATIONS

FILENAME
475.0093.020.GWDP.2–5a

FIGURE NO.	REVISION
2–5	B

Figure 2-5: Groundwater Monitoring Locations

2.5 Agricultural Description

No agricultural crops are grown within the boundaries of the site. The area was historically used for livestock grazing; there has been no grazing on the site for more than seven years.

2.6 Groundwater Discharge Control Plan

In designing the brine pond, the Company worked extensively with state, and local regulatory agencies to design a zero-discharge pond system that incorporates three stages of leak protection and detection, including a 1) double liner, 2) a leak collection recovery system (LCRS) to capture potential leakage through the primary liner, and a process component monitoring system (PCMS) to capture potential leakage through the secondary liner, and 3) a monitoring well network for assessing conditions in the water table aquifer. Potential groundwater discharge will be controlled first through the double geomembrane lining of the pond (as discussed in Section 1.1) and then through the engineered design of the LCRS and the PCMS designed by NewFields (NewFields 2020) as described in the following section and in greater detail in Appendix C. The monitoring well network is discussed in Section 2.7 and in the Groundwater Monitoring Plan in Appendix D.

As designed, the LCRS will be installed to manage the maximum leakage flow rate of the primary liner and use the interstitial space created by the drainage layer to transmit potential flows between the primary and secondary liners to a sump. If a leak occurs in the primary liner, the fluid will drain along the secondary liner to the LCRS sump, located in the pond's low point in the southwest corner of the pond. Six 18-inch wide strip drains will be installed in a radial pattern originating at the sump in the southwestern corner of the pond and extend upgradient to intersect all geomembrane panels on the floor of the pond to further facilitate flow to the LCRS sump. A four-inch diameter perforated HDPE collection pipe will also be placed along the toe of the inner embankment to increase brine flow to the sump. The LCRS sump sizing and layout are designed to be consistent with the calculated maximum leakage flow rate from the primary liner for the pond. Details specific to the sump design are available in Section 4.5 of the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report in Appendix C.

Any potential leaks will be detected and mitigated using submersible pumps placed in the LCRS leak detection sump. The pumps will be encased in two 18-inch diameter HDPE DR11 pump sleeves that will be installed between the primary and secondary liners. The pumps will be automated to turn on at regular intervals such that water in the sump is maintained at a minimum, thereby reducing the hydraulic head on the secondary liner to the greatest extent possible. The capacity of the LCRS sump pumps will be designed to manage the maximum leakage flow rate of the primary liner and to circulate discharged fluid back to the interior of the brine pond. A mechanical flow meter with a totalizer will be included in line with the pipe discharging brine back to the pond.

Primary liner maximum leakage flow rates were calculated based on Giroud et al. (1997) using a formula for the geomembrane leakage rate underlain by permeable media; the formula is derived from a model of leakage caused by potential defects in the liner. The calculation for the primary liner assumes a "good" installation of the liner with two (2) defects per acre. The purpose of calculating a maximum leakage flow rate is to design the LCRS sump and recovery/return system to manage leakage up to that maximum rate. Given the average head on the primary liner and the total wetted area for Brine Pond 4 at freeboard (3 feet below the crest), the maximum calculated leakage flow rate was calculated at 439 gallons per minute (gpm) (NewFields 2020) or approximately 632,160 gallons per day (gpd).

The PCMS will be installed to detect and mitigate potential leaks in the secondary liner and manage the maximum leakage flow rate of the secondary liner by returning captured brine to the interior of the brine ponds. The PCMS will consist of toe drains along the length of the embankment that include four-inch diameter perforated corrugated polyethylene (CPE) pipes placed in 0.5-foot-deep trenches located beneath the secondary liner and three trenches excavated along the pond bottom, orthogonal to the pond basin grading. The pipes and trenches will transmit captured brine to the PCMS sump located in the low point in the southwest portion of the pond. The PCMS sump sizing and layout are designed to be consistent with the maximum calculated leakage flow rate from the secondary liner of the pond. Greater details specific to the PCMS sump design are available in Section 4.6 of the Magnum Solution Mining, LLC Project – Brine Pond 4 Final Design Report in Appendix C.

The PCMS sump will include two 18-inch diameter DR 11 pipe pump sleeves that will be installed from the sump bottom to the pond crest to be used as a riser pipe. The PCMS sump pumps will be automated to turn on at regular intervals such that water in the sump is maintained at a minimum. PCMS sump pumps will be installed to manage the maximum calculated leakage flow rate of the secondary liner and circulate discharged fluid back to the interior of the brine pond. A mechanical flow meter with a totalizer will be included in line with the pipe discharging brine back to the pond

Secondary liner maximum leakage flow rates were calculated based on Giroud et al. (1997) using a formula for the geomembrane leakage rate underlain by a relatively low permeability media; the formula is derived from a model of leakage caused by potential defects in the liner. The calculation for the secondary liner assumes a “good” installation of the liner with three (3) defects per acre. The purpose of calculating a maximum leakage flow rate is to design the PCMS sump and recovery/return system to manage leakage up to that maximum rate. Assuming that the hydraulic head on the secondary liner is equal to or less than 1 foot, the maximum leakage flow rate was calculated to be 13.8 gpm (NewFields 2020), or 19,872 gpd.

The brine pond is designed as a zero-discharge system; both the LCRS and PCMS sumps and pumps are designed to capture and return the maximum calculated leakage flow rates back to the interior of the brine pond.

2.7 Compliance Monitoring Plan

The Company has developed a comprehensive Groundwater Monitoring Plan and Brine Pond Management Plan in conjunction with the jurisdictional state agencies. The plan covers all aspects of facility operations and monitoring of all aquifers beneath the site. With respect to the brine pond, the relevant elements of the plan are the monitoring wells installed in the water table aquifer, at locations around the perimeter of the pond. These monitoring wells will be used to assess impacts, if any, of the brine pond on water levels and water quality in the water table aquifer. A brief description is provided in the following sections; the Groundwater Monitoring Plan is included in Appendix D.

2.7.1 Groundwater Monitoring

Groundwater monitoring of the brine pond will consist of routine collection and analysis of water quality data from a network of monitoring wells around the perimeter of the pond. This network includes 8 newly proposed wells completed in the water table aquifer: GA-4, GA-5, GA-6, GA-7, GA-18, GA-19, GA-22, and GA-23 (see Figure 2-5). Two of the wells, GA-18, and GA-19, are upgradient baseline monitoring wells; two of the wells, GA-22, and GA-23, are side-gradient; the remaining wells are downgradient. There are also 10 existing water table aquifer monitoring wells around Brine Ponds 1 and 2 (GA-1, GA-2, GA-9, GA-10A, GA-11A, GA-12, GA-13, GA-14, GA-15, and GA-16) are used to monitor ponds owned and operated by Sawtooth. These wells are shown on Figure 2-5 for completeness, however, the Company is not collecting data from these wells for Project related groundwater monitoring.

To monitor water quality within the water table aquifer, the Company will install water quality monitoring wells both upgradient and downgradient of the brine pond as shown on Figure 2-5. This includes a proposed series of 8 water table aquifer monitoring wells surrounding the brine pond noted above. Monthly water quality analysis will include field measurement of pH, temperature, and conductivity, and quarterly laboratory analysis of pH, chloride, sodium, and TDS.

Monthly field monitoring will be conducted for a period of 24 months after the initiation of commercial operations. After the first 24 months of commercial operations, the frequency of field monitoring will be reduced to quarterly.

2.7.2 Source and Vadose Zone Monitoring

Source and vadose zone monitoring will also be accomplished by water table aquifer monitoring. A total of 8 new wells will be installed surrounding the pond to establish baseline water quality conditions and to verify that the double liner, LCRS, and PCMS are properly operating. Source and vadose zone monitoring will be identical to that completed for groundwater monitoring described above. (Significant increases in water elevation measured in the GA monitoring wells may indicate changes in the vadose zone beneath the pond.)

Representative groundwater samples will be collected from the monitoring wells and sent for laboratory analysis. Groundwater sample analysis and reporting will be based on acceptable water quality as regulated by Class II groundwater discharge standards and listed in Table 1 of RS-317-6-2 of the DWQ groundwater rules.

2.7.3 Leak Detection Monitoring

The Company will monitor the leak detection system by continually measuring the amount of brine collected in the LCRS and PCMS sumps, by completing routine inspections of the associated sump pump equipment, and by completing physical inspections of the brine pond. The monitoring procedures will be described in the forthcoming Brine Pond Operating Plan, to be completed before the pond is put into operation.

During solution mining operations, leak detection at the sumps will include daily monitoring of the volume of sump water recirculation back to the pond. The sump pump monitoring equipment will be designed to allow the leakage volume to be measured and therefore determine whether the leakage is within the calculated maximum leakage flow rate. The sump pump inspection schedule will be decreased to weekly during periods when there is no solution mining activity and monthly once the pond reaches full capacity.

If monitoring indicates that the maximum leakage flow rate has been exceeded, flow pumped from the sumps will be totaled daily to identify whether there is an increasing trend in flow. If an increasing trend is identified, the Company will notify the authorizing agencies with the findings.

Daily physical inspection of the pond berms and berm edges will occur during solution mining. The inspection schedule will be decreased to weekly during periods when there is no solution mining activity and monthly once the pond reaches full capacity. The purpose of the inspection is to look for signs of seepage, erosion, cracking, fissures, erosional rills or gullies or any indicators that salt or brine water may be leaking from the pond through the berms.

2.7.4 Closure and Post-Closure Plan

Final reclamation of the brine pond will take place as soon as the brine evaporation is complete, and it is determined that no further solution mining for cavern creation will take place. The salt will be shaped into a low dome that follows the general contours of the surrounding topography within the pond area. An impermeable plastic sheet with welded seams will be affixed over the salt. Earthen materials from pond berms will be spread over the plastic-covered salt, using the inside berm materials first and saving the outer-most materials, which would be least affected by brine evaporation, for use as top dressing. Earthen materials will be spread to a depth of at least four feet, which will settle over time to an average depth of three feet. A soil depth of 3 feet exceeds the State of Utah requirement for landfills.

2.7.5 Corrective Action Plan

If, during routine facilities monitoring, the sump discharge rates show and increasing trend and approach maximum design levels, or if the measured concentrations of groundwater constituents or groundwater elevation in down-gradient GA water table aquifer monitoring wells show increasing trends that exceed historical maximums, the Company will complete a facilities investigation to assess the cause of the anomaly. Based on the findings of the investigation, the Company will take an appropriate course of action to remedy the cause of the anomaly, or if the anomaly has been identified as having the potential for an unanticipated groundwater discharge or it is believed that an unanticipated discharge has occurred, will immediately notify the DWQ and the UDWRi in accordance with permit requirements. Corrective actions could include, but would not be limited to, resampling, replacement of sump pumps, installation of additional emergency sumps pumps, actions to complete leak/liner repairs, and other remedies determined at the time and specific to the issue to minimize the unanticipated groundwater discharge until the issue is resolved.

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Appended Table 2-2

Table 2-2: Groundwater Quality Data of Water Monitoring Wells

Well I.D.	Date	LABORATORY MEASUREMENTS										FIELD MEASUREMENTS	
	mm/dd/yy	Bicarboate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Conductivity (µmho/cm)	Sulfate (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	DTW^1 (feet)	pH
UDEQ SDWS		NE	NE	250	NE	250	500	NE	NE	NE	30-60*	NA	NA
B-P1-4	3/24/2010	240	<10	92	810	49	480	19	21	8.8	120	17.5	NR
	8/9/2011	230	20	112	748	35.6	464	26.8	25.9	8.9	127	21.15	8.4
	9/8/2011	230	20	92	662	39.3	492	18.6	23.1	8.9	125	21.15	7.9
	10/14/2011	230	40	99	763	36.4	472	24.5	26.1	10.7	146	21.25	7
	6/15/2017	229	<1.0	97	808	38	456	20.7	22.5	8.7	117	21.74	7.9
	9/7/2017	229	<1.0	103	808	39	448	19.5	21.7	8.3	114	21.9	8.1
	12/14/2017	244	<1.0	98	828	39	484	36.3	26.9	9.9	127	21.94	8
	3/21/2018	237	<1.0	98	862	39	480	32	25.2	8.8	111	21.94	8.42
	10/11/2018	230	<10	93	863	39	404	21.6	23.7	9.31	132	22.26	7.99
	1/23/2019	226	<10	93.5	856	39.9	506	20.5	24	9.2	130	22.3	7.76
	5/2/2019	230	<10	97.9	841	43.4	470	21.6	24.9	9.5	140	22.34	7.66
	8/7/2019	234	<10.0	104	852	41.7	600	55.7	30.5	9.57	131	22.46	7.02
	11/26/2019	228	<10	97.9	1070	40.9	464	24.2	23.2	11.6	125	22.58	NA
	2/20/2020	232	<10.0	102	1050	39.4	412	24.7	23.6	9.64	125	22.64	6.51
	5/20/2020	240	<10.0	99.3	948	39.4	568	19.7	22.2	9.22	134	22.67	8.34
B-P1-9	3/24/2010	300	<10	160	1100	57	580	37	33	11	150	31	NR
	8/9/2011	292	20	206	1140	47.7	668	200	74.4	15.1	159	34.8	7.9
	9/8/2011	289	20	141	1000	62.1	696	41.1	36.5	11	162	34.8	7.5
	10/14/2011	284	20	142	1080	60.9	668	44	35.6	12.3	173	28.1	7
	6/14/2017	303	<1.0	148	1100	59	640	285	87.9	15.1	147	35.43	7.8
	9/7/2017	299	<1.0	157	1090	60	652	163	58.1	13.2	149	35.59	7.7
	12/14/2017	308	<1.0	149	1100	59	604	489**	137	22.6	160	35.65	8
	3/21/2018	276	<1.0	147	1090	56	616	361**	104	18.1	153	35.7	8.16
	10/11/2018	276	<10	131	1100	54.5	604	45.1	33.6	10.6	162	36.05	7.8
	1/23/2019	276	<10	150	1080	43.9	618	74	39.4	11.5	168	36.12	7.39
	5/2/2019	270	<10	140	1050	58.4	564	37	30.2	10.4	165	36.2	7.02
	8/7/2019	276	<10.0	143	1010	60	608	539	102	14.3	158	36.28	7.96
	11/26/2019	274	<10	132	1160	52.1	524	50.1	33.3	14.2	141	36.4	NA
	2/20/2020	260	<10.0	135	1140	51.8	540	33.6	27.6	10.2	144	36.48	6.41
	5/20/2020	262	<10.0	132	1120	51.6	628	31.2	26.9	10.1	158	36.55	8.58
B-P2-1	3/24/2010	250	<10	100	840	47	460	20	23	9.3	130	23.25	NR
	8/9/2011	244	20	97.2	790	45.2	488	123	45.8	11	129	27.15	8.6
	9/8/2011	243	20	93.5	738	46	536	17.2	23.5	9	130	27.2	7.8
	10/14/2011	238	20	85.4	782	39.4	456	23.4	25.8	8.6	143	27.75	7
	6/15/2017	229	<1.0	105	842	34	472	24.8	25	9.1	126	27.71	7.9
	9/7/2017	235	<1.0	95	798	35	468	21.4	22.1	8.5	118	27.84	7.0
	12/14/2017	230	<1.0	782	2870	36	1520	135	99.3	18.3	333	28.01	8
	3/21/2018	224	<1.0	540	2150	34	1110	128**	89.4	15.8	257	28.14	8.36
	5/31/2018	221	<1.0	1130	3740	39	2010	144	113	17.9	407	28.2	7.81
	6/27/2018	222	<1.0	1110	3660	39	2120	135	120	19.7	426	28.23	7.97

Table 2-2: Groundwater Quality Data of Water Monitoring Wells

Well I.D.	Date	LABORATORY MEASUREMENTS										FIELD MEASUREMENTS	
	mm/dd/yy	Bicarboate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Conductivity (µmho/cm)	Sulfate (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	DTW[1] (feet)	pH
UDEQ SDWS		NE	NE	250	NE	250	500	NE	NE	NE	30-60*	NA	NA
B-P2-1	10/11/2018	240	<10	104	913	37.2	468	21.2	25.7	9.5	146	28.45	7.74
	1/23/2019	194	132	134	1170	55.9	660	29.6	31.1	10.5	170	28.6	7.36
	5/2/2019	262	<10	212	1280	41.2	668	32.6	35.7	11.2	222	28.7	7.04
	8/7/2019	194	<10.0	11200	27600	246	18600	739	503	88.7	5060	28.76	6.99
	11/26/2019	194	<10	7560	25600	164	13900	398	348	90	4880	28.9	NA
	2/20/2020	192	<10.0	4740	19800	105	6300	309	285	48.9	2500	29	6.35
	5/20/2020	220	<10.0	2840	10200	73.9	5880	165	159	32.6	1380	29.06	8.47
B-P3-3	3/24/2010	220	<10	230	1200	58	640	29	31	11	170	15	NR
	8/9/2011	215	20	249	1140	59.8	688	53.7	37.9	11.1	174	19.2	8.1
	9/8/2011	216	20	203	1140	58.2	696	34.9	34.5	10.5	183	19.4	7.7
	10/14/2011	203	20	200	1170	48.1	672	33.4	36	18.5	200	19.35	7.03
	6/15/2017	211	<1.0	198	1140	63	616	28.3	30	9.9	157	20.25	8
	9/7/2017	206	<1.0	201	1090	62	620	46.5	29.9	9.5	140	21.13	7.7
	12/14/2017	207	<1.0	185	1110	62	544	28.6	30.3	9.8	154	20.85	8.1
	3/21/2018	202	<1.0	218	1220	63	644	33.5	33.3	10.4	160	20.32	8.35
	10/11/2018	214	<10	188	1160	61.9	512	30.2	33.5	10.3	169	21.65	7.84
	1/23/2019	210	<10	193	1150	66.4	612	29.3	33.2	10.4	161	21.08	8.01
	5/2/2019	218	<10	224	1240	68.1	584	33.9	39.5	11.4	192	20.67	7.21
	8/7/2019	212	<10.0	231	1260	70.3	714	33.1	37.4	10.4	172	21.64	7.99
	11/26/2019	204	<10	204	1960	65.1	664	31.2	33.4	13.9	160	21.6	7.97
	2/20/2020	216	<10.0	238	1500	64.4	668	72.3	44	11.9	166	21.19	6.11
	5/20/2020	216	<10.0	250	1520	66.3	840	35.5	39.3	11.9	206	21.13	8.19
B-P3-5	3/24/2010	200	<10	200	1100	48	570	25	27	9.1	160	13	NR
	8/9/2011	174	20	236	900	45.2	552	61	38.8	11.6	127	17.45	NR
	9/8/2011	179	20	179	1070	54.5	660	29.7	35.9	8.73	164	17.6	7.8
	10/14/2011	184	20	148	935	85.9	564	49.1	39.1	7.93	142	17.35	7.07
	6/15/2017	170	<1.0	283	1360	83	704	47.2	46.3	9.3	151	18.59	8.1
	9/7/2017	175	<1.0	127	821	57	444	24.6	26.8	6.6	104	19.81	7.8
	12/14/2017	179	<1.0	221	1170	74	612	49.3	45.4	9.6	150	18.95	8.3
	3/21/2018	178	<1.0	120	852	56	496	27	27.2	6.8	104	18.42	8.45
	10/11/2018	178	<10	142	951	59.6	480	28.7	32.2	7.49	126	19.9	7.75
	1/23/2019	178	<10	126	889	57.7	492	26.1	30.6	7.12	120	19.2	7.91
	5/2/2019	176	<10	129	879	57.3	456	27.5	31.6	6.98	129	18.8	7.43
	8/7/2019	164	<10.0	602	2410	153	1330	81.2	96.4	14.4	274	19.95	7.2
	11/26/2019	176	<10	597	2760	139	1390	81.7	103	22.4	267	19.7	7.8
	2/20/2020	172	<10.0	543	2640	129	1230	72.3	86.2	14.3	245	19.31	6.56
	5/20/2020	178	<10.0	518	2560	127	1260	77.8	88.6	14.5	259	19.43	8.79
B-P3-7	3/24/2010	520	<10	700	3800	410	2300	32	39	17	800	11	NR
	8/9/2011	426	40	498	3130	323	1940	50.1	50.2	16.9	767	15.2	8.1
	9/8/2011	459	40	612	3120	326	2180	37.1	48	16	770	15.4	7.7
	10/14/2011	43.4	40	638	3050	126	1970	58.6	59.9	19.5	593	15.5	6.9
	6/15/2017	445	<1.0	361	2280	172	1300	27.6	24.4	11.6	454	16.61	7.9

Table 2-2: Groundwater Quality Data of Water Monitoring Wells

Well I.D.	Date	LABORATORY MEASUREMENTS										FIELD MEASUREMENTS	
	mm/dd/yy	Bicarboate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Conductivity (µmho/cm)	Sulfate (mg/L)	TDS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	DTW^1 (feet)	pH
UDEQ SDWS		NE	NE	250	NE	250	500	NE	NE	NE	30-60*	NA	NA
B-P3-7	9/7/2017	333	<1.0	343	1840	129	1010	25.9	25.9	10.6	321	17.5	7.9
	12/14/2017	406	<1.0	326	1960	154	1160	35.3	27.2	11.9	389	17.4	8.3
	3/21/2018	325	<1.0	282	1730	112	1030	37.1	28.2	11.4	305	16.89	8.32
	10/11/2018	264	<10	260	1560	88.4	888	25.9	28.5	11	275	17.91	7.79
	1/23/2019	306	<10	168	1460	77.1	840	14.6	16.1	8.71	294	17.76	8.29
	5/2/2019	294	<10	226	1470	97.1	764	19.2	21.9	9.66	316	17.35	7.68
	8/7/2019	314	20	211	1430	113	872	11	12.5	7.34	307	18.24	8.28
	11/26/2019	262	52	166	1520	94.1	784	11	8.59	9.67	267	18.41	NA
	2/20/2020	304	20	200	1600	104	766	12.8	12.7	7.99	286	18.02	6.94
	5/20/2020	312	16	183	1550	93.3	868	11.1	11.3	7.86	315	17.78	8.38
B-P3-11	3/24/2010	300	<10	470	2600	310	1500	69	79	19	330	11	NA
	8/9/2011	298	20	646	2250	263	1480	70.1	79.9	24.9	368	16.7	7.7
	9/8/2011	298	20	375	2120	275	1340	59.5	74.7	17.8	349	17.1	7.4
	10/14/2011	325	40	388	2080	76	1320	69.8	83.4	212	311	17.6	7.05
	6/15/2017	298	<1.0	290	1750	167	1040	44.5	49.1	14.6	259	17.61	7.9
	9/7/2017	298	<1.0	301	1840	169	3080	43	48.3	14	248	18.83	7.9
	12/14/2017	300	<1.0	285	1750	162	916	43.4	47.3	14	255	18.1	7.9
	3/21/2018	303	<1.0	288	1690	159	1000	49.8	51.9	15.6	274	17.5	8.12
	10/11/2018	300	<10	274	1790	160	434	40.7	48.5	15	274	19.17	7.7
	1/23/2019	320	<10	253	1750	157	1020	43.4	51.6	14.9	281	18.23	7.79
	5/2/2019	298	<10	283	1710	167	986	42.3	51.3	14.9	284	17.77	7.23
	8/7/2019	294	<10.0	298	1740	176	996	48.9	52.3	14.5	273	19.3	7.83
	11/26/2019	298	<10	277	1340	166	992	40.2	46.6	20.9	258	18.91	NA
	2/20/2020	316	<10.0	277	1950	154	916	38.7	45.9	14	250	18.41	6.19
	5/20/2020	316	<10.0	251	1910	150	1030	38.3	44.8	14.9	283	18.3	8.01

Notes:

UDEQ SDWS - Utah Department of Environmental Quality Secondary Drinking Water Standards

NE Indicates no exedences

* = USEPA Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Sodium (EPA 822-R-03-006; February 2003)

** = Sediment observed in sample

2010 samples were collected by IGES Inc. and submitted to American West Analytical Laboratories

2011 samples dated in 2011 were collected by Hansen, Allen, & Luce, Inc.

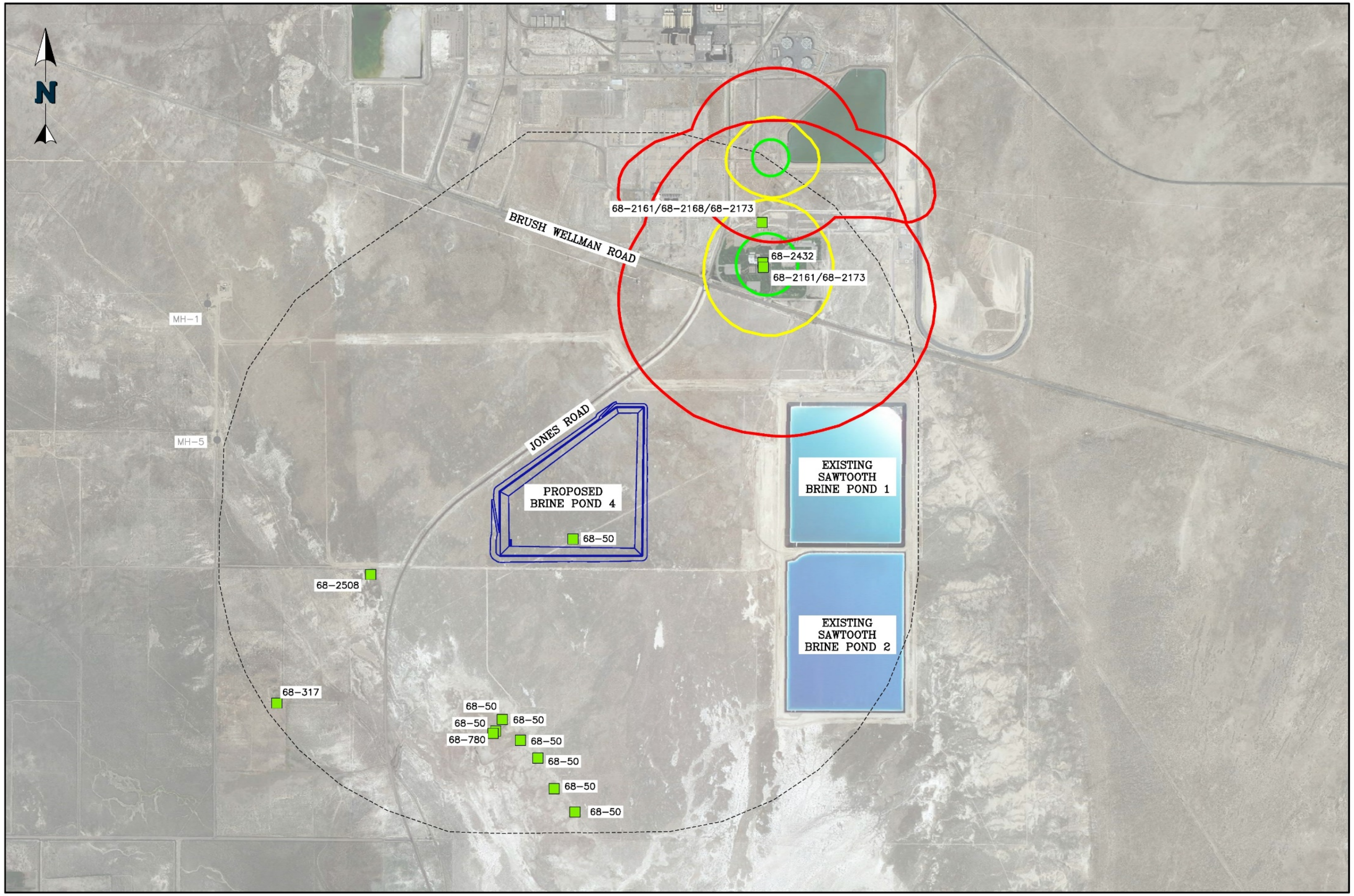
2017 to 6/27/18 samples were collected by ATC Group Services, LLC and submitted to Chemtech Ford Laboratories

10/11/18 samples were collected by Barr Engineering Co. and submitted to American West Analytical Laboratories

Bold values indicated an exceedence of the UDEQ SDWS or EPA Advisory .

DTW^1 is Depth to Water

Appendix A
Water Rights/Sources Map and Table of Water Rights



LEGEND:

🟩	WELL LOCATION (WATER RIGHTS #)
◯	1-MILE REVIEW AREA
◯	ZONE 1
◯	ZONE 2
◯	ZONE 3
◯	ZONE 4
◯	1-MILE REVIEW AREA
—	PROPOSED BRINE POND
MH-1 ●	EXISTING BASEMENT AQUIFER WATER PRODUCTION WELL

NOTES:

1. AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND IS DATED AUGUST 19, 2019
2. ZONES 1-4 BOUNDARIES WERE EXTRACTED FROM FIGURE 2-1 WITHIN THE FOLLOWING REPORT:

   "Groundwater Discharge Permit Application Attachment

   Magnum Gas Storage Project - Brine Ponds 3 and 4"

   DATED NOVEMBER 17, 2017

NOTES:

1. AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND IS DATED AUGUST 19, 2019
2. SOURCE FOR WATER RIGHTS SHOWN: "UTAH DIVISION OF WATER RIGHTS, 2020, WATER RIGHTS MAP" https://maps.waterrights.utah.gov/EsriMap/map.asp

2.1. SEARCH PARAMATERS WITHIN REVIEW AREA (POINTS OF DIVERSION)
  2.1.1. STATUS: APPROVED AND PERFECTED
  2.1.2. DIVERSION TYPE: UNDERGROUND AND SPRINGS
  2.1.3. APPLICATION TYPE: WATER RIGHT
  2.1.4. WATER USE TYPE: ALL

MAGNUM

NewFields

CLIENT MAGNUM SOLUTION MINING, LLC
PROJECT BRINE POND 4
TITLE WATER RIGHTS & SOURCES MAP
FILENAME 475.0093.020.GWDP.AppA
FIGURE NO. APP.A
REVISION A

Water Right Number	Type	Priority	Uses	CFS	ACFT	Depth (ft.) /Diameter (in.)	Location	Owner
Irrigation								
68-50	Underground	19360723	I	1.4	0	43 / 2	N2202 E264 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	420 / 8	N2423 E390 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	140 / 2	N2014 E732 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	105 / 2	N2015 E732 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	180 / 3	N1672 E1062 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	70 / 2	N1669 E1070 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	128 / 3	N1065 E1371 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	90 / 2	N608 E1767 SW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-50	Underground	19360723	I	1.4	0	90 / 2	[1]N607 E1767 NW 36 15S 7W SL	MAGNUM HOLDINGS, LLC
68-317	Underground	19510327	I	3.0	5.9	594 / 16	N43 E1269 W4 35 15S 7W SL	INTERMOUNTAIN POWER AGENCY
68-780	Underground	19331101	I	0.089	0	70 / 2	N2216 W2398 S4 36 15S 7W SL	MAGNUM HOLDINGS, LLC
Stock								
68-2508	Underground	19831209	S	0.007	2	85 / 2	S85 E462 N4 35 15S 7W SL	MAGNUM HOLDINGS, LLC
Other, Power								
68-2161	Underground	19520902	OP	30.6	26.0		N600 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY
68-2161	Underground	19520902	OP	30.6	26.0	1,200 / 20	N1470 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY
68-2168	Underground	19560823	OP	82.0	366.0	1,200 / 20	N1470 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY
68-2173	Underground	19500721	OP	67.7	154.7	1,200 / 20	N1470 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY
68-2173	Underground	19500721	OP	222	205.6		N600 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY
Other								
68-2432	Underground	19600107	O	1.7216	400	1,334 / 20	N700 E150 SW 19 15S 6W SL	INTERMOUNTAIN POWER AGENCY

Utah Division of Water Rights. 2020. Water Rights Map. Available at: https://maps.waterrights.utah.gov/EsriMap/map.asp. POD: Status: approved and perfected; Diversion Type: underground and springs; Application Type: water right; Water Use Type: all.

[1] This location is suspected to be an error on the UDWR website (SW 36 rather than NW 36). If a well is encountered during construction the contractor should immediately notify the Owner and Engineer.

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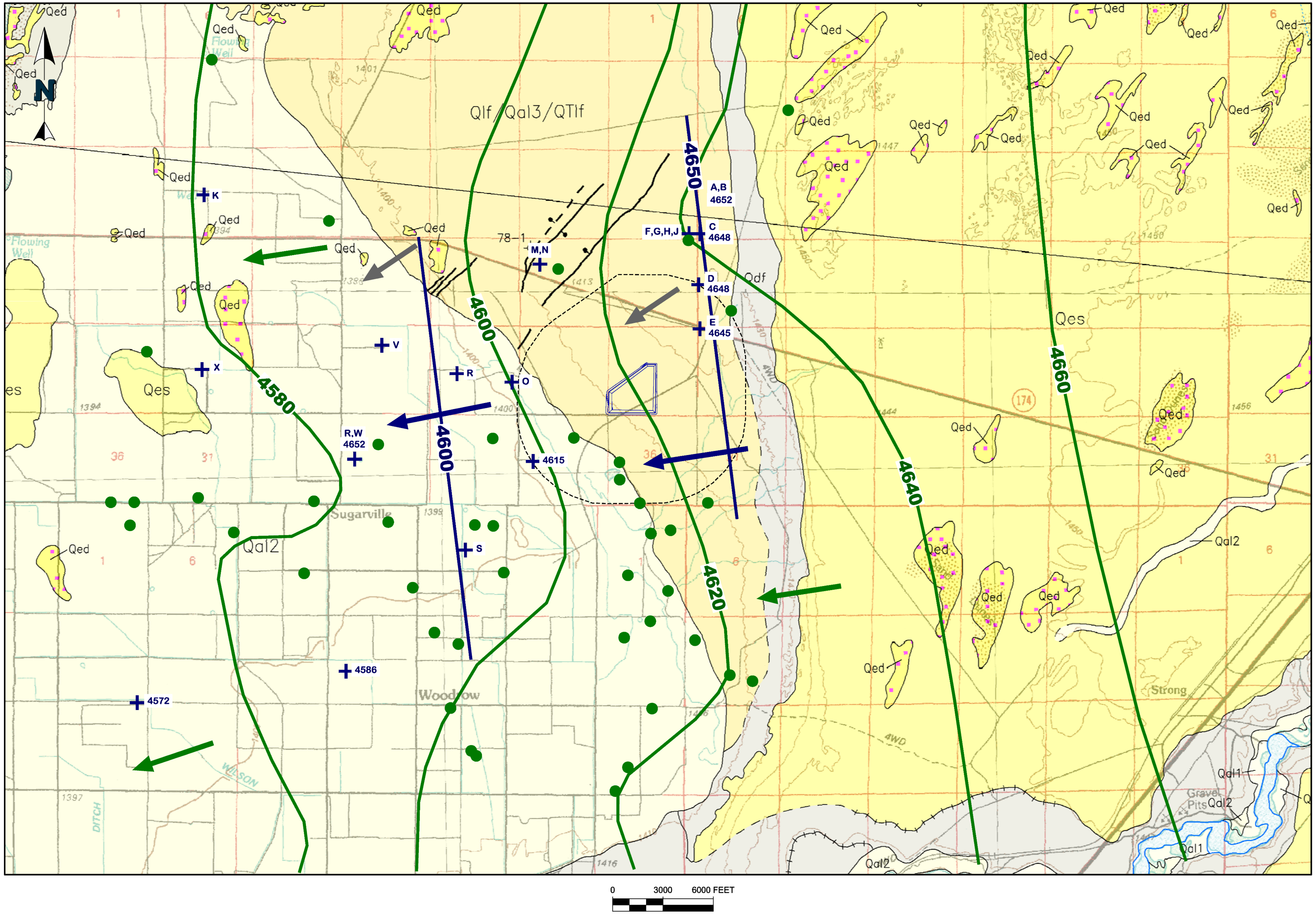
Appendix B

Geologic Map



LEGEND:

—	PROPOSED BRINE POND
◌	1-MILE REVIEW AREA
●	SHALLOW ARTESIAN AQUIFER OBSERVATION WELL
✚	DEEP ARTESIAN AQUIFER OBSERVATION WELL
—	SHALLOW ARTESIAN AQUIFER POTENTIOMETRIC CONTOUR
—	DEEP ARTESIAN AQUIFER POTENTIOMETRIC CONTOUR
⬅	SHALLOW ARTESIAN AQUIFER GROUNDWATER FLOW
⬅	DEEP ARTESIAN AQUIFER GROUNDWATER FLOW
⬅	WATER TABLE AQUIFER GROUNDWATER FLOW (UNCONFINED)

NOTES:

1. GEOLOGIC MAP IMAGE DOWNLOADED ON OCTOBER 14, 2020 FROM UTAH GEOLOGICAL SURVEY WEBSITE (https://geology.utah.gov/apps/intgeomap/)
2. AQUIFER MONITORING WELL LOCATIONS, POTENTIOMETRIC CONTOURS, AND GROUNDWATER FLOW DIRECTIONS WERE EXTRACTED FROM THE APPENDIX B FIGURE WITHIN THE FOLLOWING REPORT: "Groundwater Discharge Permit Application Attachment Magnum Gas Storage Project – Brine Evaporation Ponds 3 and 4" DATED NOVEMBER 17, 2017

MAGNUM

NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
REGIONAL GEOLOGY, POTENTIOMETRIC SURFACES, AND GENERALIZED GROUNDWATER FLOW DIRECTIONS

FILENAME	
475.0093.020.GWDP.AppB.R2	
FIGURE NO.	REVISION
APP.B	A

Table of Symbols and Geologic Descriptions

Symbol	Description
Q	Quaternary surficial units
Qal$_1$	Alluvium, upper Holocene. Youngest alluvium in channels, floodplains, and adjacent low terraces of the Sevier River and other perennial streams. Consists of sand, silt, clay with lenses of gravel
Qal$_2$	Alluvium, middle and lower Holocene -- Tan and gray silt and sandy silt in large low-gradient alluvial fans
Qal$_3$	Alluvium, pre-Lake Bonneville. Lenticular sand and sandy gravel beds. Located north of Delta but mostly covered by Lake Bonneville deposits.
Qes	Eolian sand – Wind-blown sand; mostly silty fine-grained quartz sand
Qed	Eolian dunes – Chiefly barchan, parabolic, dome and transverse sand dunes that are active and not stabilized by vegetation; mostly tan, well-sorted, fine grained quartz sand
Qdf	Underflow fan deposit – Thin-bedded to laminated, calcareous silt with minor interbedded very fine sand in thin beds that were deposited into the Lake Bonneville deltas of the Sevier River
Qlf	Fine-grained lake deposits – Grayish-tan, tan and light gray, calcareous silts that are deep-water sediments of Lake Bonneville
QTif	Fine-grained lacustrine deposits of Sevier Desert – Brown and light olive gray, calcareous, lacustrine silt and silty clay with minor sand; offshore to deep-water sediments. Pliocene to middle Pleistocene in age
Hintze, L.F. and F.D. Davis. 2003. Utah Department of Natural Resources, Utah Geological Survey, Geology of Millard County, Utah. Bulletin 133, Salt Lake City, Utah.	

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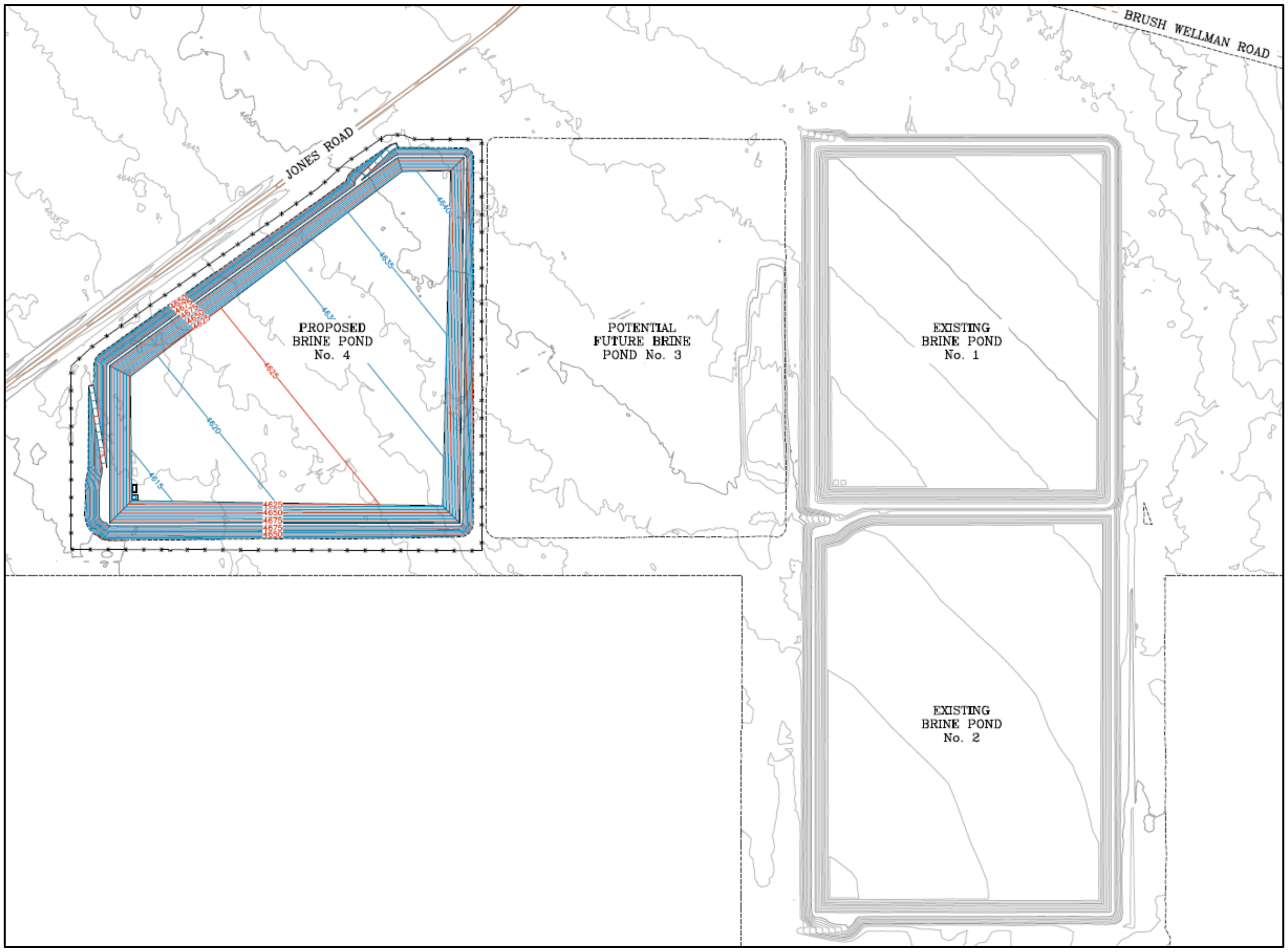
Appendix C

Brine Pond Engineering Plans and Specifications



MAGNUM SOLUTION MINING, LLC - BRINE POND 4
FINAL DESIGN REPORT – REVISION 2

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1. INTRODUCTION

NewFields Mining Design and Technical Services (NewFields) was commissioned by Magnum Solution Mining, LLC (Magnum) to provide engineering services for the final design of Brine Pond 4. Pond 4 has been designed to the same standards as the existing Sawtooth Brine Ponds 1 and 2 with some improvements made which are illustrated on the drawings and identified in this document. Two geotechnical investigations (one performing test pits and the other geotechnical borings), as well as a groundwater depth confirmation investigation, were completed in the pond footprint, and the findings are presented herein.

1.1. Project Background

Magnum is developing a series of energy storage projects that involve the construction of solution mined storage caverns in a subsurface salt deposit. The resulting brine solution from the mining process will be stored in double geomembrane lined engineered brine ponds such as Brine Pond 4.

The design for three Ponds was originally completed by AMEC (2011), and included a series of 3 evaporation ponds in a west to east alignment. After receipt of a Utah Division of Water Rights (DWRi) Dam Impoundment Permit and Division of Water Quality Groundwater Discharge Permit, Magnum constructed Pond 1 in 2013 with the original permitted design completed by AMEC (2011). The first pond is referred to as Sawtooth Brine Pond 1.

NewFields completed the design for another pond in 2015, which is located directly south of Sawtooth Brine Pond 1 and is referred to as Sawtooth Brine Pond 2. That pond was constructed before the end of 2015.

NewFields completed the design for Brine Pond 3 and a slightly different configuration of Brine Pond 4 in 2017, with Pond 3 west of and sharing an embankment with Pond 1, and Pond 4 west of and sharing an embankment with Pond 3. Magnum requested a revised Brine Pond 4 be designed in early 2020, which is the focus of this report.

1.2. Project Description

The goal of this design for the Brine Pond 4, provided by NewFields within this report, is intended to obtain a DWRi Dam Impoundment Permit and Division of Water Quality Groundwater Discharge Permit.

The proposed Pond 4 is located to the west of Sawtooth Brine Pond 1 near Jones Road. Pond 4 has an approximate footprint of 168 acres (the footprint of the outside toe). The vacant space to remain between ponds 1 and 4 is slightly larger than the pond 3 size and shape designed by NewFields in 2017.

1.3. Project Location

The project is located approximately 10 miles north of Delta in Millard County, Utah and includes leased lands from the Utah School and Institutional Trust Lands Administration (SITLA). A county and vicinity map is shown on Drawing A000.

1.4. Site Conditions

Site conditions are similar to those described for the design of Ponds 1 and 2 (AMEC, 2011; NewFields, 2015). A geotechnical investigation consisting of test pits was completed in 2016 (provided in Appendix I), and boreholes were drilled within the footprint of the proposed embankments in 2017 (provided in Appendix D). In June 2020 four pits were dug near the proposed southwest corner of pond 4 to confirm that estimated depth to groundwater had not significantly changed since the geotechnical investigations were completed. Surface and subsurface conditions encountered are discussed in detail in Section 2 and 3.

1.5. Scope of Work

Per the proposal submitted to Magnum on March 23, 2020 (NewFields Proposal No. 20PD.0036 Rev.1) the scope of work included the following:

- Complete a groundwater depth investigation near the proposed pond 4 sumps to see if depth to groundwater has changed since the previous geotechnical investigations were completed more than 3 years prior.
- Provide engineering design and permitting support for Brine Pond 4 including:
    - Review and revise existing design criteria developed during the previous phase,
    - Develop a grading plan for Brine Pond 4 utilizing AutoCAD Civil3D. The plan will utilize locally available material and will balance cut and fills to the greatest extent possible. The groundwater level in the sump area of the ponds will be a limiting factor for the grading plans and will be considered as the design is developed and advanced,
    - Prepare geomembrane plans and details for installation,
    - Prepare Leak Collection and Recovery System (LCRS) and Process Component Monitoring System (PCMS) plans and details as well as recommend pumping systems,
    - Final Design report and design drawings to be stamped by the Engineer of Record (EOR),
    - Review and utilize the existing technical specifications for earthworks, geosynthetic materials, concrete, and pipework.

1.6. Use of this Report

This report has been prepared exclusively for Magnum. No third party, other than the design team (NewFields), shall be entitled to rely on any information, conclusions, opinions, or other information contained herein without the express written consent of Magnum.

2. GEOTECHNICAL INVESTIGATION

The previous geotechnical investigations performed by NewFields consisted of test pits, whose locations are presented in Figure 1 included in Appendix I and the findings described in the Future Brine Pond Expansion Technical Memorandum (NewFields, 2017) presented in Appendix I. The boreholes were done in 2017 and are provided in Appendix D and the location of them is shown on drawing A050.

The revised proposed location of Pond 4 is within the area where the previous geotechnical investigations were performed, therefore a new investigation was not required or completed for this design. However, NewFields performed an investigation to confirm that groundwater depths have not significantly changed in the previous 3 years. In June 2020, four excavations were dug near the proposed Brine Pond 4 southwest embankment corner. The groundwater measured in all four locations was found at the expected depth and confirmed that groundwater depths have not changed.

3. GEOLOGIC AND GEOTECHNICAL CONDITIONS

3.1. Geologic Setting

The project site is located within the Sevier Desert in east-central Millard County, Utah. The Sevier Desert basin is within the eastern margin of the Basin and Range Physiographic Provence. Beginning 20 to 7 million years before present (Ma), the basin opened up dominantly by crustal extension through normal faulting within the region rather than graben subsidence (Oviatt, 1989). The basin is bounded on the east by the Canyon Range and the Gilson Mountains, on the north by the Sheeprock Mountains, Simpson Mountains, and Keg Mountain, and on the west by the Drum Mountains, Little Drum Mountains, and the House Range. The southern margin is less defined before transitioning into the Black Rock Desert.

The basin was a freshwater lake during the early Pleistocene, as indicated by the presence of calcareous clays and silts. During the Middle Pleistocene, the basin experienced a time of erosion and sediment degradation by receding lake waves lifting sediments into suspension where they were transported away in fluvial systems (Oviatt, 1989). Wind degradation also occurred during this time as the lake(s) shorelines receded. A shallow, freshwater lake filled the basin again prior to the transgression of Lake Bonneville around 20 to 21 thousand years ago. As Lake Bonneville began to regress into the Great Salt Lake basin, another freshwater lake formed in the basin. This lake was present long enough to develop a prominent 10-mile long shoreline northeast of Sevier Lake. This was Lake Gunnison, which overflowed north into the Great Salt Lake Desert via the Old River Bed channel. After Lake Gunnison retreated, the Sevier and Beaver Rivers deposited low gradient alluvial fans comprised of fine-grained sediments.

Surficial sediments in the area consist of fine-grained lacustrine deposits of Lake Bonneville and of pre-Bonneville lakes, vast areas of fine-grained alluvium deposited by the Sevier and Beaver Rivers, and coarser-grained deposits in piedmont areas. Thin aeolian deposits are also found throughout the area.

Regional structure near the project site was discussed by IGES (2009) and consists of two northeast trending normal faults.

3.2. Surface Conditions

The surface of the proposed Pond 4 is moderately vegetated with small shrubs and grasses. It is generally flat to undulating with an overall slope to the southwest. There are occasional dunes with their axis generally northeast to southwest, perpendicular to the prevailing wind direction from the northwest, in the middle of the proposed pond. These dunes, and the surface sediments to the east, are aeolian sediments that were likely deposited after the historic lakes drained.

3.3. Subsurface Conditions

The subsurface soils beneath the proposed Pond 4 to a depth of approximately 75 ft bgs are generally interbedded fluvial and lacustrine deposits with significant crossbedding sedimentary structure in the fluvial deposits. The predominant soil type is poorly-graded sand to silty sand with thin to thick sequences of lacustrine clays sporadically located through the subsurface.

Two cross sections were generated along the proposed interior toe of the proposed Pond 4 embankments, as shown on Appended Figure 1. These sections extend to the east into the footprints of Sawtooth Brine Pond 1 to illustrate the similar depositional environments of complexly interbedded fluvial deposits with lacustrine sediments within the subsurface conditions of the two facilities. The northern and southern cross sections are shown on Figures 2 and 3, respectively.

In general, the existing groundwater table is approximately 20 to 30 ft bgs throughout the footprint of the proposed Pond 4. Observations from geotechnical borings indicates the direction of groundwater flow is to the southwest.

SPT blowcounts from field penetration tests are commonly used to estimate engineering parameters of soil deposits such as relative density or stiffness, strength, and compressibility. Based on blowcounts, the cohesionless sediments tend to be medium dense to very dense and the cohesive sediments tend to be stiff to hard. Strength properties of the foundation materials for the geotechnical evaluation of the facility were also estimated from blowcounts.

3.4. Seismic Hazard

A probabilistic seismic hazard evaluation was previously performed for the facility (AMEC, 2011) based on Utah Administrative Code (UAC) R655-11-5A and is included as Attachment 1. The MCE is based on the probabilistic seismic hazard assessment considering a 4,975-year return event, and the associated PGA for this event is 0.39g based on a moment magnitude event of 6.2 at a distance of 14.7km.

A deterministic seismic hazard assessment (DSHA) was previously performed for the design of brine pond 1 (AMEC, 2011) and is included as Attachment 1. The DSHA reports both mean and mean plus one standard deviation ground motion parameters. According to Utah Administrative Code (UAC R655-11-5A), "low hazard dams will be evaluated using ground motion parameters that are at least equal to mean (50th) predictions." It is our assessment that the facility should be classified as low hazard per Utah Title 73.

3.4.1. Design Ground Motions

NewFields has reviewed the DSHA, agrees with the selection of the design seismic event, and believes they are still valid for the current understanding of regional seismicity. The ground motion parameters for the deterministic and probabilistic seismic hazards are listed in the following tables. Based on the listed PGAs, the design acceleration utilized in the geotechnical evaluation of Pond 4 is 0.38g.

TABLE 1 – SEISMIC HAZARD PARAMETERS

DETERMINISTIC SEISMIC HAZARD ASSESSMENT			
Seismic Source	**Magnitude (M_w)**	**Dist. to Site (km)**	**PGA, Soil Site (g)**
Sugarville FZ	5.8	1.8	0.25
Wasatch FZ (Levan Section)	6.7	56.4	0.05
Wasatch FZ (full rupture)	8.2	56.4	0.12
PROBABALISTIC SEISMIC HAZARD ASSESSMENT			
4,975-Year Return Event	6.2	14.7	0.38

The Sugarville Fault Zone, the closest fault to the site has a calculated MCE of 5.8 and a mean peak ground acceleration (PGA) of 0.25g. However, based on the inactive, small-scale nature of the Sugarville Fault Zone, it is very unlikely an MCE would be generated from this fault zone. A more realistic scenario may be an MCE generated by the most tectonically active USGS seismic hazard classified fault zone in proximity to site. An 8.2 magnitude MCE along the Wasatch Fault

Zone would result in a mean PGA of 0.12g. This event is recommended for post closure design (AMEC, 2011). However, a probabilistic PGA of 0.38g was used for the design and greatly exceeds values generated from the deterministic assessment.

4. BRINE POND 4 DESIGN

4.1. Brine Pond 4 Configuration

Brine Pond 4 was designed very similarly to the Sawtooth Brine Ponds 1 & 2. Containment will be provided by embankments constructed with homogenous fill material excavated from the pond areas. The embankments will have a crest width of 22 ft, 2.5H:1V interior slopes, and 2H:1V exterior slopes. See Drawings A110 and A115 for embankment sections and details.

The Pond 4 depth varies from 40 to 68 ft and the maximum embankment height is approximately 58 ft that correlates to a crest elevation of 4683 ft above mean sea level (amsl). To contain the required operational volume and provide sufficient storage for the 100 year/24 hour storm event, the resulting maximum Pond 4 elevation is 4680 ft. Given these elevations, the resultant freeboard to the embankment crest is 3 ft.

The embankments may settle over the life of the facility to a total of 1 foot (see Section 5.4) and as such the 3 ft design freeboard will require lowering the maximum operating water elevations accordingly if settlement occurs. However, the observed settlement of Brine Pond 1 has been very minimal (~1-inch) and therefore this 1-foot settlement estimate may be quite conservative. To verify that a 3 ft design freeboard is sufficient, a wave height calculation was completed. The maximum potential total wave run up was calculated to be 2.8 feet and therefore the 3 ft of freeboard is sufficient. See Appendix C4 for calculation details.

Note that the operational volume was given by Magnum and the meteoric volume for the 100 year/24 hour storm event, which results in a storm depth of 2 inches (in), was determined from the original design. See Appended Figure 4 and Appended Table 3 for the Brine Pond 4 filling curve and table.

These design elements in addition to the design features discussed in the following sections are presented in the Design Criteria in Appendix A. See Drawing A020 and A100 for details regarding the Brine Pond 4 layout and configuration.

4.2. Site Grading

The disturbance area of Brine Pond 4 is approximately 168 acres (the footprint of the outside toe). The area will be cleared of deleterious material and detritus (assumed depth of 3-inches) and the earthwork construction will include excavation of borrow material from the pond bottom and placement of the material as a continuous embankment around the perimeter of the pond.

The basin grading will generally conform to the existing natural grade and will slope at an approximate 0.80 percent grade from the northeast corner to the southwest corner, where the LCRS and PCMS sumps will be located. Full descriptions of these systems are presented in Sections 4.5 and 4.6 of this report.

The interior surfaces of the pond will be constructed with a prepared subgrade that will be constructed and compacted in accordance with the Technical Specification presented in Appendix B.

4.3. Embankment Crest

As stated previously the embankment crest width is 22 ft and provides for a 10.5 ft wide access road and 1.5 ft tall safety berms. The access road will be overlain by a 6-in thick layer of wearing course. Where the access road crosses the brine delivery pipe a 1 ft minimum ramp will be constructed. Refer to Drawings A110, A115, A120 and A135 for embankment crest and pipe ramp details.

4.4. Liner System

Brine Pond 4 will have a composite liner system that includes both an LCRS and PCMS. The system design consists of a primary liner of 80-mil HDPE single-sided textured geomembrane and a secondary 60-mil HDPE geomembrane liner. The liners will be separated by a drainage layer using either 130-mil drainage studs fabricated with the secondary liner and installed face up against the primary liner, or 250-mil geonet. The double liner system will cover the pond basin and interior embankment slopes. Installation requirements are presented in the Technical Specifications in Appendix B.

The liner anchor trench will be constructed at a setback of 3 ft with trenched dimensions of 4 ft deep by 3 ft wide. To further secure the anchor trench on the embankment crest, 6 inches of the total trench backfill will be compacted on the secondary liner prior to placement of the primary liner. The factor of safety for tensile failure and anchor pull-out due to self-weight was analyzed and the configuration was deemed suitable. See Appendix C2 for calculations.

4.5. Leak Collection and Recovery System (LCRS)

The LCRS utilizes the interstitial space created by the drainage layer to transmit potential flows between the primary and secondary liners. In the event that a leak occurs in the primary liner, the fluid will drain along the secondary liner to the LCRS sump, which is located in the pond’s low point in the southwest corner of the pond. Approximately six 18-in wide strip drains will be installed in a radial pattern originating at the sump in the southwestern corner of the pond and upgradient to intersect all geomembrane panels on the floor of the pond. The addition of the strip drains will help facilitate flow to the LCRS sump. In addition to the transmission of flows between the liners through the strip drains and leak detection layer, a 4-in diameter perforated HDPE collection pipe will be placed along the inner embankment toes to increase flows to the sump.

Any potential leaks will be detected through the use of submersible pumps placed in the leak detection sump. The pumps will be encased in two 18-in diameter HDPE DR11 pump sleeves that will be installed between the primary and secondary liners. The pumps shall be automated to turn on at regular intervals such that the water in the sump is maintained a minimum. The discharged fluid will be circulated back to the pond.

The LCRS sump has 50 by 25 ft base dimensions, is 3.5 ft deep from the pond bottom and has 2.5H:1V side slopes. For sump sizing see Appendix C3.

The sump will be lined with 60-mil HDPE geomembrane that runs continuous from the pond basin lining and be overlain by a 10-oz non-woven cushion geotextile. Select gravel will be placed in the sump to a depth of 3.5 ft which is surrounded with a perforated sacrificial liner with perforations to prevent gravel dimpling on the primary and secondary liners, and overlain by 10-oz non-woven geotextile and primary liner which runs continuous from the pond basin lining. Two (2) – 18 in diameter DR 11 pipe pump sleeves will be installed from the sump bottom to the pond crest to be used as a riser pipe. See Drawing A220 for further details and the Technical Specifications in Appendix B for construction details.

Leakage flow rates were calculated based on principles from Giroud et al. (1997) using a formula for the "Geomembrane Leakage Rate Underlain by Permeable Media." Given the average head on the liner and the total wetted area of Brine Pond 4 (the maximum operating level) the leakage rate was calculated to be 439 gallons per minute (gpm) for Brine Pond 4. For further details, see the leakage rate calculation presented in Appendix C1.

4.6. Process Component Monitoring System (PCMS)

A PCMS will be installed, consistent with Ponds 1 and 2, to detect potential leaks in the secondary liner. The PCMS consists of toe drains along the length of the embankment that is made up of 4 in diameter perforated CPe pipes placed in 0.5 ft deep trenches located beneath the secondary liner. Additionally, three (3) trenches will be excavated along the pond bottom, orthogonal to the pond basin grading. The pipes will transmit flows to the PCMS sumps located in the low point in the southwest portion of the pond.

The PCMS sump was sized consistent with the PCMS dimensions of Brine Ponds 1 and 2. For sump sizing see Appendix C3.

The PCMS has 25 by 25 ft base dimensions and 2.5H:1V side slopes. An 80-mil HDPE single-sided textured geomembrane will be placed on the sump bottom to prevent vertical infiltration of water. Overlaying the geomembrane will be a 10-oz non-woven geotextile followed by 2 ft of select gravel and the double liner system which runs continuous from pond basin lining. A sacrificial liner with perforations will surround the gravel to prevent dimpling of the double liner. Two (2) – 18 in diameter DR 11 pipe pump sleeves will be installed from the sump bottom to the pond crest to be used as a riser pipe. See Drawing A230 for further details and the Technical Specifications in Appendix B for construction details.

Leakage flow rates were calculated based on principles from Giroud (1997) on “Geomembrane Leakage Rate Underlain by Relatively Low Permeability Soil.” Assuming that the hydraulic head on the secondary liner is equal to or less than 1 foot, and a good installation with 3 defects per acre, the maximum leakage rate was calculated to be 13.8 gallons per minute (gpm) for Brine Pond 4. For further details, see the leakage rate calculation presented in Appendix C1.

4.7. Diversion Channel

An existing stormwater diversion channel was constructed along the northern and eastern sides of Brine Pond 1, with a high point to the north. The existing diversion channel runs west from Brine Pond 1 and ends near Jones Road. As part of the Brine Pond 4 design, the originally designed diversion channel will be completed along the northwest side of Brine Pond 4 and discharge into the end of the existing roadside channel running along the southeast side of Jones Road, as shown on Drawing A400. A v-ditch swale will be constructed along the eastern side of the access road along the east embankment to capture runoff flowing from the space between Ponds 1 and 4. See drawing A400 for Stormwater Diversion Channel details. The flow rate and velocity expected is non-erosive and therefore erosion protection measures are not required.

4.8. Groundwater Monitoring

To monitor groundwater impacts for the area, eight (8) proposed monitoring well locations have been proposed around the outer perimeter of the Brine Pond facility. See Drawing A300 for the proposed locations and installation details.

4.9. Brine Recovery

The design includes sloping pipe sleeves inside the southwest corner for potential future installation of brine recovery pumps and piping. If a brine recovery pipeline is constructed in the future, solution from the pond will be recycled back to caverns to aid in the cavern operation or between Brine Ponds based on capacity conditions.

4.10. Brine Influent Pipeline

A 20-inch HDPE DR11 brine influent pipeline will be installed to Brine Pond 4 near the northernmost portion of the embankment. This pipeline will deliver all the brine that enters the pond. See Drawing A150 for details.

5. GEOTECHNICAL EVALUATION

5.1. Liquefaction Evaluation

A liquefaction triggering evaluation was performed based on the penetration resistance of the foundation soils as determined by the SPT using the procedure of Idriss and Boulanger (2008). Results of this evaluation are included as Appendix F3 and indicate that only one location in the subsurface has a potential for liquefaction considering the MCE event. The location of this zone is just west of the central interior of Pond 4 at approximately 50 feet below the existing ground surface. Based on the field investigation data an approximate 5-foot layer of saturated, loose silty sand underlies the area. The layer is potentially confined by a fat clay and flowing conditions were noted during the investigation that likely influenced the penetration resistance. The remainder of the penetration data indicates that materials are either unsaturated to partially saturated, too dense, or too cohesive to liquefy. It is our assessment that any potential liquefaction during a design seismic event would be very limited, at fairly significant depth, and ultimately it would not compromise the integrity of the embankment.

5.2. Brine Pond 4 Stability Evaluation

Stability assessment of the Brine Pond 4 slopes was completed for both static and seismic conditions. Stability analyses were performed using the computer program SLIDE 2 version 9.008 by Rocscience. SLIDE is a two-dimensional slope stability program for evaluating circular or noncircular failure surfaces in soil or rock slopes using limit equilibrium methods. Spencer's procedure, which is applicable to all slope geometries and soil profiles, was utilized within the stability model and assumes all interslice forces are parallel and have the same inclination. Brine Pond 4 is considered an earthen embankment dam, and under the UAC 655-11 is required to maintain a factor of safety for static and pseudo-static conditions of 1.5 and 1.0, respectively.

To assess the stability of slopes during seismic loadings, a pseudo-static approach was utilized in which the potential sliding mass is subjected to an additional, destabilizing horizontal force that represents the effects of earthquake motions and is related to the PGA. Very simply, the seismic force is the weight of the sliding mass multiplied by a horizontal pseudo-static earthquake coefficient (k_H).

The seismic hazard for the site was discussed in Section 3.4 of this report, and the resulting PGA for the MCE event is 0.38g. Per UAC, 100 percent of the design acceleration should be used for the stability evaluation.

5.2.1. Stability Model Development

Cross-section A was cut along the Brine Pond 4 southern embankment through the sump, as shown in Appended F1, Figure 1. The location of the cross-section was selected at the tallest embankment height. The geometry of the section was developed by overlaying the existing grade with the proposed final grade. The crest width was modeled as 22-feet wide. The overall interior embankment slope was modeled as 2.5H:1V, exterior slope modeled as 2H:1V, and the impounded brine modeled at a specific gravity of 1.2 and at the crest (no freeboard). Subsurface soils were modeled with both sand and clay foundations, and groundwater depth at 22 ft as encountered during the subsurface investigation.

5.2.2. Material Properties

Material properties used for the stability evaluation are summarized in Table 2. The material and strength characteristics of the sediments were developed considering the recent penetration test data (blowcounts) from the field investigation and results from recent and historic laboratory test work (IGES, 2009; 2010a; 2010b). Brine impounded within the facility was modeled as layer with no strength and was not allowed to percolate into the embankment or subsurface soils since the pond is fully lined.

Material properties of the Clay Foundation used for the End of Construction stability model are based on the lower end of the unconsolidated triaxial compression test performed by IGES (2009) and a conservative estimate from SPT correlations. The Clay Foundation properties used for the Long Term Static stability model are based on more recent test data, disregarding the cohesion intercept, adding a factor of safety with any cohesion that is present.

To investigate the potential influence of seismically induced softening, post-seismic stability was evaluated with 20 percent reduction in the strength of the foundation soil, and the output graphics from the model are shown in Appendix F1. No strength reduction was assumed for the embankment as it will be a drained, densely compacted fill.

TABLE 2 - MATERIAL PROPERTIES USED IN THE STABILITY ANALYSES

Material	Moist Unit Weight (lb/ft^3)	Friction Angle (degrees)	Cohesion (lb/ft^2)
Embankment Fill	125	30	300
Clay Foundation[1] (Pseudostatic, Post Seismic)	120	22	0
Clay Foundation (End of Construction)	120	0	4000
Clay Foundation (Long Term Static)	120	26	0
Sand Foundation[1]	110	30	0
Brine	75	0	0
Note: [1] A 20 percent strength reduction was utilized for post-seismic softening of the soil			

5.2.3. Results of the Stability Evaluation

The stability analysis resulted in acceptable factors of safety for both static and pseudo-static conditions, as shown on Table 3. A non-circular failure along the exterior slope of the embankment represented the critical failure form. Circular failure forms were evaluated but determined to be less critical than the non-circular failure forms. Failure output graphics from the stability model are included in Appendix F1. Based on these results the proposed geometry of the pond embankments will remain stable under both static and pseudo-static conditions.

TABLE 3 - SUMMARY OF CALCULATED MINIMUM FACTORS OF SAFETY

Cross Section	Foundation Type	End of Construction Stability	Long term Static Stability	Pseudo-Static Stability (MCE Event)	Post-Seismic Stability
A	Clay	1.8	1.5	0.7	1.2
A	Sand	1.7	1.7	0.8	1.5

5.3. Deformation Analysis

Since the pseudo-static stability evaluation resulted in calculated factors of safety less than unity, potential seismic deformations of facility slopes were evaluated using a simplified method. Results of the deformation analysis are included in Appendix F2, and indicate that for the design event, potential slope displacements are approximately 11.5-inches for a 1 percent probability of exceedance and a very conservative evaluation of the seismic risk. It is our engineering assessment that any potential slope deformation from the design seismic event will not compromise the integrity of the embankment and the established freeboard will ensure that overtopping does not occur in the event of downward crest movement.

5.4. Settlement Evaluation

Settlement of the subgrade soils due to the embankment construction was estimated for Brine Pond 4. Settlements were assessed to quantify the range of potential vertical deformation within the foundation soils caused by the increase in static load from the facilities. Elastic parameters of the granular soils were estimated based on blowcounts from the penetration tests, and consolidation parameters for the saturated clay materials were estimated from site specific laboratory test work from the Brine Pond 1 design (IGES, 2009; 2010a; 2010b). Estimates predict that one foot of settlement or less will occur for the maximum facility loading. This estimate of potential settlement is conservative in consideration of monitoring of eight settlement monuments around Brine Pond 1. In general, the monitoring data indicates that the majority of the facility has seen a slight settlement underneath the embankments with a maximum recorded movement of 0.8-in.

To monitor the settlement of the Brine Pond 4 embankment, eight (8) settlement monuments will be installed along the crest of the embankment. See Drawing A400 for details.

6. CONSTRUCTION QUALITY CONTROL AND CONSTRUCTION QUALITY ASSURANCE (CQC/CQA) PLAN

The “Magnum CQC/CQA Plan for Construction of Brine Ponds,” prepared by Hansen, Allen & Luce, Inc., February 2013, which was used for the construction of Brine Pond 1 and is included in Appendix G.

The technical specifications included in Appendix B of this report shall supersede all technical specifications included in the Hansen, Allen & Luce CQC/CQA plan.

7. REFERENCES

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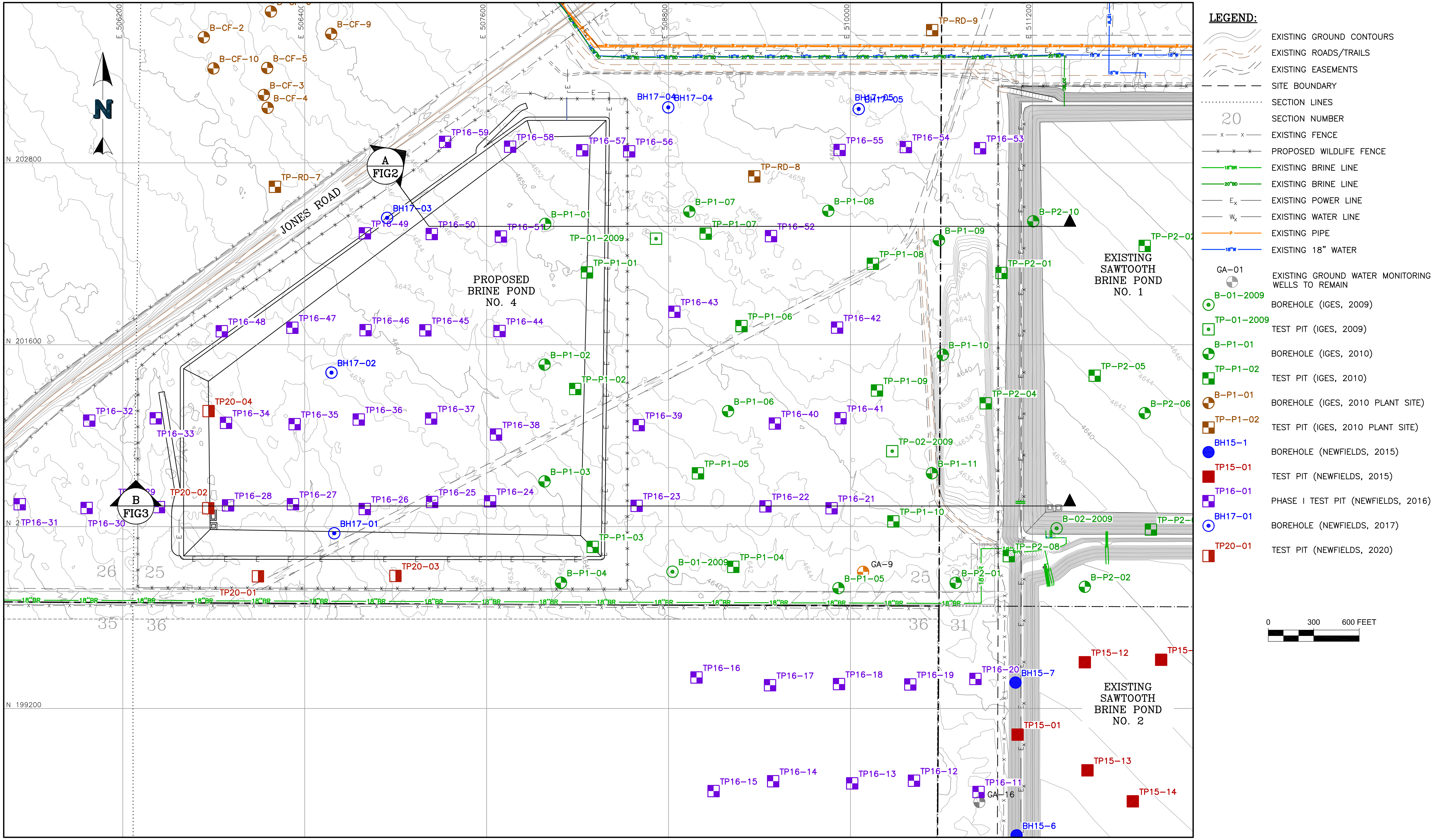
FIGURES



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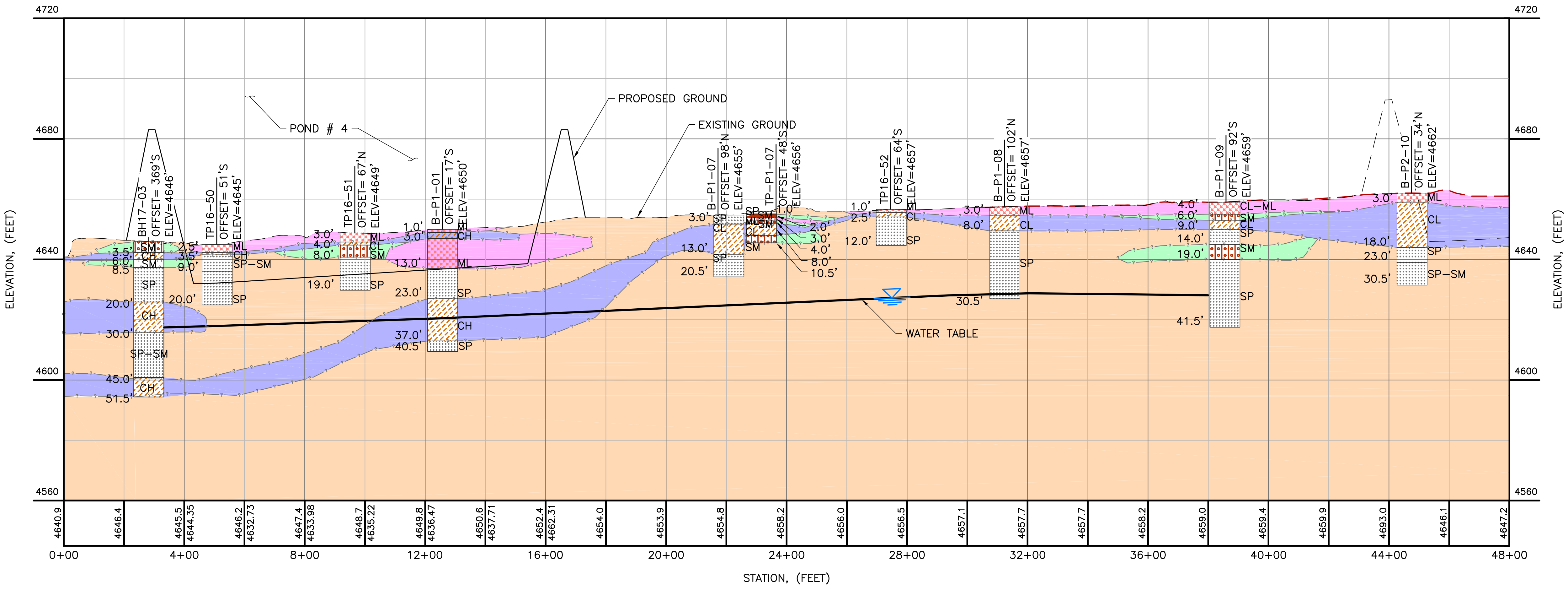
CLIENT
MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND NO. 4

TITLE
GEOTECHNICAL SECTIONS PLAN VIEW

FILENAME
Figure Geo 01

FIGURE NO.	REVISION
1	0



BORING LEGEND:

- ▨ CLAY (CL/CH)
- ▨ SILT (ML)
- ▨ POORLY GRADED SAND (SP)
- ▨ SILTY SAND (SM)
- ▨ CLAYEY SAND (SC)

INFERRED SOIL STRATIGRAPHY:

- 🟦 CLAY DOMINATED
- 🟪 SILT DOMINATED
- 🟧 SAND DOMINATED
- 🟩 SANDY SILT/ SILTY SAND

NOTES:

1. COLORED SHADING HAS NOT BEEN VERIFIED AND ONLY REPRESENTS MAJOR SOIL CLASSIFICATION INFERRED BY NEWFIELDS BASED ON BOREHOLE LOGS.

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CLIENT
MAGNUM SOLUTION
MINING, LLC

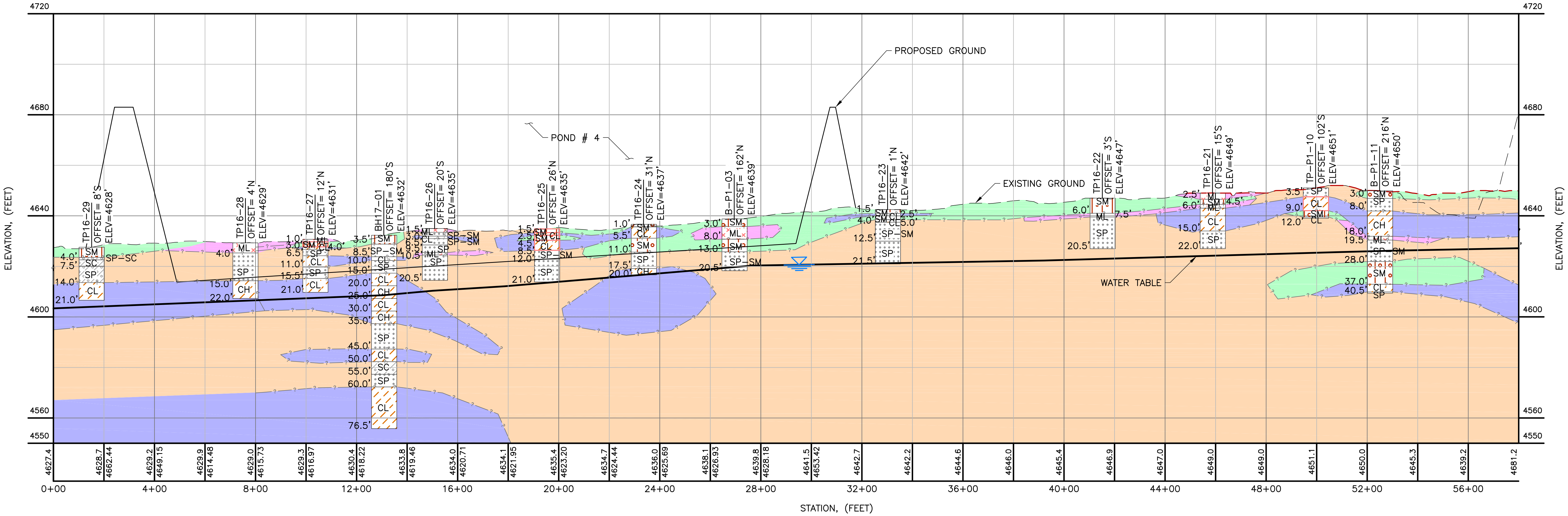
PROJECT
BRINE POND NO. 4

TITLE
GEOTECHNICAL SECTION A

FILENAME
Figure Geo 02

FIGURE NO.
2

REVISION
0



0 200 400 FEET
HORIZONTAL

0 20 40 FEET
VERTICAL

10X EXAGGERATION

BORING LEGEND:

▨	CLAY (CL/CH)
▨	SILT (ML)
▨	POORLY GRADED SAND (SP)
▨	SILTY SAND (SM)
▨	CLAYEY SAND (SC)

INFERRED SOIL STRATIGRAPHY:

🟦	CLAY DOMINATED
🟪	SILT DOMINATED
🟧	SAND DOMINATED
🟩	SANDY SILT/ SILTY SAND

NOTES:

1. COLORED SHADING HAS NOT BEEN VERIFIED AND ONLY REPRESENTS MAJOR SOIL CLASSIFICATION INFERRED BY NEWFIELDS BASED ON BOREHOLE LOGS.

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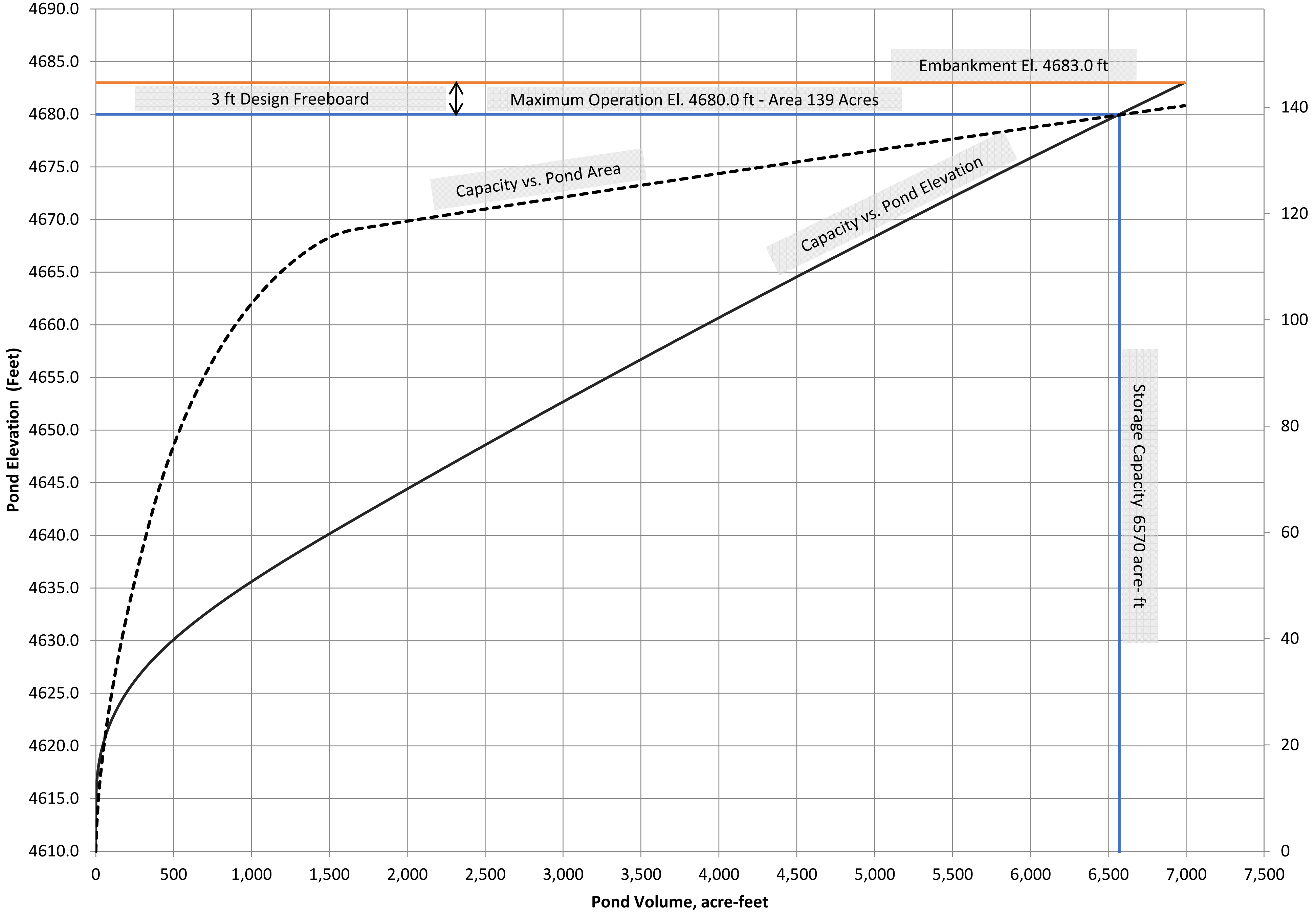
CLIENT MAGNUM SOLUTION MINING, LLC
PROJECT BRINE POND NO. 4
TITLE GEOTECHNICAL SECTION B
FILENAME Figure Geo 03
FIGURE NO. 3
REVISION 0

FIGURE 4 - Brine Pond 4 Filling Curve



TABLES

TABLE 1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR		UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (psf)	TRIAXIAL SHEAR (CU)				DIRECT SHEAR		SWELL-COLLAPSE POTENTIAL			CONSOLIDATION			PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)		Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	Compression Ratio	Recompression Ratio	Over Consolidation Ratio			Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
IGES - 2009																																
B 1	5	Poorly Graded SAND with silt	SP-SM	104.8	14.8				NP	NP	NP																					
B 1	10.5	Lean CLAY with sand	CL		17.1			71.0																								
B 1	15	Poorly Graded SAND	SP	109.7	5.1	1.7	95.0	3.3											44	174												
B 1	20	Poorly Graded SAND with silt	SP-SM		21.9	2.3	90.4	7.3																								
B 2	10	Lean CLAY with sand	CL						18	48	30																4.3E-08					
B 2	15	Clayey SAND	SC	105.5	9.0			21.0											36	770												
B 2	25	Poorly Graded SAND	SP	108.3	19.2														38	258												
B 2	30	Poorly Graded SAND	SP	107.6	20.5																											
B 2	35	Poorly Graded SAND with clay	SP-SC		22.8			9.0																								
B 2	40	Fat CLAY	CH		24.1																											
B 2	50	Fat CLAY with sand	CH	112.7	18.3			89.0	13	53	40																					
B 3	5	Sandy Lean CLAY	CL	108.5	23.8				18	35	17			4109													1.3E-07					
B 3	10	Silty SAND	SM	108.5	17.9	0.0	62.5	37.5														0.1	2000									
B 3	15	Silty SAND	SM		25.6																											
B 3	20	Silty SAND	SM	104.9	22.2																											
B 3	25	Sandy Lean CLAY	CL		22.5			56.0																								
B 3	30	Sandy Lean CLAY	CL		26.6																											
B 3	35	Sandy Fat CLAY	CH	96.9	26.5																											
B 3	40	Silty SAND	SM	98.1	25.9																											
B 3	50	Sandy Lean CLAY	CL						15	25	10																					
B 3	51	Poorly Graded SAND	SP		25.5																											
B 4	5	Sandy Lean CLAY	CL	103.6	4.6																	1.12	2000									
B 4	10	Poorly Graded SAND	SP	99.9	2.9	3.2	92.9	3.9											37	120												
B 4	15	Poorly Graded SAND	SP		4.0																											
B 4	20	Clayey SAND	SC	106.5	21.6			44.0																								
B 5	0	Silty SAND	SM									119.3	12.8															7.2				
B 5	10	Silty SAND	SM	107.1	6.0	0.0	84.4	15.6																								
B 5	15	Clayey SAND	SC	116.6	9.8			20.0																								
B 5	20	Sandy Lean CLAY	CL						14	33	19																					
B 6	5	Sandy Lean CLAY	CL	108.7	13.4				17	27	10										0.14		2000									
B 6	10	Sandy Lean CLAY	CL		17.9				15	38	23																					
B 6	15	Sandy Lean CLAY	CL	105.2	20.9									6058															2300	6400	73	8.2
B 6	20	Sandy Lean CLAY	CL		21.1				16	47	31																					
IGES - 2010 PLANT FACILITY																																
B-CF-1	5	Silt	ML	113	2.6																								160	670	480	9.36
B-CF-1	15	Tan Silty Sand	SM	96.4	8.3	0.7	73.8	25.5																								
B-CF-1	16.1	Tan Silty Sand	SM			0.7	73.8	25.5																								
B-CF-1	20	Lean CLAY	CL		16.6																											
B-CF-1	25	Lean CLAY	CL						36	20	16													0.102	0.019	4.1						
B-CF-1	35	Poorly graded Sand with silt	SP-SM	112.6	17.2	2.1	92.9	5																								
B-CF-1	40	Lean CLAY	CL		21.7				42	25	17																					
B-CF-2	4.5	Poorly graded Sand	SP																			0.47	1600									
B-CF-3	19.5	Lean CLAY	CL																			0.94	1600									
B-CF-4	4.5	Poorly graded Sand with silt	SP-SM	111.5	4.4																											
B-CF-4	14.5	Poorly graded Sand	SP	103	4.7																											
B-CF-4	19.5	Lean CLAY	CL	91.6	3.5																											
B-CF-5	9.5	Poorly graded SAND	SP																			0.37	1600									
B-CF-6	9.5	Clayey SAND	SC																			0.14	1600									
B-CF-7	4.5	Silty Sand	SM																			0.23	1600									
B-CF-8	9	Poorly graded SAND	SP			0.4	96.1	3.5																								
B-CF-9	4.5	Lean CLAY	CL																			1.08	1600									

TABLE 1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR		UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (psf)	TRIAXIAL SHEAR (CU)				DIRECT SHEAR		SWELL-COLLAPSE POTENTIAL			CONSOLIDATION			PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)		Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	Compression Ratio	Recompression Ratio	Over Consolidation Ratio			Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
B-CF-10	5	Lean CLAY	CL	107.3	16.1																0.4		1600	0.074	0.012	30.3						
B-CF-10	15	Poorly graded SAND	SP	101.7	2.2			2.7																								
B-CF-10	20	Silty SAND	SM		6.1																											
B-CF-10	25	Lean CLAY	CL						26	11	15													0.065	0.018	5.3						
B-CF-10	40	Lean CLAY	CL		23.3				37	21	16																					
B-LF-2	9.5	Lean CLAY	CL						27	11	16											0.22	1600						6100	2600	85	8.89
B-LF-2	19.5	Lean CLAY	CL																			0.28	3200									
B-LF-3	4.5	Poorly graded SAND	SP	101.9	2.5			4.8																								
B-LF-4	4.5	Poorly graded fine SAND	SP	103.4	2.4																											
B-LF-4	14.5	Lean CLAY	CL						38	24	14										0.26		1600									
B-LF-6	4.5	Silty fine SAND	SM	113.3	11.9																											
B-LF-6	14.5	Poorly Graded SAND	SP	106.2	7.6																											
B-LF-7	14.5	Lean Clay	CL																		0.45		1600									
B-LF-8	9.5	Silty fine SAND	SM																			0.28	3200									
B-LF-8	19.5	Poorly graded SAND with clay	SP-SC	102.7	22.6																								25	120	1900	8.8
B-LF-8	29.5	Clayey SAND	SC																					0.043	0.006	4.6						
B-LF-8	39.5	Lean CLAY	CL																					0.092	0.019	2.78						
B-OW-1	9.5	Poorly graded fine SAND	SP																			0.36	1600									
B-OW-2	9.5	Lean CLAY	CL						27	10	17													0.06	0.053	17.4						
B-OW-3	9.5	Lean CLAY	CL						45	29	16													0.086	0.033	18.5						
B-OW-4	14.5	Lean CLAY	CL						35	18	17																					
B-OW-5	9.5	Lean CLAY	CL																					0.108	0.029	14.9						
B-OW-7	9.5	Lean CLAY	CL																					0.09	0.028	18.1						
B-OW-7	19.5	Poorly graded find SAND	SP	107.8	19.1																											
B-OW-7	29.5	Silty SAND	SM	105.7	22.2	0	66.4	33.6																								
B-OW-8	4.5	Silty fine SAND	SM	101.5	6.3																											
B-OW-8	19	Poorly graded SAND	SP		20.3	2.2	93.8	4																								
B-WP-1	0	Silty fine SAND	SM		5.7																											
B-WP-1	5	Poorly graded SAND	SP	88.4	20.8																											
B-WP-1	10	Silty Clay	CL-ML		29.2																											
B-WP-1	15	Silty fine SAND	SM		13.7																											
B-WP-1	25	Poorly graded medium SAND	SP	102.7	23.3																											
B-WP-1	35	Poorly graded medium SAND	SP	115.9	16.5																											
B-WP-2	5	Silty SAND	SM																					0.05	0.004	30.9						
B-WP-2	10	Poorly graded SAND	SP-SM	88.9	5.5	0.3	89.4	10.3																								
B-WP-2	15	Sandy Lean CLAY	CL						29	9	20											0.03		0.092	0.009	3.06						
B-WP-2	25	Lean CLAY	CL						30	9	21													0.078	0.007	6.3						
B-WP-2	35	Silty SAND	SM	109.2	19.8	0	86.5	13.5																								
B-WP-3	5	Lean CLAY	CL						25	11	14													0.092	0.01	21.3						
B-WP-3	15	Lean CLAY	CL		15.5				27	15	12																					
B-WP-3	20	Lean CLAY	CL		25																											
B-WP-3	25	Poorly graded medium SAND	SP	105.9	21.5																											
B-WP-3	30	Silty fine SAND	SM		26.9																											
B-WP-3	35	Lean CLAY	CL						35	20	15													0.096	0.02	2.59						
B-WP-4	0	Silty fine SAND	SM		5.7																											
B-WP-4	5	Silty medium and fine SAND	SM	96.8	4.4	0	80.9	19.1																								
B-WP-4	10	Silty medium and fine SAND	SM		6.3																											
B-WP-4	15	Silty medium and fine SAND	SM	112.9	18.2																											
IGES - 2010 BRINE PONDS (Sawtooth Brine Pond 1 and area west of it)																																
B P1 01	4.5	Sandy SILT	ML	100.4	9.0	0.0	34.0	66.0														0.17	3200									
B P1 01	14.5	Poorly Graded SAND	SP	104.6	2.0		98.2	1.8																								
B P1 01	24.5	Sandy Lean CLAY	CL	109.0	18.0				17	26	9													0.033	0.006	0.82						

TABLE 1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR		UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (psf)	TRIAXIAL SHEAR (CU)				DIRECT SHEAR		SWELL-COLLAPSE POTENTIAL			CONSOLIDATION			PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)		Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	Compression Ratio	Recompression Ratio	Over Consolidation Ratio			Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
B P1 02	9.5	Silty SAND	SM	98.7	9.2			44.1																								
B P1 02	19.5	Poorly Graded SAND	SP	104.9	8.4																											
B P1 02	24	Fat CLAY	CH		22.7				17	51	34																					
B P1 02	29.5	Poorly Graded SAND	SP	106.3	20.8																											
B P1 02	49	Lean CLAY	CL		27.6				18	38	20																					
B P1 02	54	Poorly Graded SAND	SP	109.7	17.1			3.2																								
B P1 02	64	Lean CLAY	CL	99.1	26.6				14	35	21													0.097	0.034	0.93						
B P1 02	74.5	Lean CLAY	CL	97.1	26.7				17	27	10													0.09	0.02	0.56						
B P1 02	84	Poorly Graded SAND with silt	SP-SM	104.3	20.8				NP	NP	NP													0.028	0.004	0.85						
B P1 03	9.5	Silty SAND	SM	115.3	12.3				NP	NP	NP																					
B P1 03	19	Poorly Graded SAND with silt	SP-SM			1.6	93.2	5.2																								
B P1 04	5	Poorly Graded SAND with silt	SP-SM	88.2	12.8																	9.2	3200									
B P1 04	15	Poorly Graded SAND	SP	103.2	3.0														40	36												
B P1 04	25	Poorly Graded SAND with silt	SP-SM	115.4	16.3	5.3	88.0	6.7																								
B P1 04	35	Silty Lean CLAY with sand	CL-ML	112.4	17.1														28	1364												
B P1 05	4.5	Silty SAND	SM	102.7	9.3				NP	NP	NP											0.24	3200									
B P1 05	10.5	Silty SAND	SM		4.9			18.6																								
B P1 05	25	Poorly Graded SAND	SP	106.8	19.4														37	322												
B P1 06	4.5	Lean SILT	ML	97.1	11.4																0.18		3200	0.05	0.01	20.1						
B P1 06	14.5	Sandy Lean SILT	SM	96.4	11.0	0.0	49.2	50.8											33	330												
B P1 06	24	Poorly Graded SAND	SP	98.2	25.5																											
B P1 07	9.5	Lean CLAY	CL	105.2	21.1				19	48	29													0.096	0.023	8.3						
B P1 07	19.5	Poorly Graded SAND	SP		2.1	1.6	96.1	2.3																								
B P1 08	8.5 & 14	Poorly Graded SAND	SP			0.7	96.5	2.8											32	144												
B P1 08	19	Poorly Graded SAND	SP		1.7	3.6	93.2	3.2																								
B P1 09	5.5	Silty SAND	SM	103.6	13.3				NP	NP	NP											0.16	3200									
B P1 09	15.5	Silty SAND	SM	107.9	8.9			30.3																								
B P1 09	25.5	Poorly Graded SAND	SP	97.7	5.1																											
B P1 10	9.5	Lean CLAY	CL	109.6	17.0				19	28	9										0.31		3200	0.056	0.009	9						
B P1 10	19.5	Poorly Graded SAND with silt	SP-SM	98.1	2.0														34	339												
B P1 10	24 & 30	Poorly Graded SAND with silt	SP-SM			4.6	89.6	5.8											32	206												
B P1 10	39.5	Pooryl Graded SAND	SP	113.7	17.9			68.7																								
B P1 10	54.5	Sandy Lean CLAY	CL	102.5	23.5				15	30	15													0.094	0.012	0.87						
B P1 10	64.5	Poorly Graded SAND with silt	SP-SM	109.2	19.0			6.6																								
B P1 10	69.5	Fat CLAY	CH	99.6	25.7				22	57	35													0.088	0.03	0.84						
B P1 10	84.5	Lean CLAY	CL	107.3	20.7				18	26	8				36.2	87.0	40.1	0.0														
B P1 10	89.5	Fat CLAY	CH	107.5	20.6				17	52	35				25.8	678.0	25.8	0.0														
B P1 11	9.5	Fat CLAY	CH	104.6	22.3				20	54	34				26.2	760.0	26.8	489.0														
B P1 11	19.5	Lean Silt	ML	102.0	3.8	2.2	85.7	12.1											37	255												
B P1 11	29.5	Silty SAND	SM	85.3	34.0	0.0	70.2	29.8																								
B P1 11	39.5	Lean CLAY	CL	111.5	18.2				17	32	15													0.05	0.011	1.25						
B P2 01	5	Poorly Graded SAND with silt	SP-SM	96.6	2.6			9.2																								
B P2 01	15	Fat CLAY	CH	107.3	20.9				17	51	34																					
B P2 01	25	Pooryl Graded SAND	SP	98.9	24.4			3.3																								
B P2 02	5	Sandy Lean SILT	ML	111.9	10.9				15	17	2											0.29	3200									
B P2 02	15	Poorly Graded SAND	SP	105.4	20.7	0.0	96.5	3.5																								
B P2 03	5	Lean CLAY	CL	90.0	23.9				21	33	12										0.03		3200	0.046	0.008	14						
B P2 03	15	Lean SILT	ML	97.3	26.2	0.0	8.0	92.0											34	488												
B P2 04	5	Silty SAND	SM	102.5	23.2			97.6																								
B P2 04	15	Lean CLAY	CL	96.6	26.2				17	34	17				34.1	330.0	23.9	377.0														
B P2 04	25	Poorly Graded SAND	SP	107.8	8.6			2.8											32	924												
B P2 05	9.5	Silty SAND	SM	100.9	5.3			12.9																								

TABLE 1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR		UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (psf)	TRIAXIAL SHEAR (CU)				DIRECT SHEAR		SWELL-COLLAPSE POTENTIAL			CONSOLIDATION			PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)		Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	Compression Ratio	Recompression Ratio	Over Consolidation Ratio			Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
B P2 05	29.5	Poorly Graded SAND with silt	SP-SM	103.5	22.9			20.1											37	634												
B P2 05	40	Poorly Graded SAND with silt	SP-SM	105.3	21.0	0.8	94.0	5.2																								
B P2 06	4	Poorly Graded SAND	SP	97.8	1.7	0.7	97.8	1.5																								
B P2 06	14	Lean SILT	ML	94.9	12.1				23	26	3											0.18	3200									
B P2 06	34	Pooryl Graded SAND	SP	107.8	20.1			2.0																								
B P2 07	9.5	Silty SAND	SM	120.2	9.4			42.1														0.18	3200									
B P2 07	19.5	Sandy Lean CLAY	CL	105.4	19.4				17	26	9											0.13	3200									
B P2 07	39	Poorly Graded SAND	SP			3.4	94.5	2.1																								
B P2 07	40	Poorly Graded SAND	SP		20.2																											
B P2 07	79	Fat CLAY	CH	94.9	27.3				18	61	43													0.13	0.04	0.61						
B P2 08	5	Silty SAND	SM	96.0	4.0	0.0	80.7	19.3											32	72												
B P2 08	15	Fat CLAY	CH	102.3	23.1				19	51	32																					
B P2 08	20	Lean CLAY	CL		21.5				18	27	9																					
B P2 08	35	Poorly Graded SAND	SP	108.6	19.2																											
B P2 09	4.5	Poorly Graded SAND with silt	SP-SM	105.7	2.8	3.3	88.8	7.9																								
B P2 09	14.5	Lean CLAY	CL	99.3	18.5				18	26	8																					
B P2 09	24	Poorly Graded SAND	SP		2.4			1.0																								
B P2 10	4.5	Lean CLAY	CL	97.3	16.9				18	28	10											0.13	3200									
B P2 10	24	Poorly Graded SAND with silt	SP-SM		2.2	0.0	94.0	6.0																								
B P3 01	5	Sandy Lean CLAY	CL	111.5	6.1				14	27	13								26	498		0.89	3200	0.058	0.007	11						
B P3 01	24.5	Sandy Lean CLAY	CL	95.5	28.1				17	29	12													0.1	0.011	2.04						
B P3 02	9.5	Poorly Graded SAND with silt	SP-SM	97.8	25.2	0.0	92.7	7.3											34	471												
B P3 02	19.5	Poorly Graded SAND	SP	106.3	19.8	3.7	94.1	2.2																								
B P3 03	4.5	Poorly Graded SAND with silt	SP-SM	102.7	3.6	0.0	88.3	11.7																								
B P3 03	14.5	Poorly Graded SAND with silt	SP-SM	113.9	11.0	6.3	85.6	8.1																								
B P3 03	20	Lean CLAY	CL	107.1	19.7				14	34	20				19.6	1812.0	9.6	3420.0														
B P3 03	24.5	Lean CLAY	CL	104.6	20.6																			0.085	0.022	2.9						
B P3 04	9.5	Fat CLAY	CH	99.9	22.6				15	51	36										0.69		3200	0.124	0.037	8.6						
B P3 05	4.5	Silty SAND	SM	101.6	4.1	0.2	78.3	21.5																								
B P3 05	14.5	Lean CLAY	CL	100.2	22.7				17	35	18										0.28		3200	0.088	0.017	4.5						
B P3 05	20	Lean CLAY	CL	106.8	22.9				18	37	19				31.8	119.0	15.5	2902.0														
B P3 05	24	Poorly Graded SAND	SP		21.6	0.7	96.5	2.8																								
B P3 05	34.5	Poorly Graded SAND with silt	SP-SM	109.9	18.7	10.0	79.1	10.9																								
B P3 06	9.5	Silty SAND	SM	96.6	6.9				NP	NP	NP											0.36	3200									
B P3 06	29.5	Poorly Graded SAND	SP	103.9	22.2														36	312												
B P3 06	39.5	Lean CLAY	CL	111.3	17.7				14	24	10				35.6	136.0	33.0	0.0														
B P3 06	64	Poorly Graded SAND with silt	SP-SM	107.5	18.6				NP	NP	NP													0.025	0.008	1.3						
B P3 06	69.5	Lean CLAY	CL	120.0	24.0				19	52	33				30.6	162.0	25.1	0.0														
B P3 06	74.5	Lean CLAY	CL	106.3	22.3				18	49	31													0.087	0.02	1.06						
B P3 06	94.5	Lean CLAY	CL	100.6	24.6				17	37	20													0.089	0.01	0.84						
B P3 06	99.5	Lean CLAY	CL	104.4	22.7				18	54	36													0.086	0.028	0.59						
B P3 07	5	Lean CLAY	CL	107.5	19.7																0.02		3200									
B P3 07	15	Poorly Graded SAND	SP	101.9	23.6	0.9	95.4	3.7																								
B P3 07	25	Lean CLAY	CL	110.5	17.9																											
B P3 08	5	Clayey SAND	SC	110.6	13.0	0.2	72.7	27.1	20	35	15											0.2	3200									
B P3 09	5	Lean SILT	ML	85.1	19.7				22	24	2											0.48	3200									
B P3 09	15	Silty Lean CLAY	CL-ML	91.9	29.4				NP	NP	NP													0.085	0.008	5.3						
B P3 09	20	Silty Lean CLAY	CL-ML		27.7				21	27	6																					
B P3 10	5	Lean CLAY	CL	93.6	21.7				20	51	31				29.5	299.0	22.2	132.0														
B P3 11	5	Lean CLAY	CL	89.0	29.6				22	38	16				33.2	0.0	40.8	0.0														
B P3 11	15	Lean CLAY with sand	CL	101.8	21.9				15	36	21				36.4	0.0	29.4	0.0														
B P3 11	25	Silty Lean CLAY	CL-ML	98.8	25.2				15	29	14				34.8	0.0	34.2	0.0														

TABLE 1 - BOREHOLE LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR		UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (psf)	TRIAXIAL SHEAR (CU)				DIRECT SHEAR		SWELL-COLLAPSE POTENTIAL			CONSOLIDATION			PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)		Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	Compression Ratio	Recompression Ratio	Over Consolidation Ratio			Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
B P3 11	35	Lean SILT with sand	ML	92.3	29.2				21	23	2													0.114	0.01	2.4						
NewFields 2015 - Sawtooth Brine Pond 2																																
BH-15-1	5 - 6.5	poorly graded SAND	SP		3.8	0.5	94.3	5.2																								
BH-15-1	25-26.5	lean CLAY	CL		24.7	0	15.1	84.9	22	30	8																					
BH-15-2	7.5-9	poorly graded SAND w/ silt	SP-SM		**	0.6	91	8.4																								
BH-15-2	35-36.5	lean CLAY w/ sand	CL		29	0	16.8	83.2	22	44	22																					
BH-15-3	2.5-4	poorly graded SAND w/ silt	SP-SM		3.5	1.9	87.6	10.5																								
BH-15-3	10-11.5	SILT w/ sand	ML		16.5	0.1	18.7	81.2	NP	NP	NP																					
BH-15-3	15-16.5	sandy lean CLAY	CL		26.3	0.9	45.4	53.7	18	28	10																					
BH-15-4	2.5-4	lean CLAY	CL		21.4	0	4.9	95.1	18	45	27																					
BH-15-4	7.5-9	lean CLAY	CL		27.4	0	4.4	95.6	19	44	25																					
BH-15-4	10-11.5	SILT	ML		**	0	4.3	95.7																								
BH-15-4	20-21.5	lean CLAY	CL		34.1	0	15.3	84.7	21	38	17																					
BH-15-5	5-6.5	lean CLAY	CL		18.6	0	0.8	99.2	15	31	16																					
BH-15-5	15-16.5	SILT w/ sand	ML		19.9	0	20.8	79.2	20	22	2																					
BH-15-5	25-26.5	silty SAND	SM		20.6	1.6	58.9	39.5																								
BH-15-6	2.5-4	silty SAND	SM		9.9	0	51.1	48.9	NP	NP	NP																					
BH-15-6	5-6.5	silty SAND	SM		7.9	0.5	76.4	23.1																								
BH-15-6	20-21.5	slity SAND	SM		18.6	0.2	50.8	49																								
BH-15-7	2.5-4	SILT w/ sand	ML		5.5	0	21.3	78.7	NP	NP	NP																					
BH-15-7	10-11.5	slity SAND	SM		4.3	0	84.9	15.1																								
NewFields 2017 - Brine Ponds 3 and 4																																
BH-17-01	1 - 2.5				7.7																											
BH-17-01	3.5 - 4.5	silty SAND	SM	100.7	5.9	5.9	80.2	13.9	NP	NP	NP								34	454												
BH-17-01	8.5 - 9.5	Clayey SAND	SC	103.8	10.4	1.4	70.9	27.7	15	24	9													0.16		2.1						
BH-17-01	15 - 16.5	lean CLAY	CL		19.1	0	13.1	86.9	11	25	14																					
BH-17-01	20 - 21	lean CLAY	CL	101.3	24.3	0	11.2	88.8	12	38	26																					
BH-17-02	1 - 2.5	silty, clayey SAND	SC-SM		7.8	5.9	71.5	22.6	10	17	7																					
BH-17-02	3.5 - 4.5	sandy lean CLAY	CL	94.9	10.7	0.7	46.6	52.7	13	24	11																					
BH-17-02	8.5 - 9	poorly graded SAND	SP		3.3	1.6	92.8	5.6	NP	NP	NP								34	74												
BH-17-02	15 - 16.5	poorly graded SAND	SP		2.2																											
BH-17-02	20 - 21	fat CLAY	CH		20.9																											
BH-17-03	1 - 2.5	silty SAND	SM		6.2																											
BH-17-03	3.5 - 4.5	fat CLAY w/ sand	CH	107.1	18.4	0	20.6	79.4	21	62	41													0.22		1.8						
BH-17-03	6 - 7.5	Silty SAND	SM		7.0	0	56.9	43.1	NP	NP	NP																					
BH-17-03	8.5 - 9	poorly graded SAND	SP		8.6																											
BH-17-03	20 - 21	fat CLAY	CH		7.7																											
BH-17-04	3.5 - 4.5	lean CLAY	CL	110.3	17.1	0	8.4	91.6	15	30	15								24	445												
BH-17-04	8.5 - 9.5	poorly graded SAND	SP	102.2	6.1	0	86.4	13.6	NP	NP	NP																					
BH-17-04	15 - 16.5	fat CLAY	CH		9.7																											
BH-17-04	20 - 20.5	poorly graded SAND	SP		2.6																											
BH-17-05	1 - 2.5	silty SAND	SM		7.9																											
BH-17-05	3.5 - 4.5	sandy lean CLAY	CL	111.6	17.2	0	23.3	76.7	17	29	12																					
BH-17-05	8.5 - 9.5	lean CLAY	CL	107.9	21.3	0	13.5	86.5	16	27	11								27	523												
BH-17-05	15 - 16.5	silty SAND	SM		9.0																											
BH-17-05	20 - 21	poorly graded SAND w/ silt	SP-SM		5.6																											
MINIMUM				**85.1**	**1.7**	**0.0**	**0.8**	**1.0**	**10.0**	**9.0**	**2.0**	**119.3**	**12.8**	**4109.0**	**19.6**	**0.0**	**9.6**	**0.0**	**24.4**	**36.0**	**0.0**	**0.0**	**1600.0**	**0.03**	**0.00**	**0.56**	**4.3E-08**	**7.2**	**25.0**	**120.0**	**73.0**	**8.2**
MAXIMUM				**120.2**	**34.1**	**10.0**	**98.2**	**99.2**	**45.0**	**62.0**	**43.0**	**119.3**	**12.8**	**6058.0**	**36.4**	**1812.0**	**40.8**	**3420.0**	**44.0**	**1364.0**	**0.7**	**9.2**	**3200.0**	**0.22**	**0.05**	**30.90**	**1.3E-07**	**7.2**	**6100.0**	**6400.0**	**1900.0**	**9.4**
AVERAGE				**103.7**	**15.8**	**1.2**	**65.8**	**31.9**	**20.0**	**32.6**	**18.1**	**119.3**	**12.8**	**5083.5**	**31.2**	**365.3**	**27.2**	**610.0**	**33.8**	**400.6**	**0.3**	**0.7**	**2594.3**	**0.08**	**0.02**	**7.25**	**8.7E-08**	**7.2**	**2146.3**	**2447.5**	**634.5**	**8.8**

Notes:

NP Non Plastic

TABLE 2 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)	MULTI-STAGED PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)				Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
IGES - 2009																																	
TP 1	1.5	Lean CLAY	CL						16	32	16	101.6	21.3							23.0	380.0												
TP 1	3	Fat CLAY	CH	102.2	17.9																			0.38		2000							
TP 2	2.5	Fat CLAY	CH						16	53	37	96.1	26.4							25.0	256.0						5E-08						
TP 2	5	Clayey SAND	SC	102.2	12.5																												
TP 2	9	Fat CLAY	CH	98.3	19.5																				1.38	2000							
TP 3	1	Sandy Lean CLAY	CL						13	28	15	111	16.6							27.0	220.0				0.62	2000							
TP 3	2	Sandy Lean CLAY	CL	86.6	12.3																												
TP 4	1.5	Lean CLAY	CL						20	49	29	92.5	27.2							20.0	372.0				8.67	2000	2E-06						
TP 4	3	Fat CLAY	CH						25	51	26																						
TP 5	0.5	Silty CLAY	CL ML						15	21	6	118.6	12.5																				
TP 5	2.5	Poorly Graded SAND	SP		1.8	0.1	97.3	2.6																									
TP 6	3.5	Lean CLAY	CL						20	46	26	97.2	25.3																				
TP 6	5.5	Clayey SAND	SC	99.0	15.2																				1.62	2000							
IGES - 2010																																	
TP-RD-1	2.0	Sandy Silt	ML		7.8	0.2	36.1	63.7				108.7	16.3																7.9				
TP-RD-1	3.0	Sandy Silt	ML																						6.02	1600							
TP-RD-2	2.0	Silty Sand	SM		5.7	1.4	84.0	14.6				114.8	11.7																19.2				
TP-RD-2	4.0	Poorly Graded SAND with silt	SP-SM		3.3	0.8	90.9	8.3																						250	430	600	9.73
TP-RD-3	1.5	Silty Sand	SM		4.2	2.7	77.6	19.7				114.3	11.2																7.1				
TP-RD-3	2.0	Silty Sand	SM																						6.08	1600							
TP-RD-3	3.5	Silty Sand	SM		4.5	2.0	82.6	15.4																						190	270	600	10.1
TP-RD-4	2.0	Sandy Silt	ML		8.4	0.4	40.3	59.3				115.9	12.7																12				
TP-RD-4	4.0	Sandy Silt	ML																						9.28	1600							
TP-RD-4	8.0	Fat CLAY	CH						18	70	52													0.26						1800	1800	130	9.01
TP-RD-5	1.5	Silty Sand	SM		4.6	0.4	83.3	16.3				113.4	12.7																15.1				
TP-RD-5	5.0	Poorly Graded SAND	SP						NP	NP	NP																			46	9	3400	10.3
TP-RD-6Pa	5.0	Poorly Graded SAND	SP		2.0	0.8	95.0	4.2																						270	320	810	10
TP-RD-6Pb	2.0	Silty Sand	SM		3.2	1.0	79.6	19.4				118.2	11.4																8.3				
TP-RD-6Pc	4.0	Poorly Graded SAND with silt	SP-SM		3.3	1.4	87.1	11.5																									
TP-RD-6Pc	8.0	Lean CLAY	CL						17	44	27																2E-08						
TP-RD-6Pd	3.5	Silty SAND	SM		5.3	1.9	69.2	28.9																									
TP-RD-7	2.0	Sandy Silt	ML		12.1	0.2	47.9	51.9				105.6	17.4																10.6				
TP-RD-7	6.0	Silty Sand	SM																											530	4200	110	8.07
TP-RD-8	2.5	SILT with SAND	ML		11.9	0.0	28.2	71.8				110	17.1																5				
TP-RD-9	2.5	Sandy Silt	ML		8.8	0.0	42.0	58.0				106.2	16.8																7.5				
TP-RD-9	9.5	Sandy Lean CLAY	CL						17	41	24																			4900	3600	100	7.99
TP-RD-10	2.5	Poorly Graded SAND with silt	SP-SM		1.7	0.2	92.9	6.9				103.2	14.4																12.6				
TP-RD-10	9.5	Silty Sand	SM																											900	1200	160	9.91
TP P1 1	2	Silty SAND	SM		7.1	1.4	67.3	31.3																									
TP P1 1	3	Lean CLAY	CL	104.3	16.1				23	47	24																5.4E-05	7.8E-05					
TP P1 1	5	Sandy Lean CLAY	CL		13.0				14	30	16																						

TABLE 2 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)	MULTI-STAGED PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)				Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
TP P1 1	7	Sandy Lean CLAY	CL		18.7				15	37	22																						
TP P1 2	1	Clayey SAND	SC			0.8	51.3	47.9				113.4	14.3																				
TP P1 2	4	Fat CLAY	CH			0.0	5.1	94.9				102.8	20.3																				
TP P1 2	5	Fat CLAY	CH	95.1	19.7				15	39	24																5.3E-05	9.1E-05					
TP P1 3	4	Silty SAND	SM	97.2	17.2	3.5	41.2	55.3																									
TP P1 3	12.5	Lean SILT	ML		8.8				NP	NP	NP																						
TP P1 4	3	Lean CLAY	CL	101.3	19.2				17	46	29																1.2E-04	1.5E-04					
TP P1 5	2	Sandy Lean CLAY	CL		15.7				18	42	24																						
TP P1 6	3	Sandy Lean CLAY	CL	103.8	16.0																						3.1E-04	3.4E-04					
TP P1 7	5	Lean CLAY	CL	97.7	17.4																						1.2E-04	1.3E-04					
TP P1 8	2	Fat CLAY	CH		18.9				19	50	31																						
TP P1 8	11	Lean CLAY	CL		22.8				18	35	17																						
TP P1 9	2.5	Clayey SAND	SC	102.9	11.5				12	25	13																4.8E-05	5.0E-05					
TP P1 9	3	Clayey SAND	SC			0.4	30.0	69.6				111.7	16.1																				
TP P1 9	11	Silty Clayey SAND	SC SM			2.2	35.6	62.2	15	21	6																						
TP P1 10	4.5	Lean CLAY	CL	101.0	24.8				17	35	18																6.9E-06	9.9E-06					
TP P2 1	5	Lean CLAY	CL	106.6	17.6				15	35	20																9.1E-07	1.3E-06					
TP P2 1	7	Lean CLAY	CL		17.7				16	33	17																						
TP P2 2	9	Fat CLAY	CH		22.2				20	51	31																						
TP P2 3	4.5	Poorly Graded SAND with Silt	SP SM		3.6	0.0	90.8	9.2																									
TP P2 4	2	Silty SAND	SM			0.2	71.1	28.7				111.8	11.8																				
TP P2 4	8.5	Lean CLAY	CL		22.9				16	33	17																						
TP P2 5	12.5	Sandy Lean CLAY	CL		17.5				15	28	13																						
TP P2 6	11.5	Lean CLAY	CL		24.6				19	47	28																						
TP P2 7	11.5	Lean CLAY	CL	88.1	23.3				17	49	32																1.4E-04	1.5E-04					
TP P2 8	2.5	Fat CLAY	CH	99.1	21.5				18	54	36																8.5E-05	1.1E-04					
TP P2 8	8	Sandy Lean CLAY	CL		15.7	0.0	32.4	67.6																									
TP P2 9	8	Lean CLAY	CL		31.3				18	33	15																						
TP P2 10	3	Fat CLAY	CH			0.0	1.4	98.6				84.6	33.2																				
TP P2 10	4	Fat CLAY	CH	78.0	42.3				21	53	32																1.5E-06	2.5E-06					
TP P2 10	10.5	Lean CLAY	CL		35.4				21	45	24																						
TP P3 1	4	Sandy Lean CLAY	CL	107.6	19.8				15	34	19																1.1E-04	1.1E-04					
TP P3 2	4	Fat CLAY	CH			0.0	5.2	94.8				94.7	23.8																				
TP P3 2	5	Fat CLAY	CH	87.4	31.4				22	63	41																1.3E-07	3.1E-07					
TP P3 2	10	Sandy Silty CLAY	CL ML		27.4				17	23	6																						
TP P3 3	4.5	Lean CLAY	CL	96.2	17.9	0.0	9.1	90.9																			1.3E-05	3.2E-05					
TP P3 4	3.5	Sandy CLAY with Silty Sand	CL	91.8	19.7				15	43	28																1.4E-05	2.7E-05					
TP P3 4	7	Poorly Graded SAND with Silt	SP SM		11.1				NP	NP	NP																						
TP P3 5	4	Sandy Lean CLAY	CL	98.0	1.8				22	30	8																1.3E-04	1.3E-04					
TP P3 5	6	Sandy Lean CLAY	CL		10.1				19	30	11																						
TP P3 5	11	Sandy Lean CLAY	CL		23.3				18	33	15																						
TP P3 6	3	Lean SILT	ML	95.1	22.2				23	27	4																8.5E-08	1.4E-07					
TP P3 7	3.5	Sandy SILT	ML		13.0				23	26	3																						
TP P3 9	4	Clayey SAND	SC			0.6	82.6	16.8				115.6	12.7																				

TABLE 2 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)	MULTI-STAGED PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)				Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
TP P3 9	5	Clayey SAND	SC	103.6	14.6				15	27	12																2.0E-05	2.5E-05					
TP P3 10	3	Sandy CLAY	CL	95.1	18.3				13	26	13																1.1E-04	1.5E-04					
TP P3 10	6.5	Fat CLAY	CH	103.8	19.2				16	52	36																3.3E-08	4.5E-08					
NewFields 2015																																	
TP15-2	10	lean CLAY	CL		26.4	0	12.3	87.7	19	43	24																						
TP15-3	5	silty SAND	SM		8.8	0.0	59.9	40.1				101.2	18.3																				
TP15-5	3	lean CLAY	CL		34.1	0	3.6	96.4	22	46	24	88.8	31.7																				
TP15-5	9	slity SAND	SM		9.9	0.5	70	29.5																									
TP15-6	8	lean CLAY	CL		20.7	0.2	25.3	74.5	18	34	16	106.2	20.3																				
TP15-8	3	fat CLAY	CH		32.4	0	1.2	98.8	22	53	31																						
TP15-9	16	lean CLAY	CL		35.9	0	1.8	98.2	23	49	6	86.4	34.8																				
TP15-9	12 & 16	composite of (2) LD samples			**	0.3	49.8	49.9				101.5	22.4			30.0	514.1	18.8	1120.3														
TP15-11	6	silty SAND	SM		11.4	0.3	59.5	40.2	NP	NP	NP	106	18.1							31.8	665.0	30.8	371.0										
TP15-13	4	lean CLAY	CL		20.4	0	2.3	97.7	19	41	22																						
TP15-14	7	lean CLAY w/ sand	CL		34.0	0.5	28	71.5	14	31	17																						
NewFields 2016																																	
TP-16-01	5-6.5	Poorly Graded sand with silt	SP-SM		7.7	0.1	91.7	8.2	NP	NP	NP																						
TP-16-04	0-1	Silty sand	SM		6.3	0	52.1	47.9																									
TP-16-06	1-2	Lean clay	CL		21.6	0	6.9	93.1	22	44	22																						
TP-16-08	1.5-2.5	Clayey SAND	SC		6.3	1.2	65.7	33.1	14	24	10																						
TP-16-08	8.5-9	Poorly graded sand	SP		1.4	1.7	96.7	1.5	NP	NP	NP																						
TP-16-11	7-8	Lean Clay	CL		19.2	2.3	13	84.7	14	33	19			115.8	14.4												2E-07						
TP-16-12	5-6	Silt	ML		15.3	0.1	12.7	87.2						111.3	15.9																		
TP-16-15	6.5-7	Lean Clay	CL		24.4	1.3	30.9	67.8	19	44	25			107.3	18.6					30.0	226.0												
TP-16-16	5-6	Silty Sand	SM		6.9	2.6	81.4	16.0	NP	NP	NP																						
TP-16-18	5-6	Lean Clay with sand	CL		19.0	0.1	17.5	82.4	14	35	21																						
TP-16-19	0.5-2				15.1																												
TP-16-19	3-5	Sandy Lean CLAY	CL		11.2	0.5	34.3	65.2	14	30	16																						
TP-16-19	11-12				3.3																												
TP-16-21	6-7	Lean Clay	CL		22.4	0	2.1	97.9	20	39	19			113.6	14.6					28.3	339.0												
TP-16-25	5-6	Lean Clay	CL		22.3	0	4.4	95.6	16	42	26																						
TP-16-27	3-4	Sandy Lean Clay	CL		10.8	2.2	39.2	58.6	12	25	13																						
TP-16-27	7-8	Lean Clay	CL		23.3	0	15.4	84.6	14	32	18																						
TP-16-29	5-6	Silty Sand	SC		14.1	1.1	54	44.9	13	25	12																						
TP-16-30	2-3	Clayey Sand	SC		10.5	0.0	60.6	39.4	13	25	12			122.7	12.1					36.4	1112.0												
TP-16-33	5-6	Silty Sand	SM		8.6	1.9	79.7	18.4	NP	NP	NP																						
TP-16-34	7-8	Poorly Graded SAND with Silt	SP-SM		2.8	2.6	91.7	5.7	NP	NP	NP																						
TP-16-35	1-2	Lean Clay with sand	CL		10.2	0.5	27.6	71.9	13	25	16																						
TP-16-36	16-17	Lean clay	CL		23.5	0.0	3.5	96.5	17	27	10																						
TP-16-38	3-4	Fat clay with sand	CH		17.9	0.2	15.8	84	21	64	43																						
TP-16-39	1-2	Clayey sand	SC		6.4	0.8	64.3	34.9	14	29	15																						
TP-16-40	5.5-7	Lean Clay	CL		22.5	0	2	98	16	31	15																						
TP-16-41	9-10.5	Lean Clay	CL		19.8	0.0	9.8	90.2	16	44	28																						

TABLE 2 - TEST PIT LAB TESTING SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)	MULTI-STAGED PERMEABILITY (cm/s)	CBR (%)	CHEMICAL TESTS			
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)				Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Resistivity (Minimum ohm-cm)	pH
TP-16-42	1-2	Sandy Lean CLAY	CL		8.3	0.2	46	53.8	18	43	25																						
TP-16-42	11-12	Silty sand	SM		8.5	0	62.8	37.2	NP	NP	NP																						
TP-16-44	6-7	Silty sand	SM		8.4	0.0	55.1	44.9	NP	NP	NP																						
TP-16-45	2-4.5	Clayey SAND	SC		7.4	1.3	50.1	48.6	14	22	8																						
TP-16-45	6-7	Poorly graded sand	SP		2.7	6.9	90.0	3.1	19	29	10																						
TP-16-48	9.5-10.5	Lean Clay with sand	CL		21.5	0.9	23.2	75.9	14	37	23																						
TP-16-48	17-18	Lean clay with sand	CL		18.3	0.5	23	76.5	13	23	10																						
TP-16-49	3.5-5	Sandy Silt	ML		11.8	0.6	39.9	59.5	NP	NP	NP																						
TP-16-51	2-4	Silt with sand	ML		13.0	0.1	15.7	84.2																									
TP-16-51	11-12	Poorly graded sand	SP		2.3	1.5	96.9	1.6	NP	NP	NP																						
TP-16-54	12-13	Lean clay	CL		24.4	0	1.3	98.7	16	47	31			113.6	15					30.7	241.0												
TP-16-55	2-3				14.7																												
TP-16-57	17	Poorly graded sand	SP		2.9	3.1	94.1	2.8	NP	NP	NP																						
TP-16-59	3-4	Silty sand	SM		9.0	0.0	65.3	34.7																									
TP16-EVP-01	2-2.5	Silty Clayey sand	SC-SM		7.7	0.7	57.1	42.2	13	18	5																						
TP16-EVP-02	2-3.5	Clayey sand	SC		14.6	1.7	63.4	34.9	19	28	9																						
TP16-EVP-03	1.4-3.1	Silty sand	SM		7.3	0.0	63.0	26.7	NP	NP	NP																						
TP16-EVP-04	1-4	Lean clay	CL		30.8	0.0	14.4	85.6	16	47	31			115	16.1												6E-08						
TP16-EVP-05	1.4-1.8	Lean clay with sand	CL		8.9	2.8	26.4	70.8	17	27	10																						
TP16-EVP-06	3-5	Fat clay	CH		30.0	0.0	1.7	98.3	24	54	30																						
MINIMUM				78	1.4	0.0	1.2	1.5	12	21	3	84.6	11.2	107.3	12.1	30.0	514.1	18.8	1120.3	20.0	220.0	30.8	371.0	0.26	0.62	1600	2.1E-08	4.5E-08	5	46	9	100	7.99
MAXIMUM				107.6	42.3	6.9	97.3	98.8	25	70	52	118.6	34.8	122.7	18.6	30.0	514.1	18.8	1120.3	36.4	1112.0	30.8	371.0	0.38	9.28	2000	3.1E-04	3.4E-04	19.2	4900	4200	3400	10.3
AVERAGE				97.77	15.1	0.8	46.2	53.0	17.16	37.77	20.4	105.2	18.92	114.1	15.1	30.0	514.1	18.8	1120.3	28.0	423.4	30.8	371.0	0.32	4.81	1850	5.6E-05	7.9E-05	10.53	1111	1479	738.8	9.38875

Notes:

NP Non Plastic

USCS classifications based on test pit log descriptions in absense of gradation lab test data

TABLE 3

NewFields

Project: Magnum Development Solution Mining 2020.07.14
Subject: Magnum Brine Pond No. 4 Filling Table John Weingardt

ELEVATION	CUMULATIVE AREA (AC)	CUMULATIVE VOLUME (AC-FT)	
4610.0	0	0	**SUMP**
4611.0	0	0	
4612.0	0	0	
4613.0	0	0	
4614.0	0	0	**OPERATING**
4615.0	2	1	
4616.0	3	4	
4617.0	6	8	
4618.0	10	16	
4619.0	14	28	
4620.0	18	44	
4621.0	22	64	
4622.0	27	88	
4623.0	32	118	
4624.0	38	153	
4625.0	44	194	
4626.0	50	241	
4627.0	56	294	
4628.0	63	353	
4629.0	70	419	
4630.0	76	492	
4631.0	82	571	
4632.0	87	655	
4633.0	92	745	
4634.0	97	839	
4635.0	101	938	
4636.0	104	1,040	
4637.0	108	1,146	
4638.0	111	1,256	
4639.0	113	1,368	
4640.0	115	1,482	
4641.0	117	1,598	
4642.0	117	1,715	
4643.0	118	1,833	
4644.0	118	1,951	
4645.0	119	2,069	
4646.0	119	2,188	
4647.0	120	2,308	
4648.0	121	2,428	
4649.0	121	2,549	
4650.0	122	2,671	
4651.0	122	2,792	
4652.0	123	2,915	
4653.0	123	3,038	
4654.0	124	3,161	
4655.0	124	3,286	
4656.0	125	3,410	
4657.0	125	3,535	
4658.0	126	3,661	
4659.0	127	3,788	
4660.0	127	3,914	
4661.0	128	4,042	
4662.0	128	4,170	
4662.5	129	4,234	
4663.0	129	4,298	
4664.0	129	4,428	
4665.0	130	4,557	
4666.0	131	4,687	
4667.0	131	4,818	
4668.0	132	4,950	
4669.0	132	5,082	
4670.0	133	5,214	
4671.0	133	5,347	
4672.0	134	5,481	
4673.0	135	5,615	
4674.0	135	5,750	
4675.0	136	5,885	
4676.0	136	6,021	
4677.0	137	6,158	
4678.0	137	6,295	
4679.0	138	6,433	
4680.0	**139**	**6,571**	**4,680.0 IS THE MAXIMUM WATER SURFACE ELEVATION (3 FEET FREEBOARD)**
4681.0	139	6,710	
4682.0	140	6,849	
4683.0	140	6,989	

APPENDIX A – DESIGN CRITERIA

Magnum Development Solution Mining
Brine Pond 4
Design Criteria

DESCRIPTION	VALUE	SOURCE
Brine Pond 4		
Storm event direct precipitation, 100-year/24-hour storm event	2-in	Permitted Evaporation Pond Design[1]
Pond 4 Minimum Storage Volume	6500 acre-ft	MDSM[2]
Freeboard	3-ft design freeboard	Permitted Evaporation Pond Design[1]
Brine Pond Features		
Construction Materials	homogenous earthfill	Permitted Evaporation Pond Design[1]
Pond side-slopes (Inner Embankment)	2.5(Horizontal):1(Vertical)	Permitted Evaporation Pond Design[1]
Pond side-slopes (Outer Embankment)	2(Horizontal):1(Vertical)	MDSM[2]
Crest Width	22-ft	Permitted Evaporation Pond Design[1]
Crest Access Road Width	10.5-ft	Permitted Evaporation Pond Design[1]
Safety Berm Height	18-in	Permitted Evaporation Pond Design[1]
Design Flow - Cavern to Brine Pond 4	2,500 gpm Nominal	WSP[4]
Lining system	A composite system with the primary liner consisting of 80-mil (2.0mm) single sided textured HDPE liner underlain by a secondary liner consisting of a 60-mil (1.5mm) drain liner with 130-mil height raised studs facing up. 250-mil geonet may be used in lieu of the 130-mil height raised studs.	NewFields MDTS[3] & Permitted Evaporation Pond Design[1]
Leak Collection and Recovery System (LCRS)		
System	Drainage layer, strip drains between primary and secondary liner to transmit flows to the LCRS sump	Permitted Evaporation Pond Design[1]
LCRS Sump Dimensions	25-ft by 50-ft	Permitted Evaporation Pond Design[1]
LCRS Sump Sideslopes	2.5H:1V	Permitted Evaporation Pond Design[1]
Sump Basin Grading	2 percent	Permitted Evaporation Pond Design[1]
LCRS Sump Depth	3.5-ft	Permitted Evaporation Pond Design[1]
Process Component Monitoring System (PCMS)		
System	Trenches will be excavated beneath the secondary liner containing Cpe pipe in drainage material to transmit flows to a PCMS sump	Permitted Evaporation Pond Design[1]
PCMS Sump Dimensions	25-ft by 25-ft	Permitted Evaporation Pond Design[1]
PCMS Sump Sideslopes	2.5H:1V	Permitted Evaporation Pond Design[1]
PCMS Sump Depth	2-ft	Permitted Evaporation Pond Design[1]
Geotechnical Evaluation		
Maximum Credible Earthquake		
Annual Exceedance Probability (Return Period)	0.0002 (4975 yrs)	UAC R655-11-5A
Mean Magnitude	6.2	USGS Deagg. Tool
Rupture Distance	14.7 km	USGS Deagg. Tool
Peak Ground Acceleration	0.38g	USGS Deagg. Tool
Operating Basis Earthquake		
Annual Exceedance Probability (Return Period)	0.05 (200 yrs)	UAC R655-11-5A
Mean Magnitude	6.16	USGS Deagg. Tool
Rupture Distance	56.7 km	USGS Deagg. Tool
Peak Ground Acceleration	0.049g	USGS Deagg. Tool
Static Minimum Factor of Safety	≥1.5	UAC R655-11-6A
Psuedo-static Minimum Factor of Safety	≥1.0	UAC 655-11-5C
Allowance for Facility Settlement	1 ft	NewFields MDTS[3]

1. Permitted design for Evaporation Ponds 1 -3 is based on the "Magnum Gas Storage, LLC, Evaporation Ponds Final Design Report, May 23, 2011," by AMEC
2. Magnum Development Solution Mining
3. NewFields Mining Design and Technical Services
4. WSP USA, Inc.

APPENDIX B – TECHNICAL SPECIFICATIONS

APPENDIX B1 – TECHNICAL SPECIFICATIONS FOR EARTHWORKS MATERIALS AND CONSTRUCTION

NewFields	**CLIENT** MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020

PROJECT BRINE POND 4

TITLE TECHNICAL SPECIFICATIONS FOR EARTHWORKS MATERIALS AND CONSTRUCTION

SPECIFICATION NO.
0093.020-SPT-EW-1

			APPROVALS			
REV	**DATE**	**PAGES**	**ORIGINATOR**	**PM/PIC**	**CLIENT**	**REMARKS**
0	9/15/2020	18	JW	KJ	CF	Issued for Construction
1	1/29/2021	17	JW	KJ	CF	Re-issued for Construction

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	CLIENT MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020
PROJECT BRINE POND 4		
TITLE TECHNICAL SPECIFICATIONS FOR EARTHWORKS MATERIALS AND CONSTRUCTION		**SPECIFICATION NO.** 0093.020-SPT-EW-1

			APPROVALS			
REV	**DATE**	**PAGES**	**ORIGINATOR**	**PM/PIC**	**CLIENT**	**REMARKS**
0	9/15/2020	18	JW	KJ	CF	Issued for Construction
1	1/29/2021	17	JW	KJ	CF	Re-issued for Construction

LIST OF TABLES

1.0 GENERAL

This specification defines the requirements for the earthwork construction activities for Brine Pond 4. The specifications set forth in this document cover the foundation conditioning and workmanship for earthworks construction.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.1 Definition of Terms

- "Owner" is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
- "Engineer" is defined as the Consultant or Engineering Company responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- "Contractor" is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s). The Owner may elect to perform the services of the Contractor.
- "Specifications" are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- "Drawings" are defined as the Drawings for Brine Pond 4 furnished by the Owner, Engineer, or others that apply to the Work.
- "Site" is defined as the Project site near Delta, Utah that is being developed by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- "Contract" is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- "Work" is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- "Modifications" are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- "Plant" is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.
- "Units" – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

2.0 EARTHWORKS

This section presents the technical requirements for the earthworks construction for Brine Pond 4.

All equipment used by the Contractor shall meet satisfactory conditions and comply with the Specifications with the approval of the Engineer. The Engineer or Owner reserves the right to request in writing a change in the required equipment or procedure of any work and the earthwork Contractor shall comply.

2.1 Control of Surface Water Runoff

The surface water runoff control including temporary and permanent berms, canals and any other control measures, shall be built according to the line and grade indicated on the Drawings and maintained throughout the work.

The earthwork Contractor shall build berms, and embankments and other erosion control measures required to prevent significant run on or transport of sediments from the rock storage area, and other areas of the work that may be subject to the effects of meteoric waters.

The earthwork Contractor shall provide equipment and perform all necessary work to maintain the areas of surface water collection to remove sediments from the water before it leaves the immediate area. The Contractor shall provide the temporary erosion control measures and make improvements immediately to these control measures if deemed necessary by the Owner or Engineer. The earthwork Contractor shall prevent damage to the work areas due to drying, water runoff and sediment control.

The earthwork Contractor shall remove all temporary installations of erosion control measures when they are no longer necessary and restore the areas affected by these measures.

The earthwork Contractor shall be responsible for the damage that results from rainfall runoff and for failed erosion control measures.

2.2 Earthwork Specifications

2.2.1 Clearing and Stripping

The natural ground surface is to be cleared and stripped of all organic and objectionable materials to the limits shown on the Drawings or as required by the Engineer. The limits of stripping shall generally extend approximately 10 feet outside of the Work activity areas as shown on the Drawings. Any clearing and stripping beyond the limits shown on the Drawings, or as required by the Engineer, shall be subject to the approval of the Owner.

Stripping shall mean the removal of topsoil, which shall be defined as soil of any gradation or degree of plasticity that contains significant quantities of visually identifiable plant matter, sod, roots, or humus as determined by the Engineer. Over much of the facility and associated construction areas, stripping will consist of removal of the sagebrush and vegetation cover with limited removal of surface soil (approximately 6 inches) generally being required. In areas where the topsoil extends to depths greater than 6 inches, the excavations shall extend to a greater depth as directed by the Owner. The stripped material shall be hauled to stockpile areas as instructed by the Owner. Stripped surface soils and vegetation suitable for use for future reclamation purposes shall be stockpiled separately from material viewed as unsuitable for reclamation purposes.

Clearing and stripping will be carried out using whatever method is deemed necessary, providing it is consistent with producing an acceptable end result as determined by the Owner and the Engineer.

After stripping of the required area, the surface shall be treated as specified on the Drawings or in the Technical Specifications. Prior to any surface treatment on a stripped area, the Engineer shall be notified to inspect the stripped area and designate the method of treatment required for continuance of Work. A survey shall be taken of the area if necessary to determine quantities and/or for verification of lift/layer thickness.

2.2.2 Grading/Embankment and Foundation Preparation

Once the work area has been cleared and stripped to the satisfaction of the Engineer, the surface shall be prepared before any overlying materials are placed. All work areas shall be graded according to the limits shown on the Drawings. Areas of both cut and fill shall be required to bring the grading of the work area to the elevations specified in the Drawings.

Areas that are to be filled within the basin area and embankment random fill zones shall have the exposed surface scarified to a depth of approximately 8 inches; moisture conditioned; and compacted to 95 percent of the maximum dry density as determined by ASTM D698 to ensure a good foundation is provided for the first lift of fill. (Note: The Engineer may waive this requirement if the exposed surface soils, without manipulating, will provide a firm, non-yielding surface for fill placement, in which case the surface shall be moistened, lightly scarified, and the first layer of fill placed.) Cut surfaces and/or natural ground surfaces, on which fill will not be placed within the basin area, shall be scarified to a depth of 8 inches; moisture conditioned; and compacted to form a firm non-yielding surface suitable for placement of the overlying geomembrane liner. Areas where in situ materials are not suitable as a geomembrane subgrade (i.e., coarse gravel and rock) shall be covered with imported, fine-grained materials, moisture conditioned, and compacted to the specified requirements.

All boulders and cobbles that are located at the surface and/or partially exposed in a finish cut or fill area that could be detrimental to the overlying construction shall be removed as directed by the Engineer.

Areas of unsuitable material as determined by the Engineer or areas of pre-existing fill not compacted to the specifications shall be excavated to the limits designated by the Engineer and replaced with compacted random fill.

The Earthwork Contractor is responsible for maintaining the surface in a satisfactory condition after approval of the Engineer. The Contractor shall protect the prepared surface from weather, construction equipment and other factors.

2.2.3 Excavations and Borrow Areas

Excavation methods, techniques, and procedures shall be developed with consideration to the nature of the materials to be excavated and shall include all precautions that are necessary to preserve, in an undisturbed condition, all areas outside the lines and grades shown on the Drawings or as required by the Engineer. Excavation, shaping, etc., shall be carried out by whatever method is considered most suitable, providing it is consistent with producing an acceptable result as determined by the Engineer. Excavations shall be graded to provide drainage and prevent ponding. The water table shall be maintained at least 3-feet below subgrade level. The Contractor shall perform several test pits in the southwestern quadrant of each pond prior to construction to confirm this can be maintained during construction. For excavations that cannot be graded to drain or perched water conditions, the Contractor shall adhere to the following requirements:

- The Contractor shall furnish, install, maintain, and operate all necessary pumping equipment.
- Where required, water shall be collected into sumps located within low areas of the facility footprints. Water shall be directed out of the work area by pumping or construction of diversion channels/ditches so as to keep the work area dry.
- The surface water runoff control including temporary and permanent berms, canals and any other control measures, shall be built according to the line and grade indicated on the Drawings and maintained throughout the work.
- The earthwork Contractor shall prevent all damage to the Work areas (including adjacent downstream areas) due to drying, water runoff and sediment control.

No excavation beyond the lines and grades shown on the Drawings or as required by the Engineer shall be completed without the prior approval of the Engineer/Owner. If such additional excavation is done without prior approval and, in the opinion of the Engineer, requires backfilling to satisfactorily complete the Work, such backfilling shall be approved by the Engineer and shall be completed at the Contractor's cost. The Contractor shall protect and maintain all excavations until the adjacent placement or overlying placement of material has been completed.

The Contractor shall coordinate borrow activities with the Engineer to allow the sampling and testing of materials prior to their excavation. The Contractor shall allow the Engineer adequate time to evaluate potential borrow materials. Materials from excavations within the works or borrow areas that meet the specified requirements for other construction materials shall be stockpiled or placed in fill areas as directed by the Engineer/Owner. Unsuitable or excess materials shall be hauled to waste or stockpile areas.

The materials obtained from borrow pits or Owner-stockpiled material shall be selected to ensure that the gradation requirements for the various construction materials are achieved and that the materials are as homogeneous as possible. Care shall be taken to avoid cross-contaminating different types of materials.

On-site borrow areas shall be developed within the limits shown on the Drawings or as required by the Owner. Should the Contractor wish to develop additional borrow sources, the Contractor shall receive written approval from the Owner prior to proceeding. Approval by the Owner may require that subsurface investigations be carried out to obtain samples as are required by the Engineer to make an appropriate assessment of the suitability of the borrow materials in the area for the intended use.

Borrow pit operations shall be subject to the approval of the Owner and Engineer and shall avoid waste of any suitable construction material therein. Clearing and stripping of any borrow area is to be completed with all salvageable topsoil stockpiled in areas designated on the Drawings or as directed by the Owner. Each borrow area shall be developed with due consideration for drainage and runoff from the excavated surfaces so as not to cause erosion of the adjacent terrain. Each borrow area shall be excavated in near-horizontal layers and in such a manner that water will not collect and pond except as approved by the Owner. Before being abandoned, the sides of any borrow areas outside the Work area shall be brought to stable slopes (not steeper than 2.5H:1V) with slope intersections rounded and contoured to provide a natural, neatly graded appearance.

Waste and topsoil piles shall be leveled, trimmed, and shaped to prevent the occurrence of ponding and concentrations of surface runoff and to provide a neat appearance. Finished slopes of the waste and topsoil stockpiles shall be graded to 2.5H:1V for interim reclamation. All surface water runoff shall be directed to available natural drainage courses.

Care shall be taken to minimize and control the generation of dust.

2.2.4 Fill Materials

Earthfill shall not be placed until the clearing and stripping, and required foundation preparations have been completed; and the foundation has been inspected and approved by the Engineer; and any required surveys completed.

All material used for fill shall be loaded and hauled to the placement site, dumped, spread, and leveled to the specified layer thickness. Fill shall be moisture conditioned and compacted to form a dense integral fill in accordance with the Technical Specifications and as approved by the Engineer. Care shall be taken at all times to avoid segregation of the material being placed and, if required by the Engineer, all pockets of segregated or undesirable material shall be removed and replaced with material that matches the surrounding material. All fill materials shall be free of organic and inorganic debris, organic soils, frozen material, and other deleterious materials, and shall be relocated to the designated stockpile as determined by the Owner and Engineer. The suitability of all materials intended for use in the fill shall be subject to approval by the Engineer.

If the ambient air temperature is less than 32 degrees Fahrenheit (0 degrees Celsius) for more than two (2) hours over the preceding twenty four (24) hours, the Engineer will measure the temperature of any fill materials being placed to determine if the fill is frozen. “Frozen” is defined as a mean temperature of thirty-two degrees Fahrenheit (32ºF) or less. The Engineer will measure the temperature of in-place fill at depths of 3 inches and 6 inches, recording the lower of the two. Six (6) measurements will be taken per acre, and if the average is below thirty-two degrees Fahrenheit (32ºF), the fill will be considered frozen. Any areas of fill that are determined to be frozen shall be removed or reconditioned, reshaped, and re-compacted by the Contractor in conformance with this Specification, at no cost the Owner. Under no circumstances shall frozen materials be incorporated as fill nor shall fill be placed on frozen ground, snow, or other surfaces that have not been approved by the Inspector.

All oversize material shall be removed from the fill material either prior to it being placed or after it is dumped and spread but prior to compaction. No additional payment will be made to remove oversized materials unless the work is specifically identified as a payment item on the Schedule of Quantities.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of subsequent layers. Each zone shall be constructed with materials meeting the specified requirements and shall be free from lenses, pockets, and layers of materials that are substantially different in gradation from the surrounding material in the same zone, as determined by the Engineer.

Except in areas approved by the Engineer, where space is limited or as otherwise specified, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of fill. The hauling equipment shall be routed in such a manner that they do not follow in the same paths but spread their travel routes evenly over the surface of the fill to aid in compaction of the fill placed.

Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits. If moisture conditioning is necessary, it may be carried out by whatever method the Contractor deems is suitable, provided it produces the moisture content specified in these Technical Specifications or designated by the Engineer. Moisture conditioning of the fill, and any additional mixing or blending requirements shall be at the borrow source and/or stockpile areas with only minor adjustments during fill placement. The contractor shall take the necessary measures to ensure that moisture is being distributed uniformly throughout each layer of material being placed immediately prior to compaction. Measures shall be adopted as are necessary to ensure that the designated moisture content is preserved after compaction until the overlying layer is placed.

All particles having dimensions that interfere with compaction in the fill as determined by the Engineer shall be removed from the zone in which they were placed either prior to or during compaction.

The rolling pattern for compaction of all zone boundaries or construction joints shall be such that the full number of roller passes required in one of the adjacent zones, or on one side of the construction joint, extends completely across the boundary or joint.

2.2.4.1 Random Fill

Material Properties - The random fill containing will have a wide range of Unified Soil Classifications and may contain significant variations in gradation and compaction properties. Random fill shall be placed in areas where the material is not required to be of uniform character and engineering properties. Random fill shall be free of roots, grass and other organic material and consist of inorganic soil from required excavations, or borrow material from other sources, as approved by the Engineer. The Random Fill material for this project shall consist primarily of sands, silts and clays. The placement of fill materials shall be closely monitored such that weaker soils such as fat clays (CH) are not placed in concentrated horizontal zones that could affect the strength of the embankment. The Engineer will determine if the material is suitable for use as fill.

Materials containing rock or cobbles, and gravel from required excavations may be used subject to the Engineer’s approval and provided the rock be reasonably graded such that large void spaces do not result. Further, the maximum size rock shall be no larger than 2/3 the lift thickness which is equivalent to 4 inches.

Per Table 2 in the design report, the compacted random fill shall have a drained shear strength greater than 30 degrees, and 300 psf cohesion, in general, when measured using ASTM D3080. If results do not achieve these minimum criteria, the engineer shall be notified to re-evaluate the analysis.

The random fill for the embankment will generally be borrowed from within the pond basin and will be placed by the Contractor. The Contractor shall monitor borrow sources within the pond basin by surveying to ensure that the pond basin elevations do not extend lower than the design grades.

Placement Methods - Random fill shall be moisture conditioned to within 2 percent of the optimum moisture content, placed in 8-inch maximum loose lifts, and compacted to 95 percent of the maximum dry density (ASTM D698). Slight variations from the specified moisture range may be acceptable subject to the acceptance of the Engineer and provided the required compacted densities are achieved. The random fill material shall be compacted with appropriate compaction equipment capable of achieving compaction through the full thickness of the lift layer. The surface of each layer of fill shall be roughened using a sheepsfoot compactor (or approved equivalent) just prior to placing the overlying layer of fill unless otherwise approved by the Engineer. Given the dry climate of the project site, additional moisture conditioning should also be expected prior to placing the overlying layer of fill.

The Engineer shall be notified immediately if any compaction issues (i.e. shearing, slicken sides, rutting, heaving or cracking, etc.) are observed. Work in the affected area shall cease until the issues can be properly inspected by the Engineer and corrective actions made.

2.2.4.2 Select Gravel

Material Properties - Select gravel shall be a processed or natural clean gravel material containing nonplastic fines in accordance with ASTM D4318. The select gravel shall consist of rounded processed gravels composed of hard, durable stone particles free from organic material and generally free of thin, flat, and elongated pieces.

Sieve Size (square openings)	Percent Passing (by dry weight)
2 -inch	100
1 ½ -inch	30-70
1 -inch	0-15
½ -inch	0-5

2.2.4.3 Placement of Select Gravel

It is anticipated that the Select Gravel material will be imported from an off-site source by the Earthworks Contractor. The material will be hauled to the project site and stockpiled at locations approved by the owner. Care shall be used while placing this material as not to damage underlying CPe pipes or geomembrane.

2.2.4.4 Road Wearing Coarse (Aggregate Base)

Material Properties - The roadway-wearing surface is to be constructed using select mine-waste material. A source for the material will be provided by the Owner. Some removal of oversized rock will be required. Wearing course shall generally conform to the following gradation requirements as determined by ASTM C136 and C117 or as approved by the Engineer.

Sieve Size (square openings)	Percent Passing (by dry weight)
4 -inch	100
3/4 -inch	50-70
No. 4	35-50
No. 16	15-40
No. 200	2-10

The plasticity index for wearing course materials shall be no greater than 15.

Placement Methods –Wearing Course shall be placed in a maximum 8-inch lift to 95% of the maximum dry density as determined by ASTM D698. The moisture content shall be sufficient to obtain adequate density.

2.2.4.5 Pipe Bedding and Pipe Backfill - Non-Perforated Pipe, Trench Installations

Material Properties - Pipe bedding and backfill material for foundations and corrugated metal circular culverts shall consist of materials with the following typical characteristics:

Sieve Size (square openings)	Percent Passing (by dry weight)	
	Pipe Backfill	Pipe Bedding
4 -inch	100	
3 -inch	90-100	
1-½ -inch	--	100
¾ -inch	--	90-100
No. 4	--	30-70
No. 40	--	--
No. 200	20 max	20 max
Plasticity Index	10 max	10 max

Pipe bedding and pipe backfill shall be free of organic or frozen material.

Placement Methods - Backfilling shall be done as soon as possible after pipe/culvert installation/construction. Suitable backfill, free from large lumps, clods, or rocks shall be placed alongside the structure in loose layers not exceeding 8–inches thick to provide a berm of compacted earth on each side of the pipe or structure (where applicable). The fill materials shall be a minimum of 5-feet wide or the width of the pipe diameter/structure but no less than required to operate the appropriate compaction equipment. Each 8-inch layer shall be moisture-conditioned, as required to facilitate compaction, and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698 or as directed by the Engineer.

If it is necessary to construct a haul or other vehicle road over the pipe trench, the Engineer shall be consulted prior to the initiation of trench construction for specification modification to achieve structure sufficient for such traffic loading.

Backfill shall be placed symmetrically on each side of the structure. The backfill differential on either side of the pipe shall not exceed 8–inches, or one quarter of the diameter of the structure (whichever is less).

Prior to adding each new layer of loose backfill material until minimum 12-inches of cover is obtained, an inspection shall be made of the inside of the structure for local or unequal deformation caused by the backfilling operation. Only hand-operated tamping equipment shall be allowed within vertical planes 3-feet (approximately 1-meter) beyond the horizontal projection of the outside surfaces of the structure (or as recommended by the culvert/structure manufacturer/designer).

Backfill material shall not be placed against any concrete foundation, abutment, wing wall, or culvert until the concrete has been in place at least seven days or the compressive strength of the concrete is 75 percent of the required 28-day strength. On structures that are not permanently supported laterally and that cannot tolerate horizontal movement, internal bracing or support should be placed during backfill operations.

2.2.5 Finished Surface Preparation of Areas to Receive Geomembrane Lining

Areas to receive geomembrane lining shall be free of angular particles over 3/4-inch diameter and hard objects that may damage the geomembrane. Where excessive coarse material is exposed at the surface, rock removal by appropriate methods or other surface finishing as directed by the Engineer will be required. Rough areas with depressions or loose material shall be covered with a cushion of fine-grained materials or for large depressions, with screened prepared subgrade material (passed over ½--inch mesh screen) or equivalent. A smooth drum compactor shall make a minimum of 1 pass over all areas to receive geomembrane, including the embankment slopes.

Once the Contractor believes that the prepared subgrade surface preparation is complete, an inspection will be completed by the geomembrane Liner Installation Contractor, Engineer, and Owner with the Earthworks Contractor present. Any areas requiring repairs shall be fixed by the Earthworks Contractor.

2.2.6 Compaction Equipment

Sufficient compaction equipment, of the types and sizes required to complete the work, shall be provided for compaction of the various fill materials. The use of alternative equipment will be dependent upon completion of suitable test fills to the satisfaction of the Engineer to confirm that the alternative equipment will compact the fill materials to the specified density.

Compaction equipment shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is a maximum for the equipment. The Contractor shall provide the Owner and Engineer a list of proposed compaction equipment to be used before commencing Work.

2.2.6.1 Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less than 20,000 pounds at the drum when the roller is standing on level ground. The drum shall be not less than 60-inches in diameter and 78-inches in width. The vibration frequency of the roller drum during operation shall be between 1,100 and 1,500 vibrations per minute, and the centrifugal force developed by the roller, at 1,250 vibrations per minute, shall not be less than 38,000 pounds.

For compaction by the vibratory roller, a single coverage shall be defined as one pass of the roller. A minimum overlap of 12-inches shall be maintained between the surfaces traversed by adjacent passes of the roller drum. During compaction, the roller shall be propelled at 2 miles per hour (mph) or lesser speed as approved by the Engineer. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions that may be encountered during the compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to 4 mph.

2.2.6.2 Tamping-Foot (“Sheepsfoot”) Roller

The majority of the fill may be compacted with a tamping-foot roller. The tamping foot roller shall be self-propelled and fully ballasted with a standard tamping-foot design developing 5,000 pounds in force per linear foot of width at rest on level ground or equivalent as approved by the Engineer.

2.2.6.3 Special Compactors

Special compactors shall be used to compact materials that, in the opinion of the Engineer, cannot be compacted properly by the specified larger vibratory roller because of location or accessibility.

Special compaction measures shall be adopted such as hand-held or small walk behind compactors or other methods approved by the Engineer to compact fill in trenches, around structures, and in other confined areas that are not accessible to the larger vibratory roller or tamping-foot roller. Such compaction shall be to the specified density for the particular material. The material shall be placed in loose lifts that do not exceed 6-inches.

2.2.6.4 Frost Tube Installation

The Contractor shall construct at least two frost tubes at opposite corners of the site to monitor frost penetration for winter shutdown events. The frost tubes shall consist of 1/4" diameter clear plastic tubing marked at 1/2" increments, placed inside a 3/8” tube (radiant heat tube), which is placed inside a 1/2" diameter PVC pipe which is open on both ends. The water inside the inner tube shall be colored so the depth of ice is visibly obvious. The assembly shall be installed to a depth of at least 3-feet. The Contractor shall coordinate with the Engineer for other specific details.

3.0 QUALITY CONTROL

The Engineer will take samples of fill materials and perform gradation, moisture content, Atterberg Limits, and field density tests on the compacted fill and any other tests that the Engineer considers necessary to ensure that the fill being placed meets the specified requirements. The results of the tests carried out by the Engineer will be final and conclusive in determining compliance with the Technical Specifications. Test Methods are listed in Table 1 of Section 5.0.

Each lift of fill will be approved by the Engineer prior to placement of additional fill materials. Sufficient time shall be allowed by the Contractor for the Engineer to carry out the required test work and interpret the test results in order to determine the acceptability of each lift. Cooperation shall be given by the Contractor, to the Owner and the Engineer, for taking samples or making tests, and such assistance shall be rendered as is necessary to enable sampling and testing to be carried out expeditiously.

Tests carried out by the Engineer will be performed in accordance with the latest test methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized industry standards. The tests shall include Control and Record Tests.

3.1.1.1 Control Tests

Tests for gradation, moisture content, moisture density relationship, and other tests, where applicable, will be made by the Engineer on samples of fill materials taken from borrow areas and on the fill after spreading and prior to compaction at frequencies sufficient to ensure that the fill material is in full compliance with the Technical Specifications.

3.1.1.2 Record Tests

The Engineer will conduct field density, moisture content, and other tests on the compacted in-place fill and will obtain samples of the compacted fill for related laboratory testing at such frequency as the Engineer considers necessary to determine that the compacted fill is in full compliance with the Technical Specifications.

4.0 QUALITY ASSURANCE CONSTRUCTION TOLERANCES

The Contractor shall construct the various aspects of the evaporation ponds to the lines and grades shown on the Drawings, or as required by the Engineer, within the following tolerances:

- Finish grades and slopes for the embankment and basin shall be in general conformance with the Drawings. Deviations from finished grades/slopes are subject to approval by the Engineer and shall not result in low spots; pockets; non-uniform slopes or contours; or result in slopes, which deviate by more than 1 percent from the design; or result in slopes of less than 1/2 percent within the basin
- The maximum permissible combined horizontal and vertical deviation of the perimeter boundaries of the embankment from the lines and grades shown on the Drawings or as required by the Engineer shall be 36 inches
- The finished surface of the basin prepared surface shall not deviate vertically by more than 4 inches than the lines and grades shown on the drawings.
- The elevation and width of the embankment crest shall not be less than the dimensions shown on the Drawings or required by the Engineer

All pipes shall be constructed to the following tolerances:

- Alignment and grade shall not deviate more than 5 percent of the nominal diameter of the pipe from a straight line between control points.

5.0 TESTING FREQUENCIES

The Engineer will carry out frequent quality control/assurance tests as described herein to determine compliance of the Work with the Technical Specifications. The latest edition of standard procedures shall be used for all activities, and in general, these will be adopted from recognized organizations such as the American Society of Testing and Materials (ASTM). The following tables outline the test methods and the minimum testing requirements for the project:

Table 1
Test Methods

Test	Type of Test	Test Method (ASTM)
C1, R1	Atterberg Limits	D4318
C2, R2	Moisture Content	D2216
C3, R3	Particle Size Distribution	D422 [a]
C4, R4	Laboratory Compaction-Std. Proctor	D698
R5a	Nuclear Density	D2922
R5b	Sand Cone	D1556
R5c	Water Replacement	D5030
C6, R6	Direct Shear Strength	D3080

Notes: C = Control Tests; R = Record Tests

[a] Hydrometer tests down to the 2-micron size will be carried out as directed by the QA Engineer but will generally not be required; all samples to be washed over a No.200 sieve.

Table 2
Test Frequency – Random Fill

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	10,000 yd^3
C2, R2	Moisture Content (1)	1 per lift per day or 2,000 yd^3
C3, R3	Particle Size Distribution	10,000 yd^3
C4, R4	Laboratory Compaction	Soil type/ 1 per 10 field density tests
R5a	Nuclear Density (1)	1 per lift per day or 2,000 yd^3
R5b/R5c	Sand Cone or Water Replacement Density	1 per 10 nuclear density tests
C6, R6	Direct Shear Strength	1 per 1,000,000 yd^3

Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.

(1) If three consecutives moisture-density tests fail for either non-conforming compaction or moisture conditions, then the testing frequency will be increased to 1 per 1,000 yd3 until 6 acceptable tests in a row are recorded.

Table 3
Test Frequency – Select Gravel

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	1,000 yd³
C3, R3	Particle Size Distribution	1,000 yd³ or minimum of 2 tests
Note: Sample sizes to be sampled in accordance with ASTM standards.		

Table 4
Pipe Backfill/Pipe Bedding

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	Soil type/5,000 yd³ or 1 per structure
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	5,000 yd³ or 1 per structure
C4, R4	Laboratory Compaction	Soil type/5,000 yd³
R5a	Nuclear Density	Greater of 4 per structure or 500 yd³
R5b	Sand Cone Density	every 10 nuclear density tests

Table 5
Test Frequency – Road Wearing Course

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	2,000 yd³
R3	Particle Size Distribution	2,000 yd³

Table 6
Test Frequency – Embankment Foundation

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	Soil type/100,000 ft²
C2, R2	Moisture Content	50,000 ft²
C3, R3	Particle Size Distribution	100,000 ft²
C4, R4	Laboratory Compaction	Soil type/250,000 ft²
R5a	Nuclear Density	50,000 ft²
R5b	Sand Cone Density	1 per 10 nuclear density tests

Table 7
Test Frequency – Basin Foundation

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	Soil type/200,000 ft^2
C2, R2	Moisture Content	100,000 ft^2
C3, R3	Particle Size Distribution	200,000 ft^2
C4, R4	Laboratory Compaction	Soil type/500,000 ft^2
R5a	Nuclear Density	100,000 ft^2
R5b	Sand Cone Density	1 per 10 nuclear density tests

APPENDIX B2 – TECHNICAL SPECIFICATIONS FOR CORRUGATED POLYETHYLENE PIPE (CPEP) MATERIALS AND INSTALLATION

NewFields	**CLIENT** MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020

PROJECT BRINE POND 4

TITLE TECHNICAL SPECIFICATIONS FOR CORRUGATED POLYETHYLENE PIPE (CPeP) MATERIALS AND INSTALLATION

SPECIFICATION NO.
0093.020-SPT-CPeP-0

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1.0 GENERAL

This specification defines the requirements for Corrugated Polyethylene Pipe (CPeP) materials, installation, and quality control for Brine Pond 4.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.1 Definition of Terms

- "Owner" is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
- "Engineer" is defined as the Consultant or Engineering Company (NewFields) responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- "Contractor" is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- "Specifications" are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- "Drawings" are defined as the Construction Drawings for Brine Pond 4 furnished by the Owner, Engineer, or others that apply to the Work.
- "Site" is defined as the Project site near Delta, Utah that is being developed by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- "Contract" is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- "Work" is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- "Modifications" are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- "Plant" is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.
- "Units" – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

1.2 Codes and Standards

All pipe work shall be of the best quality available complying with the latest standards for the following:

➢ ANSI	American National Standard Institute
➢ ASTM	American Society of Testing and Materials
➢ AWWA	American Water Works Association
➢ AASHTO	American Association of State Highway Officials
➢ SPI	Society of the Plastics Industry, Inc.
➢ PPI	Plastics Pipe Institute

1.3 Material Properties

1.3.1 Corrugated Polyethylene Pipe (CPeP) with Smooth Interior

Pipe and fittings shall be made of virgin polyethylene compounds that conform with the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D 3350. Resins that have higher cell classifications in one or more properties, with the exception of density, are acceptable provided the product requirements are met.

For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant tensile load (NCTL) test in accordance with ASTM F2136 except that the applied stress for the NCTL test shall be 600 psi (Note: The notched depth of 20 percent of the nominal thickness of the specimen is critical to this procedure). The average failure time of the five test specimens must exceed 24 hours with no single test specimen’s failure time less than 17 hours.

Pipe and fittings shall be manufactured and comply with the current edition of AASHTO Standard Specifications M252 and M294. All sizes shall conform to the AASHTO classification “Type S” for smooth wall interior solid pipe and “Type SP” for smooth wall interior perforated pipe.

CPe pipe and couplings for watertight application shall be Advanced Drainage System ADS N12 WT IB. Prefabricated fittings for the watertight application shall have bell ends suitable for connecting to the pipe or alternatively shall have plain ends suitable for using bell-to-bell push-on gasketed couplings.

The pipe shall have a minimum pipe stiffness of 5-percent deflection when tested in accordance with ASTM D2412, as follows:

Nominal Diameter (inches)	Pipe Stiffness (psi)
4	70
6	65
8	60
10-12	50
15	42
18	40
24	34
30	28
36	22
42	20
48	18
60	14

The diameters refer to the inside pipe diameter.

Where perforations are specified, they shall conform to the requirements as follows:

- AASHTO M252 “Class 2” for 4-inch to 10-inch diameter CPeP (Max slot width = 0.125in)
- AASHTO M294 “Class 2” for 12-inch to 36-inch diameter CPeP

Couplings (non-watertight) shall be corrugated to match the pipe corrugations and shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Couplings, unless watertight connections are specified, shall be split collar and shall engage at least two full corrugations on each pipe section. Where pipe is joined to other materials or fittings, or joined by other methods, the manufacturer’s recommendations shall be strictly enforced.

CPeP-to-HDPE pipe connections, if specified, shall be made using CPeP-to-HDPE adapters supplied by the CPeP manufacturer. The HDPE pipe end of the adapter shall match the DR (Dimensional Ratio) of the pipe being connected.

Pipe sizes and types shall be as specified on the Drawings, or as required by the Engineer.

1.4 Submittals

The CPeP material supplier shall submit to the Owner, upon request, a manufacturer's certification that all pipe and fittings they intend to supply comply with the applicable portions of the specifications.

1.5 Pipe Delivery, Handling, and Storage

Pipe, fittings, valves, and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. Under no circumstances shall pipe or pipe fittings be dropped to the ground or into trenches. Pipe handled on skid ways shall not be skidded or rolled against pipe already on the ground. The interior of all pipe and pipe fittings shall be kept free from dirt and foreign material at all times.

The Earthworks Contractor shall be responsible for any material furnished to him by the Owner and shall replace or repair, in a manner approved by the Engineer at the Earthworks Contractor's expense, all such material damaged in handling after delivery. This shall include the furnishing of all materials and labor required for the replacement of installed material damaged prior to the final acceptance of the Work.

1.6 Pipe Installation

CPe pipe shall be installed to the sizes, lines, and grades shown on the Drawings. Pipe sections shall be joined with manufacturer-supplied couplers with the open seam of the coupler turned to the side of the pipe. End caps shall be installed on the upstream ends of the pipe. Pipes shall be closely monitored during backfilling activities to ensure no damage is done to the pipe.

The pipe shall be installed to the lines and grades and generally in the manner shown on the Drawings. Where specific lines and grades are not indicated on the Drawings, the lines and grades will be determined by the Engineer in the field to suit the existing ground conditions. The Earthworks Contractor shall use equipment and methods acceptable to the Engineer and in accordance with the pipe manufacturer's recommendations for handling and placement of the pipe and fittings.

The Earthworks Contractor shall provide and install all piping required to complete the piping installation in accordance with good piping practices, regardless of whether such piping is specifically detailed on the Drawings. The general layout as shown on the Drawings shall be maintained. Where interference is encountered during installation or relocation of pipelines is deemed necessary, the Engineer shall be consulted before any changes are made.

All pipelines shall be erected to preserve accurate alignment. Care shall be taken in the installation of pipeline runs where drainage is required to ensure that the pipeline has a continuous slope to the point of drainage.

Prior to installation, each segment of pipe and all fittings shall be inspected for defects and/or damage. All pipe, fittings, and other appurtenances shall be carefully lowered into position, piece by piece. Under no circumstances shall such materials be dropped into position. Extreme care shall be taken to prevent foreign material from entering the pipe while it is being installed. Temporary end caps or other approved means shall cover open ends of the pipe when installation is not in progress.

Pipe bends to form curves either in the horizontal or vertical plane shall not exceed that recommended by the manufacturer or approved by the Engineer. The cutting of pipe for inserting fittings or closure pieces shall be done in a neat manner and with good workmanship without damage to the pipe and leaving a smooth end at right angles to the axis of the pipe.

Wherever obstructions not shown on the plans are encountered during construction, and where such obstructions interfere with the work to an extent that an alteration in the lines or grades of the pipe is required, the Engineer shall approve any deviation or arrange for removal, relocation, or reconstruction of the obstructions.

APPENDIX B3 – TECHNICAL SPECIFICATIONS FOR HDPE PIPE MATERIALS AND INSTALLATION

NewFields	**CLIENT** MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020
PROJECT BRINE POND 4		
TITLE TECHNICAL SPECIFICATIONS FOR HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS MATERIALS AND CONSTRUCTION		**SPECIFICATION NO.** 0093 020-SPT-HDP-0

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1.0 GENERAL

This specification defines the requirements for High-Density Polyethylene (HDPE) PE4710 pipe materials, installation, and quality control associated for Brine Pond 4.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.1 Definition of Terms

- "Owner" is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
- "Engineer" is defined as the Consultant or Engineering Company (NewFields) responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- "Third Party Testing Contractor" is defined as the Consultant or Engineering Company (to be determined) hired by the owner to provide third party inspection and testing services for the overall project.
- "Contractor" is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- "Specifications" are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- "Drawings" are defined as the Drawings for Brine Pond 4 furnished by the Owner, Engineer, or others that apply to the Work
- "Site" is defined as the Project site near Delta, Utah that is being developed by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- "Contract" is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- "Work" is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- "Modifications" are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- "Plant" is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.
- "Units" – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

1.2 Codes and Standards

All pipework shall be of the best quality available complying with the latest standards for the following:

ANSI	American National Standard Institute
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
AASHTO	American Association of State Highway Officials
SPI	Society of the Plastics Industry, Inc.
PPI	Plastics Pipe Institute SPI
IPS	Iron Pipe Sizing

1.3 HDPE Materials

Materials used for the manufacture of high-density polyethylene (HDPE) pipe and fittings shall have a standard thermoplastic material designation code of PE 4710 and comply with all requirements for ASTM D3350. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from the resin of the same specification and from the same raw material supplier. The dimensional and performance characteristics shall conform to the requirements of ASTM F714 for sizes 4-inches IPS and larger and conform to ASTM D3035 for sizes smaller than 4-inches IPS. In addition, materials used for the manufacture of the HDPE pipe and fittings shall meet the following physical property requirements listed in the table below:

Table 1
Physical Material Properties for HDPE Pipe (PE 4710)

Property	Unit	Standard	Nominal Value
Material Designation	-	ASTM F412	PE 4710
Cell Classification	-	ASTM D3350	445474 C (black)
Density (Natural)	gm/cc	ASTM D1505	0.947
Density (Black)	gm/cc	ASTM D1505	0.959
Melt Index	gm/10 minutes	ASTM D1238	< 0.08
Flexural Modulus	Psi	ASTM D790	140,000
Tensile Strength @ Ultimate	Psi	ASTM D638	5,000
Tensile Strength @ yield	Psi	ASTM D638	>3,600
PENT	hours	ASTM F1473	>500
ESCR	hours	ASTM D1693	>10,000
HDB at 73°F (23°C)	Psi	ASTM D2837	1,600
Color; UV Stabilizer	% C	ASTM D1603	Black with minimum 2% carbon black Color with UV Stabilizer
Modulus of Elasticity (long term)	Psi	ASTM D638	30,000

The pipe manufacturer’s quality control system shall be certified by an appropriate independent body to meet the requirements of the ISO 9002 Quality Management Program.

The 4-inch perforated HDPE pipe shall be shop perforated with ½” holes spaced 6-inches apart and staggered with holes located 120-deg from one another. If possible, the 4-inch pipe should be received on rolls to minimize field fusing.

All stub ends/flange adapters, shall be of at least the same wall thickness and pressure rating and the same resin type and manufacturer as the pipe to be joined, unless otherwise approved. Backing flanges for HDPE pipe shall be the convoluted type of ductile iron material (ASTM A536 grade range from 60/40/18 to 65/45/12, drilled to ANSI bolt circles, and have a pressure rating of 150 psi) unless otherwise approved by the **Engineer**.

Fabricated fittings intended for use in non-pressure or low pressure services may be manufactured from the same diameter and DR rating as used in the piping system (Note: The pressure rating of these fittings will be approximately only 75 percent of the straight pipe of the same DR). Fittings not intended for use in pressure service shall be clearly marked or tagged.

Fabricated fittings intended for use in pressure service shall meet or exceed the design pressure of the piping system and be fabricated from pipe of at least the next numerically smaller dimension ratio unless otherwise shown on the Drawings. Ends shall be machined to match the joining pipe DR.

Where HDPE and corrugated polyethylene (CPe) pipes are connected, manufactured fittings shall be used unless approved otherwise by the **Engineer**. All other joints shall be fused or flange-jointed as shown on the Drawings. Flange assembly bolts, when specified as machine bolts, shall conform to the requirements of ASTM A307, Grade A standard, square-head machine bolts conforming to ASME/ANSI B 18.2.1 with heavy hot-pressed hexagon nuts. Bolt length shall be such that, after joints are made up, bolts shall protrude through the nut by at least than ½ inch.

Stud bolts, when specified, shall be ASTM A193 Grade B7 with two-hex head nuts, ASTM A194 Grade 2H per each for above ground service and ASTM A193 Grade B8 with Stainless Steel nuts in accordance with ASTM A194. Alternately, commercial Grade 18-8 Stainless Steel bolts and nuts may be used for buried service.

Gaskets shall be used at all flanged connections and shall be full face, black nitrile rubber gaskets (Garlock style 9122 or equal), and $^1/_8$ inch thick.

1.3.1 Strip Drain

Strip drains shall be 18-inches wide with a flow rate capacity of a minimum of 21 gpm/ft at a hydraulic gradient of 0.1. They shall not crush under a compressive load of 4,500 psf. The strip drain shall not have a geotextile wrapping. The material shall be either Terradrain Strip Drain 600, or the AdvanEDGE Strip Drain. NewFields shall provide approval prior to procurement and installation.

1.4 Submittals

The **Contractor**'s HDPE pipe supplier shall submit to the **Owner** test data for each lot and a manufacturer's certification that all pipe and fittings under their supply comply with the applicable portions of the specifications.

1.5 Pipe Delivery, Handling, and Storage

Pipe, fittings, valves, and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. The interior of all pipe and pipe fittings shall be kept free from dirt and foreign material at all times.

The **Contractor** shall be responsible for all material furnished to him and shall replace or repair, in a manner approved by the **Engineer**, at the **Contractor**'s expense, all such material damaged in handling after delivery by the **Owner**. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered damaged prior to the final acceptance of the work.

1.6 Pipe Installation

1.6.1 General

The pipe shall be installed to the lines and grades and generally in the manner shown on the Drawings. Where specific lines and grades are not indicated on the Drawings, the lines and grades will be determined, by the Engineer in the field, to suit the existing ground conditions. The **Contractor** shall use equipment and methods acceptable to the **Engineer and Third Party Testing Contractor** and in accordance with the pipe manufacturer's recommendations for handling and placement of the pipe and fittings.

The **Contractor** shall provide and install all piping required to complete the piping installation in accordance with good piping practices, regardless of whether such piping is specifically detailed on the Drawings. The general layout as shown on the Drawings shall be maintained. Where interference is encountered during installation or relocation of pipelines is deemed necessary, the **Engineer** shall be consulted before any changes are made.

All pipelines shall be erected to preserve accurate alignment. Care shall be taken, in the installation of pipeline runs where drainage is required, to ensure that the pipeline has a continuous slope to the point of drainage.

Prior to installation, each segment of pipe and all fittings shall be inspected for defects and/or damage. All pipe, fittings, and other appurtenances shall be carefully lowered into position, piece by piece. Under no circumstances shall such materials be dropped into position. Extreme care shall be taken to prevent foreign material from entering the pipe while it is being installed. Temporary end caps or other approved means shall cover open ends of the pipe when installation is not in progress.

Wherever obstructions not shown on the plans are encountered during the construction and where such obstructions interfere with the work to the extent that an alteration in the lines or grades of the pipe is required, the **Engineer** shall approve any deviation or arrange for removal, relocation, or reconstruction of the obstructions.

1.6.2 Joining

1.6.2.1 Heat Fusion

Pipe and fittings shall be joined by one of the following types of thermal fusion in accordance with the manufacturer's recommended procedures: butt fusion, saddle fusion, or socket fusion.

Upon request, the manufacturer shall provide fusion training by authorized personnel or an authorized representative. The **Contractor** shall be responsible for ensuring that personnel have received proper training in accordance with the manufacturer's recommended procedure. Records of training shall be maintained by the **Contractor** and evidence of training shall not exceed 12 months from date of construction.

Butt fusions performed between pipe ends or pipe ends and fitting outlets shall be within the following allowable wall mismatches:

- 2 DR difference for pipe and fitting diameters 6-inch IPS and smaller
- 1 DR difference for above 6-inch through 18-inch
- No difference for diameters above 18-inch.

The difference in DR is determined from the following DR values: 7.3, 9, 11, 13.5, 17, 21, 26, and 32.5.

1.6.2.2 Other Methods of Joining

Polyethylene pipe and fittings where heat fusion is not possible may be joined together or to other materials through the use of electrofusion fittings; flange adapters with backup rings; mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material; or Mechanical Joint (MJ) adapters. All alternative joining methods and devices shall be approved by the Engineer. The manufacturer of the joining device shall be consulted for proper installation procedures.

1.6.3 Marking

Pipe and tubing shall be permanently marked in accordance with all applicable standards in accordance with this Specification. Marking, as follows, shall be continuously (or spaced at intervals not exceeding 5 feet) heat-stamped indent print and shall remain legible under normal handling and installation practices:

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size

3. Dimension Ratio
4. The letters PE followed by the polyethylene grade per ASTM D3350, followed by the Hydrostatic Design basis in 100's of psi, e.g., PE4710
5. Manufacturing Standard Reference, e.g., ASTM F714
6. A production code from which the date and place of manufacture can be determined

Fittings shall be marked on the body or hub. Marking shall be in accordance with the applicable standard depending on the fitting type. Marking on the fitting shall include the following whenever possible:

1. Nominal size and Outside Diameter (OD) base (such as 12-inch IPS)
2. Standard material code designation (such as PE 4710)
3. Dimension ratio
4. Pressure class if for pressure service

Mechanical fittings shall be marked with size, body material designation code, pressure rating, and the manufacturer's name or trademark.

1.6.4 Testing

The **Contractor** shall be responsible for field setup and performance of the fusion equipment and the fusion procedure used by the operator. Upon request, the **Contractor** shall verify the fusion quality by marking and testing in accordance with the manufacturer's recommended qualification procedure or by using Time-of-Flight ultrasonic testing. The **Contractor** shall be responsible for the necessary adjustments to the setup, equipment, operation, and fusion procedure. Fusions that fail the qualification procedure shall be remade.

Hydrostatic testing shall be conducted if required by the **Owner** to a minimum of 110 percent of the maximum operating pressure or design pressure, whichever is greater.

APPENDIX B4 – TECHNICAL SPECIFICATIONS FOR GEOMEMBRANE MATERIALS AND CONSTRUCTION

NewFields	**CLIENT** MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020

PROJECT BRINE POND 4

TITLE TECHNICAL SPECIFICATIONS FOR GEOMEMBRANE MATERIALS AND CONSTRUCTION	**SPECIFICATION NO.** 0093.020-SPT-GM-1

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PROJECT BRINE POND 4

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1. GENERAL

This specification defines the requirements for geomembrane materials, installation, and quality control associated with the Brine Pond 4.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.1 Definition of Terms

- "Owner" is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
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- "Construction Manager" is defined as the Consultant or Engineering Company responsible for the overall project completion.
- "Third Party Testing Contractor" is defined as the Consultant or Engineering Company (to be determined) hired by the owner to provide third party inspection and testing services for the overall project.
- "Contractor" is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- "Installer" is defined as the qualified 3rd party(s) that have been hired to install the geomembrane for the specified Work.
- "Specifications" are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
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- "Plant" is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.
- "Units" – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

- ASTM Standard D4437, 1988 (1999), "Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes", ASTM International, West Conshohocken, PA, 1999, DOI: 10.1520/D4437-99, www.astm.org.
- ASTM Standard D5199, 2001 (2006), "Standard Test Method for Measuring the Nominal Thickness of Geosynthetics", ASTM International, West Conshohocken, PA, 1999, DOI: 10.1520/D5199-01R06, www.astm.org.
- ASTM Standard D5641, 1994 (2006), "Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber", ASTM International, West Conshohocken, PA, 1999, DOI: 10.1520/D5641-94R06, www.astm.org.
- ASTM Standard D5820, 1995 (2006), "Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes", ASTM International, West Conshohocken, PA, 1995, DOI: 10.1520/D5820-95R06, www.astm.org.
- ASTM Standard D5994, 1994 (2003), "Standard Test Method for Measuring Core Thickness of Textured Geomembrane", ASTM International, West Conshohocken, PA, 1994, DOI: 10.1520/D5994-98R03, www.astm.org.
- ASTM Standard D6365, 1999 (2006), "Standard Practice for the Non-destructive Testing of Geomembrane Seams using the Spark Test", ASTM International, West Conshohocken, PA, 1999, DOI: 10.1520/D6365-99R06, www.astm.org.
- ASTM Standard D6392, 2010 (2012), "Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods", ASTM International, West Conshohocken, PA, 1999, DOI: 10.1520/D6392-10R12, www.astm.org.
- ASTM Standard 7240, 2006 (2011), "Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)", ASTM International, West Conshohocken, PA, 2006, DOI: 10.1520/D7240-06R11, www.astm.org.

1.2.2 Geosynthetic Research Institute (GRI):

- GRI GM6 2017: "Pressurized Air Channel Test for Dual Seamd Geomembranes", Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.

- GRI GM 9, 1995, “Cold Weather Seaming of Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM 10, 1997 (2006), “The Stress Crack Resistance of HDPE Geomembrane Sheet”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM 13, 1997 (2009), “Test Properties, Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM 14, 1998, “Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM 17, 2000 (2009), “Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.
- GRI GM 19, 2002 (2010), “Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes”, Geosynthetic Institute, Folsom, PA, www.geosynthetic-institute.org.

2. GEOMEMBRANE

The geomembrane used for Brine Pond 4 shall be the following:

- Primary Liner consisting of 80-mil (2.0mm) Single Sided Textured High Density Polyethylene (HDPE)
- Secondary Liner consisting of 60-mil (1.5mm) High Density Polyethylene (HDPE) Drain liner with 130 mil high raised studs facing up. 250-mil Geonet may be used in lieu of the 130-mil height raised studs.

2.1 Manufacturer’s Quality Control

The HDPE geomembrane shall be a high quality formulation containing approximately 97 percent polymer and 3 percent carbon black with antioxidants and heat stabilizers. It shall be resistant to ultraviolet (UV) rays. All resin shall be hexene-based, consist of all virgin material from the same manufacturer, shall not be intermixed, and no reclaimed polymer may be added to the resin. The manufacturing process shall not use more than 10 percent rework. If rework is used, it must be similar HDPE to the parent material.

The geomembrane material shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures as applied to the mining industry. The material shall be produced to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. The geomembrane shall be supplied in roll form. Each roll shall be identified with labels indicating roll number, thickness, length, width, and manufacturer’s name and date of manufacture.

The manufacturer's laboratory must be certified by Geosynthetic Accreditation Institute (GAI)/Laboratory Accreditation Program (LAP) for the tests being performed and shall have a third-party independent quality assurance program. The third party shall perform the required tests at the required frequency as stated in this specification or at such frequency as mutually agreed by the **Owner**, the **Engineer**, and the manufacturer at the time of award. All test results shall be provided to the **Engineer** and the rolls of material shall be clearly identified and correlate to the test results.

Extrudate rod or bead material shall be made from the same type of resin as the geomembrane and be from the same resin supplier as the resin used for manufacture of the geomembrane.

The material shall be warranted against manufacturer's defects as well as degradation due to UV light for exposed areas for a minimum of 20 years from the date of installation or as mutually agreed prior to award of the contract for supply between the **Owner** and the geomembrane manufacturer. This warranty shall cover the cost of material, freight and duties, handling, labor, and equipment to replace the defective or failed material.

2.2 Submittals Post-Award

The manufacturer shall furnish the following product data, in writing, to the **Owner** and the **Engineer** prior to shipment of the geomembrane material:

- Resin data including the following:
- Certification stating that the resin meets the specification requirements and that it is all from the same manufacturer (see Table 4).
- Statement certifying no reclaimed polymer and no more than 10% rework of the same type of material is added to the resin (product run may be recycled).
- Copy of quality assurance and quality control certificates issued by resin supplier.
- All rolls shall be delivered with labels affixed to the selvage edge clearly stating the manufacturer's name, product identification, material thickness, roll number, roll type, roll dimensions and roll weight.

Geomembrane roll, extrudate rod and bead material:

- Copy of quality assurance and quality control certificates issued by the geomembrane manufacturer and the HDPE third-party independent quality assurance tester.
- Certification that the geomembrane material delivered to the project complies with these specifications.

- Certification that extrudate rod or bead is from one manufacturer, is the same resin type, and was obtained from the same resin supplier as used to manufacture the geomembrane rolls.

2.3 Third Party Conformance Testing

- During manufacturing of the geomembrane, samples are obtained and forwarded to the Geomembrane Quality Assurance Testing Laboratory by a third party (to be determined by the Engineer and Owner) for testing to ensure conformance with the Specifications.
- Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise stated, samples shall be 3 feet long by the width of the roll. Unless otherwise stated, samples shall be taken at a frequency of no less than one per 2,000,000 square feet or one per lot, whichever is less.
- The conformance tests shall be performed to verify conformance to the design Specifications as listed on Tables 1 for smooth geomembrane and Table 2 for textured geomembrane.

3. GEOMEMBRANE INSTALLATION

3.1 General

The HDPE geomembrane shall be installed on the areas shown on the Drawings or as directed by the **Engineer**. The **Installer** shall be an approved installer by the Manufacturer.

Prior to deployment of geomembrane, the **Installer** shall inspect and accept, with the **Engineer, Third Party Testing Contractor** and the **Owner**, all surfaces on which the geomembrane is to be placed. The surface on which the geomembrane is to be installed shall be free of sharp particles, rocks, or other debris to the satisfaction of the **Engineer**, the **Owner**, and the **Installer**. Sharp objects shall be removed by raking, sweeping, or handpicking as necessary.

The **Installer** shall supply the **Engineer** with panel layouts of the liner that must be approved by the **Engineer** prior to commencing the Work. It is the **Installer**'s responsibility to submit timely proposals (allowing a minimum of two weeks for approval).

Installation of the geomembrane shall be performed under the direction of a field engineer or supervisor who has installed a minimum of 10,000,000 square feet (ft^2) of the specified type of geomembrane or similar. Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) with seaming experience of a minimum of 3,000,000 ft^2 of the geomembrane type specified or similar product, using the same type of seaming apparatus to be used in the current project. During the seaming, the Field Installation Supervisor or Master Seamer are present. Qualified technicians employed by the **Installer** complete all seaming, patching, testing, and other welding operations.

The geomembrane shall be placed over the prepared surfaces using methods and procedures that ensure a minimum of handling. Adequate temporary and permanent anchoring devices and ballasting shall be provided to prevent uplift and damage due to winds. The **Installer** is solely responsible for the safety of his operations including decisions regarding deployment in adverse weather conditions and the amount of temporary anchoring and ballasting required. The **Contractor** shall take necessary precautions to protect the geomembrane from any damage including prohibiting workers from smoking and wearing foot apparel that would damage the membrane.

To the extent possible, seams shall be oriented parallel to the fall line, slope or grade of the ground. The panels shall be secured temporarily with sandbags or other approved ballasting method to hold them in place until the field seams have been completed and the geomembrane has been permanently anchored. Ballast material shall conform to the specified requirements for drainage material.

The **Installer** shall take into account that high winds are prevalent at the project site and may result in liner damage and delays. The **Installer** shall take all necessary measures to ensure that each panel is sufficiently ballasted to prevent damage or movement by wind. Fusion of panels and repairs will only be permitted under weather conditions allowing such work, and within the warranty limits of the geomembrane manufacturer, as approved by the **Owner** and the **Engineer**.

Horizontal field seams on slopes shall be kept to a minimum and require the approval of the **Engineer**. Horizontal seams on steep slopes shall be avoided where possible by cutting the liner at a 45-degree angle. Generally, horizontal seams are to be no closer than 10-feet from the toe of the slope. Horizontal seams shall be made by lapping the uphill material over the downhill material. Panels shall be shingled in a manner that prevents water from running beneath the liner.

The geomembrane shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. The installed geomembrane shall contain sufficient slack material to allow for thermal expansion and contraction during the annual extreme temperatures the geomembrane is expected to endure. Individual wrinkles should take the form of undulations in the liner but should not be large enough for the material to fold over on itself.

During installation, the **Installer** shall give each field panel an “identification” code number consistent with the layout plan. The **Third Party Testing Contractor** shall agree upon the numbering system. The **Installer** shall update the layout plan as each panel is installed to show the location of each panel. A field panel is defined as the area of geomembrane that is to be seamed in the field (roll or portion of a roll cut in the field).

Individual panels of geomembrane material shall be laid out in a pattern that will produce the least number of seams. The material shall be overlapped prior to welding. Extreme care shall be taken by the **Installer** in the preparation of the areas to be welded. The joint interface shall be cleaned and prepared according to industry standard procedures, those specified by the material manufacturer and those approved by the **Engineer**. Seaming shall not take place unless the panels are dry and clean. All sheeting shall be welded together by thermal methods.

Any area showing damage due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of geomembrane. The cost of replacing or repairing the geomembrane shall be borne solely by the **Installer**.

No “fish mouths” will be allowed within the seam area. Where “fish mouths” occur, the material shall be cut, overlapped, and an overlap extrusion weld applied.

Geomembrane panels must have a finished overlap of 4 to 6-inches for double-wedge welding seams and minimum 6-inches for extrusion welding seams. Notwithstanding this provision, sufficient overlap shall be provided to allow shear and peel tests to be performed on any seam.

Handling and storage of the geomembrane material shall be in accordance with the manufacturer’s printed instructions. Persons walking or working on the geomembrane shall not engage in activities or wear foot apparel that could damage the geomembrane.

An adequate amount of handling equipment, welding apparatuses, and test equipment shall be maintained on site to avoid delays due to problems with equipment failures.

3.2 Geomembrane Installation Quality Control

3.2.0 General

The **Installer** shall submit a copy of his Quality Control Manual to the **Engineer** and **Owner** prior to the start of installation of any geomembrane. If there are discrepancies between this specification and the **Installer**’s Quality Control Manual, the more stringent requirements will apply unless determined otherwise by the **Engineer**.

The **Installer** shall be fully responsible for carrying out all quality control tests on the geomembrane and shall do so to the satisfaction of the **Engineer** and in accordance with this Specification and the **Installer**’s Quality Control Manual. On-site physical nondestructive and destructive testing shall be completed on all joints to ensure that watertight uniform seams are achieved on a continuous basis as installation proceeds. The **Third Party Testing Contractor** shall be present and witness all destructive tests. At the time of bid submission, details shall be provided by the **Installer** that set forth the method proposed for both destructive and nondestructive testing of seams. The **Engineer** shall approve these methods prior to the **Installer** commencing the Work. Visual inspection alone is unacceptable.

Fusion of panels and repairs will only be permitted under weather conditions allowing work that is in conformance to the Specifications and within the warranty limits imposed by the manufacturer and to the approval of the **Engineer**.

At a minimum, the **Installer**'s field installation test program shall consist of visual observations and continuity and strength tests as defined in the following subsections. The **Installer** shall not have more than 500,000 square feet of geomembrane deployed at any time without final QA/QC and acceptance by the **Third Party Testing Contractor**. At the beginning of each day's work, the **Installer** shall provide the **Third Party Testing Contractor** with copies of all the previous days' completed paperwork as well as an update of the quantity and location of geomembrane placed.

3.2.1 Trial Welds

Trial welds shall be completed to verify the performance of the welding equipment and operator prior to performing production welds. No welding equipment or operator shall perform production welds until equipment and operator have successfully completed a trial weld and approved by the **Third Party Testing Contractor**. The following procedures shall be followed for trial welds:

- Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- Minimum of two trial welds per day per welding apparatus – one made prior to the start of work and one completed at mid-shift or for every 5 hours of seaming operations.
- Cut five 1-inch-wide-by-6-inch long test strips from the trial weld.
- Quantitatively test specimens for peel adhesion and for bonded seam strength (shear).
- Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear tests and:
  - The break, when peel testing, occurs by Separation in the Plane of the sheet (SIP), not through adhesion failure separation (AD). When the seam separation is equal to or greater than 25% of the track width, it is a failed test.
  - The break is ductile.
- Repeat the trial weld, in its entirety, when the trial weld samples fail in either peel or shear as defined on Table 3.

3.2.2 Field Seaming

The **Installer** shall have at least one Master Welder who shall provide direct supervision to other welders. The Master Welder's and other welder shall submit a description of their qualifications and experience to the **Owner and Engineer** for approval prior to arrival on site.

- The welding equipment shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the material to ensure changes in environmental conditions will not affect the integrity of the weld.
- The seam area shall be cleaned of dust, mud, moisture, and debris immediately ahead of the welding apparatus.
- The seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. A 4-inch to 6-inch overlap shall be used for double-wedge welded seams and 6-inches for extrusion welded seams unless approved otherwise by the **Engineer**.
- Seaming shall not proceed when the ambient air temperature or adverse weather conditions jeopardize the integrity of the geomembrane installation. If adverse weather prevents work from being completed then the installer shall make-up the work during a scheduled day off. If enough adverse weather causes the schedule to extend beyond the agreed upon completion date then the **Owner** may compensate the **Contractor** for delays beyond their control.
- Extrusion welding apparatus' shall be purged of heat-degraded extrudate before welding.
- The double-wedge fusion welding process shall be used unless alternate methods are approved by the **Engineer**. Extrusion welding shall be permitted to weld short seams to repair small areas where double-wedge welding is not feasible, and for caps and patches.

3.2.3 Field Seam and Panel Inspection and Testing

Nondestructive Testing and Inspection

The **Installer** shall perform visual inspections of deployed and welded HDPE panels to identify defects, damage, or protrusion of sharp objects that may affect the integrity of the geomembrane. Defective or damaged areas shall be marked and repaired according to the technical specifications and the guidelines in the **Installer**'s Quality Control Manual.

A quality control technician or field engineer acting for the **Installer** and **Third Party Testing Contractor** shall inspect each seam, marking his initials and date inspected at the end of each panel. Any area showing a defect shall be marked and repaired in accordance with the applicable repair procedures.

Continuity Testing

A maximum effort shall be made by the **Installer** to install a perfect geomembrane liner. This implies that all seams completed in the field, patches, and extrusions shall be tested and recorded. All failures shall be isolated and repaired as directed by the **Engineer and Third Party Testing Contractor**. A general testing procedure for the **Installer** is included as follows:

- Test all field seams and patches with interseam pressure, vacuum box, spark tester, or other approved methods. Non-destructive testing methods are discussed in following subsections.
- Isolate and repair all areas indicating any leakage. Retest the repair.

Interseam Pressure Testing. Test procedure in accordance with ASTM D 5820 for interseam pressure for seams (for double-wedge welding only):

- Seal both ends of the seam to be tested by applying heat to the end of the seam via a heat gun until flow temperature is achieved. Clamp off the ends and let cool.
- Insert a pressure gauge with needle assembly into the end of the seam and seal.
- Pressurize the air channel between the two seams to between 30 psi and 35 psi. Following pressure stabilization, take the initial pressure reading, hold the pressure a minimum of 5 minutes and take a second reading.
- The allowable leak-down for the seam is 3 psi maximum.
- If the pressure does not drop below the maximum allowable 3 psi, open the air channel at the end away from the pressure gauge. Air should rush out and the pressure gauge should register an immediate drop in pressure, indicating that the entire length of seam has been tested. If this does not happen, either the air channel is blocked or the equipment is faulty, and the test is not valid.
- Enter the results of the leak test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.
- Repair the area where the pressure gauge/needle assembly was installed and where the air was released.

Vacuum Box Testing: Where possible, the **Installer** shall test all extrusion seams as follows:

- Mix a solution of liquid detergent and water and apply an ample amount to the area to be tested. If a seam contains excess overlap or loose edges, it must be trimmed before testing.
- Place a rigid transparent vacuum box over the area and apply a slight amount of downward pressure to the box to seat the seal strip to the liner.
- Apply a vacuum of minimum 5 psi for a minimum of 15 seconds to the area. The **Installer** shall examine the geomembrane through the viewing window for the presence of soap bubbles indicating a leak. If no bubbles appear after 15 seconds, consider the area leak free. Once the area is leak free, depressurize the box and move it over the next adjoining area with an appropriate overlap and repeat the process.

- Enter the results of the leak test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.

Spark Testing: Extrusion welded patches, caps, pipe boots, etc., in lieu of being vacuum-box testing, shall be spark tested in accordance with ASTM D 6365 and the following procedures:

- The seam shall be prepared for extrusion welding in accordance with the **Installer's** procedures.
- Just prior to applying the extrusion bead, a small-gauge copper wire (18-gauge bare copper wire or equivalent) shall be placed into the seam. The wire should be grounded at one end and placed at the edge of the top sheet of the overlap seam. Tucking the wire under the edge of the top sheet will help hold the wire in place during welding, but this should be done prior to grinding to avoid the risk of contamination of the weld area. Electrically conductive tape placed along the edge of the overlying patch can also be used instead of copper wire.
- Apply the extrudate bead as normal and allow the weld to cool.
- Complete a calibration test on a trial seam containing a non-welded segment ensuring the identification of such a defect (non-welded segment) under the planned spark tester settings and procedures.
- Energize the spark tester and move the electrode wand near the trial seam to determine the maximum length of spark that can be generated. Adjust the output voltage setting until the spark length exceeds the greatest potential leak path distance. This is typically the diagonal distance from the embedded wire to the edge of the weld bead at a "T" joint.
- Once the output voltage has been set testing may be started. Testing is performed by passing the electrode over the seams with the electrode in contact with the membrane or the extruded weld bead. The audible and visual indication of a spark provides the determination of a potential leak path.
- If a potential leak is detected the area can be repaired with a patch. Applying additional weld beads adjacent to the leaking weld is not an acceptable repair technique. This will only lengthen the leak path to the extent that the spark tester may not be capable of generating a spark of sufficient length to breach the lengthened gap.
- After patching, the seam must be retested until no defects are indicated.
- Enter the results of the spark test on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.
- When flammable gasses are present, use special care and precautions in the area to be tested.

Destructive Testing

Peel and shear seam strength testing shall be carried out on samples of seams removed from the installed panels. For these tests, the following procedures shall be followed:

- Coupon sampling of all field seams, including patches and repair areas, shall be taken by cutting perpendicular to the seams a sample approximately 36-inch by 12-inch. This sample shall be cut into three 12-inch by 12-inch samples and labeled with the sample number, date, time, location and seam number, and individually marked "**Owner** (Archive) Sample," "QA (**Third Party Testing Contractor**) Sample," and "**Installer** QC Sample." The frequency and location shall be determined by the **Third Party Testing Contractor** but shall not be less than one sample per 500-feet of field seams. These coupons shall be tested by the Installer on-site for peel and shear seam strength and thickness in accordance with ASTM D6392.
- Heat-welded seams shall be allowed to cool or warm to about 70°F prior to testing. Solvent seams, when used, shall be allowed to cure according to the manufacturer's recommendations. Additionally, at the **Engineer**'s option, approximately 10 percent of the coupons (size 1-inch by 6-inches) shall be sent to an independent laboratory for confirmation testing. Should the lab and field tests conflict, installation shall halt until the conflict is resolved to the satisfaction of the **Engineer**.

The **Third Party Testing Contractor** shall continuously inspect the installation of the HDPE liner to ensure that the procedures specified in this section are adhered to fully.

Weld specimens shall pass the requirements for shear and peel presented in Table 3 and as follows:

- During testing, the break shall occur by Separation in the Plane of the sheet (SIP) not through adhesion failure separation (AD). When the seam separation is equal to or greater than 25% of the track width, it is a failed test.
- The break is ductile.

In the event of a failing test result, the following procedures shall be used:

- The Installer shall follow one of two options:
- Reconstruct the seam between any two passed test locations, or
- Trace the weld to an intermediate location at least 10-feet or to where the seam ends in both directions from the location of the failed test. Once the failing limits of the seam are isolated, that portion of the seam shall be reconstructed or capped.

Seams welded prior to and after the failed seam using the same welding device and/or operator shall also be tested.

- Enter the results of the destructive testing on the appropriate documentation, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.

3.2.4 Repair Procedures

Damaged or defective geomembrane or seam areas failing a destructive or non-destructive test shall be repaired. Each repair requires a non-destructive test using either a vacuum box or spark testing methods. The **Installer** shall be responsible for repair of damaged or defective areas. The repair method shall be decided by the **Installer** but must be agreed upon by the **Third Party Testing Contractor.** Procedures available include the following:

- Replacement: Remove damaged geomembrane or unacceptable seam and replace with acceptable geomembrane materials if the damage cannot be satisfactorily repaired.
- Patching: Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
- Capping: Used to repair large lengths of failed seams.

Abrading and rewelding of small seam areas and welding the flap on fusion-welded seams are not acceptable repair procedures and shall not be accepted.

In addition, the following procedures shall be observed:

- Surfaces of the polyethylene that are to be repaired by extrusion welds shall be lightly abraded to ensure cleanliness.
- All geomembrane shall be clean and dry at the time of repair.
- Extend patches or caps at least 6-inches for extrusion welds and 4-inches for wedge welds beyond the edge of the defect, and round the corners of the patch material. The edges of all patches are to be beveled.

Furthermore, repair verification shall be performed as follows:

- Number, date, location, technician and test outcome of each patch.
- Non-destructively test each repair using methods specified in this technical specification.
- Enter the results of the repair procedures on the appropriate documentation, indicating the repair verification. If the repair fails, the repair work and subsequent testing should be recorded on the same document.

4. CERTIFICATION

At the completion of the geomembrane installation, the **Installer** shall provide the **Engineer** and **Owner** with a certification stating that the geomembrane was installed and tested in accordance with the technical specifications together with a report of the test results. The certification shall be provided to the **Owner** prior to the demobilization of the installation personnel from the site unless agreed otherwise by the **Owner**. The report of the test results shall be provided in hard copy and digital format to the **Owner** and the **Engineer** no later than 30 days after the installation work has been completed.

5. COMPLETION

At the completion of the installation, the **Installer** shall provide a set of as-built drawings showing the actual geomembrane panel layout, seams, location of destructive test samples, and the location of major repairs including repaired seams and capped areas. The as-built panel layout must be submitted in hard copy and digital format to the **Owner** and the **Engineer** no later than 30 days after the installation work has been completed.

Table 1
HDPE Geomembrane - Smooth
(Per GRI Test Method GM13 revision 15 dated 9/9/2019)

Properties	Test Method	Test Value		Testing Frequency (minimum)
		60 mil (1.5 mm)	80 mil (2 mm)	
Thickness (min. avg.) ▪ Lowest individual of 10 values	ASTM D5199	Nominal -10%	Nominal -10%	Each roll
Density mg/L (min.)	ASTM D1505/D792	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties[1] (min. avg.) ▪ Yield strength ▪ Break strength ▪ Yield elongation ▪ Break elongation	ASTM D6693 Type IV	 126 lbs/in 228 lbs/in 12% 700%	 168 lbs/in 304 lbs/in 12% 700%	20,000 lbs
Tear Resistance (min. avg.)	ASTM D1004	42 lbs	56 lbs	45,000 lbs
Puncture Resistance (min. avg.)	ASTM D4833	108 lbs	144 lbs	45,000 lbs
Stress Crack Resistance [2]	ASTM D5397 (Appendix)	500 hrs	500 hrs	Per GRI-GM10
Carbon Black Content (range)	ASTM D4218 [3]	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	ASTM D5596	Note 4	Note 4	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.)[5] a) Standard OIT	ASTM D3895	100 min.	100 min.	200,000 lbs
--OR--				
101 High Pressure OIT	ASTM D5885	400 min.	400 min.	
Oven Aging at 85°C [5, 6] a) Standard OIT (min. avg.) – % retained after 90 days	ASTM D5721 ASTM D3895	55%	55%	Each formulation
--OR--				
b) High Pressure OIT (min. avg.) – % retained after 90 days	ASTM D5885	80%	80%	
UV Resistance[7] Standard OIT (min. avg.) --OR--	ASTM D7238 ASTM D3895	N.R.[8]	N.R.[8]	Each formulation
High Pressure OIT (min. avg.) - % retained after 1,600 hrs [9]	ASTM D5885	50%	50%	

[1] Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches.

[2] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

[3] Other methods such as D1603 (Tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

[4] Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.

[5] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

[6] It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.

[7] The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

[8] Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

[9] UV resistance is based on percent-retained value regardless of the original HP-OIT value.

Table 2
HDPE Geomembrane - Textured
(Per GRI Test Method GM13 revision 15 dated 9/9/2019)

Properties	Test Method	Test Value		Testing Frequency (minimum)
		60 mil (1.5 mm)	80 mil (2 mm)	
Thickness (min. avg.)	ASTM D5994	Nominal -5%	Nomina-5%	Each roll
▪ Lowest individual of 8 out of 10 values		-10%	-10%	
▪ Lowest individual for any of the 10 values		-15%	-15%	
Asperity Height mils (min. avg.)	ASTM D7466	16 mil	16 mil	Every 2nd roll[1]
Density mg/L (min. avg.)	ASTM D1505/D792	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties[2] (min. avg.)	ASTM D6693 Type IV			20,000 lbs
▪ Yield strength		126 lbs/in	168 lbs/in	
▪ Break strength		90 lbs/in	120 lbs/in	
▪ Yield elongation		12%	12%	
▪ Break elongation		100%	100%	
Tear Resistance (min. avg.)	ASTM D1004	42 lbs	56 lbs	45,000 lbs
Puncture Resistance (min. avg.)	ASTM D4833	90 lbs	120 lbs	45,000 lbs
Stress Crack Resistance [3]	ASTM D5397 (Appendix)	500 hrs	500 hrs	Per GRI-GM10
Carbon Black Content (range)	ASTM D4218 [4]	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	ASTM D5596	Note 5	Note 5	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.)[6]				200,000 lbs
a) Standard OIT	ASTM D3895	100 min.	100 min.	
--OR--				
b) High Pressure OIT	ASTM D5885	400 min.	400 min.	
Oven Aging at 85°C [6,7]	ASTM D5721			Each formulation
a) Standard OIT (min. avg.) – % retained after 90 days	ASTM D3895	55%	55%	
--OR--				
b) High Pressure OIT (min. avg.) – % retained after 90 days	ASTM D5885	80%	80%	
UV Resistance[8]	ASTM D7238			Each formulation
a) Standard OIT (min. avg.) --OR--	ASTM D3895	N.R.[8]	N.R.[8]	
b) High Pressure OIT (min. avg.) - % retained after 1,600 hrs [10]	ASTM D5885	50%	50%	

1. **Alternate the measurement side for double-sided textured sheet.**
2. **Machine direction (MD) and cross-machine direction (XMD) average values should be on the basis of five (5) test specimens each direction. Yield elongation is calculated using a gauge length of 1.3 inches. Break elongation is calculated using a gauge length of 2.0 inches.**
3. **SP-NCTL per ASTM D5397, is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.**
   The yield stress used to calculate the applied load for the SP-NCTL test should be the Manufacturer's mean value via MQC testing.
4. **Other methods, such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.**
5. **Carbon black dispersion (only near spherical agglomerates) for ten (10) different views: Nine (9) in Categories 1 or 2 and one (1) in Category 3**
6. **The Manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.**
7. **It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.**
8. **The condition of the test should be 20-hour UV cycle at 75°C followed by 4-hour condensation at 60°C.**
9. **Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV- exposed samples.**
10. **UV resistance is based on percent-retained value regardless of the original HP-OIT value.**

Table 3
Seam Strength and Related Properties of Thermally Bonded Smooth and Textured HDPE Geomembranes
(Reference: GRI Test Method GM19 Revision 9 updated 07/28/2017)

Geomembrane Nominal Thickness	60-mil (1.5 mm)	80-mil (2.0 mm)
Hot Wedge Seams [1]		
Shear strength (lbs/in.)	120	160
Shear elongation at break [2] (%)	50	50
Peel strength (lbs/in.)	91	121
Peel separation (%)	≤25	≤25
Extrusion (Fillet) Seams		
Shear strength (lbs/in.)	120	160
Shear elongation at break 2 (%)	50	50
Peel strength (lbs/in.)	78	104
Peel separation (%)	≤25	≤25

[1] **Also for hot air and ultrasonic seaming methods.**

[2] **Elongation measurements should be omitted for field testing.**

Table 4: Raw Material Properties

Property	Test Method	HDPE
Density (g/cm^3)	ASTM D1505	≥0.932
Melt Flow Index (g/10 min)	ASTM D1238 (190/2.16)	≤1.0
OIT (minutes)	ASTM D3895 (1atm/200°C)	≥100

APPENDIX B5 – TECHNICAL SPECIFICATIONS FOR GEOTEXTILE MATERIALS AND CONSTRUCTION

NewFields	CLIENT MAGNUM SOLUTION MINING, LLC	PROJECT NO 475.0093.020
PROJECT BRINE POND 4		
TITLE TECHNICAL SPECIFICATIONS FOR GEOTEXTILE MATERIALS AND CONSTRUCTION		**SPECIFICATION NO.** 0093.020-SPT-GT-0

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NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT NO
475.0093.020

PROJECT BRINE POND 4

TITLE TECHNICAL SPECIFICATIONS FOR GEOTEXTILE MATERIALS AND CONSTRUCTION

SPECIFICATION NO.
0093.020-SPT-GT-0

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1.0 GENERAL

1.1 SCOPE

This specification defines the requirements for geotextile materials, installation, and quality control for use as a protection (cushioning) material and as a separation material associated with the Brine Pond 4.

All geotextile for this project shall be 10 oz/yd^2. Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.2 Definition of Terms

- “Owner” is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
- “Engineer” is defined as the Consultant or Engineering Company (NewFields) responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- “Third Party Testing Contractor” is defined as the Consultant or Engineering Company (to be determined) hired by the owner to provide third party inspection and testing services for the overall project.
- “Contractor” is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- “Specifications” are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- “Drawings” are defined as the Construction Drawings for Brine Pond 4 furnished by the Owner, Engineer, or others that apply to the Work.
- “Site” is defined as the Project site near Delta, Utah that is being developed by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.

- “Plant” is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.
- “Units” – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

1.3 References

1.3.1 American Society for Testing and Materials (ASTM):

- D1883 – Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
- D4354 – Practice for Sampling of Geosynthetics for Testing
- D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity
- D4533 – Test Method for Trapezoidal Tearing Strength of Geotextiles
- D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
- D4759 – Practice for Determining the Specification Conformance of Geosynthetics
- D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- D4873 – Guide for Identification, Storage and Handling of Geotextiles
- D5261 – Test Method for Measuring Mass per Unit Area of Geotextiles
- D5494 – Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes
- D6241 – Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Product Using a 50-mm Probe
- D7238 – Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent Condensation Apparatus

1.3.2 American Association of State Highway and Transportation Officials (AASHTO):

- M288-05 – Geotextile Specification for Highway Applications

1.3.3 Geosynthetic Research Institute (GRI):

- GT12(a) – Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials, Revision 1, December 18, 2012, www.geosynthetic-institute.org.
- GT13(a) – Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate, Revision 3: December 19, 2012 www.geosynthetic-institute.org.

1.4 Submittals Post-Award

- Prior to material delivery to the project site, the **Contractor** shall provide the **Engineer** with a written certification or manufacturers quality control data which displays that the geotextile meets or exceeds the values specified herein.

- The **Contractor** shall submit, if required by the **Engineer**, manufacturer's quality control manual for the geotextile to be delivered to the site.

1.5 Submittals during Manufacturing

- Manufacturer quality control certificates stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile.
- The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.
- The manufacturer's certificate shall state that the finished geotextile meets the Minimum Average Roll Value (MARV) requirements of the specification as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.
- Mislabelling or misrepresentation of materials shall be reason to reject those geotextile products.

1.6 Shipment, Storage and Handling

- Geotextile labelling, shipment and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.
- Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight and contaminants. The protective wrapping shall be maintained during periods of shipment and storage.
- During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160^{o}F (71oC), and any other environmental condition that may damage the property values of the geotextile.

2.0 PRODUCT

2.1 Geotextile

- The nonwoven needle punched geotextile specified herein shall be made from staple fiber.

- The geotextile shall be of new prime quality virgin polymer of 100-percent polyethylene (97-percent polypropylene and 3-percent carbon black with antioxidants and heat stabilizers), or polyester/polypropylene blend designed and manufactured specifically for the purpose of separation, tensile reinforcement, planar flow, filtration and protection and shall be used as designated on the Drawings.
- The geotextile shall be able to withstand direct exposure to ultraviolet radiation from the Sun for up to 30 days without any noticeable effect on index or performance properties.
- Rolls shall be free of holes, contamination and foreign debris.
- Geotextile shall meet or exceed all material properties listed herein based on the specific purpose and expected conditions.

Table 1 – Required Properties, Test Methods and Values for Geotextiles Used as Geomembrane Protection (or Cushioning) Materials

Property[1]	Test Method ASTM	Unit	Mass/Unit Area (oz/yd^2)					
Mass per unit area	D5261	oz/yd^2	10	12	16	24	32	60
Grab Tensile strength	D4632	lb	230	300	370	450	500	630
Grab tensile elongation	D4632	%	50	50	50	50	50	50
Trap. Tear strength	D4533	lb	95	115	145	200	215	290
Puncture (pin) strength	D4833	lb	120	140	170	250	300	390
UV resistance[2]	D7238	%	70	70	70	70	70	70

Table 2 – Alternative Puncture Test Methods to be Considered in Place of Pin Puncture, ASTM D4833, in Table 1

Property[1]	Test Method ASTM	Unit	Mass/Unit Area (oz/yd^2)					
Mass per unit area	D5261	oz/yd^2	10	12	16	24	32	60
Puncture (pyramid) strength	D5494	lb	300	320	410	440	510	760
Puncture (CBR) strength	D6241	lb	700	800	900	1100	1700	2400
Puncture (CBR) elongation	D6241	in	1.5	1.5	1.5	1.5	1.5	1.5

Notes:

1. All values are MARV except UV resistance which is a minimum value. For geosynthetics, MARV is a manufacturing quality control tool used to establish published values such that the purchaser will have a 97.7% confidence that the property in question will meet published values. For normally distributed data, “MARV” is calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.
2. Evaluation to be on 2.0 inch strip tensile specimens after 500 lt. hours exposure.

- For the purposes of separation the geotextile shall meet the minimum required values as defined in the Tables 3, 4 and 5 below with the exception of AOS which is maximum average roll value (MaxARV) and UV stability which is a minimum average value:

Table 3– Geotextile Properties Class 1 (High Survivability)

Property[1]	ASTM Test	Unit	Elongation < 50%	Elongation ≥ 50%
Grab Tensile Strength	D4632	lb	315	203
Trapezoid Tear Strength	D4533	lb	112	79
CBR Puncture Strength	D6241	lb	630	440
Permittivity	D4491	sec^{-1}	0.02	0.02
Apparent Opening Size	D4751	in	0.024	0.024
UV Stability[2]	D7238	% Str. Ret. @ 500 lt. hours	50	50

Table 4 – Geotextile Properties Class 2 (Moderate Survivability)

Property[1]	ASTM Test	Unit	Elongation < 50%	Elongation ≥ 50%
Grab Tensile Strength	D4632	lb	248	158
Trapezoid Tear Strength	D4533	lb	90	56
CBR Puncture Strength	D6241	lb	500	320
Permittivity	D4491	sec^{-1}	0.02	0.02
Apparent Opening Size	D4751	in	0.024	0.024
UV Stability[2]	D7238	% Str. Ret. @ 500 lt. hours	50	50

Table 5– Geotextile Properties Class 3 (Low Survivability)

Property[1]	ASTM Test	Unit	Elongation < 50%	Elongation ≥ 50%
Grab Tensile Strength	D4632	lb	180	113
Trapezoid Tear Strength	D4533	lb	68	41
CBR Puncture Strength	D6241	lb	380	230
Permittivity	D4491	sec^{-1}	0.02	0.02
Apparent Opening Size	D4751	in	0.024	0.024
UV Stability[2]	D7238	% Str. Ret. @ 500 lt. hours	50	50

Table 6 – Required Degree of Survivability as a Function of Subgrade Conditions, Construction Equipment and Lift Thickness (Class 1, 2 and 3 Properties are Given in Table 3, 4 and 5; Class 1+ Properties are Higher than Class 1 but Not Defined at this Time)

	Low ground-pressure equipment < 25 kPa (3.6 psi)	Medium ground-pressure equipment > 25 to < 50 kPa (> 3.6 to < 7.3 psi)	High ground-pressure equipment > 50 kPa (> 7.3psi)
Subgrade has been cleared of all obstacles except grass, weeds, leaves and fine wood debris. Surface is smooth and level so that any shallow depressions and humps do not exceed 450 mm (18 in.) in depth or height. All larger depressions are filled. Alternatively, a smooth working table may be placed.	Low (Class 3)	Moderate (Class 2)	High (Class 1)
Subgrade has been cleared of obstacles larger than small to moderate-sized tree limbs and rocks. Tree trunks and stumps should be removed or covered with a partial working table. Depressions and humps should not exceed 450mm (18 in.) in depth or height. Larger depressions should be filled.	Moderate (Class 2)	High (Class 1)	Very High (Class 1+)
Minimal site preparation is required. Trees may be felled, delimbed, and left in place. Stumps should be cut to project not more than ± 150mm (6 in.) above subgrade. Fabric may be draped directly over the tree trunks, stumps, large depressions and humps, holes, stream channels, and large boulders. Items should be removed only if placing the fabric and cover material over them will distort the finished road surface.	High (Class 1)	Very High (Class 1+)	Not Recommended

*Recommendations are for 150 to 300 mm (6 to 12 in.) initial lift thickness. For other initial lift thicknesses:

300 to 450mm (12 to 18 in.):	reduce survivability requirement one level;
450 to 600mm (18 to 24 in.):	reduce survivability requirement two levels;
>600mm (24 in.):	reduce survivability requirement three levels;

Note 1: While separation occurs in every geotextile application, this pavement-related specification focuses on subgrade soils being “firm” as indicated by CBR values higher then 3.0 (soaked) or 8.0 (unsoaked).

Source: Modified after Christopher, Holtz and DiMaggio

3.0 EXECUTION

3.1 Quality Assurance

A. The **Engineer** or **Third Party Testing Contractor** shall examine the geotextile rolls upon delivery to the site and report any deviations from project specifications to the contractor.

B. The **Engineer** may decide to arrange conformance testing of the rolls delivered to the job site. For this purpose, the **Engineer** shall take a sample three feet (along roll length) by roll width according to ASTM Practice D 4354 The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing.

C. The pass or fail of the conformance test results shall be determined according to ASTM Practice D 4759.

3.2 Installation

A. The geotextile shall be handled in such a manner as to ensure that it is not damaged in any way. Should the **Contractor** damage the geotextile to the extent that it is no longer usable as determined by these specifications or by the **Engineer** or **Third Party Testing Contractor**, the **Contractor** shall replace the geotextile at his own cost.

B. The geotextile shall be installed to the lines and grades as shown on the contract drawings and as described herein.

C. The geotextile shall be rolled down the slope in such a manner as to continuously keep the geotextile in tension by self-weight. The geotextile shall be securely anchored in an anchor trench where applicable, or by other approved or specified methods.

D. In the presence of wind, all geotextiles shall be weighted by sandbags or approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material.

E. The **Contractor** shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. Should damage to such material occur due to the fault of the **Contractor**, the latter shall repair the damaged materials at his own cost and to the satisfaction of the **Engineer**.

F. During placement of the geotextile, care shall be taken not to entrap soil, stones or excessive moisture that could hamper subsequent seaming of the geotextile as judged by the **Engineer or Third Party Testing Contractor**.

G. The geotextile shall not be exposed to precipitation prior to being installed and shall not be exposed to direct Sun light for more than 15 days after installation.

H. The geotextile shall be seamed using heat seaming or stitching methods as recommended by the manufacturer and approved by the **Engineer**. Sewn seams shall be made using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams shall be continuous. Seams shall be oriented down slopes perpendicular to grading contours unless otherwise specified. For heat seaming, fusion welding techniques recommended by the manufacturer shall be used.

I. The contractor shall not use heavy equipment to traffic above the geotextile without approved protection.

J. The geotextile shall be covered as soon as possible after installation and approval. Installed geotextile shall not be left exposed for more than 15 days.

K. Material overlying the geotextile shall be carefully placed to avoid wrinkling or damage to the geotextile.

L. Holes in the geotextile material shall be repaired using a patch of identical material extending a minimum 6 inches on all sides of the hole and heat bonded. If heat bonding is not possible, the patch shall extend a minimum of 18 inches on all sides of the hole.

M. In areas where the non-woven geotextile is used as separation or filtration, care shall be taken to install the layer without producing holes or gaps where the migration of fines into the drainage system could occur. This is accomplished by ensuring sufficient overlap of seams of 18-inches minimum overlap and properly wrapping the edges of the geotextile under the gravel areas being protected or by over running the edges of the geotextile beyond the area requiring separation or filtration.

4.0 CERTIFICATION

At the completion of the geotextile installation, the **Contractor** shall provide the **Owner** with a certification stating that the geotextile was installed and tested in accordance with the Specifications together with a report of the test results. The certification shall be provided to the **Owner** prior to the demobilization of the installation personnel from the site unless agreed otherwise by the **Owner**. The report of the test results shall be provided in hard copy and digital format to the **Owner** and the **Engineer** no later than 30 days after the installation work has been completed.

APPENDIX B6 – TECHNICAL SPECIFICATIONS FOR GEONET MATERIALS AND CONSTRUCTION

NewFields	**CLIENT** MAGNUM SOLUTION MINING, LLC	**PROJECT NO** 475.0093.020

PROJECT BRINE POND 4

TITLE TECHNICAL SPECIFICATIONS FOR GEONET AND INSTALLATION	**SPECIFICATION NO.** 0093.020-SPT-GN-0

			APPROVALS			
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1.0 GENERAL

1.1 SCOPE

This specification defines the requirements for the manufacturing and installation of the geonet drainage layer for the Magnum Solution Mining LLC (Owner), Brine Pond 4.

The geonet for this project shall have a thickness of 200 mils as defined in Table 1. Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

1.2 Definition of Terms

- “Owner” is defined as Magnum Solution Mining LLC or any of its authorized representative(s) / agent(s).
- “Engineer” is defined as the Consultant or Engineering Company (NewFields) responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- “Contractor” is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- “Specifications” are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- “Drawings” are defined as the Construction Drawings for Brine Pond 4 furnished by the Owner, Engineer, or others that apply to the Work.
- “Site” is defined as the Magnum Project site near Delta, Utah that is being developed by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.

- “Plant” is defined as all equipment, supplies, accommodations, temporary offices, etc., required to complete the Work.

- “Units” – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.

1.3 References

1.3.1 American Society for Testing and Materials (ASTM):

- D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
- D1505 – Standard Test Method for Density of Plastics by the Density - Gradient Technique.
- D1603 – Standard Test Method for Carbon Black in Olefin Plastics.
- D4716 – Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
- D5035 – Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).
- D5199 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

1.3.2 Environmental Protection Agency (EPA):

- Daniel, D.E. and R.M. Koerner, (1993), Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182.

1.3.3 Geosynthetic Research Institute (GRI):

- GN-2 and GC-13 – Standard Guide for Joining and Attaching Geonets and Drainage Composites, September 25, 2012, www.geosynthetic-institute.org.

1.4 Submittals Post-Award

- Prior to material delivery to the project site, the **Contractor** shall provide the **Engineer** with a written certification or manufacturers quality control data which displays that the geonet meets or exceeds the values specified herein.
- The **Contractor** shall submit, if required by the **Engineer**, manufacturer’s quality control manual for the geonet to be delivered to the site.

1.5 Submittals during Manufacturing

- Manufacturer quality control certificates stating the name of the manufacturer, product name, length, width, roll number and any other pertinent information to fully describe the geonet.
- The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.
- The manufacturer's certificate shall state that the finished geonet meets the Minimum Average Roll Value (MARV) requirements of the specification as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.
- Mislabelling or misrepresentation of materials shall be reason to reject those geonet products.

1.6 Shipment, Storage and Handling

- Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.
- Delivery of rolls of geonet will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- The on-site storage location for the geonet shall be provided by the **Contractor** and shall protect the geonet from abrasions, excessive dirt and moisture. The area shall be level (no wooden pallets), smooth, protected from vandalism and close to the area being lined.
- The **Contractor** and **Installer** shall handle all geonet in such a manner as to ensure it is not damaged in any way.
- The **Installer** shall take all necessary precautions to prevent damage to the underlying layers during placement of the geonet.

1.7 Warranty

- The material shall be warranted, on a prorate basis against defects for a period of 1-year from the date of the geonet installation.
- Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geonet completion.

2.0 PRODUCT

2.1 Geonet Properties

The geonet shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure.

The geonet specified shall have the properties that meet or exceed the values listed in Table 1 below.

Table 1 – Required Properties, Test Methods and Values for Geonet

Property	Test Method ASTM	Frequency (Minimum)	Units	Values			
Thickness, nominal	D5199	1/ 50,000 ft^2	mils (mm)	200 (5.0)	250 (6.3)	275 (7.0)	300 (7.6)
Density (minimum)	D1505/ D792, Method B	1/ 50,000 ft^2	g/cm3	0.94	0.94	0.94	0.94
Tensile Strength (Machine Direction)	D5035	1/ 50,000 ft^2	lbs./in. (N/mm)	45 (7.9)	55 (9.6)	65 (11.5)	75 (13.3)
Carbon Black Content	D4218/D1603[2]	1/ 50,000 ft^2	%	2-3	2-3	2-3	2-3
Melt Flow Index	D1238, 190°, 2.16kg	Per Resin Lot	g/10 minutes (max.)	≤1.0	≤1.0	≤1.0	≤1.0
Transmissivity[1]	D4716	1/ 500,000 ft^2	m^2/sec	$2x10^{-3}$	$3x10^{-3}$	$6x10^{-3}$	$8x10^{-3}$

Notes:
[1] Gradient of 0.1, normal load of 10,000psf (479 kN/m^2), water at 70ºF (21ºC), between steel plates for 15 minutes.
[2] Modified.

3.0 EXECUTION

3.1 Quality Assurance

- The **Engineer** shall examine the geonet rolls upon delivery to the site and report any deviations from project specifications to the **Contractor**.
- The **Engineer** may decide to arrange conformance testing of the rolls delivered to the job site. For this purpose, the **Engineer** shall take a sample three feet (along roll length) by roll width according to ASTM Practice D 4354 The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing.
- The pass or fail of the conformance test results shall be determined according to ASTM Practice D 4759.

3.2 Installation

- The geonet roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the **Engineer**. At no time shall any vehicles (pickup trucks, cars, Gator Utility Vehicles (or similar), Four Wheeler ATV's (or similar) be driven on the geonet. If so, the **Engineer** shall be informed and inspect the area for damage or require replacement or repairs.

- If the project contains long, steep slopes, special care should be taken so that only full-length rolls are used at the top of the slope.
- In the presence of wind, all geonet shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.
- If the project includes an anchor trench at the top of the slopes, the geonet shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geonet.
- In applying fill material, no equipment can drive directly across the geonet. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
- The top geomembrane shall be placed in the geonet in a manner that prevents damage to the geonet. Placement of the top geomembrane shall proceed immediately following the placement and inspection of the geonet.

3.3 Seams and Overlaps

- Each component of the geonet will be secured to the like component at overlaps.
- Geonet Components
  - Adjacent edges along the length of the geonet roll shall be overlapped a minimum of 4” or as recommended by the **Engineer**.
  - The overlapped edges shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 5 feet along the roll length. Ties for connecting the seams shall be resistant to degradation due to ultraviolet light and should be compatible with the process solution for which it could be exposed. Ties should be installed such that the clasp of the tie is placed between the grids of the geonet.
  - Adjoining rolls across the roll width should be shingled down in the direction of the slope a minimum of 1-foot overlap and joined together with cable ties spaced every foot along the roll width.

3.4 Repairs

- Prior to covering the deployed geonet, each roll shall be inspected by the **Installer** and the **Engineer** for damage resulting from construction.
- Any rips, tears or damaged areas on the deployed geonet greater than 2 inches shall be patched. The patch shall extend 6 inches beyond the damage and shall be secured to the original geonet by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with Subsection 3.3.

4.0 CERTIFICATION

At the completion of the geonet installation, the **Installer** shall provide the **Owner** with a certification stating that the geonet was installed and tested in accordance with these specifications together with a report of the test results. The certification shall be provided to the **Owner** prior to the demobilization of the installation personnel from the site unless agreed otherwise by the **Owner**. The report of the test results shall be provided in hard copy and digital format to the **Owner** and the **Engineer** no later than 30 days after the installation work has been completed.

APPENDIX C – DESIGN CALCULATIONS

APPENDIX C1 – LCRS AND PCMS LEAKAGE RATES

Geomembrane Leakage Rate Underlain by Permeable Media	
Project:	Brine Pond 4
Client:	Magnum Development Solution Mining
Facility:	LCRS calculation
Calculated:	John Weingardt
Checked:	Kevin Jennings
Date	2-Mar-21

NewFields

🟨	**Inputs**
🟩	**Outputs**

$$Q = n\left(0.6 \times a \times \sqrt{2gh}\right)$$ (Giroud, 1997)

Where: $$n = \left({}^{A}\!\big/_{43{,}560\ ft^2} \right) \times DefectsPer\ \ Acre$$

$$a = \pi\left({}^{d^2}\!\big/_{4} \right)$$

Inputs Defined:

Q = Leakage Rate
n = Number of Defects in Geomembrane
a = Area of Circular Defect
g = Acceleration of Gravity (32.2 ft/s^2 or 9.81 m/s^2)
h = Hydraulic Head Above Geomembrane
d = Diameter of Circular Defect
A = Area of Geomembrane Lined Facility

Typical Installation Damage

Installation Quality	Defects per Acre
Excellent	Up to 1
Good	1 to 4
Fair	4 to 10
Poor	10 to 20

Assume 2 Defects Per Acre

Variable Inputs

English Units			Metric Units	
d (in)	0.138		d (m)	0.0035
[1]A (ft^2)	6,035,929		A (m^2)	560,756
[1]h (ft)	50.0		h (m)	15.2

[1]Area (A) and Head (h) are measured at the pond freeboard elevation

Calculated Values

English Units			Metric Units	
n	277		n	277
a (ft^2)	1.04E-04		a (m^2)	9.64E-06
Q (ft^3/s)	0.979		Q (m^3/s)	0.028

Conversion

$$0.028\ \frac{m^3}{\sec} \times \frac{60\ \sec}{\min} \times \frac{264.1\,gal}{m^3} = \boxed{439}\ \frac{gal}{\min}$$

Assumptions

1. Above flow rate based upon Bernoulli's equation which describes free flow through an orifice. This condition is valid if the hydraulic conductivity of the underlying media is greater than 10e-1 m/s, which is valid for most gravels and geonets.
2. The typical installation damage assumes a circular defect diameter of approxiately 3.5 mm given good to excellent quality control.
3. Bernoulli's equations tends to overestimate leakage rate, as impedance to flow (geonet, gravel, etc.) is not considered.

References

1. Giroud, J.P. 1984. "Impermeability: The Myth and a Rational Approach". Proceedings of the International Conference on Geomembranes. Denver, CO. 1:157-162.
2. Giroud, J.P., Khire, M.V. and Soderman, K.L. 1997. "Liquid Migration Through Defects in a Geomembrane Overlain and Underlain by Permeable Media". Geosynthetics International. Vol 4, Nos. 3-4, pp. 293-321.

Geomembrane Leakage Rate Underlain by Relatively Low Permeability Soil	
Project:	Brine Pond 4
Client:	Magnum Development Solution Mining
Facility:	PCMS calculation
Calculated:	John Weingardt
Checked:	Kevin Jennings
Date	8-Jun-20

NewFields

🟨 **Inputs**
🟩 **Outputs**

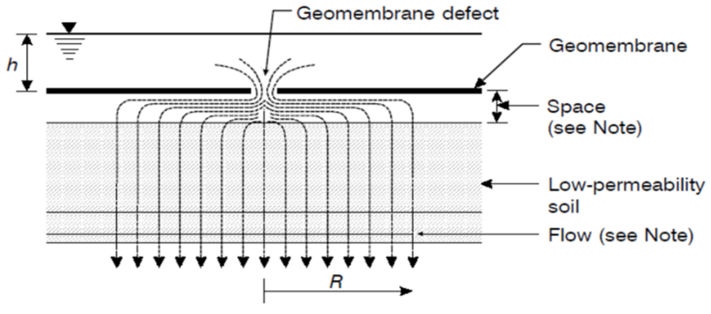


Figure 1. Liquid migration through a composite liner.

$$Q = C_{qo}\left[1+0.1(h/t_s)^{0.95}\right]a^{0.1}h^{0.9}k_s^{0.74}n \quad \text{(Giroud, 1997)}$$

Where: $n = \left(A \big/ 43{,}560 \;\; ft^2 \right) \times DefectsPer \quad Acre$

$$a = \pi\left(d^2 \big/ 4\right)$$

Inputs Defined:

Q = Leakage Rate
n = Number of Defects in Geomembrane
a = Area of Circular Defect
g = Acceleration of Gravity (32.2 ft/s^2 or 9.81 m/s^2)
h = Hydraulic Head Above Geomembrane
d = Diameter of Circular Defect
A = Area of Geomembrane Lined Facility
C_{qo} = Contact Quality Factor
k_s = Permeability of Underlying Soil Layer
t_s = Thickness of Underlying Soil Layer

Typical Installation Damage

Installation Quality	Defects per Acre
Excellent	Up to 1
Good	1 to 4
Fair	4 to 10
Poor	10 to 20

Assume 3 Defects Per Acre

Contact Quality Factor, C_{qo}

Liner/Soil Contact	Factor (Circ. Defect)
Good	0.21
Poor	1.15

Assume 0.21 for Contact Quality

Variable Inputs

English Units			Metric Units	
d (in)	0.138		d (m)	0.0035
[1]A (ft^2)	6,035,929		A (m^2)	560,756
h (ft)	1.0000		h (m)	0.3048
k_s (ft/sec)	1.02E-05		k_s (m/s)	3.10E-06
t_s (ft)	1.0		t_s (m)	0.3

[1]Area (A) is measured at the pond freeboard elevation

Calculated Values

English Units			Metric Units	
n	416		n	416
a (ft^2)	1.04E-04		a (m^2)	9.64E-06
Q (ft^3/s)	3.08E-02		Q (m^3/s)	8.71E-04

Conversion

$$8.71\text{E-}04 \;\frac{m^3}{\sec} \times \frac{60\sec}{\min} \times \frac{264.1gal}{m^3} = \boxed{13.80}\;\frac{gal}{\min}$$

Assumptions

1. Above equations are for a circular defect with a diameter less than 25 mm.
2. The hydraulic head above the liner should be equal to or less than 3 m
3. The typical installation damage assumes a circular defect diameter of approxiately 3.5 mm given good to excellent quality control.

References

1. Giroud, J.P. 1997. "Equations for Caulculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects". Geosynthetics International. Vol 4, Nos. 3-4, pp. 335-348.

APPENDIX C2 – LINER PULL-OUT CALCULATIONS

NewFields

Calculation: Factor of Safety for Tensile Failure and Anchor Pull-out due to self-weight.
Project: Brine Pond 4 Revised Design
Date: 14-May-2020
By: John Weingardt

input
calculated

Input Parameters		
Height of Slope (ft)	68	ft
Slope (Z:1)	2.5	
FML Thickness (mil)	80	mil
FML Yield Stress (psi)	2100	psi
FML Yield Stress (ppi)	168	ppi
FML Specific Gravity	0.94	
Soil Friction Angle	30	degrees
Liner-Soil Interface Friction Angle (degrees)	15	degrees
Anchor Trench Depth (ft)	4	ft
Anchor Trench Width (ft)	3	ft
Anchor Set-Back (ft)	3	ft
Soil Depth over Setback	0	ft
Soil Unit Weight (pcf)	115	pcf

4684.5 4616.2

Above cells contain the crest elev and lowest pond floor elev at the southwest corner (not including the sump depth which is negligible and can be ommitted).

TENSILE FAILURE OF LINER FROM SELF-WT CALC S			
FML Density	58.66	pcf	
Slope Length	183.90	ft	
Slope Angle	21.80	degrees	
Liner Total Wt./ Unit ft.	71.91	lbs/ft	
Max. Tensile Force From Self-Wt.	26.71	lbs/ft	
Frictional Resistance	17.89	lbs/ft	
Tensile Stress (neg. frictional resistance)	27.82	psi	
Tensile Stress (w/ frictional resistance)	9.18	psi	
FOS Tensile failure (MIN)	75	PASS	Required FOS 10 or greater
FOS Tensile failure (MAX)	229	PASS	Required FOS 10 or greater
Max. Heat/Cool Force:	44.60	lbs/ft	
Max. Tensile Stress Developed	61.94	psi	
FOS Tensile Failure	34	PASS	Required FOS 10 or greater

LINER ANCHOR CALC S		
At Rest Coeff.	0.50	
Active Pressure Coeff.	0.33	
Passive Pressure Coeff.	3.00	
Allowable Liner Force	2016.00	lbs/ft
Shear Force Above Membrane Due to Soil Cover	0.00	lbs/ft
Shear Force Below Liner Due to Soil Cover	0.00	lbs/ft
Shear Force Below Liner Due to Liner Pull-Down	200.62	lbs/ft
Active Pressure Anchor Backfill Side	306.67	lbs/ft
Passive Pressure Anchor InSitu Side	2760.00	lbs/ft
Sum of Forces	2653.95	lbs/ft
FOS Pull-out	1.42	**PASS**

Based on methods presented in Designing With Geosynthetics 4th edition
Robert M. Koerner, 1 Prentice-Hall

APPENDIX C3 – LCRS AND PCMS SUMP SIZING

LCRS Sizing Worksheet

Project Name:	Revised Brine Pond 4			
Project Number:	475.0093.020			
Client:	Magnum Development Solution Mining			
By:	JLW			
Date:	7/15/2020			

Sump Depth	3.5	ft		
Sump Side Slope	2.5	H:1V		
Sump Bottom Length	25	ft		
Sump Bottom Width	50	ft		
Sump Top Length	42.5	ft		
Sump Top Width	67.5	ft		
Sump Volume	7,208	ft^3		
Gravel Porosity	0.35			
Volume of voids in sump	2,523	ft^3		
Flow rate from liner leakage calc	1.03	ft^3/sec	462.264	gpm
LCRS Residence Time	2,449	seconds		
LCRS Residence Time	41	minutes		

PCMS Sizing Worksheet

Project Name:	Revised Brine Pond 4
Project Number:	475.0093.020
Client:	Magnum Development Solution Mining
By:	JLW
Date:	7/15/2020

Sump Depth	3.5	ft
Sump Side Slope	2.5	H:1V
Sump Bottom Length	25	ft
Sump Bottom Width	25	ft
Sump Top Length	42.5	ft
Sump Top Width	42.5	ft
Sump Volume	4,255	ft^3
Gravel Porosity	0.35	
Volume of voids in sump	1,489	ft^3
Flow rate from liner leakage calc	0.0335	ft^3/sec
PCMS Residence Time	44,452	seconds
PCMS Residence Time	741	minutes

APPENDIX C4 – WAVE RUN-UP ANALYSIS FOR FREEBOARD

Freeboard Allowances for Solution Brine Pond 4	
Project:	Brine Pond 4 (Revised 2020) Wave Height Calculation
Client:	Magnum Development Solution Mining
Facility:	Brine Pond 4 (Revised 2020)
Calculated:	John Weingardt
Checked:	Kevin Jennings
Date	15-Jul-20

NewFields

Wave Height Calculation:

(Base on USBR ACER Technical Memorandum No. 2 Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams)

Wave Run-up Analysis:

$V = Fastest\ Mile\ of\ Record = 63 mph \ \ (Figure\ 2, USBR\ suggest\ 50\ mph\ during\ IDF)$

$F = Wind\ Fetch = 2644\ feet = 0.50\ miles$

$\theta = Slope\ of\ Upstream\ Face = 21.80^0$

$\cot\theta = 2.5$

$\mathrm{D} = Average\ Depth\ of\ Reservoir = 45.06\ feet$

$T = Wave\ Period = 0.559(0.589V^{1.23}F)^{0.33} = 2.01\ seconds$

$L = Wave\ Length = 5.12T^2 = 20.65\ feet$

$H_s = Significant\ Wave\ Height = 0.0177V^{1.23}F^{0.5} = 2.05\ feet$

$Maximum\ one\ hour\ velocity = 43 mph\ (\text{Figure 6, USBR})$

$Wind\ velocity\ ratio = 1.08\ (\text{Table 2, USBR})$

Wind Duration (min)	Wind Velocity Over Land (mph)	Wind Velocity Over Water (mph)
1	67.0	72.4
60	46.0	49.7
120	44.2	47.7

Calculate $\frac{D}{H_s}$ and $\frac{H_s}{gT^2}$ to Find R on Figure 11 (Assume Smooth Slope):

$\frac{D}{H_s} = 21.98\ > 3.0\ \ \rightarrow Use\ Figure\ 11$ $\qquad \frac{H_s}{gT^2} = 0.0158$

Determine R from Figure 11:

$\frac{R}{H} = 1.20$ $\qquad R = H1.20 = 2.46$

Determine Runup Correction for Scale Effects from Figure 13:

$\cot\theta = 2.5$ $\qquad \mathrm{k} = 1.15$

Determine Total Wave Runup:

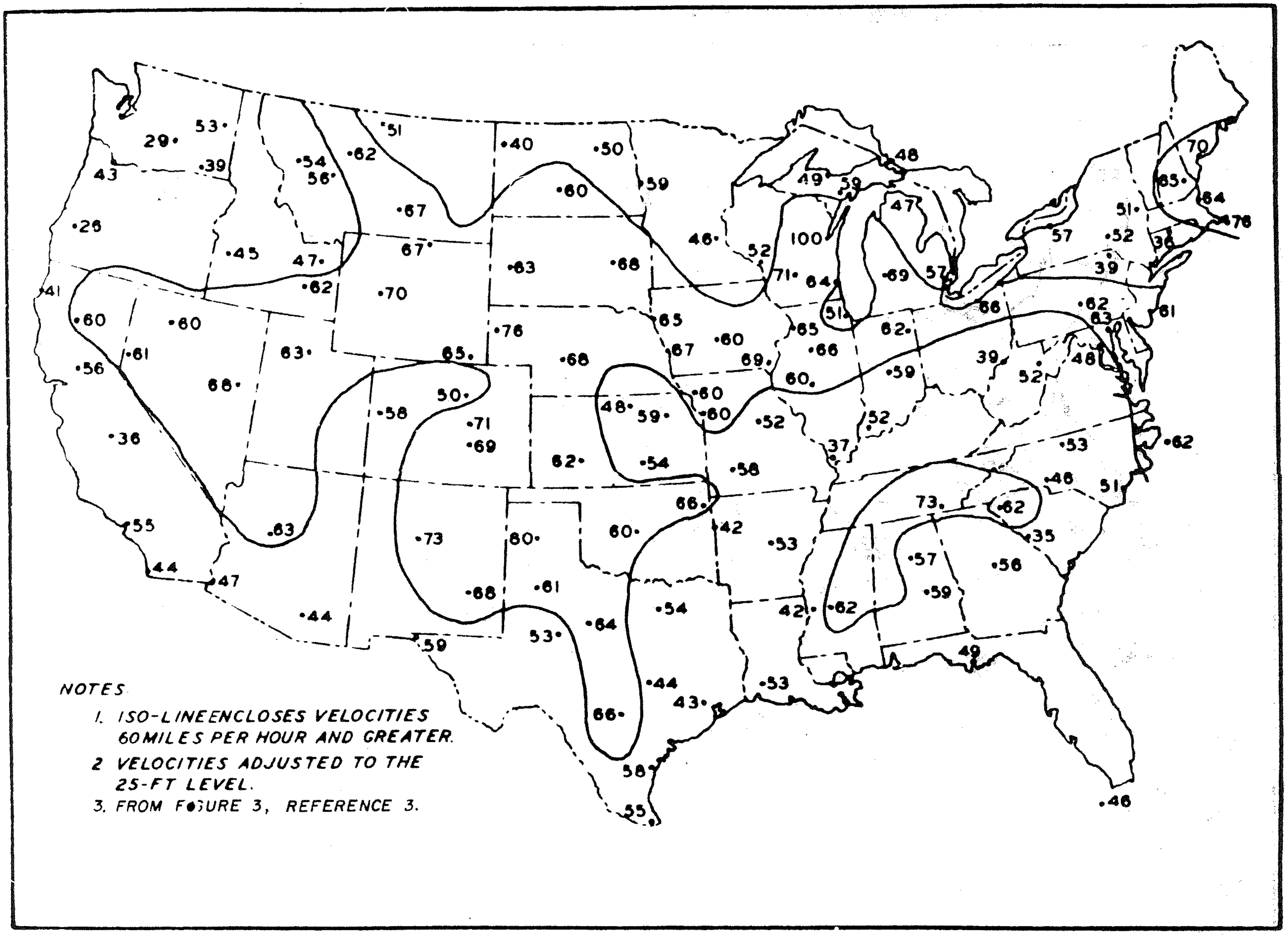
$R_{Tot} = kR = 2.83\ feet < 3\ feet\ to\ embankment\ crest \quad ok$

Assumptions:

1. Above equations are for a smooth slope.
2. Analysis was based on maximum pond water surface.

References:

1. USBR ACER Technical Memorandum No. 2 Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams



NOTES

1. ISO-LINEENCLOSES VELOCITIES 60MILES PER HOUR AND GREATER.
2. VELOCITIES ADJUSTED TO THE 25-FT LEVEL.
3. FROM FIGURE 3, REFERENCE 3.

FIGURE 2.-FASTEST MILE OF RECORD-SPRING

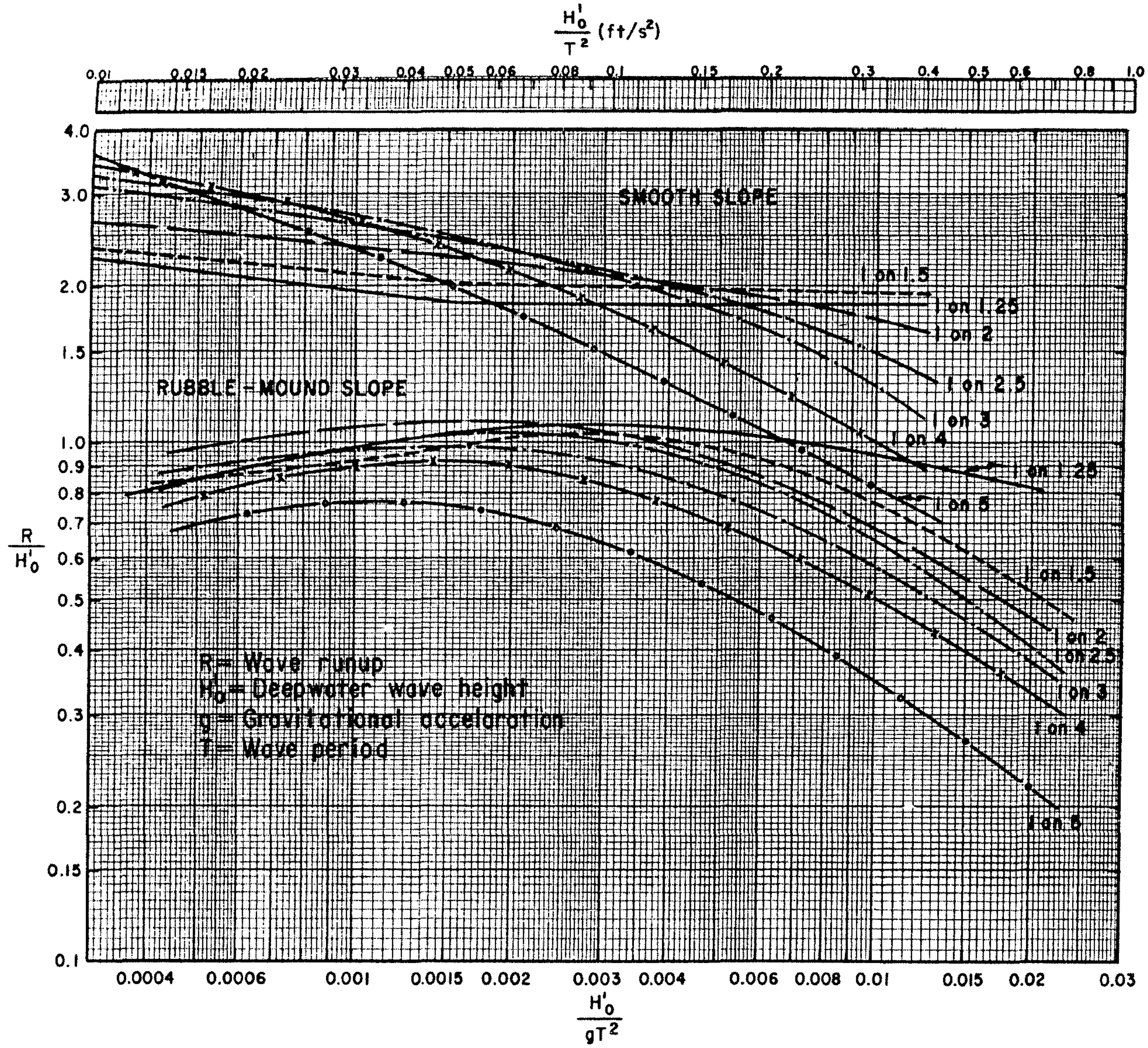


FIGURE 11.- COMPARISON OF WAVE RUNUP ON SMOOTH SLOPES WITH RUNUP ON PERMEABLE RUBBLE SLOPES (DATA FOR $d_s/H'_0 > 3.0$) (FROM FIGURE 7-20, REF. 6)

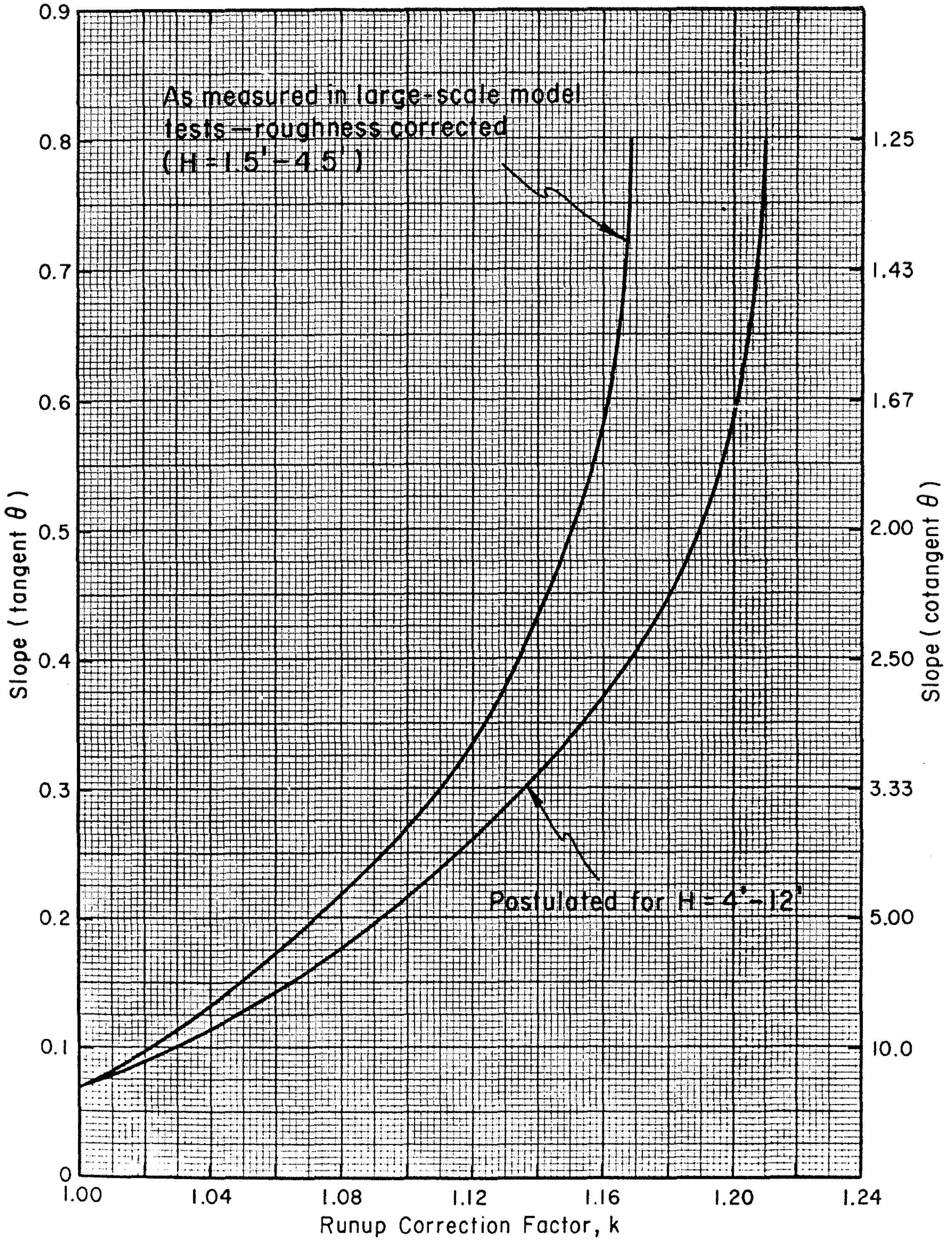


FIGURE 13.- RUNUP CORRECTION FOR SCALE EFFECTS
(FROM FIGURE 7-13, REF. 6)

APPENDIX D – BOREHOLE LOGS

NewFields

LOG of BOREHOLE: BH17-01

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

Page 1 of 3

LOGGED BY: J. Roberts	LOCATION: Brine Ponds 3&4	TOTAL DEPTH (ft bgs): 76.5
CHECKED BY: K. Jennings	COORDINATES:	GROUNDWATER (ft bgs): 24.3
ENGINEER: K. Jennings	ELEVATION (ft amsl):	HOLE DIAMETER (in): 8
START DATE: 6/13/2017	DATUM: Local Project Coord.	DRILL RIG: BK 81
END DATE: 6/13/2017	CONTRACTOR: Haz Tech Drilling	DRILL METHOD: 4 1/4" HSA

GENERAL REMARKS:

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ⊢⊣ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
0		SAND (SM), silty, trace clay, fine grained, loose, non-plastic, brown, damp			S-1	2 4 6				
		SAND (SC), with silt , some gravel, fine to coarse grained gravel, poorly graded, subrounded gravel, medium dense, non-plastic, light brown, damp			S-2	13 14 12				
5		with silt, fine grained sand			S-3	4 8 9				
		CLAY (CL), trace silt, with sand lens, medium plastic, hard, light brown, moist			S-4	13 17 24				
10										
15					S-5	7 10 9				
20		very stiff, high plastic, brown, moist			S-6	4 8 10				
			▼							
25		silty, trace sand, very stiff, low to medum plastic, brown, moist			S-7	7 10 9				
30		CLAY (CH), hard, high plastic, brown, moist			S-8	10 14 17				
35										

LOG of BOREHOLE: BH17-01

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ⊢—⊣ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
35		SAND (SP), trace silt, fine to medium grained, poorly graded, dense, non- plastic, brown, wet		◣	S-9	6 16 27				
40		very dense		⧗	S-10	11 22 31				
45		CLAY (CL), silty, very stiff, low to medium plastic, brown, moist		◣	S-11	6 8 10				
50		SAND (SC), clayey, fine to medium grained, poorly graded, very dense, medium plastic, light brown and light gray, wet		⧗	S-12	11 31 31				
55		SAND (SP), medium to coarse grained, poorly graded, rounded, dense, non-plastic, brown, wet		◣	S-13	8 13 21				
60		CLAY (CL), silty, trace fine grained sand, hard, medium plastic, brown, moist		⧗	S-14	10 26 36				
65		some silt, very stiff, light brown and light gray		◣	S-15	7 9 13				
70		trace fine grained sand, light gray		⧗	S-16	6 12 14				
75										

NewFields

LOG of BOREHOLE: BH17-01

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
	▨	silty, low plastic, light brown		◢	S-17	6 12 18				
		Borehole terminated at 76.5 ft. depth in CLAY. Groundwater encountered at 24.3 ft. depth during time of drilling. Abandoned borehole with neat cement grout: 140 gallons of water, 21 sacks of cement.								

NewFields

LOG of BOREHOLE: BH17-02

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

Page 1 of 2

LOGGED BY: J. Roberts, K Jennings
LOCATION: Brine Ponds 3&4
TOTAL DEPTH (ft bgs): 56.5
CHECKED BY: K. Jennings
COORDINATES:
GROUNDWATER (ft bgs): 24.9
ENGINEER: K. Jennings
ELEVATION (ft amsl):
HOLE DIAMETER (in): 8
START DATE: 06/14/2017
DATUM: Local Project Coord.
DRILL RIG: BK 81
END DATE: 06/14/2017
CONTRACTOR: Haz Tech Drilling
DRILL METHOD: 4 1/4" HSA
GENERAL REMARKS:

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
0		SAND (SC-SM), silty, trace fine grained gravel, loose, non-plastic, light brown, damp			S-1	2 2 6				
		CLAY (CL), silty, with fine grained sand, very stiff, low to medium plastic, light brown, damp			S-2	10 14 9				
5										
		SAND (SP), trace silt, fine grained, poorly graded, medium dense, non- plastic, brown, damp			S-3	3 7 7				
		dense			S-4	7 13 19				
10										
15					S-5	7 21 26				
20		CLAY (CH), trace fine grained sand, very stiff, medium to high plastic, light brown			S-6	11 12 16				
			▼							
25					S-7	5 8 11				
30					S-8	11 19 49				
		SAND (SP-SM), with silt and clay, fine grained, very dense, non-plastic, gray								
35										

LOG of BOREHOLE: BH17-02

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
35					S-9	6 4 6				
40		SAND (SP), fine grained, poorly graded, dense, light brown, moist			S-10	7 13 35				
45		CLAY (CH), trace fine grained sand, very stiff, medium to high plastic, gray, moist			S-11	4 8 11				
50		SAND (SM), with clay, fine to medium grained, non-plastic, gray, wet			S-12	6 6 1				
55		SAND (SP), fine to medium grained, very dense, gray, wet			S-13	11 36 R				

Borehole terminated at 56.5 ft. depth in SAND.
Groundwater encountered at 24.9 ft. depth during time of drilling.
Abandoned borehole with neat cement grout: 135 gallons of water, 14 sacks of cement.

NewFields

LOG of BOREHOLE: BH17-03

PROJECT No.: 475.0093.017
PROJECT: Magnum Brine Ponds 3 & 4
CLIENT: Magnum

LOGGED BY: Kevin Jennings
LOCATION: Brine Ponds 3&4
TOTAL DEPTH (ft bgs): 51.5
CHECKED BY: J. Roberts
COORDINATES:
GROUNDWATER (ft bgs): 29.1
ENGINEER: K. Jennings
ELEVATION (ft amsl):
HOLE DIAMETER (in): 8
START DATE: 6/15/2017
DATUM: Local Project Coord.
DRILL RIG: BK 81
END DATE: 6/15/2017
CONTRACTOR: Haz Tech Drilling
DRILL METHOD: 4 1/4" HSA
GENERAL REMARKS:

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
0		SAND (SM), silty, fine grained, loose, light brown, damp			S-1	3 4 5				
		CLAY (CH), trace fine grained sand, hard, medium to high plastic, light brown, damp			S-2	17 21 23				
5										
		SAND (SM), silty, fine grained, medium dense, light brown, moist			S-3	9 8 6				
		SAND (SP), trace gravel, fine grained, medium dense, light brown, moist			S-4	7 21 9				
10										
15		very dense			S-5	12 22 30				
20		CLAY (CH), with fine grained sand, hard, medium to high plastic, light brown, moist			S-6	10 25 41				
25		very stiff			S-7	7 9 10				
			▼							
30		SAND (SP-SM), with silt, fine grained, very dense, non-plastic, light brown, moist			S-8	10 20 39				
35										

NewFields

LOG of BOREHOLE: BH17-03

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
35	▒	medium dense		◢	S-9	10 13 15				
40	▒	dense		⧗	S-10	6 19 29				
45	▨	CLAY (CH), trace fine grained sand, very stiff, medium to high plastic, light brown, moist		◢	S-11	5 9 10				
50	▨	hard		⧗	S-12	9 17 21				
		Borehole terminated at 51.5 ft. depth in CLAY. Groundwater encountered at 29.1 ft. depth during time of drilling. Abandoned borehole with neat cement grout: 150 gallons of water, 9 sacks of cement, and 1/2 sack of bentonite.								

NewFields

LOG of BOREHOLE: BH17-04

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

Page 1 of 3

LOGGED BY: Kevin Jennings	LOCATION: Brine Ponds 3&4	TOTAL DEPTH (ft bgs): 76.5
CHECKED BY: J. Roberts	COORDINATES:	GROUNDWATER (ft bgs): 34.9
ENGINEER: K. Jennings	ELEVATION (ft amsl):	HOLE DIAMETER (in): 8
START DATE: 6/15/2017	DATUM: Local Project Coord.	DRILL RIG: BK 81
END DATE: 6/15/2017	CONTRACTOR: Haz Tech Drilling	DRILL METHOD: 4 1/4" HSA

GENERAL REMARKS:

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
0		CLAY (CL), trace fine grained sand, very stiff, medium to high plastic, light brown, damp								
					S-1	5 7 9				
					S-2	7 8 16				
5										
		stiff			S-3	3 6 9				
		SAND (SP), fine grained, poorly graded, very dense, light brown, moist			S-4	17 41 44				
10										
15		CLAY (CH), trace fine grained sand, hard, medium to high plastic, light brown, moist			S-5	7 16 21				
20		SAND (SP), fine grained, very dense, light brown, moist			S-6	9 18 35				
25					S-7	9 26 28				
30		CLAY (CH), very stiff, medium to high plastic, light brown, moist			S-8	7 8 16				
35			▼							

LOG of BOREHOLE: BH17-04

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
35	▨	SAND (SC), clayey, fine grained, medium dense, low plastic, light brown, moist		◢	S-9	3 5 12				
40	⁙	SAND (SP), fine to medium grained, dense, gray, moist		⧗	S-10	6 8 27				
45	⁙			◢	S-11	3 11 26				
50	▧	CLAY (CH), trace fine grained sand, very stiff, medium to high plastic, light gray		⧗	S-12	8 13 16				
55	⁙	SAND (SP), fine to medium grained, dense, gray, moist		◢	S-13	10 15 16				
60	⁙	very dense		⧗	S-14	11 36 41				
65	▧	CLAY (CH), trace fine grained sand, very stiff, medium to high plastic, light gray, moist		◢	S-15	8 11 13				
70	▧	hard		⧗	S-16	8 13 19				
75										

LOG of BOREHOLE: BH17-04

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ⊢ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
		SAND (SP-SM), with silt, trace clay, fine grained, very dense, non-plastic, gray, moist		◢	S-17	8 24 29				
		Borehole terminated at 76.5 ft. depth in SAND. Groundwater encountered at 34.9 ft. depth during time of drilling. Abandoned borehole with neat cement grout: 210 gallons of water, 18 sacks of cement.								

NewFields

LOG of BOREHOLE: BH17-05

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

Page 1 of 2

LOGGED BY: K.Jennings
CHECKED BY: J. Roberts
ENGINEER: K. Jennings
START DATE: 6/16/2017
END DATE: 6/16/2017
LOCATION: Brine Ponds 3&4
COORDINATES:
ELEVATION (ft amsl):
DATUM: Local Project Coord.
CONTRACTOR: Haz Tech Drilling
TOTAL DEPTH (ft bgs): 51.5
GROUNDWATER (ft bgs): 33.8
HOLE DIAMETER (in): 8
DRILL RIG: BK 81
DRILL METHOD: 4 1/4" HSA
GENERAL REMARKS:

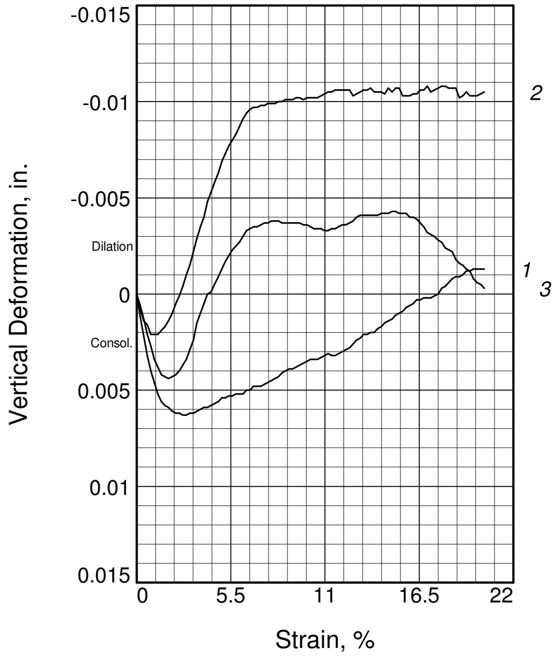
DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├───┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
0		SAND (SM), silty, trace clay, fine grained, loose, non-plastic, light brown, moist			S-1	2 2 2				
		CLAY (CL), silty, trace fine grained sand, hard, low plastic, light brown, moist			S-2	12 16 20				
5		stiff			S-3	6 8 7				
		hard, medium to high plastic, light gray, moist			S-4	8 14 23				
10										
15		SAND (SM), silty, fine grained, medium dense, non-plastic, light brown, moist			S-5	6 7 15				
20		SAND (SP-SM), with silt, trace clay, fine grained, very dense, light brown moist			S-6	18 38 R				
25		trace subrounded gravel up to 3/8in, dense			S-7	7 18 23				
30		SAND (SP), trace gravel, fine to medium grained, subrounded gravel up to 3/8in, very dense, gray, wet, capilary fringe			S-8	13 29 33				
			▼							
35										

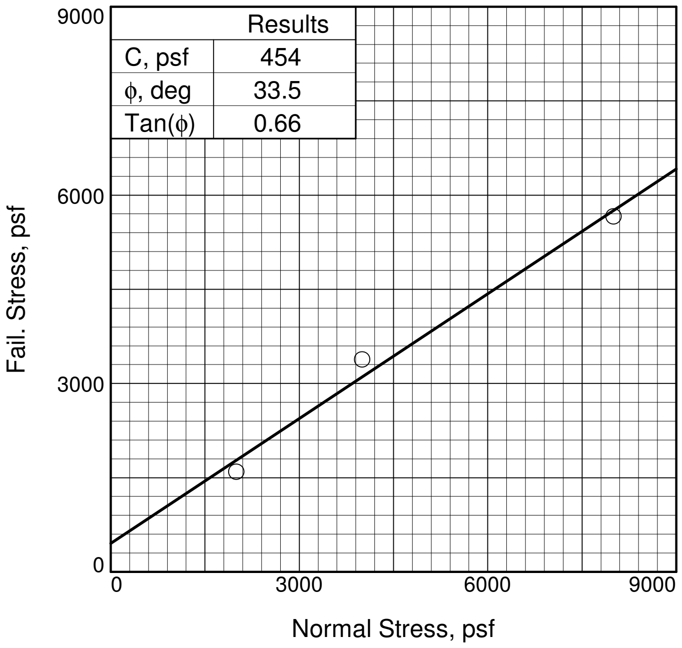
LOG of BOREHOLE: BH17-05

PROJECT No.: 475.0093.017 **PROJECT:** Magnum Brine Ponds 3 & 4
CLIENT: Magnum

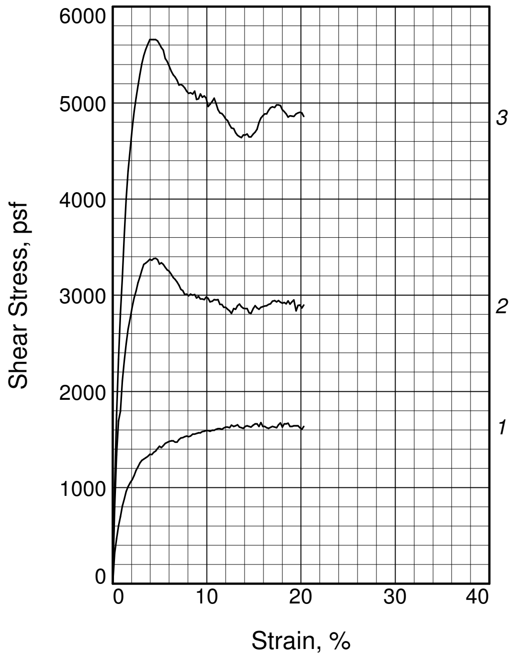
DEPTH (ft) ELEV (ft amsl)	GRAPHIC LOG	MATERIAL DESCRIPTION and REMARKS	GROUNDWATER	SAMPLE TYPE	SAMPLE No. or CORE RUN No.	SPT (6" increments) or RQD	% RECOVERY	PARTICLE SIZE DIST. (G/S/F)	PL ├──┤ LL ▲ MOISTURE CONTENT 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB TESTING
35		medium dense			S-9	2 9 9				
40		CLAY (CH), trace fine grained sand, hard, medium to high plastic, light brown, moist			S-10	13 22 33				
45					S-11	12 23 27				
50		SAND (SP), fine to medium grained, very dense, gray, moist			S-12	11 27 40				
		Borehole terminated at 51.5 ft. depth in SAND. Groundwater encountered at 33.8 ft. depth during time of drilling. Abandoned borehole with neat cement grout: 140 gallons of water, 11 sacks of cement.								

APPENDIX E – LABORATORY TESTING





Results	
C, psf	454
ϕ, deg	33.5
Tan(ϕ)	0.66



	Specimen No.	1	2	3
Initial	Water Content, %	14.7	14.7	14.7
	Dry Density, pcf	105.0	104.3	104.0
	Saturation, %	67.6	66.3	65.8
	Void Ratio	0.5749	0.5858	0.5907
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	0.99	0.99
At Test	Water Content, %	20.0	20.1	19.2
	Dry Density, pcf	108.2	107.8	109.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5291	0.5340	0.5080
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.97	0.96	0.94
	Normal Stress, psf	2000	4000	8000
	Fail. Stress, psf	1592	3383	5660
	Strain, %	10.1	4.6	4.6
	Ult. Stress, psf			
	Strain, %			
	Strain rate, %/min.	0.17	0.17	0.17

Sample Type: Remolded

Description: silty sand

LL= 22 **PI=** NP

Assumed Specific Gravity= 2.65

Remarks: Failure chosen at peak shear stress. Test was inundated. Remolding parameters provided by client.

Figure _______

Client: NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

Location: BH17-01

Sample Number: S-2A & S-2B

Proj. No.: 10800305 **Date Sampled:** 7/10/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

7/21/2017

Date: 7/10/17
Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No.: 10800305
Location: BH17-01
Sample Number: S-2A & S-2B
Description: silty sand
Remarks: Failure chosen at peak shear stress. Test was inundated. Remolding parameters provided by client.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=**22 **PL=** **PI=**NP

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	337.800		555.830
Moisture content: Dry soil+tare, gms.	318.610		530.340
Moisture content: Tare, gms.	187.700		402.690
Moisture, %	14.7	20.0	20.0
Moist specimen weight, gms.	144.8		
Diameter, in.	2.42	2.42	
Area, in.²	4.58	4.58	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet density, pcf	120.4	129.8	
Dry density, pcf	105.0	108.2	
Void ratio	0.5749	0.5291	
Saturation, %	67.6	100.0	

Test Readings for Specimen No. 1

Load ring constant = 31.408 lbs. per input unit
Normal stress = 2000 psf
Strain rate, %/min. = 0.17
Fail. Stress = 1592 psf **at reading no.** 49

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0002
1	0.0050	0.3213	10.1	0.2	317	-0.0014
2	0.0100	0.4740	14.9	0.4	468	-0.0024
3	0.0150	0.6076	19.1	0.6	600	-0.0034
4	0.0200	0.7062	22.2	0.8	697	-0.0042
5	0.0250	0.8175	25.7	1.0	807	-0.0048
6	0.0300	0.8907	28.0	1.2	879	-0.0054
7	0.0350	0.9702	30.5	1.4	958	-0.0058
8	0.0400	1.0211	32.1	1.7	1008	-0.0060
9	0.0450	1.0656	33.5	1.9	1052	-0.0061
10	0.0500	1.0974	34.5	2.1	1084	-0.0063
11	0.0550	1.1388	35.8	2.3	1124	-0.0064

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
12	0.0600	1.1929	37.5	2.5	1178	-0.0064
13	0.0650	1.2310	38.7	2.7	1215	-0.0065
14	0.0700	1.2724	40.0	2.9	1256	-0.0065
15	0.0750	1.2978	40.8	3.1	1281	-0.0064
16	0.0800	1.3137	41.3	3.3	1297	-0.0064
17	0.0850	1.3265	41.7	3.5	1310	-0.0063
18	0.0900	1.3392	42.1	3.7	1322	-0.0062
19	0.0950	1.3646	42.9	3.9	1347	-0.0061
20	0.1000	1.3583	42.7	4.1	1341	-0.0061
21	0.1050	1.3837	43.5	4.3	1366	-0.0060
22	0.1100	1.3965	43.9	4.6	1379	-0.0059
23	0.1150	1.4251	44.8	4.8	1407	-0.0058
24	0.1200	1.4473	45.5	5.0	1429	-0.0056
25	0.1250	1.4346	45.1	5.2	1417	-0.0056
26	0.1300	1.4537	45.7	5.4	1435	-0.0055
27	0.1350	1.4760	46.4	5.6	1457	-0.0055
28	0.1400	1.4887	46.8	5.8	1470	-0.0054
29	0.1450	1.4982	47.1	6.0	1479	-0.0054
30	0.1500	1.5046	47.3	6.2	1486	-0.0054
31	0.1550	1.5046	47.3	6.4	1486	-0.0052
32	0.1600	1.4919	46.9	6.6	1473	-0.0052
33	0.1650	1.4919	46.9	6.8	1473	-0.0050
34	0.1700	1.5173	47.7	7.0	1498	-0.0050
35	0.1750	1.5364	48.3	7.2	1517	-0.0050
36	0.1800	1.5396	48.4	7.5	1520	-0.0049
37	0.1850	1.5491	48.7	7.7	1530	-0.0048
38	0.1900	1.5555	48.9	7.9	1536	-0.0047
39	0.1950	1.5491	48.7	8.1	1530	-0.0046
40	0.2000	1.5555	48.9	8.3	1536	-0.0045
41	0.2050	1.5746	49.5	8.5	1555	-0.0043
42	0.2100	1.5746	49.5	8.7	1555	-0.0042
43	0.2150	1.5809	49.7	8.9	1561	-0.0041
44	0.2200	1.5873	49.9	9.1	1567	-0.0041
45	0.2250	1.5873	49.9	9.3	1567	-0.0040
46	0.2300	1.6032	50.4	9.5	1583	-0.0039
47	0.2350	1.6064	50.5	9.7	1586	-0.0038
48	0.2400	1.6128	50.7	9.9	1592	-0.0037
49	0.2450	1.6128	50.7	10.1	1592	-0.0036
50	0.2500	1.6064	50.5	10.4	1586	-0.0036
51	0.2550	1.6159	50.8	10.6	1596	-0.0036
52	0.2600	1.6159	50.8	10.8	1596	-0.0035
53	0.2650	1.6255	51.1	11.0	1605	-0.0034
54	0.2700	1.6318	51.3	11.2	1611	-0.0033
55	0.2750	1.6318	51.3	11.4	1611	-0.0034
56	0.2800	1.6255	51.1	11.6	1605	-0.0034
57	0.2850	1.6382	51.5	11.8	1618	-0.0033
58	0.2900	1.6509	51.9	12.0	1630	-0.0032

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
59	0.2950	1.6509	51.9	12.2	1630	-0.0031
60	0.3000	1.6446	51.7	12.4	1624	-0.0030
61	0.3050	1.6700	52.5	12.6	1649	-0.0028
62	0.3100	1.6573	52.1	12.8	1636	-0.0026
63	0.3150	1.6637	52.3	13.0	1643	-0.0025
64	0.3200	1.6732	52.6	13.3	1652	-0.0023
65	0.3250	1.6509	51.9	13.5	1630	-0.0023
66	0.3300	1.6446	51.7	13.7	1624	-0.0022
67	0.3350	1.6350	51.4	13.9	1614	-0.0022
68	0.3400	1.6573	52.1	14.1	1636	-0.0020
69	0.3450	1.6637	52.3	14.3	1643	-0.0019
70	0.3500	1.6573	52.1	14.5	1636	-0.0017
71	0.3550	1.6509	51.9	14.7	1630	-0.0016
72	0.3600	1.6700	52.5	14.9	1649	-0.0015
73	0.3650	1.6827	52.9	15.1	1661	-0.0013
74	0.3700	1.6827	52.9	15.3	1661	-0.0012
75	0.3750	1.6573	52.1	15.5	1636	-0.0011
76	0.3800	1.6955	53.3	15.7	1674	-0.0009
77	0.3850	1.6573	52.1	15.9	1636	-0.0008
78	0.3900	1.6573	52.1	16.1	1636	-0.0007
79	0.3950	1.6446	51.7	16.4	1624	-0.0005
80	0.4000	1.6350	51.4	16.6	1614	-0.0005
81	0.4050	1.6478	51.8	16.8	1627	-0.0004
82	0.4100	1.6573	52.1	17.0	1636	-0.0004
83	0.4150	1.6509	51.9	17.2	1630	-0.0004
84	0.4200	1.6446	51.7	17.4	1624	-0.0003
85	0.4250	1.6732	52.6	17.6	1652	-0.0002
86	0.4300	1.6923	53.2	17.8	1671	0.0001
87	0.4350	1.6509	51.9	18.0	1630	0.0002
88	0.4400	1.6827	52.9	18.2	1661	0.0004
89	0.4450	1.6827	52.9	18.4	1661	0.0006
90	0.4500	1.6891	53.1	18.6	1668	0.0007
91	0.4550	1.6573	52.1	18.8	1636	0.0007
92	0.4600	1.6573	52.1	19.0	1636	0.0008
93	0.4650	1.6637	52.3	19.3	1643	0.0010
94	0.4700	1.6637	52.3	19.5	1643	0.0010
95	0.4750	1.6637	52.3	19.7	1643	0.0011
96	0.4800	1.6446	51.7	19.9	1624	0.0011
97	0.4850	1.6255	51.1	20.1	1605	0.0011
98	0.4900	1.6573	52.1	20.3	1636	0.0011

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	337.800		553.450
Moisture content: Dry soil+tare, gms.	318.610		528.270
Moisture content: Tare, gms.	187.700		403.280
Moisture, %	14.7	20.1	20.1
Moist specimen weight, gms.	142.4		
Diameter, in.	2.42	2.42	
Area, in.²	4.58	4.58	
Height, in.	0.99	0.96	
Net decrease in height, in.		0.03	
Wet density, pcf	119.6	129.6	
Dry density, pcf	104.3	107.8	
Void ratio	0.5858	0.5340	
Saturation, %	66.3	100.0	

Test Readings for Specimen No. 2

Load ring constant = 31.408 lbs. per input unit

Normal stress = 4000 psf

Strain rate, %/min. = 0.17

Fail. Stress = 3383 psf **at reading no.** 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.8048	25.3	0.2	795	-0.0007
2	0.0100	1.3551	42.6	0.4	1338	-0.0013
3	0.0150	1.7146	53.9	0.6	1693	-0.0015
4	0.0200	1.8163	57.0	0.8	1793	-0.0020
5	0.0250	2.1344	67.0	1.0	2107	-0.0020
6	0.0300	2.3444	73.6	1.2	2315	-0.0020
7	0.0350	2.5257	79.3	1.4	2494	-0.0018
8	0.0400	2.6816	84.2	1.7	2648	-0.0016
9	0.0450	2.8024	88.0	1.9	2767	-0.0013
10	0.0500	2.9170	91.6	2.1	2880	-0.0009
11	0.0550	3.0124	94.6	2.3	2974	-0.0004
12	0.0600	3.0824	96.8	2.5	3043	0.0000
13	0.0650	3.1714	99.6	2.7	3131	0.0005
14	0.0700	3.2319	101.5	2.9	3191	0.0011
15	0.0750	3.3019	103.7	3.1	3260	0.0016
16	0.0800	3.3623	105.6	3.3	3320	0.0023
17	0.0850	3.3750	106.0	3.5	3332	0.0030
18	0.0900	3.3941	106.6	3.7	3351	0.0036
19	0.0950	3.4164	107.3	3.9	3373	0.0041
20	0.1000	3.4068	107.0	4.1	3364	0.0049
21	0.1050	3.4227	107.5	4.3	3380	0.0054
22	0.1100	3.4259	107.6	4.6	3383	0.0059
23	0.1150	3.4132	107.2	4.8	3370	0.0064
24	0.1200	3.3655	105.7	5.0	3323	0.0070
25	0.1250	3.3814	106.2	5.2	3339	0.0074
26	0.1300	3.3623	105.6	5.4	3320	0.0078
27	0.1350	3.3337	104.7	5.6	3292	0.0081

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	3.3050	103.8	5.8	3263	0.0084
29	0.1450	3.2923	103.4	6.0	3251	0.0088
30	0.1500	3.2573	102.3	6.2	3216	0.0092
31	0.1550	3.2255	101.3	6.4	3185	0.0095
32	0.1600	3.2033	100.6	6.6	3163	0.0097
33	0.1650	3.1778	99.8	6.8	3138	0.0098
34	0.1700	3.1428	98.7	7.0	3103	0.0098
35	0.1750	3.1015	97.4	7.2	3062	0.0099
36	0.1800	3.0856	96.9	7.5	3047	0.0099
37	0.1850	3.0474	95.7	7.7	3009	0.0100
38	0.1900	3.0506	95.8	7.9	3012	0.0100
39	0.1950	3.0315	95.2	8.1	2993	0.0100
40	0.2000	3.0506	95.8	8.3	3012	0.0101
41	0.2050	3.0378	95.4	8.5	2999	0.0101
42	0.2100	3.0474	95.7	8.7	3009	0.0102
43	0.2150	3.0092	94.5	8.9	2971	0.0102
44	0.2200	3.0251	95.0	9.1	2987	0.0102
45	0.2250	2.9997	94.2	9.3	2962	0.0103
46	0.2300	2.9997	94.2	9.5	2962	0.0103
47	0.2350	2.9933	94.0	9.7	2955	0.0102
48	0.2400	3.0188	94.8	9.9	2981	0.0103
49	0.2450	3.0060	94.4	10.1	2968	0.0103
50	0.2500	2.9679	93.2	10.4	2930	0.0103
51	0.2550	2.9742	93.4	10.6	2937	0.0103
52	0.2600	2.9933	94.0	10.8	2955	0.0104
53	0.2650	2.9869	93.8	11.0	2949	0.0105
54	0.2700	2.9933	94.0	11.2	2955	0.0106
55	0.2750	2.9424	92.4	11.4	2905	0.0106
56	0.2800	2.9424	92.4	11.6	2905	0.0107
57	0.2850	2.9106	91.4	11.8	2874	0.0107
58	0.2900	2.9106	91.4	12.0	2874	0.0107
59	0.2950	2.8915	90.8	12.2	2855	0.0107
60	0.3000	2.8724	90.2	12.4	2836	0.0107
61	0.3050	2.8470	89.4	12.6	2811	0.0104
62	0.3100	2.8979	91.0	12.8	2861	0.0105
63	0.3150	2.8915	90.8	13.0	2855	0.0106
64	0.3200	2.9265	91.9	13.3	2890	0.0107
65	0.3250	2.9456	92.5	13.5	2908	0.0107
66	0.3300	2.9170	91.6	13.7	2880	0.0108
67	0.3350	2.9011	91.1	13.9	2864	0.0106
68	0.3400	2.8979	91.0	14.1	2861	0.0106
69	0.3450	2.8979	91.0	14.3	2861	0.0106
70	0.3500	2.8533	89.6	14.5	2817	0.0105
71	0.3550	2.8470	89.4	14.7	2811	0.0108
72	0.3600	2.8979	91.0	14.9	2861	0.0106
73	0.3650	2.9265	91.9	15.1	2890	0.0108
74	0.3700	2.9042	91.2	15.3	2868	0.0108

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	2.8915	90.8	15.5	2855	0.0104
76	0.3800	2.9106	91.4	15.7	2874	0.0104
77	0.3850	2.9170	91.6	15.9	2880	0.0104
78	0.3900	2.9233	91.8	16.1	2886	0.0105
79	0.3950	2.9265	91.9	16.4	2890	0.0105
80	0.4000	2.9424	92.4	16.6	2905	0.0107
81	0.4050	2.9488	92.6	16.8	2912	0.0107
82	0.4100	2.9742	93.4	17.0	2937	0.0109
83	0.4150	2.9806	93.6	17.2	2943	0.0106
84	0.4200	2.9679	93.2	17.4	2930	0.0107
85	0.4250	2.9806	93.6	17.6	2943	0.0108
86	0.4300	2.9647	93.1	17.8	2927	0.0109
87	0.4350	2.9551	92.8	18.0	2918	0.0109
88	0.4400	2.9615	93.0	18.2	2924	0.0108
89	0.4450	2.9488	92.6	18.4	2912	0.0108
90	0.4500	2.9774	93.5	18.6	2940	0.0108
91	0.4550	2.9456	92.5	18.8	2908	0.0103
92	0.4600	2.9679	93.2	19.0	2930	0.0104
93	0.4650	2.9901	93.9	19.3	2952	0.0106
94	0.4700	2.8724	90.2	19.5	2836	0.0104
95	0.4750	2.9297	92.0	19.7	2893	0.0104
96	0.4800	2.9360	92.2	19.9	2899	0.0104
97	0.4850	2.9042	91.2	20.1	2868	0.0105
98	0.4900	2.9360	92.2	20.3	2899	0.0106

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	337.800		519.290
Moisture content: Dry soil+tare, gms.	318.610		495.600
Moisture content: Tare, gms.	187.700		372.000
Moisture, %	14.7	19.2	19.2
Moist specimen weight, gms.	141.9		
Diameter, in.	2.42	2.42	
Area, in.²	4.58	4.58	
Height, in.	0.99	0.94	
Net decrease in height, in.		0.05	
Wet density, pcf	119.2	130.7	
Dry density, pcf	104.0	109.7	
Void ratio	0.5907	0.5080	
Saturation, %	65.8	100.0	

Test Readings for Specimen No. 3

Load ring constant = 31.408 lbs. per input unit

Normal stress = 8000 psf

Strain rate, %/min. = 0.17

Fail. Stress = 5660 psf **at reading no.** 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.9988	31.4	0.2	986	-0.0005
2	0.0100	1.7782	55.8	0.4	1756	-0.0012
3	0.0150	2.3635	74.2	0.6	2334	-0.0020
4	0.0200	2.8438	89.3	0.8	2808	-0.0026
5	0.0250	3.2223	101.2	1.0	3182	-0.0033
6	0.0300	3.6677	115.2	1.2	3621	-0.0037
7	0.0350	4.0558	127.4	1.4	4005	-0.0041
8	0.0400	4.3484	136.6	1.7	4293	-0.0042
9	0.0450	4.5902	144.2	1.9	4532	-0.0043
10	0.0500	4.8001	150.8	2.1	4739	-0.0042
11	0.0550	4.9751	156.3	2.3	4912	-0.0041
12	0.0600	5.1182	160.8	2.5	5054	-0.0039
13	0.0650	5.2454	164.7	2.7	5179	-0.0036
14	0.0700	5.3663	168.5	2.9	5299	-0.0033
15	0.0750	5.4777	172.0	3.1	5408	-0.0028
16	0.0800	5.5635	174.7	3.3	5493	-0.0023
17	0.0850	5.6272	176.7	3.5	5556	-0.0014
18	0.0900	5.6781	178.3	3.7	5606	-0.0009
19	0.0950	5.7290	179.9	3.9	5657	-0.0004
20	0.1000	5.7290	179.9	4.1	5657	0.0001
21	0.1050	5.7290	179.9	4.3	5657	0.0002
22	0.1100	5.7321	180.0	4.6	5660	0.0006
23	0.1150	5.7162	179.5	4.8	5644	0.0010
24	0.1200	5.6844	178.5	5.0	5613	0.0014
25	0.1250	5.6462	177.3	5.2	5575	0.0018
26	0.1300	5.6176	176.4	5.4	5547	0.0021
27	0.1350	5.5317	173.7	5.6	5462	0.0024

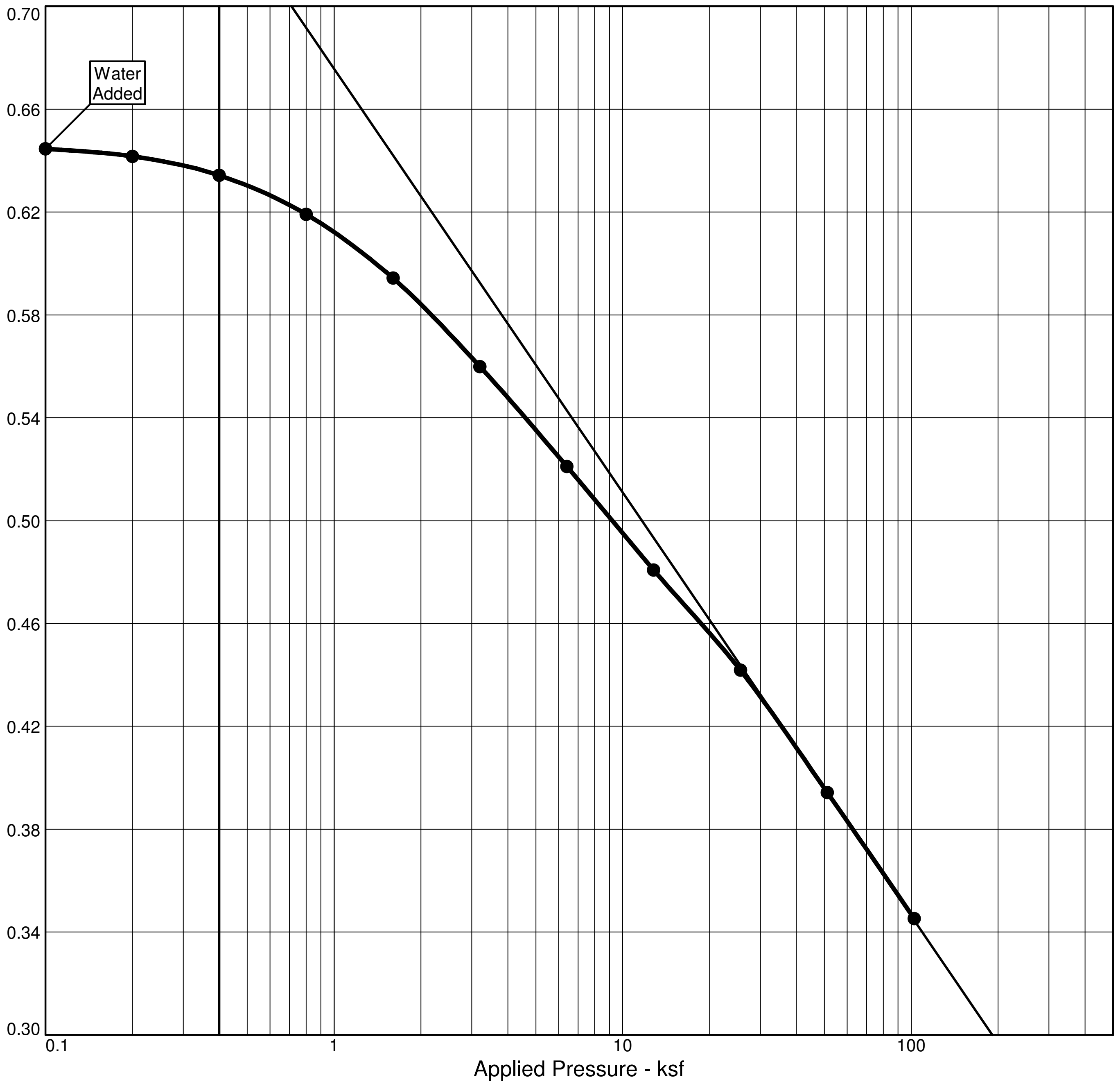
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	5.4999	172.7	5.8	5430	0.0026
29	0.1450	5.4554	171.3	6.0	5386	0.0028
30	0.1500	5.3981	169.5	6.2	5330	0.0031
31	0.1550	5.3600	168.3	6.4	5292	0.0034
32	0.1600	5.3345	167.5	6.6	5267	0.0035
33	0.1650	5.3027	166.5	6.8	5236	0.0036
34	0.1700	5.2518	164.9	7.0	5185	0.0036
35	0.1750	5.2582	165.1	7.2	5192	0.0037
36	0.1800	5.2454	164.7	7.5	5179	0.0038
37	0.1850	5.2200	163.9	7.7	5154	0.0038
38	0.1900	5.1882	163.0	7.9	5123	0.0039
39	0.1950	5.1627	162.2	8.1	5098	0.0039
40	0.2000	5.1723	162.5	8.3	5107	0.0039
41	0.2050	5.1564	162.0	8.5	5091	0.0038
42	0.2100	5.1882	163.0	8.7	5123	0.0038
43	0.2150	5.0991	160.2	8.9	5035	0.0038
44	0.2200	5.1055	160.4	9.1	5041	0.0038
45	0.2250	5.1564	162.0	9.3	5091	0.0038
46	0.2300	5.1246	161.0	9.5	5060	0.0038
47	0.2350	5.1373	161.4	9.7	5072	0.0037
48	0.2400	5.1150	160.7	9.9	5050	0.0037
49	0.2450	5.0260	157.9	10.1	4962	0.0036
50	0.2500	5.0482	158.6	10.4	4984	0.0035
51	0.2550	5.0800	159.6	10.6	5016	0.0035
52	0.2600	5.1118	160.6	10.8	5047	0.0035
53	0.2650	5.0546	158.8	11.0	4991	0.0034
54	0.2700	4.9910	156.8	11.2	4928	0.0034
55	0.2750	4.9592	155.8	11.4	4897	0.0035
56	0.2800	4.9528	155.6	11.6	4890	0.0035
57	0.2850	4.9273	154.8	11.8	4865	0.0036
58	0.2900	4.8955	153.8	12.0	4834	0.0037
59	0.2950	4.8765	153.2	12.2	4815	0.0037
60	0.3000	4.8319	151.8	12.4	4771	0.0038
61	0.3050	4.8001	150.8	12.6	4739	0.0039
62	0.3100	4.7937	150.6	12.8	4733	0.0041
63	0.3150	4.7492	149.2	13.0	4689	0.0042
64	0.3200	4.7238	148.4	13.3	4664	0.0042
65	0.3250	4.7079	147.9	13.5	4648	0.0042
66	0.3300	4.6983	147.6	13.7	4639	0.0042
67	0.3350	4.7269	148.5	13.9	4667	0.0042
68	0.3400	4.7269	148.5	14.1	4667	0.0042
69	0.3450	4.7365	148.8	14.3	4677	0.0043
70	0.3500	4.7047	147.8	14.5	4645	0.0043
71	0.3550	4.7047	147.8	14.7	4645	0.0043
72	0.3600	4.7365	148.8	14.9	4677	0.0044
73	0.3650	4.7556	149.4	15.1	4695	0.0044
74	0.3700	4.7874	150.4	15.3	4727	0.0043

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	4.8574	152.6	15.5	4796	0.0043
76	0.3800	4.9051	154.1	15.7	4843	0.0043
77	0.3850	4.9273	154.8	15.9	4865	0.0041
78	0.3900	4.9464	155.4	16.1	4884	0.0041
79	0.3950	4.9464	155.4	16.4	4884	0.0040
80	0.4000	4.9846	156.6	16.6	4922	0.0038
81	0.4050	5.0132	157.5	16.8	4950	0.0036
82	0.4100	5.0228	157.8	17.0	4959	0.0033
83	0.4150	5.0164	157.6	17.2	4953	0.0032
84	0.4200	5.0419	158.4	17.4	4978	0.0031
85	0.4250	5.0419	158.4	17.6	4978	0.0029
86	0.4300	5.0355	158.2	17.8	4972	0.0028
87	0.4350	4.9910	156.8	18.0	4928	0.0025
88	0.4400	4.9719	156.2	18.2	4909	0.0024
89	0.4450	4.9464	155.4	18.4	4884	0.0023
90	0.4500	4.9146	154.4	18.6	4853	0.0019
91	0.4550	4.9273	154.8	18.8	4865	0.0017
92	0.4600	4.9242	154.7	19.0	4862	0.0016
93	0.4650	4.9210	154.6	19.3	4859	0.0014
94	0.4700	4.9464	155.4	19.5	4884	0.0013
95	0.4750	4.9592	155.8	19.7	4897	0.0009
96	0.4800	4.9655	156.0	19.9	4903	0.0007
97	0.4850	4.9592	155.8	20.1	4897	0.0006
98	0.4900	4.9210	154.6	20.3	4859	0.0004

CONSOLIDATION TEST REPORT ASTM D2435



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Swell Press. (ksf)	Heave %	e_o
Sat.	Moist.											
64.0 %	15.3 %	102.5	24	9	2.7		2.1	0.16			0.0	0.645

MATERIAL DESCRIPTION	USCS	AASHTO
clayey sand	SC	A-2-4(0)

Project No. 10800305 **Client:** NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

Location: BH17-01 **Sample Number:** S-4B & S-4B

Remarks:
Specific gravity assumed.

Knight Piésold
CONSULTING

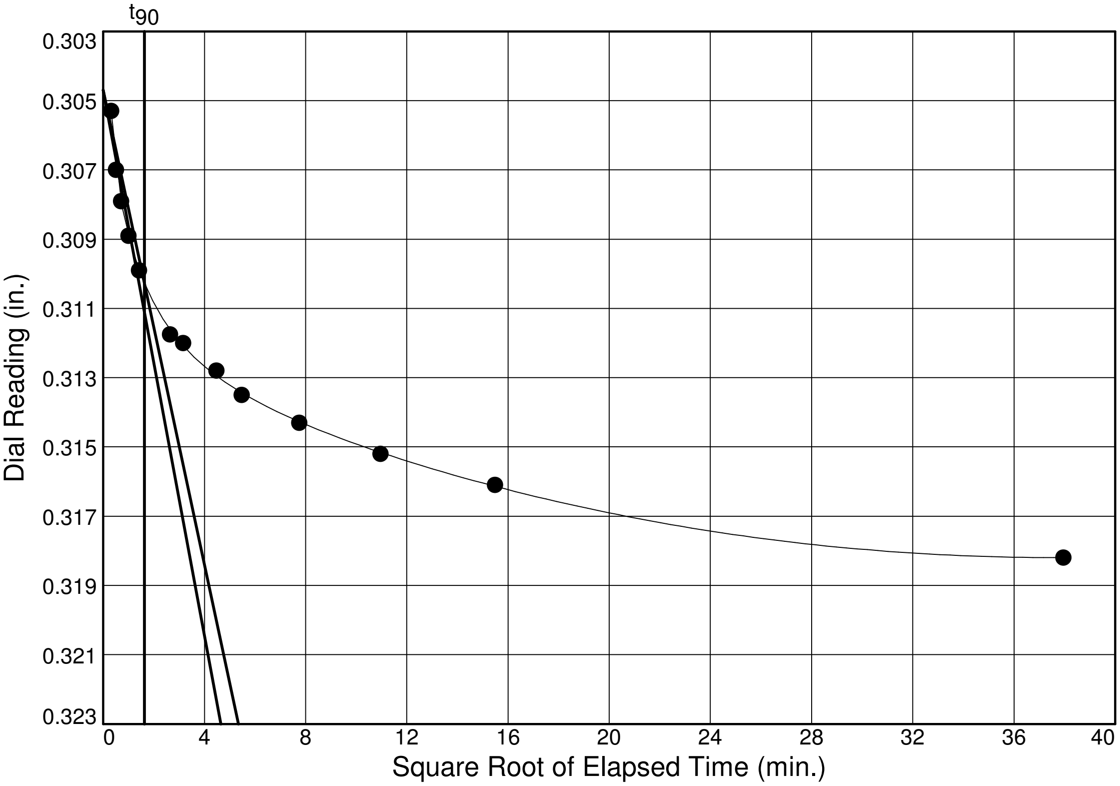
Figure

Tested By: EAG **Checked By:** JDB

Dial Reading vs. Time

Project No.: 10800305
Project: Magnum Brine Ponds 3 & 4

Location: BH17-01 Sample Number: S-4B & S-4B



Load No.= 8

Load= 6.40 ksf

D_0 = 0.3047

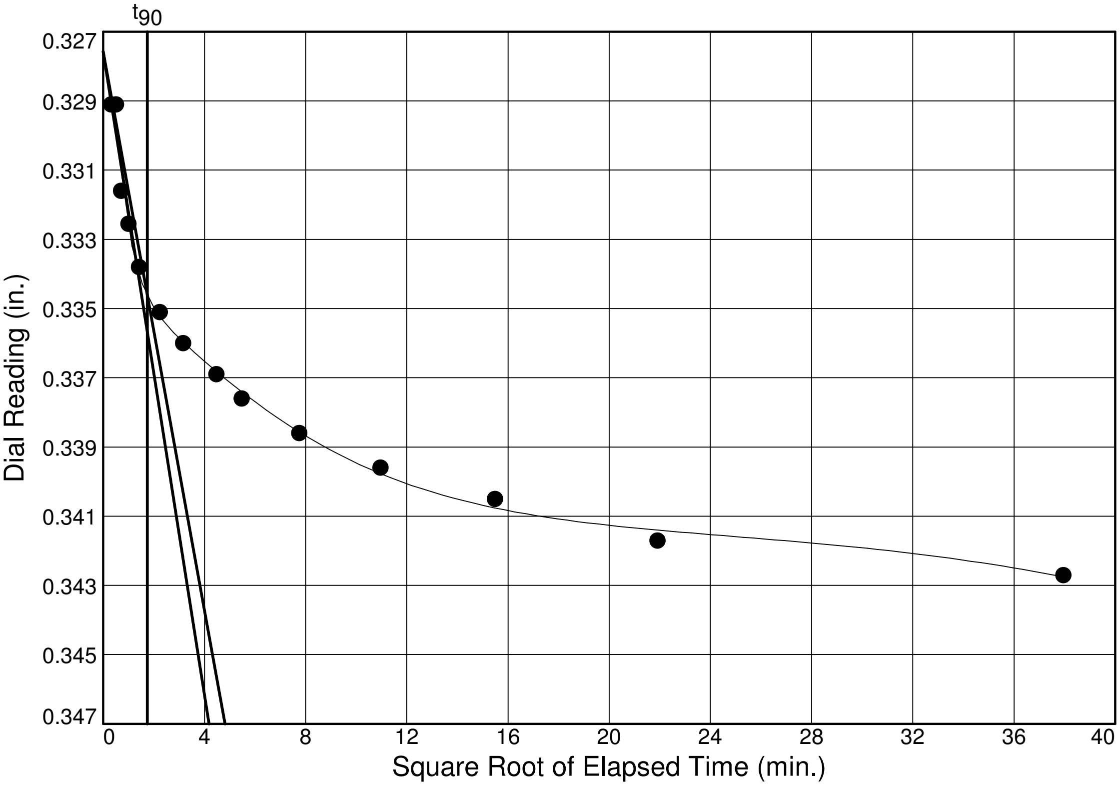
D_{90} = 0.3103

D_{100} = 0.3109

T_{90} = 2.65 min.

C_v @ T_{90}

0.701 ft.^{2}/day



Load No.= 9

Load= 12.80 ksf

D_0 = 0.3276

D_{90} = 0.3346

D_{100} = 0.3354

T_{90} = 3.05 min.

C_v @ T_{90}

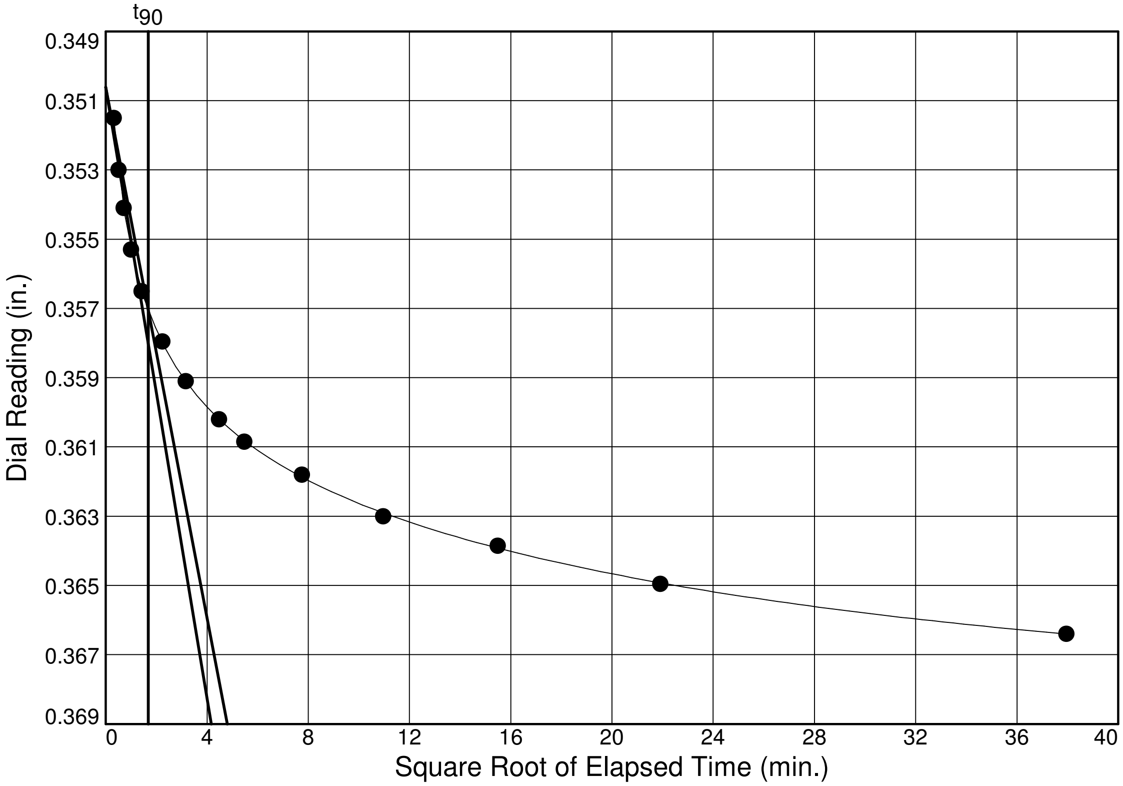
0.579 ft.^{2}/day

Figure

Dial Reading vs. Time

Project No.: 10800305
Project: Magnum Brine Ponds 3 & 4

Location: BH17-01 Sample Number: S-4B & S-4B



Load No.= 10

Load= 25.60 ksf

D_0 = 0.3506

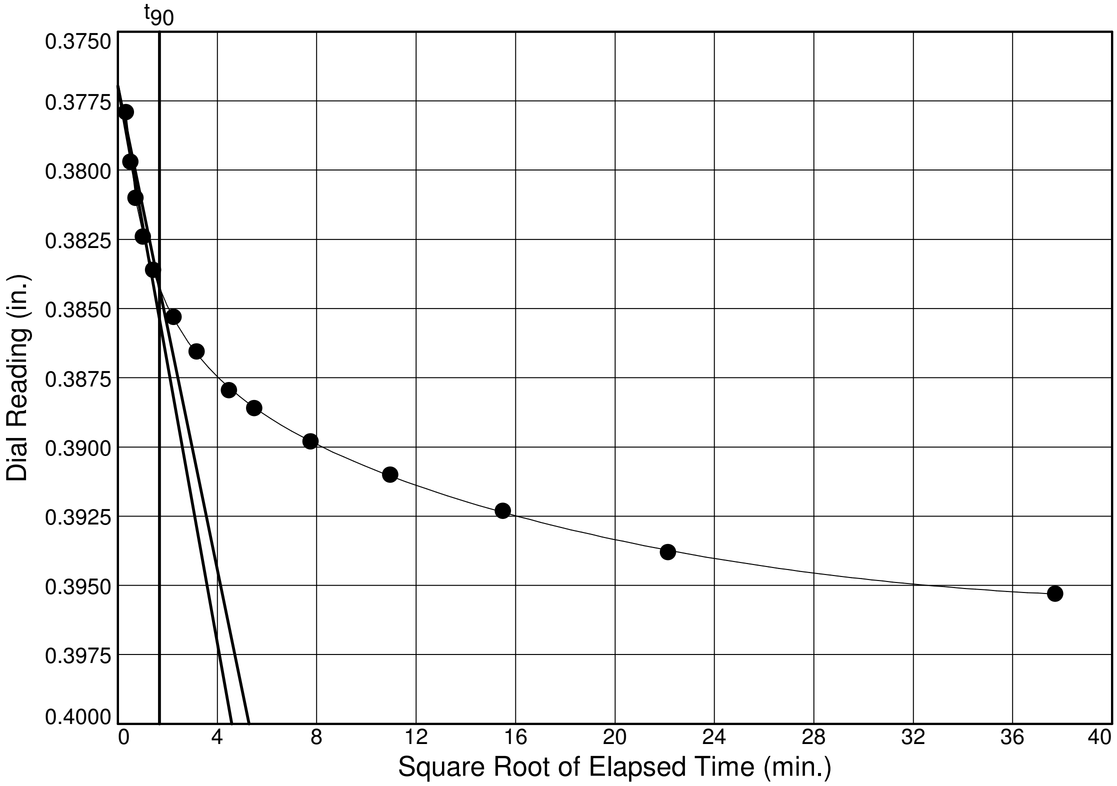
D_{90} = 0.3570

D_{100} = 0.3577

T_{90} = 2.80 min.

C_v @ T_{90}

0.597 ft.^{2}/day



Load No.= 11

Load= 51.20 ksf

D_0 = 0.3770

D_{90} = 0.3842

D_{100} = 0.3851

T_{90} = 2.78 min.

C_v @ T_{90}

0.567 ft.^{2}/day

Figure

Knight Piesold Geotechnical Lab.

SWELL/CONSOLIDATION TEST DATA

9/25/2017

Client: NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

Project Number: 10800305

Location: BH17-01

Sample Number: S-4B & S-4B

Material Description: clayey sand

Liquid Limit: 24 **Plasticity Index:** 9

USCS: SC **AASHTO:** A-2-4(0)

Testing Remarks: Specific gravity assumed.

Tested by: EAG **Checked by:** JDB

Test Specimen Data

NATURAL MOISTURE

Wet w+t = 142.05 g.
Dry w+t = 123.22 g.
Tare Wt. = 0.00 g.
Moisture = 15.3 %

UNIT WEIGHT

Height = 1.000 in.
Diameter = 2.415 in.
Weight = 142.05 g.
Dry Dens. = 102.5 pcf

VOID RATIO

Spec. Gr. = 2.7
Est. Ht. Solids = 0.608 in.
Init. V.R. = 0.645
Init. Sat. = 64.0 %

TEST START

Height = 1.000 in.
Diameter = 2.415 in.

AFTER TEST

Wet w+t = 302.16 g.
Dry w+t = 284.93 g.
Tare Wt. = 161.71 g.
Moisture = 14.0 %

Dry Wt. =123.22* g.

End-Of-Load Summary

Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.24300		0.00000			0.645	
0.10	0.24310	0.00000	0.00010			0.645	0.0 Comprs.
water	0.24310	0.00000	0.00010			0.645	0.0 Comprs.
0.20	0.24490	0.00000	0.00190			0.642	0.2 Comprs.
0.40	0.25000	0.00060	0.00640			0.634	0.6 Comprs.
0.80	0.26070	0.00210	0.01560			0.619	1.6 Comprs.
1.60	0.27780	0.00410	0.03070			0.594	3.1 Comprs.
3.20	0.30110	0.00650	0.05160			0.560	5.2 Comprs.
6.40	0.32720	0.00900	0.07520	0.701		0.521	7.5 Comprs.
12.80	0.35390	0.01120	0.09970	0.579		0.481	10.0 Comprs.
25.60	0.38040	0.01400	0.12340	0.597		0.442	12.3 Comprs.
51.20	0.41250	0.01720	0.15230	0.567		0.394	15.2 Comprs.
102.40	0.44620	0.02110	0.18210			0.345	18.2 Comprs.
0.00	0.44620	0.01210	0.19110				

Compression index (C_c), ksf = 0.16 **Preconsolidation pressure (P_p), ksf =** 2.1 **Void ratio at P_p (e_m) =** 0.581

Heave, % = 0.0

Pressure: 0.10 ksf **TEST READINGS** **Load No. 1**

No.	Elapsed Time	Dial Reading
1	.1	0.24300
2	(final)	0.24310

Void Ratio = 0.645 **Compression =** 0.0%

Pressure: 0.10 ksf **TEST READINGS** **Load No. 2**

No.	Elapsed Time	Dial Reading
1	0	0.24310
2	(final)	0.24310

Void Ratio = 0.645 **Compression =** 0.0%

Pressure: 0.20 ksf **TEST READINGS** **Load No. 3**

No.	Elapsed Time	Dial Reading
1	0	0.24310
2	(final)	0.24490

Void Ratio = 0.642 **Compression =** 0.2%

Pressure: 0.40 ksf **TEST READINGS** **Load No. 4**

No.	Elapsed Time	Dial Reading
1	0	0.24490
2	(final)	0.25000

Void Ratio = 0.634 **Compression =** 0.6%

Pressure: 0.80 ksf **TEST READINGS** **Load No. 5**

No.	Elapsed Time	Dial Reading
1	0	0.25000
2	(final)	0.26070

Void Ratio = 0.619 **Compression =** 1.6%

Pressure: 1.60 ksf **TEST READINGS** **Load No. 6**

No.	Elapsed Time	Dial Reading
1	0	0.26070
2	(final)	0.27780

Void Ratio = 0.594 **Compression =** 3.1%

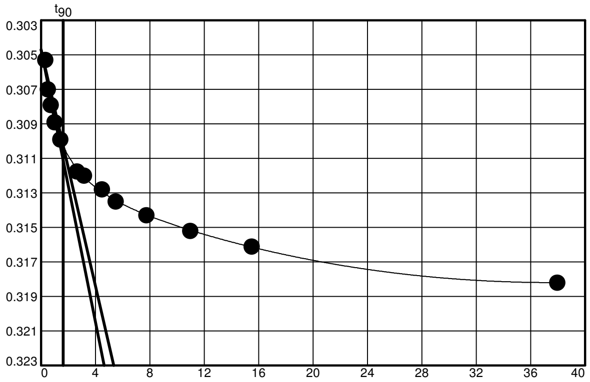
Pressure: 3.20 ksf **TEST READINGS** **Load No. 7**

No.	Elapsed Time	Dial Reading
1	0	0.27780
2	(final)	0.30110

Void Ratio = 0.560 **Compression =** 5.2%

Pressure: 6.40 ksf **TEST READINGS** **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.30110	11	60	0.32330
2	.1	0.31430	12	120	0.32420
3	.25	0.31600	13	240	0.32510
4	.5	0.31690	14	1440	0.32720
5	1	0.31790			
6	2	0.31890			
7	7	0.32075			
8	10	0.32100			
9	20	0.32180			
10	30	0.32250			

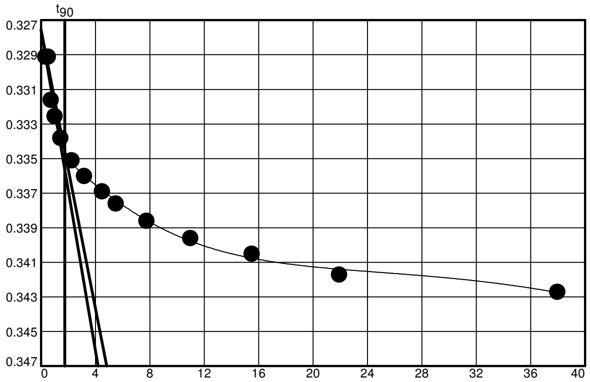


Void Ratio = 0.521 **Compression =** 7.5%

D_0 = 0.3047 **D_{90} =** 0.3103 **D_{100} =** 0.3109 **C_v at 2.65 min. =** 0.701 ft.^{2}/day

Pressure: 12.80 ksf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.32720	11	60	0.34980
2	.1	0.34030	12	120	0.35080
3	.25	0.34030	13	240	0.35170
4	.5	0.34280	14	480	0.35290
5	1	0.34375	15	1440	0.35390
6	2	0.34500			
7	5	0.34630			
8	10	0.34720			
9	20	0.34810			
10	30	0.34880			

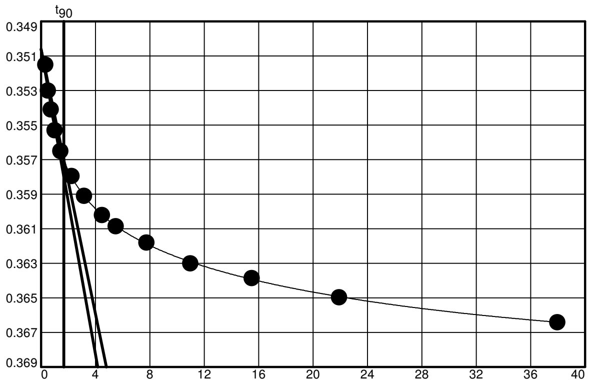


Void Ratio = 0.481 **Compression =** 10.0%

D_0 = 0.3276 **D_{90} =** 0.3346 **D_{100} =** 0.3354 **C_v at 3.05 min. =** 0.579 ft.^{2}/day

Pressure: 25.60 ksf **TEST READINGS** **Load No. 10**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.35390	11	60	0.37580
2	.1	0.36550	12	120	0.37700
3	.25	0.36700	13	240	0.37785
4	.5	0.36810	14	480	0.37895
5	1	0.36930	15	1440	0.38040
6	2	0.37050			
7	5	0.37195			
8	10	0.37310			
9	20	0.37420			
10	30	0.37485			

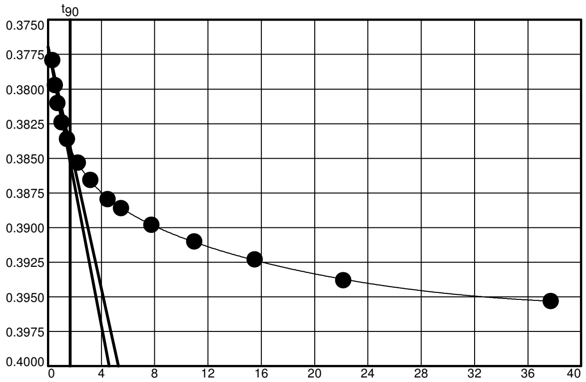


Void Ratio = 0.442 **Compression =** 12.3%

D_0 = 0.3506 D_{90} = 0.3570 D_{100} = 0.3577 C_v **at 2.80 min. =** 0.597 ft.^{2}/day

Pressure: 51.20 ksf **TEST READINGS** **Load No. 11**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.38040	11	60	0.40700
2	.1	0.39510	12	120	0.40820
3	.25	0.39690	13	240	0.40950
4	.5	0.39820	14	490	0.41100
5	1	0.39960	15	1422	0.41250
6	2	0.40080			
7	5	0.40250			
8	10	0.40375			
9	20	0.40515			
10	30	0.40580			



Void Ratio = 0.394 **Compression =** 15.2%

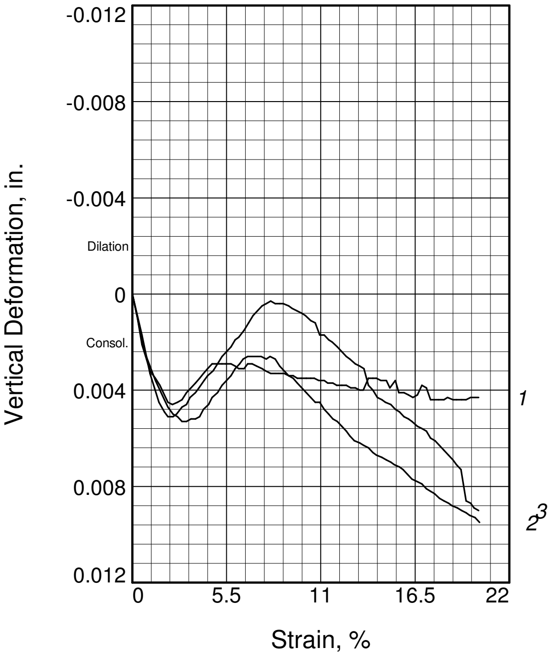
D_0 = 0.3770 D_{90} = 0.3842 D_{100} = 0.3851 C_v **at 2.78 min. =** 0.567 ft.^{2}/day

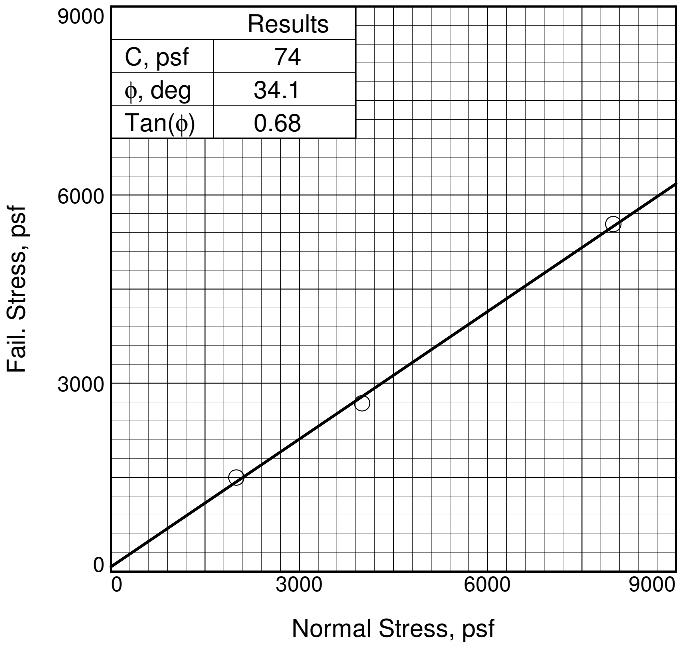
Pressure: 102.40 ksf **TEST READINGS** **Load No. 12**

No.	Elapsed Time	Dial Reading
1	0	0.41250
2	(final)	0.44620

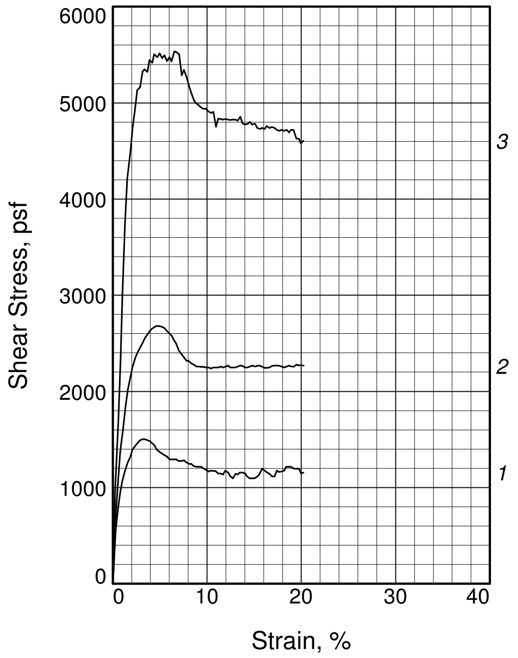
Void Ratio = 0.345 **Compression =** 18.2%

Cursory interpretations provided require review by a professional engineer. Knight Piesold accepts no responsibility in subsequent analyses.





Results	
C, psf	74
ϕ, deg	34.1
Tan(ϕ)	0.68



	Specimen No.	1	2	3
Initial	Water Content, %	14.7	15.3	15.3
	Dry Density, pcf	106.3	102.0	104.9
	Saturation, %	69.9	65.3	70.2
	Void Ratio	0.5561	0.6213	0.5767
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.00	1.00	0.99
At Test	Water Content, %	19.7	20.9	18.6
	Dry Density, pcf	108.7	106.5	110.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5213	0.5533	0.4934
	Diameter, in.	1.93	1.93	1.93
	Height, in.	0.98	0.96	0.94
	Normal Stress, psf	2000	4000	8000
	Fail. Stress, psf	1501	2681	5535
	Strain, %	3.2	4.7	6.5
	Ult. Stress, psf			
	Strain, %			
	Strain rate, %/min.	0.34	0.34	0.34

Sample Type: Remolded

Description:

Assumed Specific Gravity= 2.65

Remarks: Failure chosen at peak shear stress.Test was inundated.Remolding parameters provided by client.

Figure _______

Client: NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

Location: BH17-02

Sample Number: S-4B

Proj. No.: 10800305 **Date Sampled:** 7/5/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

7/21/2017

Date: 7/5/17
Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No.: 10800305
Location: BH17-02
Sample Number: S-4B
Description:
Remarks: Failure chosen at peak shear stress.Test was inundated.Remolding parameters provided by client.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.610		493.280
Moisture content: Dry soil+tare, gms.	81.640		477.220
Moisture content: Tare, gms.	0.000		395.580
Moisture, %	14.7	19.7	19.7
Moist specimen weight, gms.	93.6		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet density, pcf	121.9	130.1	
Dry density, pcf	106.3	108.7	
Void ratio	0.5561	0.5213	
Saturation, %	69.9	100.0	

Test Readings for Specimen No. 1

Load ring constant = 49.2 lbs. per input unit
Normal stress = 2000 psf
Strain rate, %/min. = 0.34
Fail. Stress = 1501 psf **at reading no.** 12

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0060	0.2316	11.4	0.3	561	-0.0011
2	0.0110	0.3312	16.3	0.6	802	-0.0022
3	0.0160	0.4002	19.7	0.8	969	-0.0028
4	0.0200	0.4449	21.9	1.0	1077	-0.0033
5	0.0260	0.4896	24.1	1.3	1186	-0.0036
6	0.0310	0.5221	25.7	1.6	1264	-0.0039
7	0.0360	0.5465	26.9	1.9	1323	-0.0043
8	0.0400	0.5749	28.3	2.1	1392	-0.0046
9	0.0450	0.5892	29.0	2.3	1427	-0.0047
10	0.0510	0.6054	29.8	2.6	1466	-0.0046
11	0.0560	0.6156	30.3	2.9	1491	-0.0045
12	0.0610	0.6196	30.5	3.2	1501	-0.0042

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
13	0.0660	0.6196	30.5	3.4	1501	-0.0040
14	0.0710	0.6156	30.3	3.7	1491	-0.0038
15	0.0760	0.6115	30.1	3.9	1481	-0.0036
16	0.0800	0.6034	29.7	4.1	1461	-0.0034
17	0.0850	0.5953	29.3	4.4	1442	-0.0032
18	0.0900	0.5770	28.4	4.7	1397	-0.0030
19	0.0950	0.5668	27.9	4.9	1373	-0.0030
20	0.1010	0.5587	27.5	5.2	1353	-0.0030
21	0.1050	0.5526	27.2	5.4	1338	-0.0030
22	0.1110	0.5465	26.9	5.8	1323	-0.0030
23	0.1160	0.5343	26.3	6.0	1294	-0.0031
24	0.1200	0.5343	26.3	6.2	1294	-0.0032
25	0.1260	0.5343	26.3	6.5	1294	-0.0032
26	0.1300	0.5343	26.3	6.7	1294	-0.0030
27	0.1350	0.5262	25.9	7.0	1274	-0.0030
28	0.1400	0.5262	25.9	7.3	1274	-0.0031
29	0.1460	0.5303	26.1	7.6	1284	-0.0032
30	0.1500	0.5221	25.7	7.8	1264	-0.0033
31	0.1560	0.5140	25.3	8.1	1245	-0.0034
32	0.1610	0.5140	25.3	8.3	1245	-0.0034
33	0.1650	0.5059	24.9	8.5	1225	-0.0034
34	0.1710	0.5018	24.7	8.9	1215	-0.0034
35	0.1760	0.5018	24.7	9.1	1215	-0.0035
36	0.1810	0.5018	24.7	9.4	1215	-0.0035
37	0.1860	0.4957	24.4	9.6	1200	-0.0036
38	0.1900	0.4896	24.1	9.8	1186	-0.0036
39	0.1960	0.4815	23.7	10.2	1166	-0.0036
40	0.2010	0.4856	23.9	10.4	1176	-0.0036
41	0.2050	0.4835	23.8	10.6	1171	-0.0036
42	0.2100	0.4835	23.8	10.9	1171	-0.0037
43	0.2160	0.4734	23.3	11.2	1146	-0.0037
44	0.2200	0.4734	23.3	11.4	1146	-0.0038
45	0.2260	0.4693	23.1	11.7	1137	-0.0038
46	0.2300	0.4856	23.9	11.9	1176	-0.0039
47	0.2360	0.4774	23.5	12.2	1156	-0.0039
48	0.2410	0.4612	22.7	12.5	1117	-0.0039
49	0.2460	0.4531	22.3	12.7	1097	-0.0040
50	0.2510	0.4713	23.2	13.0	1141	-0.0040
51	0.2560	0.4693	23.1	13.3	1137	-0.0041
52	0.2600	0.4774	23.5	13.5	1156	-0.0041
53	0.2660	0.4774	23.5	13.8	1156	-0.0036
54	0.2710	0.4734	23.3	14.0	1146	-0.0036
55	0.2750	0.4612	22.7	14.2	1117	-0.0036
56	0.2800	0.4531	22.3	14.5	1097	-0.0037
57	0.2860	0.4531	22.3	14.8	1097	-0.0037
58	0.2900	0.4531	22.3	15.0	1097	-0.0040
59	0.2960	0.4591	22.6	15.3	1112	-0.0037

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
60	0.3000	0.4693	23.1	15.5	1137	-0.0042
61	0.3060	0.4937	24.3	15.9	1196	-0.0042
62	0.3110	0.4856	23.9	16.1	1176	-0.0043
63	0.3160	0.4774	23.5	16.4	1156	-0.0044
64	0.3210	0.4713	23.2	16.6	1141	-0.0043
65	0.3260	0.4612	22.7	16.9	1117	-0.0039
66	0.3310	0.4612	22.7	17.2	1117	-0.0040
67	0.3360	0.4856	23.9	17.4	1176	-0.0045
68	0.3400	0.4795	23.6	17.6	1161	-0.0045
69	0.3450	0.4815	23.7	17.9	1166	-0.0045
70	0.3510	0.4856	23.9	18.2	1176	-0.0045
71	0.3550	0.5018	24.7	18.4	1215	-0.0044
72	0.3610	0.5018	24.7	18.7	1215	-0.0045
73	0.3650	0.5018	24.7	18.9	1215	-0.0045
74	0.3710	0.4937	24.3	19.2	1196	-0.0045
75	0.3760	0.4937	24.3	19.5	1196	-0.0045
76	0.3810	0.4937	24.3	19.7	1196	-0.0044
77	0.3860	0.4734	23.3	20.0	1146	-0.0044
78	0.3900	0.4774	23.5	20.2	1156	-0.0044

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	90.360		205.170
Moisture content: Dry soil+tare, gms.	78.360		188.810
Moisture content: Tare, gms.	0.000		110.450
Moisture, %	15.3	20.9	20.9
Moist specimen weight, gms.	90.4		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet density, pcf	117.7	128.7	
Dry density, pcf	102.0	106.5	
Void ratio	0.6213	0.5533	
Saturation, %	65.3	100.0	

Test Readings for Specimen No. 2

Load ring constant = 49.2 lbs. per input unit

Normal stress = 4000 psf

Strain rate, %/min. = 0.34

Fail. Stress = 2681 psf **at reading no.** 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0002
1	0.0060	0.2946	14.5	0.3	713	-0.0012
2	0.0110	0.4531	22.3	0.6	1097	-0.0021
3	0.0150	0.5668	27.9	0.8	1373	-0.0027
4	0.0210	0.6664	32.8	1.1	1614	-0.0033
5	0.0260	0.7537	37.1	1.3	1825	-0.0038
6	0.0310	0.8350	41.1	1.6	2022	-0.0042
7	0.0360	0.8878	43.7	1.9	2150	-0.0046
8	0.0400	0.9284	45.7	2.1	2248	-0.0049
9	0.0460	0.9691	47.7	2.4	2347	-0.0052
10	0.0510	0.9955	49.0	2.6	2411	-0.0053
11	0.0560	1.0138	49.9	2.9	2455	-0.0055
12	0.0610	1.0341	50.9	3.2	2504	-0.0055
13	0.0660	1.0544	51.9	3.4	2553	-0.0054
14	0.0710	1.0707	52.7	3.7	2593	-0.0054
15	0.0760	1.0869	53.5	3.9	2632	-0.0053
16	0.0800	1.0950	53.9	4.1	2652	-0.0050
17	0.0860	1.1032	54.3	4.5	2672	-0.0048
18	0.0900	1.1072	54.5	4.7	2681	-0.0045
19	0.0960	1.1052	54.4	5.0	2676	-0.0043
20	0.1010	1.1032	54.3	5.2	2672	-0.0040
21	0.1060	1.0971	54.0	5.5	2657	-0.0038
22	0.1110	1.0849	53.4	5.8	2627	-0.0036
23	0.1160	1.0747	52.9	6.0	2603	-0.0033
24	0.1210	1.0646	52.4	6.3	2578	-0.0031
25	0.1250	1.0483	51.6	6.5	2539	-0.0029
26	0.1300	1.0300	50.7	6.7	2494	-0.0028
27	0.1350	1.0016	49.3	7.0	2426	-0.0028

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1410	0.9853	48.5	7.3	2386	-0.0028
29	0.1450	0.9731	47.9	7.5	2357	-0.0028
30	0.1510	0.9569	47.1	7.8	2317	-0.0029
31	0.1550	0.9569	47.1	8.0	2317	-0.0028
32	0.1610	0.9467	46.6	8.3	2293	-0.0029
33	0.1660	0.9406	46.3	8.6	2278	-0.0032
34	0.1710	0.9325	45.9	8.9	2258	-0.0034
35	0.1760	0.9325	45.9	9.1	2258	-0.0036
36	0.1810	0.9305	45.8	9.4	2253	-0.0037
37	0.1860	0.9305	45.8	9.6	2253	-0.0039
38	0.1910	0.9284	45.7	9.9	2248	-0.0041
39	0.1960	0.9284	45.7	10.2	2248	-0.0043
40	0.2010	0.9244	45.5	10.4	2239	-0.0045
41	0.2060	0.9284	45.7	10.7	2248	-0.0047
42	0.2110	0.9284	45.7	10.9	2248	-0.0047
43	0.2160	0.9284	45.7	11.2	2248	-0.0050
44	0.2210	0.9325	45.9	11.5	2258	-0.0052
45	0.2260	0.9284	45.7	11.7	2248	-0.0054
46	0.2310	0.9325	45.9	12.0	2258	-0.0055
47	0.2360	0.9366	46.1	12.2	2268	-0.0057
48	0.2410	0.9284	45.7	12.5	2248	-0.0059
49	0.2450	0.9284	45.7	12.7	2248	-0.0061
50	0.2500	0.9284	45.7	13.0	2248	-0.0063
51	0.2560	0.9325	45.9	13.3	2258	-0.0064
52	0.2610	0.9366	46.1	13.5	2268	-0.0065
53	0.2660	0.9345	46.0	13.8	2263	-0.0066
54	0.2710	0.9284	45.7	14.0	2248	-0.0068
55	0.2750	0.9284	45.7	14.2	2248	-0.0069
56	0.2810	0.9325	45.9	14.6	2258	-0.0070
57	0.2860	0.9366	46.1	14.8	2268	-0.0071
58	0.2910	0.9325	45.9	15.1	2258	-0.0072
59	0.2950	0.9345	46.0	15.3	2263	-0.0073
60	0.3010	0.9366	46.1	15.6	2268	-0.0074
61	0.3050	0.9325	45.9	15.8	2258	-0.0075
62	0.3100	0.9264	45.6	16.1	2244	-0.0077
63	0.3150	0.9264	45.6	16.3	2244	-0.0079
64	0.3210	0.9284	45.7	16.6	2248	-0.0080
65	0.3260	0.9345	46.0	16.9	2263	-0.0081
66	0.3310	0.9366	46.1	17.2	2268	-0.0083
67	0.3360	0.9366	46.1	17.4	2268	-0.0084
68	0.3400	0.9366	46.1	17.6	2268	-0.0085
69	0.3460	0.9325	45.9	17.9	2258	-0.0087
70	0.3510	0.9284	45.7	18.2	2248	-0.0088
71	0.3560	0.9325	45.9	18.4	2258	-0.0089
72	0.3600	0.9366	46.1	18.7	2268	-0.0090
73	0.3660	0.9325	45.9	19.0	2258	-0.0091
74	0.3710	0.9325	45.9	19.2	2258	-0.0092

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3760	0.9406	46.3	19.5	2278	-0.0093
76	0.3800	0.9386	46.2	19.7	2273	-0.0094
77	0.3860	0.9386	46.2	20.0	2273	-0.0095
78	0.3910	0.9366	46.1	20.3	2268	-0.0097

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	91.960		481.710
Moisture content: Dry soil+tare, gms.	79.770		466.860
Moisture content: Tare, gms.	0.000		387.090
Moisture, %	15.3	18.6	18.6
Moist specimen weight, gms.	92.0		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	0.99	0.94	
Net decrease in height, in.		0.05	
Wet density, pcf	121.0	131.4	
Dry density, pcf	104.9	110.8	
Void ratio	0.5767	0.4934	
Saturation, %	70.2	100.0	

Test Readings for Specimen No. 3

Load ring constant = 49.2 lbs. per input unit

Normal stress = 8000 psf

Strain rate, %/min. = 0.34

Fail. Stress = 5535 psf **at reading no.** 25

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0050	0.4002	19.7	0.3	969	-0.0009
2	0.0110	0.6948	34.2	0.6	1683	-0.0018
3	0.0160	0.9569	47.1	0.8	2317	-0.0027
4	0.0200	1.2474	61.4	1.0	3021	-0.0034
5	0.0250	1.5501	76.3	1.3	3754	-0.0040
6	0.0300	1.7391	85.6	1.6	4212	-0.0046
7	0.0360	1.8569	91.4	1.9	4497	-0.0050
8	0.0400	1.9483	95.9	2.1	4718	-0.0052
9	0.0460	2.0458	100.7	2.4	4954	-0.0052
10	0.0500	2.1190	104.3	2.6	5132	-0.0051
11	0.0560	2.1312	104.9	2.9	5161	-0.0048
12	0.0610	2.2002	108.3	3.2	5328	-0.0047
13	0.0650	2.2084	108.7	3.4	5348	-0.0044
14	0.0710	2.1982	108.2	3.7	5323	-0.0042
15	0.0750	2.2490	110.7	3.9	5446	-0.0040
16	0.0810	2.2368	110.1	4.2	5417	-0.0037
17	0.0850	2.2734	111.9	4.4	5505	-0.0035
18	0.0910	2.2612	111.3	4.7	5476	-0.0033
19	0.0960	2.2774	112.1	5.0	5515	-0.0030

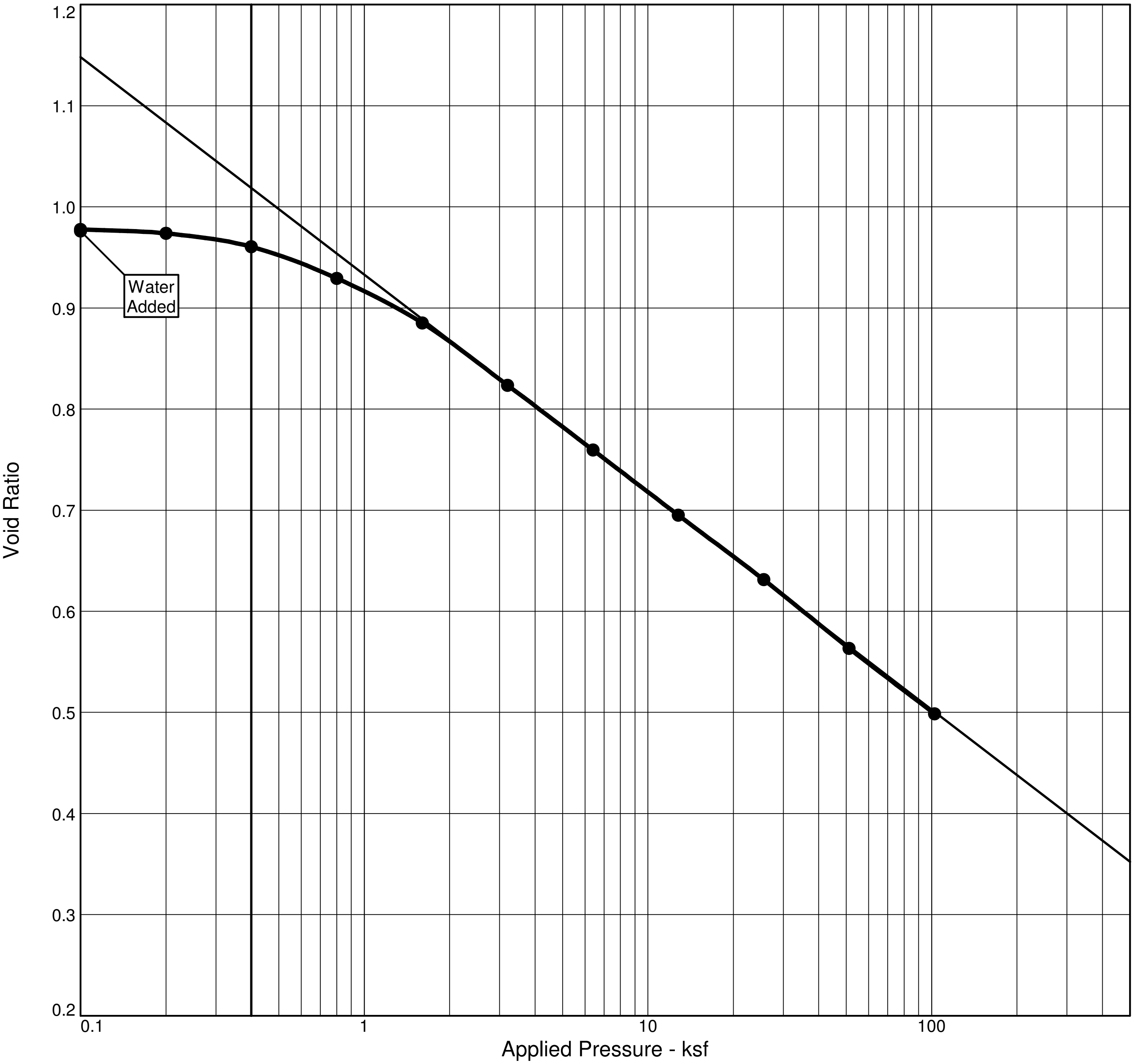
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
20	0.1010	2.2571	111.1	5.2	5466	-0.0027
21	0.1060	2.2693	111.7	5.5	5496	-0.0025
22	0.1110	2.2449	110.5	5.8	5437	-0.0023
23	0.1160	2.2612	111.3	6.0	5476	-0.0020
24	0.1200	2.2429	110.4	6.2	5432	-0.0019
25	0.1260	2.2856	112.5	6.5	5535	-0.0016
26	0.1310	2.2815	112.3	6.8	5525	-0.0013
27	0.1360	2.2734	111.9	7.0	5505	-0.0010
28	0.1410	2.1840	107.5	7.3	5289	-0.0008
29	0.1460	2.2063	108.6	7.6	5343	-0.0006
30	0.1510	2.1759	107.1	7.8	5269	-0.0005
31	0.1560	2.1373	105.2	8.1	5176	-0.0004
32	0.1610	2.1068	103.7	8.3	5102	-0.0005
33	0.1660	2.0763	102.2	8.6	5028	-0.0005
34	0.1700	2.0641	101.6	8.8	4999	-0.0005
35	0.1760	2.0540	101.1	9.1	4974	-0.0006
36	0.1800	2.0458	100.7	9.3	4954	-0.0007
37	0.1850	2.0397	100.4	9.6	4940	-0.0008
38	0.1910	2.0397	100.4	9.9	4940	-0.0009
39	0.1950	2.0296	99.9	10.1	4915	-0.0010
40	0.2010	2.0215	99.5	10.4	4895	-0.0012
41	0.2060	2.0255	99.7	10.7	4905	-0.0013
42	0.2110	1.9625	96.6	10.9	4753	-0.0018
43	0.2160	1.9971	98.3	11.2	4836	-0.0018
44	0.2210	1.9950	98.2	11.5	4831	-0.0020
45	0.2250	1.9930	98.1	11.7	4827	-0.0021
46	0.2310	1.9950	98.2	12.0	4831	-0.0023
47	0.2360	1.9930	98.1	12.2	4827	-0.0025
48	0.2410	1.9910	98.0	12.5	4822	-0.0027
49	0.2450	1.9930	98.1	12.7	4827	-0.0028
50	0.2510	1.9930	98.1	13.0	4827	-0.0030
51	0.2560	1.9890	97.9	13.3	4817	-0.0031
52	0.2610	2.0052	98.7	13.5	4856	-0.0032
53	0.2660	1.9768	97.3	13.8	4787	-0.0039
54	0.2710	1.9727	97.1	14.0	4777	-0.0041
55	0.2760	1.9747	97.2	14.3	4782	-0.0044
56	0.2810	1.9829	97.6	14.6	4802	-0.0045
57	0.2850	1.9727	97.1	14.8	4777	-0.0046
58	0.2910	1.9747	97.2	15.1	4782	-0.0047
59	0.2960	1.9564	96.3	15.3	4738	-0.0049
60	0.3010	1.9524	96.1	15.6	4728	-0.0050
61	0.3060	1.9564	96.3	15.9	4738	-0.0052
62	0.3110	1.9524	96.1	16.1	4728	-0.0053
63	0.3150	1.9646	96.7	16.3	4758	-0.0054
64	0.3210	1.9564	96.3	16.6	4738	-0.0056
65	0.3260	1.9605	96.5	16.9	4748	-0.0057
66	0.3310	1.9564	96.3	17.2	4738	-0.0058

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
67	0.3360	1.9483	95.9	17.4	4718	-0.0061
68	0.3410	1.9443	95.7	17.7	4708	-0.0062
69	0.3460	1.9483	95.9	17.9	4718	-0.0064
70	0.3510	1.9443	95.7	18.2	4708	-0.0066
71	0.3560	1.9483	95.9	18.4	4718	-0.0068
72	0.3610	1.9382	95.4	18.7	4694	-0.0070
73	0.3650	1.9483	95.9	18.9	4718	-0.0072
74	0.3700	1.9483	95.9	19.2	4718	-0.0074
75	0.3760	1.9118	94.1	19.5	4630	-0.0087
76	0.3810	1.9097	94.0	19.7	4625	-0.0088
77	0.3850	1.8914	93.1	19.9	4581	-0.0090
78	0.3900	1.9016	93.6	20.2	4605	-0.0091

CONSOLIDATION TEST REPORT ASTM D2435



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Swell Press. (ksf)	Heave %	e_o
Sat.	Moist.											
55.1 %	19.9 %	85.3	62	41	2.7		0.8	0.22		0.1	0.1	0.977

MATERIAL DESCRIPTION	USCS	AASHTO
fat clay with sand	CH	A-7-6(33)

Project No. 10800305 **Client:** NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

Location: BH17-03 **Depth:** 3.5-4.5' **Sample Number:** S-2A & S-2B

Knight Piésold
CONSULTING

Remarks:
Specific gravity assumed.

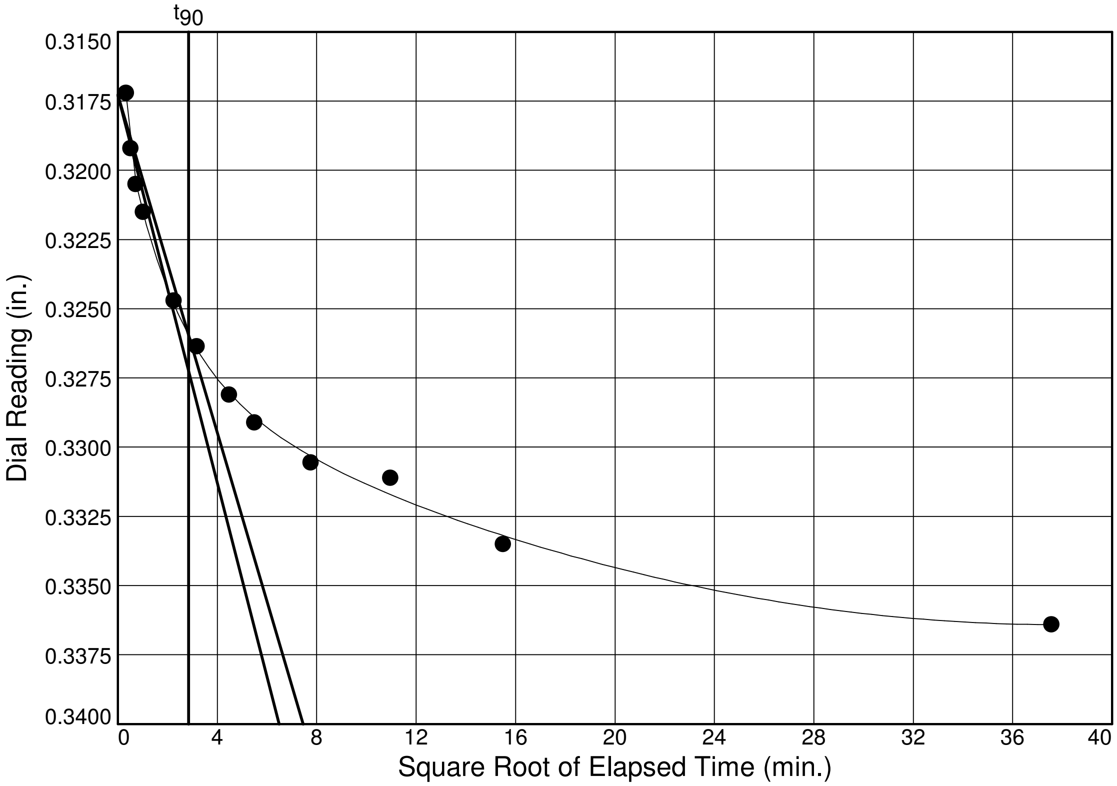
Figure

Tested By: EAG **Checked By:** JDB

Dial Reading vs. Time

Project No.: 10800305
Project: Magnum Brine Ponds 3 & 4

Location: BH17-03 Depth: 3.5-4.5' Sample Number: S-2A & S-2B



Load No.= 8

Load= 6.40 ksf

D_0 = 0.3173

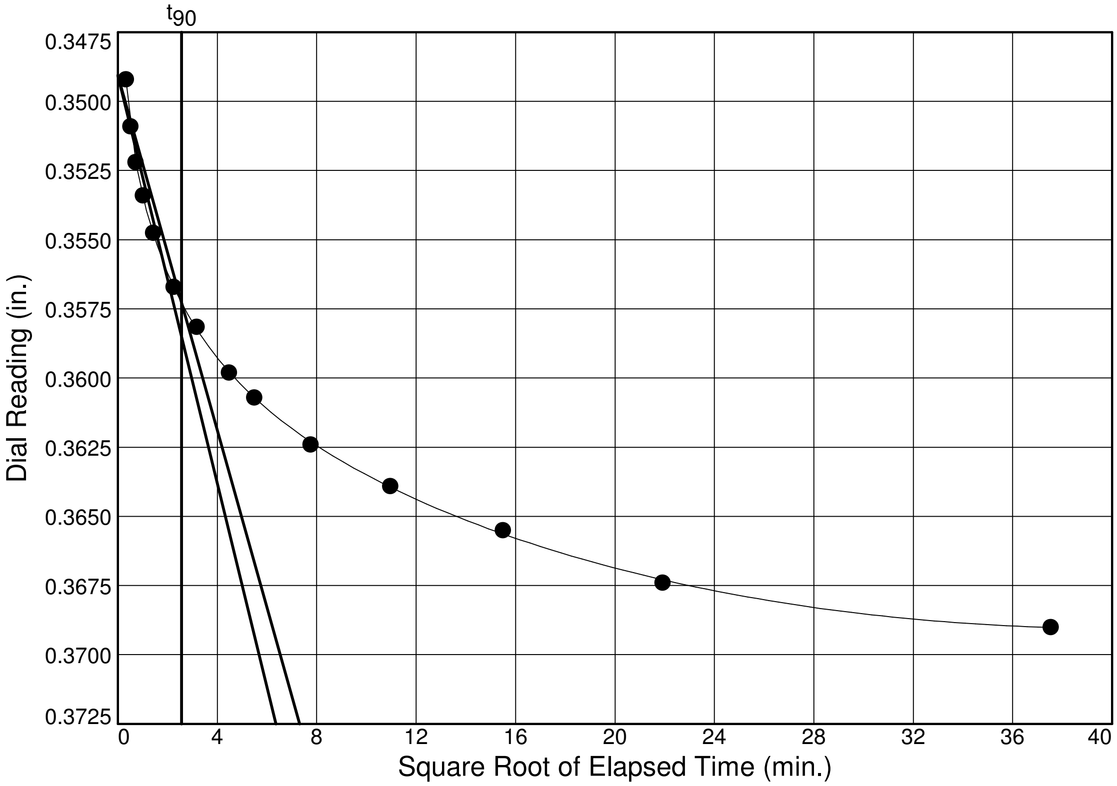
D_{90} = 0.3260

D_{100} = 0.3269

T_{90} = 8.09 min.

C_v @ T_{90}

0.215 ft.^{2}/day



Load No.= 9

Load= 12.80 ksf

D_0 = 0.3491

D_{90} = 0.3573

D_{100} = 0.3582

T_{90} = 6.59 min.

C_v @ T_{90}

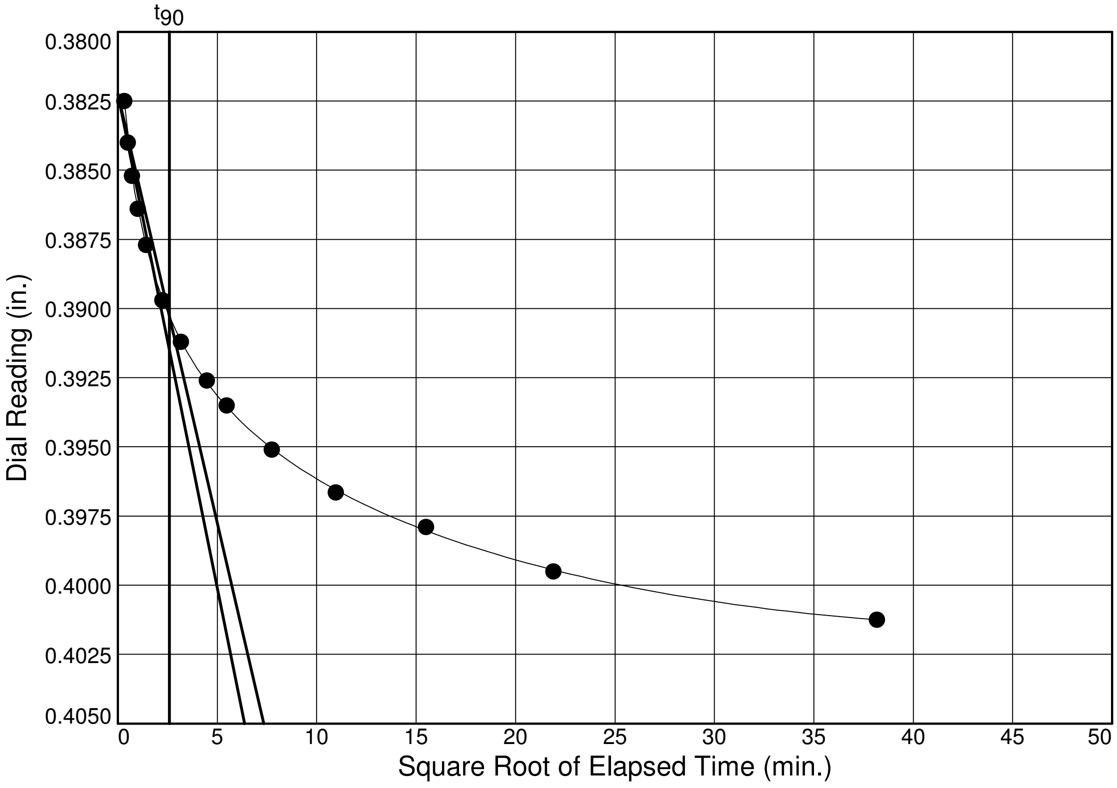
0.246 ft.^{2}/day

Figure

Dial Reading vs. Time

Project No.: 10800305
Project: Magnum Brine Ponds 3 & 4

Location: BH17-03 Depth: 3.5-4.5' Sample Number: S-2A & S-2B



Load No.= 10

Load= 25.60 ksf

D_0 = 0.3822

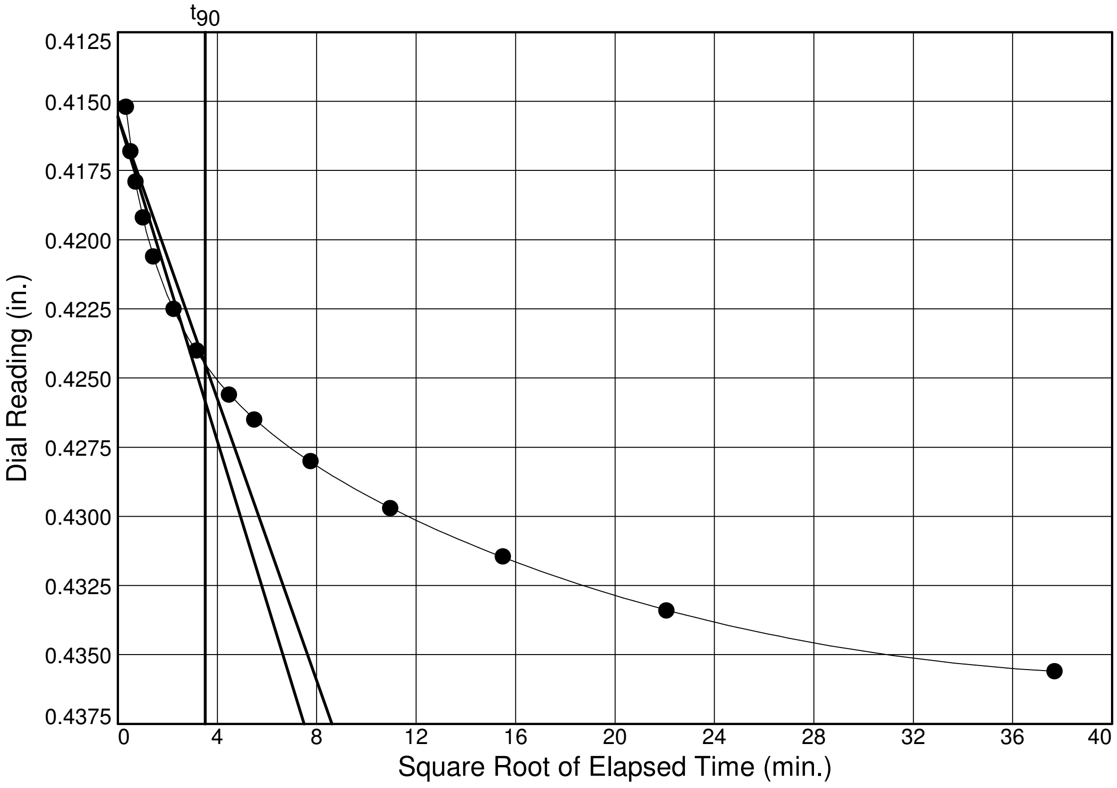
D_{90} = 0.3903

D_{100} = 0.3912

T_{90} = 6.70 min.

C_v @ T_{90}

0.224 ft.^{2}/day



Load No.= 11

Load= 51.20 ksf

D_0 = 0.4155

D_{90} = 0.4245

D_{100} = 0.4255

T_{90} = 12.38 min.

C_v @ T_{90}

0.112 ft.^{2}/day

Figure

Knight Piesold Geotechnical Lab.

SWELL/CONSOLIDATION TEST DATA

9/25/2017

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project Number: 10800305
Location: BH17-03
Depth: 3.5-4.5' **Sample Number:** S-2A & S-2B
Material Description: fat clay with sand
Liquid Limit: 62 **Plasticity Index:** 41
USCS: CH **AASHTO:** A-7-6(33)
Testing Remarks: Specific gravity assumed.
Tested by: EAG **Checked by:** JDB

Test Specimen Data

NATURAL MOISTURE		VOID RATIO		AFTER TEST	
Wet w+t =	122.97 g.	**Spec. Gr.**	= 2.7	**Wet w+t** =	285.83 g.
Dry w+t =	102.53 g.	**Est. Ht. Solids**	= 0.506 in.	**Dry w+t** =	262.81 g.
Tare Wt. =	0.00 g.	**Init. V.R.**	= 0.977	**Tare Wt.** =	160.28 g.
Moisture =	19.9 %	**Init. Sat.**	= 55.1 %	**Moisture** =	22.5 %
UNIT WEIGHT		**TEST START**		**Dry Wt.**	=102.53* g.
Height =	1.000 in.	**Height**	= 1.000 in.		
Diameter =	2.415 in.	**Diameter**	= 2.415 in.		
Weight =	122.97 g.				
Dry Dens. =	85.3 pcf				

End-Of-Load Summary

Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.22650		0.00000			0.977	
0.10	0.22680	0.00000	0.00030			0.976	0.0 Comprs.
water	0.22605	0.00000	-0.00045			0.978	0.0 Swell
0.20	0.22800	0.00000	0.00150			0.974	0.2 Comprs.
0.40	0.23530	0.00060	0.00820			0.960	0.8 Comprs.
0.80	0.25260	0.00210	0.02400			0.929	2.4 Comprs.
1.60	0.27690	0.00410	0.04630			0.885	4.6 Comprs.
3.20	0.31050	0.00650	0.07750			0.823	7.7 Comprs.
6.40	0.34540	0.00900	0.10990	0.215		0.759	11.0 Comprs.
12.80	0.38020	0.01120	0.14250	0.246		0.695	14.2 Comprs.
25.60	0.41525	0.01400	0.17475	0.224		0.631	17.5 Comprs.
51.20	0.45280	0.01720	0.20910	0.112		0.563	20.9 Comprs.
102.40	0.48940	0.02110	0.24180			0.499	24.2 Comprs.
0.00	0.48940	0.01210	0.25080				

Compression index (C_c), ksf = 0.22 **Preconsolidation pressure (P_p), ksf** = 0.8 **Void ratio at P_p (e_m)** = 0.926
Heave, % = 0.1 **Swell pressure, ksf** = 0.1

Pressure: 0.10 ksf **TEST READINGS** **Load No. 1**

No.	Elapsed Time	Dial Reading
1	.1	0.22650
2	(final)	0.22680

Void Ratio = 0.976 **Compression =** 0.0%

Pressure: 0.10 ksf **TEST READINGS** **Load No. 2**

No.	Elapsed Time	Dial Reading
1	0	0.22680
2	(final)	0.22605

Void Ratio = 0.978 **Swell =** 0.0%

Pressure: 0.20 ksf **TEST READINGS** **Load No. 3**

No.	Elapsed Time	Dial Reading
1	0	0.22605
2	(final)	0.22800

Void Ratio = 0.974 **Compression =** 0.2%

Pressure: 0.40 ksf **TEST READINGS** **Load No. 4**

No.	Elapsed Time	Dial Reading
1	0	0.22800
2	(final)	0.23530

Void Ratio = 0.960 **Compression =** 0.8%

Pressure: 0.80 ksf **TEST READINGS** **Load No. 5**

No.	Elapsed Time	Dial Reading
1	0	0.23530
2	(final)	0.25260

Void Ratio = 0.929 **Compression =** 2.4%

Pressure: 1.60 ksf **TEST READINGS** **Load No. 6**

No.	Elapsed Time	Dial Reading
1	0	0.25260
2	(final)	0.27690

Void Ratio = 0.885 **Compression =** 4.6%

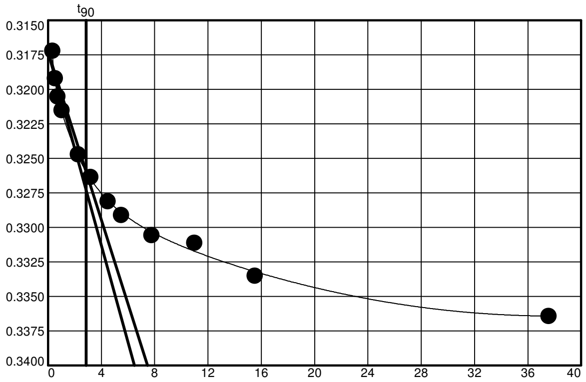
Pressure: 3.20 ksf **TEST READINGS** **Load No. 7**

No.	Elapsed Time	Dial Reading
1	0	0.27690
2	(final)	0.31050

Void Ratio = 0.823 **Compression =** 7.7%

Pressure: 6.40 ksf **TEST READINGS** **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.31050	11	120	0.34010
2	.1	0.32620	12	240	0.34250
3	.25	0.32820	13	1410	0.34540
4	.5	0.32950			
5	1	0.33050			
6	5	0.33370			
7	10	0.33535			
8	20	0.33710			
9	30	0.33810			
10	60	0.33955			

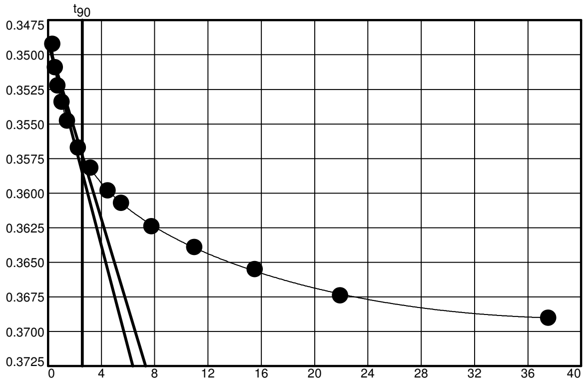


Void Ratio = 0.759 **Compression =** 11.0%

D_0 = 0.3173 **D_{90} =** 0.3260 **D_{100} =** 0.3269 **C_v at 8.09 min. =** 0.215 ft.^{2}/day

Pressure: 12.80 ksf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.34540	11	60	0.37360
2	.1	0.36040	12	120	0.37510
3	.25	0.36210	13	240	0.37670
4	.5	0.36340	14	480	0.37860
5	1	0.36460	15	1408	0.38020
6	2	0.36595			
7	5	0.36790			
8	10	0.36935			
9	20	0.37100			
10	30	0.37190			

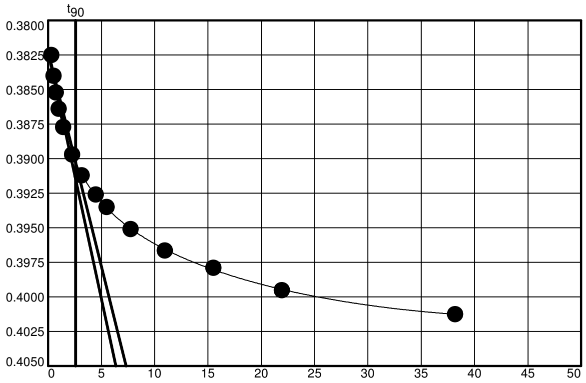


Void Ratio = 0.695 **Compression =** 14.2%

D_0 = 0.3491 **D_{90} =** 0.3573 **D_{100} =** 0.3582 **C_v at 6.59 min. =** 0.246 ft.^{2}/day

Pressure: 25.60 ksf **TEST READINGS** **Load No. 10**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.38020	11	60	0.40910
2	.1	0.39650	12	120	0.41065
3	.25	0.39800	13	240	0.41190
4	.5	0.39920	14	480	0.41350
5	1	0.40040	15	1457	0.41525
6	2	0.40170			
7	5	0.40370			
8	10	0.40520			
9	20	0.40660			
10	30	0.40750			

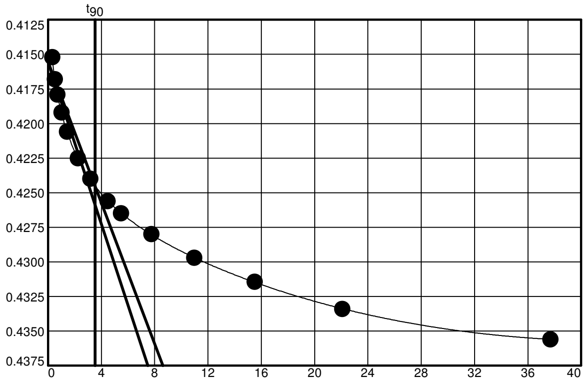


Void Ratio = 0.631 **Compression =** 17.5%

D_0 = 0.3822 **D_{90} =** 0.3903 **D_{100} =** 0.3912 **C_v at 6.70 min. =** 0.224 ft.^{2}/day

Pressure: 51.20 ksf **TEST READINGS** **Load No. 11**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.41525	11	60	0.44520
2	.1	0.43240	12	120	0.44690
3	.25	0.43400	13	240	0.44865
4	.5	0.43510	14	487	0.45060
5	1	0.43640	15	1420	0.45280
6	2	0.43780			
7	5	0.43970			
8	10	0.44120			
9	20	0.44280			
10	30	0.44370			



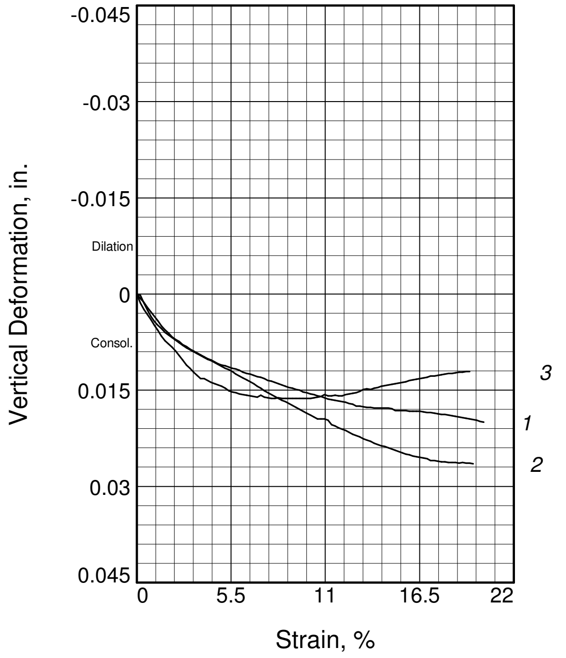
Void Ratio = 0.563 **Compression =** 20.9%

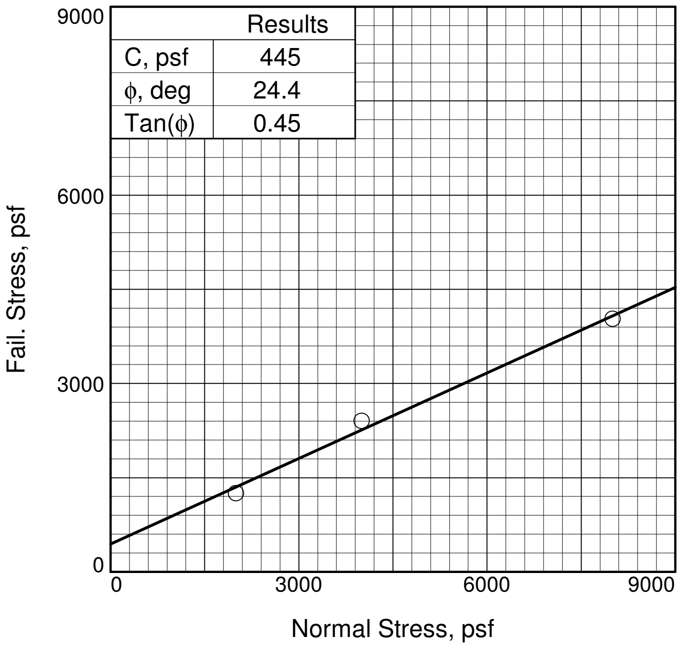
D_0 = 0.4155 **D_{90} =** 0.4245 **D_{100} =** 0.4255 **C_v at 12.38 min. =** 0.112 ft.^{2}/day

Pressure: 102.40 ksf **TEST READINGS** **Load No. 12**

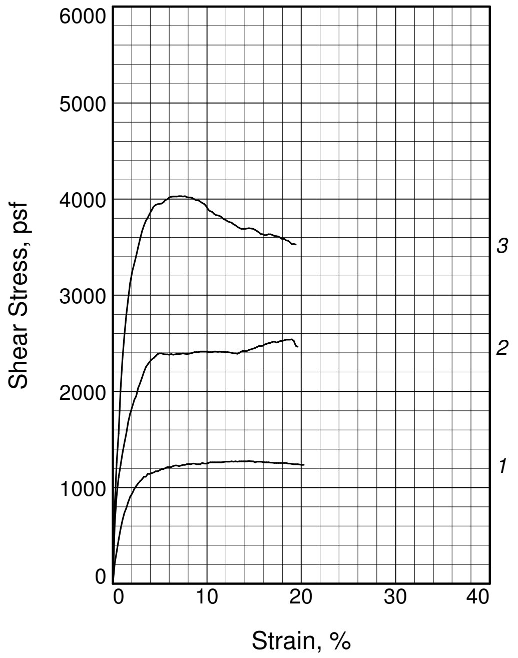
No.	Elapsed Time	Dial Reading
1	0	0.45280
2	(final)	0.48940

Void Ratio = 0.499 **Compression =** 24.2%





Results	
C, psf	445
ϕ, deg	24.4
Tan(ϕ)	0.45



Specimen No.		1	2	3
Initial	Water Content, %	15.0	15.0	15.0
	Dry Density, pcf	94.8	102.1	103.2
	Saturation, %	51.9	62.1	63.8
	Void Ratio	0.7782	0.6511	0.6338
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	25.2	19.3	16.9
	Dry Density, pcf	100.2	110.9	115.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6817	0.5197	0.4564
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.95	0.92	0.89
Normal Stress, psf		2000	4000	8000
Fail. Stress, psf		1255	2407	4029
Strain, %		10.1	10.1	7.0
Ult. Stress, psf				
Strain, %				
Strain rate, %/min.		0.05	0.05	0.05

Sample Type: Trimmed from MC Liner
Description: lean clay

LL= 30 **PL=** 15 **PI=** 15
Assumed Specific Gravity= 2.7
Remarks: Failure chosen at 10% strain and peak shear stress. Test was inundated.

Figure _______

Client: NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Location: BH17-04
Sample Number: S-2A & S-2B **Depth:** 3.5-4.5'
Proj. No.: 10800305 **Date Sampled:** 7/14/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

7/21/2017

Date: 7/14/17
Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No.: 10800305
Location: BH17-04
Depth: 3.5-4.5' **Sample Number:** S-2A & S-2B
Description: lean clay
Remarks: Failure chosen at 10% strain and peak shear stress. Test was inundated.
Type of Sample: Trimmed from MC Liner
Assumed Specific Gravity=2.7 **LL=**30 **PL=**15 **PI=**15

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	371.300		535.930
Moisture content: Dry soil+tare, gms.	346.910		507.210
Moisture content: Tare, gms.	184.000		393.420
Moisture, %	15.0	25.2	25.2
Moist specimen weight, gms.	131.6		
Diameter, in.	2.42	2.42	
Area, in.²	4.60	4.60	
Height, in.	1.00	0.95	
Net decrease in height, in.		0.05	
Wet density, pcf	109.0	125.5	
Dry density, pcf	94.8	100.2	
Void ratio	0.7782	0.6817	
Saturation, %	51.9	100.0	

Test Readings for Specimen No. 1

Load ring constant = 31.408 lbs. per input unit
Normal stress = 2000 psf
Strain rate, %/min. = 0.05
Fail. Stress = 1255 psf **at reading no.** 49

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0003
1	0.0050	0.2165	6.8	0.2	213	-0.0010
2	0.0100	0.3406	10.7	0.4	335	-0.0016
3	0.0150	0.4648	14.6	0.6	457	-0.0024
4	0.0200	0.5762	18.1	0.8	567	-0.0031
5	0.0250	0.6717	21.1	1.0	661	-0.0038
6	0.0300	0.7482	23.5	1.2	736	-0.0045
7	0.0350	0.7991	25.1	1.4	786	-0.0053
8	0.0400	0.8628	27.1	1.7	848	-0.0059
9	0.0450	0.9169	28.8	1.9	902	-0.0064
10	0.0500	0.9583	30.1	2.1	942	-0.0070
11	0.0550	1.0028	31.5	2.3	986	-0.0074
12	0.0600	1.0347	32.5	2.5	1017	-0.0077

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
13	0.0650	1.0601	33.3	2.7	1042	-0.0082
14	0.0700	1.0856	34.1	2.9	1067	-0.0085
15	0.0750	1.1047	34.7	3.1	1086	-0.0089
16	0.0800	1.1302	35.5	3.3	1111	-0.0092
17	0.0850	1.1302	35.5	3.5	1111	-0.0095
18	0.0900	1.1620	36.5	3.7	1143	-0.0098
19	0.0950	1.1620	36.5	3.9	1143	-0.0101
20	0.1000	1.1684	36.7	4.1	1149	-0.0104
21	0.1050	1.1748	36.9	4.3	1155	-0.0106
22	0.1100	1.1875	37.3	4.5	1168	-0.0109
23	0.1150	1.1907	37.4	4.8	1171	-0.0112
24	0.1200	1.2002	37.7	5.0	1180	-0.0114
25	0.1250	1.2130	38.1	5.2	1193	-0.0115
26	0.1300	1.2130	38.1	5.4	1193	-0.0117
27	0.1350	1.2225	38.4	5.6	1202	-0.0119
28	0.1400	1.2321	38.7	5.8	1211	-0.0120
29	0.1450	1.2321	38.7	6.0	1211	-0.0122
30	0.1500	1.2321	38.7	6.2	1211	-0.0125
31	0.1550	1.2448	39.1	6.4	1224	-0.0127
32	0.1600	1.2512	39.3	6.6	1230	-0.0128
33	0.1650	1.2512	39.3	6.8	1230	-0.0130
34	0.1700	1.2448	39.1	7.0	1224	-0.0132
35	0.1750	1.2512	39.3	7.2	1230	-0.0133
36	0.1800	1.2575	39.5	7.4	1237	-0.0135
37	0.1850	1.2575	39.5	7.6	1237	-0.0138
38	0.1900	1.2639	39.7	7.9	1243	-0.0139
39	0.1950	1.2671	39.8	8.1	1246	-0.0141
40	0.2000	1.2639	39.7	8.3	1243	-0.0143
41	0.2050	1.2703	39.9	8.5	1249	-0.0145
42	0.2100	1.2703	39.9	8.7	1249	-0.0147
43	0.2150	1.2639	39.7	8.9	1243	-0.0149
44	0.2200	1.2639	39.7	9.1	1243	-0.0150
45	0.2250	1.2639	39.7	9.3	1243	-0.0152
46	0.2300	1.2766	40.1	9.5	1255	-0.0153
47	0.2350	1.2703	39.9	9.7	1249	-0.0156
48	0.2400	1.2703	39.9	9.9	1249	-0.0157
49	0.2450	1.2766	40.1	10.1	1255	-0.0159
50	0.2500	1.2830	40.3	10.3	1262	-0.0160
51	0.2550	1.2830	40.3	10.5	1262	-0.0162
52	0.2600	1.2830	40.3	10.7	1262	-0.0163
53	0.2650	1.2830	40.3	11.0	1262	-0.0165
54	0.2700	1.2830	40.3	11.2	1262	-0.0167
55	0.2750	1.2830	40.3	11.4	1262	-0.0168
56	0.2800	1.2830	40.3	11.6	1262	-0.0169
57	0.2850	1.2862	40.4	11.8	1265	-0.0170
58	0.2900	1.2894	40.5	12.0	1268	-0.0171
59	0.2950	1.2894	40.5	12.2	1268	-0.0172

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
60	0.3000	1.2894	40.5	12.4	1268	-0.0174
61	0.3050	1.2957	40.7	12.6	1274	-0.0175
62	0.3100	1.2894	40.5	12.8	1268	-0.0178
63	0.3150	1.2925	40.6	13.0	1271	-0.0178
64	0.3200	1.2894	40.5	13.2	1268	-0.0179
65	0.3250	1.2957	40.7	13.4	1274	-0.0180
66	0.3300	1.2957	40.7	13.6	1274	-0.0180
67	0.3350	1.2957	40.7	13.8	1274	-0.0181
68	0.3400	1.2957	40.7	14.0	1274	-0.0181
69	0.3450	1.2957	40.7	14.3	1274	-0.0181
70	0.3500	1.2989	40.8	14.5	1277	-0.0181
71	0.3550	1.2957	40.7	14.7	1274	-0.0181
72	0.3600	1.2957	40.7	14.9	1274	-0.0182
73	0.3650	1.2830	40.3	15.1	1262	-0.0185
74	0.3700	1.2894	40.5	15.3	1268	-0.0185
75	0.3750	1.2894	40.5	15.5	1268	-0.0185
76	0.3800	1.2894	40.5	15.7	1268	-0.0185
77	0.3850	1.2862	40.4	15.9	1265	-0.0186
78	0.3900	1.2830	40.3	16.1	1262	-0.0186
79	0.3950	1.2830	40.3	16.3	1262	-0.0186
80	0.4000	1.2830	40.3	16.5	1262	-0.0186
81	0.4050	1.2798	40.2	16.7	1258	-0.0187
82	0.4100	1.2798	40.2	16.9	1258	-0.0188
83	0.4150	1.2766	40.1	17.1	1255	-0.0188
84	0.4200	1.2766	40.1	17.4	1255	-0.0189
85	0.4250	1.2766	40.1	17.6	1255	-0.0190
86	0.4300	1.2766	40.1	17.8	1255	-0.0191
87	0.4350	1.2766	40.1	18.0	1255	-0.0191
88	0.4400	1.2766	40.1	18.2	1255	-0.0192
89	0.4450	1.2766	40.1	18.4	1255	-0.0193
90	0.4500	1.2703	39.9	18.6	1249	-0.0194
91	0.4550	1.2703	39.9	18.8	1249	-0.0195
92	0.4600	1.2671	39.8	19.0	1246	-0.0196
93	0.4650	1.2639	39.7	19.2	1243	-0.0197
94	0.4700	1.2639	39.7	19.4	1243	-0.0198
95	0.4750	1.2639	39.7	19.6	1243	-0.0199
96	0.4800	1.2607	39.6	19.8	1240	-0.0200
97	0.4850	1.2575	39.5	20.0	1237	-0.0202
98	0.4900	1.2575	39.5	20.2	1237	-0.0203

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	371.300		547.300
Moisture content: Dry soil+tare, gms.	346.910		523.930
Moisture content: Tare, gms.	184.000		402.540
Moisture, %	15.0	19.3	19.3
Moist specimen weight, gms.	141.7		
Diameter, in.	2.42	2.42	
Area, in.^{2}	4.60	4.60	
Height, in.	1.00	0.92	
Net decrease in height, in.		0.08	
Wet density, pcf	117.4	132.3	
Dry density, pcf	102.1	110.9	
Void ratio	0.6511	0.5197	
Saturation, %	62.1	100.0	

Test Readings for Specimen No. 2

Load ring constant = 31.408 lbs. per input unit

Normal stress = 4000 psf

Strain rate, %/min. = 0.05

Fail. Stress = 2407 psf **at reading no.** 49

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0050	0.6399	20.1	0.2	629	-0.0003
2	0.0100	0.9392	29.5	0.4	923	-0.0015
3	0.0150	1.1238	35.3	0.6	1105	-0.0026
4	0.0200	1.2512	39.3	0.8	1230	-0.0036
5	0.0250	1.3785	43.3	1.0	1355	-0.0044
6	0.0300	1.4868	46.7	1.2	1462	-0.0050
7	0.0350	1.5886	49.9	1.4	1562	-0.0055
8	0.0400	1.7096	53.7	1.7	1681	-0.0061
9	0.0450	1.7987	56.5	1.9	1769	-0.0065
10	0.0500	1.8752	58.9	2.1	1844	-0.0069
11	0.0550	1.9452	61.1	2.3	1913	-0.0073
12	0.0600	1.9834	62.3	2.5	1950	-0.0077
13	0.0650	2.0694	65.0	2.7	2035	-0.0081
14	0.0700	2.1203	66.6	2.9	2085	-0.0085
15	0.0750	2.1776	68.4	3.1	2141	-0.0088
16	0.0800	2.2381	70.3	3.3	2201	-0.0091
17	0.0850	2.2890	71.9	3.5	2251	-0.0094
18	0.0900	2.3209	72.9	3.7	2282	-0.0097
19	0.0950	2.3463	73.7	3.9	2307	-0.0100
20	0.1000	2.3718	74.5	4.1	2332	-0.0103
21	0.1050	2.3845	74.9	4.3	2345	-0.0105
22	0.1100	2.4100	75.7	4.5	2370	-0.0108
23	0.1150	2.4291	76.3	4.8	2389	-0.0111
24	0.1200	2.4355	76.5	5.0	2395	-0.0114
25	0.1250	2.4355	76.5	5.2	2395	-0.0117
26	0.1300	2.4291	76.3	5.4	2389	-0.0119
27	0.1350	2.4259	76.2	5.6	2385	-0.0122

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	2.4259	76.2	5.8	2385	-0.0126
29	0.1450	2.4227	76.1	6.0	2382	-0.0129
30	0.1500	2.4291	76.3	6.2	2389	-0.0132
31	0.1550	2.4227	76.1	6.4	2382	-0.0135
32	0.1600	2.4259	76.2	6.6	2385	-0.0138
33	0.1650	2.4291	76.3	6.8	2389	-0.0141
34	0.1700	2.4291	76.3	7.0	2389	-0.0145
35	0.1750	2.4323	76.4	7.2	2392	-0.0148
36	0.1800	2.4355	76.5	7.4	2395	-0.0152
37	0.1850	2.4323	76.4	7.6	2392	-0.0155
38	0.1900	2.4291	76.3	7.9	2389	-0.0158
39	0.1950	2.4323	76.4	8.1	2392	-0.0161
40	0.2000	2.4355	76.5	8.3	2395	-0.0164
41	0.2050	2.4418	76.7	8.5	2401	-0.0167
42	0.2100	2.4482	76.9	8.7	2407	-0.0169
43	0.2150	2.4482	76.9	8.9	2407	-0.0172
44	0.2200	2.4482	76.9	9.1	2407	-0.0175
45	0.2250	2.4546	77.1	9.3	2414	-0.0178
46	0.2300	2.4546	77.1	9.5	2414	-0.0181
47	0.2350	2.4546	77.1	9.7	2414	-0.0184
48	0.2400	2.4546	77.1	9.9	2414	-0.0187
49	0.2450	2.4482	76.9	10.1	2407	-0.0190
50	0.2500	2.4482	76.9	10.3	2407	-0.0193
51	0.2550	2.4482	76.9	10.5	2407	-0.0196
52	0.2600	2.4546	77.1	10.7	2414	-0.0196
53	0.2650	2.4546	77.1	11.0	2414	-0.0196
54	0.2700	2.4514	77.0	11.2	2410	-0.0198
55	0.2750	2.4546	77.1	11.4	2414	-0.0205
56	0.2800	2.4514	77.0	11.6	2410	-0.0207
57	0.2850	2.4514	77.0	11.8	2410	-0.0210
58	0.2900	2.4482	76.9	12.0	2407	-0.0212
59	0.2950	2.4482	76.9	12.2	2407	-0.0214
60	0.3000	2.4450	76.8	12.4	2404	-0.0217
61	0.3050	2.4418	76.7	12.6	2401	-0.0220
62	0.3100	2.4355	76.5	12.8	2395	-0.0222
63	0.3150	2.4355	76.5	13.0	2395	-0.0224
64	0.3200	2.4323	76.4	13.2	2392	-0.0227
65	0.3250	2.4418	76.7	13.4	2401	-0.0229
66	0.3300	2.4546	77.1	13.6	2414	-0.0231
67	0.3350	2.4609	77.3	13.8	2420	-0.0234
68	0.3400	2.4578	77.2	14.0	2417	-0.0236
69	0.3450	2.4609	77.3	14.3	2420	-0.0238
70	0.3500	2.4737	77.7	14.5	2432	-0.0239
71	0.3550	2.4800	77.9	14.7	2439	-0.0241
72	0.3600	2.4864	78.1	14.9	2445	-0.0243
73	0.3650	2.4928	78.3	15.1	2451	-0.0245
74	0.3700	2.5023	78.6	15.3	2461	-0.0247

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	2.5119	78.9	15.5	2470	-0.0249
76	0.3800	2.5119	78.9	15.7	2470	-0.0251
77	0.3850	2.5182	79.1	15.9	2476	-0.0252
78	0.3900	2.5310	79.5	16.1	2489	-0.0254
79	0.3950	2.5373	79.7	16.3	2495	-0.0255
80	0.4000	2.5437	79.9	16.5	2501	-0.0256
81	0.4050	2.5469	80.0	16.7	2504	-0.0257
82	0.4100	2.5564	80.3	16.9	2514	-0.0258
83	0.4150	2.5596	80.4	17.1	2517	-0.0261
84	0.4200	2.5501	80.1	17.4	2507	-0.0261
85	0.4250	2.5564	80.3	17.6	2514	-0.0262
86	0.4300	2.5660	80.6	17.8	2523	-0.0263
87	0.4350	2.5692	80.7	18.0	2526	-0.0263
88	0.4400	2.5755	80.9	18.2	2533	-0.0264
89	0.4450	2.5819	81.1	18.4	2539	-0.0264
90	0.4500	2.5819	81.1	18.6	2539	-0.0264
91	0.4550	2.5819	81.1	18.8	2539	-0.0265
92	0.4600	2.5851	81.2	19.0	2542	-0.0264
93	0.4650	2.5692	80.7	19.2	2526	-0.0265
94	0.4700	2.5182	79.1	19.4	2476	-0.0265
95	0.4750	2.5055	78.7	19.6	2464	-0.0266

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	371.300		541.590
Moisture content: Dry soil+tare, gms.	346.910		521.540
Moisture content: Tare, gms.	184.000		402.930
Moisture, %	15.0	16.9	16.9
Moist specimen weight, gms.	143.2		
Diameter, in.	2.42	2.42	
Area, in.²	4.60	4.60	
Height, in.	1.00	0.89	
Net decrease in height, in.		0.11	
Wet density, pcf	118.6	135.3	
Dry density, pcf	103.2	115.7	
Void ratio	0.6338	0.4564	
Saturation, %	63.8	100.0	

Test Readings for Specimen No. 3

Load ring constant = 31.408 lbs. per input unit

Normal stress = 8000 psf

Strain rate, %/min. = 0.05

Fail. Stress = 4029 psf **at reading no.** 34

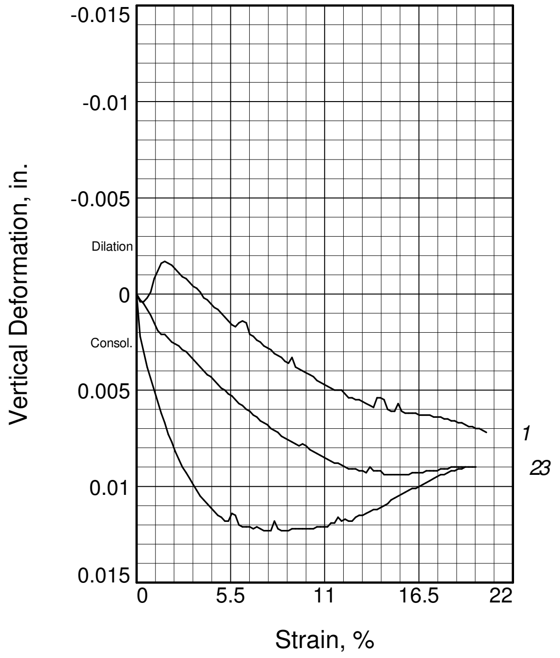
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0050	0.8341	26.2	0.2	820	-0.0015
2	0.0100	1.2830	40.3	0.4	1262	-0.0025
3	0.0150	1.5886	49.9	0.6	1562	-0.0033
4	0.0200	2.0471	64.3	0.8	2013	-0.0041
5	0.0250	2.3750	74.6	1.0	2335	-0.0050
6	0.0300	2.6265	82.5	1.2	2583	-0.0058
7	0.0350	2.8430	89.3	1.4	2795	-0.0067
8	0.0400	3.0149	94.7	1.7	2965	-0.0074
9	0.0450	3.1804	99.9	1.9	3127	-0.0079
10	0.0500	3.3078	103.9	2.1	3253	-0.0084
11	0.0550	3.3874	106.4	2.3	3331	-0.0090
12	0.0600	3.4670	108.9	2.5	3409	-0.0097
13	0.0650	3.5593	111.8	2.7	3500	-0.0104
14	0.0700	3.6452	114.5	2.9	3584	-0.0112
15	0.0750	3.7248	117.0	3.1	3663	-0.0117
16	0.0800	3.7853	118.9	3.3	3722	-0.0123
17	0.0850	3.8363	120.5	3.5	3772	-0.0128
18	0.0900	3.8713	121.6	3.7	3807	-0.0133
19	0.0950	3.9127	122.9	3.9	3847	-0.0133
20	0.1000	3.9509	124.1	4.1	3885	-0.0136
21	0.1050	3.9859	125.2	4.3	3919	-0.0139
22	0.1100	4.0082	125.9	4.5	3941	-0.0141
23	0.1150	4.0145	126.1	4.8	3947	-0.0143
24	0.1200	4.0177	126.2	5.0	3951	-0.0145
25	0.1250	4.0209	126.3	5.2	3954	-0.0148
26	0.1300	4.0336	126.7	5.4	3966	-0.0152
27	0.1350	4.0559	127.4	5.6	3988	-0.0154

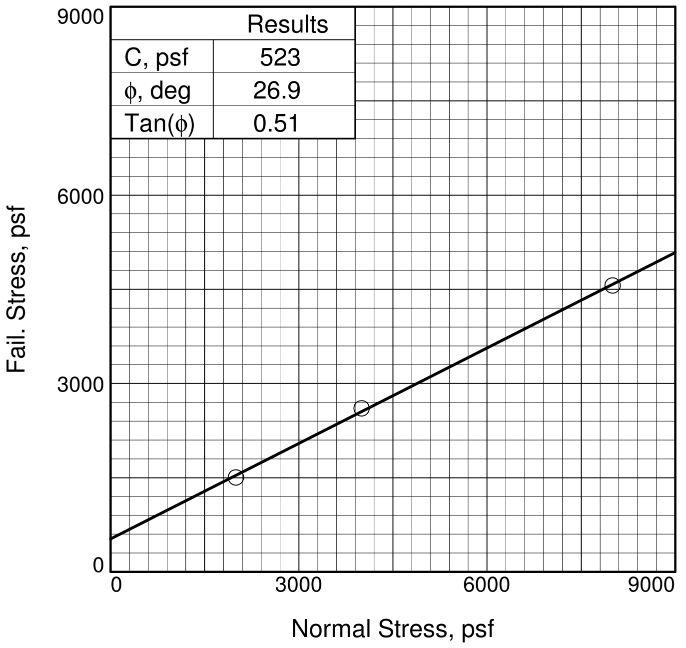
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	4.0655	127.7	5.8	3998	-0.0155
29	0.1450	4.0846	128.3	6.0	4016	-0.0157
30	0.1500	4.0910	128.5	6.2	4023	-0.0158
31	0.1550	4.0941	128.6	6.4	4026	-0.0159
32	0.1600	4.0941	128.6	6.6	4026	-0.0160
33	0.1650	4.0941	128.6	6.8	4026	-0.0161
34	0.1700	4.0973	128.7	7.0	4029	-0.0162
35	0.1750	4.0973	128.7	7.2	4029	-0.0159
36	0.1800	4.0941	128.6	7.4	4026	-0.0162
37	0.1850	4.0973	128.7	7.6	4029	-0.0163
38	0.1900	4.0878	128.4	7.9	4019	-0.0164
39	0.1950	4.0846	128.3	8.1	4016	-0.0164
40	0.2000	4.0846	128.3	8.3	4016	-0.0163
41	0.2050	4.0782	128.1	8.5	4010	-0.0164
42	0.2100	4.0655	127.7	8.7	3998	-0.0164
43	0.2150	4.0527	127.3	8.9	3985	-0.0164
44	0.2200	4.0527	127.3	9.1	3985	-0.0164
45	0.2250	4.0400	126.9	9.3	3973	-0.0164
46	0.2300	4.0273	126.5	9.5	3960	-0.0164
47	0.2350	4.0145	126.1	9.7	3947	-0.0164
48	0.2400	3.9891	125.3	9.9	3922	-0.0164
49	0.2450	3.9572	124.3	10.1	3891	-0.0164
50	0.2500	3.9381	123.7	10.3	3872	-0.0163
51	0.2550	3.9318	123.5	10.5	3866	-0.0162
52	0.2600	3.9127	122.9	10.7	3847	-0.0161
53	0.2650	3.8999	122.5	11.0	3835	-0.0158
54	0.2700	3.8936	122.3	11.2	3829	-0.0160
55	0.2750	3.8872	122.1	11.4	3822	-0.0160
56	0.2800	3.8745	121.7	11.6	3810	-0.0159
57	0.2850	3.8554	121.1	11.8	3791	-0.0160
58	0.2900	3.8490	120.9	12.0	3785	-0.0160
59	0.2950	3.8299	120.3	12.2	3766	-0.0158
60	0.3000	3.8235	120.1	12.4	3760	-0.0157
61	0.3050	3.8172	119.9	12.6	3753	-0.0156
62	0.3100	3.8012	119.4	12.8	3738	-0.0155
63	0.3150	3.7885	119.0	13.0	3725	-0.0153
64	0.3200	3.7726	118.5	13.2	3710	-0.0150
65	0.3250	3.7630	118.2	13.4	3700	-0.0149
66	0.3300	3.7535	117.9	13.6	3691	-0.0150
67	0.3350	3.7535	117.9	13.8	3691	-0.0148
68	0.3400	3.7535	117.9	14.0	3691	-0.0147
69	0.3450	3.7567	118.0	14.3	3694	-0.0145
70	0.3500	3.7599	118.1	14.5	3697	-0.0144
71	0.3550	3.7567	118.0	14.7	3694	-0.0143
72	0.3600	3.7535	117.9	14.9	3691	-0.0142
73	0.3650	3.7439	117.6	15.1	3681	-0.0141
74	0.3700	3.7280	117.1	15.3	3666	-0.0140

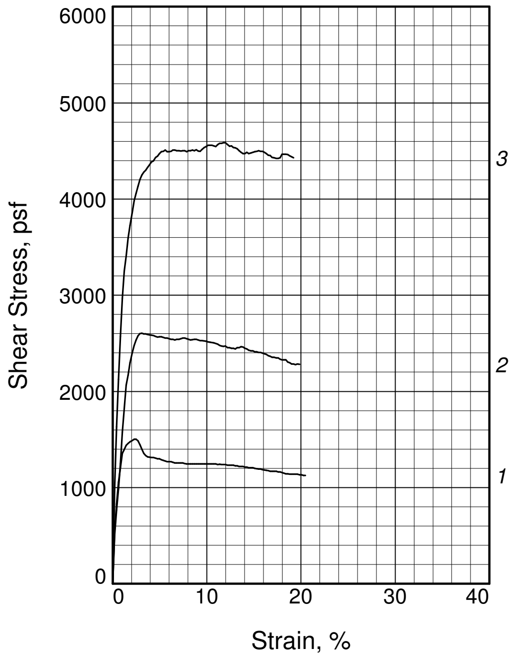
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	3.7153	116.7	15.5	3653	-0.0139
76	0.3800	3.6994	116.2	15.7	3638	-0.0138
77	0.3850	3.6962	116.1	15.9	3634	-0.0136
78	0.3900	3.6866	115.8	16.1	3625	-0.0135
79	0.3950	3.6898	115.9	16.3	3628	-0.0134
80	0.4000	3.6962	116.1	16.5	3634	-0.0133
81	0.4050	3.6962	116.1	16.7	3634	-0.0132
82	0.4100	3.6898	115.9	16.9	3628	-0.0131
83	0.4150	3.6771	115.5	17.1	3616	-0.0129
84	0.4200	3.6739	115.4	17.4	3613	-0.0129
85	0.4250	3.6707	115.3	17.6	3609	-0.0128
86	0.4300	3.6580	114.9	17.8	3597	-0.0127
87	0.4350	3.6452	114.5	18.0	3584	-0.0126
88	0.4400	3.6484	114.6	18.2	3587	-0.0125
89	0.4450	3.6325	114.1	18.4	3572	-0.0125
90	0.4500	3.6261	113.9	18.6	3566	-0.0124
91	0.4550	3.6102	113.4	18.8	3550	-0.0123
92	0.4600	3.5911	112.8	19.0	3531	-0.0123
93	0.4650	3.5943	112.9	19.2	3534	-0.0122
94	0.4700	3.5879	112.7	19.4	3528	-0.0122





Results	
C, psf	523
ϕ, deg	26.9
Tan(ϕ)	0.51



Specimen No.		1	2	3
Initial	Water Content, %	15.0	15.0	15.0
	Dry Density, pcf	108.4	105.4	99.9
	Saturation, %	72.9	67.5	58.8
	Void Ratio	0.5551	0.5989	0.6879
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	19.5	19.9	20.8
	Dry Density, pcf	110.5	109.7	108.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5258	0.5368	0.5610
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.96	0.92
Normal Stress, psf		2000	4000	8000
Fail. Stress, psf		1501	2604	4560
Strain, %		2.3	3.1	10.1
Ult. Stress, psf				
Strain, %				
Strain rate, %/min.		0.05	0.05	0.05

Sample Type: Trimmed from MC liner
Description: lean clay

LL= 27 **PL=** 16 **PI=** 11
Assumed Specific Gravity= 2.7
Remarks: Failure chosen at peak shear stress and 10% strain. Test was inundated.

Figure _______

Client: NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Location: BH17-05
Sample Number: S-4A & S-4B
Proj. No.: 10800305 **Date Sampled:** 7/3/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

7/21/2017

Date: 7/3/17
Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No.: 10800305
Location: BH17-05
Sample Number: S-4A & S-4B
Description: lean clay
Remarks: Failure chosen at peak shear stress and 10% strain. Test was inundated.
Type of Sample: Trimmed from MC liner
Assumed Specific Gravity=2.7 **LL=**27 **PL=**16 **PI=**11

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	324.500		556.880
Moisture content: Dry soil+tare, gms.	306.470		531.840
Moisture content: Tare, gms.	186.100		403.250
Moisture, %	15.0	19.5	19.5
Moist specimen weight, gms.	150.5		
Diameter, in.	2.42	2.42	
Area, in.²	4.60	4.60	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet density, pcf	124.6	132.0	
Dry density, pcf	108.4	110.5	
Void ratio	0.5551	0.5258	
Saturation, %	72.9	100.0	

Test Readings for Specimen No. 1

Load ring constant = 31.34 lbs. per input unit
Normal stress = 2000 psf
Strain rate, %/min. = 0.05
Fail. Stress = 1501 psf **at reading no.** 11

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.5590	17.5	0.2	548	-0.0004
2	0.0100	0.8465	26.5	0.4	831	-0.0004
3	0.0150	1.0764	33.7	0.6	1056	-0.0002
4	0.0200	1.2298	38.5	0.8	1207	0.0001
5	0.0250	1.3831	43.3	1.0	1357	0.0008
6	0.0300	1.4214	44.5	1.2	1395	0.0012
7	0.0350	1.4661	45.9	1.4	1439	0.0016
8	0.0400	1.4885	46.6	1.7	1460	0.0017
9	0.0450	1.5045	47.1	1.9	1476	0.0016
10	0.0500	1.5172	47.6	2.1	1489	0.0015
11	0.0550	1.5300	48.0	2.3	1501	0.0013
12	0.0600	1.5300	48.0	2.5	1501	0.0011

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
13	0.0650	1.5140	47.4	2.7	1486	0.0009
14	0.0700	1.4725	46.1	2.9	1445	0.0008
15	0.0750	1.4246	44.6	3.1	1398	0.0006
16	0.0800	1.3831	43.3	3.3	1357	0.0004
17	0.0850	1.3575	42.5	3.5	1332	0.0003
18	0.0900	1.3447	42.1	3.7	1319	0.0001
19	0.0950	1.3416	42.0	3.9	1316	-0.0002
20	0.1000	1.3384	41.9	4.1	1313	-0.0003
21	0.1050	1.3384	41.9	4.3	1313	-0.0005
22	0.1100	1.3320	41.7	4.5	1307	-0.0007
23	0.1150	1.3256	41.5	4.8	1301	-0.0008
24	0.1200	1.3256	41.5	5.0	1301	-0.0010
25	0.1250	1.3128	41.1	5.2	1288	-0.0012
26	0.1300	1.3064	40.9	5.4	1282	-0.0014
27	0.1350	1.3000	40.7	5.6	1276	-0.0016
28	0.1400	1.2936	40.5	5.8	1269	-0.0017
29	0.1450	1.2936	40.5	6.0	1269	-0.0015
30	0.1500	1.2936	40.5	6.2	1269	-0.0014
31	0.1550	1.2873	40.3	6.4	1263	-0.0015
32	0.1600	1.2809	40.1	6.6	1257	-0.0021
33	0.1650	1.2809	40.1	6.8	1257	-0.0022
34	0.1700	1.2809	40.1	7.0	1257	-0.0024
35	0.1750	1.2809	40.1	7.2	1257	-0.0025
36	0.1800	1.2809	40.1	7.4	1257	-0.0027
37	0.1850	1.2745	39.9	7.6	1250	-0.0028
38	0.1900	1.2681	39.7	7.9	1244	-0.0029
39	0.1950	1.2681	39.7	8.1	1244	-0.0031
40	0.2000	1.2681	39.7	8.3	1244	-0.0032
41	0.2050	1.2681	39.7	8.5	1244	-0.0033
42	0.2100	1.2681	39.7	8.7	1244	-0.0035
43	0.2150	1.2681	39.7	8.9	1244	-0.0036
44	0.2200	1.2681	39.7	9.1	1244	-0.0033
45	0.2250	1.2681	39.7	9.3	1244	-0.0038
46	0.2300	1.2681	39.7	9.5	1244	-0.0039
47	0.2350	1.2681	39.7	9.7	1244	-0.0040
48	0.2400	1.2681	39.7	9.9	1244	-0.0041
49	0.2450	1.2681	39.7	10.1	1244	-0.0042
50	0.2500	1.2681	39.7	10.3	1244	-0.0043
51	0.2550	1.2681	39.7	10.5	1244	-0.0045
52	0.2600	1.2681	39.7	10.7	1244	-0.0046
53	0.2650	1.2681	39.7	11.0	1244	-0.0047
54	0.2700	1.2617	39.5	11.2	1238	-0.0048
55	0.2750	1.2649	39.6	11.4	1241	-0.0049
56	0.2800	1.2617	39.5	11.6	1238	-0.0050
57	0.2850	1.2617	39.5	11.8	1238	-0.0050
58	0.2900	1.2617	39.5	12.0	1238	-0.0050
59	0.2950	1.2553	39.3	12.2	1232	-0.0052

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
60	0.3000	1.2553	39.3	12.4	1232	-0.0054
61	0.3050	1.2553	39.3	12.6	1232	-0.0054
62	0.3100	1.2553	39.3	12.8	1232	-0.0055
63	0.3150	1.2489	39.1	13.0	1225	-0.0055
64	0.3200	1.2489	39.1	13.2	1225	-0.0056
65	0.3250	1.2425	38.9	13.4	1219	-0.0057
66	0.3300	1.2425	38.9	13.6	1219	-0.0058
67	0.3350	1.2425	38.9	13.8	1219	-0.0059
68	0.3400	1.2361	38.7	14.0	1213	-0.0054
69	0.3450	1.2361	38.7	14.3	1213	-0.0054
70	0.3500	1.2298	38.5	14.5	1207	-0.0055
71	0.3550	1.2298	38.5	14.7	1207	-0.0060
72	0.3600	1.2298	38.5	14.9	1207	-0.0061
73	0.3650	1.2234	38.3	15.1	1200	-0.0061
74	0.3700	1.2202	38.2	15.3	1197	-0.0057
75	0.3750	1.2170	38.1	15.5	1194	-0.0061
76	0.3800	1.2138	38.0	15.7	1191	-0.0062
77	0.3850	1.2074	37.8	15.9	1185	-0.0062
78	0.3900	1.2042	37.7	16.1	1182	-0.0062
79	0.3950	1.2010	37.6	16.3	1178	-0.0062
80	0.4000	1.1978	37.5	16.5	1175	-0.0063
81	0.4050	1.1914	37.3	16.7	1169	-0.0063
82	0.4100	1.1914	37.3	16.9	1169	-0.0063
83	0.4150	1.1914	37.3	17.1	1169	-0.0063
84	0.4200	1.1914	37.3	17.4	1169	-0.0064
85	0.4250	1.1850	37.1	17.6	1163	-0.0064
86	0.4300	1.1850	37.1	17.8	1163	-0.0064
87	0.4350	1.1786	36.9	18.0	1156	-0.0065
88	0.4400	1.1723	36.7	18.2	1150	-0.0065
89	0.4450	1.1659	36.5	18.4	1144	-0.0066
90	0.4500	1.1659	36.5	18.6	1144	-0.0066
91	0.4550	1.1595	36.3	18.8	1138	-0.0067
92	0.4600	1.1595	36.3	19.0	1138	-0.0067
93	0.4650	1.1595	36.3	19.2	1138	-0.0068
94	0.4700	1.1595	36.3	19.4	1138	-0.0069
95	0.4750	1.1595	36.3	19.6	1138	-0.0069
96	0.4800	1.1531	36.1	19.8	1131	-0.0070
97	0.4850	1.1531	36.1	20.0	1131	-0.0070
98	0.4900	1.1467	35.9	20.2	1125	-0.0071
99	0.4950	1.1467	35.9	20.5	1125	-0.0072

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	324.500		544.730
Moisture content: Dry soil+tare, gms.	306.470		519.530
Moisture content: Tare, gms.	186.100		392.830
Moisture, %	15.0	19.9	19.9
Moist specimen weight, gms.	146.3		
Diameter, in.	2.42	2.42	
Area, in.²	4.60	4.60	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet density, pcf	121.2	131.5	
Dry density, pcf	105.4	109.7	
Void ratio	0.5989	0.5368	
Saturation, %	67.5	100.0	

Test Readings for Specimen No. 2

Load ring constant = 31.34 lbs. per input unit

Normal stress = 4000 psf

Strain rate, %/min. = 0.05

Fail. Stress = 2604 psf **at reading no.** 15

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.5175	16.2	0.2	508	-0.0002
2	0.0100	0.7794	24.4	0.4	765	-0.0004
3	0.0150	1.0062	31.5	0.6	987	-0.0007
4	0.0200	1.2745	39.9	0.8	1250	-0.0010
5	0.0250	1.6067	50.4	1.0	1576	-0.0014
6	0.0300	1.8558	58.2	1.2	1821	-0.0018
7	0.0350	2.1050	66.0	1.4	2065	-0.0020
8	0.0400	2.2104	69.3	1.7	2169	-0.0020
9	0.0450	2.3413	73.4	1.9	2297	-0.0022
10	0.0500	2.4467	76.7	2.1	2401	-0.0024
11	0.0550	2.5266	79.2	2.3	2479	-0.0025
12	0.0600	2.5841	81.0	2.5	2535	-0.0026
13	0.0650	2.6288	82.4	2.7	2579	-0.0028
14	0.0700	2.6512	83.1	2.9	2601	-0.0029
15	0.0750	2.6544	83.2	3.1	2604	-0.0031
16	0.0800	2.6480	83.0	3.3	2598	-0.0033
17	0.0850	2.6480	83.0	3.5	2598	-0.0035
18	0.0900	2.6416	82.8	3.7	2592	-0.0037
19	0.0950	2.6384	82.7	3.9	2589	-0.0039
20	0.1000	2.6352	82.6	4.1	2586	-0.0041
21	0.1050	2.6320	82.5	4.3	2582	-0.0042
22	0.1100	2.6192	82.1	4.5	2570	-0.0044
23	0.1150	2.6128	81.9	4.8	2564	-0.0046
24	0.1200	2.6160	82.0	5.0	2567	-0.0048
25	0.1250	2.6160	82.0	5.2	2567	-0.0049
26	0.1300	2.6096	81.8	5.4	2560	-0.0051
27	0.1350	2.6032	81.6	5.6	2554	-0.0052

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	2.6032	81.6	5.8	2554	-0.0054
29	0.1450	2.5969	81.4	6.0	2548	-0.0056
30	0.1500	2.5905	81.2	6.2	2542	-0.0057
31	0.1550	2.5905	81.2	6.4	2542	-0.0059
32	0.1600	2.5841	81.0	6.6	2535	-0.0060
33	0.1650	2.5905	81.2	6.8	2542	-0.0062
34	0.1700	2.5905	81.2	7.0	2542	-0.0063
35	0.1750	2.5969	81.4	7.2	2548	-0.0065
36	0.1800	2.6032	81.6	7.4	2554	-0.0066
37	0.1850	2.6032	81.6	7.6	2554	-0.0067
38	0.1900	2.5969	81.4	7.9	2548	-0.0069
39	0.1950	2.5905	81.2	8.1	2542	-0.0070
40	0.2000	2.5841	81.0	8.3	2535	-0.0071
41	0.2050	2.5873	81.1	8.5	2539	-0.0073
42	0.2100	2.5905	81.2	8.7	2542	-0.0074
43	0.2150	2.5905	81.2	8.9	2542	-0.0075
44	0.2200	2.5841	81.0	9.1	2535	-0.0076
45	0.2250	2.5777	80.8	9.3	2529	-0.0077
46	0.2300	2.5777	80.8	9.5	2529	-0.0078
47	0.2350	2.5745	80.7	9.7	2526	-0.0077
48	0.2400	2.5713	80.6	9.9	2523	-0.0078
49	0.2450	2.5617	80.3	10.1	2513	-0.0080
50	0.2500	2.5585	80.2	10.3	2510	-0.0081
51	0.2550	2.5553	80.1	10.5	2507	-0.0082
52	0.2600	2.5521	80.0	10.7	2504	-0.0083
53	0.2650	2.5458	79.8	11.0	2498	-0.0084
54	0.2700	2.5394	79.6	11.2	2492	-0.0085
55	0.2750	2.5266	79.2	11.4	2479	-0.0086
56	0.2800	2.5202	79.0	11.6	2473	-0.0087
57	0.2850	2.5138	78.8	11.8	2466	-0.0087
58	0.2900	2.5202	79.0	12.0	2473	-0.0088
59	0.2950	2.5010	78.4	12.2	2454	-0.0089
60	0.3000	2.5010	78.4	12.4	2454	-0.0090
61	0.3050	2.4946	78.2	12.6	2448	-0.0090
62	0.3100	2.4946	78.2	12.8	2448	-0.0090
63	0.3150	2.4883	78.0	13.0	2441	-0.0091
64	0.3200	2.5010	78.4	13.2	2454	-0.0091
65	0.3250	2.5010	78.4	13.4	2454	-0.0092
66	0.3300	2.5106	78.7	13.6	2463	-0.0089
67	0.3350	2.5074	78.6	13.8	2460	-0.0091
68	0.3400	2.4946	78.2	14.0	2448	-0.0091
69	0.3450	2.4883	78.0	14.3	2441	-0.0091
70	0.3500	2.4755	77.6	14.5	2429	-0.0093
71	0.3550	2.4691	77.4	14.7	2423	-0.0093
72	0.3600	2.4691	77.4	14.9	2423	-0.0093
73	0.3650	2.4563	77.0	15.1	2410	-0.0093
74	0.3700	2.4563	77.0	15.3	2410	-0.0093

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	2.4499	76.8	15.5	2404	-0.0093
76	0.3800	2.4499	76.8	15.7	2404	-0.0093
77	0.3850	2.4435	76.6	15.9	2398	-0.0093
78	0.3900	2.4372	76.4	16.1	2391	-0.0092
79	0.3950	2.4308	76.2	16.3	2385	-0.0092
80	0.4000	2.4180	75.8	16.5	2372	-0.0092
81	0.4050	2.4116	75.6	16.7	2366	-0.0092
82	0.4100	2.3988	75.2	16.9	2354	-0.0091
83	0.4150	2.3988	75.2	17.1	2354	-0.0091
84	0.4200	2.3924	75.0	17.4	2347	-0.0091
85	0.4250	2.3924	75.0	17.6	2347	-0.0091
86	0.4300	2.3797	74.6	17.8	2335	-0.0090
87	0.4350	2.3733	74.4	18.0	2329	-0.0090
88	0.4400	2.3733	74.4	18.2	2329	-0.0090
89	0.4450	2.3733	74.4	18.4	2329	-0.0089
90	0.4500	2.3477	73.6	18.6	2303	-0.0089
91	0.4550	2.3413	73.4	18.8	2297	-0.0089
92	0.4600	2.3286	73.0	19.0	2285	-0.0089
93	0.4650	2.3286	73.0	19.2	2285	-0.0089
94	0.4700	2.3222	72.8	19.4	2278	-0.0089
95	0.4750	2.3286	73.0	19.6	2285	-0.0089
96	0.4800	2.3254	72.9	19.8	2282	-0.0089

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	324.500		547.170
Moisture content: Dry soil+tare, gms.	306.470		522.360
Moisture content: Tare, gms.	186.100		402.910
Moisture, %	15.0	20.8	20.8
Moist specimen weight, gms.	138.6		
Diameter, in.	2.42	2.42	
Area, in.²	4.60	4.60	
Height, in.	1.00	0.92	
Net decrease in height, in.		0.08	
Wet density, pcf	114.8	130.4	
Dry density, pcf	99.9	108.0	
Void ratio	0.6879	0.5610	
Saturation, %	58.8	100.0	

Test Readings for Specimen No. 3

Load ring constant = 31.34 lbs. per input unit

Normal stress = 8000 psf

Strain rate, %/min. = 0.05

Fail. Stress = 4560 psf **at reading no.** 49

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0006
1	0.0050	1.0189	31.9	0.2	1000	-0.0028
2	0.0100	1.6642	52.2	0.4	1633	-0.0036
3	0.0150	2.1656	67.9	0.6	2125	-0.0044
4	0.0200	2.6192	82.1	0.8	2570	-0.0050
5	0.0250	3.0249	94.8	1.0	2968	-0.0056
6	0.0300	3.3124	103.8	1.2	3250	-0.0062
7	0.0350	3.4721	108.8	1.4	3407	-0.0068
8	0.0400	3.6637	114.8	1.7	3595	-0.0073
9	0.0450	3.7979	119.0	1.9	3726	-0.0079
10	0.0500	3.9352	123.3	2.1	3861	-0.0083
11	0.0550	4.0598	127.2	2.3	3983	-0.0088
12	0.0600	4.1365	129.6	2.5	4059	-0.0092
13	0.0650	4.2131	132.0	2.7	4134	-0.0096
14	0.0700	4.2834	134.2	2.9	4203	-0.0099
15	0.0750	4.3313	135.7	3.1	4250	-0.0102
16	0.0800	4.3600	136.6	3.3	4278	-0.0105
17	0.0850	4.3824	137.3	3.5	4300	-0.0108
18	0.0900	4.4111	138.2	3.7	4328	-0.0111
19	0.0950	4.4399	139.1	3.9	4356	-0.0113
20	0.1000	4.4686	140.0	4.1	4384	-0.0115
21	0.1050	4.4814	140.4	4.3	4397	-0.0117
22	0.1100	4.5166	141.5	4.5	4431	-0.0119
23	0.1150	4.5325	142.0	4.8	4447	-0.0121
24	0.1200	4.5581	142.9	5.0	4472	-0.0122
25	0.1250	4.5772	143.5	5.2	4491	-0.0124
26	0.1300	4.5836	143.7	5.4	4497	-0.0124
27	0.1350	4.5964	144.1	5.6	4510	-0.0120

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
28	0.1400	4.5772	143.5	5.8	4491	-0.0121
29	0.1450	4.5772	143.5	6.0	4491	-0.0126
30	0.1500	4.5836	143.7	6.2	4497	-0.0127
31	0.1550	4.5964	144.1	6.4	4510	-0.0127
32	0.1600	4.5964	144.1	6.6	4510	-0.0127
33	0.1650	4.5900	143.9	6.8	4504	-0.0128
34	0.1700	4.5900	143.9	7.0	4504	-0.0127
35	0.1750	4.5868	143.8	7.2	4500	-0.0128
36	0.1800	4.5900	143.9	7.4	4504	-0.0129
37	0.1850	4.5900	143.9	7.6	4504	-0.0129
38	0.1900	4.5804	143.6	7.9	4494	-0.0129
39	0.1950	4.5900	143.9	8.1	4504	-0.0124
40	0.2000	4.5900	143.9	8.3	4504	-0.0128
41	0.2050	4.5964	144.1	8.5	4510	-0.0129
42	0.2100	4.5900	143.9	8.7	4504	-0.0129
43	0.2150	4.5996	144.2	8.9	4513	-0.0129
44	0.2200	4.5868	143.8	9.1	4500	-0.0128
45	0.2250	4.5836	143.7	9.3	4497	-0.0128
46	0.2300	4.6028	144.3	9.5	4516	-0.0128
47	0.2350	4.6220	144.9	9.7	4535	-0.0128
48	0.2400	4.6347	145.3	9.9	4547	-0.0128
49	0.2450	4.6475	145.7	10.1	4560	-0.0128
50	0.2500	4.6475	145.7	10.3	4560	-0.0128
51	0.2550	4.6475	145.7	10.5	4560	-0.0127
52	0.2600	4.6411	145.5	10.7	4554	-0.0127
53	0.2650	4.6347	145.3	11.0	4547	-0.0127
54	0.2700	4.6539	145.9	11.2	4566	-0.0127
55	0.2750	4.6667	146.3	11.4	4579	-0.0125
56	0.2800	4.6667	146.3	11.6	4579	-0.0125
57	0.2850	4.6731	146.5	11.8	4585	-0.0122
58	0.2900	4.6731	146.5	12.0	4585	-0.0124
59	0.2950	4.6539	145.9	12.2	4566	-0.0123
60	0.3000	4.6379	145.4	12.4	4551	-0.0124
61	0.3050	4.6411	145.5	12.6	4554	-0.0124
62	0.3100	4.6220	144.9	12.8	4535	-0.0122
63	0.3150	4.6188	144.8	13.0	4532	-0.0121
64	0.3200	4.6092	144.5	13.2	4522	-0.0121
65	0.3250	4.5900	143.9	13.4	4504	-0.0120
66	0.3300	4.5709	143.3	13.6	4485	-0.0119
67	0.3350	4.5581	142.9	13.8	4472	-0.0118
68	0.3400	4.5581	142.9	14.0	4472	-0.0118
69	0.3450	4.5709	143.3	14.3	4485	-0.0117
70	0.3500	4.5581	142.9	14.5	4472	-0.0116
71	0.3550	4.5645	143.1	14.7	4478	-0.0115
72	0.3600	4.5709	143.3	14.9	4485	-0.0113
73	0.3650	4.5804	143.6	15.1	4494	-0.0112
74	0.3700	4.5836	143.7	15.3	4497	-0.0111

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
75	0.3750	4.5900	143.9	15.5	4504	-0.0110
76	0.3800	4.5836	143.7	15.7	4497	-0.0109
77	0.3850	4.5836	143.7	15.9	4497	-0.0108
78	0.3900	4.5709	143.3	16.1	4485	-0.0107
79	0.3950	4.5581	142.9	16.3	4472	-0.0107
80	0.4000	4.5421	142.3	16.5	4457	-0.0106
81	0.4050	4.5389	142.2	16.7	4453	-0.0105
82	0.4100	4.5166	141.5	16.9	4431	-0.0104
83	0.4150	4.5134	141.4	17.1	4428	-0.0103
84	0.4200	4.5070	141.2	17.4	4422	-0.0102
85	0.4250	4.5070	141.2	17.6	4422	-0.0101
86	0.4300	4.5134	141.4	17.8	4428	-0.0100
87	0.4350	4.5517	142.7	18.0	4466	-0.0100
88	0.4400	4.5517	142.7	18.2	4466	-0.0099
89	0.4450	4.5517	142.7	18.4	4466	-0.0098
90	0.4500	4.5485	142.5	18.6	4463	-0.0098
91	0.4550	4.5357	142.1	18.8	4450	-0.0097
92	0.4600	4.5229	141.7	19.0	4438	-0.0097
93	0.4650	4.5134	141.4	19.2	4428	-0.0096

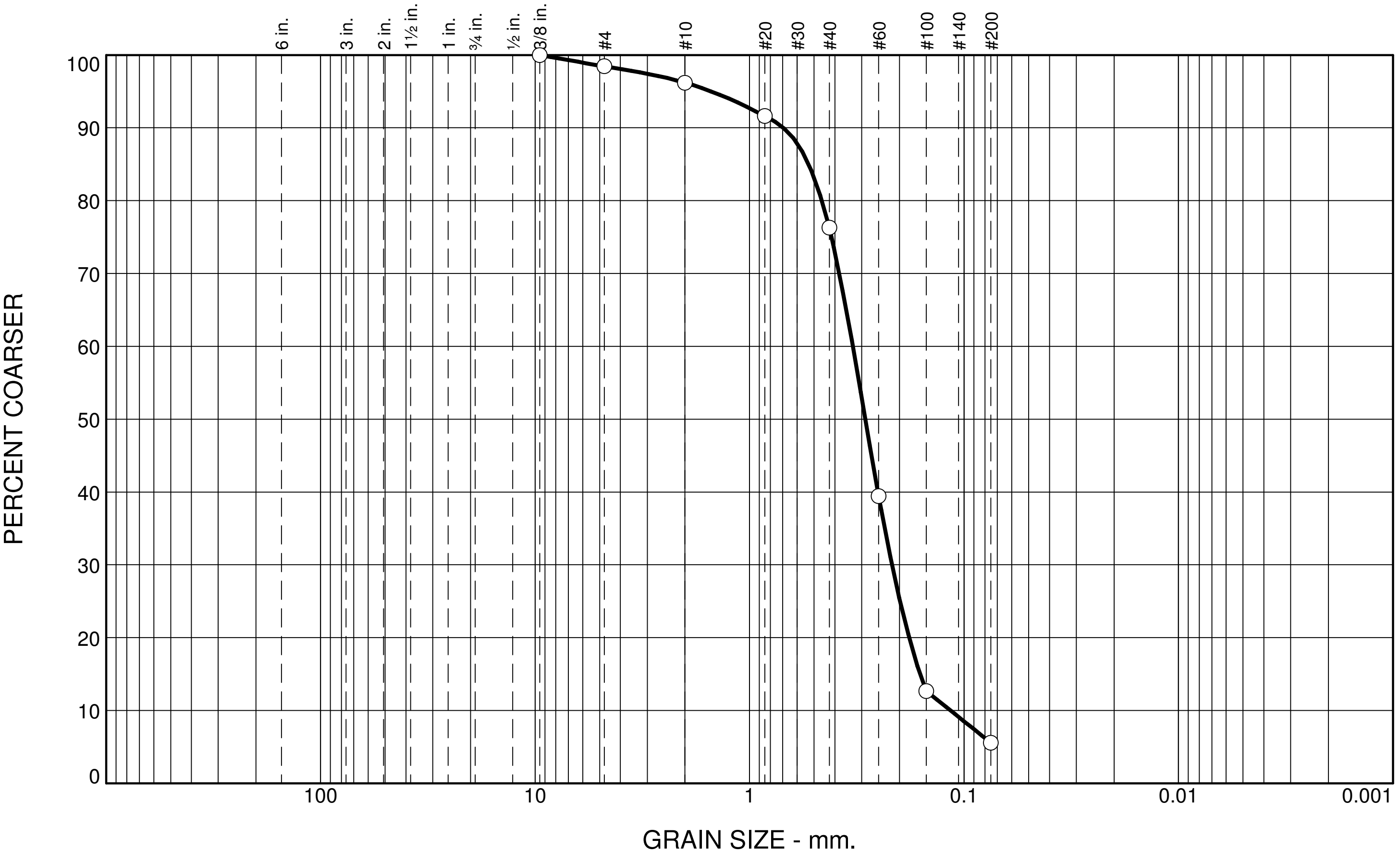
Moisture-Density Worksheet

Identification				*Test Results (Summary)*				*Density Determination*					*Moisture Determination*				
Hole	Depth (ft)	Sample No.	Sample Type	% Moisture	Dry Density (pcf)	USCS	Component, Color, Consistency, Structure ...	Sample Length (in)	Sample Diameter (in)	Wet Wt. + Tare, g	Tare, g	Wet Soil Wt., g	Tare I.D.	Wet Wt. + Tare	Dry Wt. + Tare	Tare	Run By
BH17-01		S-2A	MC	5.9	100.7			6.000	2.400	1293.3	533.5	759.8	RG12	738.6	708.0	185.8	JHK
BH17-01		S-4A	MC	10.4	103.8			6.000	2.400	1063.6	247.5	816.1	RG16	779.5	723.7	185.3	JHK
BH17-02		S-4B	SD	3.3	NA			NA					RG5	536.3	525.1	187.4	JDB
BH17-03		S-2A	MC	18.4	107.1			6.000	2.400	1151.0	247.5	903.5	RG4	650.2	578.1	186.4	JHK
BH17-04		S-2A	MC	17.1	110.3			6.000	2.400	1174.6	254.5	920.1	RG7	662.4	592.7	185.3	JHK
BH17-05		S-4A	MC	21.3	107.9			6.000	2.400	1191.10	258.60	932.50	RG6	557.90	492.30	184.40	JHK

Project Magnum Brine Ponds 3 & 4 **Sheet Prep. By** EAG/JHK **Lab No.** L2017-062

Project No. DV108-00305/06 **Checked By** JDB **Date** 7/7/2017

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	2.2	19.9	70.7	5.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.4		
#10	96.2		
#20	91.6		
#40	76.3		
#60	39.4		
#100	12.7		
#200	5.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6962 D_{85}= 0.5305 D_{60}= 0.3301
D_{50}= 0.2888 D_{30}= 0.2167 D_{15}= 0.1604
D_{10}= 0.1156 C_u= 2.86 C_c= 1.23

Classification

USCS= AASHTO=

Remarks

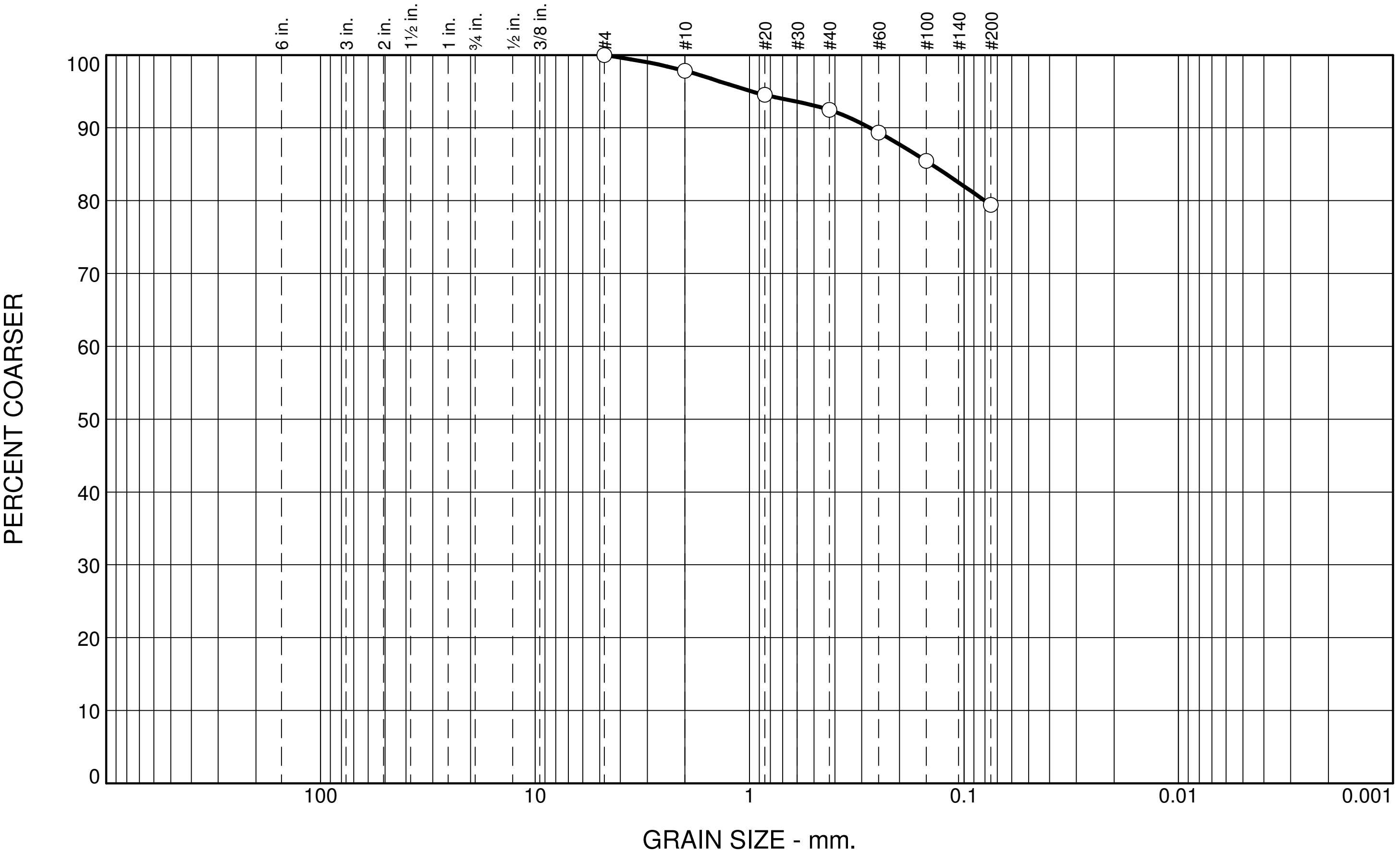
Sample No.: S-4B **Source of Sample:** **Date:** 7/5/17
Location: BH17-02 **Elev./Depth:**

Knight Piésold CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305 **Figure**

Tested By: EAG **Checked By:**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	2.2	5.3	13.1	79.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	97.8		
#20	94.5		
#40	92.5		
#60	89.4		
#100	85.4		
#200	79.4		

* (no specification provided)

Soil Description

fat clay with sand

Atterberg Limits

PL= 21 LL= 62 PI= 41

Coefficients

D_{90}= 0.2746 D_{85}= 0.1422 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(33)

Remarks

Sample No.: S-2A & S-2B
Location: BH17-03

Source of Sample:

Date: 7/17/17
Elev./Depth: 3.5-4.5'

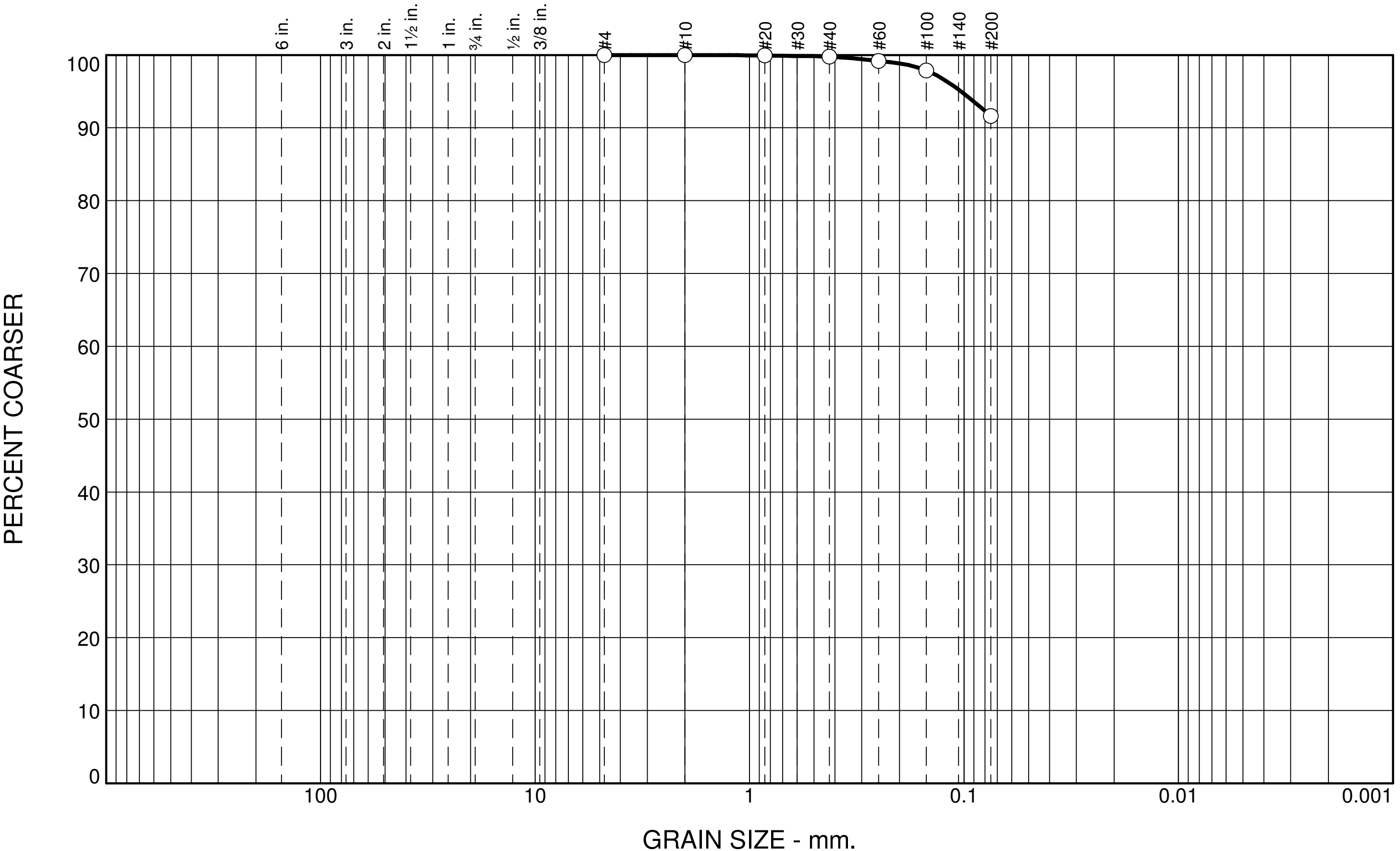
Knight Piésold
CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305

Figure

Tested By: EAG **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	8.2	91.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.8		
#60	99.2		
#100	97.9		
#200	91.6		

* (no specification provided)

Soil Description

lean clay

Atterberg Limits

PL= 15 LL= 30 PI= 15

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(12)

Remarks

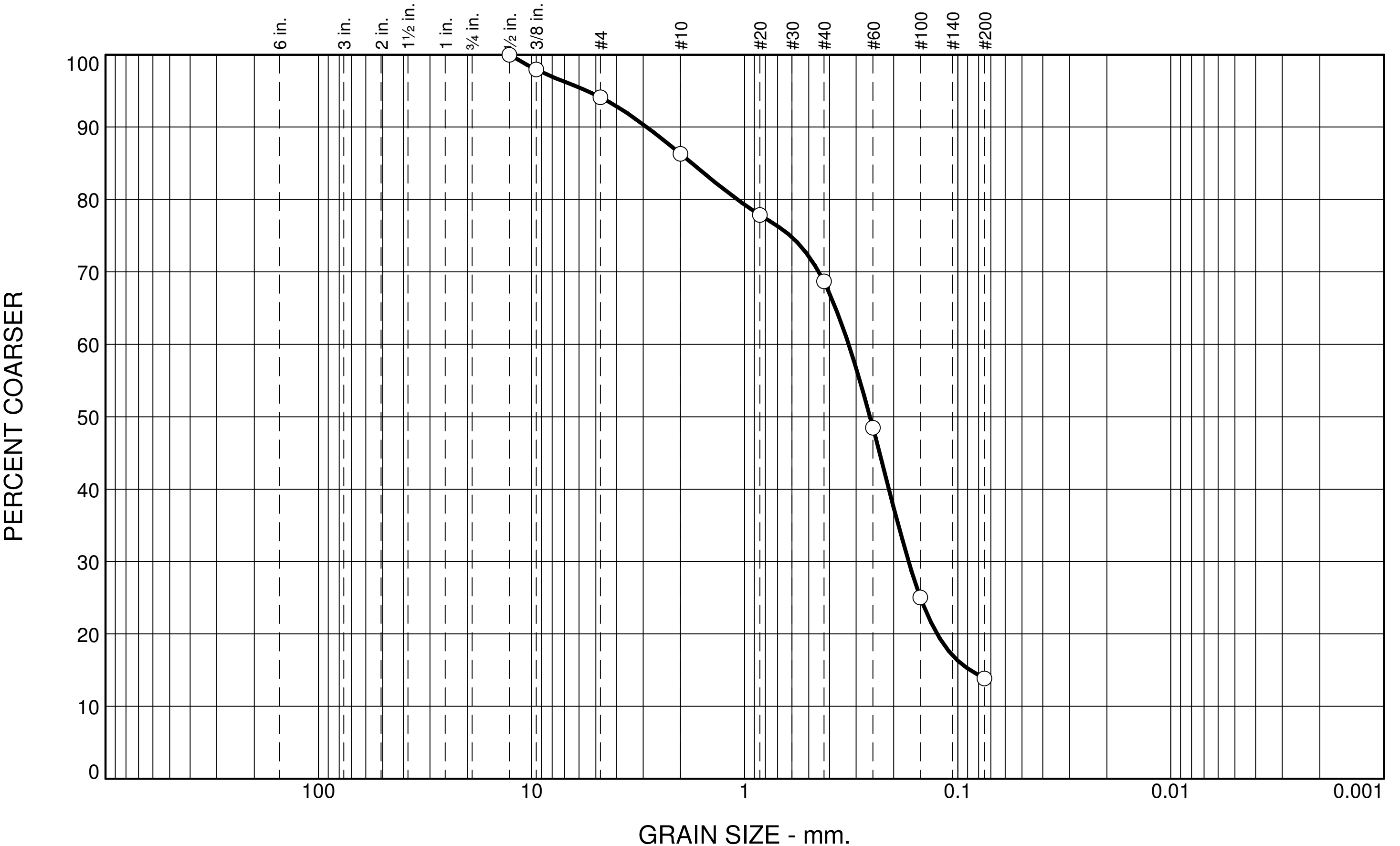
Sample No.: S-2A & S-2B **Source of Sample:** **Date:** 7/14/17
Location: BH17-04 **Elev./Depth:** 3.5-4.5'

Knight Piésold
CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305 **Figure**

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.9	7.8	17.6	54.8	13.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	98.0		
#4	94.1		
#10	86.3		
#20	77.9		
#40	68.7		
#60	48.5		
#100	25.1		
#200	13.9		

* (no specification provided)

Soil Description

silty sand

Atterberg Limits

PL= NP LL= 22 PI= NP

Coefficients

D_{90}= 2.8834	D_{85}= 1.7680	D_{60}= 0.3256
D_{50}= 0.2583	D_{30}= 0.1703	D_{15}= 0.0875
D_{10}=	C_u=	C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

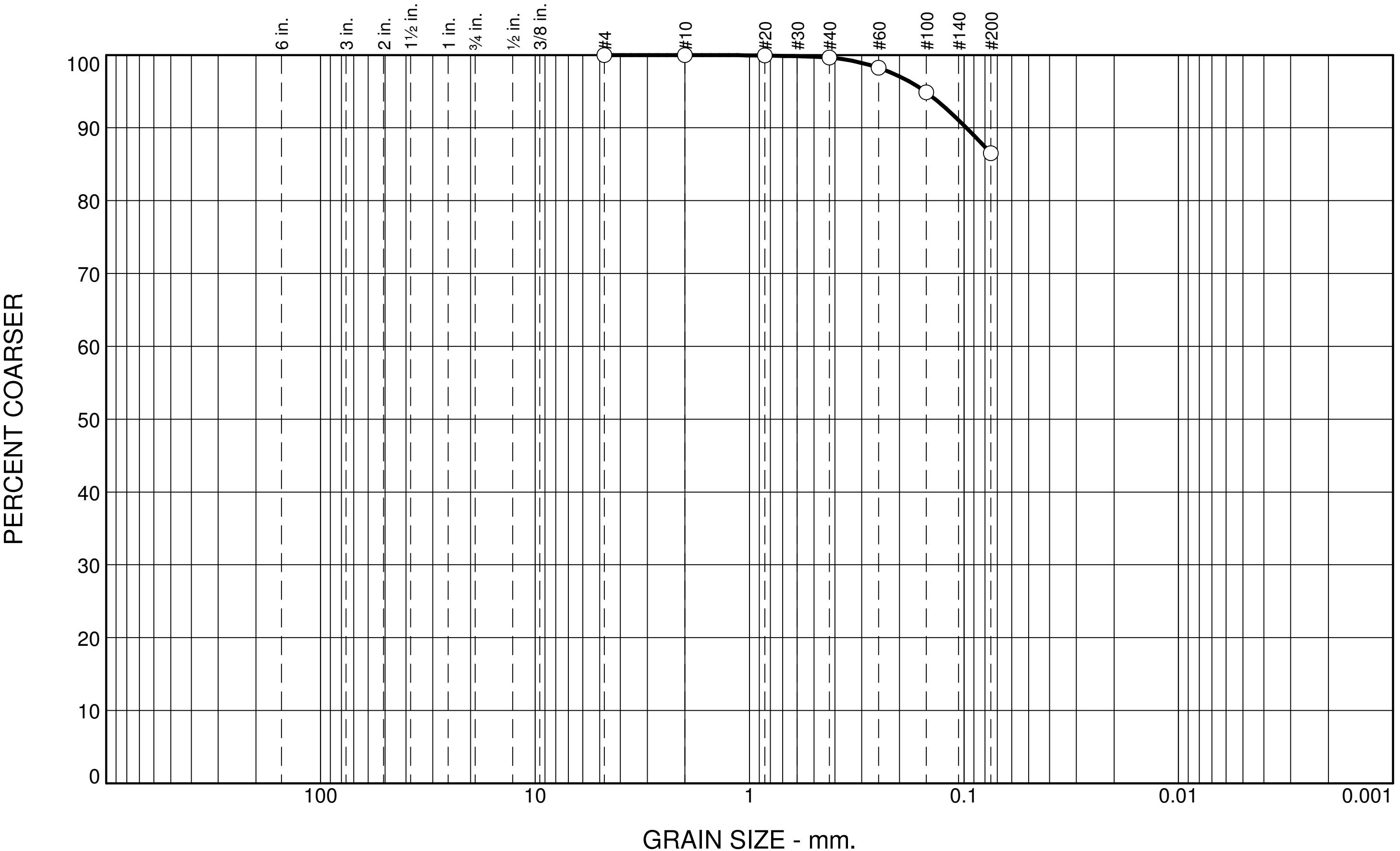
Sample No.: S-2A & S-2B **Source of Sample:** **Date:** 7/10/17
Location: BH17-01 **Elev./Depth:**

Knight Piésold CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305 **Figure**

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	13.2	86.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.7		
#60	98.2		
#100	94.9		
#200	86.5		

* (no specification provided)

Soil Description

lean clay

Atterberg Limits

PL= 16 LL= 27 PI= 11

Coefficients

D_{90}= 0.0975 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(8)

Remarks

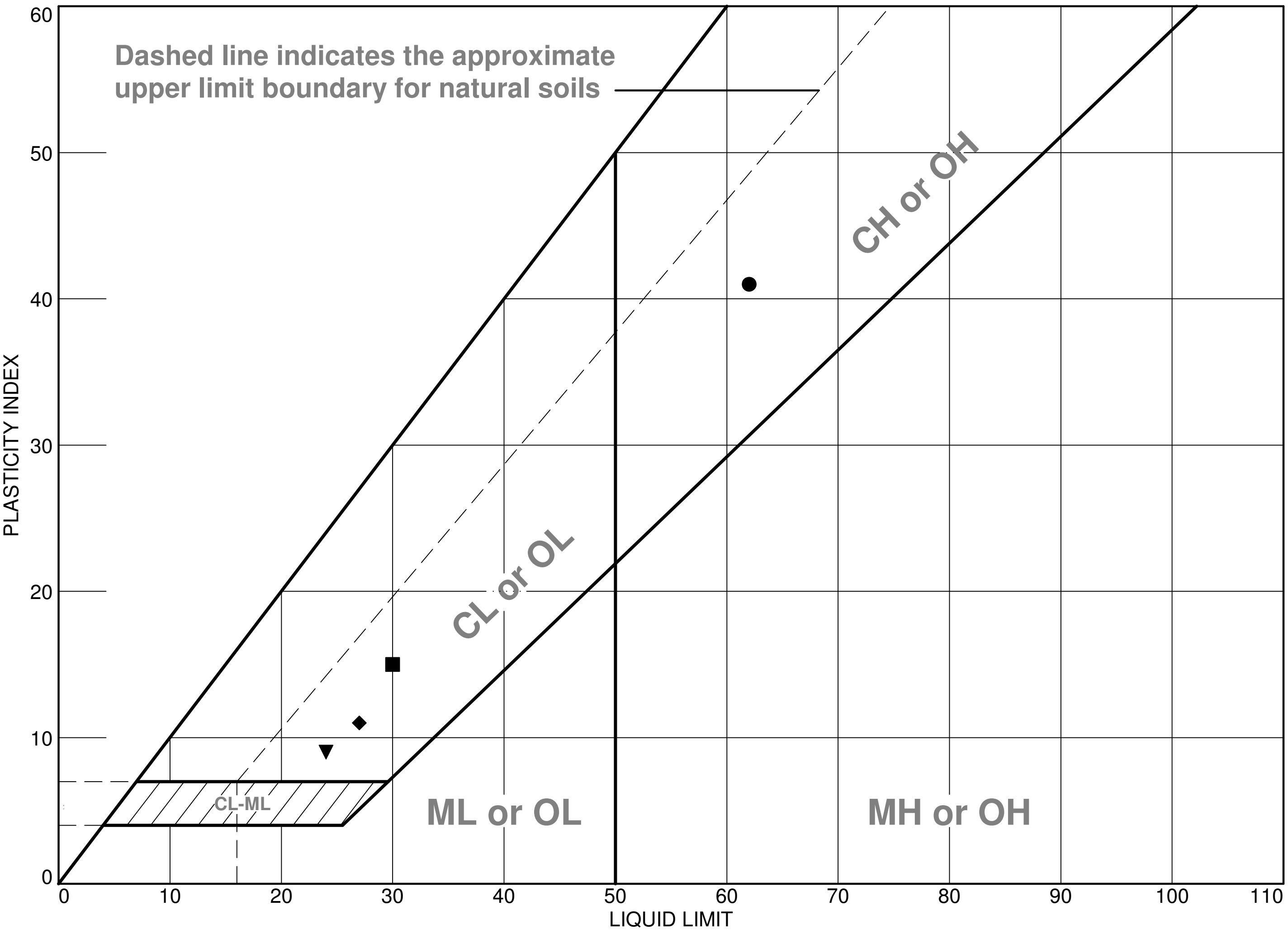
Sample No.: S-4A & S-4B
Location: BH17-05
Source of Sample:
Date: 7/3/17
Elev./Depth:

Knight Piésold CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305
Figure

Tested By: JHK **Checked By:** JDB

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	fat clay with sand	62	21	41	92.5	79.4	CH
■	lean clay	30	15	15	99.8	91.6	CL
▲	silty sand	22	NP	NP	68.7	13.9	SM
◆	lean clay	27	16	11	99.7	86.5	CL
▼	clayey sand	24	15	9	82.8	27.7	SC

Project No. 10800305 **Client:** NewFields

Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017

● **Location:** BH17-03 **Depth:** 3.5-4.5' **Sample Number:** S-2A & S-2B
■ **Location:** BH17-04 **Depth:** 3.5-4.5' **Sample Number:** S-2A & S-2B
▲ **Location:** BH17-01 **Sample Number:** S-2A & S-2B
◆ **Location:** BH17-05 **Sample Number:** S-4A & S-4B
▼ **Location:** BH17-01 **Sample Number:** S-4B & S-4B

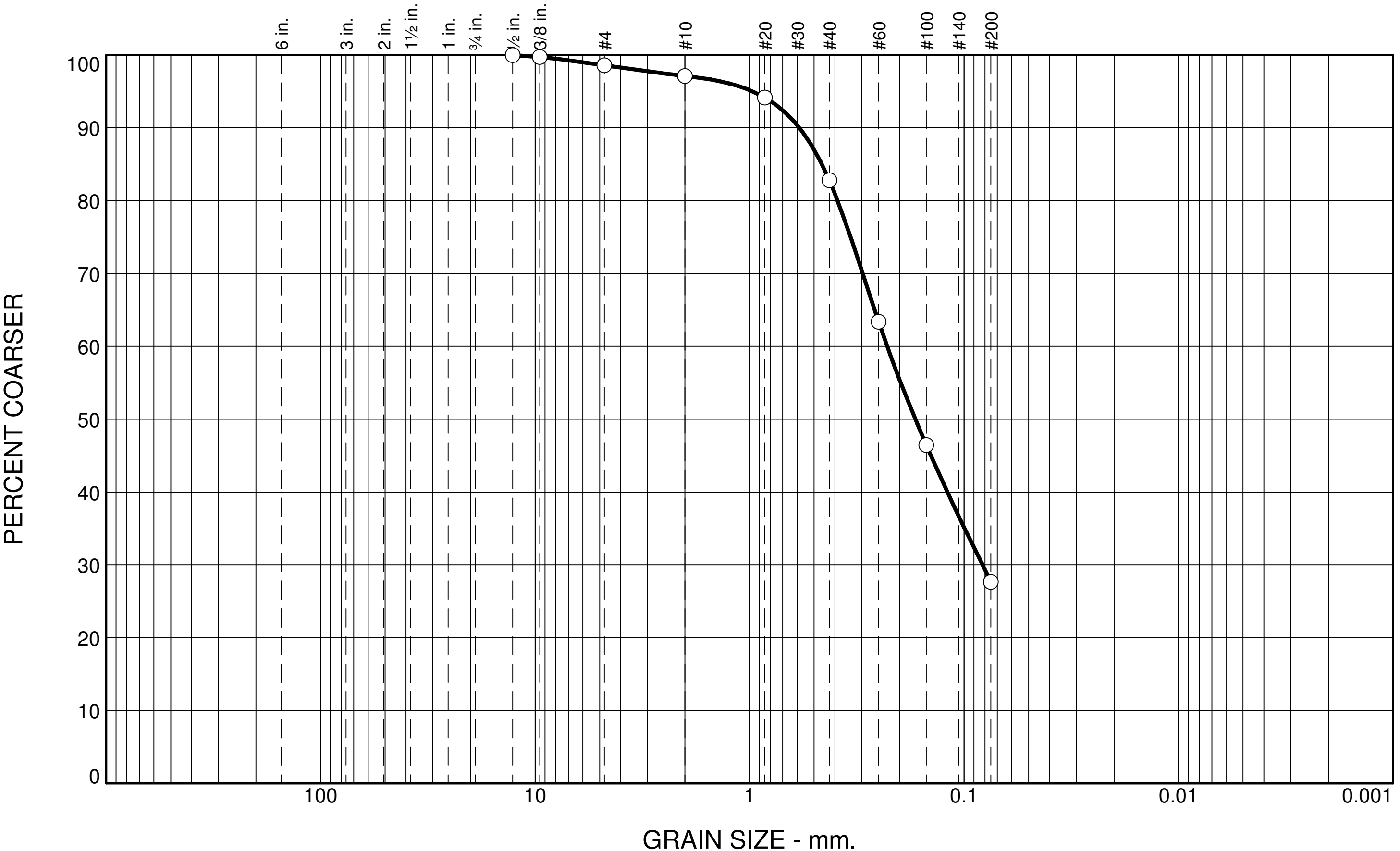
Remarks:

Knight Piésold
CONSULTING

Figure

Tested By: JDH **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	1.5	14.3	55.1	27.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.7		
#4	98.6		
#10	97.1		
#20	94.1		
#40	82.8		
#60	63.4		
#100	46.4		
#200	27.7		

* (no specification provided)

Soil Description

clayey sand

Atterberg Limits

PL= 15 LL= 24 PI= 9

Coefficients

D_{90}= 0.5856 D_{85}= 0.4599 D_{60}= 0.2281
D_{50}= 0.1688 D_{30}= 0.0821 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Sample No.: S-4B & S-4B **Source of Sample:** **Date:** 7/14/17
Location: BH17-01 **Elev./Depth:**

Knight Piésold CONSULTING

Client: NewFields
Project: Magnum Brine Ponds 3 & 4
NewFields #475.0093.017
Project No: 10800305 **Figure**

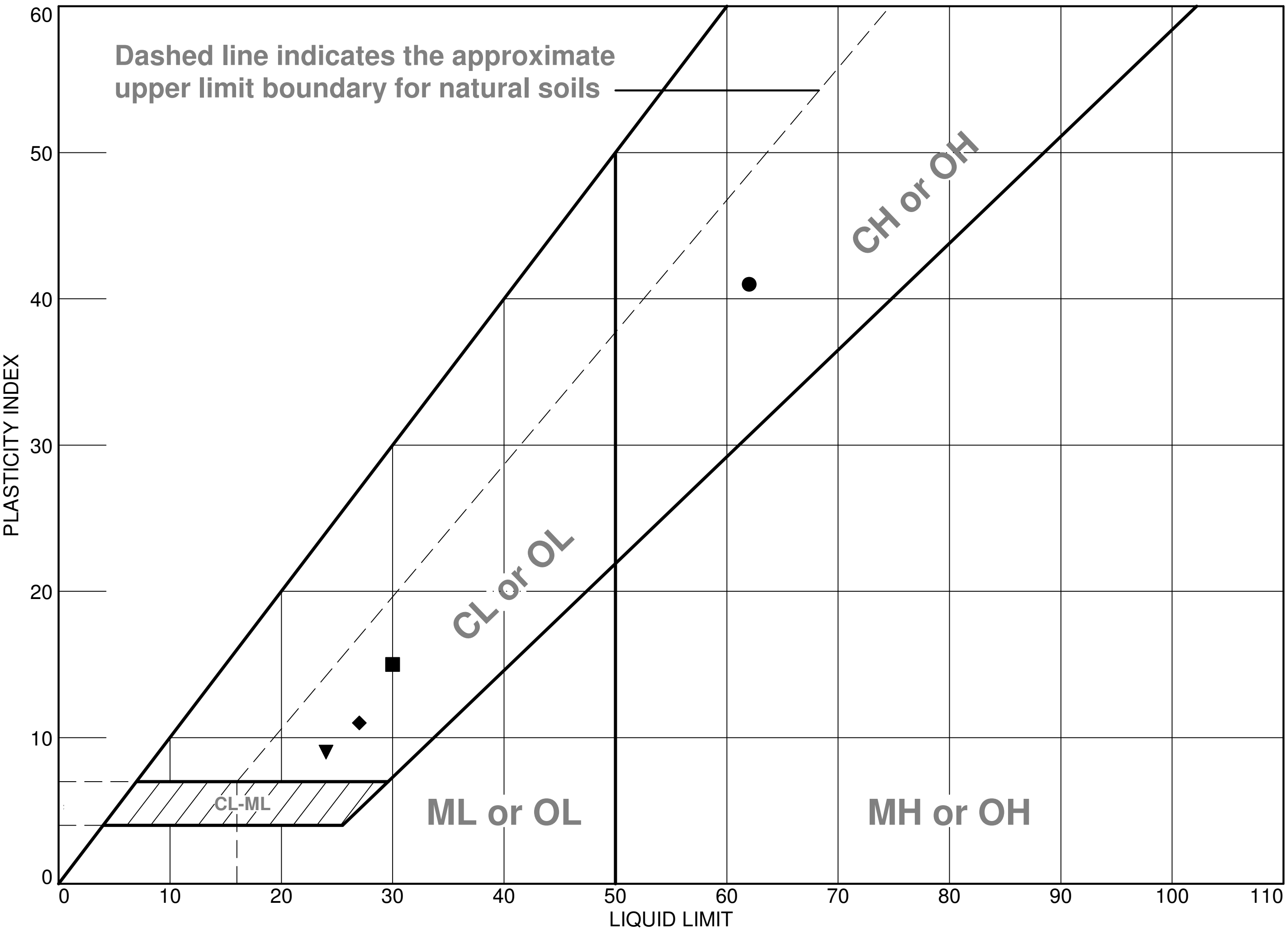
Tested By: JHK **Checked By:** JDB

Moisture-Density Worksheet

Identification				*Test Results (Summary)*				*Density Determination*					*Moisture Determination*				
Hole	Depth (ft)	Sample No.	Sample Type	% Moisture	Dry Density (pcf)	USCS	Component, Color, Consistency, Structure ...	Sample Length (in)	Sample Diameter (in)	Wet Wt. + Tare, g	Tare, g	Wet Soil Wt., g	Tare I.D.	Wet Wt. + Tare	Dry Wt. + Tare	Tare	Run By
BH17-01		S-2A	MC	5.9	100.7			6.000	2.400	1293.3	533.5	759.8	RG12	738.6	708.0	185.8	JHK
BH17-01		S-4A	MC	10.4	103.8			6.000	2.400	1063.6	247.5	816.1	RG16	779.5	723.7	185.3	JHK
BH17-02		S-4B	SD	3.3	NA			NA					RG5	536.3	525.1	187.4	JDB
BH17-03		S-2A	MC	18.4	107.1			6.000	2.400	1151.0	247.5	903.5	RG4	650.2	578.1	186.4	JHK
BH17-04		S-2A	MC	17.1	110.3			6.000	2.400	1174.6	254.5	920.1	RG7	662.4	592.7	185.3	JHK
BH17-05		S-4A	MC	21.3	107.9			6.000	2.400	1191.10	258.60	932.50	RG6	557.90	492.30	184.40	JHK

Project Magnum Brine Ponds 3 & 4
Sheet Prep. By EAG/JHK
Lab No. L2017-062
Project No. DV108-00305/06
Checked By JDB
Date 7/7/2017

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	fat clay with sand	62	21	41	92.5	79.4	CH
■	lean clay	30	15	15	99.8	91.6	CL
▲	silty sand	22	NP	NP	68.7	13.9	SM
◆	lean clay	27	16	11	99.7	86.5	CL
▼	clayey sand	24	15	9	82.8	27.7	SC

Project No. 10800305 **Client:** NewFields

Project: Magnum Brine Ponds 3 & 4

NewFields #475.0093.017

● **Location:** BH17-03 **Depth:** 3.5-4.5' **Sample Number:** S-2A & S-2B

■ **Location:** BH17-04 **Depth:** 3.5-4.5' **Sample Number:** S-2A & S-2B

▲ **Location:** BH17-01 **Sample Number:** S-2A & S-2B

◆ **Location:** BH17-05 **Sample Number:** S-4A & S-4B

▼ **Location:** BH17-01 **Sample Number:** S-4B & S-4B

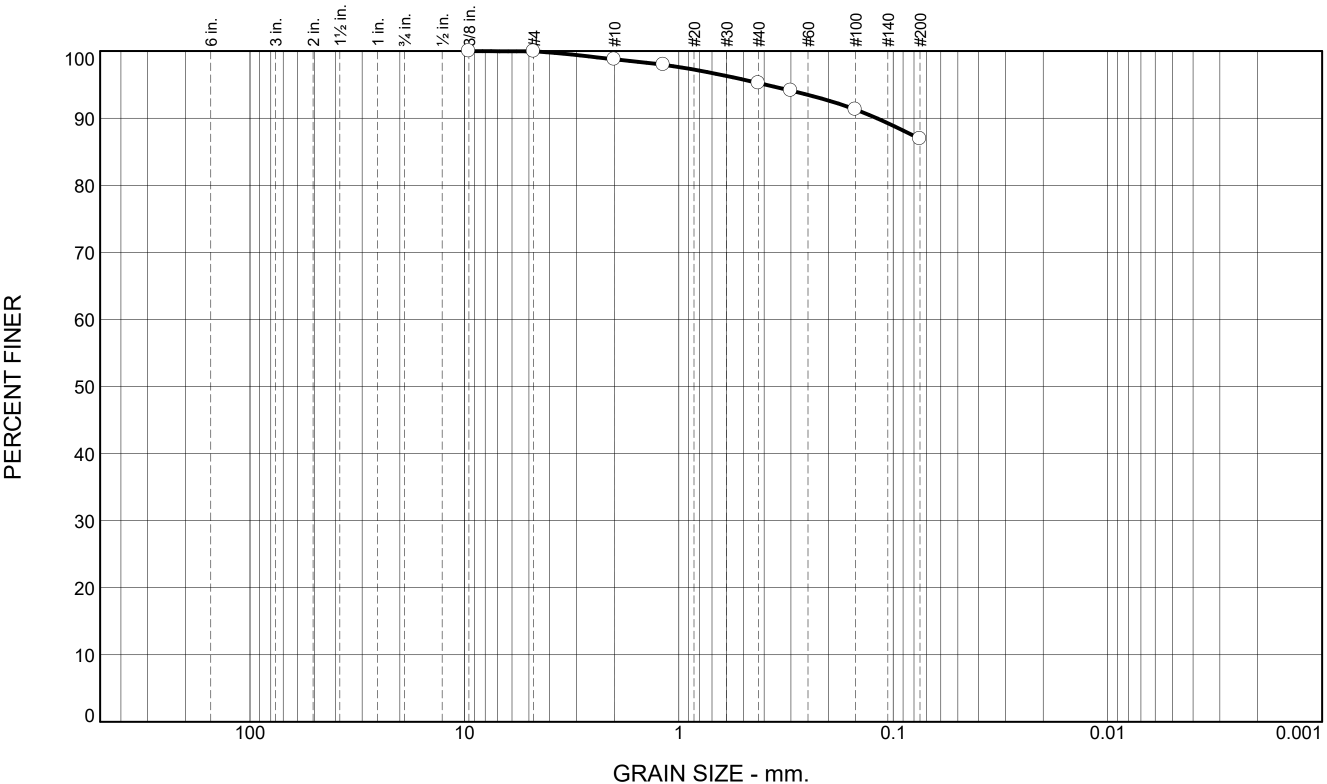
Remarks:

Knight Piésold
CONSULTING

Figure

Tested By: JDH **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.2	3.6	8.3	86.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	98.8		
#16	98.0		
#40	95.2		
#50	94.1		
#100	91.3		
#200	86.9		

* (no specification provided)

Material Description

Brown lean clay

Atterberg Limits

PL= 11 LL= 25 PI= 14

Coefficients

D_{90}= 0.1196 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(9)

Remarks

Location: BH17-01
Sample Number: 17-164-02 **Depth:** 15'-16.5' **Date:** 07/14/2017

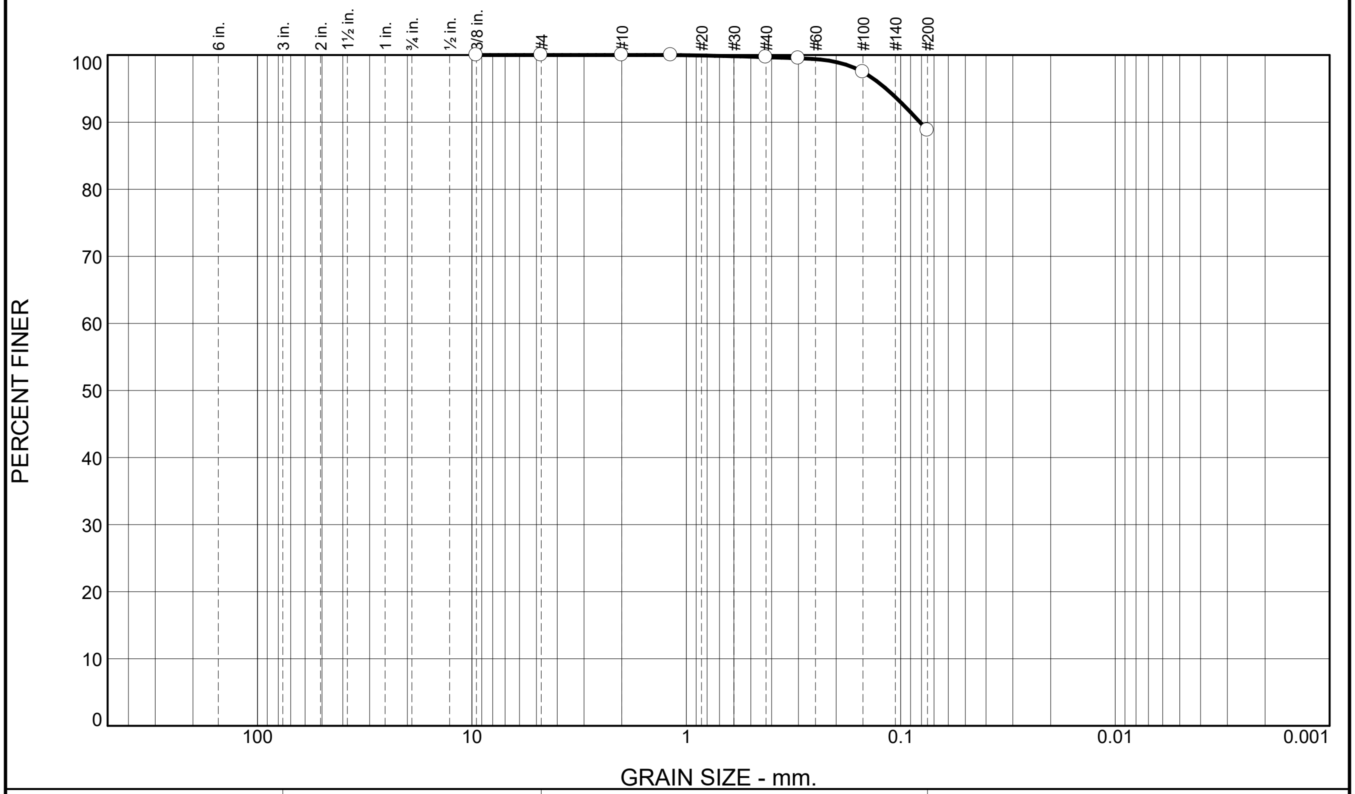
NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4

Project No: 475.0093.017 **Figure** 17-164-02

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	10.9	88.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	99.7		
#50	99.5		
#100	97.5		
#200	88.8		

* (no specification provided)

Material Description

Brown lean clay

Atterberg Limits

PL= 12 LL= 38 PI= 26

Coefficients

D_{90}= 0.0814 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(22)

Remarks

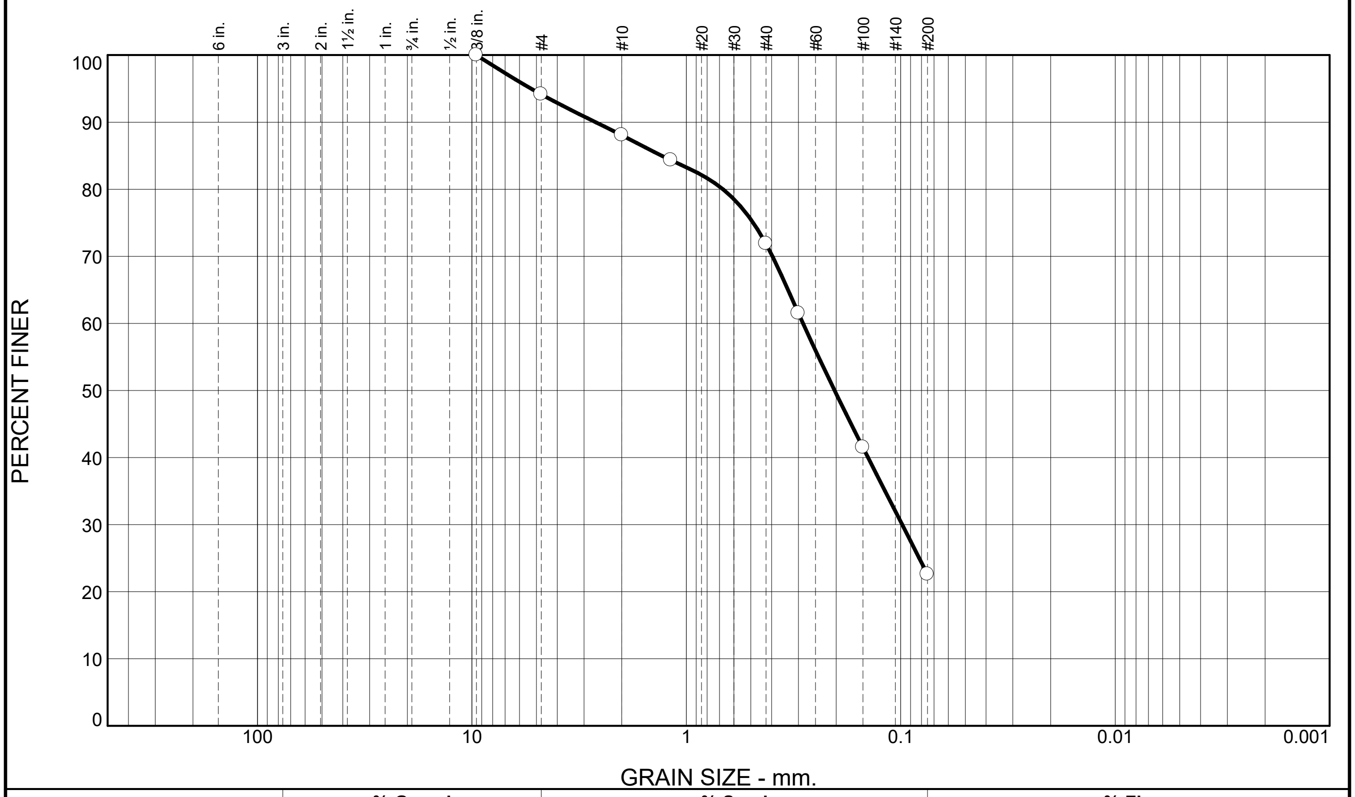
Location: BH17-01
Sample Number: 17-164-03 **Depth:** 20'-21' **Date:** 07/14/2017

NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4
Project No: 475.0093.017 **Figure** 17-164-03

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.9	6.0	16.2	49.3	22.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	94.1		
#10	88.1		
#16	84.3		
#40	71.9		
#50	61.5		
#100	41.5		
#200	22.6		

* (no specification provided)

Material Description

Brown silty, clayey sand

Atterberg Limits

PL= 10 LL= 17 PI= 7

Coefficients

D_{90}= 2.6499 D_{85}= 1.3037 D_{60}= 0.2857
D_{50}= 0.2035 D_{30}= 0.0985 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-2-4(0)

Remarks

Location: BH17-02
Sample Number: 17-164-04 **Depth:** 1'-2.5' **Date:** 07/14/2017

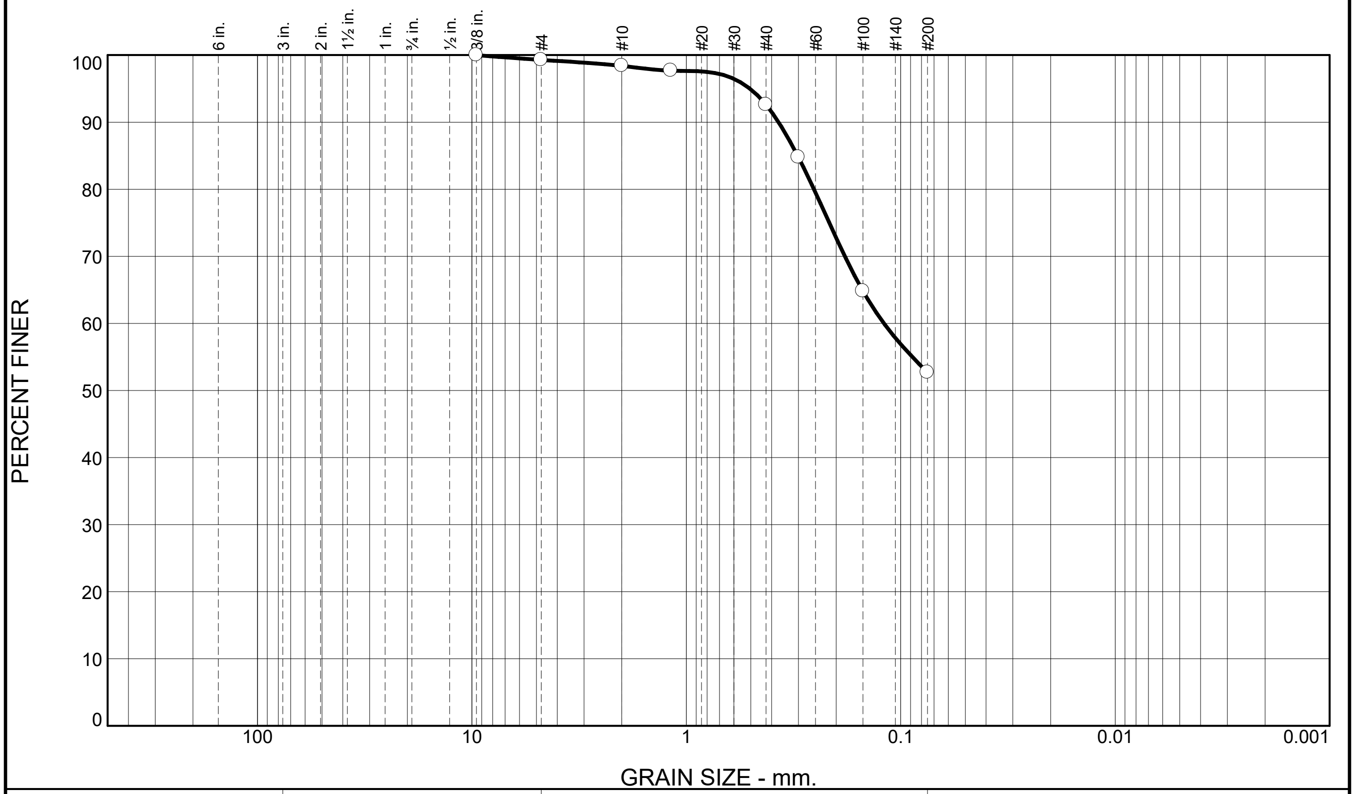
NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4

Project No: 475.0093.017 **Figure** 17-164-04

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.9	5.8	39.9	52.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	99.3		
#10	98.4		
#16	97.7		
#40	92.6		
#50	84.8		
#100	64.8		
#200	52.7		

* (no specification provided)

Material Description

Brown sandy lean clay

Atterberg Limits

PL= 13 LL= 24 PI= 11

Coefficients

D_{90}= 0.3713 D_{85}= 0.3027 D_{60}= 0.1199
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(3)

Remarks

Location: BH17-02
Sample Number: 17-164-05 **Depth:** 3.5'-4.5' **Date:** 07/14/2017

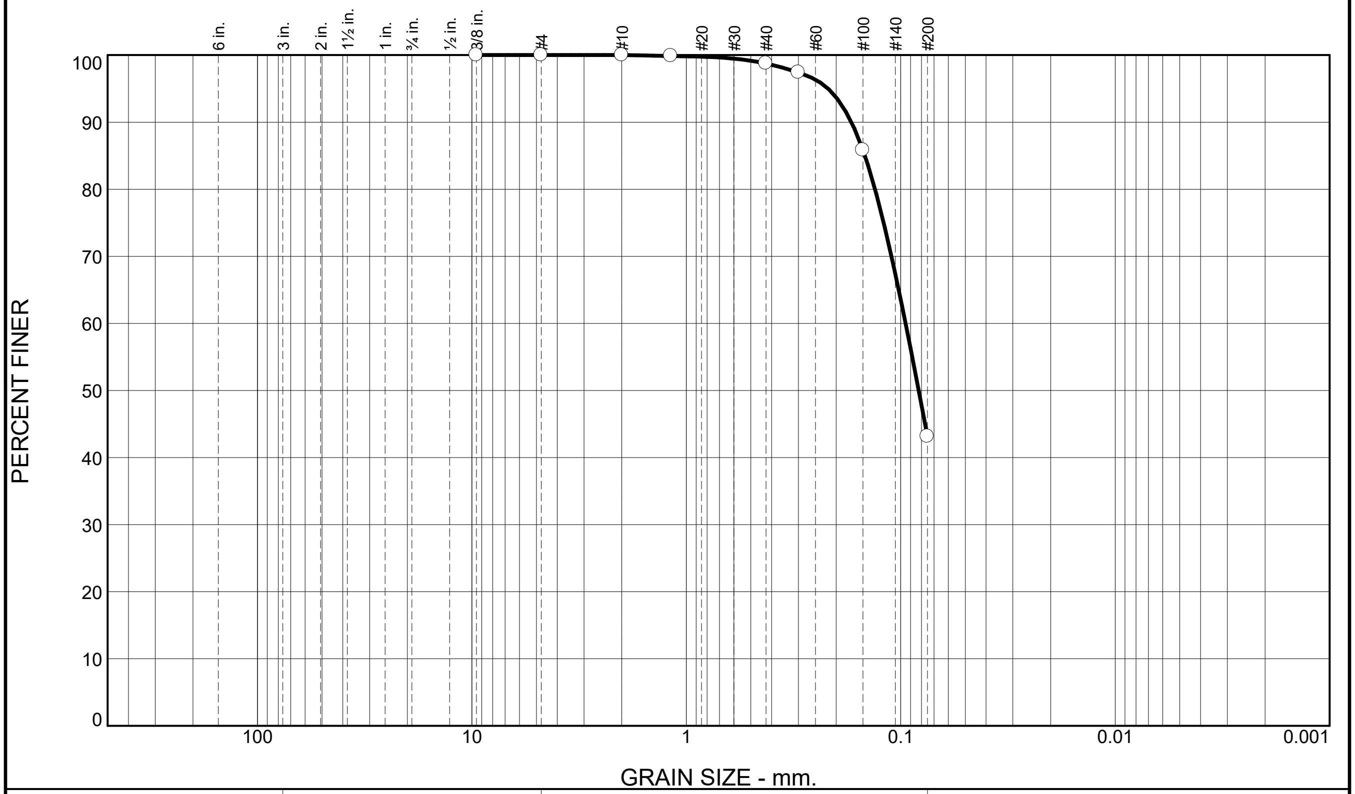
NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4

Project No: 475.0093.017 **Figure** 17-164-05

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.3	55.6	43.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	99.9		
#40	98.7		
#50	97.4		
#100	85.8		
#200	43.1		

* (no specification provided)

Material Description

Brown sand

Atterberg Limits

PL= NR LL= NR PI= NR

Coefficients

D_{90}= 0.1698 D_{85}= 0.1470 D_{60}= 0.0950
D_{50}= 0.0825 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Material description based upon visual classification only.

NR= Not Recorded

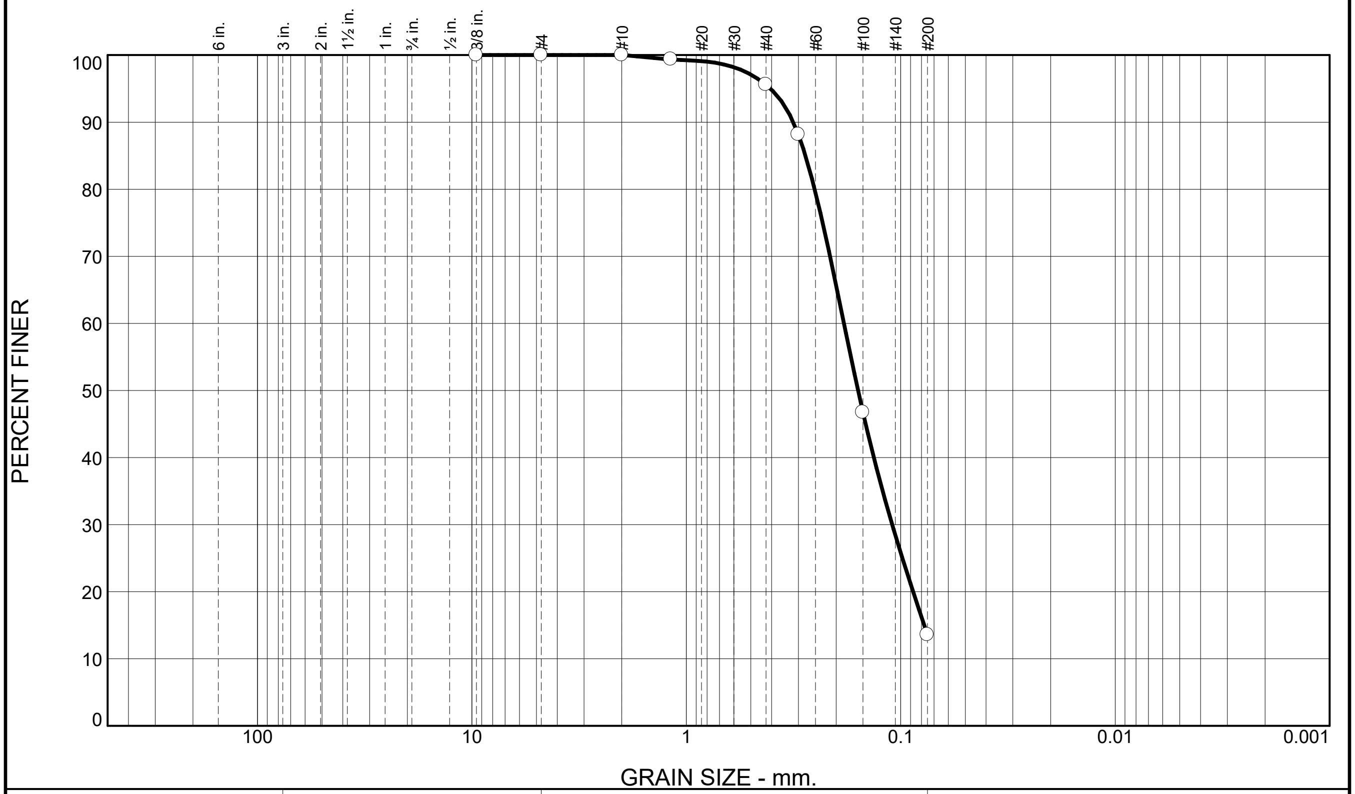
Location: BH17-03
Sample Number: 17-164-09 **Depth:** 6'-7.5' **Date:** 07/14/2017

NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4
Project No: 475.0093.017 **Figure** 17-164-09

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.4	82.0	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	99.4		
#40	95.6		
#50	88.1		
#100	46.7		
#200	13.6		

* (no specification provided)

Material Description

Brown sand

Atterberg Limits

PL= NR LL= NR PI= NR

Coefficients

D_{90}= 0.3169 D_{85}= 0.2783 D_{60}= 0.1840
D_{50}= 0.1581 D_{30}= 0.1097 D_{15}= 0.0777
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Material description based upon visual classification only.

NR= Not Recorded

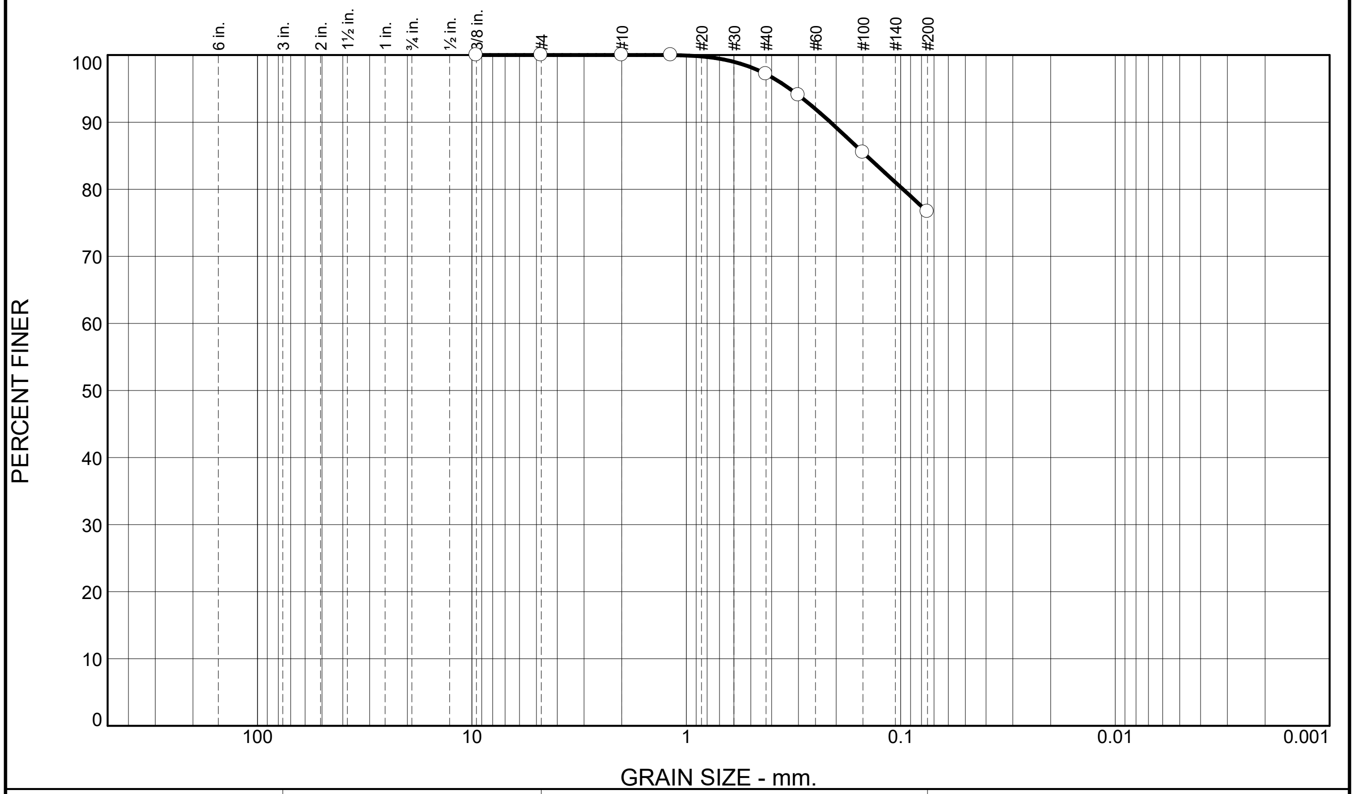
Location: BH17-04
Sample Number: 17-164-12 **Depth:** 8.5'-9.5' **Date:** 07/14/2017

NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4
Project No: 475.0093.017 **Figure** 17-164-12

Tested By: OS **Checked By:** RF

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.8	20.5	76.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	97.2		
#50	94.0		
#100	85.5		
#200	76.7		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits

PL= 17 LL= 29 PI= 12

Coefficients

D_{90}= 0.2129 D_{85}= 0.1445 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(7)

Remarks

Location: BH17-05
Sample Number: 17-164-16 **Depth:** 3.5'-4.5' **Date:** 07/14/2017

NewFields

Client: Magnum Development Solution Mining
Project: Magnum Brine Ponds 3 & 4

Project No: 475.0093.017 **Figure** 17-164-16

Tested By: OS **Checked By:** RF

NewFields

NATURAL DENSITY (ASTM 2937)

LABORATORY WORKSHEET

NF Form #16

Client:	Magnum Development Solution Mining	**Location:**	See below per sample
Project Title:	Magnum Brine Ponds 3 & 4	**Elevation:**	See below per sample
Project Number:	475.0093.017	**Test Start Date:**	
Project Engineer:	Kevin Jennings	**Tested By:**	OS
Field Sample ID:	17-164	**Checked By:**	RF
Laboratory Sample ID:	17-164		

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M)

Trail No.		**1**	**2**	**3**	**4**
Sample No.		17-164-03	17-164-05	17-164-012	17-164-016
Location		BH-17-01	BH-17-02	BH-17-04	BH-17-05
Depth		20'-21'	3.5'-4.5'	8.5-9.5'	3.5'-4.5'
Soil Description		BROWN	BROWN	BROWN	BROWN
(USCS)					
Soil + Liner Wt., g.	**A**	1181.9	1040.6	1028.8	1117.9
Liner Wt., g.	**B**	254.8	250.0	256.0	205.4
Soil Wt., g.	**C= A-B**	927.1	790.6	772.8	912.5
Liner Length, in.	**D**	6.307	6.291	6.007	6.003
Liner Diameter, in.	**E**	2.380	2.409	2.399	2.374
Liner Area, in^2	**F= (E^2/4)*pi**	4.45	4.56	4.52	4.43
Liner Volume, in^3	**G= D*F**	28.06	28.67	27.15	26.57
Sample Wet Density, pcf	**H= (C/G)*3.81**	125.9	105.1	108.4	130.8
Sample Dry Density, pcf	**H/(1+(N/100))**	101.3	94.9	102.2	111.6
Tare No.					
Tare + Wet Soil	**I**	1175.9	1023	979.4	921.7
Tare + Dry Soil	**J**	998.7	948.9	937.1	819.1
Tare	**K**	268.8	254.9	247.9	223.2
Wt. of Water	**L= I-J**	177.2	74.10	42.30	102.60
Dry Soil, Ws	**M=-J-K**	729.9	694.00	689.20	595.90
Moisture Content, (%)	**N= (L/M) x100**	24.3%	10.7%	6.1%	17.2%

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client: Magnum Development Solution Mining	**Location: See Below**
Project Title: Magnum Brine Ponds 3 & 4	**Elevation: See Below**
Project Number: 475.0093.017	**Test Start Date:**
Project Engineer: Kevin Jennings	**Tested By: OS**
Field Sample ID: 17-164	**Checked By: RF**

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H

Sample No.	17-164-01	17-164-02	17-164-03	17-164-04	17-164-05
Location	BH17-01	BH17-01	BH17-01	BH17-02	BH17-02
Depth	1'-2.5'	15'-16.5'	20'-21'	1'-2.5'	3.5'-4.5'
Soil Description	Brown	Brown	Brown	Brown	Brown
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	825.2	383.8	1175.9	636.4	1023
Tare + Dry Soil **B**	801.5	341.7	998.7	606.5	948.9
Tare **C**	123.9	121.4	268.8	222.3	254.9
Wt. of Water **D= A-B**	49.5	42.1	177.2	29.9	74.1
Dry Soil, Ws **E= B-C**	646.2	220.3	729.9	384.2	694
Moisture Content, (%) **(D/E) x100**	7.7	19.1	24.3	7.8	10.7

Sample No.	17-164-06	17-164-07	17-164-08	17-164-09	17-164-10
Location	BH17-02	BH17-02	BH17-03	BH17-03	BH17-03
Depth	15'-16.5'	20'-21'	1'-2.5'	6'-7.5'	8.5'-9'
Soil Description	Brown	Brown	Brown	Brown	Brown
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**	923.7	731.7	703	357.9	1025.6
Tare + Dry Soil **B**	907.7	625.9	673.4	342.4	962
Tare **C**	190.1	120.2	192.5	120.3	223.2
Wt. of Water **D= A-B**	16	105.8	29.6	15.5	63.6
Dry Soil, Ws **E= B-C**	717.6	505.7	480.9	222.1	738.8
Moisture Content, (%) **(D/E) x100**	2.2	20.9	6.2	7.0	8.6

Remarks:

NewFields

NF Form #15

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client: Magnum Development Solution Mining **Location: See Below**
Project Title: Magnum Brine Ponds 3 & 4 **Elevation: See Below**
Project Number: 475.0093.017 **Test Start Date:**
Project Engineer: Kevin Jennings **Tested By: OS**
Field Sample ID: 17-164 **Checked By: RF**

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H

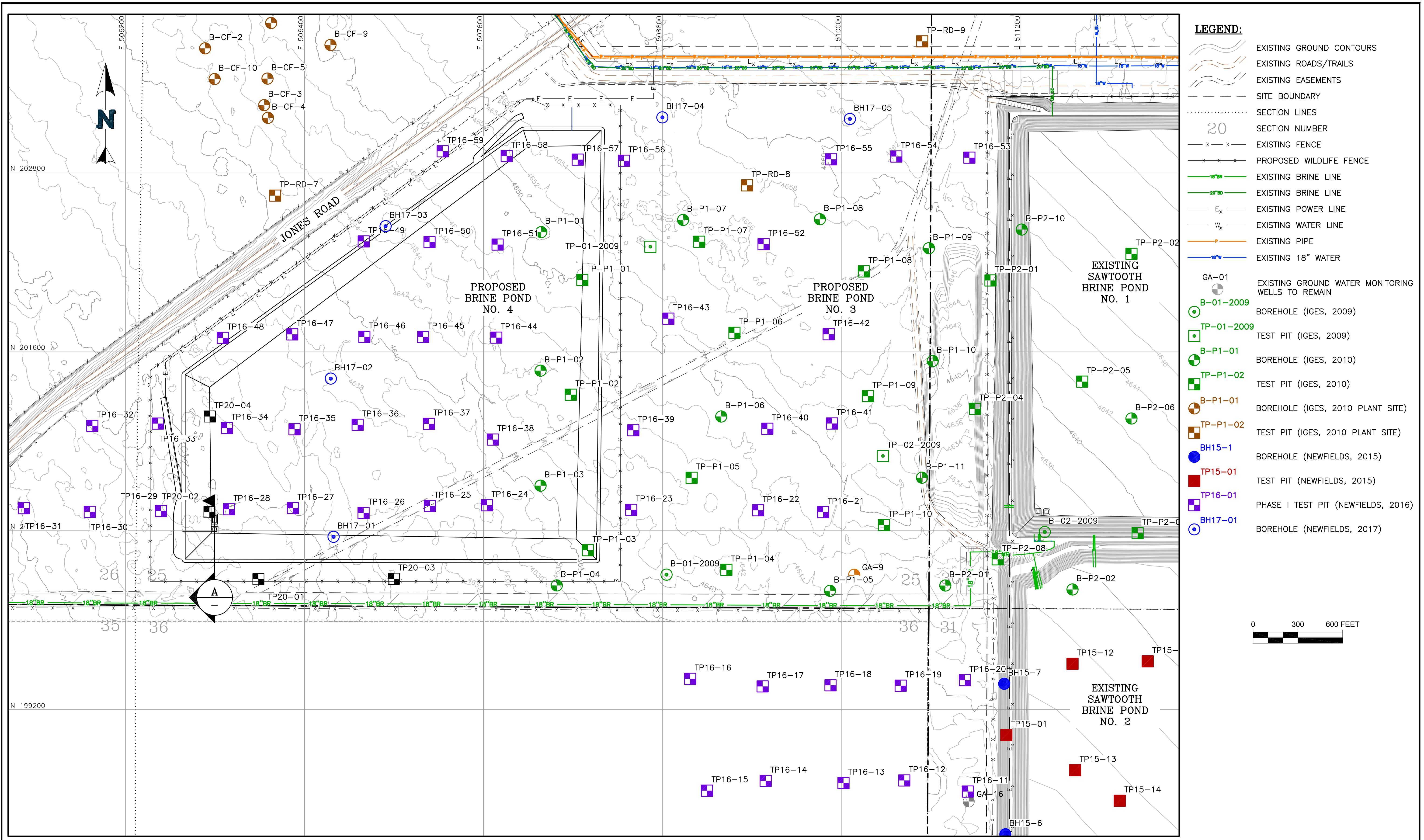
Sample No.	17-164-11	17-164-12	17-164-13	17-164-14	17-164-15
Location	BH17-03	BH17-04	BH17-04	BH17-04	BH17-05
Depth	20'-21'	8.5'-9.5'	15'-16.5'	20'-20.5'	1'-2.5'
Soil Description	Brown	Brown	Brown	Brown	Brown
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	896.4	979.4	717.3	940.6	499.5
Tare + Dry Soil **B**	866.3	937.1	670.8	922.6	472.1
Tare **C**	126.9	247.9	189.2	222.8	125.4
Wt. of Water **D= A-B**	49.5	42.3	46.5	18	27.4
Dry Soil, Ws **E= B-C**	646.2	689.2	481.6	699.8	346.7
Moisture Content, (%) **(D/E) x100**	7.7	6.1	9.7	2.6	7.9

Sample No.	17-164-16	17-164-17	17-164-18		
Location	BH17-05	BH17-05	BH17-05		
Depth	3.5'-4.5'	15'-16.5'	20'-21'		
Soil Description	Brown	Brown	Brown		
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**	921.7	640.9	970.6		
Tare + Dry Soil **B**	819.1	604	931		
Tare **C**	223.2	193.5	223.3		
Wt. of Water **D= A-B**	102.6	36.9	39.6		
Dry Soil, Ws **E= B-C**	595.9	410.5	707.7		
Moisture Content, (%) **(D/E) x100**	17.2	9.0	5.6		

Remarks:

APPENDIX F – GEOTECHNICAL EVALUATION

APPENDIX F1 – POST SEISMIC STABILITY RESULTS



NewFields

CLIENT
MAGNUM DEVELOPMENT
SOLUTION MINING

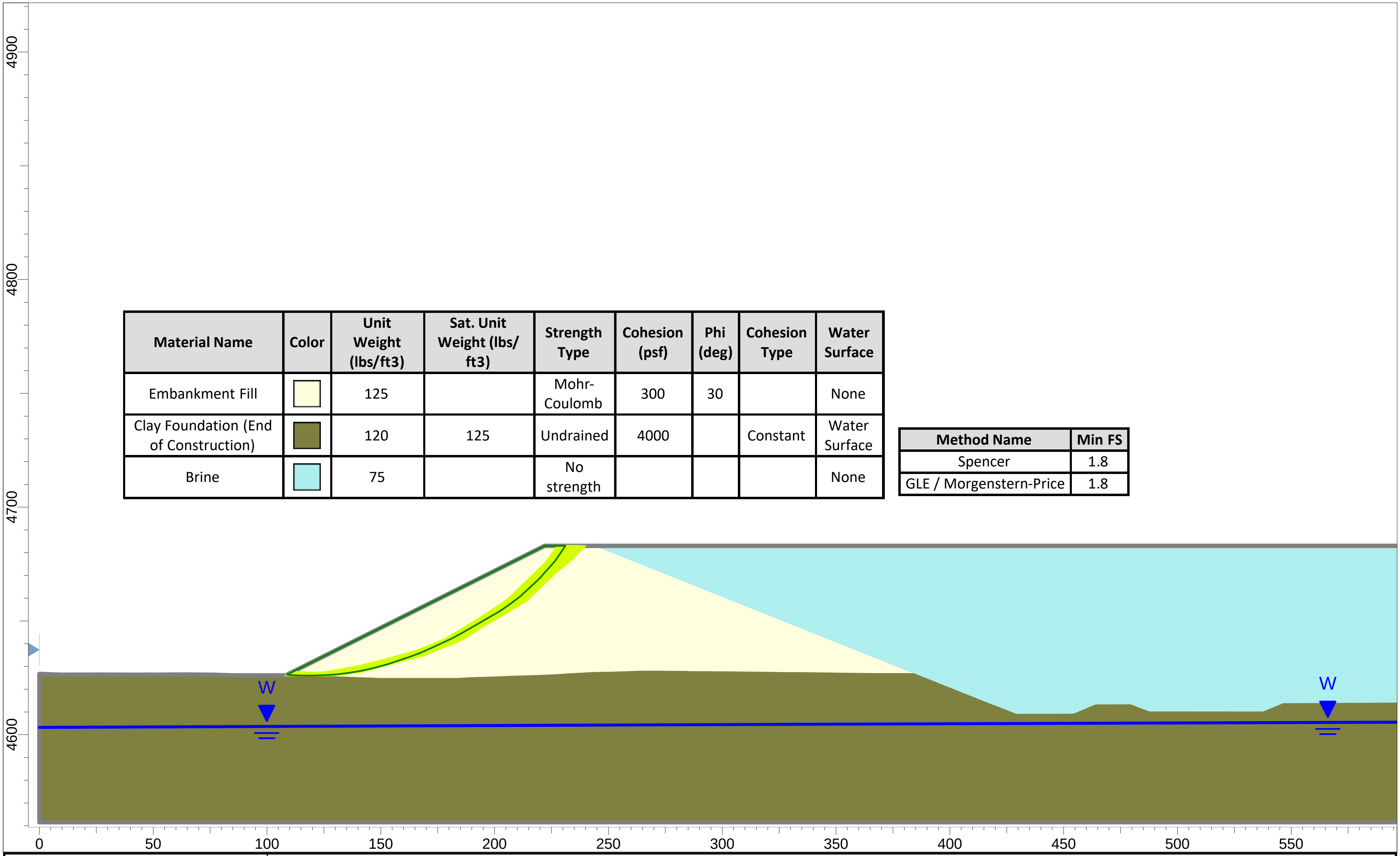
PROJECT
BRINE POND NO. 4

TITLE
SLOPE STABILITY SECTION LAYOUT

FILENAME
Figure Stability 01

FIGURE NO.
1

REVISION
A



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30		None
Clay Foundation (End of Construction)	🟫	120	125	Undrained	4000		Constant	Water Surface
Brine	🟦	75		No strength				None

Method Name	Min FS
Spencer	1.8
GLE / Morgenstern-Price	1.8

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - END OF CONSTRUCTION WITH CLAY FOUNDATION

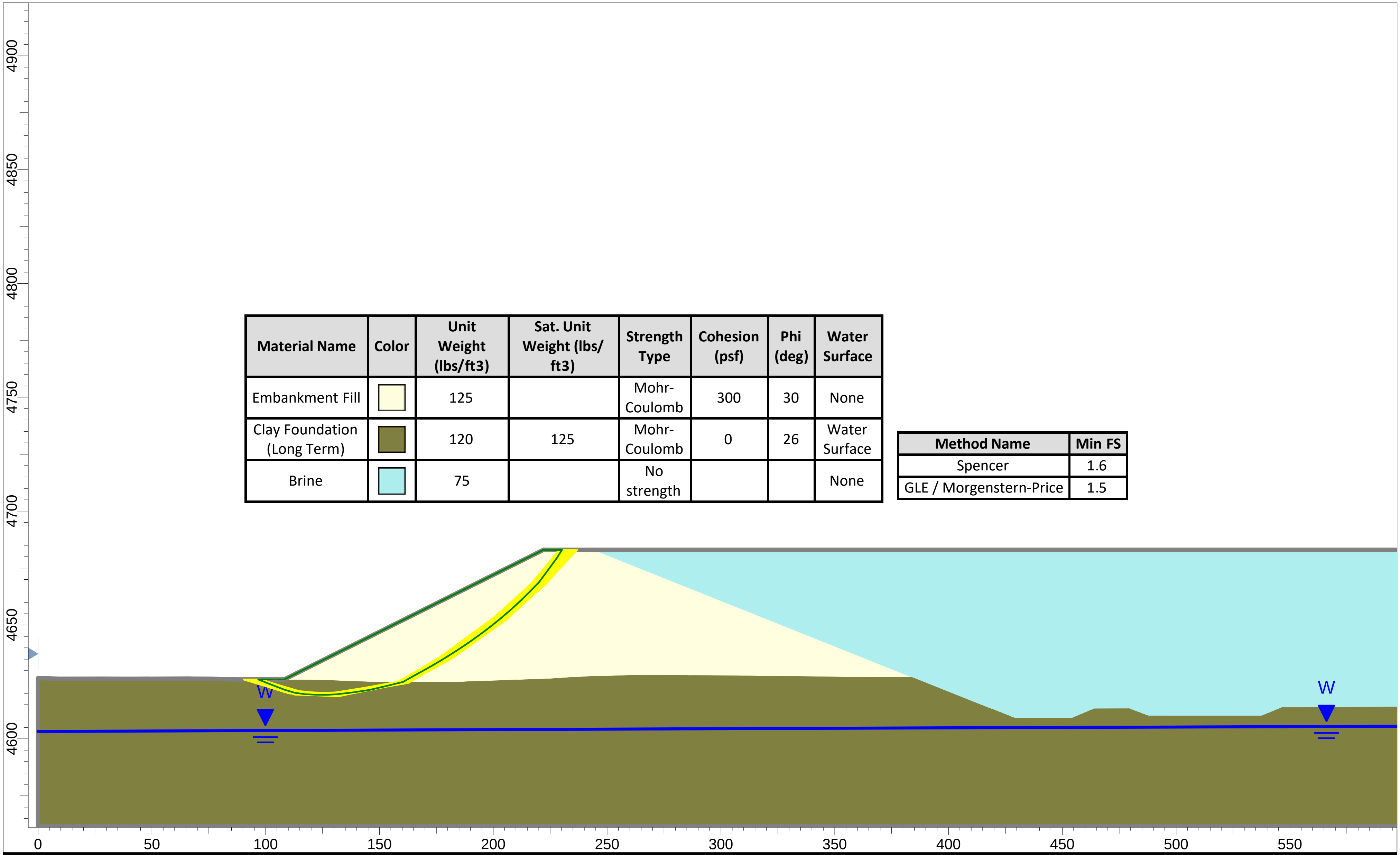
Drawn By NO

Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Clay Foundation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Clay Foundation (Long Term)	🟫	120	125	Mohr-Coulomb	0	26	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min FS
Spencer	1.6
GLE / Morgenstern-Price	1.5

NewFields

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - LONG TERM STATIC CONDITIONS WITH CLAY FOUNDATION

Drawn By NO

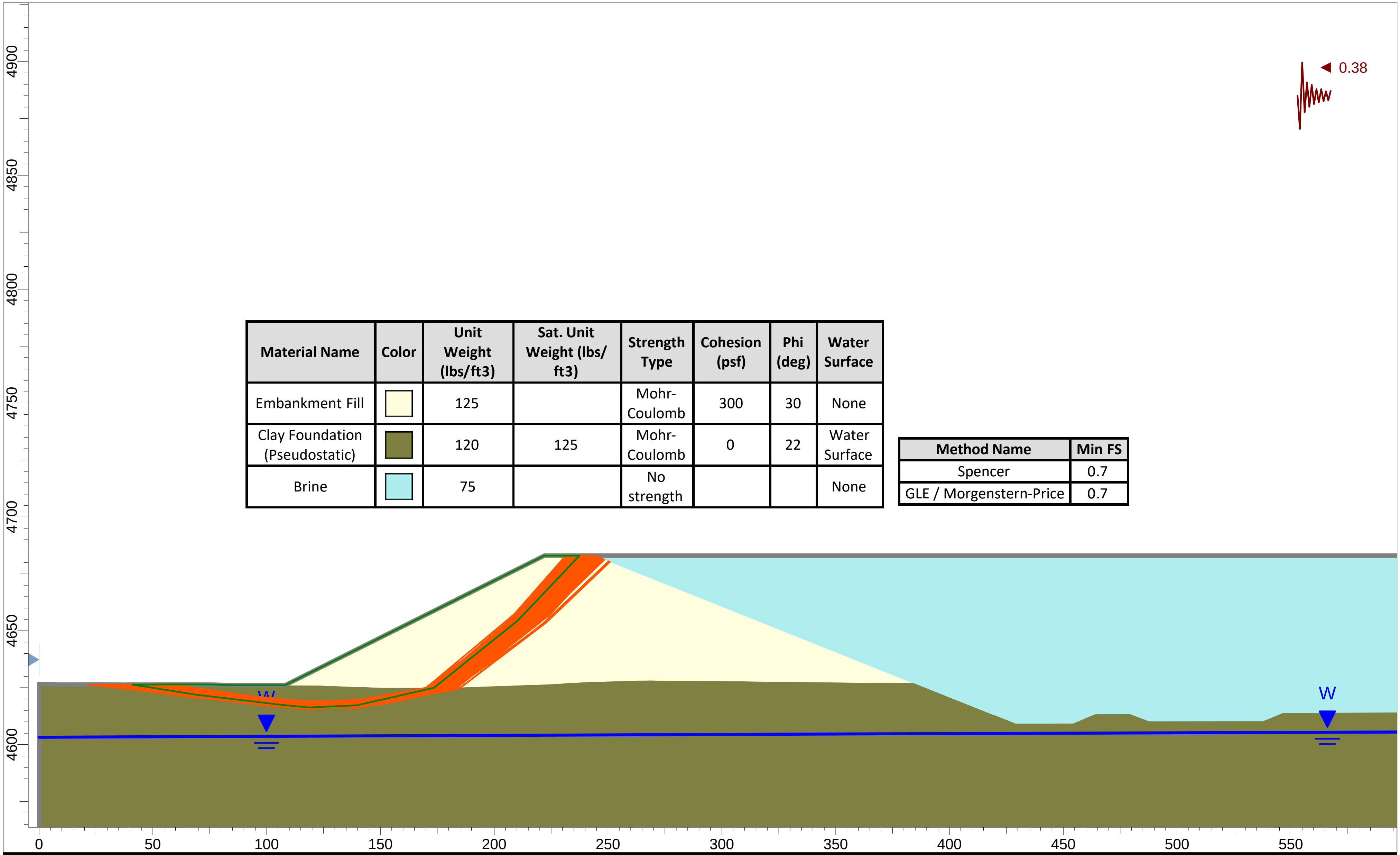
Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Clay Foundation.slmd

SLIDEINTERPRET 9.008



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Clay Foundation (Pseudostatic)	🟫	120	125	Mohr-Coulomb	0	22	Water Surface
Brine	🟦	75		No strength			None

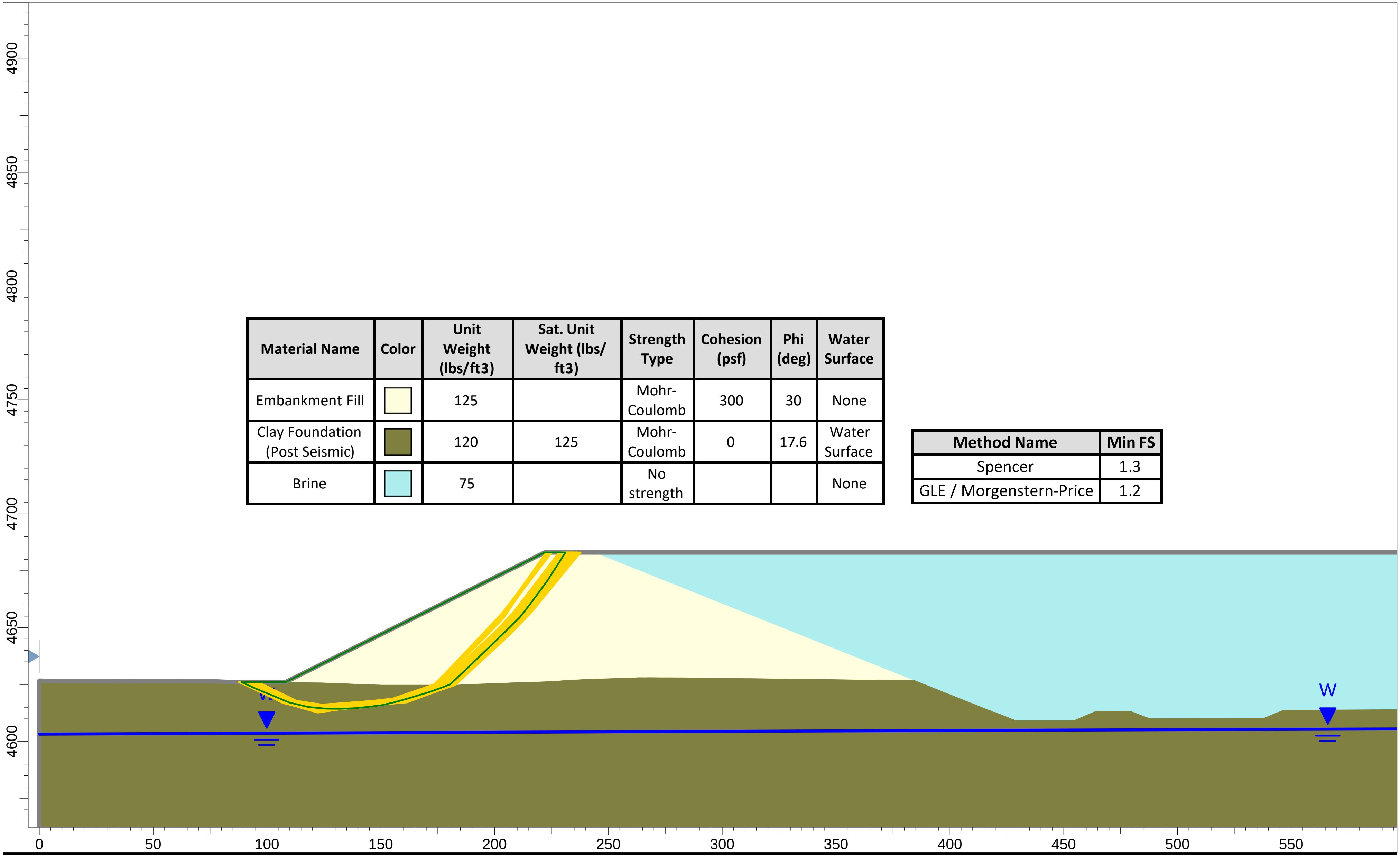
Method Name	Min FS
Spencer	0.7
GLE / Morgenstern-Price	0.7

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

Analysis Description	SECTION A - PSEUDOSTATIC CONDTIONS WITH CLAY FOUNDATION
Drawn By	NO
Scale	1:700
Company	MAGNUM DEVELOPMENT SOLUTION MINING
Date Printed	7/19/2020
File Name	Section A - Magnum Brine Pond 4 - Clay Foundation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Clay Foundation (Post Seismic)	🟫	120	125	Mohr-Coulomb	0	17.6	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min FS
Spencer	1.3
GLE / Morgenstern-Price	1.2

NewFields

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - POST SEISMIC CONDITIONS WITH CLAY FOUNDATION

Drawn By NO

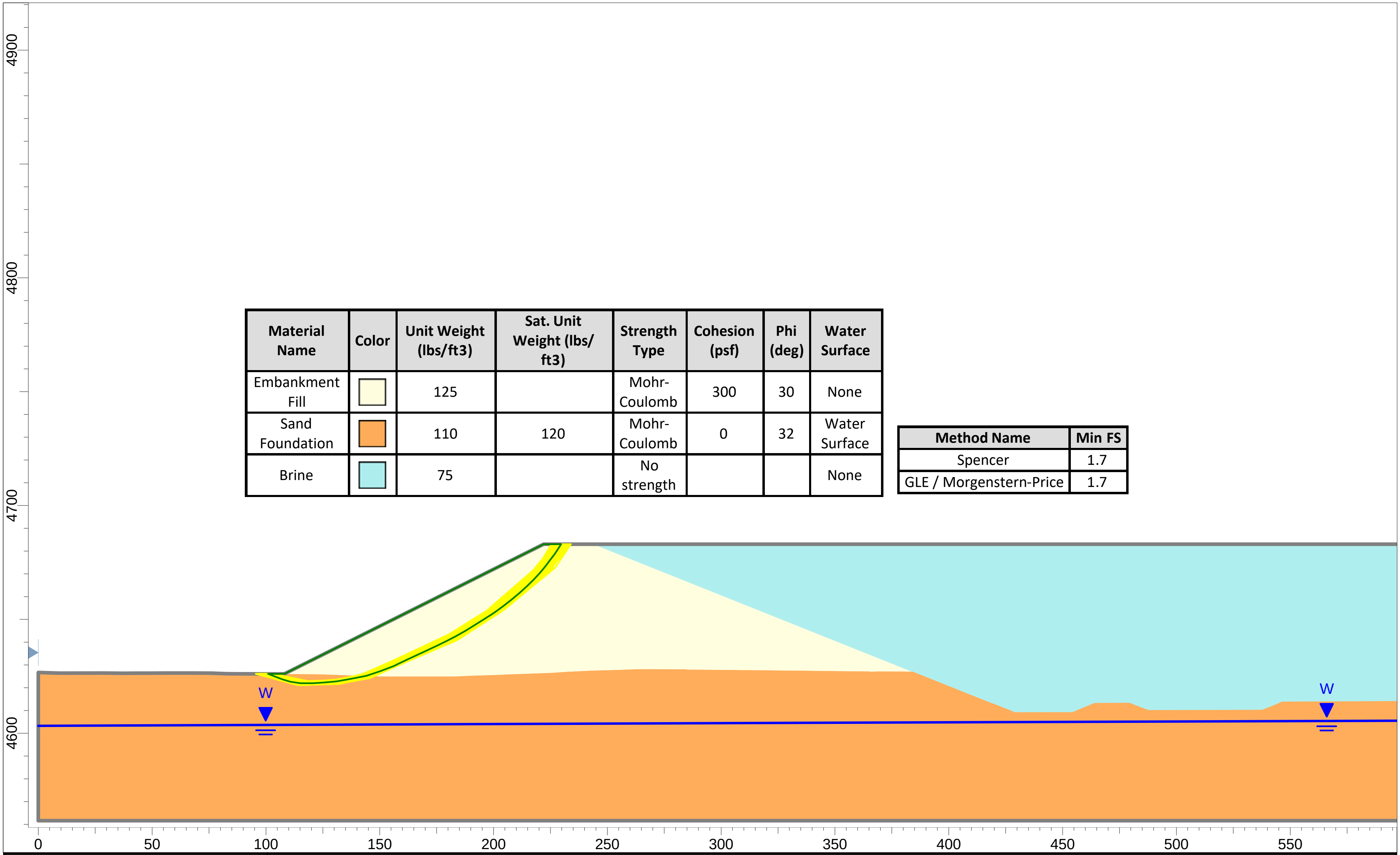
Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Clay Foundation.slmd

SLIDEINTERPRET 9.008



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Sand Foundation	🟧	110	120	Mohr-Coulomb	0	32	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min FS
Spencer	1.7
GLE / Morgenstern-Price	1.7

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - END OF CONSTRUCTION WITH SAND FOUNDATION

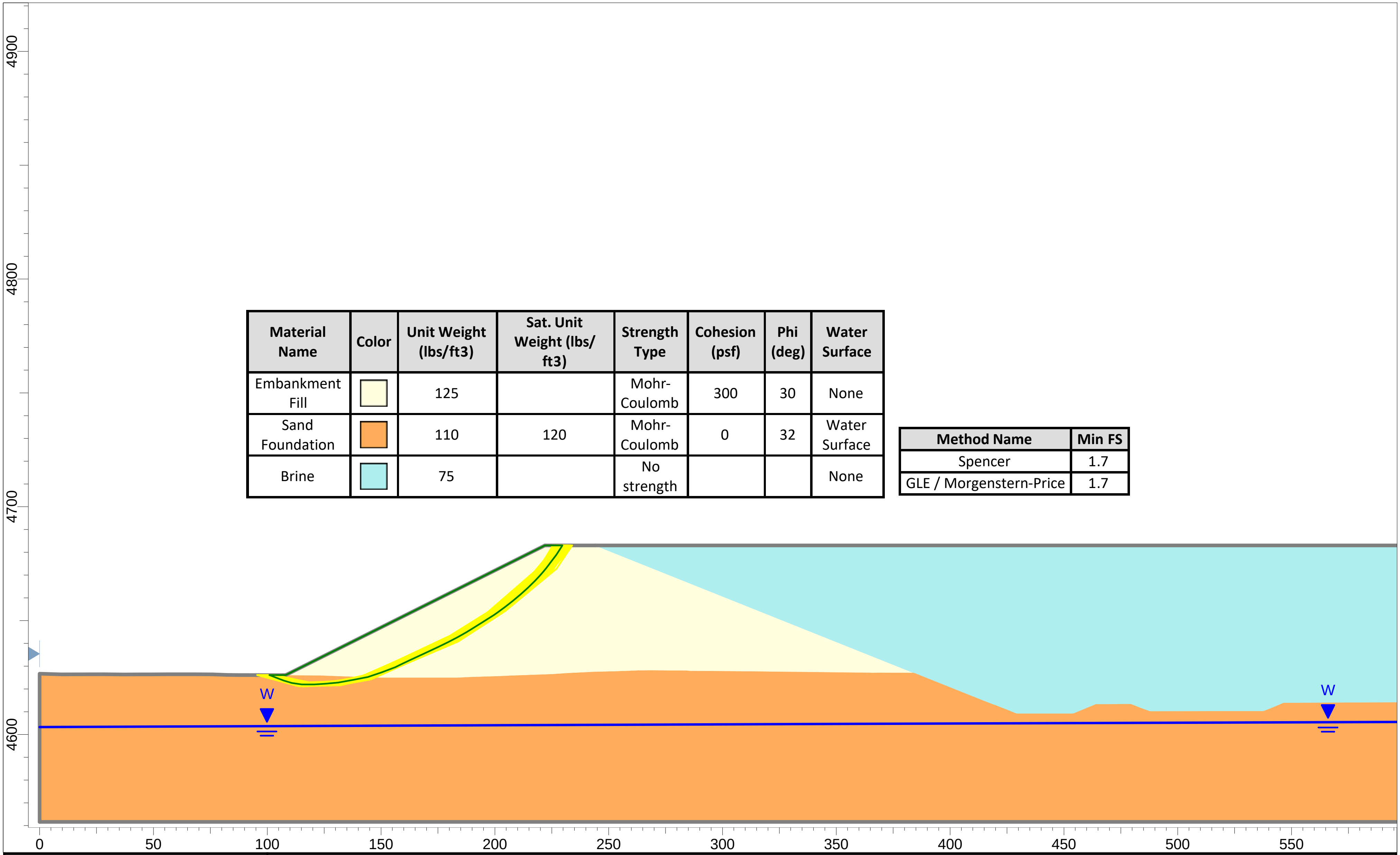
Drawn By NO

Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Sand Foundation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	⬜	125		Mohr-Coulomb	300	30	None
Sand Foundation	🟧	110	120	Mohr-Coulomb	0	32	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min FS
Spencer	1.7
GLE / Morgenstern-Price	1.7

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - LONG TERM STATIC CONDITIONS WITH SAND FOUNDATION

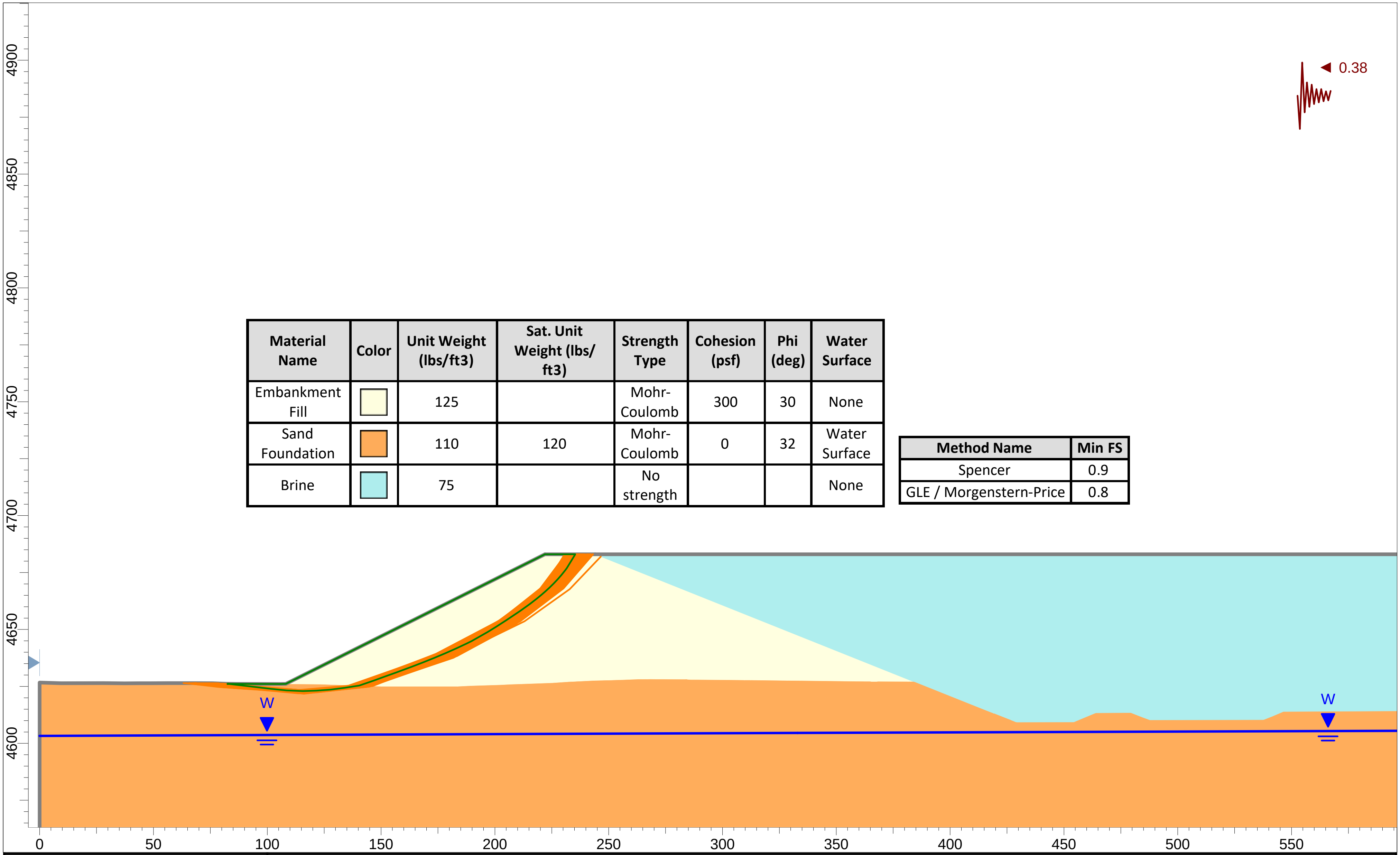
Drawn By NO

Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Sand Foundation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Sand Foundation	🟧	110	120	Mohr-Coulomb	0	32	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min FS
Spencer	0.9
GLE / Morgenstern-Price	0.8

NewFields

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - PSEUDOSTATIC CONDTIONS WITH SAND FOUNDATION

Drawn By NO

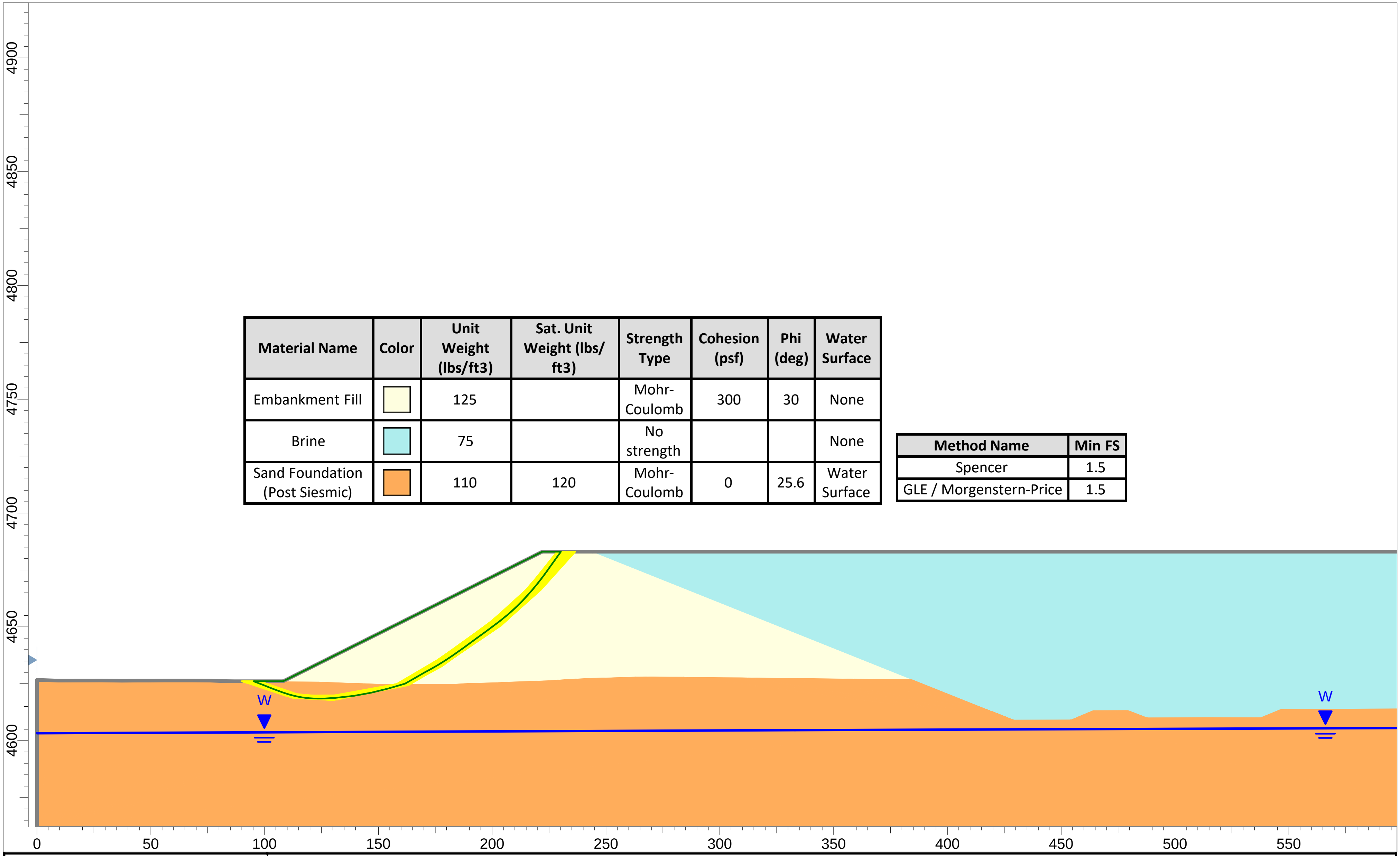
Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/19/2020

File Name Section A - Magnum Brine Pond 4 - Sand Foundation.slmd

SLIDEINTERPRET 9.008



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Brine	🟦	75		No strength			None
Sand Foundation (Post Siesmic)	🟧	110	120	Mohr-Coulomb	0	25.6	Water Surface

Method Name	Min FS
Spencer	1.5
GLE / Morgenstern-Price	1.5

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

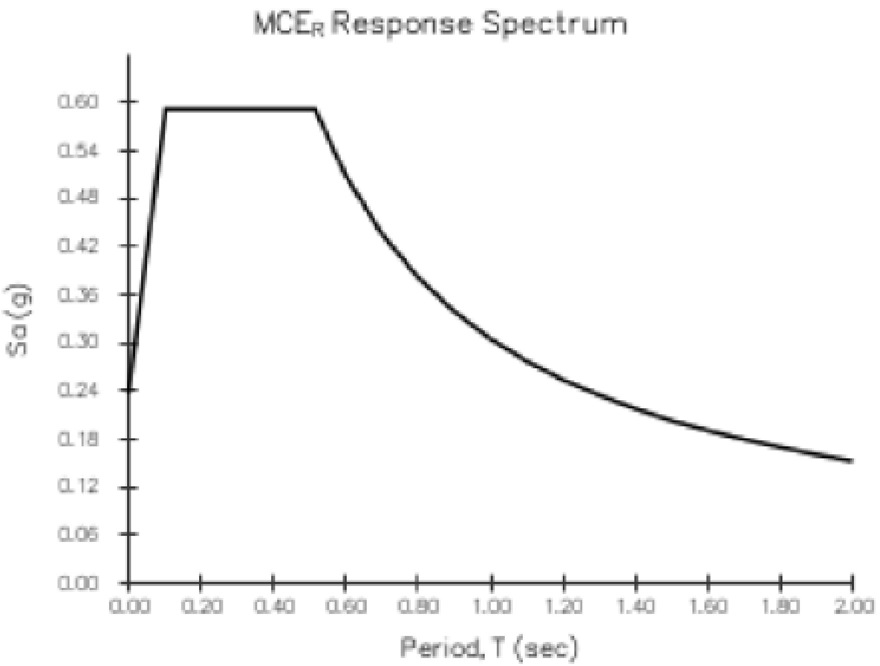
Analysis Description	SECTION A - POST SEISMIC CONDITIONS WITH SAND FOUNDATION
Drawn By	NO
Scale	1:700
Company	MAGNUM DEVELOPMENT SOLUTION MINING
Date Printed	7/19/2020
File Name	Section A - Magnum Brine Pond 4 - Sand Foundation.slmd

APPENDIX F2 – DEFORMATION ANALYSIS RESULTS

Magnum Brine Pond 4 – Potential Slope Displacement Calculation according to Bray & Travasarou (2007) methodology

Input Parameters:

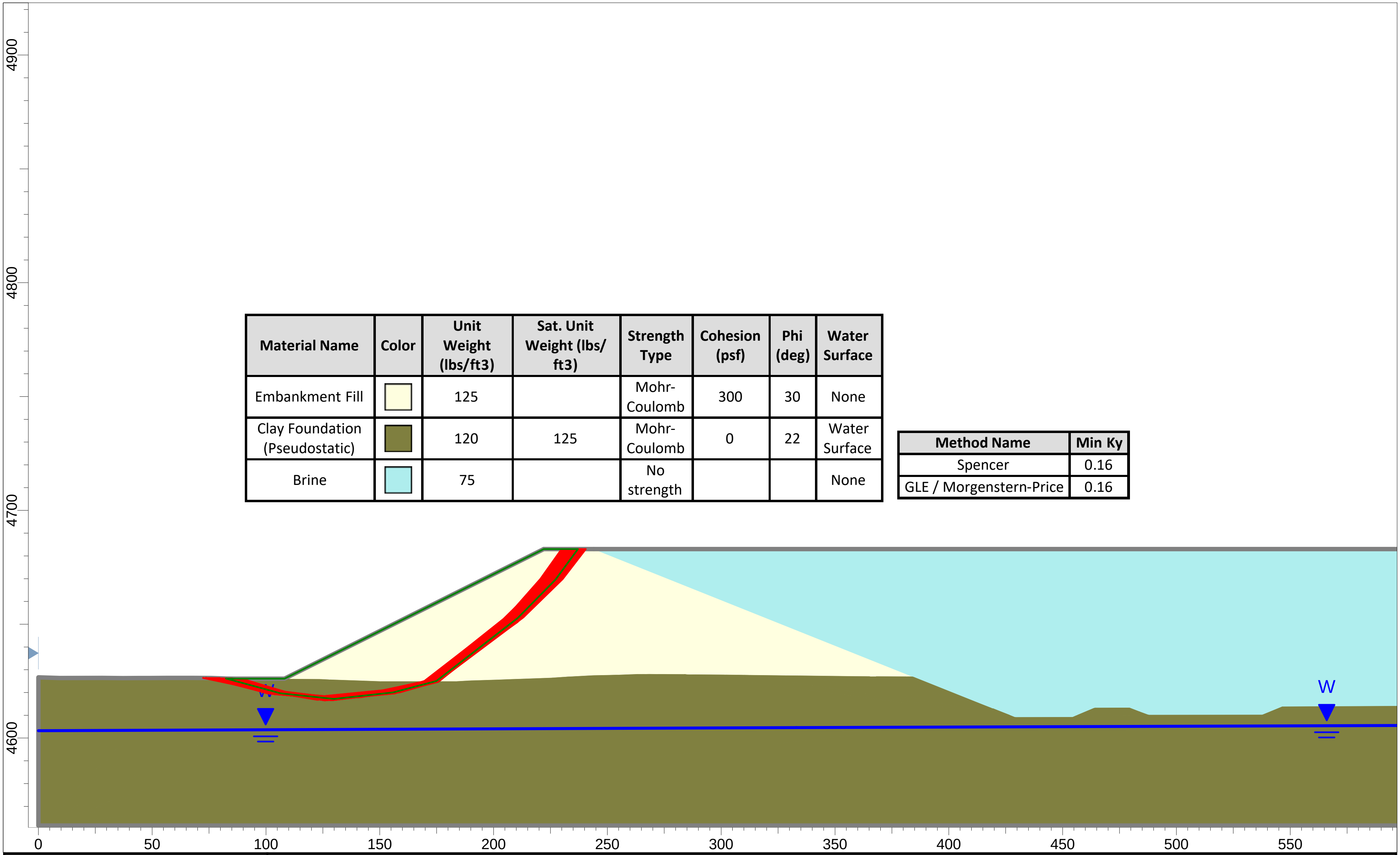
1. Yield Coefficient: The yield coefficient was determined from the pseudo-static stability analysis of the facility slopes. For section A (clay foundation), the most critical section analyzed, the yield coefficient is approximately **0.16 (Section A, Pseudostatic Stability Evaluation)**.
2. Initial Fundamental Period: The initial fundamental period is a relationship between the height of the slope and stiffness. The estimate is 2.6H/Vs. The height of the embankment slopes are approximately 57ft (17m) for Section A and Vs was estimated as 366 m/sec in the seismic hazard evaluation (AMEC, 2011). The calculated fundamental period was approximately [2.6*17]/366 = **0.12sec**.
3. Moment Magnitude: Based on the seismic hazard assessments (AMEC, 2011) and Utah code, the MCE event is based on a 4,975-year return event characterized by a **6.2 moment magnitude** event at a distance of 14.2 km a defined by the USGS Unified Hazard Tool.
4. Spectral Acceleration at Degraded Period: The degraded period is 1.5x the fundamental period, thus it is 0.18sec. The uniform hazard response spectrum for a 4,975-year return event and 5% damping was determined from the USGS Design Seismic Maps, and is shown below. Based on the MCE response spectrum, the **spectral acceleration at the degraded period is approximately 0.6g**.



5. Calculated Displacements

Ky	Ts	Mw	Sa(1.5Ts)	Displacement (cm)		
				D(84%)	D(50%)	D(1%)
0.16	0.12	6.2	0.6g	3.2	6.3	29.1

- The calculated displacement ranged from approximately 3 cm to 29 cm for the MCE event and different levels of risk. The most conservative assessment, a 1 percent probability of exceedance, indicates that a maximum of 11.5-inches (29 cm) of slope deformation could occur.



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Embankment Fill	🟨	125		Mohr-Coulomb	300	30	None
Clay Foundation (Pseudostatic)	🟫	120	125	Mohr-Coulomb	0	22	Water Surface
Brine	🟦	75		No strength			None

Method Name	Min Ky
Spencer	0.16
GLE / Morgenstern-Price	0.16

NewFields

SLIDEINTERPRET 9.008

BRINE POND 4 STABILITY ANALYSIS

Analysis Description SECTION A - PSEUDOSTATIC CONDTIONS WITH CLAY FOUNDATION

Drawn By NO

Scale 1:700

Company MAGNUM DEVELOPMENT SOLUTION MINING

Date Printed 7/20/2020

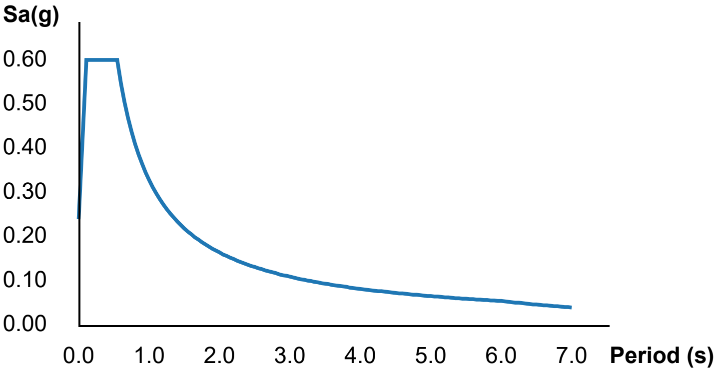
File Name Section A - Magnum Brine Pond 4 - Clay Foundation.slmd

ATC Hazards by Location

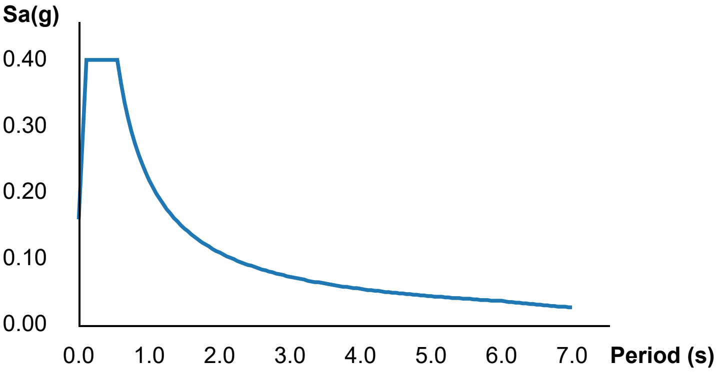
Search Information

Coordinates:	39.482, -112.588
Elevation:	4631 ft
Timestamp:	2020-07-20T15:59:27.106Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	III
Site Class:	D

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.408	MCE_R ground motion (period=0.2s)
S_1	0.142	MCE_R ground motion (period=1.0s)
S_{MS}	0.601	Site-modified spectral acceleration value
S_{M1}	0.329	Site-modified spectral acceleration value
S_{DS}	0.401	Numeric seismic design value at 0.2s SA
S_{D1}	0.219	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1.474	Site amplification factor at 0.2s
F_v	2.316	Site amplification factor at 1.0s
CR_S	0.922	Coefficient of risk (0.2s)

CR_1	0.929	Coefficient of risk (1.0s)
PGA	0.177	MCE_G peak ground acceleration
F_{PGA}	1.446	Site amplification factor at PGA
PGA_M	0.256	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	0.408	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.442	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.142	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.153	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Simplified Procedure for Estimating Earthquake Induced Deviatoric Slope Displacements
by Jonathan D. Bray and Thaleia Travasarou
Journal of Geotechnical and Geoenvironmental Engineering, ASCE, V. 133(4), pp. 381-392, April 2007

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Yield Coefficient (ky)	0.16		Based on pseudostatic analysis
Initial Fundamental Period (Ts)	0.12	seconds	1D: Ts=4H/Vs 2D: Ts=2.6H/Vs
Degraded Period (1.5Ts)	0.18	seconds	
Moment Magnitude (Mw)	6.2		
Spectral Acceleration (Sa(1.5Ts))	0.6	g	

Additional Input Parameters		
Probability of Exceedance #1 (P1)	84	%
Probability of Exceedance #2 (P2)	50	%
Probability of Exceedance #3 (P3)	1	%
Displacement Threshold (d_threshold)	30	cm

Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	6.29	cm	eq. (5) or (6)
Standard Deviation of Non-Zero Seismic D	0.66		

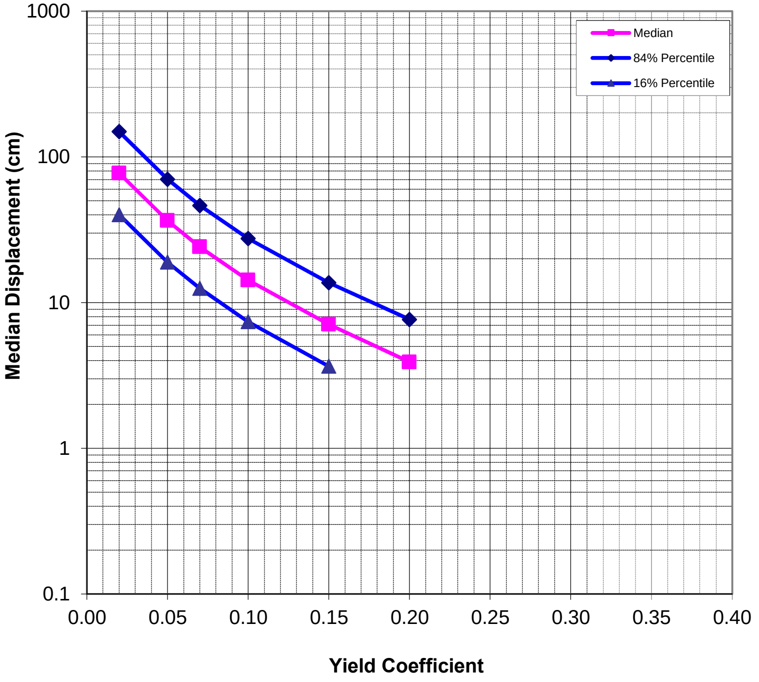
Results			
Probability of Negligible Displ. (P(D=0))	0.01		eq. (3)
D1	3.2	cm	calc. using eq. (7)
D2	6.3	cm	calc. using eq. (7)
D3	29.1	cm	calc. using eq. (7)
P(D>d_threshold)	0.01		eq. (7)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. ky may range between 0.01 and 0.5, Ts between 0 and 2 s, Sa between 0.002 and 2.7 g, M between 4.5 and 9
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 1cm
9. ky may be estimated using the simplified equations shown below.
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

Dependence on ky

ky	P(D 0)	D (cm)	Dmedian (cm)	D- 4 (cm)	D-1 (cm)
0.020	0.00	77.2	77.2	148.9	40.1
0.05	0.00	36.5	36.5	70.3	18.9
0.07	0.00	24.1	24.1	46.4	12.5
0.1	0.00	14.3	14.3	27.5	7.4
0.15	0.00	7.1	7.1	13.7	3.6
0.2	0.04	4.0	3.9	7.7	1.9
0.3	0.35	1.7	1.0	2.6	<1
0.4	0.71	0.8	<1	0.8	<1



APPENDIX F3 – LIQUEFACTION ANALYSIS RESULTS

MAGNUM BRINE PONDS 3 & 4 SPT-based liquefaction triggering analysis for a single borehole (Idriss & Boulanger, 2008)

Completed by: JWR
Date: 8/8/2017
Completed by: NTR
Date: 9/18/2017

Borehole ID: BH17-01

Input parameters:
Peak ground acceleration (g) = 0.38
Earthquake magnitude, M = 6.2
4,975yr Return Event
Water table depth (m) = 7.22 DTW (ft) = 23.7
Average Ɣ above water table (KN/m^3) = 18
Average Ɣ below water table (KN/m^3) = 20
Borehole diameter (mm) = 203.2 BH dia (in) = 8
Requires correction for samples liners (YES/NO): YES
Rod lengths assumed equal to the depth plus 1.5m (for above ground extention)

*Depth is the midpoint of the recorded N-value (i.e. 1ft into SPT interval)

**Fines Content (%) to the nearest whole number is estimated based on the log

SPT Sample Number	*Depth (ft)	Depth (m)	Measured N-value	Soil Type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	**Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPA)	σ_{VC}' (kPA)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60-cs}$	Stress Reduct. Coeff, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety
1	2	0.6	10	SM	Unsaturated	45	75	1.25	1.15	0.75	1.22	13.20	10.97	10.97	1.70	22.44	5.61	28.05	1.00	0.25	1.41	1.10	0.39	n.a.	n.a.
2	4.5	1.4	26	SP-SM	Unsaturated	12	75	1.25	1.15	0.75	1.30	36.44	24.69	24.69	1.45	52.79	2.07	54.86	0.99	0.24	1.41	1.10	2.00	n.a.	n.a.
3	7	2.1	17	SP-SM	Unsaturated	12	75	1.25	1.15	0.80	1.30	25.42	38.40	38.40	1.36	34.60	2.07	36.67	0.98	0.24	1.41	1.10	1.61	n.a.	n.a.
4	9.5	2.9	41	CL	Clay		75	1.25	1.15	0.85	1.30	65.13	52.12	52.12	1.19	n.a.	n.a.	n.a.	0.96	0.24	1.41	1.10	n.a.	n.a.	n.a.
5	16	4.9	19	CL	Clay		75	1.25	1.15	0.95	1.30	33.73	87.78	87.78	1.04	n.a.	n.a.	n.a.	0.93	0.23	1.41	1.04	n.a.	n.a.	n.a.
6	21	6.4	18	CH	Clay		75	1.25	1.15	0.95	1.30	31.96	115.21	115.21	0.97	n.a.	n.a.	n.a.	0.89	0.22	1.41	0.96	n.a.	n.a.	n.a.
7	26	7.9	19	CL	Clay		75	1.25	1.15	0.95	1.30	33.73	144.06	137.14	0.92	n.a.	n.a.	n.a.	0.86	0.22	1.41	0.91	n.a.	n.a.	n.a.
8	31	9.4	31	CH	Clay		75	1.25	1.15	1.00	1.30	57.93	174.54	152.67	0.90	n.a.	n.a.	n.a.	0.82	0.23	1.41	0.88	n.a.	n.a.	n.a.
9	36	11.0	43	SP		4	75	1.25	1.15	1.00	1.30	80.36	205.02	168.20	0.87	70.27	0.00	70.27	0.79	0.24	1.41	0.85	2.00	2.00	2.00
10	41	12.5	50	SP		4	75	1.25	1.15	1.00	1.30	93.44	235.50	183.73	0.85	79.83	0.00	79.83	0.75	0.24	1.41	0.82	2.00	2.00	2.00
11	46	14.0	18	CL	Clay		75	1.25	1.15	1.00	1.30	33.64	265.98	199.26	0.84	n.a.	n.a.	n.a.	0.72	0.24	1.41	0.80	n.a.	n.a.	n.a.
12	51	15.5	50	SC		35	75	1.25	1.15	1.00	1.30	93.44	296.46	214.79	0.82	76.61	5.51	82.12	0.68	0.23	1.41	0.78	2.00	2.00	2.00
13	56	17.1	34	SP		1	75	1.25	1.15	1.00	1.30	63.54	326.94	230.31	0.81	51.15	0.00	51.15	0.65	0.23	1.41	0.76	2.00	2.00	2.00
14	61	18.6	50	CL	Clay		75	1.25	1.15	1.00	1.30	93.44	357.42	245.84	0.79	n.a.	n.a.	n.a.	0.62	0.22	1.41	0.74	n.a.	n.a.	n.a.
15	66	20.1	22	CL	Clay		75	1.25	1.15	1.00	1.30	41.11	387.90	261.37	0.78	n.a.	n.a.	n.a.	0.59	0.22	1.41	0.72	n.a.	n.a.	n.a.
16	71	21.6	26	CL	Clay		75	1.25	1.15	1.00	1.30	48.59	418.38	276.90	0.77	n.a.	n.a.	n.a.	0.57	0.21	1.41	0.70	n.a.	n.a.	n.a.
17	76	23.2	30	CL	Clay		75	1.25	1.15	1.00	1.30	56.06	448.86	292.43	0.76	n.a.	n.a.	n.a.	0.55	0.21	1.41	0.69	n.a.	n.a.	n.a.

White Cells represent input data
Gray Cells represent calculated data
Factor of Safety is the ratio of the Cyclic Resistance Ratio (CRR) and the Cyclic Stress Ratio (CSR)
Factor of Safety less than 1.00 indicates a soil that liquefies
Factor of Safety of "n.a." represents a soil that is cohesive or unsaturated and thus not applicable to liquefaction

MAGNUM BRINE PONDS 3 & 4 SPT-based liquefaction triggering analysis for a single borehole (Idriss & Boulanger, 2008)

Completed by: JWR
Date: 8/8/2017
Completed by: NTR
Date: 9/18/2017

Borehole ID: BH17-02

Input parameters:
Peak ground acceleration (g) = 0.38
Earthquake magnitude, M = 6.2
4,975yr Return Event
Water table depth (m) = 7.40 DTW (ft) = 24.3
Average ϒ above water table (KN/m^3) = 18
Average ϒ below water table (KN/m^3) = 20
Borehole diameter (mm) = 203.2 BH dia (in) = 8
Requires correction for samples liners (YES/NO): YES
Rod lengths assumed equal to the depth plus 1.5m (for above ground extention)

*Depth is the midpoint of the recorded N-value (i.e. 1ft into SPT interval)

**Fines Content (%) to the nearest whole number is estimated based on the log

SPT Sample Number	*Depth (ft)	Depth (m)	Measured N-value	Soil Type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	**Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPA)	σ_{VC}' (kPA)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct. Coeff, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety
1	2	0.6	8	SM	Unsaturated	23	75	1.25	1.15	0.75	1.17	10.11	10.97	10.97	1.70	17.18	4.88	22.07	1.00	0.25	1.41	1.10	0.23	n.a.	n.a.
2	4.5	1.4	23	CL	Clay	53	75	1.25	1.15	0.75	1.30	32.24	24.69	24.69	1.45	n.a.	n.a.	n.a.	0.99	0.24	1.41	1.10	n.a.	n.a.	n.a.
3	7	2.1	14	SP	Unsaturated	4	75	1.25	1.15	0.80	1.30	20.89	38.40	38.40	1.42	29.73	0.00	29.73	0.98	0.24	1.41	1.10	0.47	n.a.	n.a.
4	9.5	2.9	32	SP	Unsaturated	4	75	1.25	1.15	0.85	1.30	50.83	52.12	52.12	1.19	60.49	0.00	60.49	0.96	0.24	1.41	1.10	2.00	n.a.	n.a.
5	16	4.9	47	SP	Unsaturated	4	75	1.25	1.15	0.95	1.30	83.44	87.78	87.78	1.04	86.58	0.00	86.58	0.93	0.23	1.41	1.04	2.00	n.a.	n.a.
6	21	6.4	28	CH	Clay		75	1.25	1.15	0.95	1.30	49.71	115.21	115.21	0.97	n.a.	n.a.	n.a.	0.89	0.22	1.41	0.96	n.a.	n.a.	n.a.
7	26	7.9	19	CH	Clay		75	1.25	1.15	0.95	1.30	33.73	143.70	138.53	0.92	n.a.	n.a.	n.a.	0.86	0.22	1.41	0.91	n.a.	n.a.	n.a.
8	31	9.4	50	SP-SM		10	75	1.25	1.15	1.00	1.30	93.44	174.18	154.06	0.89	83.61	1.15	84.76	0.82	0.23	1.41	0.88	2.00	2.00	2.00
9	36	11.0	10	SP-SM		10	75	1.25	1.15	1.00	1.12	16.17	204.66	169.59	0.77	12.47	1.15	13.62	0.79	0.24	1.41	0.95	0.14	0.19	0.82
10	41	12.5	48	SP		4	75	1.25	1.15	1.00	1.30	89.70	235.14	185.12	0.85	76.48	0.00	76.48	0.75	0.24	1.41	0.82	2.00	2.00	2.00
11	46	14.0	19	CH	Clay		75	1.25	1.15	1.00	1.30	35.51	265.62	200.65	0.83	n.a.	n.a.	n.a.	0.72	0.23	1.41	0.80	n.a.	n.a.	n.a.
12	51	15.5	7	SM		35	75	1.25	1.15	1.00	1.10	11.07	296.10	216.18	0.68	7.53	5.51	13.03	0.68	0.23	1.41	0.92	0.14	0.18	0.79
13	56	17.1	50	SP		4	75	1.25	1.15	1.00	1.30	93.44	326.58	231.71	0.80	75.10	0.00	75.10	0.65	0.23	1.41	0.75	2.00	2.00	2.00

White Cells represent input data
Gray Cells represent calculated data
Factor of Safety is the ratio of the Cyclic Resistance Ratio (CRR) and the Cyclic Stress Ratio (CSR)
Factor of Safety less than 1.00 indicates a soil that liquefies
Factor of Safety of "n.a." represents a soil that is cohesive or unsaturated and thus not applicable to liquefaction

MAGNUM BRINE PONDS 3 & 4 SPT-based liquefaction triggering analysis for a single borehole (Idriss & Boulanger, 2008)

Input parameters:
Peak ground acceleration (g) = 0.38
Earthquake magnitude, M = 6.2
4,975yr Return Event
Water table depth (m) = 8.65 DTW (ft) = 28.4
Average ϒ above water table (KN/m^3) = 18
Average ϒ below water table (KN/m^3) = 20
Borehole diameter (mm) = 203.2 BH dia (in) = 8
Requires correction for samples liners (YES/NO): YES
Rod lengths assumed equal to the depth plus 1.5m (for above ground extention)

Borehole ID: BH17-03

Completed by: JWR
Date: 8/8/2017
Completed by: NTR
Date: 9/18/2017

*Depth is the midpoint of the recorded N-value (i.e. 1ft into SPT interval)
**Fines Content (%) to the nearest whole number is estimated based on the log

SPT Sample Number	*Depth (ft)	Depth (m)	Measured N-value	Soil Type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	**Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPA)	σ_{VC}' (kPA)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct. Coeff, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety
1	2	0.6	9	SP-SM	Unsaturated	10	75	1.25	1.15	0.75	1.20	11.62	10.97	10.97	1.70	19.75	1.15	20.90	1.00	0.25	1.41	1.10	0.22	n.a.	n.a.
2	4.5	1.4	44	CH	Clay		75	1.25	1.15	0.75	1.30	61.67	24.69	24.69	1.45	n.a.	n.a.	n.a.	0.99	0.24	1.41	1.10	n.a.	n.a.	n.a.
3	7	2.1	14	SM	Unsaturated	43	75	1.25	1.15	0.80	1.29	20.71	38.40	38.40	1.38	28.62	5.60	34.22	0.98	0.24	1.41	1.10	0.95	n.a.	n.a.
4	9.5	2.9	50	SP	Unsaturated	4	75	1.25	1.15	0.85	1.30	79.42	52.12	52.12	1.19	94.52	0.00	94.52	0.96	0.24	1.41	1.10	2.00	n.a.	n.a.
5	16	4.9	50	SP	Unsaturated	1	75	1.25	1.15	0.95	1.30	88.77	87.78	87.78	1.04	92.10	0.00	92.10	0.93	0.23	1.41	1.04	2.00	n.a.	n.a.
6	21	6.4	50	CH	Clay		75	1.25	1.15	0.95	1.30	88.77	115.21	115.21	0.97	n.a.	n.a.	n.a.	0.89	0.22	1.41	0.96	n.a.	n.a.	n.a.
7	26	7.9	18	CH	Clay		75	1.25	1.15	0.95	1.30	31.96	142.65	142.65	0.91	n.a.	n.a.	n.a.	0.86	0.21	1.41	0.90	n.a.	n.a.	n.a.
8	31	9.4	50	SP-SM		15	75	1.25	1.15	1.00	1.30	93.44	171.69	163.80	0.88	82.27	3.26	85.54	0.82	0.21	1.41	0.86	2.00	2.00	2.00
9	36	11.0	28	SP-SM		15	75	1.25	1.15	1.00	1.30	52.33	202.17	179.33	0.86	44.99	3.26	48.25	0.79	0.22	1.41	0.83	2.00	2.00	2.00
10	41	12.5	40	SP-SM		15	75	1.25	1.15	1.00	1.30	74.75	232.65	194.86	0.84	62.88	3.26	66.14	0.75	0.22	1.41	0.81	2.00	2.00	2.00
11	46	14.0	19	CH	Clay		75	1.25	1.15	1.00	1.30	35.51	263.13	210.39	0.82	n.a.	n.a.	n.a.	0.72	0.22	1.41	0.78	n.a.	n.a.	n.a.
12	51	15.5	38	CH	Clay		75	1.25	1.15	1.00	1.30	71.01	293.61	225.92	0.81	n.a.	n.a.	n.a.	0.68	0.22	1.41	0.76	n.a.	n.a.	n.a.

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MAGNUM BRINE PONDS 3 & 4 SPT-based liquefaction triggering analysis for a single borehole (Idriss & Boulanger, 2008)

Input parameters:
Peak ground acceleration (g) = 0.38 4,975yr Return Event
Earthquake magnitude, M = 6.2
Water table depth (m) = 10.37 DTW (ft) = 34.0
Average ϒ above water table (KN/m^3) = 18
Average ϒ below water table (KN/m^3) = 20
Borehole diameter (mm) = 203.2 BH dia (in) = 8
Requires correction for samples liners (YES/NO): YES
Rod lengths assumed equal to the depth plus 1.5m (for above ground extention)

Borehole ID: BH17-04

Completed by: JWR
Date: 8/8/2017
Completed by: NTR
Date: 9/18/2017

*Depth is the midpoint of the recorded N-value (i.e. 1ft into SPT interval) **Fines Content (%) to the nearest whole number is estimated based on the log

SPT Sample Number	*Depth (ft)	Depth (m)	Measured N-value	Soil Type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	**Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPA)	σ_{VC}' (kPA)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct. Coeff, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety
1	2	0.6	16	CH	Clay		75	1.25	1.15	0.75	1.30	22.43	10.97	10.97	1.70	n.a.	n.a.	n.a.	1.00	0.25	1.41	1.10	n.a.	n.a.	n.a.
2	4.5	1.4	24	CH	Clay		75	1.25	1.15	0.75	1.30	33.64	24.69	24.69	1.45	n.a.	n.a.	n.a.	0.99	0.24	1.41	1.10	n.a.	n.a.	n.a.
3	7	2.1	15	CH	Clay		75	1.25	1.15	0.80	1.30	22.43	38.40	38.40	1.29	n.a.	n.a.	n.a.	0.98	0.24	1.41	1.10	n.a.	n.a.	n.a.
4	9.5	2.9	50	SP	Unsaturated	14	75	1.25	1.15	0.85	1.30	79.42	52.12	52.12	1.19	94.52	2.91	97.43	0.96	0.24	1.41	1.10	2.00	n.a.	n.a.
5	16	4.9	37	CH	Clay		75	1.25	1.15	0.95	1.30	65.69	87.78	87.78	1.04	n.a.	n.a.	n.a.	0.93	0.23	1.41	1.04	n.a.	n.a.	n.a.
6	21	6.4	50	SP	Unsaturated	1	75	1.25	1.15	0.95	1.30	88.77	115.21	115.21	0.97	85.74	0.00	85.74	0.89	0.22	1.41	0.96	2.00	n.a.	n.a.
7	26	7.9	50	SP	Unsaturated	1	75	1.25	1.15	0.95	1.30	88.77	142.65	142.65	0.91	81.06	0.00	81.06	0.86	0.21	1.41	0.90	2.00	n.a.	n.a.
8	31	9.4	24	CH	Clay		75	1.25	1.15	1.00	1.30	44.85	170.08	170.08	0.87	n.a.	n.a.	n.a.	0.82	0.20	1.41	0.85	n.a.	n.a.	n.a.
9	36	11.0	17	SP-SC		10	75	1.25	1.15	1.00	1.23	30.10	198.72	192.79	0.77	23.16	1.15	24.31	0.79	0.20	1.41	0.90	0.27	0.35	1.73
10	41	12.5	35	SP		1	75	1.25	1.15	1.00	1.30	65.41	229.20	208.32	0.83	54.06	0.00	54.06	0.75	0.20	1.41	0.79	2.00	2.00	2.00
11	46	14.0	37	SP		1	75	1.25	1.15	1.00	1.30	69.14	259.68	223.85	0.81	56.08	0.00	56.08	0.72	0.21	1.41	0.77	2.00	2.00	2.00
12	51	15.5	29	CH	Clay		75	1.25	1.15	1.00	1.30	54.19	290.16	239.38	0.80	n.a.	n.a.	n.a.	0.68	0.20	1.41	0.75	n.a.	n.a.	n.a.
13	56	17.1	31	SP	Unsaturated	1	75	1.25	1.15	1.00	1.30	57.93	320.64	254.91	0.78	45.22	0.00	45.22	0.65	0.20	1.41	0.73	2.00	n.a.	n.a.
14	61	18.6	50	SP	Unsaturated	1	75	1.25	1.15	1.00	1.30	93.44	351.12	270.44	0.77	72.11	0.00	72.11	0.62	0.20	1.41	0.71	2.00	n.a.	n.a.
15	66	20.1	24	CH	Clay		75	1.25	1.15	1.00	1.30	44.85	381.60	285.97	0.76	n.a.	n.a.	n.a.	0.59	0.20	1.41	0.69	n.a.	n.a.	n.a.
16	71	21.6	32	CH	Clay		75	1.25	1.15	1.00	1.30	59.80	412.08	301.50	0.75	n.a.	n.a.	n.a.	0.57	0.19	1.41	0.68	n.a.	n.a.	n.a.
17	76	23.2	50	SP-SM		15	75	1.25	1.15	1.00	1.30	93.44	442.56	317.03	0.74	69.15	3.26	72.41	0.55	0.19	1.41	0.66	2.00	1.86	2.00

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MAGNUM BRINE PONDS 3 & 4 SPT-based liquefaction triggering analysis for a single borehole (Idriss & Boulanger, 2008)

Input parameters:
Peak ground acceleration (g) = 0.38
Earthquake magnitude, M = 6.2
4,975yr Return Event
Water table depth (m) = 10.04 DTW (ft) = 32.9
Average ϒ above water table (KN/m^3) = 18
Average ϒ below water table (KN/m^3) = 20
Borehole diameter (mm) = 203.2 BH dia (in) = 8
Requires correction for samples liners (YES/NO): YES
Rod longths assumed equal to the depth plus 1.5m (for above ground extention)

Borehole ID: BH17-05

Completed by: JWR
Date: 8/8/2017
Completed by: NTR
Date: 9/18/2017

*Depth is the midpoint of the recorded N-value (i.e. 1ft into SPT interval)

**Fines Content (%) to the nearest whole number is estimated based on the log

SPT Sample Number	*Depth (ft)	Depth (m)	Measured N-value	Soil Type (USCS)	Flag "Clay" "Unsaturated" "Unreliable"	**Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{VC} (kPA)	σ_{VC}' (kPA)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60-cs}$	Stress Reduct. Coeff, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{VC}'=1atm	CRR	Factor of Safety
1	2	0.6	4	SM	Unsaturated	15	75	1.25	1.15	0.75	1.10	4.74	10.97	10.97	1.70	8.06	3.26	11.33	1.00	0.25	1.41	1.10	0.13	n.a.	n.a.
2	4.5	1.4	36	CL	Clay	77	75	1.25	1.15	0.75	1.30	50.46	24.69	24.69	1.45	n.a.	n.a.	n.a.	0.99	0.24	1.41	1.10	n.a.	n.a.	n.a.
3	7	2.1	15	CL	Clay		75	1.25	1.15	0.80	1.30	22.43	38.40	38.40	1.29	n.a.	n.a.	n.a.	0.98	0.24	1.41	1.10	n.a.	n.a.	n.a.
4	9.5	2.9	37	CH	Clay		75	1.25	1.15	0.85	1.30	58.77	52.12	52.12	1.19	n.a.	n.a.	n.a.	0.96	0.24	1.41	1.10	n.a.	n.a.	n.a.
5	16	4.9	32	SM	Unsaturated	35	75	1.25	1.15	0.95	1.30	56.81	87.78	87.78	1.04	58.95	5.51	64.45	0.93	0.23	1.41	1.04	2.00	n.a.	n.a.
6	21	6.4	50	SP-SM	Unsaturated	15	75	1.25	1.15	0.95	1.30	88.77	115.21	115.21	0.97	85.74	3.26	89.00	0.89	0.22	1.41	0.96	2.00	n.a.	n.a.
7	26	7.9	41	SP-SM	Unsaturated	15	75	1.25	1.15	0.95	1.30	72.79	142.65	142.65	0.91	66.47	3.26	69.73	0.86	0.21	1.41	0.90	2.00	n.a.	n.a.
8	31	9.4	50	SP	Unsaturated	1	75	1.25	1.15	1.00	1.30	93.44	170.08	170.08	0.87	81.46	0.00	81.46	0.82	0.20	1.41	0.85	2.00	n.a.	n.a.
9	36	11.0	18	SP		1	75	1.25	1.15	1.00	1.25	32.38	199.37	190.24	0.78	25.16	0.00	25.16	0.79	0.20	1.41	0.90	0.29	0.37	1.81
10	41	12.5	50	CH	Clay		75	1.25	1.15	1.00	1.30	93.44	229.85	205.77	0.83	n.a.	n.a.	n.a.	0.75	0.21	1.41	0.79	n.a.	n.a.	n.a.
11	46	14.0	50	CH	Clay		75	1.25	1.15	1.00	1.30	93.44	260.33	221.30	0.81	n.a.	n.a.	n.a.	0.72	0.21	1.41	0.77	n.a.	n.a.	n.a.
12	51	15.5	50	SP		1	75	1.25	1.15	1.00	1.30	93.44	290.81	236.83	0.80	74.67	0.00	74.67	0.68	0.21	1.41	0.75	2.00	2.00	2.00

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APPENDIX G – CONSTRUCTION QUALITY CONTROL / CONSTRUCTION QUALITY ASSURANCE (CQC/CQA) PLAN

PREPARED BY HANSEN, ALLEN & LUCE, INC.

MAGNUM

NGLs

CONSTRUCTION QUALITY CONTROL CONSTRUCTION QUALITY ASSURANCE (CQC/CQA) PLAN

FOR CONSTRUCTION OF BRINE PONDS

HAL Project No.: 345.03.102

February 2013

HANSEN ALLEN & LUCE INC
ENGINEERS

MAGNUM

CONSTRUCTION QUALITY CONTROL / CONSTRUCTION QUALITY ASSURANCE (CQC/CQA) PLAN

FOR CONSTRUCTION OF BRINE PONDS

GORDON L. JONES
No. 5048470-2202
2/20/13

Project Engineer

Prepared by:

Hansen, Allen & Luce, INC.
Consulting Engineers
6771 South 900 East
Midvale, Utah 84047

February 2013

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I. INTRODUCTION

Magnum NGLs, L.L.C. (Magnum) has developed this Construction Quality Control / Construction Quality Assurance (CQC/CQA) Plan to ensure that its NGLs project with its accompanying brine ponds complies with the applicable EPA and Utah Department of Water Quality (UDWQ) regulations and demonstrates that the regulatory requirements for the construction impoundment structures, including the inspection of liners, will be met. The plan is intended as a reference for both construction and regulatory personnel. The plan first discusses the project organization, responsibilities, and authority of the various personnel involved. It describes the qualifications of personnel involved in the administration and implementation of the CQA Plan. The inspection activities associated with the project are defined. It discusses meetings that should be held during the project. Finally, the plan details the documentation required to provide evidence of adherence to this plan.

The professional work and good judgment of each contractor and each employee, supplemented by strong management commitment and resources, is essential to maintaining the expected quality of construction. This CQC/CQA Plan is accepted by management of Magnum as their standard for brine pond construction. All employees shall adhere to its provisions and are encouraged to report all issues of non-conformance or of conditions affecting quality.

The process of continuous quality improvement leads to the development of a better and more responsive CQC/CQA Plan. Lessons learned from each aspect of construction, operation, and technological evaluations and updates should be used to augment or enhance Magnum s CQC/CQAS Plan. Contractors and consultants are empowered to perform to the best of their abilities and are encouraged to identify opportunities for improvement, problems, and to offer solutions to problems. Magnum management seeks continuous quality improvement and encourages and supports meeting or exceeding the expectations of customers and regulatory agencies whenever possible.

II. ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

Magnum NGLs, L.L.C. (Magnum) will be the operator of the brine ponds at their facility. As such, it recognizes that it is ultimately responsible for the design, construction, and operation of the facilities at the site. Magnum recognizes that it is responsible for complying with the requirements of the permitting agency in these activities, including providing high quality CQC/CQA that provides the proper documentation that the facility was constructed as specified in the CQC/CQA Plan. Magnum has the authority and responsibility to determine what individuals or organizations will be responsible for the design, CQA, and construction activities. Magnum also has the authority and responsibility for determining the organizational structure for these activities.

Organization and Authority

Magnum has assigned the above indicated responsibilities of overseeing all activities associated with the design and construction of their brine ponds, with specific emphasis to the CQA program, to the Project Manager. The organizational structure for the CQA program is illustrated in Figure 1. As illustrated in Figure 1, the Project Manager is ultimately responsible for all activities associated with the successful construction of the brine ponds. The construction quality assurance has been organized so that all individuals involved in construction will ultimately report to the CQA Officer, who will report to the Project Manager.

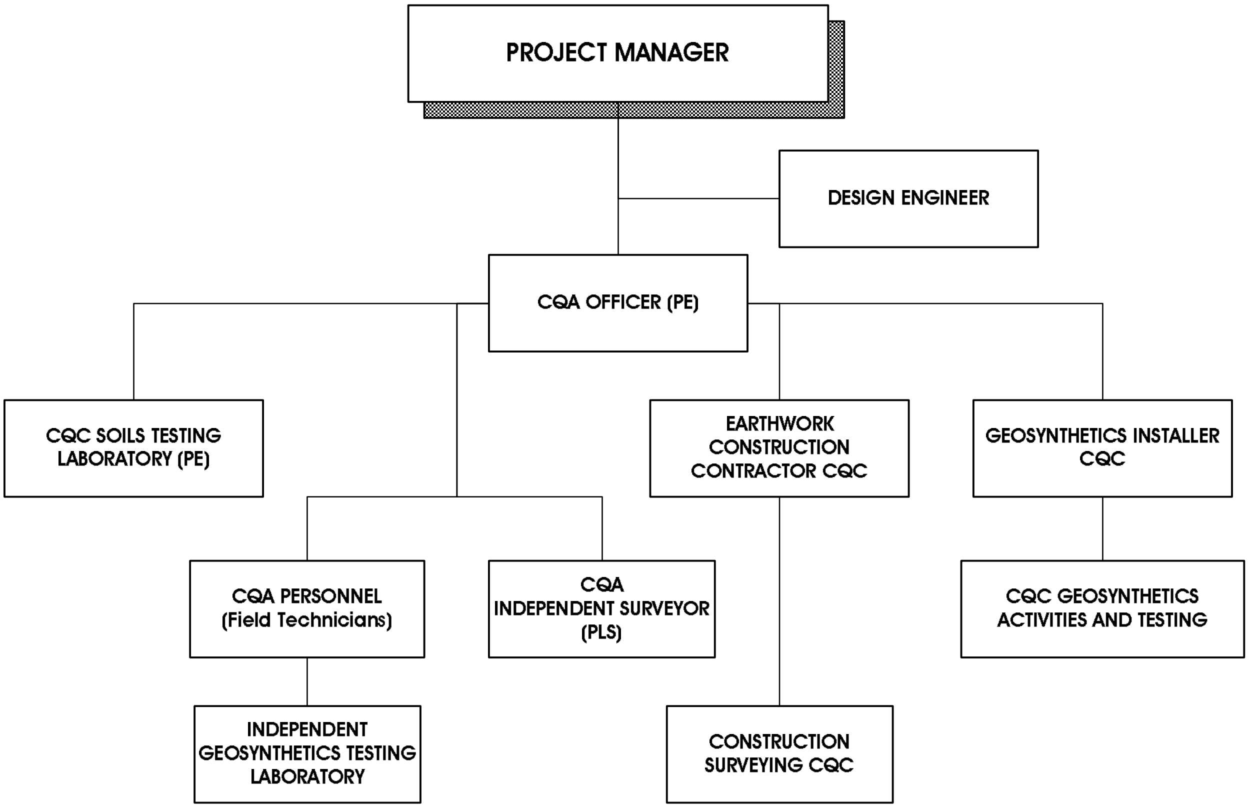
The implementation of the CQA Plan occurs through the CQA Officer. The Construction Quality Control (CQC) personnel will function independently of the CQA personnel and will be responsible for ensuring that the work items associated with the ponds are constructed in accordance with the plans and the specifications defined herein. CQC personnel will be responsible for conducting the various tests and observations within their assigned areas as specified in the CQA Plan, for documenting those tests, and for reporting and reviewing the test results with the CQA personnel.

CQA personnel will ensure that all observation and testing activities required to ensure compliance with the plans and the specifications are being carried out by CQC personnel. CQA personnel will ensure that the designated frequency of testing is being accomplished and that all aspects of the CQA Plan are being carried out. The primary responsibility of the CQA personnel will be to review the documentation prepared and/or obtained by the CQC personnel, as defined herein. The review of documentation by the CQA personnel will also include field observation of activities associated with the CQA Plan at the frequencies specified herein to ensure that the CQA Plan is being executed properly.

Responsibilities

The specific responsibilities of the various individuals or entities presented in the organizational chart of Figure 1 are presented on the following page.

FIGURE 1
CQA PROGRAM ORGANIZATIONAL STRUCTURE



Project Manager

As indicated, the Project Manager has the responsibility for overseeing all aspects associated with the design and construction of the brine ponds at the Western Energy Hub. The Project Manager assumes the responsibilities of the facility owner.

The specific responsibilities of the Project Manager include:

1. Ultimately responsible for successful design and construction of the brine ponds and for selecting and dismissing organizations or individuals charged with design, construction, CQC and CQA activities.

2. Oversee CQC and CQA activities.

CQA Officer

The Project Manager assigns the CQA Officer the specific responsibility of overseeing the construction quality assurance aspects of the project. The CQA Officer coordinates aspects of the CQA Plan with the Project Manager. In the absence of the CQA Officer from the work site, the duties and responsibilities of the CQA Officer shall be delegated to one of the CQA personnel. The CQA Officer shall have the following qualifications:

- Licensed Professional Engineer in the State of Utah
- 10 years of experience.
- Two years of similar project construction observation and management experience.

The specific responsibilities of the CQA Officer include:

1. Report directly to the Project Manager.
2. Interaction with CQC Personnel.
3. Review soils and geosynthetic materials testing documentation completeness.
4. Review of Surveying documentation.
5. Periodic site visits during the brine pond construction.
6. Responsible for activities of CQA personnel. CQA personnel will not be on-site during the earthwork construction other than periodic site visits by the CQA Officer. CQA personnel will be on-site during geosynthetics installation.
7. Verify that the CQC personnel are completing and properly documenting all on-site observations and tests required to ensure compliance with the CQA Plan. This is accomplished by verifying that CQA personnel are reviewing and approving, on a daily basis, the results of on-site observations and testing completed by the CQC personnel and that CQA personnel are satisfied that testing and observations are in accordance with the CQA Plan.
8. Review, coordinate, and approve CQA activities to ensure that testing and documentation are complete and accurate (as specified in Table 1 and Appendix A)
9. Oversee preparation of the final construction report at the completion of the project, which will be a compilation of all of the daily reports generated during the course of construction, as well as a summary report of all CQC and CQA activities.

Design Engineer

The responsibilities of the Design Engineer include those design activities which occur during the construction of the project. The specific responsibilities include the following:

1. Review and approve minor design changes to the brine ponds to meet the operational requirements of the owner and the permitting requirements of the agencies.

2. Coordinate design changes with the CQA Officer.

3. Approve corrective measures to be implemented where deviation occurs during construction from the design.

The Design Engineer has authority to work within the framework of the design and CQA Plan. The Design Engineer does not have the authority to make any decisions that would alter the design and the CQA Plan for the facility without the express approval of the CQA Officer (refer to Section V Minor Design Change Procedures) and the regulatory agency (UDWQ and UDWRi), where applicable.

Earthwork Contractor

The Earthwork Contractor will have the following qualifications:

- Licensed as a General Contractor in the State of Utah.

Specific responsibilities of the Earthwork Contractor with regard to CQC are as follows:

1. Facilitate CQC activities associated with earthwork construction.

2. Report to the Project Manager.

3. Ensure that all construction activities performed by the Earthwork Contractor and all Sub-contractors is in accordance with the project specifications and the CQA/CQC Plan.

4. Facilitate all testing required to ensure compliance with project specifications.

5. Provide for grade control and construction surveying beyond site survey controls provided.

6. Ensure that all regulatory requirements associated with construction activities and the construction contract are met.

7. Obtain all required environmental and safety permits required by regulations (including but not limited to dust control, storm water pollution prevention, health and safety, etc.)

Construction Quality Assurance (CQA) Personnel

The Construction Quality Assurance (CQA) personnel will work under the direction of the CQA Officer to ensure that the CQA Plan is executed properly. The CQA personnel will ensure that all observation and testing activities required to ensure compliance with the CQA Plan are being carried out by the CQC personnel. The authority of the CQA personnel will be limited to the performance of observation and documentation requirements of the CQA Plan. The CQA personnel will not have the authority to modify in any way the design or requirements of the CQA Plan. The CQA personnel will have authority to stop work as per the directive of the CQA Officer. Specific responsibilities of the CQA personnel include the following:

1. Conduct all reviews and observations defined in the CQA Plan that have been established as measures to determine the effectiveness of all testing, observations, and controls conducted or established to ensure a quality outcome for the construction of the cells and closure caps. This includes daily reviews of the results of all testing and observations conducted by CQC personnel as defined herein. It includes additional observations required to be conducted by CQA personnel directly to ensure compliance of the CQC personnel with testing and observation requirements.

2. Verify that the equipment used in testing has been calibrated.

3. Ensure that all required testing is conducted in accordance with the CQA Plan.

4. Report to the CQC personnel immediately the results of observations and tests that fail to meet the CQA Plan.

5. Verify that corrective action has been taken (where required) and recorded on the daily construction reports.

6. Prepare and assemble the required documentation of the results of on-site observations, testing, and reviews conducted by CQC and CQA personnel.

7. Provide the results of on-site observations, testing, and documentation of the work in progress to the CQA Officer.

Geosynthetics Installer Contractor

The Earthwork Contractor will have the qualifications set forth in the CQA/CQC Plan (Table 1).

The geosynthetics installer will provide CQC according to the following:

1. Perform all CQC activities defined in this CQA/CQC Plan for geosythetics installation.

2. Report to the Project Manager and interaction with the CQA Officer and CQA personnel.

3. Provide all submittals regarding qualifications, personnel, materials, etc. required by the specifications and this CQA/CQC Plan to the CQA Officer.

4. Provide all documentation and required testing associated with installation of geosynthetic materials as defined in this CQA/CQC Plan. Document the results of all required testing and submit the documentation to the CQA Officer.

Independent Geosynthetics Testing Laboratory (CQA)

The independent geosynthetics testing laboratory will provide CQA according to the following:

1. Perform all CQA activities defined in this CQA/CQC Plan for independent geosythetics testing.

2. Report to the CQA Officer and Project Manager.

3. Provide testing of geosynthetic materials required of the independent geosynthetics testing laboratory as defined in this CQA/CQC Plan. Document the results of all required testing and submit the documentation to the CQA Officer.

Soils Testing Laboratory (CQC)

The soils testing laboratory will provide CQC and will have the following qualifications:

- Necessary equipment and personnel to conduct required testing.

- Licensed Professional Engineer in the State of Utah in charge of all testing activities.

The soils testing laboratory will provide CQC testing according to the following:

1. Report to the Project Manager and interaction with the CQA Officer for field CQC testing of soils.

2. Provide all documentation and required testing associated with soils placement as defined in this CQA/CQC Plan and in the specifications. Document the results of all required testing and submit the documentation to the CQA Officer.

3. Prepare and submit a report to the CQA Officer certifying the results of all materials testing performed by the Soils Testing Laboratory. Provide a Professional

Engineer seal on the certification report by the Professional Engineer responsible for soils testing activities certification report.

Independent Survey (CQA)

The surveyor will provide CQA and will have the following qualifications:

- Necessary equipment and personnel to conduct required survey.
- Registered Land Surveyor in the State of Utah.

The surveyor will provide CQA survey according to the following:

1. Report to the Project Manager and the CQA Officer.
2. Provide surveying if requested by the CQA Officer to document grade controls and grading tolerances from design lines and grades.
3. Provide certification of all survey documentation.

III. PROJECT MEETINGS

Meetings should be held during the project to enhance communications between personnel responsible for design, inspection, and construction of the project. These meetings will include a pre-construction CQA meeting and weekly construction/CQA meetings.

Pre-Construction CQA Meeting

Pre-construction CQA meetings should be held prior to the commencement of soils-related construction activities and geosynthetics-related installation activities for the project. Those to attend should include the Project Manager, CQA Officer, CQC and CQA personnel, and the earthwork construction contractor and liner installation contractor, as appropriate. Copies of the CQA Plan should be distributed to the above indicated parties prior to the pre-construction CQA meeting. Minutes of the meeting should be prepared and transmitted to all personnel in attendance. The CQA Officer should notify the UDWQ and UDWRi of the proposed pre-construction meeting date. Items to be discussed in this meeting should include, but not be limited to:

1. Familiarizing each organization with the CQA Plan and their role relative to the CQA Plan.
2. Reviewing the responsibilities, lines of authority, and communication of each organization.
3. Discussing the procedures for observations and testing (as specified in Table 1 and Appendix A).
4. Discussing procedures for handling construction deficiencies, repairs, and retesting.
5. Reviewing methods for reporting and documenting testing and inspection activities.
6. Reviewing methods for distributing and storing documents and reports.
7. Identifying work areas and equipment and materials storage areas.
8. Identifying required submittals for the project.
9. Discussing procedures employed by soils contractor and/or geosynthetics installer to train operators and/or technicians to provide a quality work product.

Weekly Construction/CQA Meetings

Meetings should be held approximately once per week to discuss the progress of the project during both earthwork construction and liner installation. Those to attend should include the CQA Officer, a representative of the CQC personnel, a representative of the CQA personnel, and a representative of the contractor (as needed). When earthwork and liner installation are happening at the site simultaneously then the weekly meeting will combine CQA and construction update discussions for both earthwork and liner installation. Additional meetings can be called by the CQA Officer to address critical problems. Items to be discussed in this meeting should include, but not be limited to:

1. Discussing the CQC, CQA, and construction activities and accomplishments of the previous week.

2. Exchanging, reviewing, and discussing required documentation of construction, observation, and testing activities.

3. Defining and discussing problems or deficiencies associated with the work and CQC and CQA activities. Documenting problems or deficiencies discussed in the CQC file.

4. Reviewing alternative solutions.

5. Implementing corrective actions to resolve problems or deficiencies.

CQA personnel should prepare minutes of the meeting for distribution to all attending parties.

IV. INSPECTION ACTIVITIES

This section of the CQA Plan describes the inspection activities (observations and tests) that will be performed by the CQC and CQA personnel during the construction and installation of the work elements associated with the project.

Table 1 provides the specific requirements of the CQC/CQA Plan for the pond construction for both the earthwork and the liner installation and includes the major work elements that comprise the project; the specifications governing each work element; the CQC activities to be performed in a timely manner to ensure a quality outcome of each work element; and the CQA activities to be performed in a timely manner to determine and ensure the effectiveness of the CQC activities. Table 1 identifies the observations and tests to be conducted by the CQC and CQA personnel, the frequency of observations and tests, the acceptance/rejection criteria that will be used in the evaluation of the tests, and how the observations and tests are to be recorded and documented. Table 1 may also refer to tests and frequencies located in the technical specifications for the project.

Measuring and testing equipment (M&T) used for critical items of construction must be controlled in order to ensure the quality outcome of the project. M&T equipment used for critical items of construction include the nuclear gage, scales, sealed single ring infiltrometer used by the CQC personnel associated with the testing of the soils related aspects of the project, surveying equipment used by the surveyor in checking and controlling construction grades, pressure gages used in the non-destructive testing of the HDPE liner welds and tensiometers, for peel and shear tests of HDPE welds. The M&T equipment is provided to the project by the firm that provides the CQC services. This equipment is to be calibrated annually at a minimum. At the beginning of the project, the CQC firm will provide the CQA personnel with documentation confirming that the equipment has been calibrated. This documentation will be included in the construction documentation report at the completion of construction of the project.

V. MINOR DESIGN CHANGE PROCEDURES FOR EITHER EARTHWORK OR LINER

This section describes the procedure for initiating and approving minor changes in a timely manner necessary to maintain or enhance quality during construction. As the need for minor changes occurs, they must be controlled by both Magnum and by the regulatory agency. A minor change can be defined as changes that do not decrease the environmental protection or stability of the unit (minor changes will not include decreasing the number or thickness of liners, changing lining requirements, providing steeper sideslopes, etc.).

Mutual agreement between the regulatory authority and Magnum as to the proposed change will normally occur prior to submission of supporting documentation to the regulatory agency for processing. The following procedures will be applicable:

1. The need for a design change, engineering, or construction changes may become apparent during the course of construction of the project and a request for a change may be initiated by any individual associated with the project.

2. All proposed design engineering and construction changes will be reviewed and approved by the Design Engineer and the Project Manager. If approved, the Project Manager will provide documentation to the CQA Officer indicating that the proposed change(s) will meet the minimum quality requirements of the project.

3. The Project Manager will review and approve or disapprove the proposed change(s) based on the documentation and recommendation of the Design Engineer.

4. If the Project Manager approves the proposed change(s), verbal notification of the proposal should be made to the Utah Department of Water Quality (UDWQ) and Utah Division of Water Rights (UDWRi). The scope of the proposal will be discussed to obtain a mutual understanding and agreement as to the proper type of change action.

5. All documentation submitted to the agencies regarding change(s) will be included in the construction documentation report. Record Drawing details of the project will be prepared that will reflect approved changes.

VI. DOCUMENTATION

Documentation of construction and inspection activities associated with the CQA Plan will consist of daily recordkeeping and a final report to be prepared under the direction of the CQA Officer. Daily reporting procedures associated with the CQC and CQA activities are described based on specific work elements in Table 1 of the CQC and CQA activities section and are to be performed in a timely manner.

The results of testing and observations as recorded on the daily construction reports will be reviewed and accepted by the CQA Officer or his designee. Acceptance of the daily construction reports will consist of either counter-signing the forms directly or having one of the CQA personnel sign the forms indicating that they have been reviewed and accepted on behalf of the CQA Officer. During the construction of the facility, the CQA Officer will be responsible for maintaining and storing the originals or copies of all data sheets and reports that are generated in carrying out the CQA Plan as identified herein. The Project Manager will review and approve of the construction reports and documentation at appropriate intervals as the project progresses.

Results of all material tests and daily inspection reports will be submitted to the UDWRi on a weekly basis during the construction phase.

The CQA Officer will direct the preparation of a final construction documentation report at the completion of the project. This report will contain all of the documentation associated with the daily reporting procedures, as well as the following summary reports:

1. CQA Report
2. Soils Report Completed by CQC Soils Testing Laboratory
3. Synthetic Liner Report Completed by the Geosynthetics Installer Contractor
4. "Record" Drawings

The CQA report will provide a summary of CQA activities and will demonstrate that the construction satisfied the CQA Plan and applicable State and Federal regulations. The CQA report will provide an evaluation of the degree of reconciliation between non-conforming work and the specifications as defined in the CQA Plan and the ability of the CQA program to meet the quality objectives of the CQA Plan.

The Soils Report will provide a summary of the soils observation and testing aspects of the construction or closure project. The report will certify that the soils portions of the pond were constructed in accordance with the CQA Plan and any field design, engineering, or construction changes made in accordance with the minor change procedures.

The Synthetic Liner Report will include a summary of the synthetic liner observation and testing aspects of the project. The report will certify that the synthetic liner portions of the pond are constructed in accordance with the CQA Plan and any field design, engineering, or construction changes made in accordance with the minor change procedures. The Synthetic Liner Report will be certified by the geosynthetics installer.

The Final Report will be reviewed and approved by the Project Manager and will be submitted to the UDWQ and UDWRi following the completion of the project. The CQA Officer must certify that the CQA Plan has been successfully carried out.

TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

EARTHWORKS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	Review geotechnical investigation report to become familiar with the expected site conditions.	Review geotechnical investigation report to become familiar with the expected site conditions.
CLEARING & STRIPPING: Remove all organic and objectionable materials to the limits shown on the Drawings or as required by the Engineer. Stripping is defined as the removal of topsoil, which shall be defined as soil of any gradation or degree of plasticity that contains significant quantities of visually identifiable plant matter, sod, roots, or humus as determined by the engineer. Prior to any surface treatment on a stripped area notify CQC so that inspection of area may be completed.	Observe and document the clearing and stripping operation. Ensure soft and yielding spots are corrected by drying and recompacting the material or are removed and disposed of as directed by the CQA Officer. Ensure material so removed is replaced with a suitable material and is compacted to the density requirements. Provide daily observation until task is completed. Record observations and corrective actions taken on "Daily Construction Reports". Provide CQA personnel with copies of "Daily Construction Reports" and obtain their signature on reports indicating acceptance. Ensure that corrective actions required by CQA personnel are accomplished.	Observe area when task is complete. Review daily reports generated by CQC personnel. Report deficiencies to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Reports". Record findings of observations, review, and actions taken.
GRADING/EMBANKMENT FOUNDATION PREPARATION: Grade all work areas according to the limits shown on the drawings and as described in the technical specifications. All standards laid out in technical specifications are to be met. Areas of unsuitable material shall be excavated to the limits designated by CQC and replaced with compacted random fill. No fill material shall be placed on the foundation without prior approval of the State Engineer. Arrangements to place such fill shall be made with the State Engineer s personnel sufficiently in advance to avoid construction delays. Any conditions that differ appreciably from those assumed during design must be reported to the State Engineer before work continues.	Ensure sub-grade is prepared according to technical specifications. Conduct in-place moisture and density tests. Testing is to be conducted at the frequency and using applicable methods as indicated in technical specifications. The location of the tests shall be chosen on a random basis. 1. Approve areas with tests indicating a density ≥ 95.0% 2. Approve areas with moisture contents from minus (-) 2.0% to plus (+) 2.0%. 3. Identify each area that does not meet compaction criteria and verify the area is brought into compliance via the contractor reworking the area. 4. Retest areas reworked and approve areas meeting criteria of "1" above. 5. Continue reworking and retesting until the area meets criteria of "1" above. 6. Record all results and corrective actions taken on "Daily Construction Reports . 7. Provide CQA personnel with copies of the "Daily Construction Reports" and obtain their signature on Reports indicating acceptance. 8. Ensure that corrective actions required by CQA personnel are accomplished. Ensure that areas of unsuitable material as defined in technical specification are removed.	Review density test results recorded on Daily Construction Reports . 1. Verify frequency of tests. 2. Verify that compaction in areas accepted is at least 95.0%. 3. Verify that the moisture content in areas accepted is within the range of minus (-) 2.0% to plus (+) 2.0% of the optimum moisture content. Report deficiencies to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Reports . Record findings of observations, review, and actions taken. Send the results of all material tests and daily inspection reports to the UDWRi on a weekly basis and to UDWQ as requested.

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

EARTHWORKS

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
EXCAVATIONS AND BORROWS: Remove vegetation, debris, organic, or deleterious material from excavation and borrow areas and other activities as stated in technical specifications. If historical resources such as human remains (skeletons), prehistoric arrowheads/spear points, waste flakes from stone tool production, pottery, ancient fire pits, historical building foundations/remains, artifacts (glass, ceramic, metal, etc.) are found, call the Utah Division of State History at (801) 533-3555.	Observe excavation and borrow areas once they has been cleared and grubbed. Record observations and corrective actions taken on "Daily Construction Reports". Provide CQA personnel copies of "Daily Construction Reports" and obtain their signature on reports indicating acceptance. Ensure that corrective actions required by CQA personnel are accomplished. Observe that no historical resources are found.	Observe excavation and borrow areas when task is complete. Review daily reports generated by CQC personnel. Report deficiencies to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Reports." Record findings of observations, review, and actions taken.
EMBANKMENT AND BACKFILL: Embankment and backfill material will be placed with heavy construction equipment and will be compacted to at least 95% of the Standard Proctor density as determined by ASTM D-698 with a moisture content of minus (-) 2.0% to plus (+) 2.0% of the optimum moisture content. Material compacted with hand operated tampers will be compacted to 95% of the maximum dry density as determined by ASTM-D-698 with a moisture content of minus (-) 2.0% to plus (+) 2.0% of the optimum moisture content.	Conduct in-place moisture and density tests. Testing is to be conducted using applicable methods and at a frequency indicated in the technical specifications. The location of the test site shall be chosen on a random basis. 1. Approve areas with tests indicating a density □ 95.0%. Approve areas with moisture content from minus (-) 2.0% to plus (+) 2.0% of the optimum moisture content. 2. Identify each area that does not meet compaction criteria and verify that the area is brought into compliance via the contractor reworking the area or by removing and replacing the material. 3. Retest areas reworked or for which material was removed and replaced, and approve areas meeting criteria of "1" above. 4. Continue "2" and "3" until the area meets criteria of "1" above. 5. Record all results and corrective actions taken on "Daily Construction Reports . 6. Provide CQA personnel with copies of the "Daily Construction Reports and obtain their signature on reports indicating acceptance. 7. Ensure that corrective actions required by CQA personnel are accomplished.	Review density test results recorded on the Daily Construction Reports . 1. Verify frequency of tests. 2. Verify that compaction in areas accepted is □ 95.0%. Verify that the moisture content in areas accepted is (-) 2.0% to plus (+) 2.0% of the optimum moisture content. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Observation and Testing" reports. Record findings of observations, review, and actions taken. Send the results of all material tests and daily inspection reports to the UDWRi on a weekly basis and to UDWQ as requested.
PLACEMENT: Backfill and fill shall be placed in uniform lifts. A lift is defined as 8 inches or less in loose depth for material compacted by heavy compaction equipment, and 4 inches or less in loose depth for material compacted by hand-operated tampers. In anchor trenches, the first lift shall be placed not more than 12 inches in loose depth with subsequent lifts placed 4 inches in loose depth. Where backfill is placed around pipes, the first lift will be	Observe material as it is placed. Record observations and corrective actions taken in "Daily Construction Reports" throughout fill placement. Provide CQA personnel with copies of the "Daily Construction Reports" and obtain their signature on reports indicating acceptance. Ensure that corrective actions required by CQA personnel are accomplished.	Review daily reports generated by CQC personnel. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Reports." Record findings of observations, review, and actions taken.

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TABLE 1   BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

EARTHWORKS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
placed to a depth slightly higher than the spring-line of the pipe, to prevent displacement of the pipe.		
If the ambient air temperature is less than 32 degrees Fahrenheit for more than 2 hours over the preceding 24 hours the temperature of any fill materials being placed must be measured to determine if fill is frozen. The contractor may either remove and replace frozen fill or wait until subsequent temperature monitoring indicates the fill is unfrozen, prior to placing additional materials.	Ensure fill is not frozen my measuring the temperature of in-place fill according to technical specifications. Construction may not continue without corrective action. Record observations and corrective actions taken in "Daily Construction Reports." Provide CQA personnel with copies of the "Daily Construction Reports" and obtain their signature on reports indicating acceptance. Ensure that corrective actions required by CQA personnel are accomplished.	
GRADING: In-place embankment materials and natural soils shall be fine graded to the designed elevation and typical sections. Acceptable grading tolerance limits for finished embankment surfaces shall be as follows: 1. Finish grades and slopes for the embankment and basin shall be in general conformance with the Drawings. Deviations from finished grades/slopes are subject to approval by CQC and shall not result in low spots; pockets; non-uniform slopes or contours; or result in slopes which deviate by more than 1% from the design; or result in slopes of less than 0.5% within the basin. 2. The maximum permissible combined horizontal and vertical deviation of the perimeter boundaries of the embankment from the lines and grades shown on the Drawings or as required by CQC shall be 36 inches 3. The finished surface of the basin prepared surface shall not deviate vertically by more than 4 inches than the lines and grades shown on the drawings. 4. The elevation and width of the embankment crest shall not be less than the dimensions shown on the Drawings or required by CQC.	Review certified record survey for compliance to CQA Plan. Document results in Daily Construction Report .	Ensure a licensed surveyor conducts survey at completion. Survey points will be on at least a 50 foot grid and at all control points. Surveyor shall indicate where the embankment meets the design line and grade. Deficiencies shall be reported to the CQC personnel. Once corrective action has been taken the deficient area will be re-surveyed to verify line and grade. Final survey measurement will be documented, certified, and provided to the design engineer and the CQA Officer. Review final survey data. Verify the frequency of survey measuring points. Verify that the surveyor certified that the construction is to the specified line and grade. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Record findings of observations, review, and actions taken.
ANCHOR TRENCH: The anchor trenches shall be completed in accordance with the drawings. Smooth out or cushion rough areas of the trench prior to placement of the geomembrane in the trench. The geomembrane shall be seamed or welded through the bottom of the anchor trench. Acceptable backfill shall be select native clay and	Periodically inspect backfill materials, welding of geomembrane in anchor trench, & lift thickness. Test primary anchor trench backfill for density and moisture content at a rate of one test per 200 feet of trench per lift of backfill.	Observe and document that welding of geomembrane materials in the anchor trench is completed as specified.

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

EARTHWORKS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
silt materials and shall not consist of sand or other coarse grained materials. The backfill shall be placed in an initial twelve inch lose lift. Subsequent lifts shall be six loose inches. The backfill will be placed and compacted to 95% of the maximum dry density by ASTM D-698		

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
REQUIREMENTS PRIOR TO LINER PLACEMENT: Prior to geomembrane installation, the liner manufacturer and installer contractor shall provide the CQA and CQC personnel: 1. Quality Control Certificates: Each roll of liner must have a unique identification number, an indication of thickness, length, width, and manufacturer s name. A QC certificate must be provided for every 25,000 square feet of material manufactured consecutively. A certificate will be provided for each roll that was not produced consecutively. If liner certificates indicate material does not meet the specifications defined in the Technical Specifications, the material is to be marked conspicuously and removed from the construction area. 2. Polymer Raw Material Certificates: The liner manufacturer is to supply certification that the resin meets the density specification defined in the Technical Specifications and that it is all from the same manufacturer. 3. Welding Rod Certification: The welding rod manufacturer is to provide certification that the rod is of the same polymer as the sheet and from the same manufacturer. 4. Résumé of Installation Supervisor: Installation supervisor is to have prior experience supervising installation of a minimum of ten (10) million square feet of liner. 5. Installer s Quality Control Manual.	Review installer s Quality Control Manual to ensure adherence to the stricter of the guidelines between the installer s manual and the Engineers Technical Specifications. Review required submittals for compliance with specifications. Rolls of liner not meeting specifications are to be marked conspicuously and moved to a location designated by the CQA personnel. Rolls of liner shall not be deployed until approval has been received from the CQA personnel indicating that the rolls meet specifications. Submit a copy of the installer s Quality Control Manual to the Engineer and to CQA personnel.	Review installer s Quality Control Manual to ensure adherence to the stricter of the guidelines between the installer s manual and the Engineers Technical Specifications. The Lead technician over CQA personnel shall have a minimum of 10,000,000 square feet of geosynthetics CQA experience. Receive, review, and approve required submittals prior to allowing liner to be deployed in landfill. Review the results of the required submittals with the CQA Officer. 1. Document roll numbers and quality control certificates received. Note any rolls not meeting specifications and document that roll was removed from the construction area. 2. Document the polymer raw material certificates received and the package number of the polymer raw material certificates with corresponding roll numbers to which it pertains. 3. Ensure that the welding rod certification is received and included in the documentation record. 4. Provide documentation to CQC personnel noting which rolls of liner were approved and installation supervisors and master welders that have been approved.
GEOMEMBRANE LINER SUBSURFACE PREPARATION: The surfaces on which the HDPE liner is to be placed is to be free of sharp particles, rocks, or other debris that might damage the overlying geosynthetics. Sharp objects shall be removed by raking, sweeping or handpicking as necessary. No standing water shall be allowed.	Activities identifying the requirements for surveying to check grades of the surfaces are identified under the earthwork section of this table. In addition to these requirements, CQC personnel and the liner contractor are to observe the surface which will form the subgrade. The contractor is to certify in writing that the surface on which the HDPE liner is to be installed is acceptable.	Activities regarding grading are identified under the earthwork section of this table. Observe the subgrade for the HDPE liners with the CQC personnel and the liner contractor. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Reports." Countersign "Daily Construction

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	Record observations and corrective actions taken on the "Daily Construction Reports." Provide CQA personnel with copies of the "Daily Construction Reports" and obtain their signature on reports indicating acceptance. Verify that corrective actions required by CQA personnel are accomplished.	Reports" indicating documentation is adequate, correct, and has been accepted by CQA. Record findings of observations, reviews, and action taken.
HANDLING OF GEOMEMBRANE LINER: HDPE liner shall be labeled with manufacturer, thickness, and roll number prior to shipment to the site. When transported to the site, the HDPE liner shall be handled by appropriate means so that no damage is caused to the liner. Transportation to the site shall be the responsibility of the installer. On-site unloading, storage, and handling are the responsibilities of the installer. Liner materials shall be stored in a location away from possible sources of deterioration. Appropriate handling equipment shall be used to move HDPE liner. The liner shall not be dragged on the ground. Persons walking or working on the geomembrane shall not engage in activities or wear shoes that could damage the geomembrane liner.	Review HDPE liner rolls to ensure that they are labeled according to the specifications. Ensure HDPE liner is handled according to specifications.	Note any rolls not labeled properly and have them removed from the construction area. Observe and document that the HDPE rolls are handled according to the specifications.
GEOMEMBRANE LINER PLACEMENT: Prior to installation, the liner contractor shall present to the CQA Officer a liner placement plan. The plan shall indicate the panel configuration and location of seams. Seams shall be oriented parallel to the line of the maximum slope. Seams placed in high stress areas will be minimized (i.e., cell corners, parallel with the top of the embankment, or at the toe of the side slopes). No seams shall be placed parallel to and within 10 feet of the toe of the slope. The installer shall take into account that frequent high winds may result in delays. The installer shall take all necessary measures to ensure that each panel is sufficiently ballasted to prevent damage or movement by wind. The panels shall be secured temporarily with sandbags or other approved ballasting method to hold them in place until the field seams have been completed and the geomembrane liner has been permanently anchored. Fusion of panels and repairs will only be permitted under weather conditions allowing work that is in conformance to	Review liner placement plan and submit plan to the CQA officer for approval.	The CQA Officer is to review the liner placement plan and approve or disapprove the plan. The CQA Officer is to review and approve any modifications to the proposed layout plan during construction. Observe panel deployment and verify that the placement specification items have been met. Review the panel deployment forms for accuracy and completeness. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on the form. Record findings of review and actions taken. Countersign form indicating acceptance of documentation and accuracy and completeness of data. Include copy of executed form in CQA documents.

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
the specifications and within the warranty limits imposed by the manufacturer and to the approval of the Engineer.		
The liner is to be placed as closely as practical to the layout plan. The installer shall give each field panel an identification code number consistent with the layout plan. The record drawing will be updated to reflect any modifications to the layout plan. Care shall be exercised to not damage the HDPE liner during installation.	Observe that the liner is placed in accordance with the approved layout plan. Advise the CQA Officer of contractor-proposed modifications. Maintain a record drawing showing the placement of the panels. Document the deployment of the panels on the appropriate form.	Observe that the liner is placed in accordance with the approved layout plan. Maintain a record drawing showing the placement of the panels.
Rolls are to be inspected as they are unwound for equipment damage, holes, blisters, thin spots, undispersed raw materials, or any signs of contamination by foreign material. Note: In several instances, visual defects (such as blisters) are small enough that the repair of a visual defect may consist of placing a bead of extrudate from the extrusion welding gun over the visual defect. Welding beads placed to repair such visual defects are not considered extrusion welding and therefore do not require vacuum testing. Any form of hole or penetration through the liner must be patched with a liner cap which must be vacuum tested.	Observe the liner as the rolls are unwound for holes, blisters, thin spots, undispersed raw materials, or any signs of contamination by foreign material. Mark roll number conspicuously on the panel and then more closely inspect the panel for defects. Mark defective areas found for repair or removal. Document that defective areas were repaired.	Observe the liner as the rolls are unwound for holes, blisters, thin spots, undispersed raw materials, or any signs of contamination by foreign material. Mark roll number conspicuously on the panel and then more closely inspect the panel for defects. Mark defective areas found for repair or removal. Document that defective areas were repaired.
WELDING: The double-wedge fusion welding process shall be used unless alternate methods are approved by the Engineer. Extrusion welding will be permitted to weld short seams, to repair small areas, where double-wedge welding is not feasible, and where test samples have been removed.	Document the type of weld, the date welded, and the welding technician for each seam on the appropriate form.	Review results recorded on CQC and CQA forms for accuracy and completeness.
No welding equipment or operator shall perform production welds until equipment and operator have successfully completed a trial weld. Trial welds shall be completed under the same surface and environmental conditions as the production welds. A minimum of two trial welds per day per welding apparatus shall be completed one prior to the start of work and one at mid-shift or for every 5 hours of seaming operations. Five 1-inch-wide-by-6-inch-long test strips will be cut from the trial weld and will be tested for peel adhesion and for bonded seam strength. Trial weld specimens shall pass when the results shown in Table 4 of the Geomembrane technical specifications in both peel and shear tests and the break, when peel testing, occurs by Separation in the Plane of the sheet (SIP), not through adhesion failure separation (AD) and the break is ductile. The trial weld is to be repeated in its entirety when the trial weld samples fail in either peel or	Observe pre-weld testing and record results on the appropriate form. Ensure that problems are corrected and actions taken to correct problems are recorded.	Observe pre-weld testing. Review results recorded on CQC forms for accuracy and completeness. Report deficiencies (if any) to CQC personnel and the CQA Officer and record communications. Verify that corrective action has been taken (where required) and recorded on the above form. Record findings of review and actions taken. Countersign forms indicating acceptance of documentation and accuracy and completeness of data. Include copy of executed forms in CQA documentation.

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
shear as defined on Table 4, footnote 2 of the Geomembrane technical specifications. After any second pre-weld test failure, two consecutive pre-weld samples must be made, tested, and have passing results before that particular technician/equipment combination is put into production welding.		
Seams shall be cleaned of dust, mud, moisture, and debris immediately ahead of welding apparatus and shall be aligned consistent with the requirements of the welding equipment being used. Overlap shall be 4 to 6-inches for double wedge welded seams and 6-inches for extrusion welded seams unless approved otherwise by the Engineer. No overlaps shall be placed parallel to and within 10 feet of the toe of the embankment. Seams must be aligned with the fewest amount of wrinkles or fishmouths.	Observe seams prior to welding to ensure compliance with the specifications.	Review results recorded on CQC and CQA forms for accuracy and completeness.
NON-DESTRUCTIVE SEAM TESTING: All production welding using the Fusion Weld method will be tested using the "Seam Air Pressure Test", while seams using the extrusion process will be tested by vacuum testing or electrostatic spark testing. Procedures for the non-destructive testing as well as procedures for repairing or patching the seams in the event of failure are presented in the technical specifications.	Perform non-destructive testing of welds. Record and document the results of the non-destructive seam testing on the appropriate form. Mark each panel with initials and date inspected at the end of each panel. Mark any area showing a defect and repaired in accordance with the applicable repair procedures.	Observe the testing performed by the CQC personnel on the seam welds. Where defective results are obtained, require and verify that the seams are repaired in accordance with the requirements presented in the technical specifications. Review daily the forms prepared by CQC personnel.
DESTRUCTIVE SEAM TESTING: Seams of the installed geomembrane shall be destructively tested including patches and repair areas in accordance with technical specifications. Destructive testing is to be accomplished by cutting a sample of a seam for the purpose of verifying conditions through field and laboratory testing. One sample of destructive testing will be cut from seams at least every 500 linear feet or part of 500 feet if the part is 50 feet. The sample shall be taken by cutting perpendicular to the seams a sample approximately 36 by 12 inches. These samples shall be tested on site for peel and shear seams strength and thickness in accordance with D6392. 20% of these samples shall also be sent to an independent third party laboratory to be tested. The third party laboratory shall perform the tests required in the technical specifications.	Obtain samples for destructive testing at the intervals indicated. Pass/fail criteria will be according to GRI GM-19. Number each sample obtained and document the seam number associated with the sample, the seam length, the sample number, the sample location, etc. on the appropriate forms. Record sampling locations on the liner placement plan. Divide the sample into three approximately 12 inch x 12 inch samples, one of which is to be tested in the peel and shear modes. The other samples are to be divided between CQA personnel and the owner of the facility.	Accompany CQC personnel and designate sampling locations in accordance with required frequency. Review the forms prepared by the CQC personnel to ensure that sample numbers with corresponding information have been properly recorded. Verify that indicated locations for samples on the form correspond with locations in the field by observation and measurement. Resolve any discrepancies with CQC personnel. Archive samples (approximately 12 inches x 12 inches or portions thereof) as directed by the CQA Officer. The CQA Officer shall send 20& of destructive samples to third party laboratory for testing and review results to confirm independent testing meets specifications and confirm passing/failing results to CQC personnel.
ANCHOR TRENCH: The anchor trenches shall be completed in accordance with the drawings. Smooth out or cushion rough areas of the trench prior to placement of	Periodically inspect backfill materials, welding of geomembrane in anchor trench, & lift thickness. Test primary anchor trench backfill for density and moisture	Observe and document that welding of geomembrane materials in the anchor trench is completed as specified.

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
the geomembrane in the trench. The geomembrane shall be seamed or welded through the bottom of the anchor trench. Acceptable backfill shall be select native clay and silt materials and shall not consist of sand or other coarse grained materials. The backfill shall be placed in an initial twelve inch lose lift. Subsequent lifts shall be six loose inches. The backfill will be placed and compacted to 95% of the maximum dry density by ASTM D-698	content at a rate of one test per 200 feet of trench per lift of backfill.	
REPAIR PROCEDURES: Damaged or defective geomembrane or seam areas failing a destructive or non-destructive test shall be repaired. The Installer shall be responsible for repair of damaged or defective areas. The repair method shall be decided by the installer but shall be decided agreed upon by the Engineer.	Perform non-destructive testing on the seams of all patches and caps. Where defective results are obtained, require, verify, and document that seams are repaired. Record and document observations on the appropriate form. Perform field peel and shear testing on coupons taken from the samples as indicated above. Record the results of the peel and shear testing on the appropriate form. If a sample fails the destructive testing, then the following shall be done: 1. Two coupons shall be taken from the same seam approximately 10 feet from each side of the original sample. The coupons are to be tested for peel & shear. 2. If any one of the coupons fails to meet the passing criteria, more coupons will be taken at a distance away from the failure at the discretion of the CQA personnel. The coupons are to be tested for peel & shear. 3. Item b. is to be repeated until it is determined that the extent of the defective seam has been defined. 4. When the extent of the defective seam has been defined, a regular 36" x 12" sample will be taken at the perceived end of the defect for testing. 5. Each sample hole and coupon hole shall be individually patched, then the entire length of the defective seam, including the patches, shall be capped; or each sample hole and coupon hole shall be individually patched, then the entire length of	Inspect, on a daily basis when the activity is occurring, patches and caps prior to welding to ensure that seams are clean, dry, and have adequate overlap, as per the specifications. Observe seams for excessive grinding. Observe the non-destructive testing performed by CQC personnel. Where defective results are obtained, require and verify that seams are repaired. Review daily the forms prepared by CQC personnel. Observe, on a daily basis when the activity is occurring, the peel and shear testing conducted by the CQC personnel. Determine, based on the pass/fail criteria, whether or not the peel and sheer tests have passed or failed. Review daily the form prepared by CQC personnel to ensure that the results are immediately recorded and are recorded accurately. Obtain copies of the report for the CQA file. Ensure destructive testing is completed in accordance with the criteria set forth under the CQC column in the event that destructive testing indicates a failure. Designate required additional sampling locations to CQC personnel. Review daily destructive seam testing forms prepared by CQC personnel to ensure that sample numbers with corresponding information have been properly recorded. Verify that the indicated locations for samples on the form correspond with locations in the field by observation and measurement. Resolve any discrepancies with the CQC personnel. Once each page of the above indicated form is complete and the CQA personnel have reviewed and accepted the results indicated on the form, the CQA personnel shall approve data thereon. A copy of the forms are then retained for CQA documentation. Compare peel and shear testing results with the acceptance-rejection criteria to ensure that welds meet the criteria. Review the above indicated forms to ensure that the results have

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TABLE 1 BRINE POND CONSTRUCTION INSPECTION ACTIVITIES

GEOMEMBRANE LINERS		
SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	defective seam between holes previously patched and vacuum tested shall be either capped and vacuum tested or, if the seam was welded using the fusion welding method, the loose flap of the upper sheet (which extends beyond the outer track) shall be extrusion welded to the bottom sheet and vacuum tested. In the latter case, where the loose flap of the upper sheet is extrusion welded to the bottom sheet, the extrusion weld becomes the primary seam.	been recorded. Follow procedures indicated above if results indicate a seam failure.
CERTIFICATION: At the completion of the geomembrane installation the installer shall provide the Owner with a certification stating that the geomembrane was installed and tested in accordance with the Specifications together with a report of the test results.	Provide Owner with the certification and the report of the test results as a digital and hard copy prior to the demobilization of the installation personnel from the site and no later than 30 days after the installation has been completed.	Participate in final walk through and inspection of the project with UDWRi designated personnel from Dam Safety Section and representatives from UDWQ.
COMPLETION: At the completion of the installation, the Installer shall provide a set of record drawings showing the actual geomembrane panel layout, seams location of destructive test samples, and the location of major repairs including repaired seams and capped areas.	Provide CQA personnel and Owner with set of record drawings no later than 30 days after the installation work has been completed.	Provide CQA Officer with record drawings completed by and according to CQA personnel observations showing the actual geomembrane panel layout. CQA officer is to review and approve CQA personnel record drawings. CQA officer is to review and approve installer provided record drawings. Upon approval of CQA Officer, provide record drawings to the Owner and include them in the final CQA report to be submitted to UDWQ and UDWRi.

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APPENDIX A

TESTING FREQUENCY TABLES

From Approved Technical Specifications – Completed by AMEC

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5.0 TABLE 1–TEST METHODS

Test	Type of Test	Test Method (ASTM)
C1, R1	Atterberg limits	D4318
C2, R2	Moisture content	D2216
C3, R3	Particle size distribution	D422 [a]
C4, R4	Laboratory compaction	D1557
R5a	Nuclear density	D2922
R5b	Sand cone	D1556
R5c	Water replacement	D2167
C6, R6	Laboratory permeability	D5084

Notes:

C = Control Tests; R = Record Tests

[a] Hydrometer tests down to the 2-micron size will be carried out as directed by the QA Engineer but will generally not be required; all samples to be wash graded over a #200 sieve.

6.0 TABLE 2–TEST FREQUENCY–RANDOM FILL

Test	Type of Test	Frequency (1 per)
R1	Atterberg limits	50,000 yd^3
C2, R2	Moisture content	Minimum of 1 per lift per day of production or 15,000 yd^3
C3, R3	Particle size distribution	50,000 yd^3
C4, R4	Laboratory compaction	Minimum 1 per Soil type or 200,000 yd^3
R5a	Nuclear density	Minimum of 1 per lift per day of production or 15,000 yd^3
R5b/R5c	Sand cone or water replacement density	1 per 10 nuclear density tests
C8, R8	Shear strength	1 per 1,000,000 yd^3

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7.0 TABLE 10–TEST FREQUENCY–CLEAN GRAVEL

Test	Type of Test	Frequency (1 per)
C3, R3	Particle size distribution	1,000 yd^3 or minimum 2 tests

Note: Sample sizes to be sampled in accordance with ASTM standards.

8.0 TABLE 11–TEST FREQUENCY–EMBANKMENT FOUNDATION

Test	Type of Test	Frequency (1 per)
R1	Atterberg limits	Lesser of soil type/100,000 ft^2
C2, R2	Moisture content	50,000 ft^2
C3, R3	Particle size distribution	100,000 ft^2
C4, R4	Laboratory compaction	Lesser of soil type/250,000 ft^2
R5a	Nuclear density	50,000 ft^2
R5b	Sand cone density	1 per 10 nuclear density tests

9.0 TABLE 12–TEST FREQUENCY–BASIN FOUNDATION

Test	Type of Test	Frequency (1 per)
R1	Atterberg limits	Lesser of soil type/200,000 ft^2
C2, R2	Moisture content	100,000 ft^2
C3, R3	Particle size distribution	200,000 ft^2
C4, R4	Laboratory compaction	Lesser of soil type/500,000 ft^2
R5a	Nuclear density	100,000 ft^2
R5b	Sand cone or water replacement density	1 per 10 nuclear density tests

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TABLE 1 – HDPE GEOMEMBRANE, SMOOTH

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. avg.) • Lowest individual of 10 values	D5199	Nominal -10%	Nominal -10%	Nominal -10%	Nominal -10%	Nominal -10%	Nominal -10%	Nominal -10%	Per roll
Density mg/L (min.)	D1505/D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties [1] (min. avg.) • Yield strength • Break strength • Yield elongation • Break elongation	D6693 Type IV	63 lbs/in 114 lbs/in 12% 700%	84 lbs/in 152 lbs/in 12% 700%	105 lbs/in 190 lbs/in 12% 700%	126 lbs/in 228 lbs/in 12% 700%	168 lbs/in 304 lbs/in 12% 700%	210 lbs/in 380 lbs/in 12% 700%	252 lbs/in 456 lbs/in 12% 700%	20,000 lbs
Tear Resistance (min. avg.)	D1004	21 lbs	28 lbs	35 lbs	42 lbs	56 lbs	70 lbs	84 lbs	45,000 lbs
Puncture Resistance (min. avg.)	D4833	54 lbs	72 lbs	90 lbs	108 lbs	144 lbs	180 lbs	216 lbs	45,000 lbs
Stress Crack Resistance [2]	D5397 (Appendix)	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	Per GRI-GM10
Carbon Black Content (range)	D1603 [3]	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	D5596	Note [4]	Note [4]	Note [4]	Note [4]	Note [4]	Note [4]	Note [4]	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.) [5] a) Standard OIT --OR-- b) High Pressure OIT	D3895 D5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lbs
Oven Aging at 85°C [5,6] a) Standard OIT (min. avg.) - % retained after 90 days --OR-- b) High Pressure OIT (min. avg.) - % retained after 90 days	D5721 D3895 D5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	Per each formulation

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
UV Resistance [7] a) Standard OIT (min. avg.) --OR-- b) High Pressure OIT (min. avg.) - % retained after 1,600 hrs [9]	GM11 D3895 D5885	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	Per each formulation

[1] Machine direction (MD) and cross-machine direction (XMD) average values should be based on five (5) test specimens each direction.
- Yield elongation is calculated using a gauge length of 1.3 inches.
- Break elongation is calculated using a gauge length of 2.0 inches.

[2] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

[3] Other methods, such as D4218 (muffle furnace) or microwave methods, are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.

[4] Carbon black dispersion (only near spherical agglomerates) for ten (10) different views: Nine (9) in Categories 1 or 2 and one (1) in Category 3.

[5] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

[6] It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.

[7] The condition of the test should be 20-hour UV cycle at 75°C followed by 4-hour condensation at 60°C.

[8] Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV-exposed samples.

[9] UV resistance is based on percent-retained value regardless of the original HP-OIT value.

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TABLE 2 – HDPE GEOMEMBRANE, TEXTURED

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. avg.) ▪ Lowest individual of 10 values	D5994	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Per roll
Asperity Height mils (min. avg.) [1]	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	Every 2nd roll [2]
Density mg/L (min.)	D1505/D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties [3] (min. avg.) ▪ Yield strength ▪ Break strength ▪ Yield elongation ▪ Break elongation	D6693 Type IV	63 lbs/in 45 lbs/in 12% 150%	84 lbs/in 60 lbs/in 12% 150%	105 lbs/in 75 lbs/in 12% 150%	126 lbs/in 90 lbs/in 12% 150%	168 lbs/in 120 lbs/in 12% 150%	210 lbs/in 150 lbs/in 12% 150%	252 lbs/in 180 lbs/in 12% 150%	20,000 lbs
Tear Resistance (min. avg.)	D1004	21 lbs	28 lbs	35 lbs	42 lbs	56 lbs	70 lbs	84 lbs	45,000 lbs
Puncture Resistance (min. avg.)	D4833	54 lbs	72 lbs	90 lbs	108 lbs	144 lbs	180 lbs	216 lbs	45,000 lbs
Stress Crack Resistance [4]	D5397 (App.)	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	Per GRI-GM10
Carbon Black Content (range)	D1603 [5]	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	D5596	Note [6]	Note [6]	Note [6]	Note [6]	Note [6]	Note [6]	Note [6]	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.) [7] c) Standard OIT --OR-- d) High Pressure OIT	D3895 D5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lbs
Oven Aging at 85°C [7, 8] c) Standard OIT (min. avg.) - % retained after 90 days --OR-- d) High Pressure OIT (min. avg.) - % retained after 90 days	D5721 D3895 D5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	Per each formulation

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
UV Resistance [7] c) Standard OIT (min. avg.) --OR-- d) High Pressure OIT (min. avg.) - % retained after 1,600 hrs [9]	GM11 D3895 D5885	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	Per each formulation

[1] Of 10 readings; 8 out of 10 readings must be ≥ 7 mils, and the lowest individual reading must be ≥ 5 mils

[2] Alternate the measurement side for double-sided textured sheet.

[3] Machine direction (MD) and cross-machine direction (XMD) average values should be on the basis of five (5) test specimens each direction.
- Yield elongation is calculated using a gauge length of 1.3 inches.
- Break elongation is calculated using a gauge length of 2.0 inches.

[4] P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.

The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

[5] Other methods, such as D4218 (muffle furnace) or microwave methods, are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.

[6] Carbon black dispersion (only near spherical agglomerates) for ten (10) different views: Nine (9) in Categories 1 or 2 and one (1) in Category 3.

[7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

[8] It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.

[9] The condition of the test should be 20-hour UV cycle at 75°C followed by 4-hour condensation at 60°C.

[10] Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV-exposed samples.

[11] UV resistance is based on percent-retained value regardless of the original HP-OIT value.

TABLE 3 – HDPE GEOMEMBRANE, DRAIN LINER

Properties	Test Method	Test Value				Testing Frequency (minimum)
		50 mils	60 mils	80 mils	100 mils	
Thickness (min. avg.) ▪ Lowest individual of 10 values	D5994	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Nominal (-5%) -10%	Per roll
Drainage Stud Height (min. avg.) [1]	GM 12	130 mil	130 mil	130 mil	130 mil	Every 2nd roll [2]
Density mg/L (min.)	D1505/D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lbs
Tensile Properties [3] (min. avg.) ▪ Yield strength ▪ Break strength ▪ Yield elongation ▪ Break elongation	D6693 Type IV	110 lbs/in 110 lbs/in 13% 300%	132 lbs/in 132 lbs/in 13% 300%	176 lbs/in 176 lbs/in 13% 300%	220 lbs/in 220 lbs/in 13% 300%	20,000 lbs
Tear Resistance (min. avg.)	D1004	38 lbs	50 lbs	67 lbs	83 lbs	45,000 lbs
Puncture Resistance (min. avg.)	D4833	80 lbs	95 lbs	126 lbs	158 lbs	45,000 lbs
Stress Crack Resistance [4]	D5397 (App.)	300 hrs	300 hrs	300 hrs	300 hrs	Per GRI-GM10
Carbon Black Content (range)	D1603 [5]	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lbs
Carbon Black Dispersion	D5596	Note [6]	Note [6]	Note [6]	Note [6]	45,000 lbs
Oxidative Induction Time (OIT) (min. avg.) [7] e) Standard OIT --OR-- f) High Pressure OIT	D3895 D5885	≥100 min.	≥100 min.	≥100 min.	≥100 min.	200,000 lbs
Oven Aging at 85°C [7, 8] e) Standard OIT (min. avg.) - % retained after 90 days --OR-- f) High Pressure OIT (min. avg.) - % retained after 90 days	D5721 D3895 D5885	N.R. 80%	N.R. 80%	N.R. 80%	N.R. 80%	Per each formulation

Properties	Test Method	Test Value				Testing Frequency (minimum)
		50 mils	60 mils	80 mils	100 mils	
UV Resistance [7] e) Standard OIT (min. avg.) --OR-- f) High Pressure OIT (min. avg.) - % retained after 1,600 hrs [9]	GM11 D3895 D5885	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	N.R. [8] 50%	Per each formulation

[1] Of 10 readings; 8 out of 10 readings must be ≥ 7 mils, and the lowest individual reading must be ≥ 5 mils

[2] Alternate the measurement side for double-sided textured sheet.

[3] Machine direction (MD) and cross-machine direction (XMD) average values should be on the basis of five (5) test specimens each direction.
- Yield elongation is calculated using a gauge length of 1.3 inches.
- Break elongation is calculated using a gauge length of 2.0 inches.

[4] P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.

The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

[5] Other methods, such as D4218 (muffle furnace) or microwave methods, are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.

[6] Carbon black dispersion (only near spherical agglomerates) for ten (10) different views: Nine (9) in Categories 1 or 2 and one (1) in Category 3.

[7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

[8] It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.

[9] The condition of the test should be 20-hour UV cycle at 75°C followed by 4-hour condensation at 60°C.

[10] Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV-exposed samples.

[11] UV resistance is based on percent-retained value regardless of the original HP-OIT value.

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TABLE 4 – SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HDPE GEOMEMBRANES

Geomembrane Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams [1]							
Shear strength [2], lb/in.	57	80	100	120	160	200	240
Shear elongation at break [3], %	50	50	50	50	50	50	50
Peel strength [2], lb/in.	45	64	76	91	121	151	181
Peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
Shear strength [2], lb/in.	57	80	100	120	160	200	240
Shear elongation at break [3], %	50	50	50	50	50	50	50
Peel strength [2], lb/in.	39	52	65	78	104	130	156
Peel separation, %	25	25	25	25	25	25	25

[1] Also for hot air and ultrasonic seaming methods

[2] Value listed for shear and peel strengths are for four out of five test specimens; the fifth specimen can be as low as 80% of the listed values

[3] Elongation measurements should be omitted for field testing

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APPENDIX B

NON-DESTRUCTIVE SEAM TESTING PROCEDURES

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B.1 Procedure for Fusion Weld Testing

This test is intended to provide a nondestructive evaluation of the integrity of geomembrane seams made in the form of two closely spaced tracks by the fusion weld technique. The presence of the un-welded channel between the two distinct seamed regions allows for inflation of the sealed channel with air to a predetermined pressure. Extremely long lengths of seam can be evaluated, e.g., greater than 300 feet. The tightness of the pressurized air channel over time is noted and recorded. If air pressure cannot be maintained, a leak in the seam is indicated and corrective actions are taken.

The fusion weld technique utilizes a dual, or double, bonded seam where an air channel exists between the two seam tracks. Both ends of the air channel are sealed as designated below using Alternative A or Alternative B with a hollow needle with attached pressure gage inserted into the air space. Air pressure is applied and the gage is monitored for excessive air pressure drop. Air pressures are related to the thickness and stiffness of the geomembrane and vary from 24 to 30 lb/in^2. Monitoring time shall be a minimum of 5 minutes. Maximum allowable loss of air pressure varies from 2 to 4 lb/in^2 depending upon thickness and stiffness of the geomembrane.

A hot air device is necessary to seal either one or both ends of the air channel. Wide mouth vice grips are sometimes necessary to further lock-off these sealed ends. A sharp, hollow needle with a properly functioning pressure gage is necessary to insert air into the open channel and monitor its pressure. An air pump capable of generating and sustaining the required air pressures is necessary. The pump is not to be attached while the air pressure is being monitored.

The procedure for conducting the non-destructive test on a fusion weld seam shall be as follows:

1. After making the desired dual track seam and deciding upon the length of seam that is to be evaluated, seal off the two ends of the continuous air channel and insert the air pressure needle into the air channel using either Alternative A or Alternative B below.

   Alternative A: Heat both of the ends of the air channel with a hot air device. Clamp both ends of the air channel with wide-mouth vice grips so as to form an air-tight seal at both ends of the channel. The wide-mouth vice grips can remain in place throughout the test or be removed as the installer sees fit.

   Insert the air pressure needle into the air channel by penetrating the upper geomembrane. The needle is to be inserted at the shallowest possible angle and only until the upper sheet is penetrated. The lower sheet beneath the air channel must not be penetrated. The pressure gage is connected directly to the end of the hollow needle. If problems are encountered in obtaining a good seal around the needle, heating of the needle with hot air may be helpful.

   Alternative B: Seal off one end of the air channel by heating the end with the hot air devise. Clamp this end of the air channel with wide-mouth vice grips so as to form an air-tight seal at this end of the channel. The wide-mouth vice grips can remain in place throughout the test or be removed as the installer sees fit.

Insert the air pressure needle with attached pressure gage into the air space at the other end of the channel. The needle is to be fitted with a prefabricated end piece which can be clamped onto the other end of the air channel with vice grips so as to form an air tight seal around the needle and at the end of the air channel. Clamp the needle with prefabricated end piece onto the end of the air channel with vice grips so as to form an air-tight seal at this end of the channel.

2. Connect an air pump to the pressure gage and pressurize the air channel. The pressure schedule for high density polyethylene (HDPE) geomembranes is as follows:

Geomembrane Thickness (mil)	Minimum Pressure (lb/in^2)	Maximum Pressure (lb/in^2)
60	30	35
80	30	35

Maintain these pressures with the air pump connected during a two-minute stabilization period.

3. Disconnect the air pump. Observe the air pressure gage for a minimum of 3 minutes. Record the time and pressure of the beginning and end of the test. The maximum allowable pressure drop should not exceed the following schedule.

Geomembrane Thickness (mil)	Maximum Pressure Drop (lb/in^2)
60	3.0
80	3.0

4. If the pressure does not drop below the above value after the minimum 3 minute test period, cut the air channel open at the end away from the pressure gage. Air should rush out and the pressure gage should register an immediate drop in pressure, indicating that the entire length of the seam has been tested. If this does not happen, the air channel is blocked. Walk the seam to look and feel for the location of the blockage. The channel should be inflated up to that point.

Cut the air channel on the gage side of the blockage and verify the pressure loss. Then inflate the weld from the far side. If the pressure holds, cut the seam just prior to the blockage and verify the pressure drop. If the location of the blockage can not be found, it may be necessary to cut the seam in the middle and treat both halves as separate welds. Patch all cuts and seal small holes with extrudate from a fillet extrusion seam device.

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Note 1: If multiple blocked locations are suspected or if the seam is short, it may be easiest to cut the seam out and remake the weld.

5. For a pressure drop greater than the above value, check the end seals and where the needle enters into the air channel. Reseal these areas with a hand held hot air device if a leak is noticed and then repeat the entire test.

   Note 2: Leaks around the end seals and air pressure insertion needle can usually be located by putting moisture around the suspected area and looking for bubbles to occur.

6. If the problem is not located, perform peel tests at the beginning and end of the seam to determine seam strength.

7. If the seam strength is inadequate, the edge of the loose flap of the upper sheet (which extends beyond the outer track) is extrusion fillet welded to the bottom sheet. Thus the extrusion fillet weld becomes the primary seam. It is then vacuum box tested until satisfactory performance is obtained.

8. If the seam passes the destructive tests, the leak is looked for with the flap in place. If the leak is found, it is repaired. If it cannot be found, cut away the flap. Then vacuum box test the outer track of the seam. If a leak is found, repair it. In both cases, repairs are made by extrusion fillet welds.

9. If no leak is found in the outer track and all other leak location possibilities have been eliminated, the leak is assumed to be in the inner track. Since this inner track is for the purpose of air channel testing only, it is redundant and can be ignored. The single good outer track is adequate and should be accepted as such.

   Note 3: If the outer air track cannot be accepted as the primary and only seam, a cap strip over the entire seam, or the entire seam cut out and rewelded, are alternative possibilities.

10. Record the results for seam air pressure testing.

B.2 Procedure For Vacuum Testing

In those locations where extrusion welding is used, all of the welding will be vacuum tested. Defects found will be repaired and retested. Vacuum testing, repair procedures, and retesting will be recorded and made part of the CQA Report.

The procedure that will be followed for vacuum testing will conform to the procedure identified in ASTM Designation D4437-84 "Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes." This procedure will be followed with two exceptions. First, the vacuum pressure applied to the vacuum box will not be less than 5 psi which is in accordance with the current EPA specifications given in guidance memorandum, "Use of Construction Quality Assurance (CQA) Programs and Control of Stress Cracking in Flexible Membrane Liner's Seams," rather than the 4 to 8 inches of mercury (approximately 2 psi to 4 psi) as indicated in the ASTM D4437-84 standard. Second, a dwell time of 15 seconds will be specified in accordance with the EPA current guidance. There is no designated dwell time in the ASTM D4437-84 standard. The procedure will be as follows:

All seams welded using the extrusion process shall be inspected for unbonded areas by applying a vacuum to a soaped section of the seam. The vacuum shall be applied by a vacuum box equipped with a vacuum gage, a clear glass view panel in the top, and a soft rubber gasket on the periphery of the open bottom. Thoroughly soap a section of the seam and place the inspection box over the soaped seam section and the gasket sealed to the liner. Apply a vacuum of not less than 5 psi to the box by use of a vacuum pump. The vacuum will be applied for a minimum dwell time of fifteen (15) seconds. The applied vacuum will show bubbles over unbonded areas; the unbonded areas shall then be marked for repair.

Record the results for the vacuum testing.

B.3 Procedure For Electrostatic Spark Test

The electrostatic spark test is a non-destructive test used to detect voids, pinholes, or unbonded areas primarily in HDPE extrusion welds. Seams tested by this method are provided with a copper wire properly embedded in the seam and grounded. A high voltage electric current is then applied to a probe which is slowly moved along the length of the seam and any leakage to ground (i.e., through a pinhole to the copper wire) is detected by sparking. Procedures for conducting the electrostatic spark test are as follows:

A. Prepare the seam to be welded.
B. Insert an 18 gauge bare copper wire in the seam area, where it will appear at the bottom of the weld after the seam is welded, with one end of the wire left exposed.
C. Weld the seam.
D. After the weld has cooled, connect the exposed end of the copper wire to the ground terminal on a high voltage spark tester capable of operating in a range of 10 to 55 KV.
E. Turn the spark tester on and adjust the output voltage control to minimum. Hold the test probe on the spark tester near the exposed end of the copper wire and increase the output voltage until a spark can be obtained at least twice as long as the thickness of the material to be tested (or twice as thick as the weld).
F. Move the probe slowly along the length of the welded seam. Document and mark on the HDPE liner adjacent to the weld locations where sparking is observed. Locations where sparking is observed indicates the presence of leaks in the weld.
G. After testing the seam, verify that the length of the spark to the exposed end of the copper wire is still adequate before turning the power to the machine off. If the spark is not adequate, readjust the output voltage and retest the seam.
H. Record the results from the spark test.
I. Repair locations indicating the presence of a leak by grinding and re-welding.
J. Retest repair area.

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APPENDIX H – EXCERPT FROM GEOTECHNICAL INVESTIGATION FOR EVAPORATION POND SITE – PREPARED BY IGES, 2010

GEOTECHNICAL INVESTIGATION for
EVAPORATION POND SITE
MAGNUM Gas Storage Project
Near Delta, Utah

For

MAGNUM ENERGY, LLC
2150 South 1300 East
Suite 500
Salt Lake City, Utah 84106

IGES Job No. 01286-002

June 2, 2010

EXECUTIVE SUMMARY

The following summary presents our findings for the Geotechnical Investigation conducted for the Brine Ponds as part of MAGNUM Gas Storage's project near Delta, Utah. Our work was performed under contract with MAGNUM dated October 5, 2009 and further defined in Work Release 2 effective as of January 13, 2010.

Based on our site-specific investigation, analyses and engineering calculations, the site being considered for the proposed development can suitably be developed for brine storage.

This investigation involved excavating 30 test pits, drilling 32 holes, and emplacing 9 piezometers (monitoring wells) at the three pond sites. Piezometers were sampled and water chemistry results are attached. One sample tested showed moisture sensitive characteristic of any significance (9.2% under 3,200 psf loading at 5 ft. in B-P1-4). One shallow soil sample from within Pond 1 showed the near-surface soil to be dispersive. The sites proposed for pond site development otherwise provide suitable materials for embankment construction and general impoundment development.

1.0 INTRODUCTION

This reports presents the results of excavating 30 test pits, drilling 32 borings, and emplacing 9 piezometers by Intermountain GeoEnvironmental Services, Inc. (IGES) for MAGNUM Gas Storage, LLC (MAGNUM) related to brine storage ponds at their Western Energy Hub Project. The site is located south of West Brush Wellman Road 10 miles west of the intersection with US 6, approximately 10 miles north of Delta, Utah. General locations of these sites are shown on Plate A-1: Vicinity Map. Our work was performed under contract with MAGNUM dated October 5, 2009 and further defined in Work Release 2 effective as of January 13, 2010.

2.0 PROJECT DESCRIPTION

The project will include the development of deep underground caverns for storage of compressed natural gas. Caverns will be developed using solution mining methods and produce a waste stream of brine requiring management via temporary storage, evaporation, salt harvesting and sale or their combination. In any event, approximately two years of plant site storage will be required for project startup and to manage occasional upset conditions, should they occur. The focus of this report has been the pond development at the plant site.

3.0 SCOPE OF WORK

The following outlines the scope of services performed in excavating test pits, drilling, and piezometer installation and sampling at the Proposed Brine Pond System:

- Conduct geotechnical investigation including excavation of test pits, drilling, and sampling at the three pond sites to characterize near-surface soil conditions that will impact pond system development, lining potential and embankment development. Relatively undisturbed and bulk samples were obtained from the test pits and borings for laboratory testing including compaction, permeability, strength properties and other index parameters.
- Install piezometers in some of the pond site borings and collect background water chemistry samples.
- A summary report presenting the results of our site investigations, soil and water testing.
- Attachments include:
    - Site drawing with exploration locations
    - Test pit logs
    - Boring logs with piezometer construction
    - Laboratory testing results of soil and water

4.0 INVESTIGATIONS

4.1 GEOTECHNICAL INVESTIGATION

A geotechnical investigation of the three pond sites was conducted to observe existing soil conditions and to provide samples for laboratory testing. The findings of the laboratory testing are presented in Section 4.3 of this report. The soils are described in Section 5.0 and attached boring logs and test pit logs. Piezometer installation is described in Section 4.2.

As a part of this investigation, subsurface soil conditions were explored by advancing 32 borings and excavating 30 test pits across the pond sites. The locations of the borings and test pits are shown on the Site Map (Plate A-2). An experienced geologist/geological engineer visually logged soils in the borings and test pits at the time of exploration according to the Unified Soil Classification System (USCS). The borings varied in depth from approximately 20.5 feet to 100.5 feet below the existing site grade. The test pit depths varied from approximately 10 to 13 feet below the existing site grade. Logs of the borings and test pits are included at the end of this report (Plates A-3 thru A-64). A Key to Soil Symbols and Terms is also provided as Plate A-65.

Borings were advanced with a CME-55 truck-mounted drill rig and a Marl M-3 track-mounted drill rig, each equipped with hollow stem augers. Mud rotary was used to drill 100-foot deep borings. IGES collected disturbed boring samples with the aid of a standard split spoon sampler (SPT). The SPT sampler was driven with a 140-lb hammer being dropped from a distance of 30 inches. Relatively undisturbed boring samples were obtained by driving a U-type Dames and Moore sampler and by advancing Shelby tubes. Blow counts were recorded every 6 inches and are included on the final boring logs included in this report.

The test pits were excavated with a John Deere 310SG rubber-tire backhoe. Representative samples of the soils encountered in the test pits were collected and classified by the field geologist and were packaged and transported to our laboratory for testing. Relatively undisturbed samples were collected with the use of a U-type hand sampler driven by a 2 lb. sledge hammer. Bulk samples and other disturbed samples were collected and placed in buckets and heavy zip-lock plastic bags respectively.

4.2 PIEZOMETERS

Nine two-inch diameter piezometers were installed at the pond sites to a depth of approximately 40 feet. The piezometers were installed at completion of drilling selected 40-foot borings. Two-inch diameter PVC 10-slot (0.010 inch) well screen was placed from 30 to 40-foot depth, two-inch PVC blank was connected to the well screen and placed from surface to 30-foot depth, sand pack was placed from 28 to 40-foot depth, bentonite was placed from 26 to 28-foot depth, grout was mixed and placed from 2 to 26-foot depth, and concrete was placed in the upper two feet with a concrete pad and PVC and steel casing stick-up. See the attached boring logs for well-construction graphic.

Groundwater samples were collected from the piezometers on March 23 and 24, 2010, and tested for total dissolved solids (TDS), conductivity, and a list of cations and anions. Prior to sampling, the water level was measured and wells were developed using an SS Geosub submersible 2-inch pump. A volume of water was purged from the piezometer that equaled or exceeded 3 times the volume of water occupying the piezometer including sand pack. Groundwater samples were obtained using the submersible pump and were placed on ice immediately and transported to American West Analytical Laboratories. See Plate A-67 for water table measurements and Appendix C for water chemistry laboratory results.

4.3 GEOTECHNICAL LABORATORY INVESTIGATION

Representative soil samples taken from the borings and test pits were tested in the laboratory to evaluate pertinent physical and engineering properties. Laboratory soil tests consisted of moisture content, in situ dry unit weight, grain size distribution, fines content determination, Atterberg Limits, consolidation, swell/collapse, direct shear, unconsolidated undrained triaxial, moisture density relationships (Standard Proctor), pinhole dispersion test, and back pressure permeability. The results of the laboratory tests are presented on the Boring and Test Pit Logs in Appendix A (Plates A-3 to A-64), the Summary of Laboratory Test Results Table (Plate A-66), the Grain Size Distribution Graph (Plate A-68 and A-80) and in the Geotechnical Soil Laboratory Results in Appendix B.

Results of laboratory tests indicate that on-site soils have dry unit weights ranging from approximately 78 to 120 pounds per cubic foot (pcf). The subsurface soil moisture contents ranged from a low of 1.7% to a high of 42.3%.

Atterberg Limit tests indicate that the soil liquid limits ranged from 17 to 66 and plasticity index ranged from 2 to 46, with 9 samples classified as non-plastic. Based on the Atterberg Limit tests, the fine-grained site soils were classified as Fat CLAY (CH), Lean CLAY (CL), Lean SILT (ML), and Silty CLAY (CL-ML).

Laboratory collapse testing indicates that the native soils at the site have a low to high collapse potential ranging from less than 1% to 9.2% and low swell potential below 1%. Consolidation testing generally indicates, with some variation, that shallow soils are over consolidated and deep soils are under consolidated.

Fifteen direct shear tests were completed under drained conditions to characterize the effective strength properties of the native near-surface soils. For the undisturbed samples of sandy materials, friction angles determined ranged between 26 and 40 degrees with cohesion values between 36 psf and 1364 psf.

Five Consolidated Undrained Triaxial tests resulted in an effective friction angle range of 19.6 degrees to 36.4 degrees and effective cohesion of 0 psf to 1812 psf.

Seven moisture density relationship tests (ASTM D-698 – Standard Proctor) were completed with maximum dry densities ranging from 78 to 120 pcf and optimum moisture contents ranging from 1.7% to 42%.

4.3 WATER CHEMISTRY LABORATORY INVESTIGATION

Piezometers were constructed to depths of 40 feet in 9 borings. The results of the background groundwater sampling on March 23-24, 2010, are attached as Appendix C. The depths to groundwater are summarized in Plate A-67. The 9 borings in which piezometers were installed included B-P1-4, B-P1-9, B-P2-1, B-P2-4, B-P2-8, B-P3-3, B-P3-5, B-P3-7, and B-P3-11.

Water samples from the piezometers were tested by American West Analytical Laboratories. The testing results are attached as Appendix C. Water chemistry testing included calcium, magnesium, potassium, sodium, bicarbonate, carbonate, chloride, conductivity, sulfate, and total dissolved solids (TDS).

Utah Ground Water Quality Protection Program indicates the project groundwater would be classified as **Class II** based on TDS below 3000 mg/L and predominantly above 500 mg/L. Drinking water quality standards were compared to Utah Department of Environmental Quality (DEQ 2010) standards and the 2006 EPA publication (EPA 2006). Drinking water quality standards were not established for some components tested on site, and the water quality standards include chemical analyses not conducted on the water samples from the project site. Site water samples were tested for some components that fall under the Secondary Drinking Water Regulations (SDWR), which refer to cosmetic effects or aesthetic effects of drinking water. For example, sodium and sulfate limits are taste thresholds. All piezometer samples exceeded SDWR for sodium, while some samples exceeded SDWR for chloride, sulfate, and TDS.

	SDWR	Site sample range
calcium		17 – 69 mg/L
magnesium		20 – 79 mg/L
potassium		7.9 – 19 mg/L
sodium	30 – 60 mg/L	110 – 800 mg/L
bicarbonate		200 – 520 mg/L
carbonate		<10 mg/L
chloride	250 mg/L	83 – 700 mg/L
conductivity		740 – 3800 mg/L
sulfate	250 mg/L	21 – 410 mg/L
TDS	500 mg/L	410 – 2300 mg/L

5.0 GENERALIZED SITE CONDITIONS

5.1 SURFACE CONDITIONS

The brine pond study area consists of a portion of three sections in Millard County, Utah. The approximate location of the study area is shown on the Vicinity Map (Plate A-1). The topography at the site is relatively flat with some minor relief observed locally. Drainage channels, a canal, and vegetated sand dunes exist on the site. Vegetation at the site includes native sage brush, shrubs, weeds, and grasses. No structures were observed on the property, however, it appears that portions of the study area are currently being used as rangeland for cattle. Several unpaved roads exist on the site.

5.2 SUBSURFACE CONDITIONS

As previously mentioned, the subsurface soil conditions were explored at the subject property by advancing 32 borings and excavating 30 test pits across the development site. The explorations were in Sections 25 and 26 in Township 15 South and Range 7 West and in Section 30 in Township 15 South and Range 6 West of the Salt Lake Base and Meridian. The boring and test pit depths varied from approximately 20.5 feet to 100.5 feet and approximately 10 to 13 feet below the existing site grade respectively. Subsurface soil conditions were logged at the time of drilling and excavating and are included in the Boring and Test Pit Logs in Appendix A (Plates A-3 to A-64). The soil and moisture conditions encountered during our investigation are discussed below.

5.2.1 Soils

In general, the soils encountered within the borings and test pits excavated in Ponds 1, 2, and 3 consisted of alternating layers of Fat CLAY (CH), Lean CLAY (CL), Lean SILT (ML), Clayey SAND (SC), Silty SAND (SM), Poorly Graded SAND with Silt (SP-SM), and Poorly Graded SAND (SP).

The stratification lines shown on the enclosed Borings and Test Pit Logs represent the approximate boundary between soil types. The actual in situ transition may be gradual. The soil layers underlying the site were frequently interbedded and varied in thickness and continuity. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond exploration locations.

5.2.2 Groundwater

Groundwater was encountered in one of the 30 test pits. At Pond 3, test pit TP-P3-6 encountered water at 10 feet below the existing ground surface at the time of our investigation.

Groundwater was encountered in 27 of the 32 borings completed at the site. Groundwater was observed approximately between 10.6 feet and 31 feet below the existing ground surface at the time of our investigation. Perched water appeared to be in boring B-P3-9 at 5 feet, above the regional water table, which was encountered at 10.6 feet. IGES returned to the site on March 23-24, 2010 to collect groundwater samples from the 9 piezometers. Most of the groundwater levels estimated in the soils in February and March drilling were within approximately a foot of the measured groundwater levels at the time of sampling the piezometers. The exception was B-P3-11 where a moist silt layer from 15-16.5 feet did not appear to contain the water during drilling while water in the piezometer rose to 11.0 feet below ground surface.

It should be noted that seasonal fluctuations in precipitation, surface runoff from adjacent properties, perched water, or other on or off-site sources may also increase moisture conditions at the site. Due to the season of our investigation, we anticipate groundwater levels to be between their seasonal low and seasonal high.

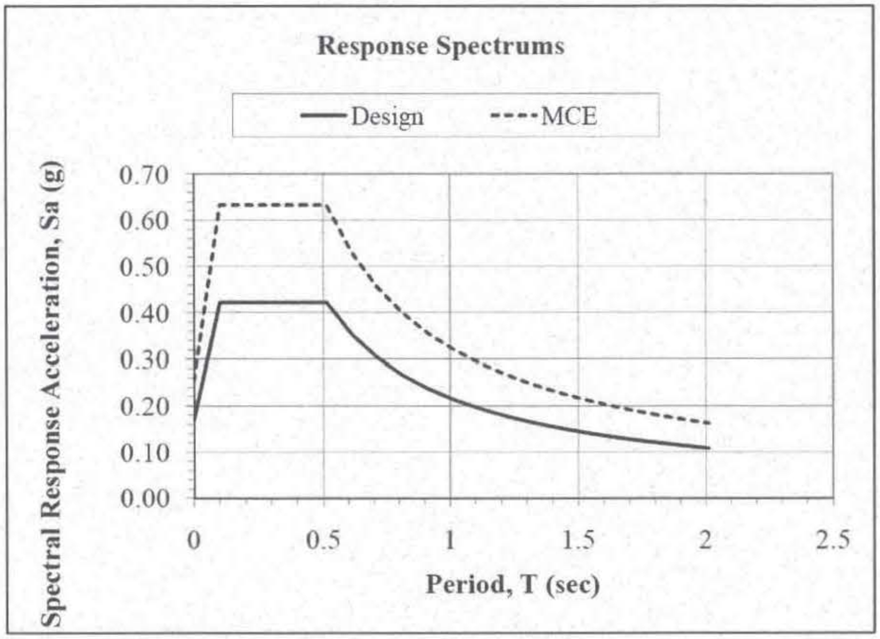
5.3 SEISMIC SETTING

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U.S. Geological Survey as part of NEHRP/NSHMP (Frankel et al, 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2006). The seismic hazard was assessed for the site using the Java Application Ground Motion Parameter Calculator – Version 5.0.8 developed by the USGS located on their website at http://earthquake.usgs.gov/research/hazmaps/design/, which correlates with the International Building Code (IBC, 2006) seismic hazard maps. This program, as with the IBC maps, is used to develop the probabilistic spectral accelerations corresponding to MCE seismic hazard level for rock-like conditions. Spectral responses for the Maximum Credible Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a "firm rock" site. To account for site soil effects, site coefficients (F_a and F_v), which vary with the magnitude of spectral acceleration, should be used to adjust the rock-based spectral acceleration values. Based on our field exploration, soil types encountered, and blow counts, we believe that the soils at this project location are representative of a "stiff soil" profile; best described by IBC Site Class D. The spectral accelerations are shown in the table at the end of this section. Site coefficients for the site are F_a=1.451 and F_v=2.211. The spectral accelerations are calculated based on the site's approximate latitude and longitude of 39.483153° and –112.571716° respectively. The Peak Ground Acceleration (PGA) from these data is 0.253g. The MCE PGA and design response spectrum are presented in the graphic following the table below.

MCE Seismic Response Spectrum Spectral Acceleration Values [a]

Site Location: **Latitude = 39.483153 ° N** **Longitude = -112.571716° W**	**Site Class D Site Coefficients:** **Fa = 1.451** **Fv = 2.211**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.200	0.633
1.000	0.326

[a] 2006 IBC recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values as shown below for buildings.


Response Spectrums
Design
MCE
Spectral Response Acceleration, Sa (g)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
0.5
1
1.5
2
2.5
Period, T (sec)

6.0 CLOSURE

6.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If the scope of the proposed construction changes from that described in this report, our firm should be notified in order to reflect proposed design or construction changes.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

Respectfully Submitted,
IGES, Inc.

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6/2/10
5158972
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STATE OF UTAH

Sheila Kluck, P.E., P.G.
Project Engineer

John F. Wallace, P.E.
President

Attachments

Appendix A:
- Plate A-1: Vicinity Map
- Plate A-2: Site Map
- Plate A-3 to A-34: Boring Logs
- Plate A-35 to A-64: Test Pit Logs
- Plate A-65: Key to Soil Symbols and Terms
- Plate A-66: Summary of Laboratory Test Results Table
- Plate A-67: Piezometer Readings
- Plate A-68 to A-80: Grain Size Distribution Graphs

Appendix B: Geotechnical Soil Laboratory Results

Appendix C: Water Chemistry Laboratory Results

7.0 REFERENCES CITED

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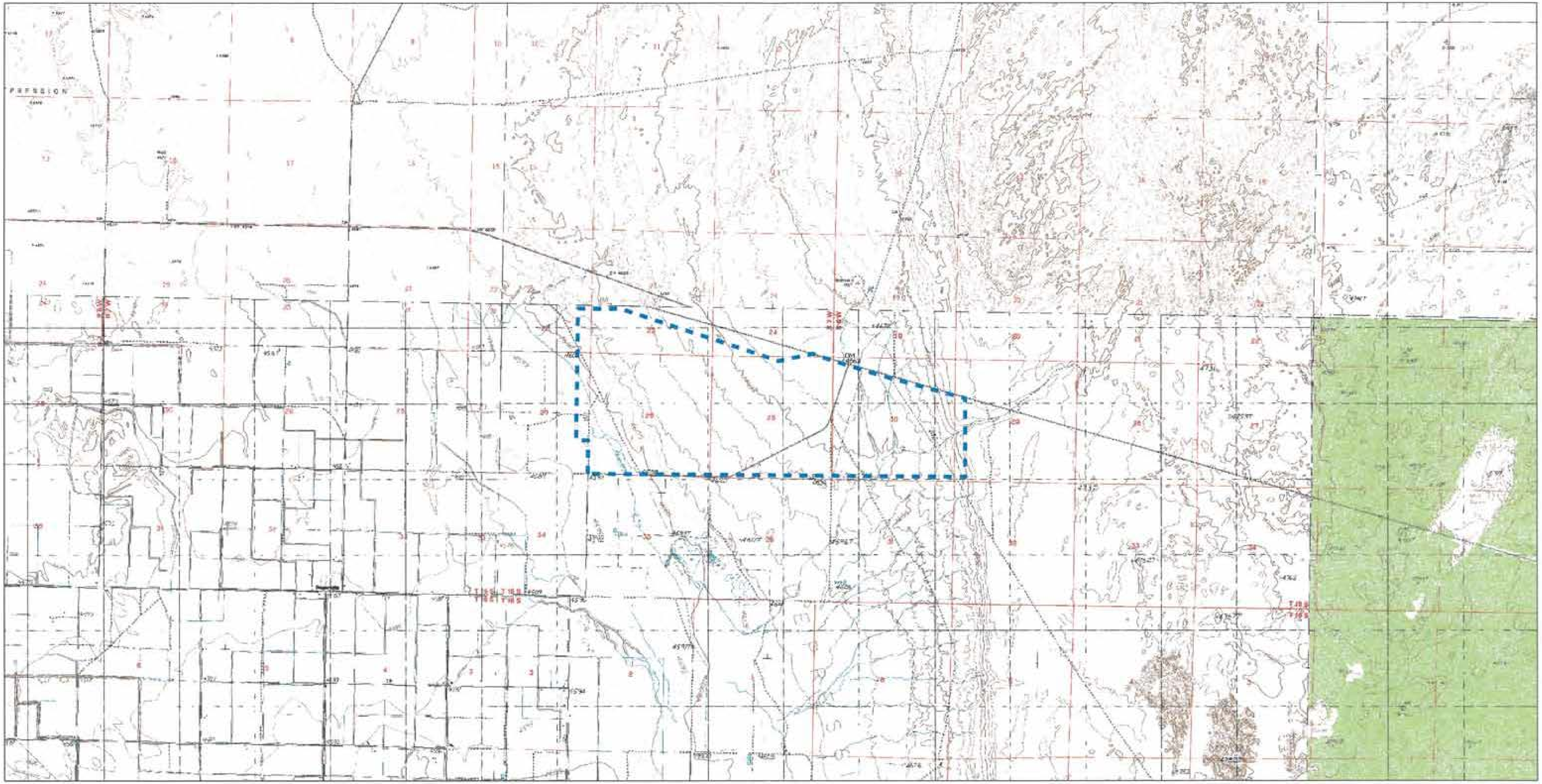
Frankel, A., Mueller, C., Barnard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M. 1996. “National Seismic-Hazard Maps: Documentation” [NSHMP] U.S. Geological Survey Open-File Report 96-532, June.

International Building Code [IBC], International Code Council, 2006

Utah Department of Environmental Quality (DEQ) Groundwater Quality Protection Program Classes and Protection Levels, 2010, Table 1 of R317-6-2.1; http://www.waterquality.utah.gov/GroundWater/gwclasses.htm

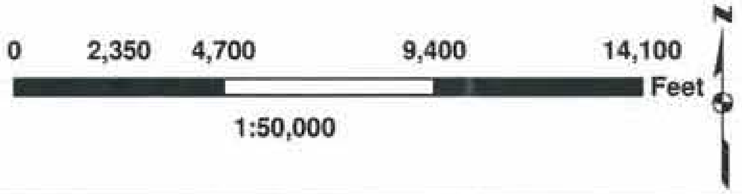
APPENDIX A

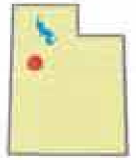


BASE MAPS:

BAKER HOT SPRINGS, UTAH	DELTA NE, UTAH
FUMAROLE BUTTE, UTAH	LYNNDYL WEST, UTAH
RAIN LAKE, UTAH	SMELTER KNOLLS EAST, UTAH
STRONG, UTAH	SUTHERLAND, UTAH

U.S.G.S. 7.5 MINUTE QUADRANGLES





Map Datum: UTM NAD 1983

🟦 Site Location

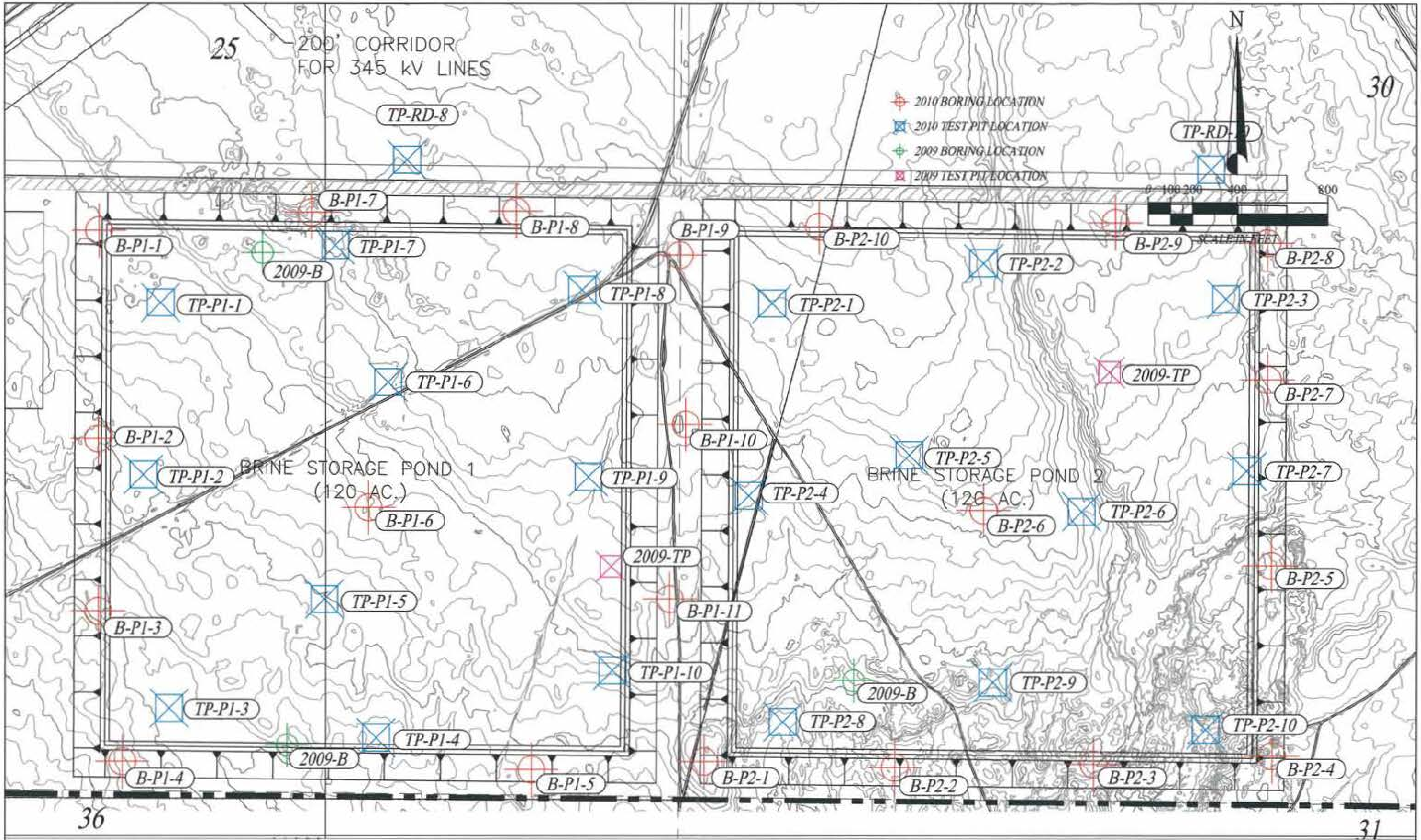
IGES

Project Number - 1286-002

Geotechnical Investigation
Magnum
Jones Road Brush Wellman Road
Delta, Utah

SITE VICINITY MAP

Plate
A-1



MARK	REVISIONS	DATE	BY	CHK	MARK	REVISIONS	DATE	BY	CHK

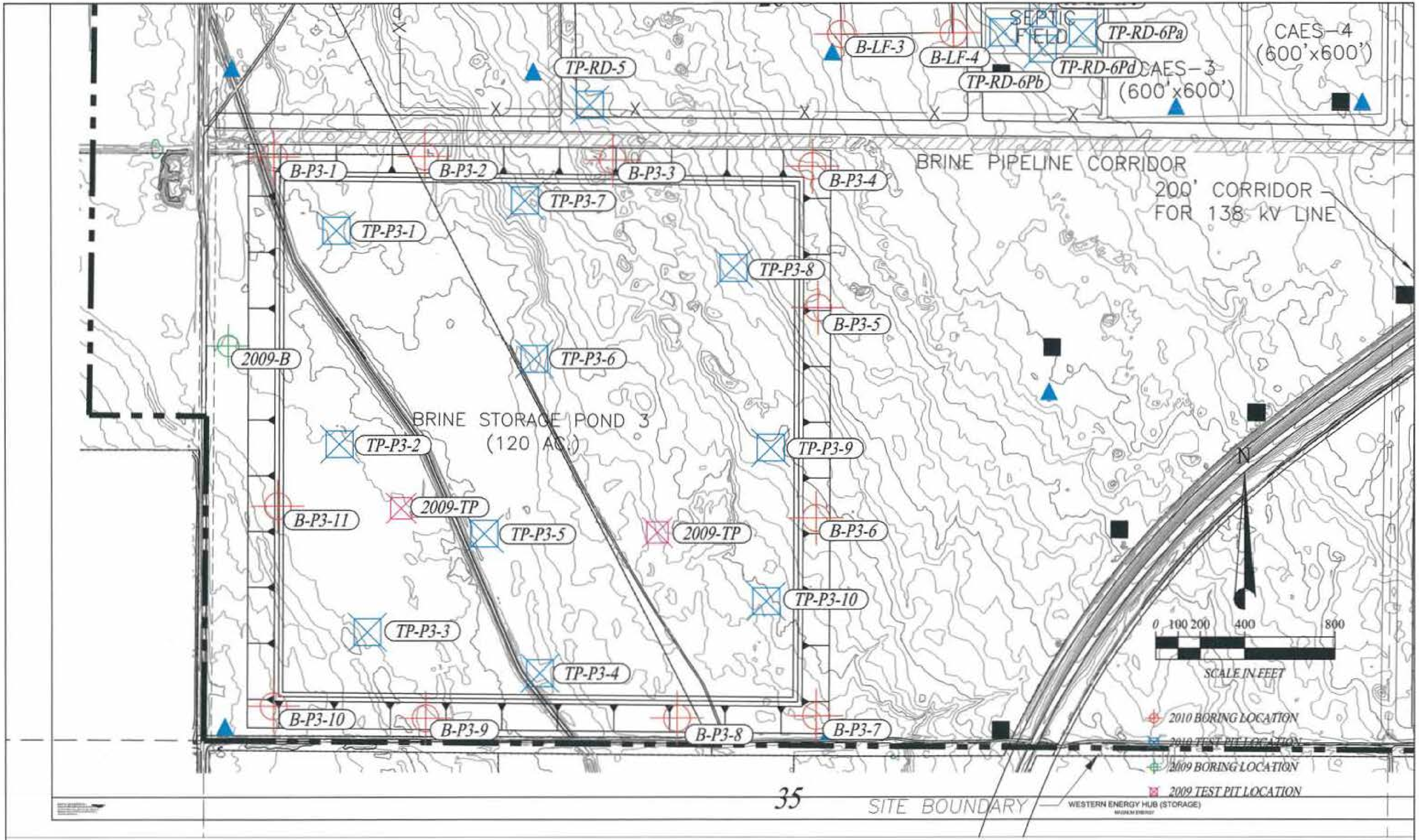
CONSULTANTS:

IGES
ideas for a changing world

4153 Commerce Drive
Salt Lake City, Utah
(801) 270-9400
(801) 270-9401 Fax

MAGNUM ENERGY, LLC
WESTERN ENERGY HUB GAS STORAGE FACILITY
DELTA, UT
SUBSURFACE INVESTIGATION PLAN (PONDS 1 & 2)

PROJECT: 01285-002
SCALE: 1"=400'
REVISION NO.: 1
DRAWING NO.: -
SHEET: A-2a



MARK	REVISIONS	DATE	BY	CHK	MARK	REVISIONS	DATE	BY	CHK

CONSULTANTS:

IGES
ideas for a changing world

4153 Commerce Drive
Salt Lake City, Utah
(801) 270-9400
(801) 270-9401 Fax

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MAGNUM ENERGY, LLC
WESTERN ENERGY HUB GAS STORAGE FACILITY
DELTA, UT
SUBSURFACE INVESTIGATION PLAN (POND 3)

PLOT SCALE 1=1
DWG SCALE 1"=400'
PROJECT 01286-002
REVISION NO. 1
DRAWING NO. -
SHEET A-2b

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

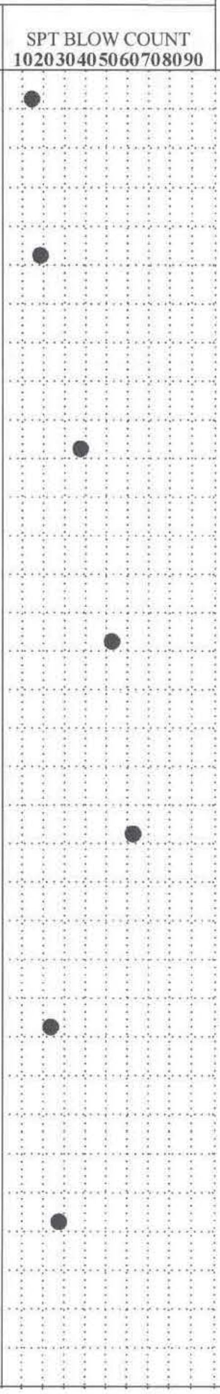
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

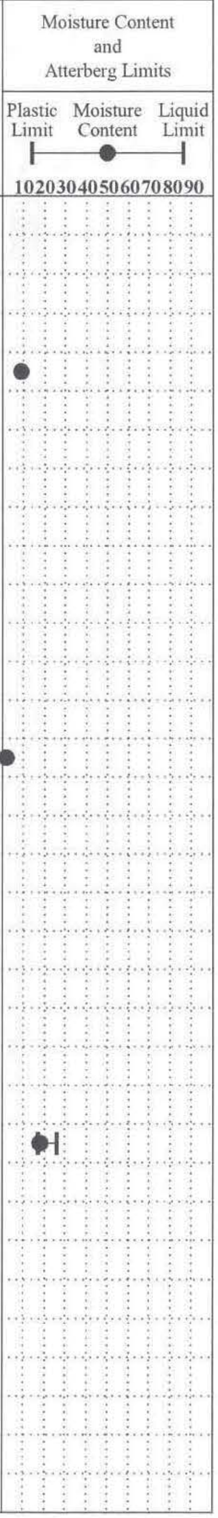
IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P1-01
Sheet 1 of 2

LOCATION
NORTHING 202,397.50 EASTING 507,986.50 ELEVATION 4,650.00
Pond 1

SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
☒		ML	Lean SILT with sand, light brown, moist, stiff	14	14					
		CL	Lean CLAY, light brown							
⧗		ML	Sandy SILT, light brown, moist, very stiff	45	18	100	9	66		
☒			- Hard	37	37					
⧗		SP	Poorly-Graded SAND, fine to coarse, gray brown, over light brown fine sand, moist, very dense	132	52	105	2	2		
☒				62	62					
⧗		CL	Sandy Lean CLAY, light brown, very stiff	47	23	109	18		26	9
☒	▼		Lean CLAY, light brown, very stiff	27	27					





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
⊟- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◩- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
3a

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P1-01
Sheet 2 of 2

LOCATION
NORTHING 202,397.50 EASTING 507,986.50 ELEVATION 4,650.00
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
	35	⧓		▨		- Hard clay	78	39	●						
11															
12	40	⊠		░	SP	Slough in auger, presume SP. Dense.	33	33	●						
						Bottom of Boring @ 40.5 Feet									
13															
14	45														
15	50														
16															
17	55														
18	60														
19															
20	65														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ⊟ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate
3b

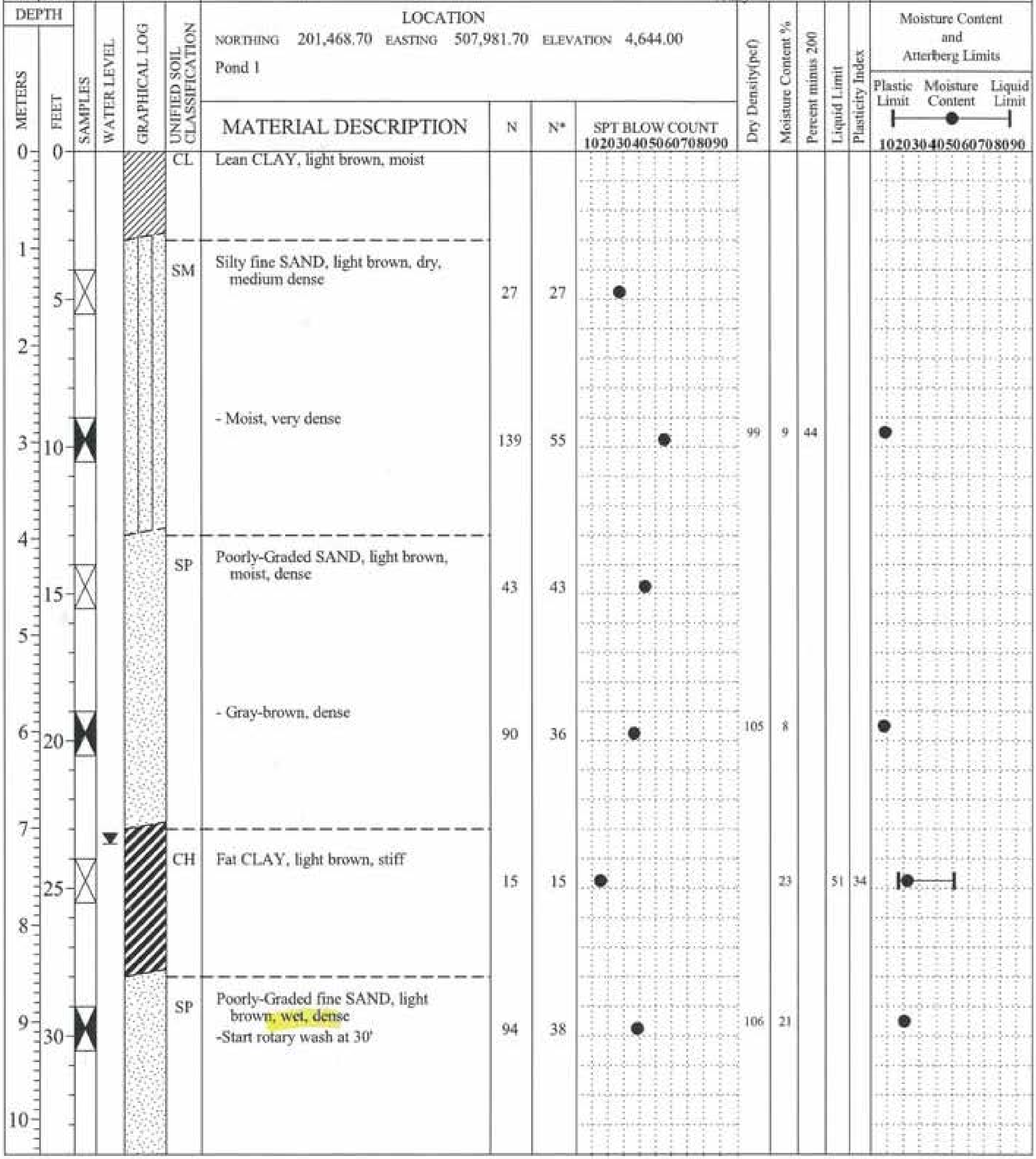
DATE	
STARTED:	2/22/10
COMPLETED:	2/23/10
BACKFILLED:	2/23/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger and rotary
Project Number: 01286-002

BORING NO:
B-P1-02
Sheet 1 of 3

LOCATION
NORTHING 201,468.70 EASTING 507,981.70 ELEVATION 4,644.00
Pond 1



DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	Lean CLAY, light brown, moist							
5	SM	Silty fine SAND, light brown, dry, medium dense	27	27					
10		- Moist, very dense	139	55	99	9	44		
15	SP	Poorly-Graded SAND, light brown, moist, dense	43	43					
20		- Gray-brown, dense	90	36	105	8			
25	CH	Fat CLAY, light brown, stiff	15	15		23		51	34
30	SP	Poorly-Graded fine SAND, light brown, wet, dense -Start rotary wash at 30'	94	38	106	21			

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▯- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
▮- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
4a

DATE	
STARTED:	2/22/10
COMPLETED:	2/23/10
BACKFILLED:	2/23/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger and rotary
Project Number:	01286-002

BORING NO:
B-P1-02
Sheet 2 of 3

LOCATION
NORTHING 201,468.70 EASTING 507,981.70 ELEVATION 4,644.00
Pond 1

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
35	☒		- Gray brown, fine to coarse	46	46					
40	■		- Fine-grained, very dense	60	60					
45	☒	CL	Lean CLAY, light brown, stiff	21	11					
50	■			14	14		28		38	20
55	☒	SP	Poorly-Graded SAND, gray-brown, very dense	240	79	110	17	3		
60	■	CL	Lean CLAY, red brown, CL to CH, very stiff	18	18					
65	☒		- Light gray with some sand, hard	81	40	99	27		35	21

METERS: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
4b

DATE		
STARTED:	2/22/10	
COMPLETED:	2/23/10	
BACKFILLED:	2/23/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger and rotary
Project Number: 01286-002

BORING NO:
B-P1-02
Sheet 3 of 3

LOCATION
NORTHING 201,468.70 EASTING 507,981.70 ELEVATION 4,644.00
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
21												
	70	⧗				75	75					
22												
23	75	☒			- Very stiff	54	27	97	27		27	10
24												
	80	⧗				20	20					
25												
26	85	☒		SP-SM	Poorly-Graded SAND with Silt, gray-brown, non-plastic, very dense	230	79	104	21			
27												
	90	⧗		CL	Lean CLAY, light red brown, CL to CH, hard	60	60					
28												
29	95	☒		SP	Lost sample. Trace SP gray-brown sand, dense	92	37					
30												
	100	⧗			- Very dense	200	200					
31					Bottom of Boring @ 100.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content ● — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▤- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◩- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
4c

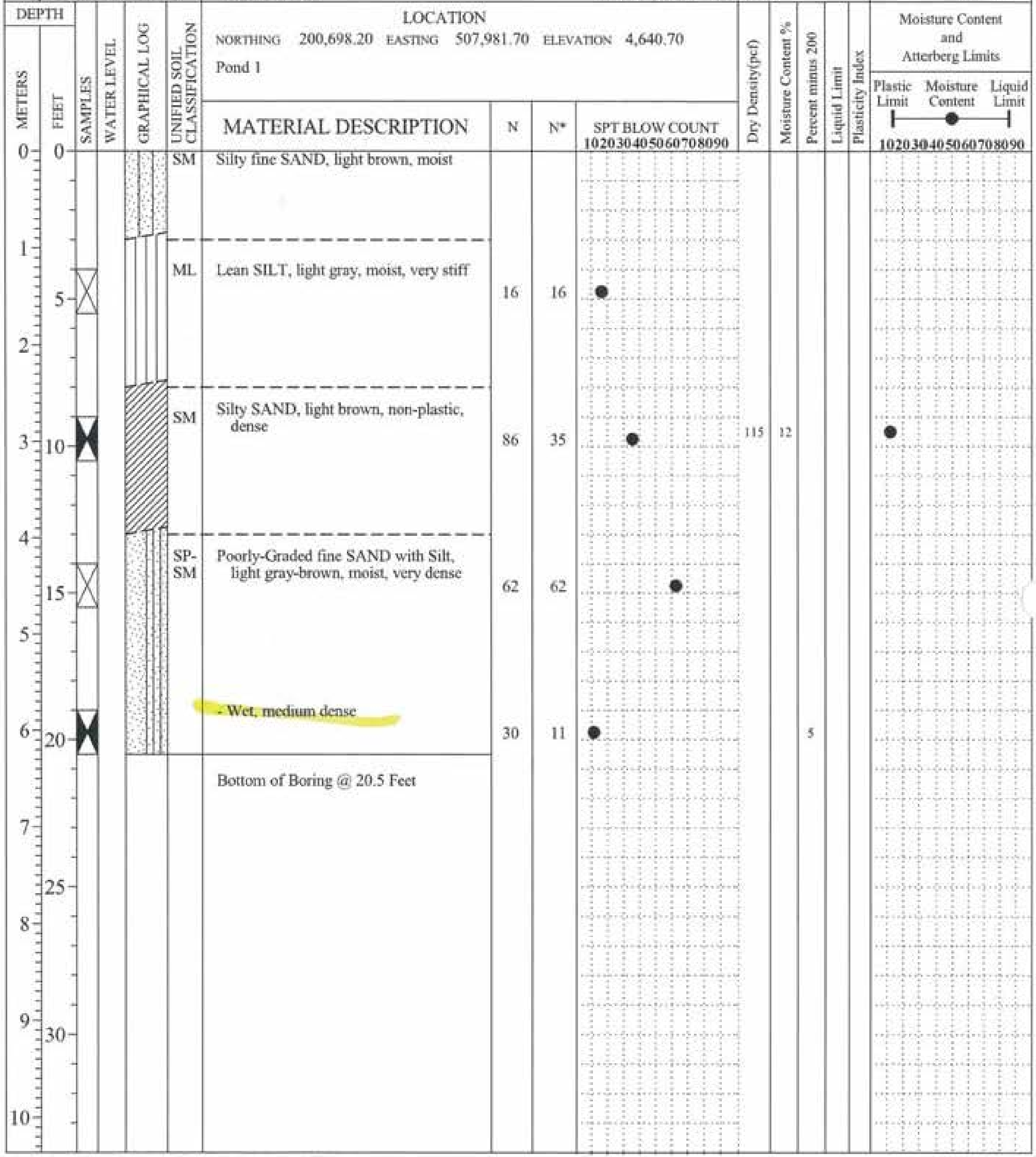
DATE	
STARTED:	2/19/10
COMPLETED:	2/19/10
BACKFILLED:	2/19/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P1-03
Sheet 1 of 1

LOCATION
NORTHING 200,698.20 EASTING 507,981.70 ELEVATION 4,640.70
Pond 1



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty fine SAND, light brown, moist							
ML	Lean SILT, light gray, moist, very stiff	16	16					
SM	Silty SAND, light brown, non-plastic, dense	86	35	115	12			
SP-SM	Poorly-Graded fine SAND with Silt, light gray-brown, moist, very dense	62	62					
	- Wet, medium dense	30	11			5		
	Bottom of Boring @ 20.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

FR - FIELD REFUSAL

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
- ▯ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◢ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
5

DATE	
STARTED:	3/3/10
COMPLETED:	3/3/10
BACKFILLED:	

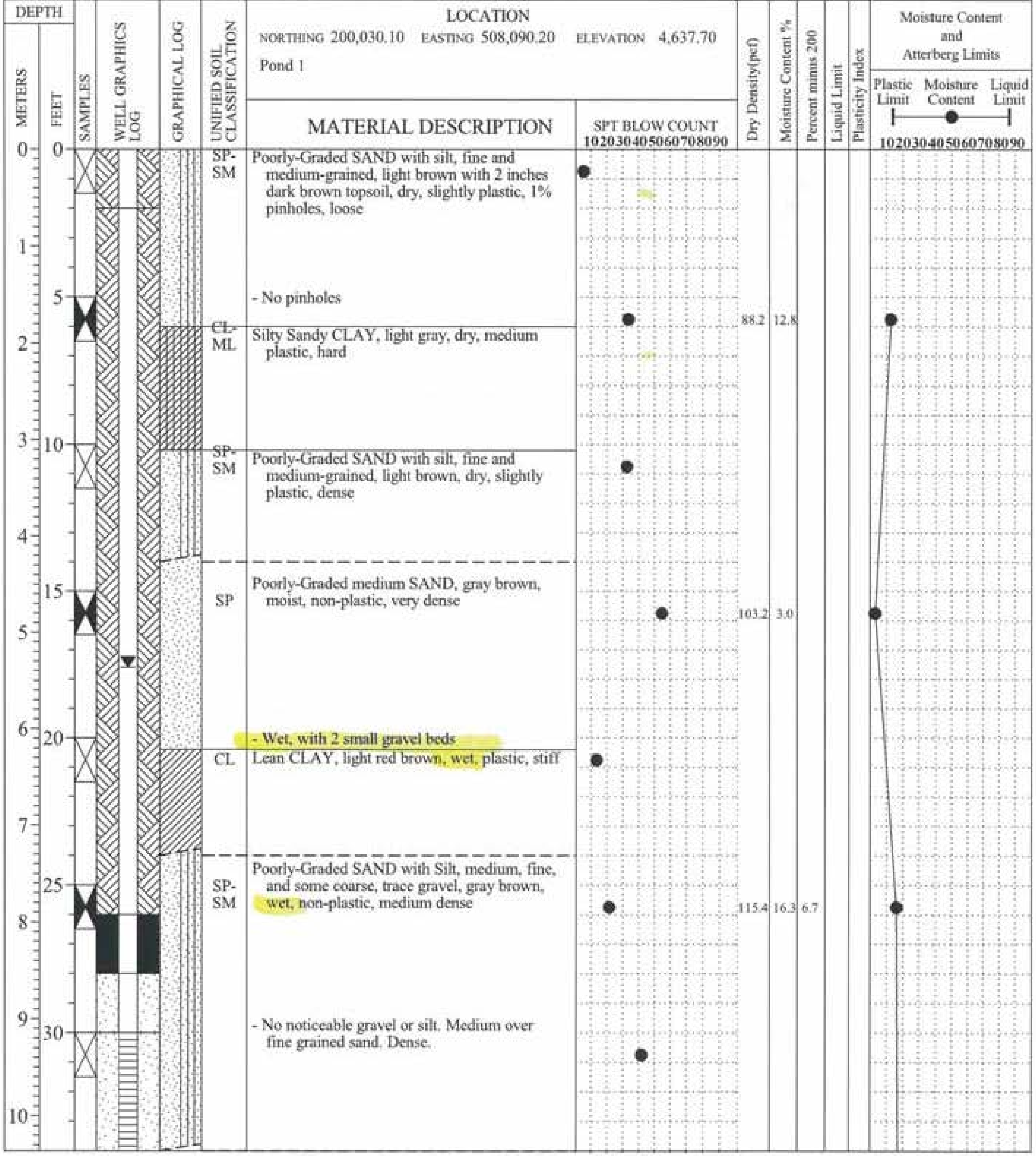
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Mari M3
Boring Type: Hollowstem Auger

WELL NO:
B-P1-04
Sheet 1 of 2

LOCATION
NORTHING 200,030.10 EASTING 508,090.20 ELEVATION 4,637.70
Pond 1



Depth (ft)	Unified Soil Classification	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200
0	SP-SM	Poorly-Graded SAND with silt, fine and medium-grained, light brown with 2 inches dark brown topsoil, dry, slightly plastic, 1% pinholes, loose			
5		- No pinholes	88.2	12.8	
	CL-ML	Silty Sandy CLAY, light gray, dry, medium plastic, hard			
10	SP-SM	Poorly-Graded SAND with silt, fine and medium-grained, light brown, dry, slightly plastic, dense			
15	SP	Poorly-Graded medium SAND, gray brown, moist, non-plastic, very dense	103.2	3.0	
20		- Wet, with 2 small gravel beds			
	CL	Lean CLAY, light red brown, wet, plastic, stiff			
25	SP-SM	Poorly-Graded SAND with Silt, medium, fine, and some coarse, trace gravel, gray brown, wet, non-plastic, medium dense	115.4	16.3	6.7
30		- No noticeable gravel or silt. Medium over fine grained sand. Dense.			

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

WELL DESCRIPTION(PLATE 20) GINT POND 1.GPJ IGES.GDT 6/1/10

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
▩- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
6a

DATE	
STARTED:	3/3/10
COMPLETED:	3/3/10
BACKFILLED:	

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Mat M3
Boring Type: Hollowstem Auger

WELL NO: **B-P1-04**

Sheet 2 of 2

LOCATION
NORTHING 200,030.10 EASTING 508,090.20 ELEVATION 4,637.70
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WELL GRAPHICS LOG	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
11	35	☒			CL-ML	Silty Lean CLAY with sand to SM/SC, light brown, wet, medium plastic, hard	112.4	17.1			
12	40	☒			CL	Lean CLAY, light gray brown to light red brown, wet, plastic, minor silt, stiff					
13						Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'					
14	45					Bottom of Boring @ 41.5 Feet					
15	50										
16											
17	55										
18	60										
19											
20	65										

SPT BLOW COUNT

Moisture Content and Atterberg Limits

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- ☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
- ☒ - 3" O.D./2.42" I.D. U SAMPLER
- ▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
- ☐ - GRAB SAMPLE
- ▮ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▤	▦

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

6b

WELL DESCRIPTION(PLATE 20) GINT POND 1.GPJ IGES.GDT 6/1/10

DATE	
STARTED:	3/3/10
COMPLETED:	3/3/10
BACKFILLED:	3/3/10

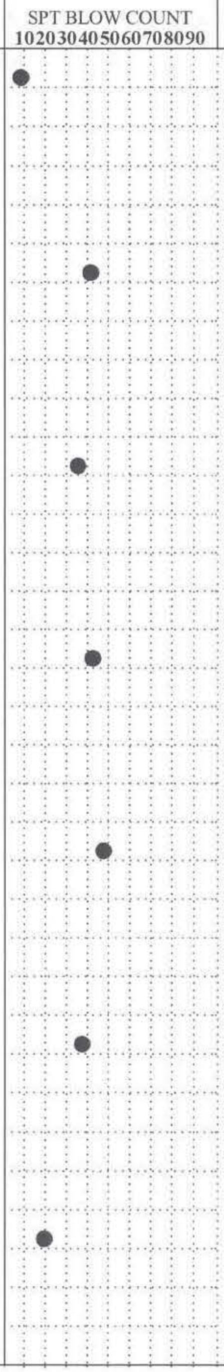
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

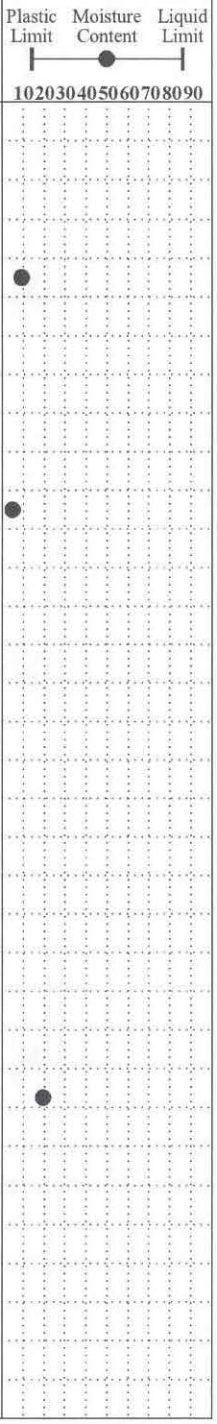
IGES Rep:	S. Kluck
Rig Type:	ConeTec Track Marl M3
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P1-05
Sheet 1 of 1

LOCATION
NORTHING 199,994.00 EASTING 509,921.00 ELEVATION 4,644.40
Pond 1

DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	☒	CL-ML	Silty Lean CLAY with Sand, light brown, dry, medium plastic, trace pinholes, trace white salt (CO3) veins, medium stiff	8	8					
		SM	Silty fine SAND, light brown, dry, nonplastic, 1-2% large pinholes (2mm), dense			103	9			
5	⧗			103	41					
10	☒		- No pinholes, dense	35	35		5	19		
15	⧗	SP	Blowcounts not representative, problem with rings. Poorly-Graded SAND, medium and fine-grained, light brown, dry, nonplastic, dense	104	42					
20	☒		- Brown, changes from moist to wet at 21.2', dense	47	47					
25	⧗		- Gray-brown, medium grained, dense	92	37	107	19			
30	☒		- Trace gravel, 3 inches of clay layers in SP, medium dense	19	19					
			Bottom of Boring @ 31.5 Feet							





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▤ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
7

DATE		
STARTED:	3/3/10	
COMPLETED:	3/3/10	
BACKFILLED:	3/3/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO: **B-P1-06**
Sheet 1 of 2

LOCATION
NORTHING 201,161.70 EASTING 509,192.30 ELEVATION 4,649.00
Pond 1

DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	☒		CL	Lean CLAY with Silt, light brown, moist, very stiff	28	28					
3			ML	Lean SILT, light gray-brown, few pinholes, very stiff							
5	■				43	21	97	11			
10	☒			- Hard	53	53					
13				Sandy Lean SILT, light brown, moist, very dense							
15	■				170	67	96	11	51		
18			SP	Poorly-Graded fine SAND, moist, dense							
20	☒				43	43					
25	■			- Very moist, medium dense	72	29	98	26			
25			CL	Lean CLAY, gray							
28		▼									
30	☒			- Red brown, very stiff	24	24					
33				- Lost sample caused by slough,							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

IGES®
Copyright (c) 2010, IGES, INC.

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate 8a

DATE	
STARTED:	3/3/10
COMPLETED:	3/3/10
BACKFILLED:	3/3/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P1-06
Sheet 2 of 2

LOCATION
NORTHING 201,161.70 EASTING 509,192.30 ELEVATION 4,649.00
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
	35	▣		▨		blowcounts may not be representative (very stiff)	35	17	●						
12	40	☒		▨		- Hard	80	80	●						
						Bottom of Boring @ 40.5 Feet									

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▯ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▨ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate

8b

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P1-07
Sheet 1 of 1

LOCATION
NORTHING 202,479.10 EASTING 508,936.90 ELEVATION 4,656.30
Pond 1

SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
	SP	Poorly-Graded fine SAND, light brown, moist							
☒	CL	Sandy Lean CLAY, light brown, moist, stiff	10	10					
■		- Lean CLAY, not sandy, very stiff	41	20	105	21		48	29
☒	SP	Poorly-Graded fine SAND, light brown, moist, dense	47	47					
■		- Gray-brown fine to coarse sand to light brown fine sand, moist, medium dense	69	28		2	2		
		Bottom of Boring @ 20.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▤- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
▨- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

IGES®

Plate 9

DATE STARTED:	2/25/10
COMPLETED:	2/25/10
BACKFILLED:	2/25/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P1-08
Sheet 1 of 1

LOCATION
NORTHING 202,483.40 EASTING 509,853.10 ELEVATION 4,657.90
Pond 1

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		ML	Sandy Lean SILT to Silty fine Sand (SM), light brown, moist							
		CL	Lean CLAY, red-brown, moist							
5	☒			30	30					
		SP	Poorly-Graded SAND, gray brown, moist					3		
10	■			56	22					
15	☒		- Dry	42	42					
20	■		- Light gray	80	33		2	3		
25	☒		- Moist	54	54					
30	■		- Very moist	180	71					
			Bottom of Boring @ 30.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

IGES®

Copyright (c) 2010, IGES, INC.

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
- ☐- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▨- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate

10

BORING LOG (NEW) (PLATE) GINT POND 1.GPJ IGES.GDT 6/1/10

DATE	
STARTED:	2/26/10
COMPLETED:	2/26/10
BACKFILLED:	

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

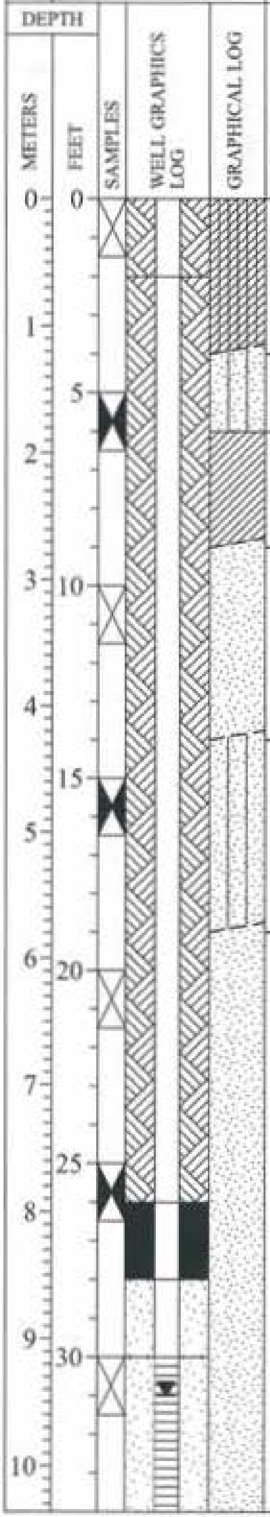
Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

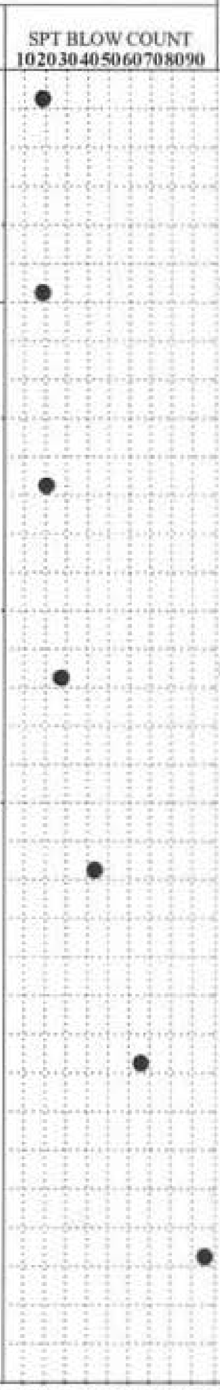
WELL NO: **B-P1-09**

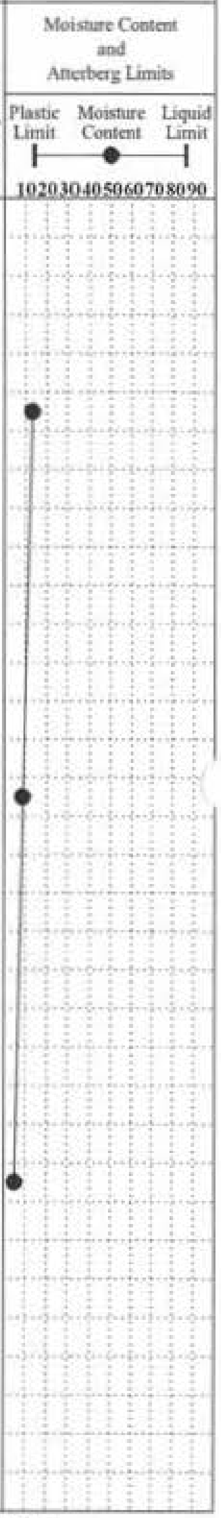
Sheet 1 of 2

LOCATION
NORTHING 202,289.20 EASTING 510,583.60 ELEVATION 4,659.10
Pond 1



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL-ML	Silty Lean CLAY, light brown, dry, buff-colored patches, no pinholes, plastic, very stiff					
SM	Silty SAND, fine and medium grained, light brown, dry, nonplastic, trace pinholes <1%, medium dense	103.6	13.3			
CL	Lean CLAY, light brown, moist, plastic, white patches CaCO3 crystals					
SP	Poorly-Graded SAND, medium and fine grained, light gray-brown, dry, beach sand, nonplastic, medium dense. ML-CL small layers at top and bottom of sample.					
SM	Silty fine SAND, light brown, dry, low to medium plastic, pinholes 1-2%, medium dense	107.9	8.9	30.3		
SP	Poorly-Graded SAND, medium and fine grained, light gray-brown, dry, nonplastic. Small ML-CL layer at top of sample.					
	- No pinholes. SP with small layer SM, light brown.	97.7	5.1			
	- SP, medium sand, <5% pebbles, gray brown, wet, nonplastic, very dense					





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
▮- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◪- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

11a

DATE	
STARTED:	2/26/10
COMPLETED:	2/26/10
BACKFILLED:	

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

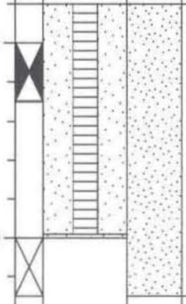
Project Number 01286-002

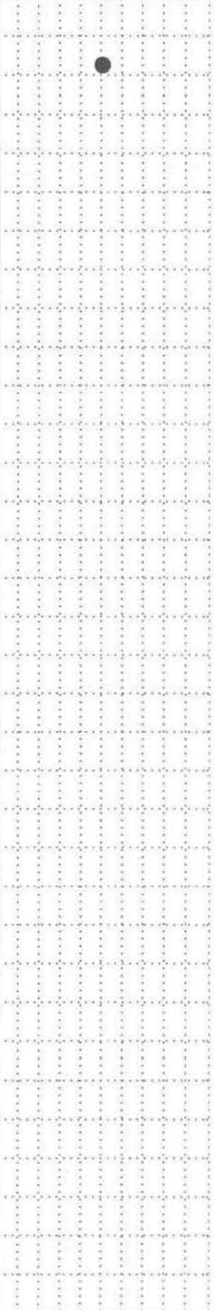
IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO: **B-P1-09**
Sheet 2 of 2

LOCATION
NORTHING 202,289.20 EASTING 510,583.60 ELEVATION 4,659.10
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WELL GRAPHICS LOG	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
11	35	☒				- Dense	●						
12	40	☒				no sample							
13						Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'							
14	45					Bottom of Boring @ 41.5 Feet							
15	50												
16													
17	55												
18	60												
19													
20	65												





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

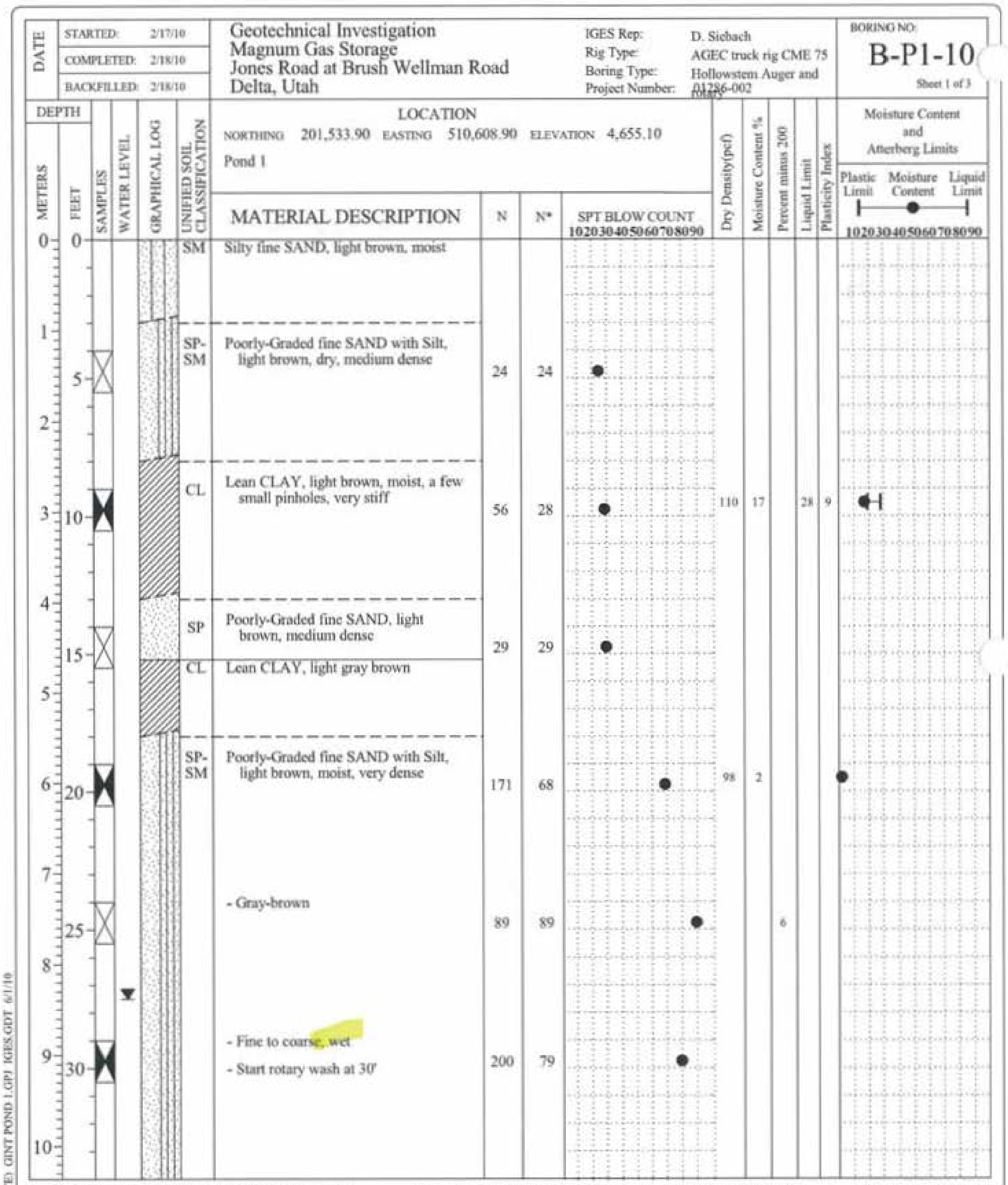
SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
▮ - 3" O.D./2.42" I.D. U SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
▮ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
11b



DATE	
STARTED:	2/17/10
COMPLETED:	2/18/10
BACKFILLED:	2/18/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger and rotary
Project Number: 01286-002

BORING NO: **B-P1-10**
Sheet 1 of 3

LOCATION
NORTHING 201,533.90 EASTING 510,608.90 ELEVATION 4,655.10
Pond 1

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty fine SAND, light brown, moist							
SP-SM	Poorly-Graded fine SAND with Silt, light brown, dry, medium dense	24	24					
CL	Lean CLAY, light brown, moist, a few small pinholes, very stiff	56	28	110	17		28	9
SP	Poorly-Graded fine SAND, light brown, medium dense	29	29					
CL	Lean CLAY, light gray brown							
SP-SM	Poorly-Graded fine SAND with Silt, light brown, moist, very dense	171	68	98	2			
	- Gray-brown	89	89			6		
	- Fine to coarse, wet - Start rotary wash at 30'	200	79					

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate
12a

DATE	
STARTED:	2/17/10
COMPLETED:	2/18/10
BACKFILLED:	2/18/10

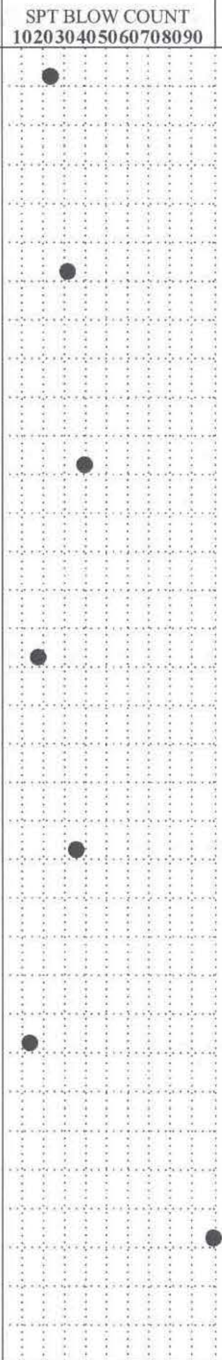
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

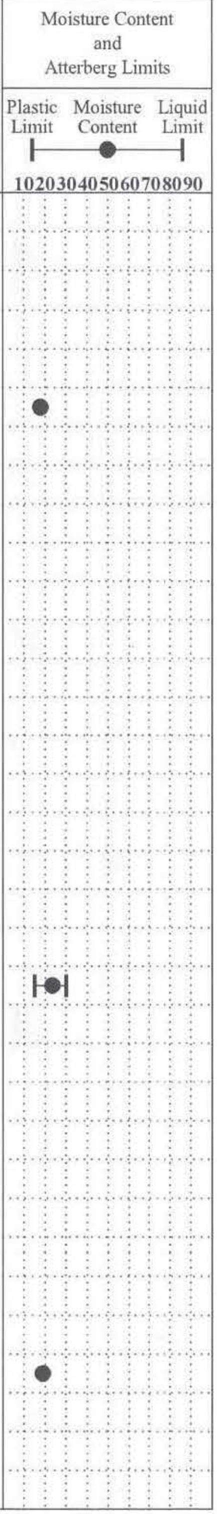
IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger and rotary
Project Number: 01286-002

BORING NO:
B-P1-10
Sheet 2 of 3

LOCATION
NORTHING 201,533.90 EASTING 510,608.90 ELEVATION 4,655.10
Pond 1

DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
35	☒	CL	Lean CLAY, light brown, very stiff	23	23					
		SP	Poorly-Graded fine SAND, light brown							
40	⧓	CL	Lean Sandy CLAY, light brown, hard	63	31	114	18	69		
45	☒	SM	Silty fine SAND, light brown, dense	39	39					
		CL	Lean CLAY, light brown							
50	⧓	SP	Poorly-Graded fine SAND, light brown, medium dense	44	17					
55	☒	CL	Sandy Lean CLAY, light brown, hard	35	35	103	24		30	15
60	⧓		- Stiff	24	13					
65	☒	SP-SM	Poorly-Graded SAND with Silt, gray-brown, fine to coarse, very dense	270	270	109	19	7		





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
⊟- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◪- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
12b

BORING LOG (NEW) (PLATE) GINT POND 1.GPJ IGES.GDT 6/1/10

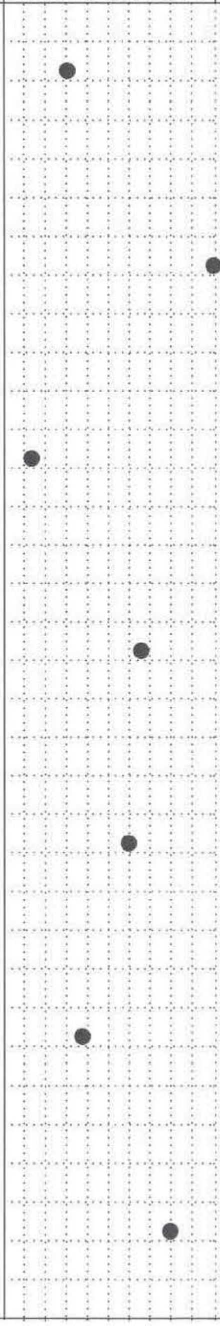
DATE	
STARTED:	2/17/10
COMPLETED:	2/18/10
BACKFILLED:	2/18/10

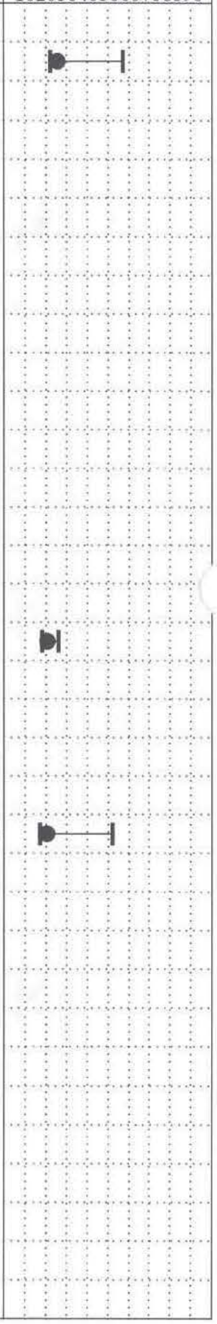
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger and rotary
Project Number: 01286-002

BORING NO:
B-P1-10
Sheet 3 of 3

LOCATION
NORTHING 201,533.90 EASTING 510,608.90 ELEVATION 4,655.10
Pond 1





DEPTH METERS: 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31

DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
70	⧗		CH	Fat CLAY (CH), light reddish brown, very stiff	60	30	100	26		57	35
75	☒			Mostly slough. Suspect Fat Clay. Hard.	100	100					
80	⧗			No Recovery. Suspect CH. Blowcounts may be inaccurate / slough (very stiff).	34	13					
85	☒		CL	Lean CLAY (CL), light reddish brown, hard	65	65	107	21		26	8
90	⧗		CH	Fat CLAY (CH), light reddish brown, hard	119	59	108	21		52	35
95	☒		SP	Poorly-Graded SAND, gray-brown, dense	37	37					
100	⧗			- Very dense	200	79					
				Bottom of Boring @ 100.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate 12c

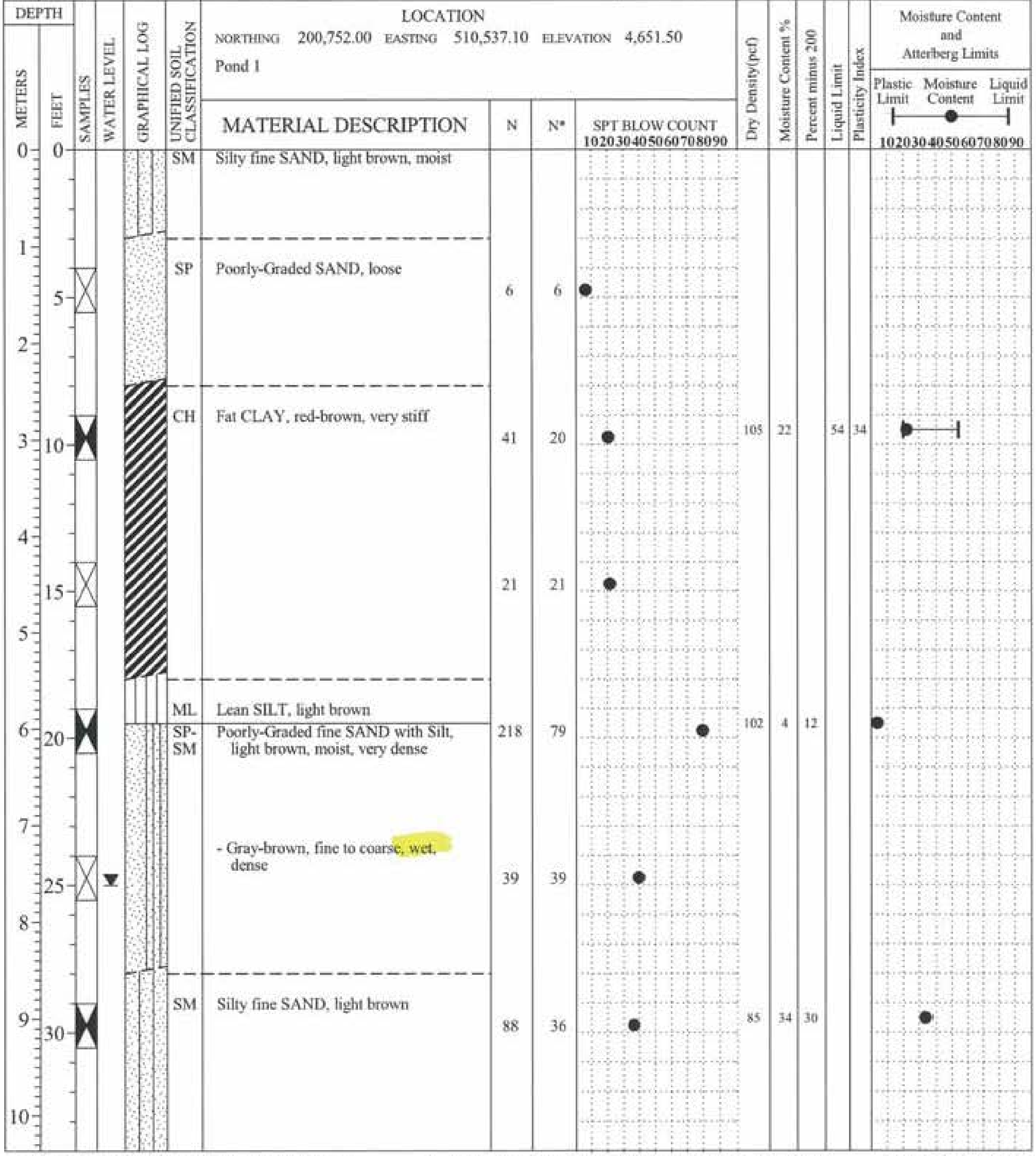
DATE		
STARTED:	3/3/10	
COMPLETED:	3/3/10	
BACKFILLED:	3/3/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P1-11
Sheet 1 of 2

LOCATION
NORTHING 200,752.00 EASTING 510,537.10 ELEVATION 4,651.50
Pond 1



DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			SM	Silty fine SAND, light brown, moist							
			SP	Poorly-Graded SAND, loose							
5	☒				6	6					
			CH	Fat CLAY, red-brown, very stiff							
10	■				41	20	105	22		54	34
15	☒				21	21					
			ML	Lean SILT, light brown							
20	■		SP-SM	Poorly-Graded fine SAND with Silt, light brown, moist, very dense	218	79	102	4	12		
25	☒	▼		- Gray-brown, fine to coarse, wet, dense	39	39					
			SM	Silty fine SAND, light brown							
30	■				88	36	85	34	30		

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT   FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▨ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate
13a

BORING LOG (NEW) (PLATE) GINT POND 1.GPJ IGES.GDT 6/1/10

DATE	
STARTED:	3/3/10
COMPLETED:	3/3/10
BACKFILLED:	3/3/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P1-11
Sheet 2 of 2

LOCATION
NORTHING 200,752.00 EASTING 510,537.10 ELEVATION 4,651.50
Pond 1

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
35	☒		- Gray-brown, very dense	59	59					
40	⧗	CL	Lean CLAY, light brown, hard	68	34	112	18		32	15
		SP	Poorly-Graded SAND, gray							
			Bottom of Boring @ 40.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
⊟- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◩- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

IGES®

Plate 13b

DATE
STARTED: 3/2/10
COMPLETED: 3/2/10
BACKFILLED:

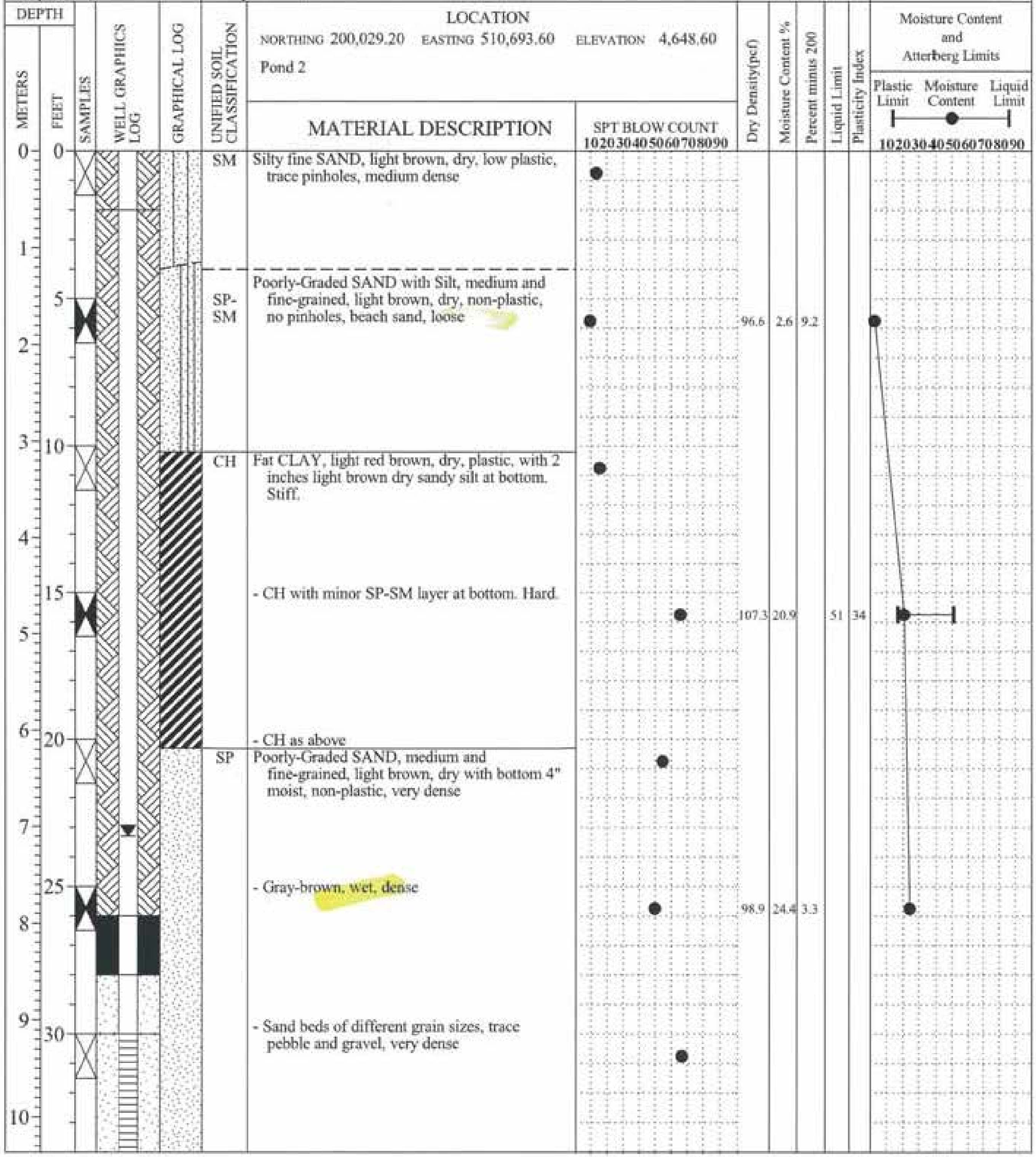
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO: **B-P2-01**
Sheet 1 of 2

LOCATION
NORTHING 200,029.20 EASTING 510,693.60 ELEVATION 4,648.60
Pond 2



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty fine SAND, light brown, dry, low plastic, trace pinholes, medium dense					
SP-SM	Poorly-Graded SAND with Silt, medium and fine-grained, light brown, dry, non-plastic, no pinholes, beach sand, loose	96.6	2.6	9.2		
CH	Fat CLAY, light red brown, dry, plastic, with 2 inches light brown dry sandy silt at bottom. Stiff.					
	- CH with minor SP-SM layer at bottom. Hard.	107.3	20.9		51	34
	- CH as above					
SP	Poorly-Graded SAND, medium and fine-grained, light brown, dry with bottom 4" moist, non-plastic, very dense					
	- Gray-brown, wet, dense	98.9	24.4	3.3		
	- Sand beds of different grain sizes, trace pebble and gravel, very dense					

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
■- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
■	▥	▦	▩

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
14a

DATE
STARTED: 3/2/10
COMPLETED: 3/2/10
BACKFILLED:

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

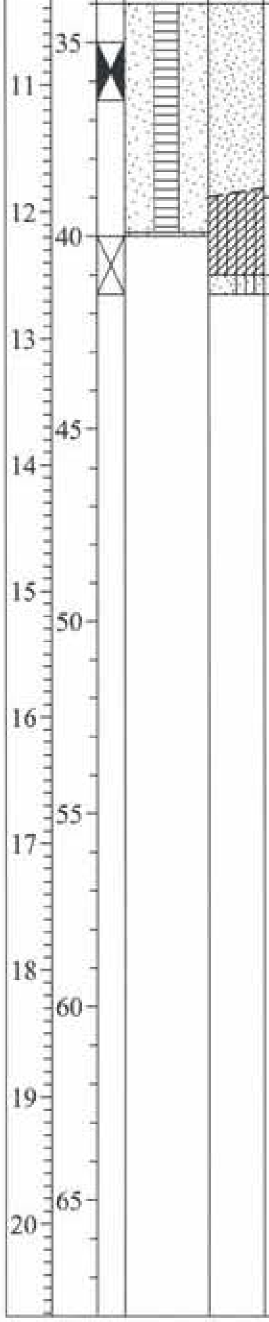
Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO: **B-P2-01**
Sheet 2 of 2

LOCATION
NORTHING 200,029.20 EASTING 510,693.60 ELEVATION 4,648.60
Pond 2

DEPTH METERS	DEPTH FEET	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION
11	35		Lost sample. Presume SP (loose).
12	40	CL-ML	Silty Lean CLAY, light red-brown, wet, plastic, grades into SP-SM. Very stiff.
		SP-SM	Poorly-Graded SAND with Silt, light red-brown
13			Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'
14	45		Bottom of Boring @ 41.5 Feet



Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
☒ - 3" O.D./2.42" I.D. U SAMPLER
◩ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▤	▦

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plat
14b

DATE	STARTED: 3/3/10 COMPLETED: 3/3/10 BACKFILLED: 3/3/10		BORING NO:

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-02
Sheet 1 of 1

LOCATION
NORTHING 200,002.80 EASTING 511,545.70 ELEVATION 4,641.50
Pond 2

SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
☒	CL	Lean CLAY, light red-brown, dry, plastic, very stiff	16	16					
⧗	ML	Sandy Lean SILT, light gray brown, dry, low plastic, hard, grades to SM	130	65	112	11		17	2
	SM	Silty SAND, light gray brown, dry, non-plastic							
☒		Interbedded SM and ML; Silty SAND: light brown, dry, slightly plastic; and Sandy Silt: light red brown, dry, low plastic, trace pinholes. Medium dense.	26	26					
⧗	SP	Poorly-Graded SAND, medium and fine, brown, wet, non-plastic, 3" ML at top. Dense.	75	31	105	21	4		
☒		- Heave, blowcounts not representative (very dense). Medium-grained dune sand, brown, wet, non-plastic, 1 thin layer gravel and clay.	92	92					
⧗		- Medium and fine-grained, gray brown, trace silt, dense	110	44					
☒		- Medium, fine, and coarse-grained, medium dense	19	19					
		Bottom of Boring @ 31.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT   FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▮ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES

Plate

15

DATE		
STARTED:	3/1/10	
COMPLETED:	3/1/10	
BACKFILLED:	3/1/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-03
Sheet 1 of 1

LOCATION
NORTHING 200,017.40 EASTING 512,434.70 ELEVATION 4,644.60
Pond 2

DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	☒	SP	Poorly-Graded SAND, light brown, powder dry							
		CL-ML	Silty Lean CLAY with Sand, light brown, dry, no pinholes, medium stiff	5	5					
5	■	CL	Lean CLAY, light gray, dry, plastic, hard	120	60	90	24		33	12
10	☒	ML	Lean SILT, light brown, moist, low plastic, no pinholes, very stiff	28	28					
15	■		- Wet, dry at top, water table at ~15'	57	23	97	26	92		
20	☒	SP	Poorly-Graded SAND, fine and medium-grained, brown, wet, non-plastic, very dense	61	61					
25	■		- Gray brown, <=5% subrounded Gravel, dense	101	41					
30	☒		- Medium-grained sand, no gravel, medium dense	20	20					
			Bottom of Boring @ 31.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
16

DATE
STARTED: 3/2/10
COMPLETED: 3/2/10
BACKFILLED:

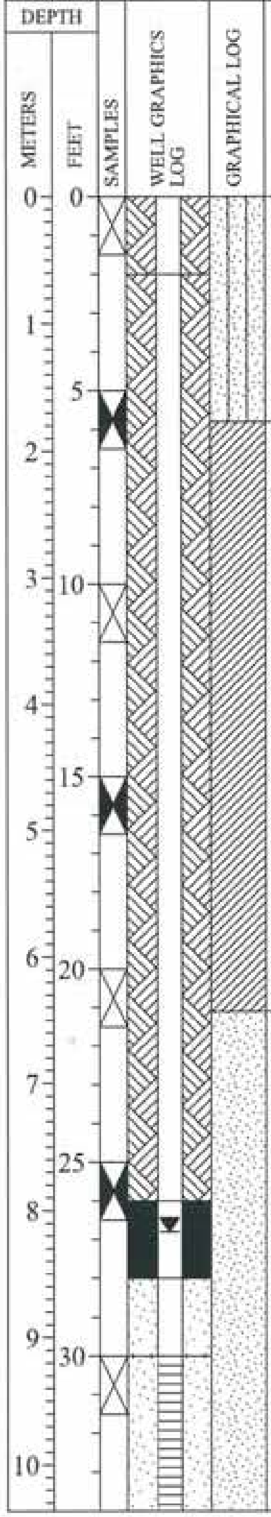
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

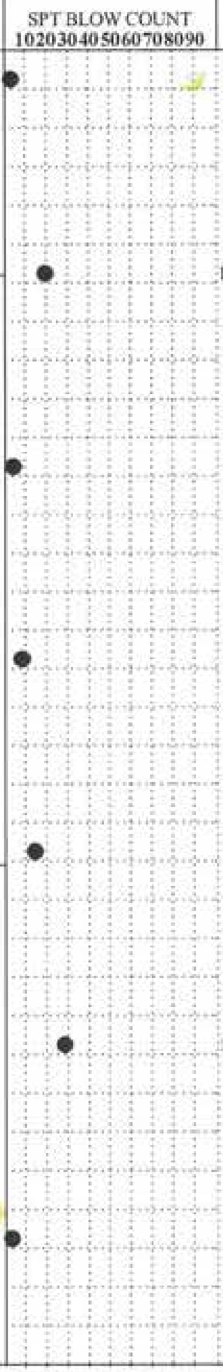
IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

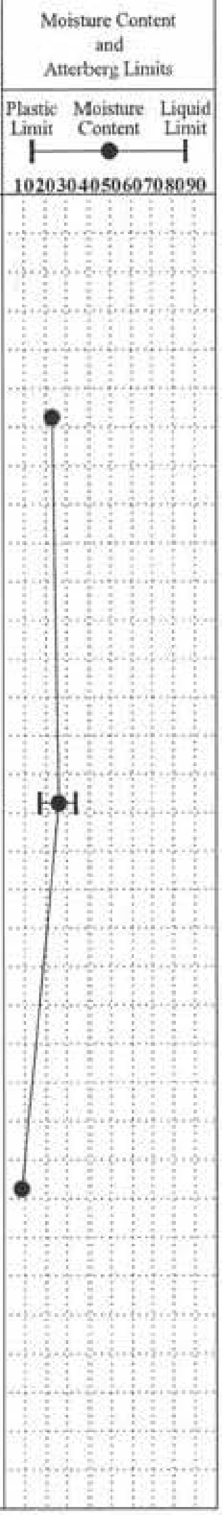
WELL NO:
B-P2-04
Sheet 1 of 2

LOCATION
NORTHING 200,055.40 EASTING 513,230.00 ELEVATION 4,656.50
Pond 2



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty fine SAND, light brown, powder dry therefore no pinholes, very loose					
	- Minor clay in sample overflow					
CL	Lean CLAY, light brown, moist, plastic, very stiff	102.5	23.2	97.6		
	- 2" ML-CL at top, light brown, moist. CL: Light gray-brown to light gray, moist, plastic, soft (like toothpaste). 0.5" dark brown organic layer at 10.9'					
	- Light gray CL with 40% rusty patches, minor silt, moist, plastic, medium stiff	96.6	26.2		34	17
	- CL with a few small silt beds, light gray with rusty patches as above, stiff					
SP	Poorly-Graded SAND, medium to coarse-grained, brown, moist, non-plastic.					
	- Minor sub-rounded gravel, medium dense	107.8	8.6	2.8		
	- Heave, blowcounts inaccurately low (very loose). SP medium sand, gray-brown, wet, non-plastic.					





N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
☒- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
☐- GRAB SAMPLE
▨- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▥	▦

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
17a

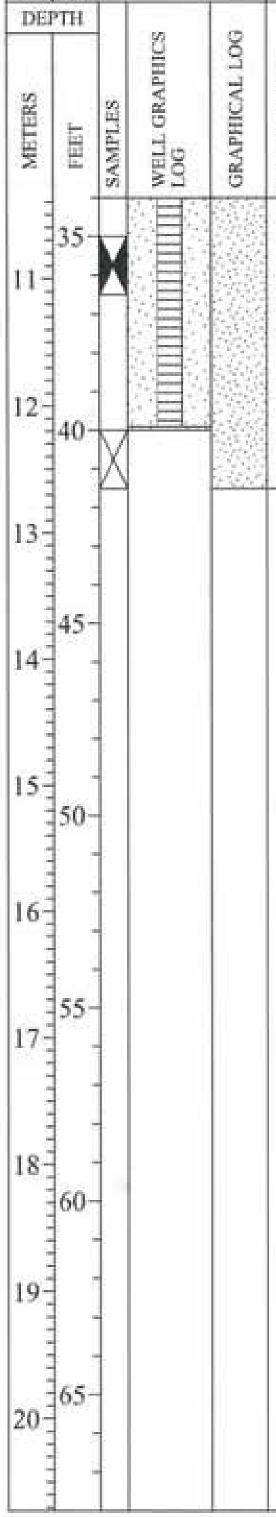
DATE	
STARTED:	3/2/10
COMPLETED:	3/2/10
BACKFILLED:	

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO: **B-P2-04**
Sheet 2 of 2

LOCATION
NORTHING 200,055.40 EASTING 513,230.00 ELEVATION 4,656.50
Pond 2



UNIFIED SOIL CLASSIFICATION

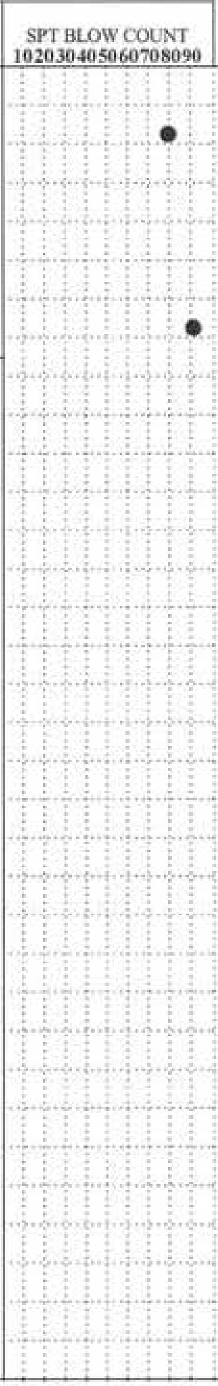
MATERIAL DESCRIPTION

- Heave, sample overfilled, blowcounts inaccurately high (very dense). SP as above with trace gravel.

- Brown, layers of medium-coarse and medium-fine sand, very dense

Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'

Bottom of Boring @ 41.5 Feet



Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content ● — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
▮- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
▮- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
17b

WELL DESCRIPTION(PLATE 20) GINT POND 2.GPJ IGES.GDT 6/1/10

DATE	
STARTED:	3/2/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-05
Sheet 1 of 2

LOCATION
NORTHING 200,902.00 EASTING 513,224.90 ELEVATION 4,652.00
Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL	Lean CLAY, light brown, moist							
	- Light gray							
SM	Silty fine SAND, light brown, moist, loose	22	8					
	- Gray-brown, dense	48	48	101	5	13		
CL	Lean CLAY, light brown							
ML	Lean SILT, light brown, moist, stiff	16	9					
SP-SM	Lost sample, traces of Poorly-Graded fine SAND with Silt, brown, moist, very dense	163	163					
	Poorly-Graded fine SAND with Silt. Heaving sand, blowcounts may not be representative (medium dense)	29	11					
	- Gray-brown, very dense	63	63	104	23	20		

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

18a

DATE	
STARTED:	3/2/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P2-05
Sheet 2 of 2

LOCATION
NORTHING 200,902.00 EASTING 513,224.90 ELEVATION 4,652.00
Pond 2

DEPTH (FEET)	SAMPLES	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
		- Medium dense							
35	☒		47	18					
39.5	▼	- Very dense	275	275	105	21	5		
40.5		Bottom of Boring @ 40.5 Feet							

Columns: METERS, FEET, SAMPLES, WATER LEVEL, GRAPHICAL LOG, UNIFIED SOIL CLASSIFICATION; SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◢ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
18b

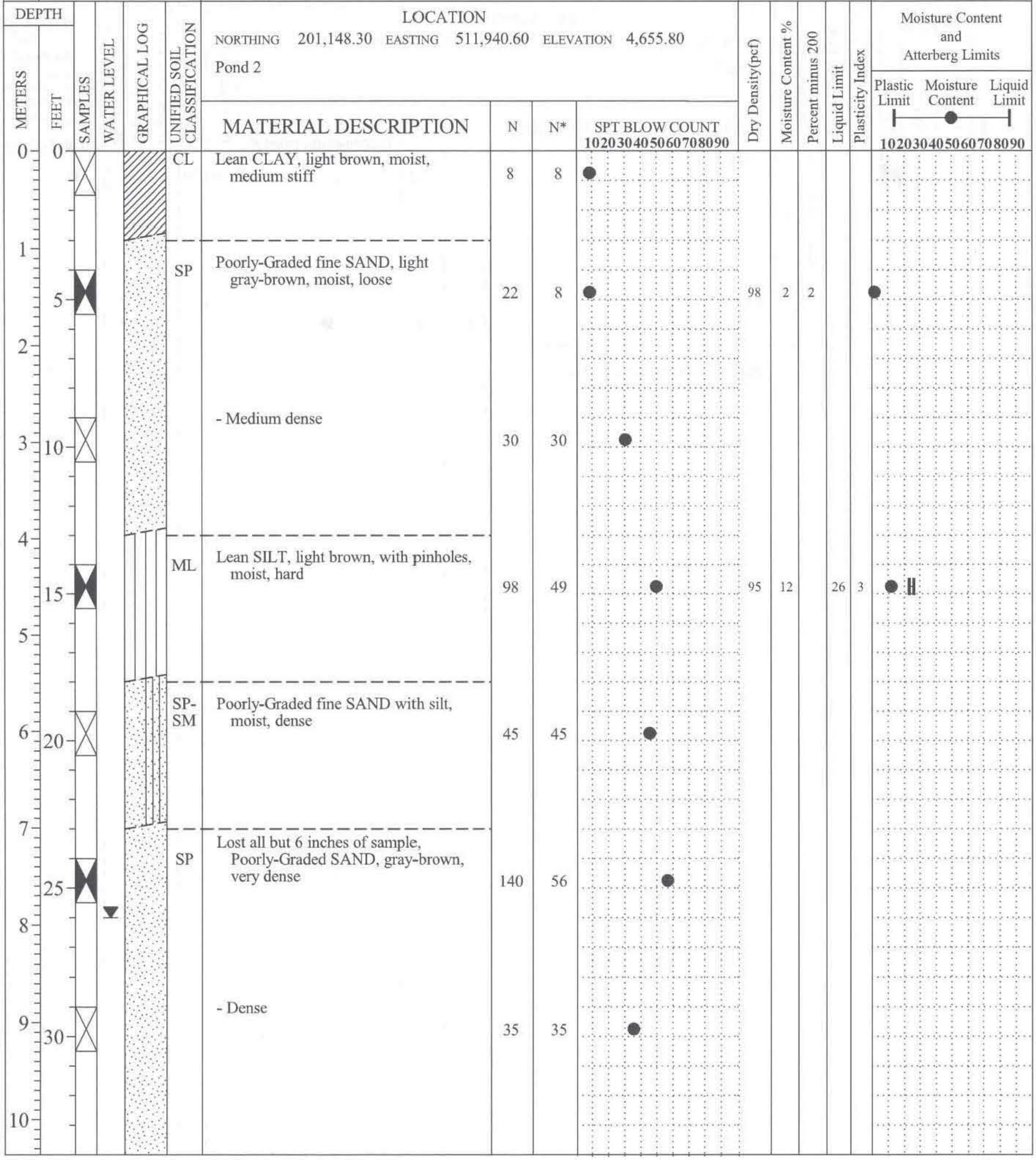
DATE	
STARTED:	3/2/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-06
Sheet 1 of 2

LOCATION
NORTHING 201,148.30 EASTING 511,940.60 ELEVATION 4,655.80
Pond 2



FEET	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	Lean CLAY, light brown, moist, medium stiff	8	8					
5	SP	Poorly-Graded fine SAND, light gray-brown, moist, loose	22	8	98	2	2		
10		- Medium dense	30	30					
15	ML	Lean SILT, light brown, with pinholes, moist, hard	98	49	95	12		26	3
20	SP-SM	Poorly-Graded fine SAND with silt, moist, dense	45	45					
25	SP	Lost all but 6 inches of sample, Poorly-Graded SAND, gray-brown, very dense	140	56					
30		- Dense	35	35					

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT   FR - FIELD REFUSAL

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
- ▤ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

19a

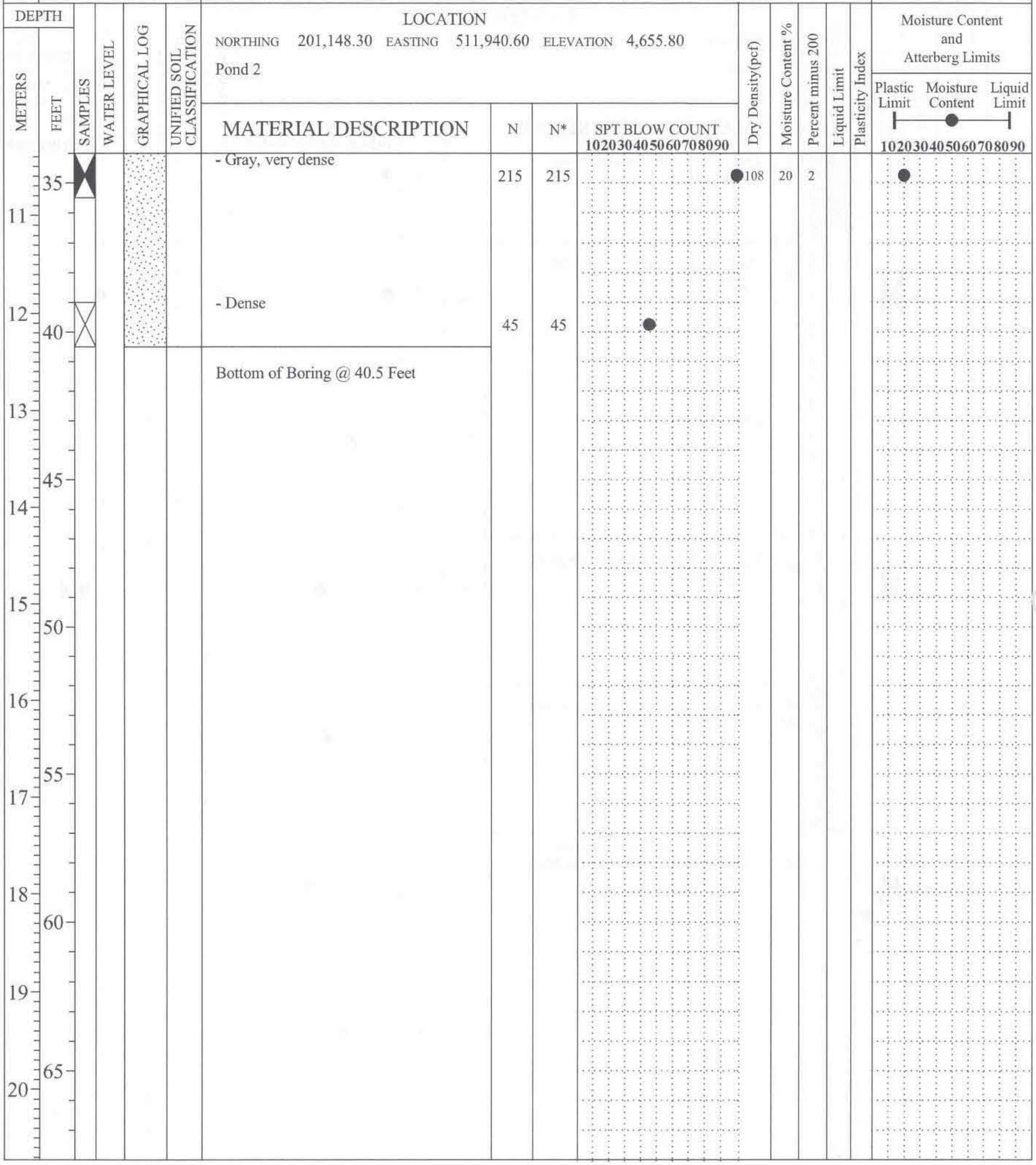
DATE		
STARTED:	3/2/10	
COMPLETED:	3/2/10	
BACKFILLED:	3/2/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-06
Sheet 2 of 2

LOCATION
NORTHING 201,148.30 EASTING 511,940.60 ELEVATION 4,655.80
Pond 2



MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
- Gray, very dense	215	215	108	20	2		
- Dense	45	45					
Bottom of Boring @ 40.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT *N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
☐ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
▮ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
19b

DATE	
STARTED:	3/1/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-07
Sheet 1 of 3

LOCATION
NORTHING 201,735.00 EASTING 513,209.10 ELEVATION 4,654.20
Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty fine SAND, light brown, moist							
	- Dry, medium dense	15	15					
	- Moist, medium dense	45	18	120	9	42		
CL	Sandy Lean CLAY, moist, hard	51	51					
	- Few pinholes	160	80	105	19		26	9
SP	Poorly-Graded SAND, fine to coarse, gray-brown, wet, dense Start rotary wash drilling at 24'	43	43					
	- Very dense	200	79					

DEPTH: METERS 0 1 2 3 4 5 6 7 8 9 10; FEET 0 5 10 15 20 25 30

SAMPLES | WATER LEVEL | GRAPHICAL LOG

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

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
- ⊟ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

20a

DATE	
STARTED:	3/1/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-07
Sheet 2 of 3

LOCATION
NORTHING 201,735.00 EASTING 513,209.10 ELEVATION 4,654.20
Pond 2

DEPTH – METERS: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content ●, Liquid Limit) 10 20 30 40 50 60 70 80 90
35	☒					60	60	●						
40	⧗					218	79	●		20	2			●
45	☒					66	66	●						
50	⧗				- Medium dense	35	13	●						
55	☒				Lost sample. Presume SP, very dense	200	200	●						
60	⧗				- Continued SP, fine sand, light brown, medium dense	49	19	●						
65	☒				- Gray-brown, very dense	282	282	●						

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▮ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
20b

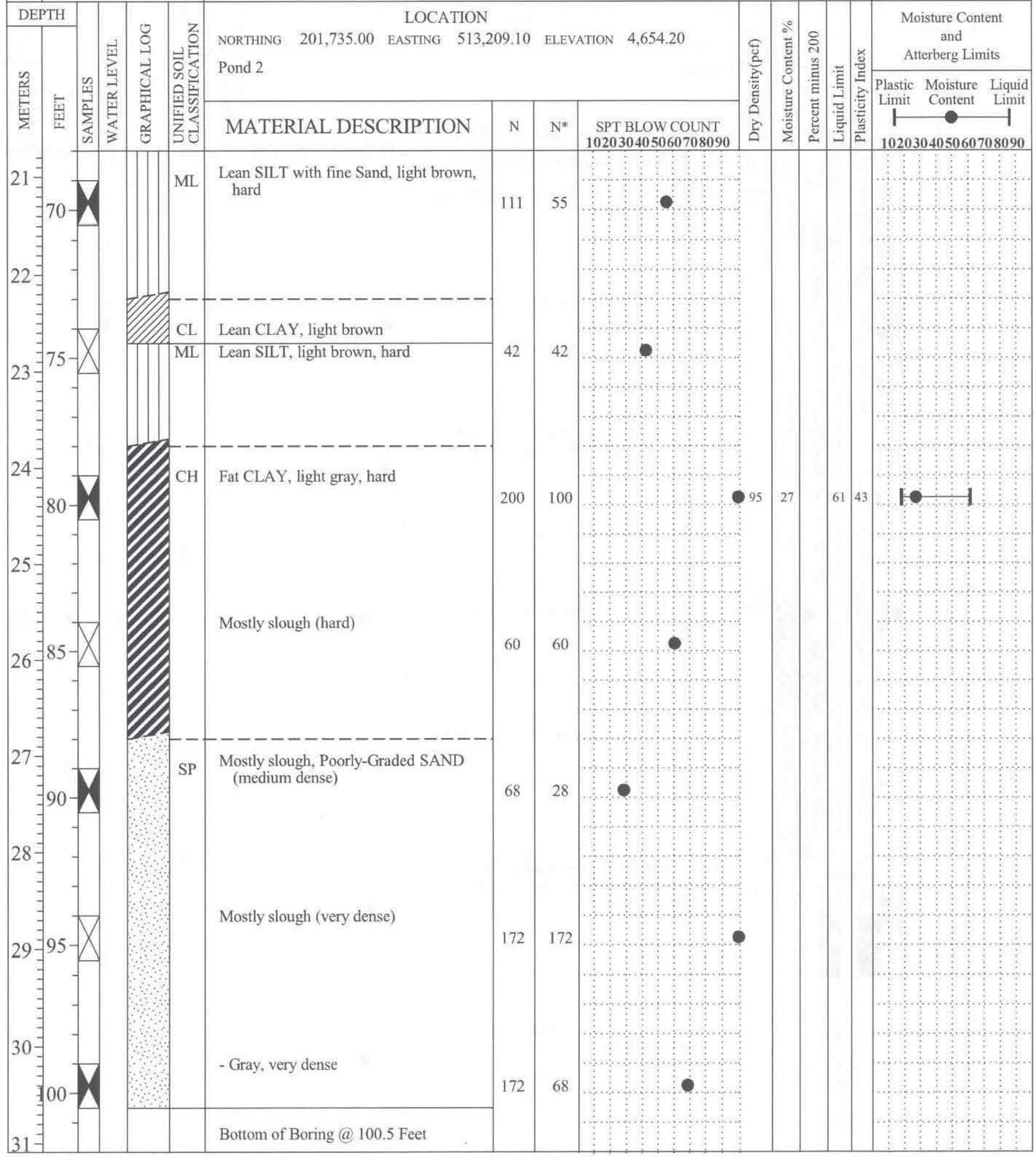
DATE	
STARTED:	3/1/10
COMPLETED:	3/2/10
BACKFILLED:	3/2/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-07
Sheet 3 of 3

LOCATION
NORTHING 201,735.00 EASTING 513,209.10 ELEVATION 4,654.20
Pond 2



Depth (ft)	Unified Soil Classification	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
70	ML	Lean SILT with fine Sand, light brown, hard	111	55					
	CL	Lean CLAY, light brown							
75	ML	Lean SILT, light brown, hard	42	42					
80	CH	Fat CLAY, light gray, hard	200	100	95	27		61	43
85		Mostly slough (hard)	60	60					
90	SP	Mostly slough, Poorly-Graded SAND (medium dense)	68	28					
95		Mostly slough (very dense)	172	172					
100		- Gray, very dense	172	68					
		Bottom of Boring @ 100.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ☐- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▨- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate

20c

DATE
STARTED: 3/1/10
COMPLETED: 3/1/10
BACKFILLED:

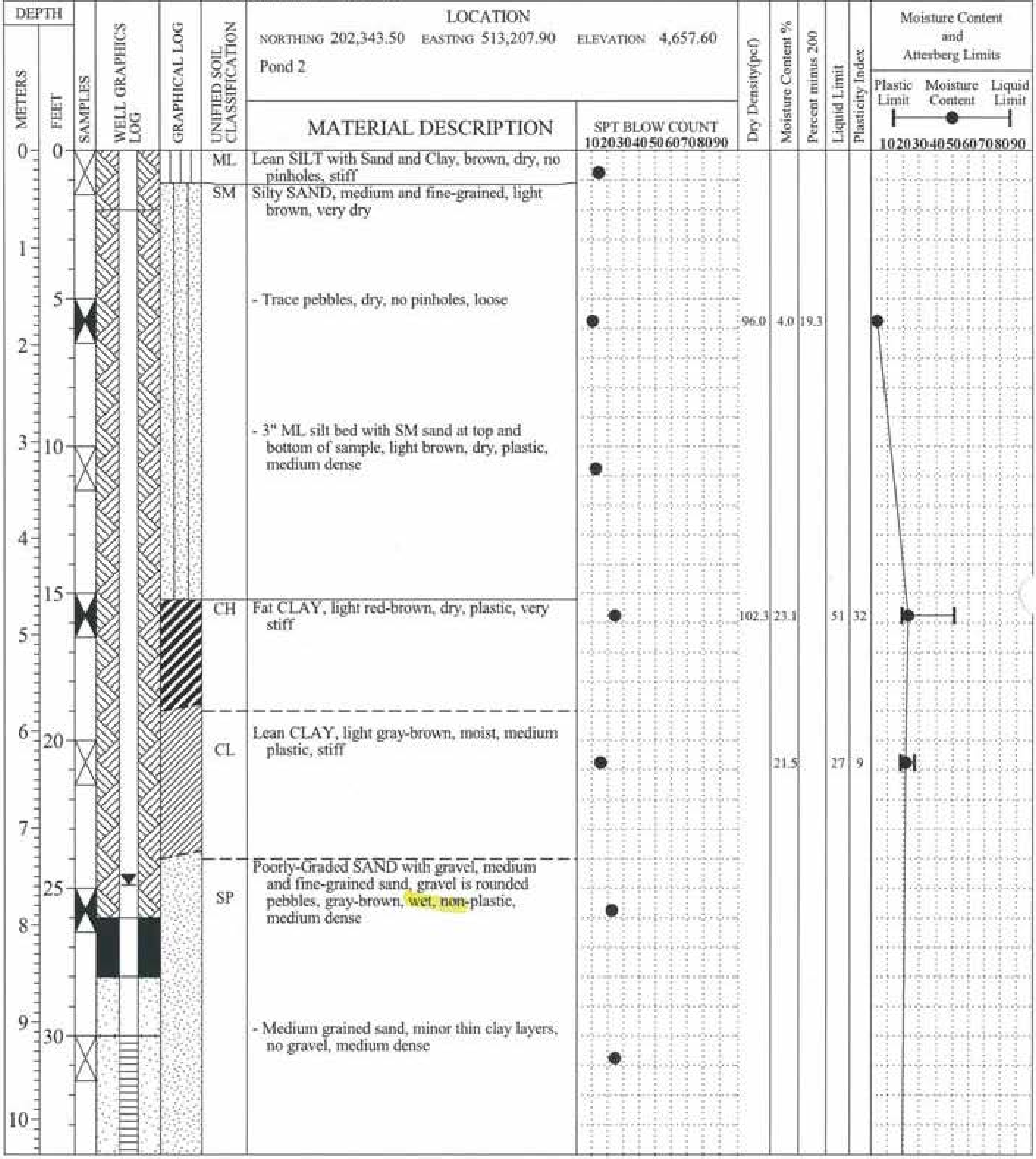
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P2-08
Sheet 1 of 2

LOCATION
NORTHING 202,343.50 EASTING 513,207.90 ELEVATION 4,657.60
Pond 2



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
ML	Lean SILT with Sand and Clay, brown, dry, no pinholes, stiff					
SM	Silty SAND, medium and fine-grained, light brown, very dry					
	- Trace pebbles, dry, no pinholes, loose	96.0	4.0	19.3		
	- 3" ML silt bed with SM sand at top and bottom of sample, light brown, dry, plastic, medium dense					
CH	Fat CLAY, light red-brown, dry, plastic, very stiff	102.3	23.1		51	32
CL	Lean CLAY, light gray-brown, moist, medium plastic, stiff		21.5		27	9
SP	Poorly-Graded SAND with gravel, medium and fine-grained sand, gravel is rounded pebbles, gray-brown, wet, non-plastic, medium dense					
	- Medium grained sand, minor thin clay layers, no gravel, medium dense					

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
■- Modified California Sampler

NOTES:			
Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
■	▥	▦	▩

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
21a

DATE	
STARTED:	3/1/10
COMPLETED:	3/1/10
BACKFILLED:	

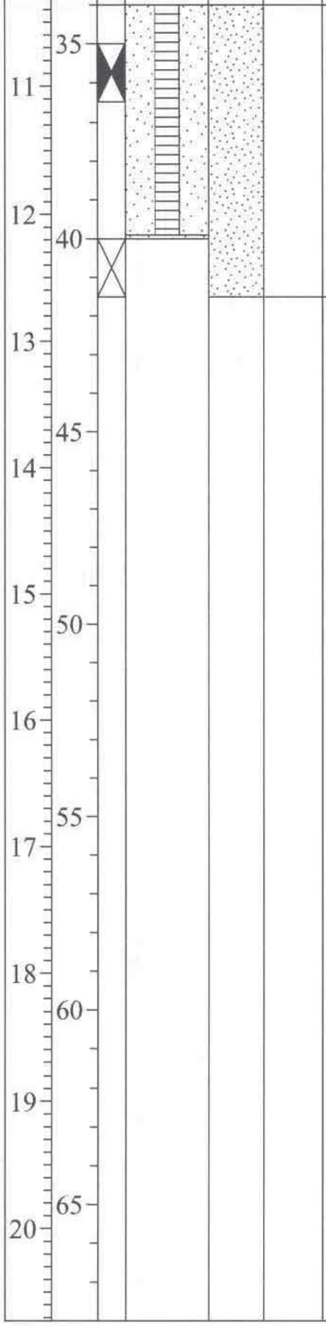
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-002

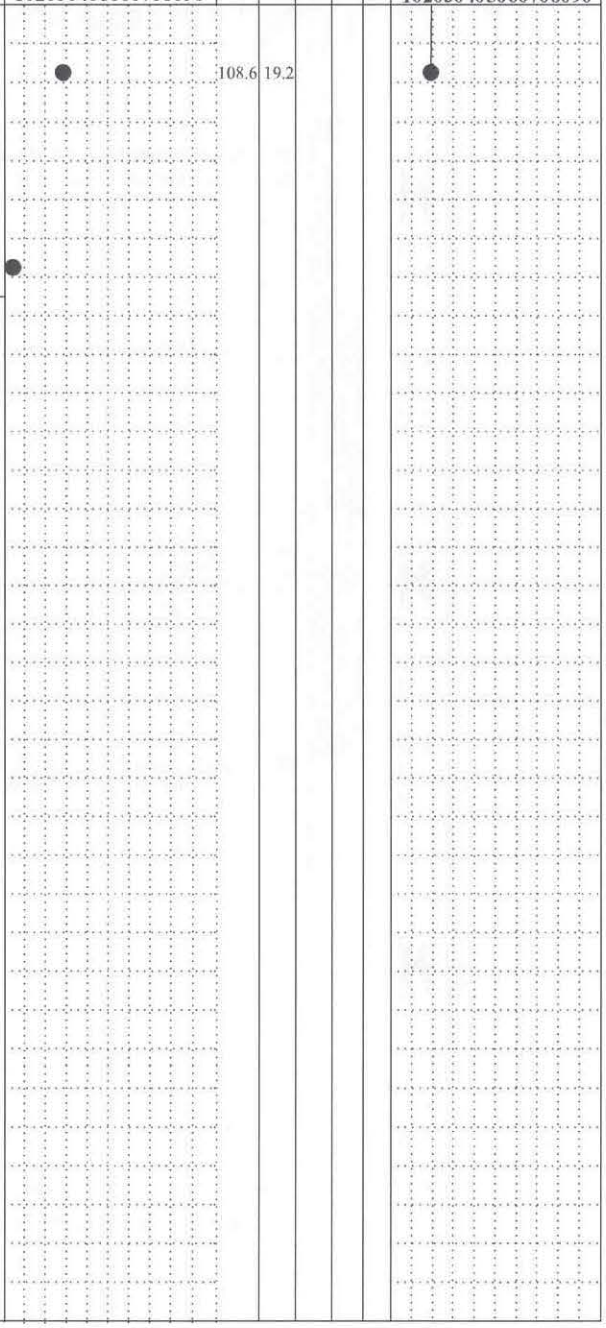
IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO: **B-P2-08**
Sheet 2 of 2

LOCATION
NORTHING 202,343.50 EASTING 513,207.90 ELEVATION 4,657.60
Pond 2

DEPTH METERS	DEPTH FEET	SAMPLES	WELL GRAPHICS LOG	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90
	35					- Light brown, minor clay, medium dense		108.6	19.2				
	40					- Gray brown, trace gravel, very loose							
						Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'							
	45					Bottom of Boring @ 41.5 Feet							





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
☒- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
▨- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▯	▤	▦

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
21b

DATE	STARTED:	3/2/10
	COMPLETED:	3/2/10
	BACKFILLED:	3/2/10

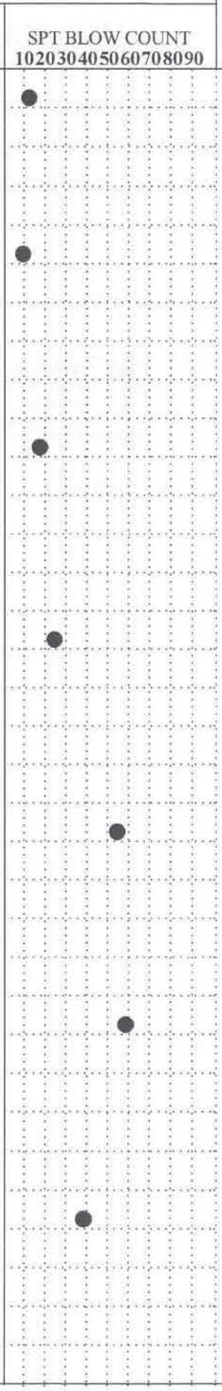
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

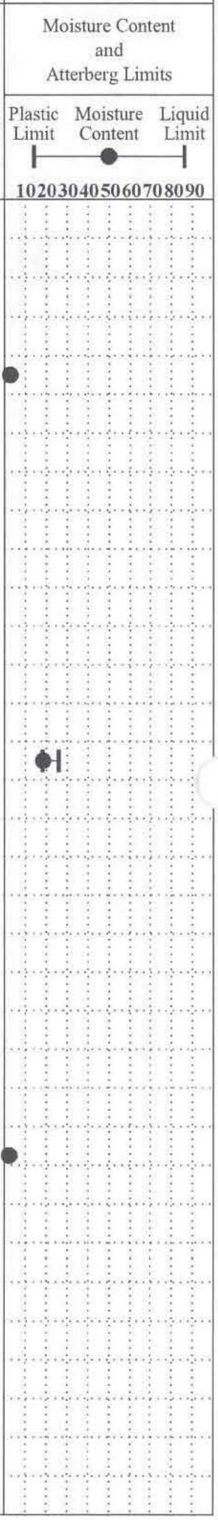
IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO: **B-P2-09**
Sheet 1 of 1

LOCATION
NORTHING 202,432.40 EASTING 512,531.90 ELEVATION 4,661.50
Pond 2

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	ML	Lean SILT, light brown, dry to moist, stiff	12	12					
5	SP-SM	Poorly-Graded fine SAND with Silt, light brown, moist, loose	24	9	106	3	8		
10	CL	Lean CLAY, light brown, moist, very stiff	17	17					
	ML	Lean SILT, light brown, moist, pinholes							
15	CL	Lean CLAY, light red-brown, moist, very stiff	60	24	99	19		26	8
20	SP	Poorly-Graded fine SAND, light gray-brown, dry, very dense	54	54					
25			146	58		2	1		
30		- Dense	38	38					
		Bottom of Boring @ 30.5 Feet							





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ☐ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ■ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate
22

DATE	
STARTED:	2/19/10
COMPLETED:	2/19/10
BACKFILLED:	2/19/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P2-10
Sheet 1 of 1

LOCATION
NORTHING 202,414.70 EASTING 511,205.00 ELEVATION 4,662.20
Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
ML	Lean SILT with fine sand, light brown, moist, stiff	10	10					
CL	Lean CLAY, light red brown, moist, with a few pinholes, very stiff	60	30	97	17		28	10
		27	27					
	- Hard	91	45					
SP	Poorly-Graded fine SAND, light gray, dry, very dense	62	62					
SP-SM	- with Silt	154	61		2	6		
	- Moist	65	65					
	Bottom of Boring @ 30.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▤ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
23

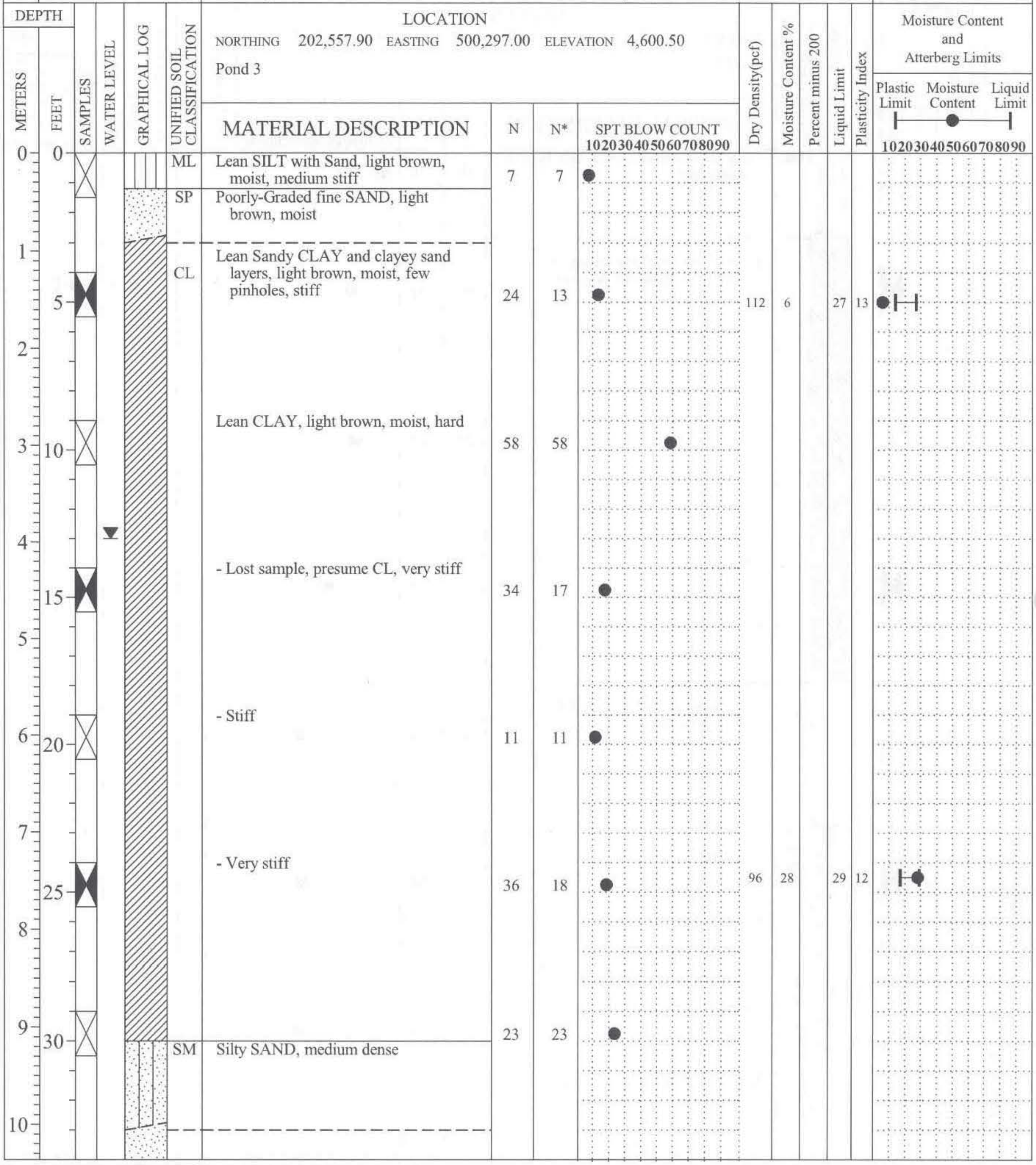
DATE	
STARTED:	2/25/10
COMPLETED:	2/25/10
BACKFILLED:	2/25/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P3-01
Sheet 1 of 2

LOCATION
NORTHING 202,557.90 EASTING 500,297.00 ELEVATION 4,600.50
Pond 3



Depth (feet)	Unified Soil Classification	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	ML	Lean SILT with Sand, light brown, moist, medium stiff	7	7					
	SP	Poorly-Graded fine SAND, light brown, moist							
	CL	Lean Sandy CLAY and clayey sand layers, light brown, moist, few pinholes, stiff	24	13	112	6		27	13
		Lean CLAY, light brown, moist, hard	58	58					
		- Lost sample, presume CL, very stiff	34	17					
		- Stiff	11	11					
		- Very stiff	36	18	96	28		29	12
30			23	23					
	SM	Silty SAND, medium dense							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ☐ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
24a

DATE	
STARTED:	2/25/10
COMPLETED:	2/25/10
BACKFILLED:	2/25/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P3-01
Sheet 2 of 2

LOCATION
NORTHING 202,557.90 EASTING 500,297.00 ELEVATION 4,600.50
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
	35	■		SP	Lost sample, presume SP, dense	81	33					
12	40	☒			Heave, blowcounts may be inaccurate (loose). Poorly-Graded fine SAND, light gray-brown	7	7					
					Bottom of Boring @ 40.5 Feet							

Depth scale: METERS 11, 12, 13, 14, 15, 16, 17, 18, 19, 20; FEET 35, 40, 45, 50, 55, 60, 65

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▯- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
■- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
24b

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P3-02
Sheet 1 of 1

LOCATION
NORTHING 202,560.70 EASTING 500,973.60 ELEVATION 4,600.10
Pond 3

Depth (feet)	Samples	Unified Soil Classification	MATERIAL DESCRIPTION	N	N*	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		ML	Sandy Lean SILT, light brown, dry, pinholes							
		SM	Silty SAND							
		CL	Lean CLAY, light brown, moist, very stiff							
4–5	☒	SP-SM	Poorly-Graded fine SAND with Silt, light brown, moist	20	20					
9–10	■		- Medium dense	41	16	98	25	7		
14–15	☒		- Sand heave, blowcounts questionable (loose). Gray-brown.	10	10					
19–20	■	SP	- Fine to coarse sand, medium dense	54	21	106	20	2		
			Bottom of Boring @ 20.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT   FR - FIELD REFUSAL

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
- ☐ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	

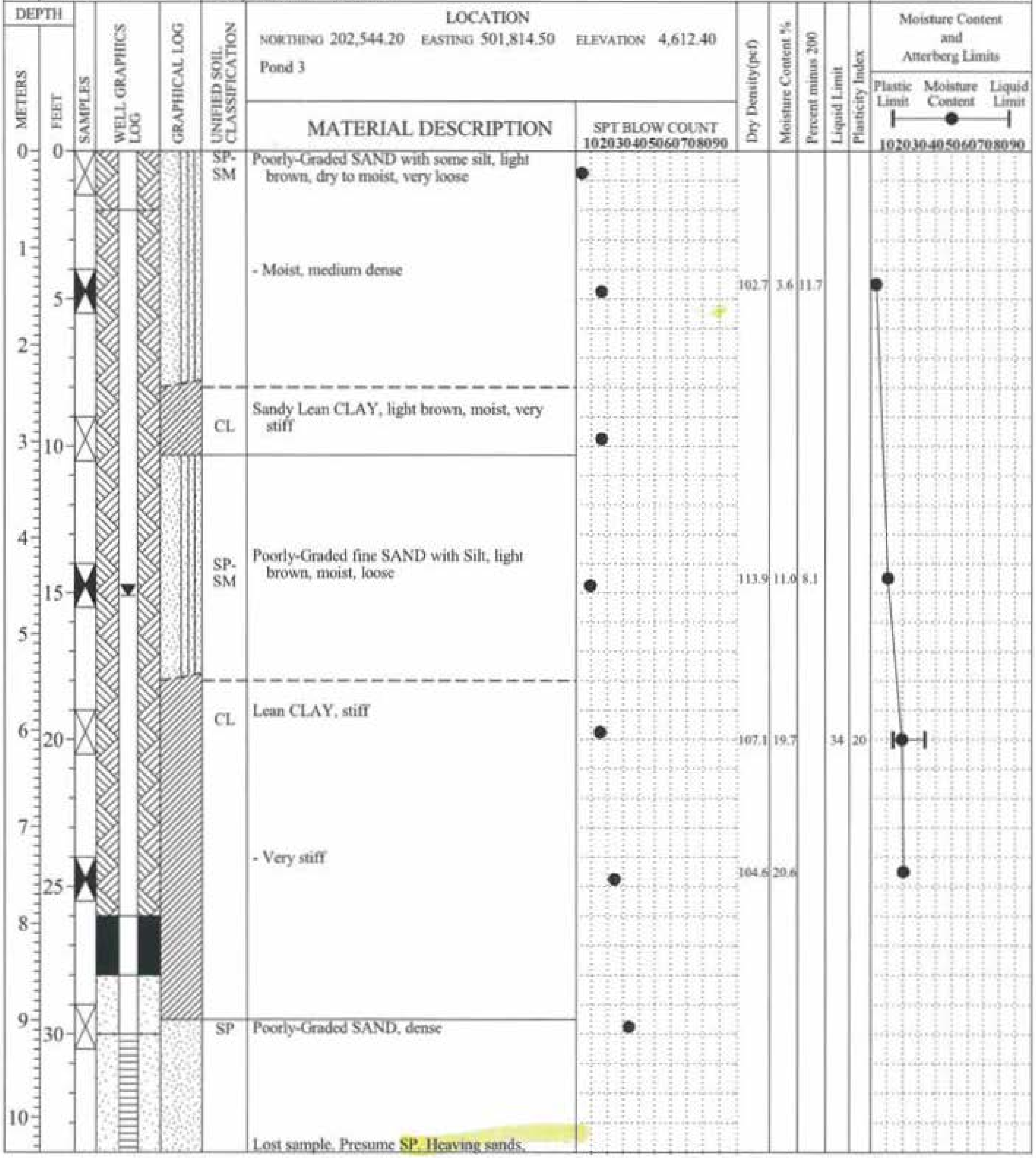
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: D. Siebach/ S. Kluck
Rig Type: CME 75 / Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-03
Sheet 1 of 2

LOCATION
NORTHING 202,544.20 EASTING 501,814.50 ELEVATION 4,612.40
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP-SM	Poorly-Graded SAND with some silt, light brown, dry to moist, very loose					
	- Moist, medium dense	102.7	3.6	11.7		
CL	Sandy Lean CLAY, light brown, moist, very stiff					
SP-SM	Poorly-Graded fine SAND with Silt, light brown, moist, loose	113.9	11.0	8.1		
CL	Lean CLAY, stiff	107.1	19.7		34	20
	- Very stiff	104.6	20.6			
SP	Poorly-Graded SAND, dense					
	Lost sample. Presume SP. Heaving sands.					

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- ☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
- ▮ - 3" O.D./2.42" I.D. U SAMPLER
- ▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯ - GRAB SAMPLE
- ◪ - Modified California Sampler

NOTES:			
Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	⊞	▦

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
26a

DATE		
STARTED:	2/16/10	
COMPLETED:	2/16/10	
BACKFILLED:		

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

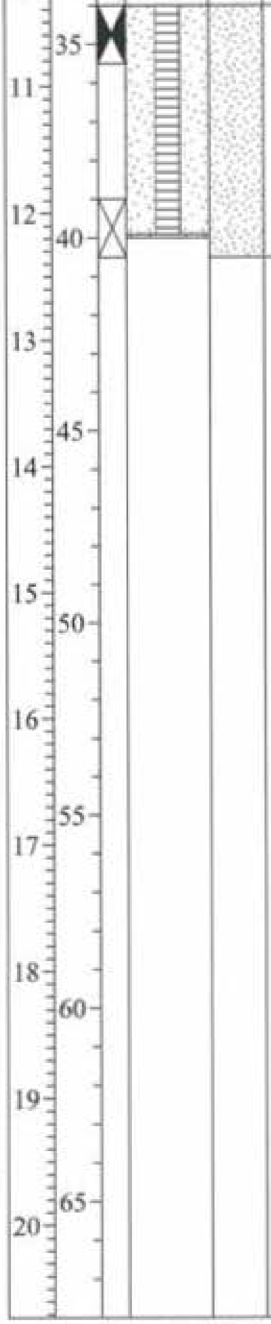
Project Number 01286-002

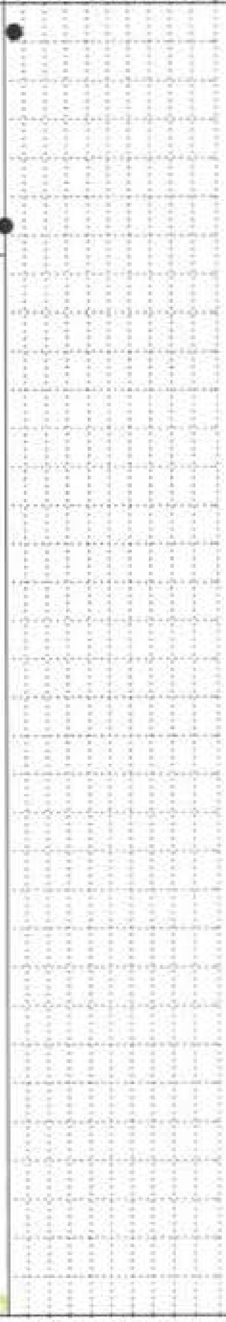
IGES Rep: D. Siebach/ S. Kluck
Rig Type: CME 75 / Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-03
Sheet 2 of 2

LOCATION
NORTHING 202,544.20 EASTING 501,814.50 ELEVATION 4,612.40
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	WELL GRAPHICS LOG	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90
	35					blowcounts questionably low (loose)							
12	40					- Heave, zero blowcounts							
						Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'							
						Bottom of Boring @ 40.5 Feet							





N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
- 3" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
26b

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P3-04
Sheet 1 of 1

LOCATION
NORTHING 202,516.90 EASTING 502,707.50 ELEVATION 4,620.60
Pond 3

DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		SM	Silty fine SAND, light brown, moist							
		SP	Poorly-Graded fine SAND, dry, medium dense							
5	☒			11	11					
		CH	Fat CLAY, light brown, stiff							
10	⧓			29	15	100	23		51	36
15	☒		- Very stiff	20	20					
		SP	Lost sample. Presume SP. Medium dense.							
20	⧓			45	18					
			Bottom of Boring @ 20.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate 27

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	

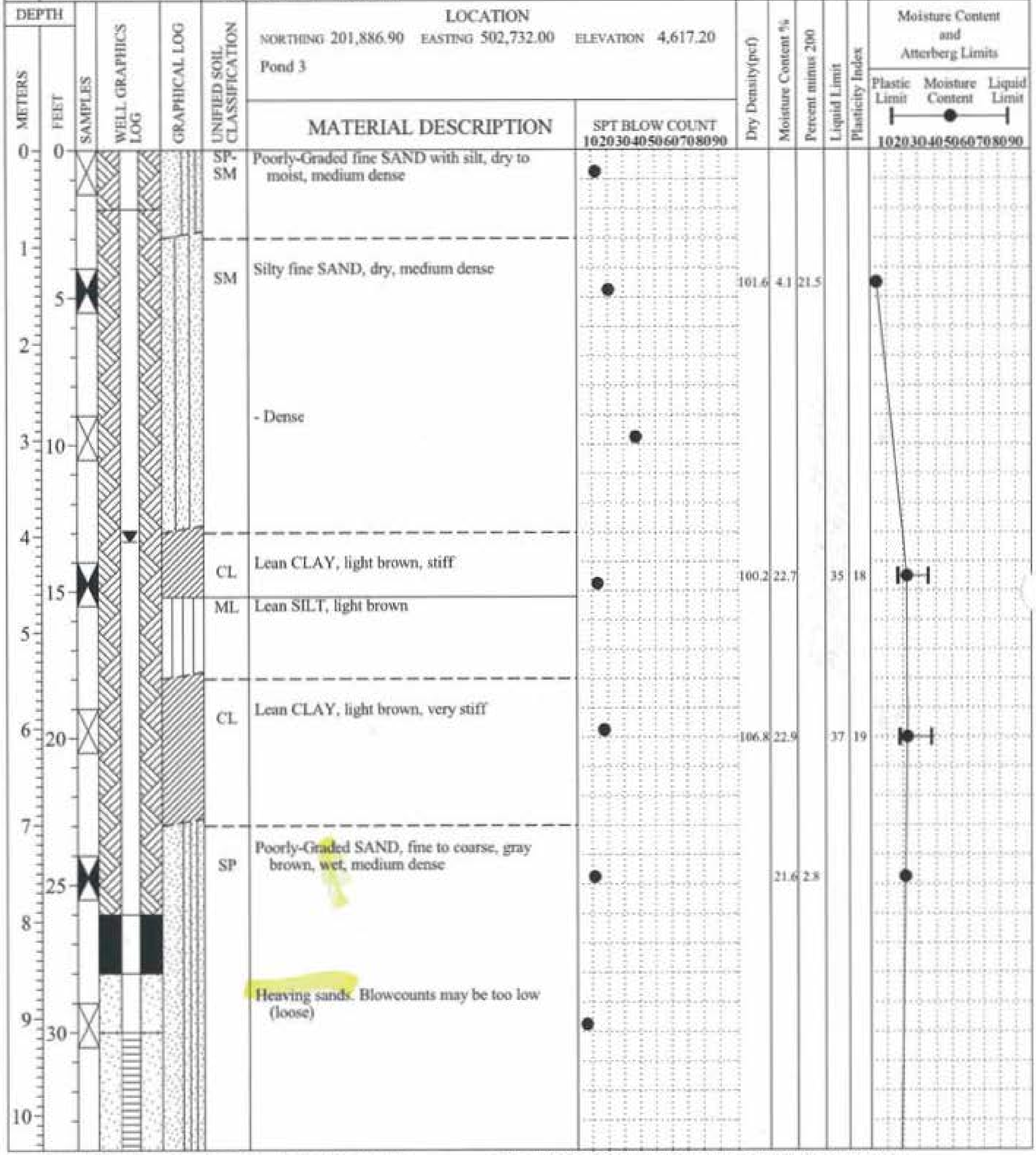
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: D. Siebach/ S. Kluck
Rig Type: CME 75 / Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-05
Sheet 1 of 2

LOCATION
NORTHING 201,886.90 EASTING 502,732.00 ELEVATION 4,617.20
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP-SM	Poorly-Graded fine SAND with silt, dry to moist, medium dense					
SM	Silty fine SAND, dry, medium dense	101.6	4.1	21.5		
	- Dense					
CL	Lean CLAY, light brown, stiff	100.2	22.7		35	18
ML	Lean SILT, light brown					
CL	Lean CLAY, light brown, very stiff	106.8	22.9		37	19
SP	Poorly-Graded SAND, fine to coarse, gray brown, wet, medium dense		21.6	2.8		
	Heaving sands. Blowcounts may be too low (loose)					

N - OBSERVED UNCORRECTED BLOW COUNT

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
⧓ - 3" O.D./2.42" I.D. U SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	⊞	▦

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
28a

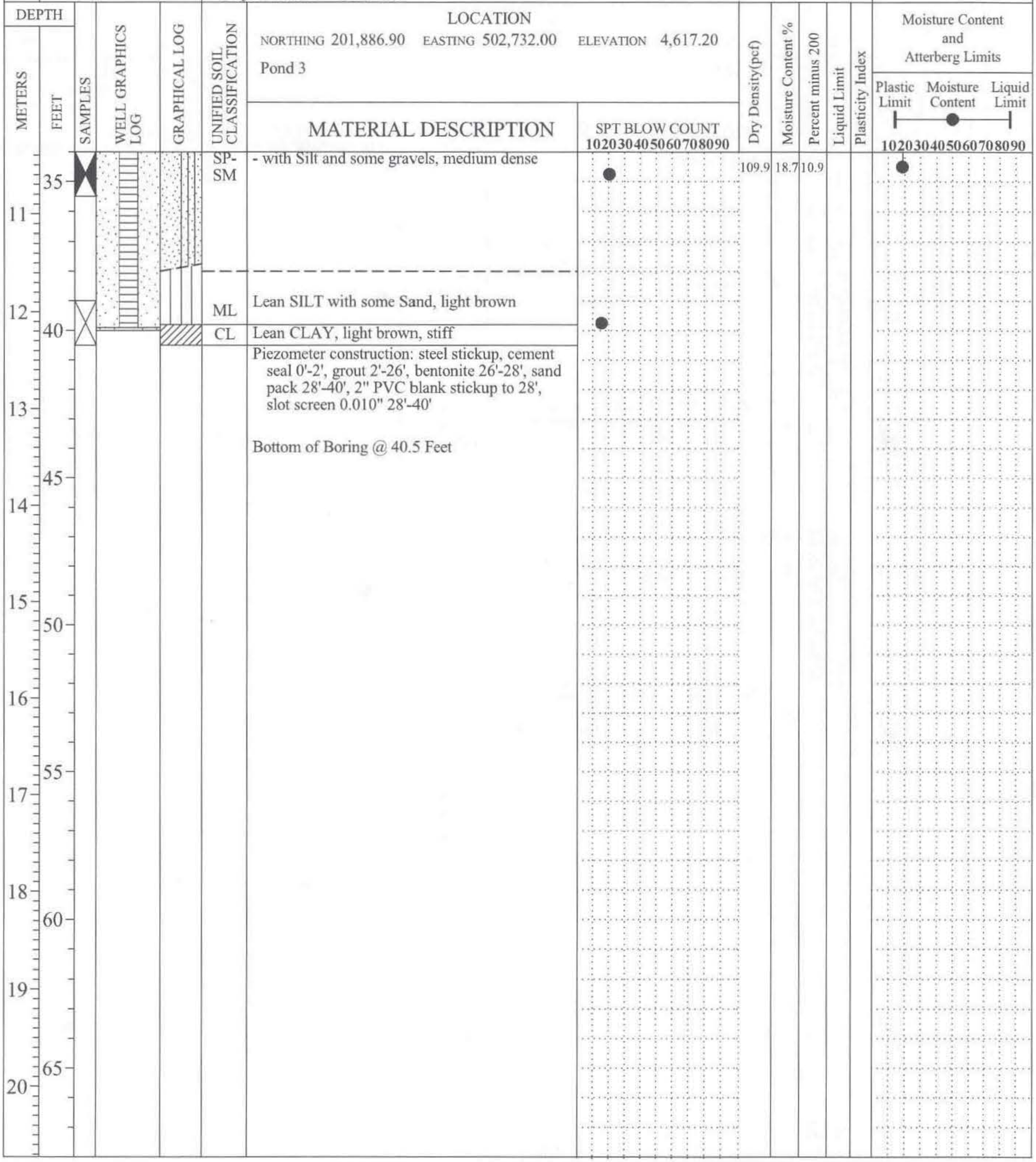
DATE
STARTED: 2/15/10
COMPLETED: 2/15/10
BACKFILLED:

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-002

IGES Rep: D. Siebach/ S. Kluck
Rig Type: CME 75 / Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-05
Sheet 2 of 2

LOCATION
NORTHING 201,886.90 EASTING 502,732.00 ELEVATION 4,617.20
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP-SM	- with Silt and some gravels, medium dense	109.9	18.7	10.9		
ML	Lean SILT with some Sand, light brown					
CL	Lean CLAY, light brown, stiff					

Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'

Bottom of Boring @ 40.5 Feet

N - OBSERVED UNCORRECTED BLOW COUNT

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■ - 3" O.D./2.42" I.D. U SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◪ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▦	▤	▩

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
28b

DATE	
STARTED:	2/23/10
COMPLETED:	2/24/10
BACKFILLED:	2/24/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:

B-P3-06

Sheet 1 of 3

LOCATION

NORTHING 200,944.50 EASTING 502,722.10 ELEVATION 4,608.70

Pond 3

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			SM	Silty SAND							
1				CL	Lean CLAY with Sand, light brown, moist, stiff							
	5	⊠				11	11					
3	10	■		SM	Silty fine SAND, light brown, moist, non-plastic, somewhat cemented, pinholes, very dense	195	97	97	7			
4				CL	Lean CLAY with Sand, light brown, moist, very stiff							
	15	⊠				22	22					
6	20	■		SP	Poorly-Graded SAND with some gravel, gray-brown, overly-full sampler so blowcounts questionable (very dense)	240	100					
	25	⊠			- Very dense	60	60					
9	30	■			- Fine sand, brown, very dense	220	79	104	22			
10					Lean CLAY to fat clay (CH), light							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▯ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
▮ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

29a

DATE	
STARTED:	2/23/10
COMPLETED:	2/24/10
BACKFILLED:	2/24/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: D. Siebach
Rig Type: AGEC truck rig CME 75
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO: **B-P3-06**
Sheet 2 of 3

LOCATION
NORTHING 200,944.50 EASTING 502,722.10 ELEVATION 4,608.70
Pond 3

FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
35	☒	CL	red-brown, stiff	14	14					
40	⧓		Lean CLAY with fine Sand, light brown, very stiff	42	21	111	18			
45	☒			26	26					
50	⧓			42	21					
55	☒	SP	Poorly-Graded SAND with some gravel, gray-brown, very dense	280	280					
60	⧓	CL	Lean CLAY, stiff	27	14					
65	☒	SP-SM	Poorly-Graded SAND with Silt, brown, non-plastic, very dense	210	210	108	19			

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▭ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◩ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate 29b

IGES®

DATE	
STARTED:	2/23/10
COMPLETED:	2/24/10
BACKFILLED:	2/24/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	D. Siebach
Rig Type:	AGEC truck rig CME 75
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P3-06
Sheet 3 of 3

LOCATION
NORTHING 200,944.50 EASTING 502,722.10 ELEVATION 4,608.70
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
21			CL	Lean CLAY, Red-brown, hard							
	70	■			180	90	120	24			
22–23	75	☒			230	230	106	22		49	31
24			SP	Poorly-Graded SAND, gray-brown, very dense							
	80	■			200	79					
25–26	85	☒			218	218					
27	90	■			300	79					
28			CL	Lean CLAY, red-brown, hard							
29	95	☒			98	98	101	25		37	20
30	100	■			75	37	104	23		54	36
31				Bottom of Boring @ 100.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ☐- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▨- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
29c

DATE
STARTED: 2/24/10
COMPLETED: 2/24/10
BACKFILLED:

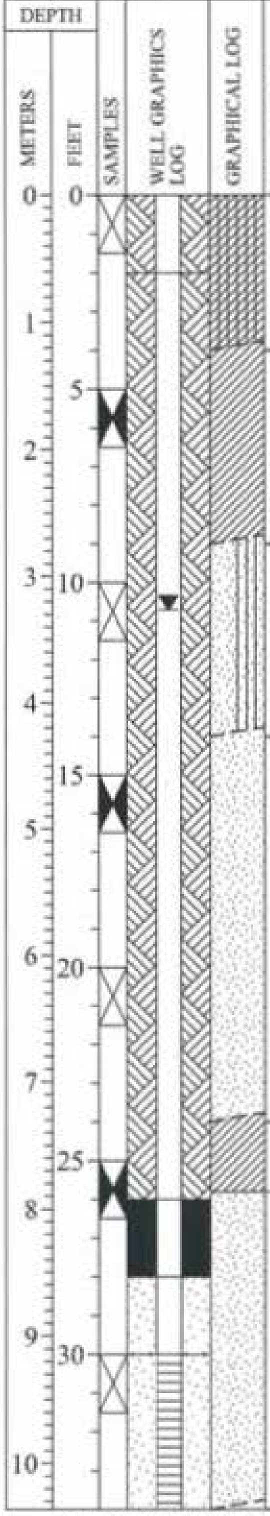
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

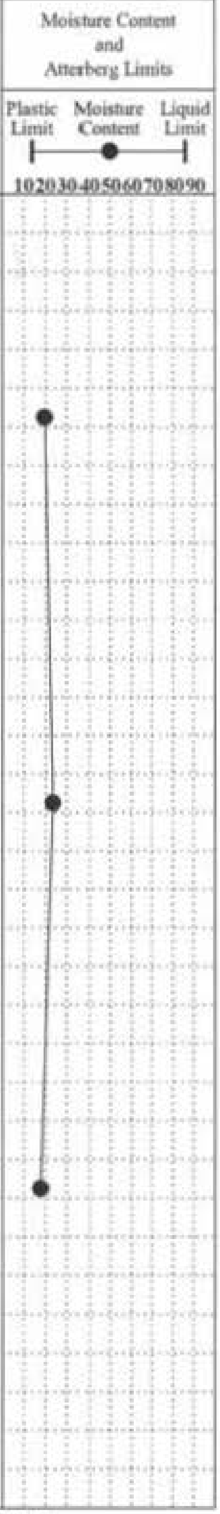
IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-07
Sheet 1 of 2

LOCATION
NORTHING 200,061.10 EASTING 502,722.10 ELEVATION 4,602.50
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL-ML	Silty Lean CLAY with fine Sand, light brown, dry, low plastic, medium stiff					
CL	Lean CLAY to CL-ML, light brown, moist but top 1" is dry, plastic, no pinholes, very stiff	107.5	19.7			
SP-SM	Poorly-Graded SAND with Silt, fine and medium-grained, light brown, wet but top 4" is moist, non-plastic, medium dense					
SP	Poorly-Graded SAND, fine and medium-grained, brown to gray-brown, wet, non-plastic, loose	101.9	23.6	3.7		
	- Medium dense					
CL	Lean CLAY, light red-brown, plastic, wet	110.5	17.9			
SP	Poorly-Graded SAND, fine and medium-grained, brown to gray-brown, wet, non-plastic, dense					
	- Very stiff					
	Driller detected gravel around 33 feet					



N - OBSERVED UNCORRECTED BLOW COUNT

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■ - 3" O.D./2.42" I.D. U SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:
Bentonite ▮
20-40 Silica Sand ▥
20 Slot Screen ▤
Pipe in Native Soil ▦

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
30a

DATE	
STARTED:	2/24/10
COMPLETED:	2/24/10
BACKFILLED:	

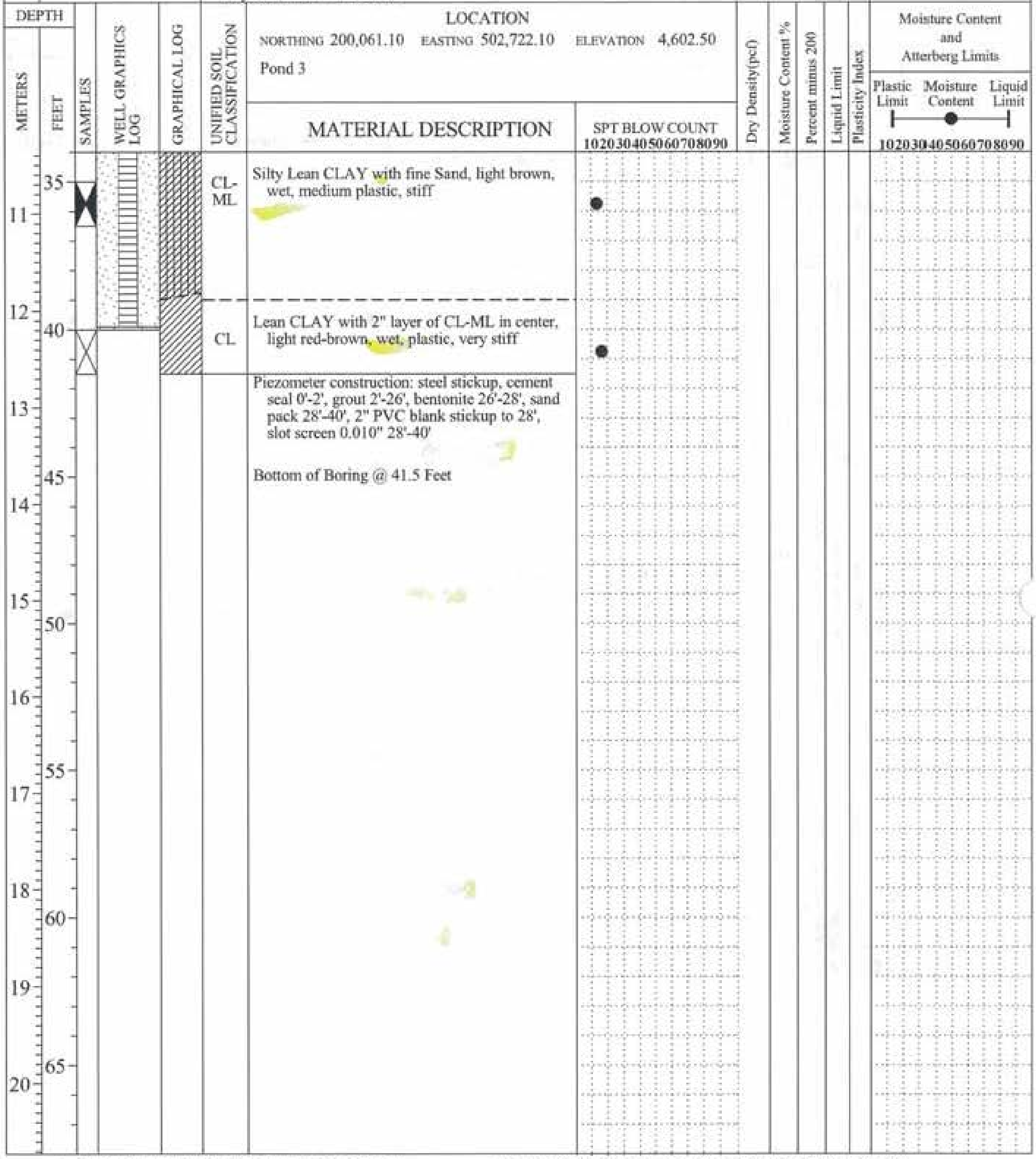
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Mari M3
Boring Type: Hollowstem Auger

WELL NO:
B-P3-07
Sheet 2 of 2

LOCATION
NORTHING 200,061.10 EASTING 502,722.10 ELEVATION 4,602.50
Pond 3



Silty Lean CLAY with fine Sand, light brown, wet, medium plastic, stiff

Lean CLAY with 2" layer of CL-ML in center, light red-brown, wet, plastic, very stiff

Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'

Bottom of Boring @ 41.5 Feet

N - OBSERVED UNCORRECTED BLOW COUNT *N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
⧗- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▥- GRAB SAMPLE
◩- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
30b

DATE	
STARTED:	2/22/10
COMPLETED:	2/22/10
BACKFILLED:	2/22/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	S. Kluck
Rig Type:	ConeTec Track Marl M3
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:

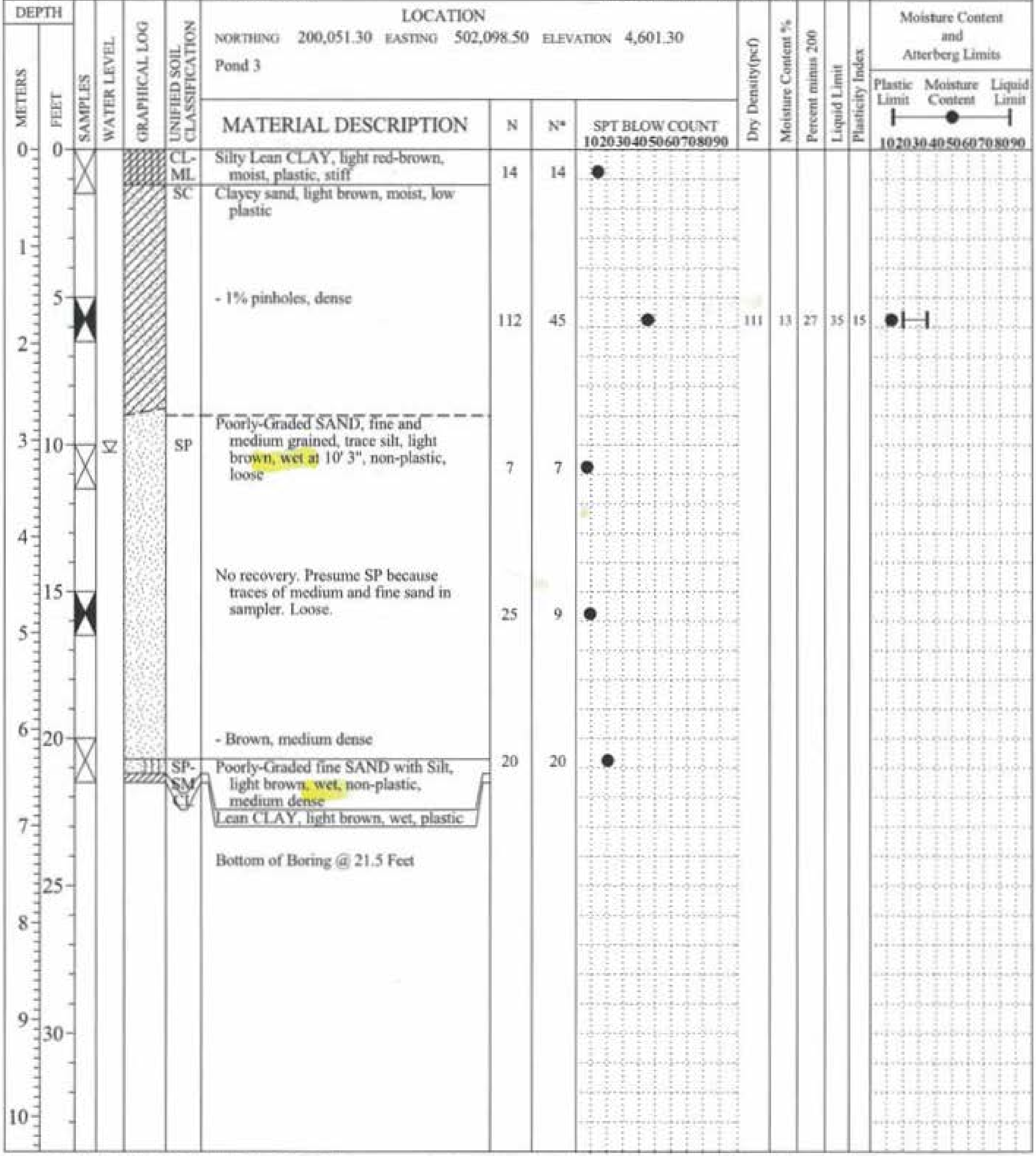
B-P3-08

Sheet 1 of 1

LOCATION

NORTHING 200,051.30 EASTING 502,098.50 ELEVATION 4,601.30

Pond 3



Depth (Feet)	Unified Soil Classification	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL-ML	Silty Lean CLAY, light red-brown, moist, plastic, stiff	14	14					
	SC	Clayey sand, light brown, moist, low plastic							
5		- 1% pinholes, dense	112	45	111	13	27	35	15
10	SP	Poorly-Graded SAND, fine and medium grained, trace silt, light brown, wet at 10' 3", non-plastic, loose	7	7					
15		No recovery. Presume SP because traces of medium and fine sand in sampler. Loose.	25	9					
20		- Brown, medium dense							
	SP-SM	Poorly-Graded fine SAND with Silt, light brown, wet, non-plastic, medium dense	20	20					
	CL	Lean CLAY, light brown, wet, plastic							
		Bottom of Boring @ 21.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT   * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT   FR - FIELD REFUSAL

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
- ▯ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

31

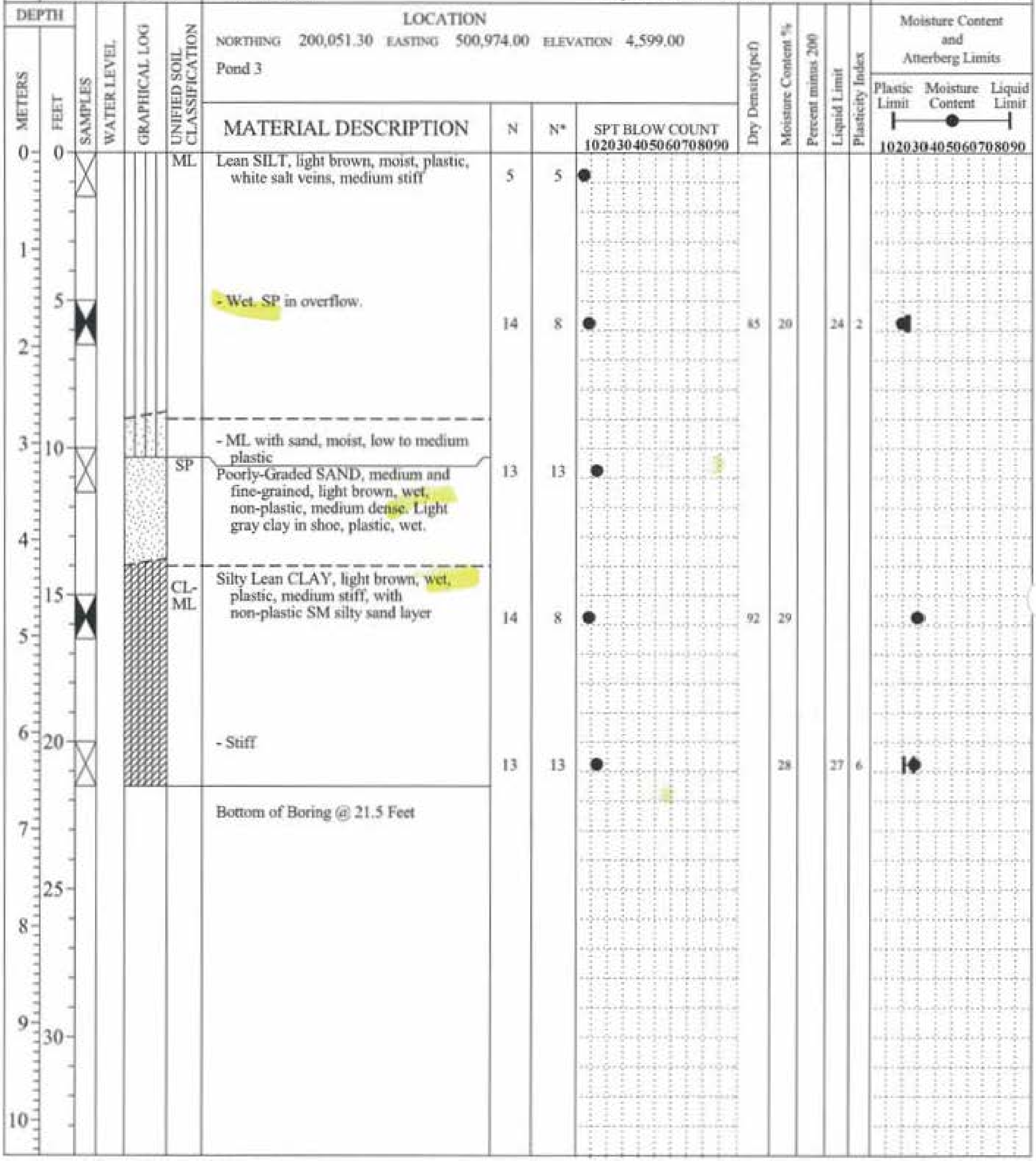
DATE		
STARTED:	2/22/10	
COMPLETED:	2/22/10	
BACKFILLED:	2/22/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep: S. Kluck
Rig Type: ConeTec Track Marl M3
Boring Type: Hollowstem Auger
Project Number: 01286-002

BORING NO:
B-P3-09
Sheet 1 of 1

LOCATION
NORTHING 200,051.30 EASTING 500,974.00 ELEVATION 4,599.00
Pond 3



Depth (feet)	Unified Soil Classification	Material Description	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	ML	Lean SILT, light brown, moist, plastic, white salt veins, medium stiff	5	5					
5		- Wet. SP in overflow.	14	8	85	20		24	2
		- ML with sand, moist, low to medium plastic							
10	SP	Poorly-Graded SAND, medium and fine-grained, light brown, wet, non-plastic, medium dense. Light gray clay in shoe, plastic, wet.	13	13					
15	CL-ML	Silty Lean CLAY, light brown, wet, plastic, medium stiff, with non-plastic SM silty sand layer	14	8	92	29			
20		- Stiff	13	13		28		27	6
		Bottom of Boring @ 21.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
▭- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
◩- 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

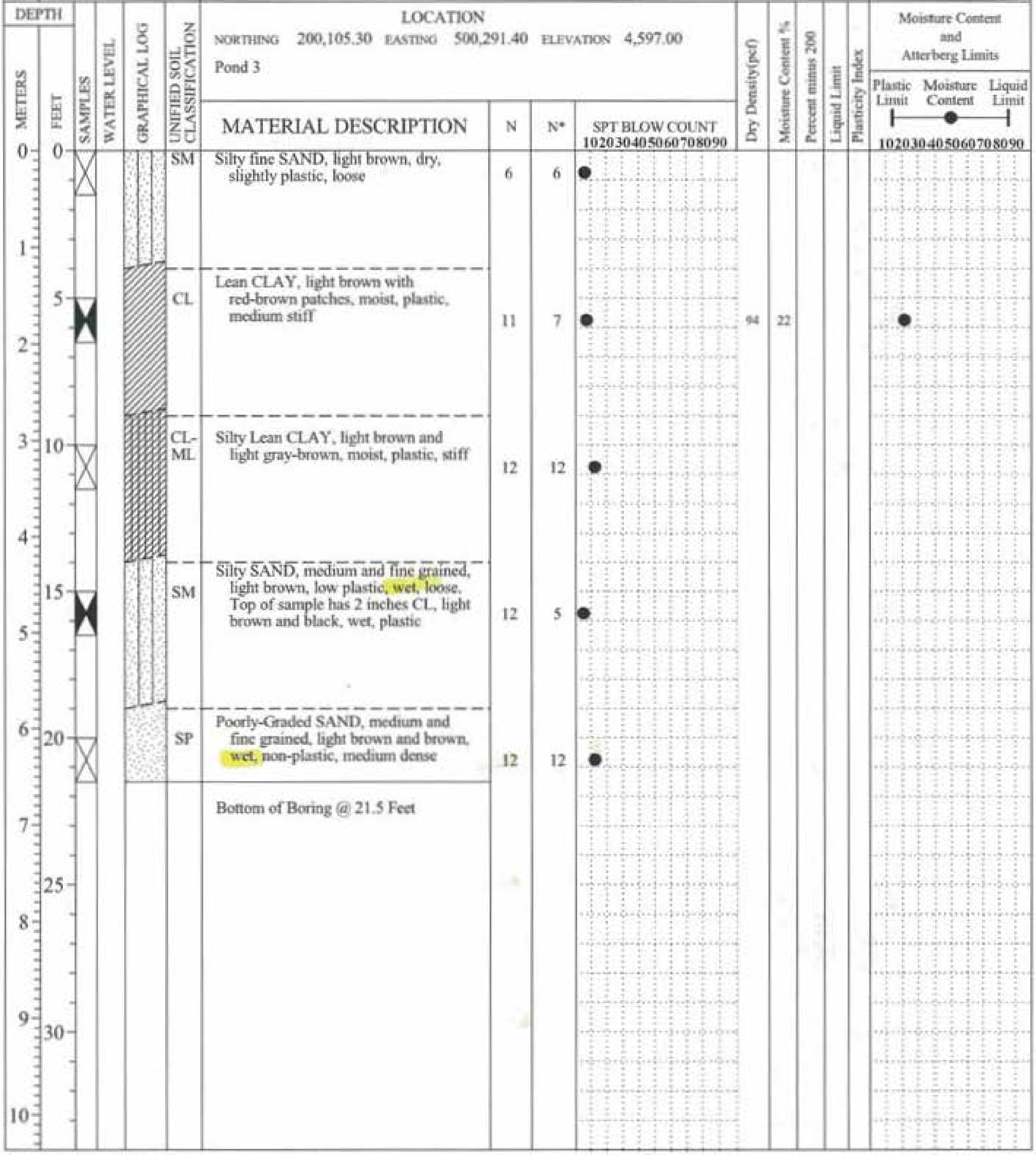
DATE	
STARTED:	2/23/10
COMPLETED:	2/23/10
BACKFILLED:	2/23/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

IGES Rep:	S. Kluck
Rig Type:	ConeTec Track Marl M3
Boring Type:	Hollowstem Auger
Project Number:	01286-002

BORING NO:
B-P3-10
Sheet 1 of 1

LOCATION
NORTHING 200,105.30 EASTING 500,291.40 ELEVATION 4,597.00
Pond 3



Depth (ft)	Unified Soil Classification	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %
0	SM	Silty fine SAND, light brown, dry, slightly plastic, loose	6	6		
5	CL	Lean CLAY, light brown with red-brown patches, moist, plastic, medium stiff	11	7	94	22
10	CL-ML	Silty Lean CLAY, light brown and light gray-brown, moist, plastic, stiff	12	12		
15	SM	Silty SAND, medium and fine grained, light brown, low plastic, wet, loose, Top of sample has 2 inches CL, light brown and black, wet, plastic	12	5		
20	SP	Poorly-Graded SAND, medium and fine grained, light brown and brown, wet, non-plastic, medium dense	12	12		
		Bottom of Boring @ 21.5 Feet				

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

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
- ▯ - 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ◪ - 2.5" O.D./1.88" I.D. MOD. CAL. SAMPLER

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
33

DATE	
STARTED:	2/23/10
COMPLETED:	2/23/10
BACKFILLED:	2/23/10

Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

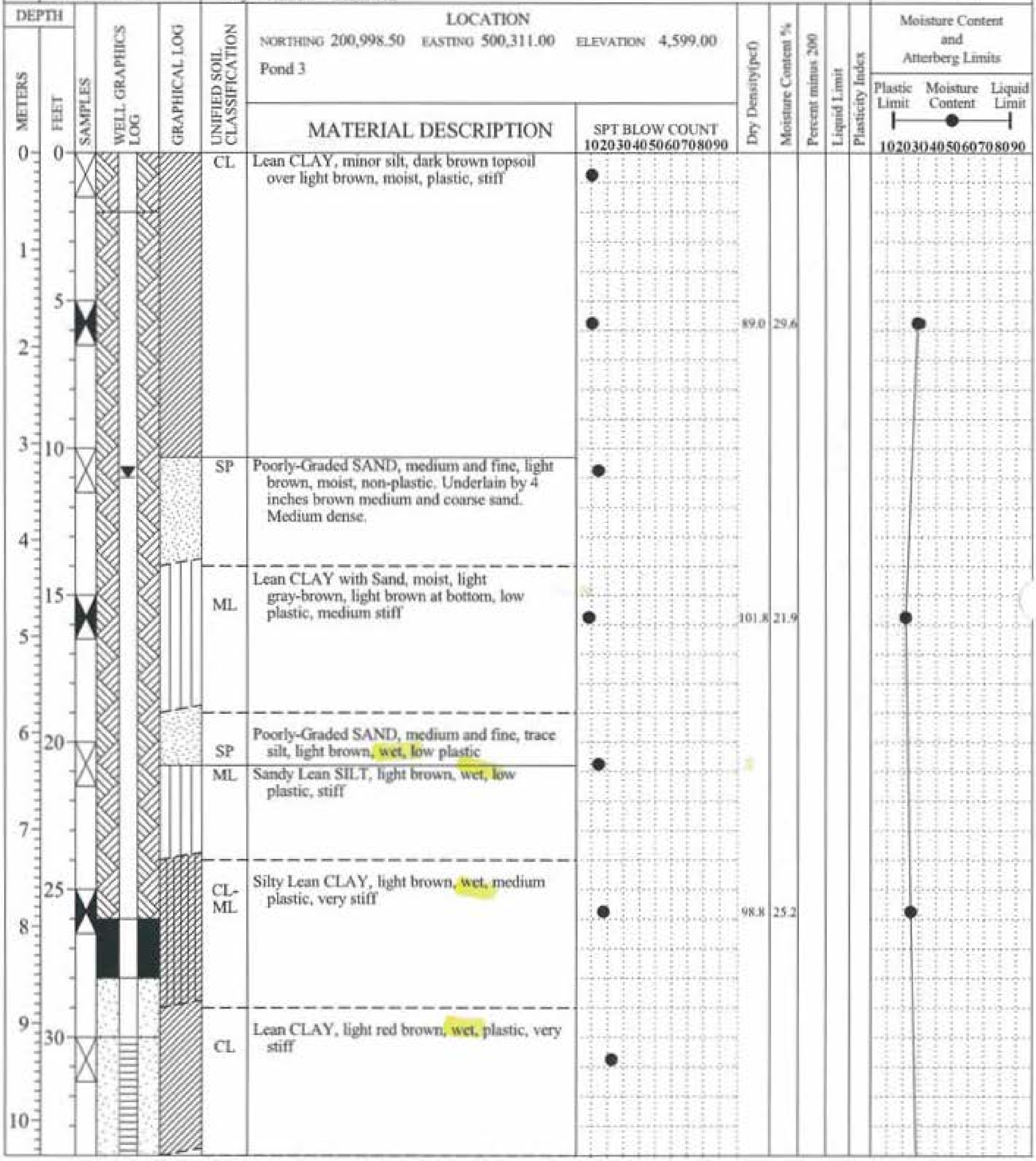
Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Mar1 M3
Boring Type: Hollowstem Auger

WELL NO: **B-P3-11**

Sheet 1 of 2

LOCATION
NORTHING 200,998.50 EASTING 500,311.00 ELEVATION 4,599.00
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %
CL	Lean CLAY, minor silt, dark brown topsoil over light brown, moist, plastic, stiff	89.0	29.6
SP	Poorly-Graded SAND, medium and fine, light brown, moist, non-plastic. Underlain by 4 inches brown medium and coarse sand. Medium dense.		
ML	Lean CLAY with Sand, moist, light gray-brown, light brown at bottom, low plastic, medium stiff	101.8	21.9
SP	Poorly-Graded SAND, medium and fine, trace silt, light brown, wet, low plastic		
ML	Sandy Lean SILT, light brown, wet, low plastic, stiff		
CL-ML	Silty Lean CLAY, light brown, wet, medium plastic, very stiff	98.8	25.2
CL	Lean CLAY, light red brown, wet, plastic, very stiff		

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒ - 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
▮ - 3" O.D./2.42" I.D. U SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
▮ - Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
▮	▥	▦	▩

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
34a

DATE	
STARTED:	2/23/10
COMPLETED:	2/23/10
BACKFILLED:	2/23/10

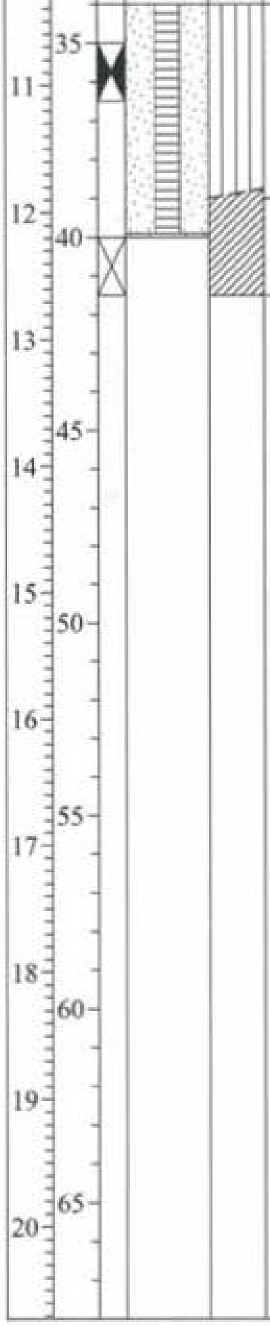
Geotechnical Investigation
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-002

IGES Rep: S. Kluck
Rig Type: ConeTec Track Ma l M3
Boring Type: Hollowstem Auger

WELL NO: **B-P3-11**
Sheet 2 of 2

LOCATION
NORTHING 200,998.50 EASTING 500,311.00 ELEVATION 4,599.00
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
ML	Lean SILT with Sand, light red-brown with mottled light gray, wet, low to medium plastic, very stiff	92.3	29.2		23	2
CL	Lean CLAY, light red-brown with minor light gray, wet, plastic, stiff					

Piezometer construction: steel stickup, cement seal 0'-2', grout 2'-26', bentonite 26'-28', sand pack 28'-40', 2" PVC blank stickup to 28', slot screen 0.010" 28'-40'

Bottom of Boring @ 41.5 Feet

N - OBSERVED UNCORRECTED BLOW COUNT

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
☒- 2" O.D./1.38 I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
☐- GRAB SAMPLE
■- Modified California Sampler

NOTES:

Bentonite	20-40 Silica Sand	20 Slot Screen	Pipe in Native Soil
■	▥	▦	▦

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
34b

WELL DESCRIPTION(PLATE 20) GINT POND 3.GPJ IGES.GDT 6/1/10

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

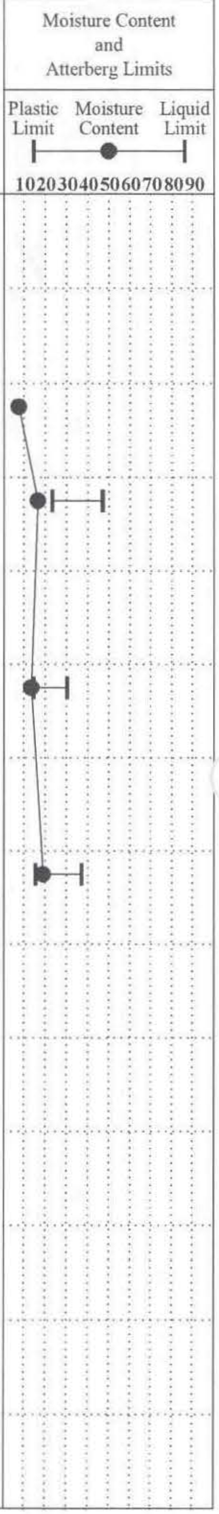
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 1
Sheet 1 of 1

LOCATION
NORTHING 202,076.80 EASTING 508,262.10 ELEVATION 4,649.70
Pond 1

DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			SP	Poorly-Graded SAND - loose, slightly moist, brown					
			SM	Silty SAND - medium stiff to stiff, slightly moist, brown, pinholes, fine-grained sand					
	▯					7.1	31.3		
	⧗		CL	Lean CLAY - medium stiff, slightly moist, reddish-brown, pinholes, low plasticity	104.3	16.1		47	24
			SM	Silty SAND - dense, slightly moist, light brown					
			CL	Sandy CLAY - medium stiff, slightly moist, brown					
5	▯					13.0		30	16
	▯			- stiff, slightly moist, reddish-brown, blocky, low plasticity		18.7		37	22
	▯		SP	Poorly-Graded SAND - medium dense to dense, slightly moist, reddish-brown, fine-grained					
10				NO GROUNDWATER ENCOUNTERED					
				Bottom of Test Pit @ 10.5 Feet					



IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachmen
35

DATE
STARTED: 2/15/10
COMPLETED: 2/15/10
BACKFILLED: 2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

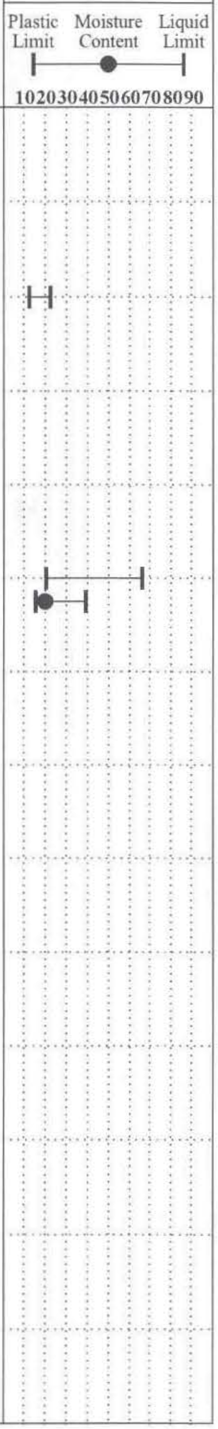
IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 2
Sheet 1 of 1

LOCATION
NORTHING 201,307.90 EASTING 508,184.50 ELEVATION 4,645.60
Pond 1

DEPTH METERS	DEPTH FEET	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0	SP	Poorly-Graded SAND - loose, slightly moist, light brown					
		SC	Clayey SAND - medium dense, slightly moist, brown, slight pinholes, fine-grained					
						47.9	22	10
		CH	Fat to Lean CLAY - stiff, slightly moist, reddish-brown, slight pinholes, CaCO3 veins, medium to high plasticity					
	5					94.9	66	46
				95.1	19.7		39	24
2		SP-SM	Poorly-Graded SAND with Silt - dense, slightly moist, reddish-brown, fine-grained sand, appears to be bedded					
3	10	SP	Poorly-Graded SAND - dense, slightly moist, reddish-brown, fine-grained					
			NO GROUNDWATER ENCOUNTERED					
			Bottom of Test Pit @ 12 Feet					

Moisture Content and Atterberg Limits



IGES®

SAMPLE TYPE
[] - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
36

DATE
STARTED: 2/15/10
COMPLETED: 2/15/10
BACKFILLED: 2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

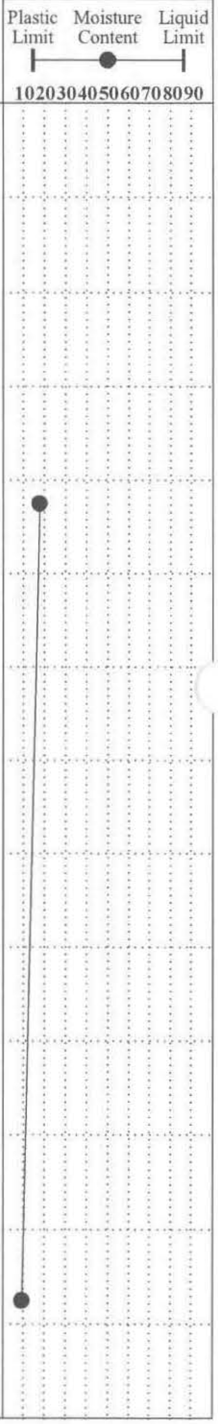
IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 3
Sheet 1 of 1

LOCATION
NORTHING 200,265.80 EASTING 508,299.20 ELEVATION 4,640.40
Pond 1

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		SP	Poorly-Graded SAND - medium dense, slightly moist, light brown, fine-grained sand, roots, no bedding					
	◫							
	☒	SM	Silty SAND with isolated gravel - medium dense, slightly moist, light brown to white, slight pinholes	97.2	17.2	55.3		
	◫		@ 9' - Lean CLAY (CL) layers up to 3" thick					
	◫	ML	Lean SILT - hard, slightly moist, olive-gray, bedded, low plasticity to non-plastic		8.8			
			NO GROUNDWATER ENCOUNTERED					
			Bottom of Test Pit @ 13 Feet					

Moisture Content and Atterberg Limits



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SAMPLE TYPE
◫ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm

37

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 4
Sheet 1 of 1

LOCATION
NORTHING 200,134.30 EASTING 509,226.90 ELEVATION 4,641.30
Pond 1

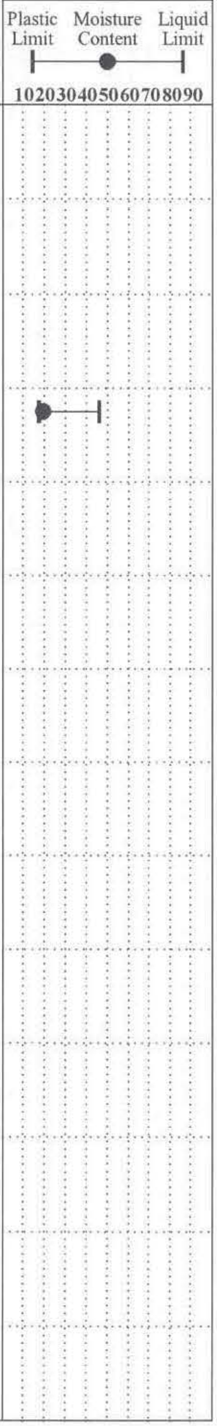
UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, light brown to brown, fine-grained sand					
CL	Lean CLAY - medium stiff, slightly moist, brown, slight pinholes, CaCO3 veins, low plasticity	101.3	19.2		46	29
SM	Silty Sand - medium dense, slightly moist, brown, slight pinholes					
SP	Poorly-Graded SAND - medium dense, slightly moist, brown, bedded					
SM	Silty SAND - dense, slightly moist, brown					
SP	Poorly-Graded SAND with isolated gravel - medium dense, slightly moist, light brown, sand is fine-grained, gravel up to 1/2" in diameter					

NO GROUNDWATER ENCOUNTERED

Bottom of Test Pit @ 12 Feet

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

IGES®

Attachment
38

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 5
Sheet 1 of 1

LOCATION
NORTHING 200,751.40 EASTING 508,994.10 ELEVATION 4,644.90
Pond 1

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, brown					
CL	Sandy Lean CLAY - medium stiff, slightly moist, light brown, bedded, slight pinholes		15.7		42	24
SP	Poorly-Graded SAND - medium dense, slightly moist, light brown, fine-grained sand					
SM	Silty SAND with isolated gravel - medium dense, slightly moist, light brown to white, gravel up to 1/2" in diameter					
SP	Poorly-Graded SAND - dense, slightly moist, light brown, fine-grained x-bedded sand					
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 13 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10
SAMPLES | WATER LEVEL | GRAPHICAL LOG

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
▮ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm

39

DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

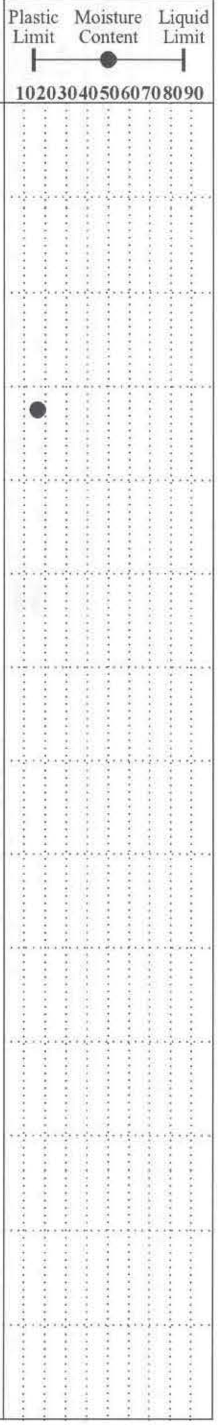
TEST PIT NO:
TP-P1- 6
Sheet 1 of 1

LOCATION
NORTHING 201,722.70 EASTING 509,280.90 ELEVATION 4,652.60
Pond 1

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		SP	Poorly-Graded SAND - loose, slightly moist, light brown, fine-grained sand					
		CL	Sandy Lean CLAY - medium stiff, slightly moist, brown, CaCO3 stringers, slight pinholes, bedded, low plasticity					
	⧗			103.8	16.0			
		SM	Silty SAND - dense, slightly moist, light-brown, fine-grained sand					
5	▯							
	▯		@ 8' - Partially cemented with CaCO3					
10								
	▯							
			NO GROUNDWATER ENCOUNTERED					
			Bottom of Test Pit @ 12.5 Feet					

METERS: 0, 1, 2, 3, 4

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
40

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DATE	
STARTED:	2/15/10
COMPLETED:	2/15/10
BACKFILLED:	2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO: **TP-P1- 7**
Sheet 1 of 1

LOCATION
NORTHING 202,333.10 EASTING 509,044.70 ELEVATION 4,655.70
Pond 1

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0			SP	Poorly-Graded SAND - loose, slightly moist, light brown, roots						
				SM	Silty SAND - medium dense, slightly moist, light brown						
		▯		ML	Sandy SILT - stiff, slightly moist , olive-green, pinholes						
1		▯		SM	Silty SAND - medium dense, slightly moist, brown, fine-grained sand						
				CL	Lean CLAY - medium stiff, slightly moist, brown, pinholes, low plasticity						
	5	⧗				97.7	17.4				●
2		▯									
				SM	Silty SAND - medium dense, slightly moist, light brown to brown, fine-grained sand, also contains 3" thick clay layers (CL)						
3	10	▯									
					NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 10.5 Feet						
4											

IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachmen

DATE
STARTED: 2/15/10
COMPLETED: 2/15/10
BACKFILLED: 2/15/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 8
Sheet 1 of 1

LOCATION
NORTHING 202,134.10 EASTING 510,147.80 ELEVATION 4,656.20
Pond 1

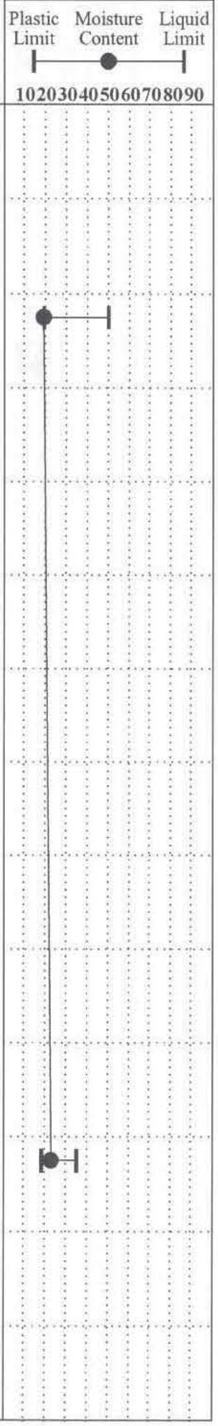
UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL	Lean CLAY - soft to medium stiff, slightly moist, brown					
ML	Sandy SILT - medium stiff, slightly moist, olive-green, CaCO3 staining					
CH	Fat CLAY		18.9		50	31
SM	Silty SAND - dense, slightly moist, brown with iron staining					
SP	Poorly-Graded SAND - medium stiff, to stiff, slightly moist, brown					
ML	Sandy SILT - medium stiff, slightly moist, brown with iron staining					
CL	Lean CLAY - stiff, slightly moist, brown, iron staining, low plasticity		22.8		35	17

NO GROUNDWATER ENCOUNTERED

Bottom of Test Pit @ 12 Feet

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
◧ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
42

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P1- 9
Sheet 1 of 1

LOCATION
NORTHING 2,012,978.00 EASTING 510,174.80 ELEVATION 4,652.50
Pond 1

MATERIAL DESCRIPTION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0			SP	Poorly-Graded SAND - loose, slightly moist, light brown						
				SC	Clayey SAND - medium dense, slightly moist, brown						
					- stiff, slightly moist, olive-green to light brown, slight pinholes, CaCO3 stringers, isolated gravel.						
		⧗				102.9	11.5				●
1		▯						69.6			
	5	▯									
2		▯		SM	Silty SAND with clay (CL) layers - dense, slightly moist, brown, fine-grained sand						
3	10										
		▯		SC-SM	Silty Clayey SAND - dense, slightly moist, light brown, pinholes			62.2	21	6	H
					NO GROUNDWATER ENCOUNTERED						
					Bottom of Test Pit @ 11.5 Feet						
4											

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Attachm
43

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

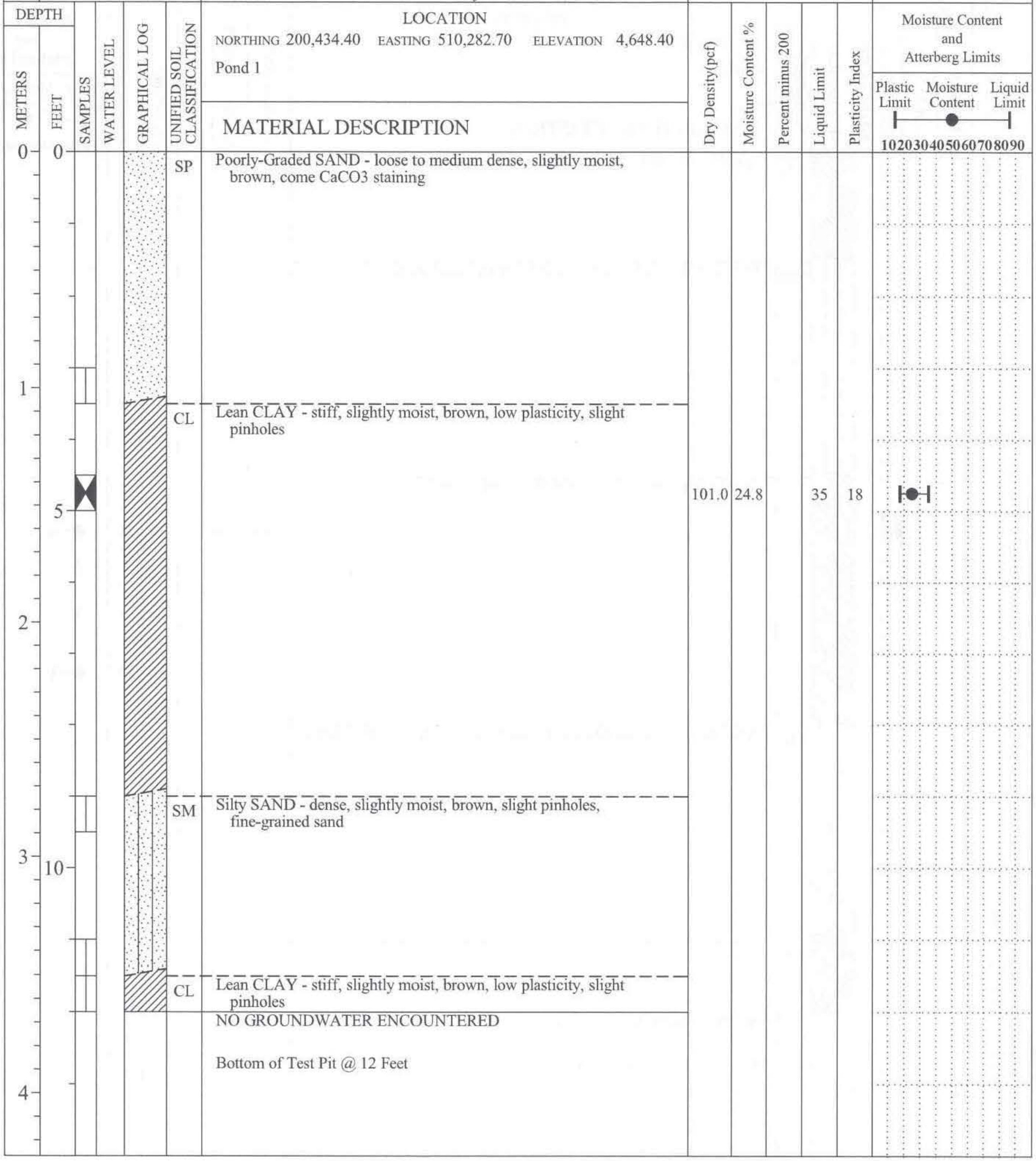
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO: **TP-P1-10**
Sheet 1 of 1

LOCATION
NORTHING 200,434.40 EASTING 510,282.70 ELEVATION 4,648.40
Pond 1

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose to medium dense, slightly moist, brown, come CaCO3 staining					
CL	Lean CLAY - stiff, slightly moist, brown, low plasticity, slight pinholes	101.0	24.8		35	18
SM	Silty SAND - dense, slightly moist, brown, slight pinholes, fine-grained sand					
CL	Lean CLAY - stiff, slightly moist, brown, low plasticity, slight pinholes					
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 12 Feet					



IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
44

DATE		
STARTED:	2/16/10	
COMPLETED:	2/16/10	
BACKFILLED:	2/16/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE

Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 1

Sheet 1 of 1

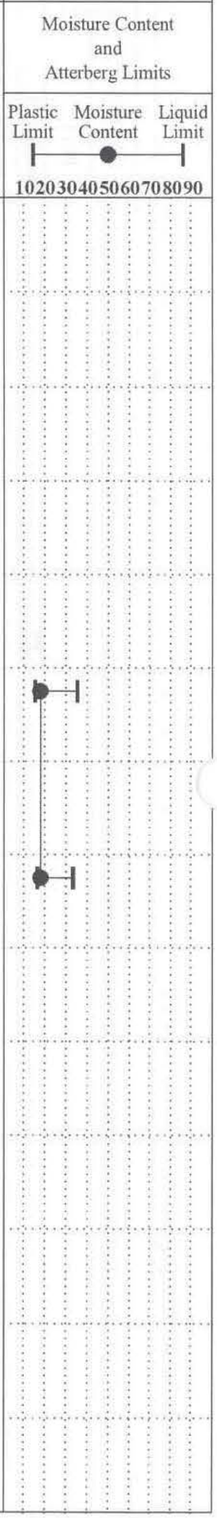
LOCATION

NORTHING 202,073.40 EASTING 510,996.30 ELEVATION 4,658.90

Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL	Lean CLAY - stiff, slightly moist, brown to white, pinholes					
SM	Silty SAND - medium dense, slightly moist, light brown					
CL	Lean CLAY - stiff to medium stiff, slightly moist,	106.6	17.6		35	20
			17.7		33	17
ML	Sandy SILT - stiff, slightly moist, light brown, bedded, slight pinholes					
CL						
	NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 12 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10



SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

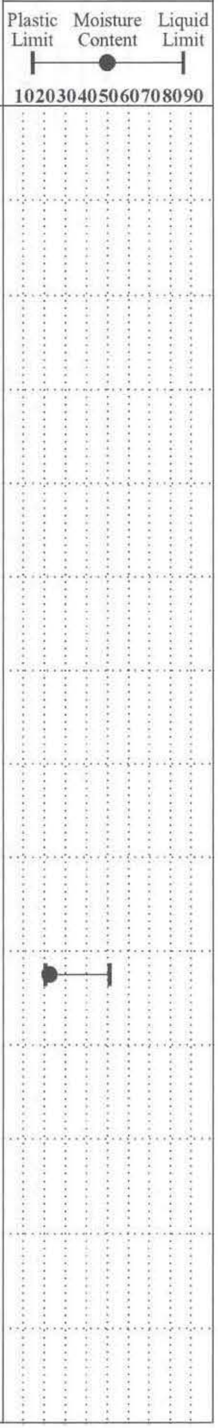
TEST PIT NO: **TP-P2- 2**
Sheet 1 of 1

LOCATION
NORTHING 202,252.10 EASTING 511,940.80 ELEVATION 4,657.50
Pond 2

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, brown					
CL	Lean CLAY - stiff, slightly moist, brown to light grey, pinholes					
SM	Silty SAND - loose, slightly moist, olive-gray					
SP	Poorly-Graded SAND - loose to medium dense, slightly moist, reddish-brown					
SM	Silty SAND - medium dense, slightly moist, reddish-brown					
CH	Lean CLAY - stiff, slightly moist, reddish-brown		22.2		51	31
ML	Sandy SILT - stiff, slightly moist, light brown					
SP	Poorly-Graded SAND - loose to medium dense, slightly moist, light brown, fine-grained sand					
	NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 12.5 Feet					

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

IGES®

DATE			
STARTED:	2/16/10		
COMPLETED:	2/16/10		
BACKFILLED:	2/16/10		

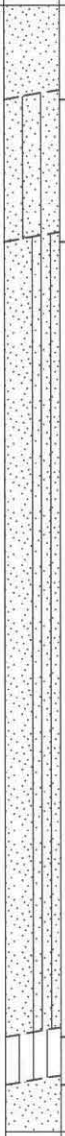
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

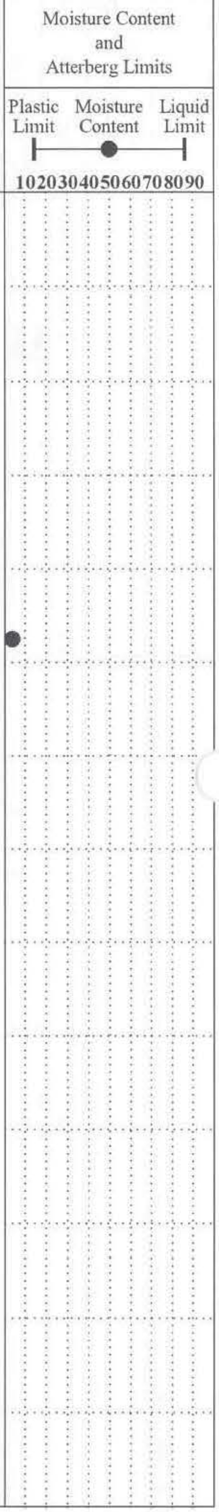
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 3
Sheet 1 of 1

LOCATION
NORTHING 202,093.60 EASTING 513,027.50 ELEVATION 4,658.20
Pond 2





DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			SP	Poorly-Graded SAND - loose, slightly moist, brown, (Eolian deposit)					
				SM	Silty SAND - dense, slightly moist, brown, pinholes					
				SP-SM	Poorly-Graded SAND with Silt - medium dense, slightly moist, light brown, fine to medium-grained, bedded					
1										
	5	▯					3.6	9.2		
2										
3	10									
		▯		ML	Sandy SILT- stiff, slightly moist, light brown to light gray					
				SP	Poorly-Graded SAND - medium dense, slightly moist, light brown					
					NO GROUNDWATER ENCOUNTERED					
					Bottom of Test Pit @ 12 Feet					
4										

IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
▮ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm

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DATE				
STARTED:	2/16/10	Geotechnical Investigation Magnum Gas Storage Jones Road at Brush Wellman Road Delta, Utah	IGES Rep: CLE	TEST PIT NO:
COMPLETED:	2/16/10		Rig Type: 310 SG Backhoe	**TP-P2- 4**
BACKFILLED:	2/16/10	Project Number 01286-003		Sheet 1 of 1

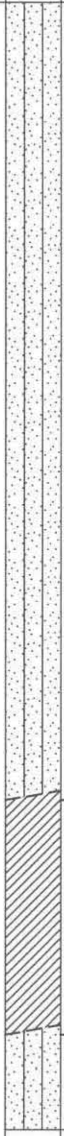
LOCATION

NORTHING 201,213.40 EASTING 510,892.20 ELEVATION 4,653.50

Pond 2

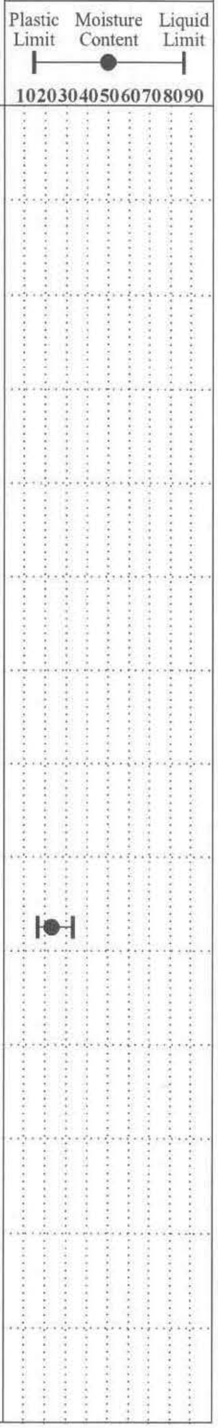
DEPTH METERS	DEPTH FEET	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0	SM	Silty SAND - medium dense, slightly moist, light brown, pinholes					
			SM with isolated gravel - loose to medium dense, slightly moist, light brown, bedded, gravel up to 1/2" in diameter					
1						28.7		
2	5							
		CL	Lean CLAY - stiff, slightly moist, light brown, low plasticity, bedded		22.9		33	17
3	10							
		SM	Silty SAND - dense, slightly moist, light brown, fine-grained sand, bedded					
			NO GROUNDWATER ENCOUNTERED					
			Bottom of Test Pit @ 12 Feet					
4								

SAMPLES | WATER LEVEL | GRAPHICAL LOG



Moisture Content and Atterberg Limits

Plastic Limit Moisture Content Liquid Limit



LOG OF TEST PITS MAGNUM TEST PITS 01286-003.GPJ IGES.GDT 6/1/10

IGES®

SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ▮ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Attachment

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DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 5
Sheet 1 of 1

LOCATION
NORTHING 201,395.50 EASTING 511,610.70 ELEVATION 4,657.50
Pond 2

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			SP-SM	Poorly-Graded SAND with Silt - loose to medium dense, slightly moist, light brown to brown, sand is fine-grained, eolian in nature					
	5	▯								
2		▯								
3	10			SP	Poorly-Graded SAND - loose, slightly moist, light brown, cross-bedded, fine to medium-grained sand					
				CL	Sandy CLAY - stiff to very stiff, slightly moist, brown		17.5		28	13
4					NO GROUNDWATER ENCOUNTERED					
					Bottom of Test Pit @ 13 Feet					

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

SAMPLE TYPE
▯ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

IGES®

Attachm

49

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 6
Sheet 1 of 1

LOCATION
NORTHING 201,142.60 EASTING 512,379.80 ELEVATION 4,654.20
Pond 2

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			SP	Poorly-Graded SAND - loose, slightly moist, brown, roots					
				SM	Silty SAND - medium dense to dense, slightly moist, brown, pinholes					
1		▯								
	5	▯		SP	Poorly-Graded SAND with gravel - medium dense, slightly moist, reddish brown, medium to fine-grained					
2										
		▯			@ 8' - mostly medium-grained					
3	10									
				CL	Lean CLAY - hard, slightly moist, brown		24.6		47	28
					NO GROUNDWATER ENCOUNTERED					
					Bottom of Test Pit @ 12 Feet					
4										

Moisture Content and Atterberg Limits

SAMPLE TYPE
▯ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
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DATE STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO: **TP-P2- 7**
Sheet 1 of 1

LOCATION
NORTHING 201,324.70 EASTING 513,118.60 ELEVATION 4,653.60
Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - very loose, slightly moist, brown, fine-grained					
CL	Lean CLAY - stiff, slightly moist, light brown to white, pinholes, low plasticity					
SP	Poorly-Graded SAND - loose, slightly moist, light brown, x-bedding, fine-grained @ 10.5' - more silt in sample					
CL	Lean CLAY - stiff, slightly moist, olive-grey, slight pinholes, bedded	88.1	23.3		49	32
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 12 Feet					

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 8
Sheet 1 of 1

LOCATION
NORTHING 200,205.10 EASTING 511,044.00 ELEVATION 4,641.60
Pond 2

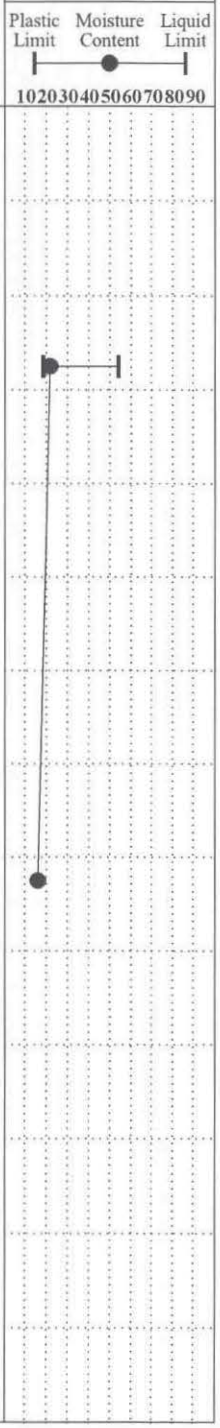
UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, fine-grained sand, roots					
CH	Lean CLAY - hard, slightly moist, reddish-brown, pinholes	99.1	21.5		54	36
SM	Silty SAND - very dense, slightly moist, light-grey, possibly slightly cemented with CaCO3, fine-grained sand					
CL	Sandy Lean CLAY - light-brown		15.7	67.6		
SP	Poorly-Graded SAND - dense, slightly moist, brown, fine-grained sand					

NO GROUNDWATER ENCOUNTERED

Bottom of Test Pit @ 12 Feet

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits



IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment
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DATE	
STARTED:	2/16/10
COMPLETED:	2/16/10
BACKFILLED:	2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P2- 9
Sheet 1 of 1

LOCATION
NORTHING 200,380.40 EASTING 511,981.80 ELEVATION464,734.00
Pond 2

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - very loose, slightly moist, light brown, roots					
CL	Lean CLAY - stiff, slightly moist, olive-grey to white, slight pinholes, blocky, low plasticity					
SP	Poorly-Graded SAND - loose, slightly moist, light brown, bedded, some sand layers contain magnetite, cross bedding					
CL	Lean CLAY - stiff, slightly moist, red @ top of layer; rest of unit brown, slight pinholes, blocky, low plasticity		31.3		33	15
	@ 11' - iron staining, root traces					
ML	Sandy SILT - stiff, slightly moist, light brown					
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 13 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

DATE
STARTED: 2/16/10
COMPLETED: 2/16/10
BACKFILLED: 2/16/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

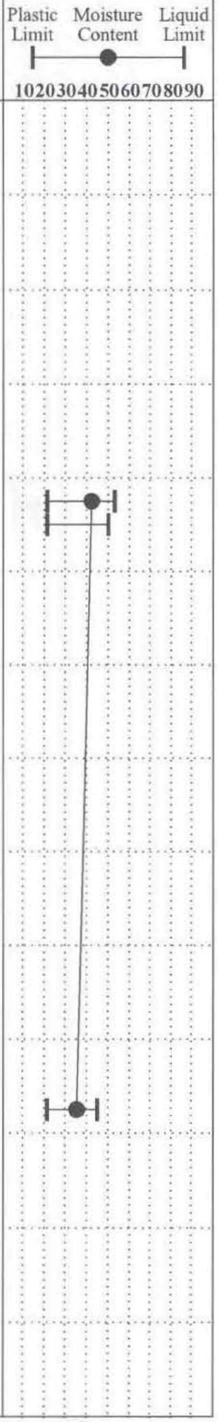
TEST PIT NO:
TP-P2-10
Sheet 1 of 1

LOCATION
NORTHING 200,171.30 EASTING 512,936.40 ELEVATION 4,647.00
Pond 2

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL	Lean CLAY - stiff, slightly moist, brown, blocky, low plasticity					
CH	Fat CLAY - soft, moist, light grey, bedded, low to high plasticity					
		78.0	42.3		53	32
				98.6	50	29
SM	Silty SAND - medium dense, slightly moist, brown to reddish-brown					
CL	Lean CLAY - stiff, slightly moist, light grey, bedded, iron staining, low plasticity, (contains thin beds of SP-SM up to 3" thick)					
			35.4		45	24
SP	Poorly-Graded SAND - medium dense, slightly moist, brown, fine-grained sand					
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 13 Feet					

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
▮ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Attachment
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DATE	
STARTED:	2/12/10
COMPLETED:	2/12/10
BACKFILLED:	2/12/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 1
Sheet 1 of 1

LOCATION
NORTHING 202,230.90 EASTING 500,578.40 ELEVATION 4,600.60
Pond 3

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - medium dense, slightly moist, light brown, fine-grained, roots					
CL	Sandy Lean CLAY - stiff, slightly moist, olive-grey, pinholes, root traces, some iron staining	107.6	19.8		34	19
SM	Silty SAND - medium dense, slightly moist, brown, fine-grained					
	NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 10 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits
Plastic Limit ├──●──┤ Liquid Limit
Moisture Content
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm

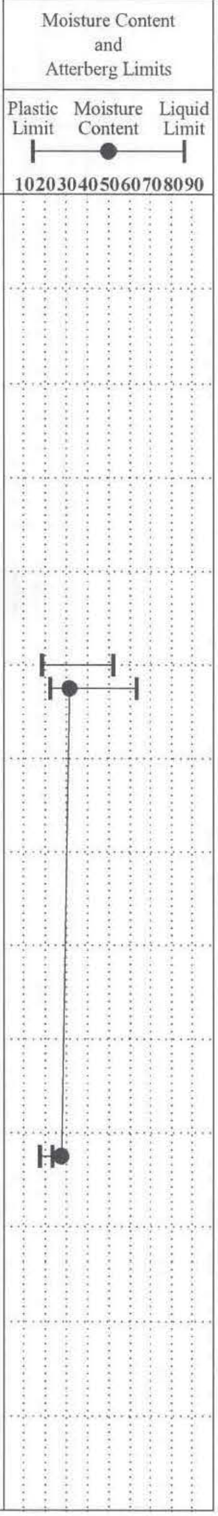
DATE				
STARTED: 2/12/10	Geotechnical Investigation	IGES Rep:	CLE	TEST PIT NO:
COMPLETED: 2/12/10	Magnum Gas Storage			**TP-P3- 2**
BACKFILLED: 2/12/10	Jones Road at Brush Wellman Road Delta, Utah Project Number 01286-003	Rig Type:	310 SG Backhoe	Sheet 1 of 1

LOCATION

NORTHING 201,276.70 EASTING 500,590.30 ELEVATION 4,599.00

Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0		CL	Lean CLAY (Topsoil) - soft, slightly moist, brown, blocky, low plasticity					
			SM	Silty SAND - medium dense, slightly moist, light brown, fine-grained sand					
			CL	Lean CLAY - soft, slightly moist, brown with reddish upper layer, blocky, low plasticity					
1		▯	SM	Silty SAND - medium dense, slightly moist, light brown, fine-grained sand					
			CH	Fat CLAY - soft to medium stiff, slightly moist, light brown, Lake Bonneville clams, pinholes, blocky, high plasticity					
	5	⧗					94.8	52	34
					87.4	31.4		63	41
2		▯							
			CL-ML	Sandy Silty CLAY - soft to medium stiff, slightly moist, reddish-brown, slight pinholes					
3	10	▯				27.4		23	6
				NO GROUNDWATER ENCOUNTERED					
				Bottom of Test Pit @ 10.5 Feet					
4									



SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment

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DATE		
STARTED:	2/12/10	
COMPLETED:	2/12/10	
BACKFILLED:	2/12/10	

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 3
Sheet 1 of 1

LOCATION
NORTHING 200,434.90 EASTING 500,713.00 ELEVATION 4,599.00
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0		CL	Lean CLAY (Topsoil) - soft, slightly moist, brown, blocky, low plasticity					
			SM	Silty SAND - medium dense, slightly moist, light brown, fine-grained sand					
1		▯							
		☒	CL	Lean CLAY - medium stiff, slightly moist, brown, blocky, low plasticity, pinholes	96.2	17.9	90.9		
	5		SM	Silty SAND - medium dense, slightly moist, light brown					
2		▯							
3	10	▯	SP	Poorly-Graded SAND - loose, slightly moist, light brown, fine-grained sand					
				NO GROUNDWATER ENCOUNTERED					
				Bottom of Test Pit @ 10.5 Feet					
4									

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

SAMPLE TYPE
▯ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm
57

DATE					
STARTED: 2/11/10	Geotechnical Investigation Magnum Gas Storage Jones Road at Brush Wellman Road Delta, Utah		IGES Rep:	CLE	TEST PIT NO:
COMPLETED: 2/11/10			Rig Type:	310 SG Backhoe	**TP-P3- 4**
BACKFILLED: 2/11/10	Project Number	01286-003			Sheet 1 of 1

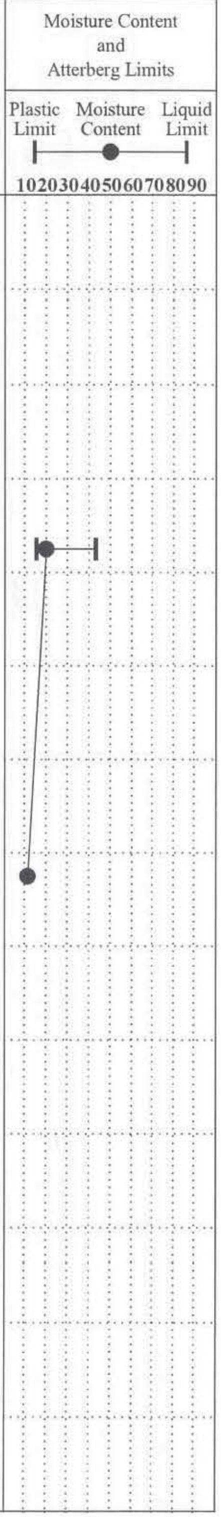
LOCATION

NORTHING 200,250.80 EASTING 501,486.90 ELEVATION 4,601.00

Pond 3

MATERIAL DESCRIPTION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			CL	Lean CLAY - soft, slightly moist, brown, blocky, low plasticity, slight pinholes, CaCO3 staining @ 1' - 2" layer of red clay					
					Sandy CLAY with Silty sand (SM) layers - medium stiff, slightly moist, brown, slight pinholes, some charcoal in areas, bedded					
1		⧗				91.8	19.7		43	28
	5									
2		▯								
		▯		SP-SM	Poorly-Graded SAND with Silt - loose, slightly moist, light-brown, fine-grained sand, bedded, non-plastic		11.1			
3	10									
		▯			@ 10.5' - coarse-grained with isolated gravel					
					NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 11 Feet					
4										



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SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachment

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DATE	
STARTED:	2/12/10
COMPLETED:	2/12/10
BACKFILLED:	2/12/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

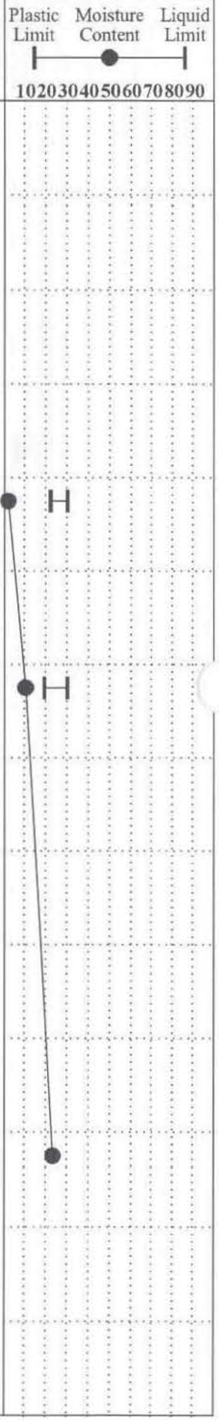
TEST PIT NO: TP-P3- 5
Sheet 1 of 1

LOCATION
NORTHING 200,874.50 EASTING 501,238.00 ELEVATION 4,600.30
Pond 3

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
CL	Lean CLAY - soft, slightly moist, brown, roots, blocky, low plasticity, pinholes					
	Sandy Lean CLAY - medium stiff, slightly moist, light brown, pinholes, root traces					
		98.0	1.8		30	8
			10.1		30	11
SM	Silty SAND - loose, slightly moist, brown, pinholes, fine-grained sand					
CL	Sandy Lean CLAY - medium stiff to stiff, slightly moist, brown, pinholes throughout		23.3			
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 11.5 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10
SAMPLES | WATER LEVEL | GRAPHICAL LOG

Moisture Content and Atterberg Limits



SAMPLE TYPE
▯ - GRAB SAMPLE
⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

IGES®

Attachm

DATE	
STARTED:	2/11/10
COMPLETED:	2/11/10
BACKFILLED:	2/11/10

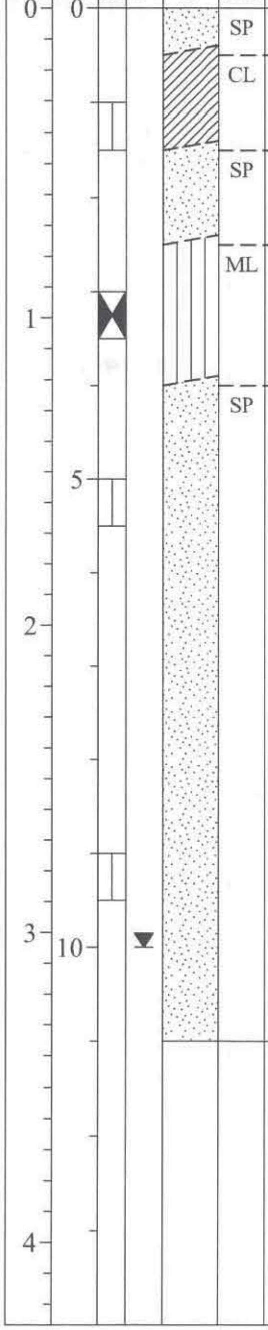
Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah

Project Number 01286-003

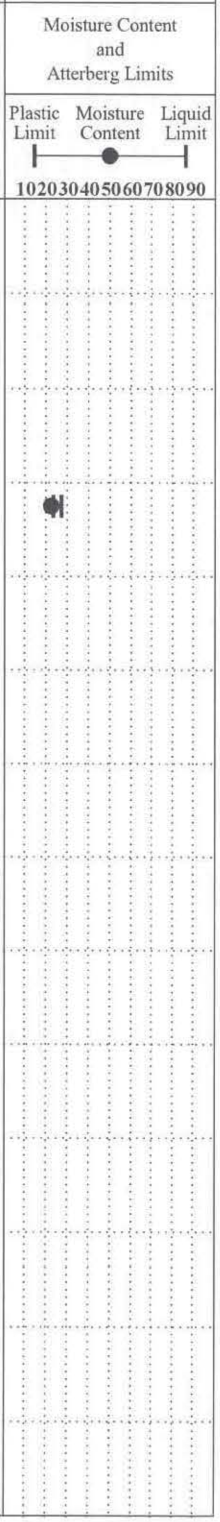
IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 6
Sheet 1 of 1

LOCATION
NORTHING 201,658.40 EASTING 501,463.00 ELEVATION 4,601.00
Pond 3



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, brown					
CL	Lean CLAY - soft, slightly moist, brown, blocky, low plasticity, slight pinholes					
SP	Poorly-Graded SAND - loose to medium dense, slightly moist, light brown, fine-grained sand					
ML	Lean SILT - stiff, slightly moist, brown, blocky, low plasticity, pinholes, root traces	95.1	22.2		27	4
SP	Poorly-Graded SAND - loose to medium dense, slightly moist, reddish brown, fine-grained sand @ 9' - more CL layers up to 3" thick @ 10' very loose, very moist, grey					
	Bottom of Test Pit @ 11 Feet					



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SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Attachment
60

DATE		
	STARTED:	2/11/10
	COMPLETED:	2/11/10
	BACKFILLED:	2/11/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 7
Sheet 1 of 1

LOCATION
NORTHING 202,363.90 EASTING 501,422.10 ELEVATION 4,607.60
Pond 3

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SP	Poorly-Graded SAND - loose, slightly moist, light brown, root traces					
ML	Sandy SILT with SP layers - medium stiff, slightly moist, light brown, slight pinholes, root traces, crude bedding		13.0		26	3
SP	Poorly-Graded SAND - loose, slightly moist, light brown, well-bedded, crossbedding					
	NO GROUNDWATER ENCOUNTERED					
	Bottom of Test Pit @ 12 Feet					

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content ● — Liquid Limit
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Attachm
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DATE	
STARTED:	2/11/10
COMPLETED:	2/11/10
BACKFILLED:	2/11/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 8
Sheet 1 of 1

LOCATION
NORTHING 202,063.90 EASTING 502,356.20 ELEVATION 4,613.50
Pond 3

DEPTH: METERS / FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION
SP	Poorly-Graded SAND - loose, slightly moist, light brown, fine-grained sand
CL	Sandy Lean CLAY - stiff, slightly moist, light brown, blocky, low plasticity, pinholes
SP	Poorly-Graded SAND - loose, slightly moist, light brown @ 4.25' - coarse sand with gravel @ 6 ' - thin clay beds up to 3" thick @ 9' - no clay present, fine-grained sand
	NO GROUNDWATER ENCOUNTERED Bottom of Test Pit @ 10 Feet

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SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Attachment
62

DATE
STARTED: 2/11/10
COMPLETED: 2/11/10
BACKFILLED: 2/11/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

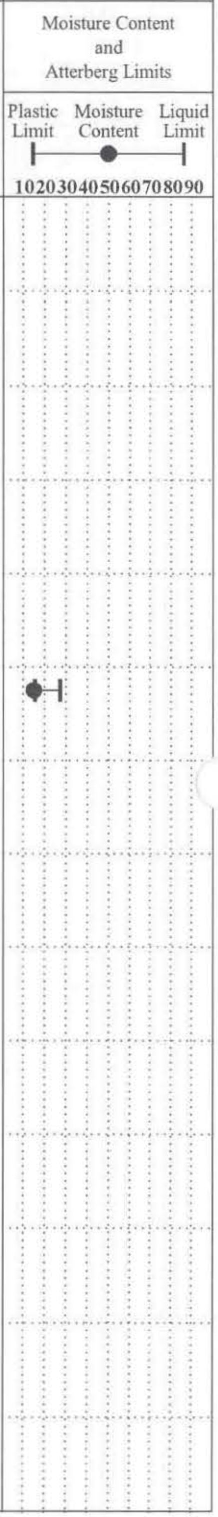
IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3- 9
Sheet 1 of 1

LOCATION
NORTHING 201,259.60 EASTING 502,519.80 ELEVATION 4,609.70
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SP	Poorly-Graded SAND - loose, slightly moist, light brown, fine-grained, root traces					
						@ 2' - dense, more coarse-grained, partially cemented with CaCO3					
1											
					SC	Clayey SAND, light brown					
	5					Clayey sand, stiff, slightly moist, light grey to almost white, slight pinholes, low plasticity	103.6	14.6	16.8	27	12
2											
					SM	Silty SAND - very dense, slightly moist, light brown, slight pinholes, fine-grained, no plasticity, partially cemented with CaCO3					
3	10										
						NO GROUNDWATER ENCOUNTERED					
						Bottom of Test Pit @ 11 Feet					
4											

Moisture Content and Atterberg Limits



IGES®

SAMPLE TYPE
▯ - GRAB SAMPLE
☒ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Attachm

63

DATE	
STARTED:	2/11/10
COMPLETED:	2/11/10
BACKFILLED:	2/11/10

Geotechnical Investigation
Magnum Gas Storage
Jones Road at Brush Wellman Road
Delta, Utah
Project Number 01286-003

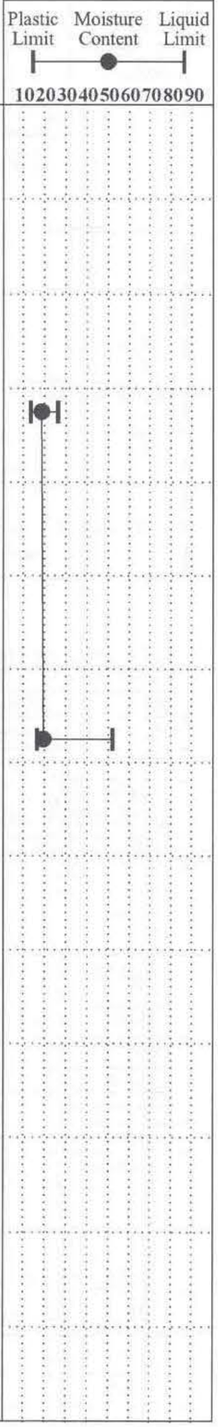
IGES Rep: CLE
Rig Type: 310 SG Backhoe

TEST PIT NO:
TP-P3-10
Sheet 1 of 1

LOCATION
NORTHING 200,571.20 EASTING 502,499.30 ELEVATION 4,604.50
Pond 3

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SP	Poorly-Graded SAND - loose, slightly moist, light brown, roots					
					SC	Clayey SAND - medium dense, slightly moist, brown slight pinholes					
		GRAB SAMPLE									
1		3" O.D. THIN-WALLED HAND SAMPLER			CL	Sandy CLAY - medium stiff, slightly moist, olive-grey, slight pinholes, low plasticity	95.1	18.3		26	13
	5										
					CH	Fat CLAY - medium stiff, slightly moist, light brown, blocky, low plasticity, slight pinholes					
2		3" O.D. THIN-WALLED HAND SAMPLER					103.8	19.2		52	36
		GRAB SAMPLE									
3	10										
						NO GROUNDWATER ENCOUNTERED					
						Bottom of Test Pit @ 11.5 Feet					
4											

Moisture Content and Atterberg Limits



IGES®

SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ⧗ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Attachment
64

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

⊕ BORING SAMPLE LOCATION	⧗ TEST-PIT SAMPLE LOCATION
▼ WATER LEVEL (level after completion)	▽ WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBURG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

		TORVANE	POCKET PENETROMETER	FIELD TEST
CONSISTENCY	SPT (blows/ft)	UNTRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

IGES

KEY TO SOIL SYMBOLS AND TERMINOLOGY

Project Number 01286-002

Plate

A - 65

APPENDIX I – NEWFIELDS 2016 GEOTECHNICAL INVESTIGATION FINDINGS

NewFields
Perspective. Vision. Solutions.

9400 Station Street, Suite 300
Lone Tree, CO 80124

T: 303.508.3300

GEOTECHNICAL FIELD INVESTIGATION FINDINGS

Project: **Brine Pond Future Expansion Phase I, and**
Evaporation Pond Project
Magnum Gas Storage

Project No: **475.0093.011 and .012**

Subject: **Summary of Geotechnical Field Investigation Findings**

Date: **March 6, 2017**

NewFields completed a field investigation from November 2nd through November 6th, 2016 for Phase I of the Brine Pond Future Expansion Project and the Evaporation Pond Project. A total of 59 test pits were excavated within the Phase I site, which includes proposed brine pond sites to the west of Sawtooth Brine Pond 1 and 2 and a potential borrow site in a small parcel of land adjacent to Jones Road, as presented in **Figure 1**, attached. The Evaporation Pond investigation included six shallow test pit excavations within a parcel of land south of Sawtooth Brine Pond 2 as a preliminary investigation for design/construction requirements for the development of an evaporation pond on existing lake bed sediments. The test pits were excavated with a CAT 320 excavator capable of reaching to 22 feet depth. The purpose of the investigation was to determine the shallow subsurface conditions including:

- Near surface soil classification;
- Determine engineering properties from laboratory testing completed on samples collected;
- Potential borrow materials for proposed future construction;
- Depth to shallow groundwater for grade plan design; and
- Fines (silt/clay) content and permeability characteristics of near surface materials for evaporation pond development on existing lake bed sediments.

The surface of the site is moderately vegetated with small shrubs and grasses. It is generally flat to undulating with an overall slope to the southwest. There are occasional dunes with their axis generally northeast to southwest parallel to the prevailing wind direction. These dunes, and the surface sediments to the east, are aeolian sediments deposited after the historic lakes drained.

1.0 PHASE I EXPANSION AREA TEST PITS

The subsurface soils beneath Phase I sites are generally interbedded fluvial and lacustrine deposits with significant crossbedding sedimentary structure in the fluvial deposits. The predominant soil type is poorly-graded sand to silty sand with lacustrine clays interbedded throughout the subsurface. The maximum depth of materials observed was 22 feet.

Groundwater was observed at 10 feet depth in TP16-03 at 20 feet depth in TP16-20 in the parcel of land adjacent to existing Brine Pond 2. Groundwater was observed from 17.5 to 20 feet depth in the south-southwest area of Phase I near Jones Road. The depths of observed groundwater are consistent with previous investigations by NewFields and others.

2.0 EVAPORATION POND AREA TEST PITS

The near surface conditions in the Evaporation Pond areas investigated generally had varying thicknesses of silt and clay overlying sand. TP16-06 encountered silt at the surface before penetrating medium plastic clay at 0.8 feet depth. The clay had a reduction in silt content and a raise in plastic behavior from 2.6 to 3.5 feet depth where the material became high plastic.

3.0 LABORATORY TEST WORK

A laboratory testing program was performed on select samples of subsurface material collected during the field investigation. Phase I samples were selected for testing based on location and testing on similar materials in adjacent test pits to provide coverage across the investigation site. The laboratory testing program included:

- Natural moisture content (ASTM D 2216);
- Atterberg limits (ASTM D 4318);
- Particle size distribution analysis, including hydrometer (ASTM D 422);
- Permeability (ASTM D 5084);
- Modified soil compaction (ASTM D 1557); and
- Direct shear (ASTM D 3080).

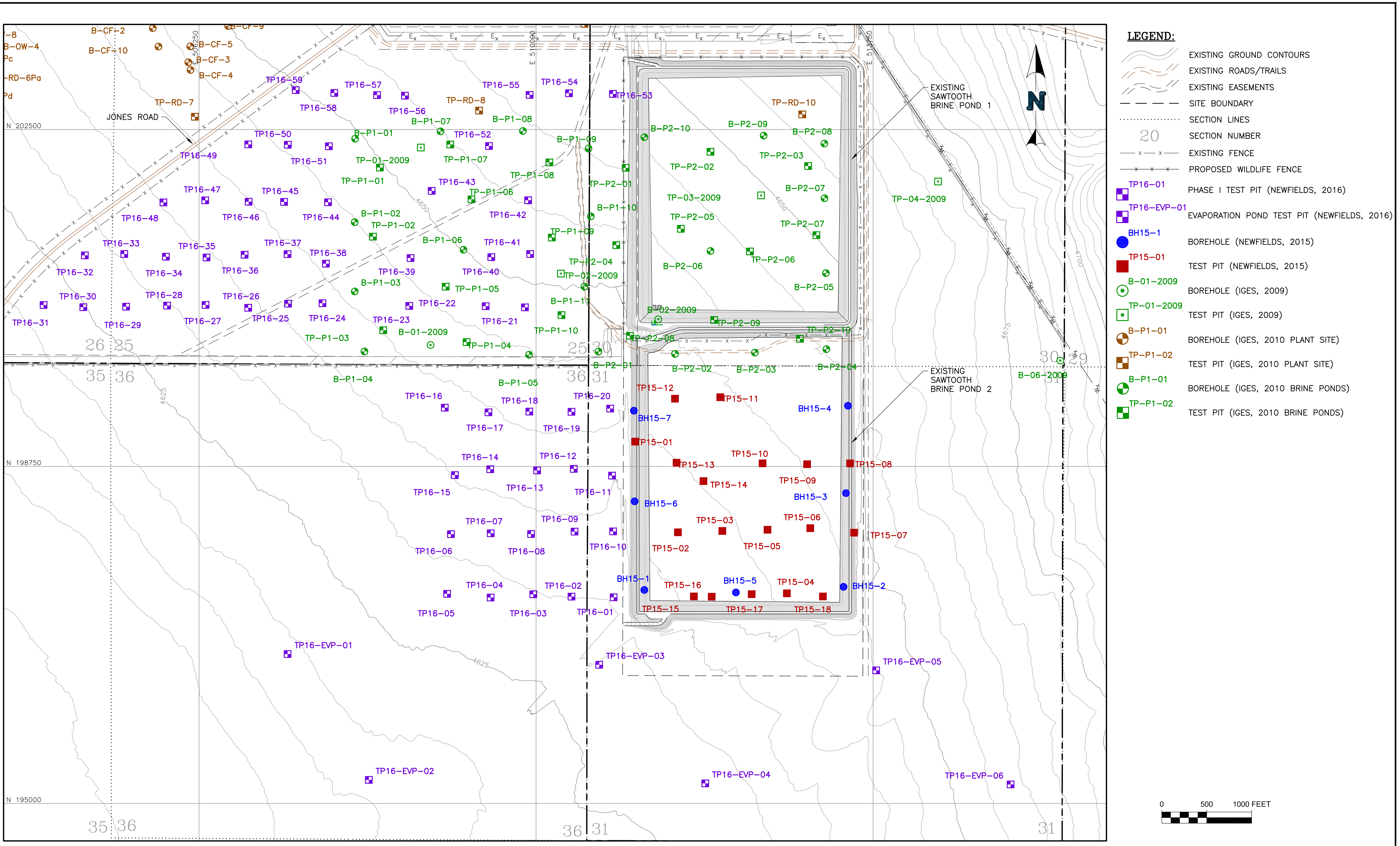
The laboratory testing results are attached to this memorandum. A summary of the completed test results is presented in **Table 1**, attached.

Attachments:

Attachment 1 – Geotechnical Investigation Locations Figure
Attachment 2 – Phase I Expansion Area Test Pit Logs
Attachment 3 – Evaporation Pond Area Test Pit Logs
Attachment 4 – 2016 Laboratory Test Results Summary
Attachment 5 – Phase I Expansion Area Laboratory Test Results
Attachment 6 – Evaporation Pond Area Laboratory Test Results

ATTACHMENT 1

GEOTECHNICAL INVESTIGATION LOCATIONS FIGURE



LEGEND:

		EXISTING GROUND CONTOURS
		EXISTING ROADS/TRAILS
		EXISTING EASEMENTS
		SITE BOUNDARY
		SECTION LINES
	20	SECTION NUMBER
		EXISTING FENCE
		PROPOSED WILDLIFE FENCE
▨	TP16-01	PHASE I TEST PIT (NEWFIELDS, 2016)
▨	TP16-EVP-01	EVAPORATION POND TEST PIT (NEWFIELDS, 2016)
●	BH15-1	BOREHOLE (NEWFIELDS, 2015)
🟥	TP15-01	TEST PIT (NEWFIELDS, 2015)
⊙	B-01-2009	BOREHOLE (IGES, 2009)
▣	TP-01-2009	TEST PIT (IGES, 2009)
◐	B-P1-01	BOREHOLE (IGES, 2010 PLANT SITE)
▨	TP-P1-02	TEST PIT (IGES, 2010 PLANT SITE)
◐	B-P1-01	BOREHOLE (IGES, 2010 BRINE PONDS)
▨	TP-P1-02	TEST PIT (IGES, 2010 BRINE PONDS)

NewFields

CLIENT
MAGNUM DEVELOPMENT
SOLUTION MINING

PROJECT
MAGNUM FUTURE BRINE POND EXPANSION
& EVAPORATION POND INVESTIGATION

TITLE
GEOTECHNICAL INVESTIGATION LAYOUT

FILENAME 93.011.001F
FIGURE NO. 1
REVISION 0

P:\Projects\0093.011 Magnum Future Brine Pond Geotechnical Investigation\A-CAD\FIGS\93.011.001F.dwg-2/7/2017 1:19 PM

ATTACHMENT 2

PHASE I EXPANSION AREA TEST PIT LOGS

NewFields

Pit ID: **TP16-01**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N 197,294.71 E 510,863.56

Elevation: 1,410.30ft

Total Pit Depth: 13.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

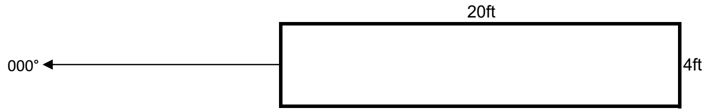
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SILT (ML), sandy, with clays, light brown, damp	Clay at surface 0.05ft thick with mud cracks
		1.0	SAND (SP-SM), with silt, trace fine gravel, fine grained, poorly graded, brown, moist	Hard digging @ 2ft
2.5				
5.0	SD-1 5-6ft			
		6.0	SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	Sidewalls collapsing from 6ft
7.5				
10.0				
12.5				
		13.0	▼	
15.0				
17.5				
20.0				Test pit terminated at 13.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-02**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/7/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 197,302.15 E: 510,393.75

Elevation: 1,411.90ft

Total Pit Depth: 15.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

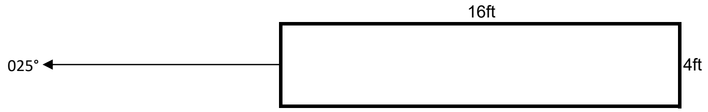
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SILT (ML), clayey, with sand, brown, damp	Topsoil 0.1ft
2.5	LD-1 2-3ft		Sandy with gravel, moist @ 2ft	
		3.5	SAND (SM), silty, fine grained, poorly graded, brown, damp	
5.0			Tuffaceous layer approximately 0.2 ft thick @ 6.0ft	
7.5				
			Trace silt @ 9 ft	
10.0				
12.5				
		14.0	▼	
15.0				
17.5				
20.0				Test pit terminated at 15.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-03**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/7/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 197,327.68 E: 509,968.70

Elevation: 1,412.30ft

Total Pit Depth: 10.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

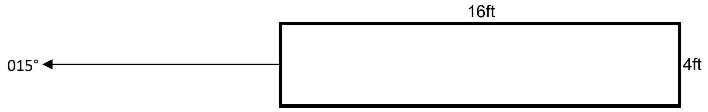
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.5	SAND (SM), silty, fine grained, poorly graded, brown, damp	0.05ft clay crust with trace gravel on surface
			SILT (ML), sandy, with clay, medium plastic, tan, damp Gravels @ 2ft Tuffaceous layer approximately 0.2ft thick @ 2.5ft	
2.5		3.0	SAND (SP), with gravel, trace silt, fine grained, poorly graded, cross bedded, brown, damp Tuffaceous layer approximately 0.1ft thick @ 3.5ft	
5.0				
7.5				
10.0		10.0	▼	
12.5				
15.0				
17.5				
20.0				Test pit terminated at 10.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-04**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/7/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 197,291.63 E: 509,494.05

Elevation: 1,409.20ft

Total Pit Depth: 13.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

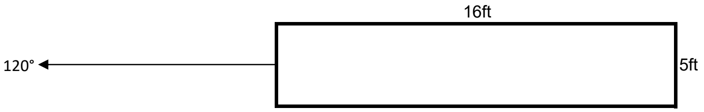
Backfilled: Yes

Depth (ft)	**Sample** (depth & type)	**Pit Wall Profile**	**Description**	**Additional Notes**
	LD-1 0-1ft		SAND (SM), silty, trace clay, light gray and brown, damp	
2.5			cross bedded, brown, damp Trace silt @ 2.5ft	
5.0			Moist @ 7ft	
7.5				
10.0			▼	
12.5				
15.0				
17.5				
20.0				Test pit terminated at 13.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-05**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/7/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 197,332.53 E: 509,010.21

Elevation: 1,411.50ft

Total Pit Depth: 16.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

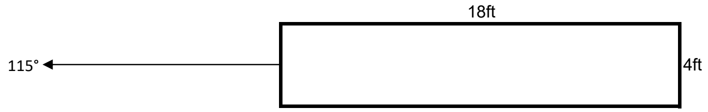
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
		1.0	SILT (ML), sandy, with clay, brown, damp	
		2.0	CLAY (CL), silty, medium plastic, light gray with limonite staining, damp	
2.5			SAND (SP-SM), with silt, trace gravel, fine grained, poorly graded, brown, moist	
			Gravelly @ 4ft Cemented fragments @ 4.5ft	
5.0			Trace silt @ 6ft	
7.5				
10.0				
12.5			Increase moisture content @ 12ft	
	SD-1 13-14ft			
15.0			Increase moisture content @ 15ft - capillary fringe	
		15.5	▼	
17.5				
20.0				Test pit terminated at 16.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-06**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/7/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 197,997.33 E: 509,052.19
Elevation: 1414.40ft
Total Pit Depth: 16.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
	LD-1 1-2ft	1.0	SAND/SILT (SP/ML), silty/sandy, brown, damp	
			CLAY (CL), silty, some sand, medium plastic, light gray, damp	
2.5		2.5	SAND (SP-SM), with silt, trace gravel, fine grained, poorly graded, brown, moist Interbedded gravel beds up to 0.3ft thick	
5.0			Roots @ 5ft	
		5.5	SAND (SP), some gravel, trace silt, brown, damp	
7.5				
10.0				
			Moist @ 11ft	
12.5				
			Increase moisture content @ 14ft - capillary fringe	
15.0				
		16.0	▼	
17.5				
20.0				Test pit terminated at 16.5ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-07**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/7/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 198,007.15 E: 509,494.59
Elevation: 1,408.40ft
Total Pit Depth: 13.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.3	Topsoil	
		1.5	SILT (ML), sandy, some clay, light orangish brown, damp	
2.5		2.5	CLAY (CL), silty, medium plastic, light gray, damp	
		4.0	SILT (ML), sandy, nonplastic, light brown, damp	
5.0			SAND (SP), gravelly, some silt, fine grained, poorly graded, lenticular bedding, brown, damp Lenses of silty sand interbedded throughout from 6ft	Sidewalls collapsing
7.5				
10.0				
12.5		12.5	▼	
15.0				
17.5				
20.0				Test pit terminated at 13.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-08**

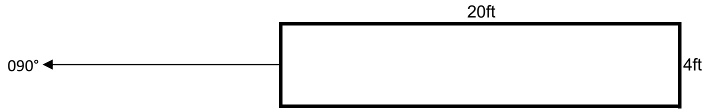
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/2/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 197,998.75 E: 509,944.00
Elevation: 1,410.70ft
Total Pit Depth: 14.0ft
Shoring (if used): None
Surface Condtions: Undulating, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SILT (ML), some sand and clay, light brown, damp	
2.5	LD-1 1.5-2.5ft	1.5	SAND (SC), clayey, trace gravel, low plastic, tan, limonite staining, damp	
		2.5	SAND (SM), silty, trace gravel, fine grained, poorly graded, brown, damp Gravel bed 0.1ft thick @ 3.5ft	
5.0				
7.5				
10.0	SD-1 8.5-9ft	8.0	SAND (SP), trace fine gravel and silt, fine grained, poorly graded, subrounded to rounded, brown, moist	
12.5				
15.0		13.5	▼	
17.5				
20.0				Test pit terminated at 14.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-09**

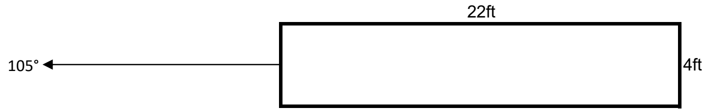
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/2/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 198,025.67 E: 510,428.02
Elevation: 1,409.50ft
Total Pit Depth: 18.0ft
Shoring (if used): None
Surface Condtions: Gently sloped south west, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.1	Topsoil	
			SILT (ML), sandy, some clay, light brown, damp	
2.5		2.5	CLAY (CL), silty, low to medium plastic, tan, damp	
		3.5	SILT (ML), clayey, some sand, medium plastic, light brown, damp	
5.0				
			Cemented fragments @ 7ft	
7.5				
		8.0	SAND (SP-SM), with silt, trace gravel, fine grained, poorly graded, brown, moist	
		9.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, brown, moist Roots @ 10-12ft	
10.0				
12.5				
			Increase moisture content @ 15ft - capillary fringe	
15.0				
		17.0	▼	
17.5				
20.0				Test pit terminated at 18.0ft depth due to ground water

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-10**

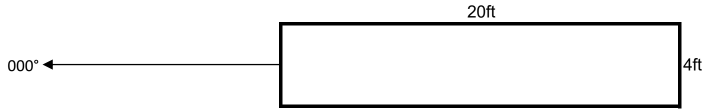
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 198,027.46 E: 510,857.06
Elevation: 1,408.70ft
Total Pit Depth: 18.5ft
Shoring (if used): None
Surface Condtions: Undulating, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.2	Topsoil	
				SILT (ML), sandy, with clay lens, brown, damp	
2.5			2.5	Coarse sand and gravel lens @ 2.5ft	
				SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	
5.0				Cemented from 5-7.5ft	Hard digging from 5-7.5ft
7.5					
10.0					
12.5				Increase moisture content @ 13ft - capillary fringe	
15.0					
17.5					
			18.5	▼	
20.0					Test pit terminated at 18.5ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-11**

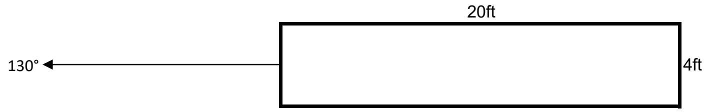
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 198,648.89 E: 510,844.74
Elevation: 1,412.90ft
Total Pit Depth: 13.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SILT (ML), some clay and sand, light brown, damp	0.05ft of clay at surface with pentagonal and hexagonal mud cracking
2.5			Cemented fragments @ 3ft	
5.0		5.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, cross bedded, brown, moist	
		6.5	CLAY (CL), silty, with sand, trace gravel, medium plastic, light brown, moist	
7.5	LD-1 7-8ft			
10.0				
12.5		12.5		
		13.0	▼ SAND (SP), some gravel, fine grained, poorly graded, brown, moist	
15.0				
17.5				
20.0				Test pit terminated at 13.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-12**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/6/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 198,723.41 E: 510,418.74

Elevation: 1,417.60ft

Total Pit Depth: 19.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SILT (ML), some sand and clay, nonplastic, light brown, damp	
2.5				
			Sandy with some gravel @ 3.5ft	
			Trace sand @ 4.5ft	
5.0	LD-1 5-6ft			
				Hard digging @ 7ft
7.5				
		9.5	SAND (SP), with gravel, trace silt, fine grained, poorly graded, brown, moist	
10.0				
12.5				
15.0		15.0	CLAY (CL), some silt, medium plastic, mottled, red and brown, damp	Very hard digging @ 15ft
17.5				
20.0				Test pit terminated at 19.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-13**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/6/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 198,705.97 E: 510,011.17
Elevation: 1411.30ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.2	Topsoil	
				SILT (ML), sandy, some clay, brown, damp	
2.5	LD-1 2-3ft		2.0	CLAY (CL), silty, trace fine sand, some limonite staining, medium plastic, brown, damp	
5.0			4.0	SAND (SM), silty, fine grained, poorly graded, brown, damp Trace silt @ 5ft	
7.5			6.5	CLAY (CL), some silt, medium plastic, reddish brown, moist	
			7.5	SILT (ML), some sand, trace gravel, nonplastic, light brown to tan, moist	
10.0	SD-1 10-11ft		8.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, brown, moist Cemented fragments @ 10ft Roots @ 10-14ft	
12.5					
15.0					
17.5				Increase moisture content @ 18ft - capillary fringe	
20.0			20.0	▼	Test pit terminated at 20.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-14**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/6/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 198,719.72 E: 509,489.85

Elevation: 1,417.40ft

Total Pit Depth: 16.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

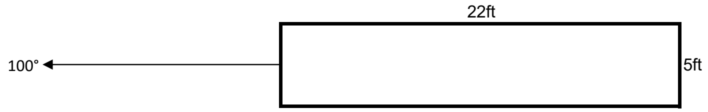
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.1	Topsoil	
2.5			SILT (ML), sandy, some clay, light brown, damp Some gravels @ 2.5ft Clay lenses @ 3.5ft	
5.0		5.0	GRAVEL (GP), sandy, trace silt, poorly graded, maximum particle size less than 0.1ft, brown, moist	
7.5		8.0	SAND(SP-SM), with silt, trace gravel, cemented fragments, fine grained, poorly graded, brown, moist	
10.0				
12.5			Increase moisture content @ 13ft - capillary fringe	
15.0		16.0	▼	
17.5				
20.0				Test pit terminated at 16.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-15**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/6/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 198,654.92 E: 509,096.89

Elevation: 1,415.50ft

Total Pit Depth: 17.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

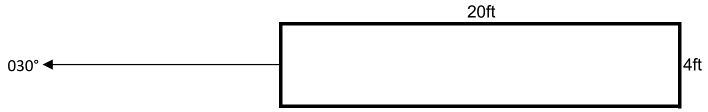
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SAND (SM), silty, fine grained, poorly graded, light brown, damp	
	LD-1 1-2.5ft	1.0	SILT (ML), some sand and clay, trace gravel, tan, damp	
2.5		2.5	SAND (SP-SM), with silt and gravel, fine grained, poorly graded, brown, damp	
		4.0	SAND (SP), trace silt and gravel, fine grained, poorly graded, brown, damp	
5.0				
		6.0	CLAY (CL), silty, some sand, trace gravel, medium plastic, brown, moist	
	LD-2 6.5-7ft			
7.5				
		9.0	SAND (SM), silty, fine grained, poorly graded, brown, moist	
10.0				
12.5				
		13.0	SAND (SP), trace silt and gravel, fine grained, poorly graded, brown, moist	Sidewalls collapsing
15.0			Increase moisture content @ 15ft - capillary fringe	
		16.5	▼	
17.5				
20.0				Test pit terminated at 17.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-16**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/6/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 199,404.28 E: 508,984.21

Elevation: 1,411.30ft

Total Pit Depth: 19.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.2	Topsoil	
				SAND (SM), silty, light brown, damp	
			2.0	SILT (ML), sandy, some clay, low plastic, brown, moist	
2.5					
			4.0	CLAY (CL), silty, medium plastic, light gray, moist	
			4.5	SAND (SM), silty, trace fine gravel, fine grained, poorly graded, brown, moist	
5.0	SD-1 5-6ft				
				Silty @ 7ft	
7.5					
			9.0	SAND (SP), trace gravel and silt, fine grained, poorly graded, brown, moist	North sidewall collapsing from 9ft
10.0					
12.5					
				Cemented fragments @ 14ft	
15.0					
	SD-2 17-18ft			Increase moisture content @ 17ft - capillary fringe	
17.5					
			19.0	▼	
20.0					Test pit terminated at 19.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-17**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/6/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 199,353.26 E: 509,469.54

Elevation: 1,411.30ft

Total Pit Depth: 18.5ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

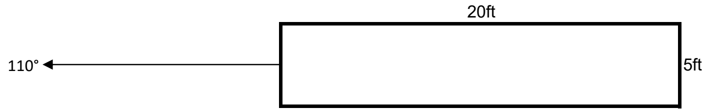
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.1	Topsoil	
			2.0	SAND (SM), silty, fine grained, poorly graded, brown, damp	
2.5				SAND (SP), with gravel, trace silt, fine to coarse grained, poorly graded, coarse and fine lenticular and cross bedding, brown, damp	
5.0					
7.5				Trace gravel from 6.5ft	
10.0				Cemented Fragments @ 10.5ft	
12.5					
15.0					
17.5				Increase moisture content @ 16ft - capillary fringe	
			18.5	▼	
20.0				CLAY (CL), some silt, hard, medium plastic, light brown, damp	Test pit terminated at 18.5ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-18**

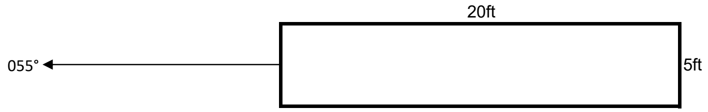
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/6/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 199,361.03 E: 509,924.46
Elevation: 1,417.20ft
Total Pit Depth: 19.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
			SILT (ML), sandy, some clay, brown, damp	
		2.0		
2.5			SAND (SP-SM), with silt, fine grained, poorly graded, brown, damp	
		3.5		
			SILT (ML), some sand, nonplastic, brown, moist	
		4.5		
5.0	LD-1		CLAY (CL), silty, with sand, medium plastic, brown, damp	
	5-6ft	5.5		
			SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	
7.5				
		8.5		
			SAND (SP), gravelly, trace silt, fine grained, poorly graded, subangular to subrounded, maximum particle size 0.1ft, cross bedded, brown, moist	
10.0				
			Some to trace gravel @ 11ft	
12.5				
			Silt lenses @ 14ft	
15.0				
			Sandy clay lenses @ 16ft	
17.5				
		19.0	▼	
20.0				Test pit terminated at 19.0ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-19**

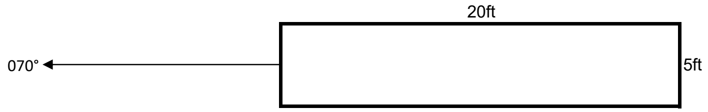
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/6/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 199,358.64 E: 510,394.25
Elevation: 1,417.30ft
Total Pit Depth: 17.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0.5-2ft	0.3	Topsoil	
			CLAY (CH), some silt, rootlets, high plastic, brown, damp	
		2.0	CLAY (CL), sandy, low plastic, brown, damp	
2.5	LD-2 3-5ft			
5.0				
		7.0	SAND (SP), with gravel, trace silt, fine grained, poorly graded, subangular to subrounded, planar bedding, brown, damp	
7.5				
10.0	SD-1 11-12ft			
12.5				
15.0			Increase moisture content @ 15ft - capillary finge	
17.5		17.5	▼	
20.0				Test pit terminated at 17.5ft depth due to groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-20**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 199,394.84 E: 510,824.16

Elevation: 1,412.40ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

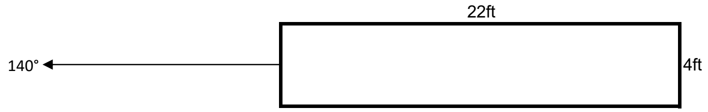
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
0.3			Topsoil	
			SAND (SM), silty, fine grained, poorly graded, light brown, damp	
2.0			SAND (SP), trace silt and gravel, fine grained, poorly graded, cross bedded, brown, moist	
2.5				
5.0				
7.5				
			Gravel lens @ 9ft	
9.5			SAND (SM), silty, fine grained, poorly graded, partially cemented, light brown, damp	Hard digging @ 9.5-15ft
10.0	SD-1 10-10.5ft			
12.0			SAND (SP), some gravel, partially cemented, brown, moist	
12.5				
15.0			No cement @ 15ft	
			Increase moisture content @ 17ft - capillary fringe	
17.5				
20.0			▼	Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-21**

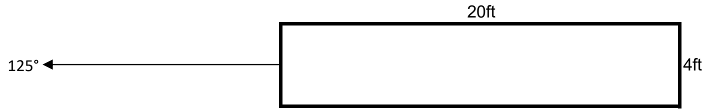
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 200,520.98 E: 509,875.32
Elevation: 1,415.70ft
Total Pit Depth: 22.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.5	Topsoil	
2.5		2.5	SILT (ML), sandy, some clay, light brown, damp Caliche @ 2ft	
		4.5	SAND (SM), silty, fine grained, poorly graded, brown, moist Clay lenses @ 4ft	
5.0		6.0	SILT (ML), sandy, nonplastic, brown, moist	
	LD-1 6-7ft		CLAY (CL), some silt, trace fine sand, low plastic, brown, damp	
7.5				
10.0				
12.5				
15.0		15.0		
			SAND (SP), trace silt, fine grained, poorly graded, brown, moist	
17.5				
20.0				Test pit terminated at 22.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-22**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,533.40 E: 509,439.30

Elevation: 1,418.30ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

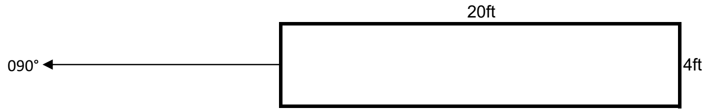
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.6	Topsoil	
2.5			SAND (SM), silty, fine grained, poorly graded, brown, damp Caliche @ 0.6-2ft	
5.0			Cemented fragments @ 4ft Some fine gravels @ 5ft	
		6.0	SILT (ML), sandy, nonplastic, brown, moist	
7.5		7.5	SAND (SP), some gravel and silt, fine grained, poorly graded, brown, moist Clay lenses @ 9ft	
10.0				
12.5			Clay lenses @ 14.5ft	
15.0				
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-23**

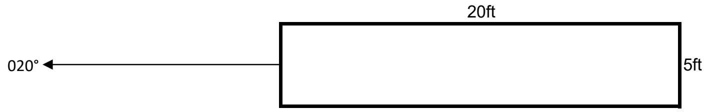
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 200,536.94 E: 508,589.17
Elevation: 1,409.60ft
Total Pit Depth: 21.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.2	Topsoil	
		1.5	SAND (SM), silty, fine grained, poorly graded, brown, damp	
2.5		2.5	CLAY (CL), silty, trace fine sand, medium plastic, light gray, damp	
		4.0	SAND (SM), silty, fine grained, poorly graded, brown, damp	
5.0		5.0	CLAY (CL), silty, trace fine sand, medium plastic, grayish brown, moist	
			SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	
7.5			Cemented sands @ 7.5ft	Hard digging @ 7.5ft
10.0			Clay lenses and cemented sands @ 11.5-12.5ft	
12.5		12.5	SAND (SP), some gravel, trace silt, fine grained, poorly graded, subrounded to rounded, brown, moist	
15.0				
17.5				
20.0				Increase moisture content @21.5ft Test pit terminated at 21.5ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-24**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/4/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,567.16 E: 507,623.04

Elevation: 1,412.60ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

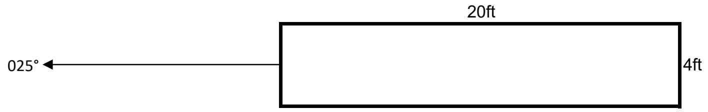
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.3	Topsoil	
		1.0	SAND (SM), silty, trace clay, fine grained, poorly graded, light brown, damp	
			CLAY (CL), silty, some sand, medium plastic, tan, damp	
2.5				
5.0			Limonite staining and decrease silt content @ 5ft	
		5.5	SAND (SM), silty, fine grained, poorly graded, brown, moist	
			Clay lenses @ 7ft	
7.5			Cemented fragments @ 8ft	Hard digging @ 8ft
10.0				
		11.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, subrounded to rounded, cross bedded, brown, moist	
12.5				
15.0				
17.5		17.5	CLAY (CH), some silt, trace fine sand, high plastic, mottled, brown and light gray, moist	
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-25**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,562.25 E: 507,240.30

Elevation: 1,414.50ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

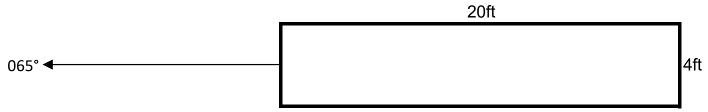
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.4	Topsoil	
		1.5	SAND (SM), silty, fine grained, poorly graded, light brown, damp	
2.5		2.5	CLAY (CL), silty, trace find sand, medium plastic, light brown, damp	
		4.5	SAND (SM), silty, find grained, poorly graded, light brown, damp	
5.0	LD-1 5-6ft			
7.5				
		8.5	CLAY (CL), silty, trace fine sand, medium plastic, grayish brown, moist	
10.0				
		12.0	SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist Clay lenses @ 9.5ft	
12.5				
15.0	SD-1 14-15ft			
17.5				
20.0		20.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, subrounded to rounded, brown, moist Increase moisture content @ 18ft - capillary fringe ▼	Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-26**

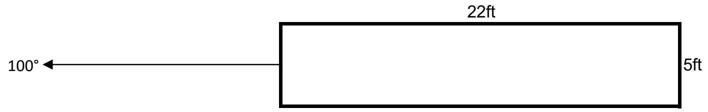
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/4/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 200,516.04 E: 506,796.26
Elevation: 1,401.60ft
Total Pit Depth: 20.5ft
Shoring (if used): None
Surface Condtions: Undulating, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
		1.5	SILT (ML), sandy, trace clay, nonplastic, brown, damp	
2.5		3.0	SAND (SP-SM), with silt, partial cement, brown, moist	
		4.0	CLAY (CL), silty, medium to high plastic, brown, damp	
5.0		6.5	SAND (SP-SM), with silt, some gravel, fine grained, poorly graded, subrounded to rounded, brown, moist	
7.5		9.5	SAND (SP), some gravel, trace silt, fine grained, poorly graded, brown, moist	
10.0		10.5	SILT (ML), clayey, low plastic, gray-brown, with limonite staining, rootlets, moist	
12.5			SAND (SP), some silt and gravel, partial cement, fine grained, poorly graded, brown, moist Clay lenses @ 11ft No cement @ 13.5ft	
15.0				
17.5				
20.0		20.0	▽	Test pit terminated at 20.5ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▽	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-27**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/4/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,547.85 E: 506,322.66

Elevation: 1,407.30ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

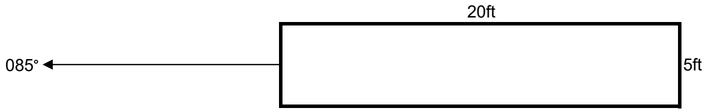
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.2	Topsoil	
		1.0	SILT (ML), some clay and fine sand, brown, damp	
2.5			SAND (SM), silty, fine grained, poorly graded, brown, damp	
	LD-1 3-4ft	3.0	CLAY (CL), sandy, some silt, trace fine gravel, low plastic, light grayish brown, damp	
5.0		4.0	SAND (SP), trace silt, fine grained, poorly graded, brown, moist	
7.5	LD-2 7-8ft	6.5	CLAY (CL), silty, some fine sand, low plastic, mottled, limonite staining, rootlets, brown, moist	
10.0		11.0	SAND (SP), trace silt and gravel, fine grained, poorly graded, brown, moist	
12.5				
15.0		15.5	CLAY (CL), silty, medium plastic, brown, moist	
17.5	SD-1 16-17ft			
20.0				Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-28**

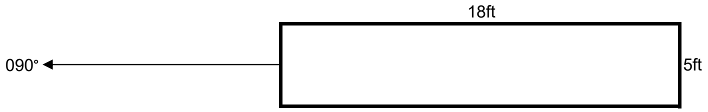
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/4/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 200,540.07 E: 500,894.43
Elevation: 1,402.20ft
Total Pit Depth: 22.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.3	Topsoil	
			SILT (ML), sandy, some clay, caliche, brown, damp	
2.5				
		4.0	SAND (SP), with fine gravel, trace silt, fine grained, poorly graded, planar bedding, brown, moist No gravel @ 5ft Silt lens @ 6ft	
5.0				
7.5				
			Clay lenses @ 9-15ft	
10.0				
			Cement @ 11ft	Hard digging @ 11ft
12.5				
			Increase moisture content @ 14-15ft	
15.0		15.0	CLAY (CH), some silt, high plastic, local limonite staining, free water in vugs/ pits, light brown, moist	
	LD-1 16-18ft			
17.5				
20.0				Test pit terminated at 22.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-29**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/3/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,528.32 E: 505,438.73

Elevation: 1,399.60ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

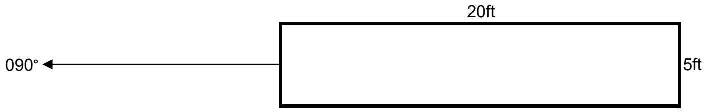
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.4	Topsoil	
				SAND (SM), silty, fine grained, poorly graded, brown, damp	
2.5					
			4.0	SAND (SP-SC), with silt, fine grained, poorly graded, brown, damp	
5.0	LD-1 5-6ft			SAND (SC), clayey, low plastic, brown, moist	
7.5			7.5	SAND (SP), with gravel, trace silt, partial cement, find and coarse grained, poorly graded, brown, moist	Hard digging @ 7.5ft
10.0					
				Silty, no gravel @ 11ft	Softer @ ~11ft
12.5					
			14.0	CLAY (CL), silty, trace fine sand, medium plastic, brown, moist	
15.0	SD-1 15-16ft				
17.5					
20.0					Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-30**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 200,522.73 E: 504,961.88
Elevation: 1,411.50ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Undulating, sparse vegetation
Backfilled: Yes

Depth (ft)	**Sample** (depth & type)	**Pit Wall Profile**	**Description**	**Additional Notes**
		 0.4	Topsoil	
			SAND (SC), clayey, trace fine gravel, fine grained, poorly graded, brown, damp	
2.5	LD-1 2-3ft			
5.0				
		7.0	SAND (SP), trace gravel and silt, low to medium plastic, poorly graded, subangular to subrounded, brown, moist Gravelly @ 8-10ft	
7.5	SD-1 8-9ft			
10.0				
12.5				
		13.5	CLAY (CL), silty, trace fine sand, low plastic, brown, moist	
15.0				
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

22ft

100° ←

5ft

NewFields

Pit ID: **TP16-31**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/3/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 200,547.39 E: 504,520.41

Elevation: 1,406.30ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

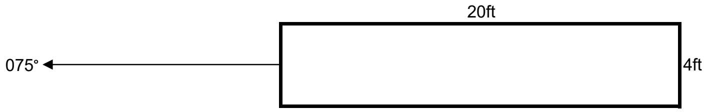
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.5	Topsoil	
			SAND (SP-SM), with silt, some clay, fine grained, poorly graded, nonplastic, orange, damp Becomes brown @ 1.5ft	
2.5				
5.0			Trace gravel and partial cement @ 5ft	Hard digging @ 5ft
		6.5	SAND (SP), trace silt and gravel, fine grained, poorly graded, brown, damp	
7.5				
10.0				Soft @ 10ft
		12.0	CLAY (CL), silty, trace fine sand, medium plastic, brown, moist	
12.5	SD-1 12.5-13.5ft			
15.0				
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: TP16-32

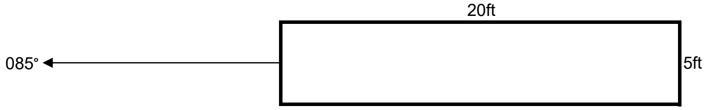
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,099.54, E: 504,979.37
Elevation: 1,406.90ft
Total Pit Depth: 21.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.8	Topsoil	
			SAND (SM), silty, fine grained, poorly graded, brown, damp	
2.5				
		3.0	SILT (ML), some sand and clay, caliche, low plastic, light brown and light gray, damp	
		4.5	SAND (SP), some gravel, trace silt, partial cement, fine and coarse grained, poorly graded, subangular to subrounded, brown, moist	Hard digging @ 4.5ft
5.0				
7.5				
10.0				
			Clay lenses @ 11ft	
12.5				
15.0				
			Increase moisture content @ 16ft - capillary fringe	
	SD-1 17ft			
17.5	LD-1 17.5-19ft	17.5	▼ Perched water @ 17.5ft	Not enough perched water to fill in test pit after 10 minutes
			CLAY (CL), silty, trace fine sand, medium plastic, brown, moist	
20.0				Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-33**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/3/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,114.37 E: 505,417.81

Elevation: 1,400.20ft

Total Pit Depth: 18.5ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

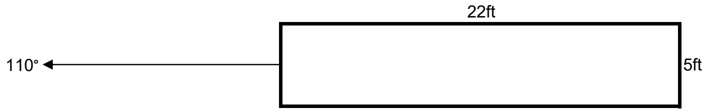
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.8	Topsoil	
			SILT (ML), sandy, some clay, caliche, brown and light gray, damp	
2.5				
5.0	SD-1 5-6ft	5.0	SAND (SM), silty, trace fine gravel, fine grained, poorly graded, subangular to subrounded, orange, moist Becomes brown @ 7ft	
7.5				
10.0				
12.5				Hard digging @ 13ft
15.0				
17.5			Increase moisture content @ 17ft - capillary fringe	
		18.0	▼	
20.0				Test pit terminated at 18.5ft depth due to encountering groundwater

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-34**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/4/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,084.59 E: 505,881.21

Elevation: 1,392.80ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

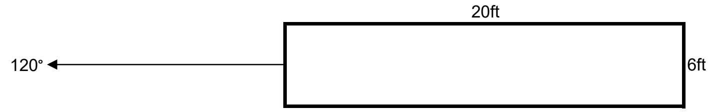
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
		1.0	SILT (ML), some clay and sand, light brown, damp	
			SAND (SM), silty, trace clay, fine grained, poorly graded, nonplastic, light brown, damp	
2.5				
5.0				
		5.5	SAND (SP-SM), with silt, trace fine gravel, partial cement, fine grained, poorly graded, subrounded to rounded, brown, moist No cement @ 6ft Coarse sand lenses @ 7ft	
7.5	SD-1 7-8ft			
			Hard damp clay lenses @ 9ft	Hard dig @ 9ft
10.0				
			Cement @ 12ft	
12.5				
15.0		15.0	CLAY (CL), silty, trace fine sand and gravel, low to medium plastic, brown, moist	
	LD-1 16-17ft			
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-35**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/4/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,076.11 E: 506,333.70

Elevation: 1,412.70ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Undulating, sparse vegetation

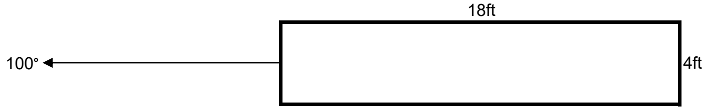
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
				
		0.4	Topsoil	
		1.0	SAND (SM), silty, trace gravel, fine grained, poorly graded, brown, damp	
	LD-1 1-2ft		CLAY (CL), silty, with fine sand, trace fine gravel, rootlets, low plastic, light brown, damp	
2.5		2.0	SILT (ML), some clay and fine sand, low plastic, light brown, damp	
5.0		5.0	SAND (SP), some gravel, trace silt, find grained, poorly graded, subrounded to rounded, brown, moist thin coarse sand beds interbedded Clay lenses @ 7ft	
7.5				
10.0				
12.5				
15.0		15.0	CLAY (CL), silty, trace fine sand, medium plastic, brown, moist	
		15.5	SAND (SC), clayey, some silt, fine grained, poorly graded, low to medium plastic, slow dilatency, brown, wet	
17.5	LD-2 16-17ft			
	SD-1 18-19ft	18.0	CLAY (CL), some silt, medium to high plasticity, brown, moist	
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-36**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/4/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,106.19 E: 506,756.50

Elevation: 1,412.50ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

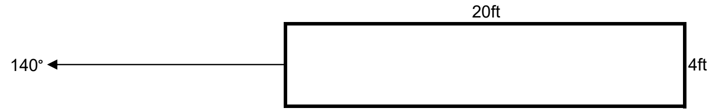
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.6	Topsoil	
			SILT (ML), sandy, brown, damp	
2.5	SD-1 2-3ft	2.0	CLAY (CL), silty, trace fine sand, medium plastic, light brown, damp	
5.0 7.5 10.0 12.5		5.0	SAND (SP), trace silt and gravel, fine grained, poorly graded, brown, moist Cemented sands @ 10ft	Very hard dig 10-14ft
15.0 17.5 20.0	LD-1 16-17ft	14.0	CLAY (CL), some silt, trace fine sand, low plastic, mottled, brown and light gray, moist	Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-37**

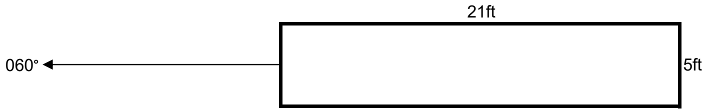
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/4/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,112.83 E: 507,234.13
Elevation: 1,413.60ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.2	Topsoil	
		1.5	SILT (ML), sandy, brown, damp	
2.5		3.0	CLAY (CL), silty, trace fine sand, light brown, damp	
			SAND (SP), some silt, fine grained, brown, moist	
5.0				
			Cement and clay lens @ 6ft	Hard dig @ 6ft
7.5				
10.0				
			Trace silt from 11.5ft	
12.5				
15.0				
		16.0	CLAY (CH), some interbedded silt, high plastic, mottled, brown and light gray, moist	
17.5				
20.0	SD-1 19-20ft			Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-38**

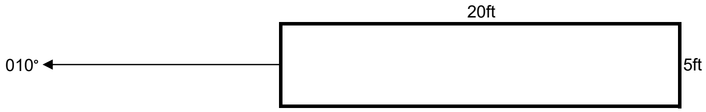
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/4/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,007.29 E: 507,662.01
Elevation: 1,413.40ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.3	Topsoil	
			SAND (SM), silty, trace clay, brown, damp	
2.5	SD-1 3-4ft	2.0	CLAY (CH), with fine sand, trace fine gravel, high plastic, light gray, brown, damp Limonite staining @ 4.5ft	
5.0		5.0	SAND (SM), silty, with clay lenses, nonplastic, light brown, moist Sand and gravel lens @ 8.5ft	
7.5				
10.0				
12.5		12.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, rounded, brown, moist	
15.0				
17.5				
20.0	LD-1 19-20ft	19.0	CLAY (CH), some silt, trace fine sand, high plastic, mottled, brown and light gray, moist	Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-39**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,069.23 E: 508,603.30

Elevation: 1,413.30ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

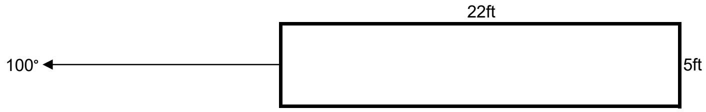
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.2	Topsoil	
	LD-1 1-2ft	1.0	SILT (ML), clayey, with sand, brown, damp	
2.5			SAND (SC), clayey, trace fine gravel, low plastic, light gray, damp	
	SD-1 3.5-4ft	3.5	CLAY (CL), silty, caliche, medium plastic, reddish brown, moist	
		4.0	SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	
5.0				
7.5				
10.0				Hard dig @10.5ft
12.5				
		14.5	SAND (SP), trace silt, fine grained, poorly graded, brown, moist	
15.0				
			Some gravel @ 17ft	
17.5				
20.0				Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-40**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,079.72 E: 509,501.30

Elevation: 1,418.50ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Gently sloping north, sparse vegetation

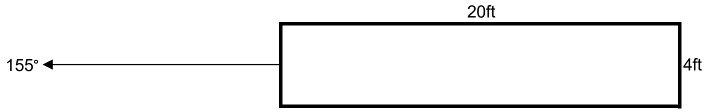
Backfilled: Yes

Depth (ft)	**Sample** (depth & type)	**Pit Wall Profile**	**Description**	**Additional Notes**
		 0.8	Topsoil	
			SAND (SM), silty, trace clay, fine grained, poorly graded, brown, damp	
2.5				
5.0				
	LD-1 5.5-7ft	5.5	CLAY (CL), silty, trace fine sand, low plastic, interbedded, some mottling, red and brown, moist	
7.5				
		8.5	SAND (SP-SM), with silt, fine grained, poorly graded, subangular to subrounded, brown, moist	
10.0				
12.5				
		13.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, brown, moist	
15.0				
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-41**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,114.88 E: 509,934.31

Elevation: 1,418.80ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Gently sloping north, sparse vegetation

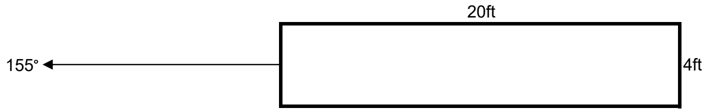
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.6	Topsoil	
		1.0	SAND (SM), silty, fine grained, poorly graded, brown, damp	
		2.0	CLAY (CL), silty, trace fine sand, low to medium plastic, light gray, damp	
2.5			SILT (ML), some clay, trace fine sand, nonplastic, light brown, moist	
5.0				
7.5		7.0	SAND (SM), silty, fine grained, poorly graded, brown, moist	
10.0	LD-1 9-10.5ft	9.0	CLAY (CL), some sand, rootlets, medium plastic, mottled, orangish red and brown, damp	
12.5		12.0	SAND (SP), trace gravel and silt, fine grained, poorly graded, brown, moist	
15.0				
17.5				
20.0				Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-42**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/5/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,713.07 E: 509,911.76

Elevation: 1,417.20ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

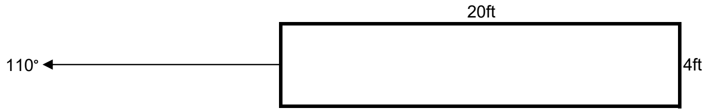
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.8	Topsoil	
		1.0	SILT (ML), some sand, light brown, damp	
2.5	LD-1 1-2ft	3.0	CLAY (CL), sandy, trace fine gravel, medium plastic, light gray, damp	
5.0 7.5		8.0	SILT (ML), sandy, light brown, damp gradational contact, coarsening down section	
10.0		10.5	SAND (SM),silty, trace clay, fine grained, poorly graded, brown, moist	
12.5 15.0	SD-1 11-12ft		SAND (SM), silty, non plastic, brown, damp Partial cement fragments @ 11.0ft	
17.5 20.0			SAND (SM), silty, fine grained, poorly graded, brown, damp	Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-43**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,817.45 E: 508,838.45
Elevation: 1,417.50ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
			SAND (SM), silty, trace clay, fine grained, poorly graded, brown, damp	
2.5				
	LD-1 4-4.5ft	4.0	CLAY (ML), some sand, trace clay, non plastic, brown, moist	
5.0	LD-2 5-6ft	4.5	SILT (ML) some sand, trace clay, non plastic, brown, moist	
7.5				
10.0				
			cemented silts 2 12ft	hard dig @ 12ft
12.5				
		14.0	SAND (SM), silty, some cemented fragments, fine grained, poorly graded, brown, moist	
15.0				
17.5				
		19.5	SAND (SP), trace silt, fine grained, poorly graded, brown, moist	Test pit terminated at 20.0ft depth due to machine limits
20.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-44**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,690.36 E: 507,685.25
Elevation: 1,410.10ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Undulating, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.6 	Topsoil	
			SAND (SM), silty, fine grained, poorly graded, brown damp Caliche @ 1.0ft	
2.5				
5.0			Silt lenses @ 6.0ft	
	SD-1 6-7ft			
7.5			Clay lenses @ 9.0ft	
10.0				
		11.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, subrounded to rounded, cross bedded, brown, moist	
12.5				
15.0				
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

Pit ID: **TP16-45**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/3/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 201,694.88 E: 507,195.90

Elevation: 1,409.90ft

Total Pit Depth: 21.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

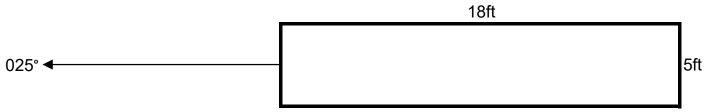
Backfilled: Yes

Depth (ft)	**Sample** (depth & type)	**Pit Wall Profile**	**Description**	**Additional Notes**
		 0.5	Topsoil	
			SAND (SC), clayey, trace gravel, poorly graded, low plastic, brown, damp	
2.5	LD-1 2-4.5ft			
		4.6	SAND (SP), with gravel, trace silt, fine grained, poorly graded, hummocky, subgranular to subrounded, maximum particle size 0.1ft, brown, moist	
5.0				
7.5	SD-1 6-7ft			
10.0				
12.5				
15.0				
17.5				Hard Dig @ 16ft
20.0			Silt lenses @ 18.0ft	Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



Pit ID: **TP16-46**

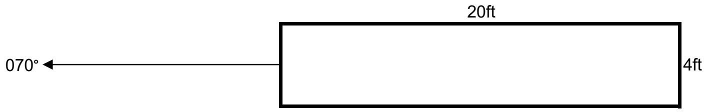
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,696.08 E: 506,801.44
Elevation: 1,404.60ft
Total Pit Depth: 18.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.4	Topsoil	
			SILT (ML), sandy, trace gravel, non plastic, brown, damp	
2.5				
		4.0	SAND (SM), silty, fine grained, poorly graded, brown, damp	
5.0				
		6.0	SAND (SP), trace silt and gravelly, fine grained, poorly graded, subrouned to rounded, brown, moist Gravelly @ 6.0-9.0ft	
7.5				
10.0		10.0		
			Clay leneses @ 12ft	
12.5				
			Gravelly @ 14-15ft	
15.0				
17.5				
		18.0		
20.0				Test pit terminated at 18.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-47**

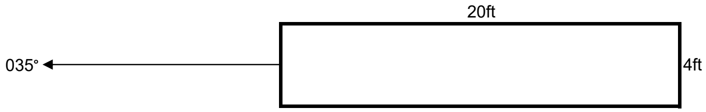
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,711.73 E: 506,318.40
Elevation: 1,404.60ft
Total Pit Depth: 19.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.4	Topsoil	
2.5			SILT (ML), sandy, trace gravel, non plastic, brown, damp	
5.0	LD-1 5-6ft	5.0	SAND (SM), silty, some gravel, occasional sandy clay lens, non plastic, light brown, damp	
7.5				
10.0		10.0	SAND (SP), trace silt, some gravel, fine grained, some coarse, poorly graded, subrounded to rounded, brown, moist	
12.5	SD-1 12-13ft			
15.0				
17.5		18.0	CLAY (CL), silty, trace fine sand, low plastic, exhibits structure, brown, moist	*Trace sand. Sand in sample contamination from bucket and overlying material Test pit terminated at 19.5ft depth due to machine limits
20.0	*LD-2 18-19.5ft			

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-48**

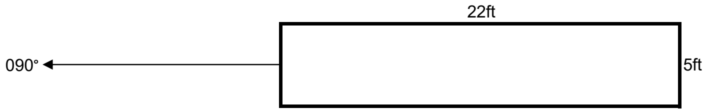
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/3/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 201,688.80 E: 505,853.28
Elevation: 1,406.60ft
Total Pit Depth: 19.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 0.6	Topsoil	
		1.5	SAND (SM), silty, brown, damp	
2.5		5.0	SILT (ML), some clay and sand, caliche, nonplastic, light brown, damp	
5.0 7.5		9.5	SAND (SP), some gravel, trace silt, fine grained, poorly graded, subrounded to rounded, planar and cross bedded, brown, moist	
10.0	SD-1 9.5-10.5ft	10.5	CLAY (CL), silty, with sand, trace fine gravel, root casts with limonite staining, medium plastic, gray, damp	
12.5 15.0	SD-2 11-12ft	16.5	SAND (SP), gravelly, fine and course grained, poorly graded, rounded, maximum particle size 0.1ft, brown, moist Clay lenses @ 15ft	
17.5 20.0	LD-1 17-18ft		CLAY (CL), interbedded silt, with sand, low plastic, reddish brown, moist	Test pit terminated at 19.5ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-49**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,334.70 E: 506,797.12

Elevation: 1,404.60ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

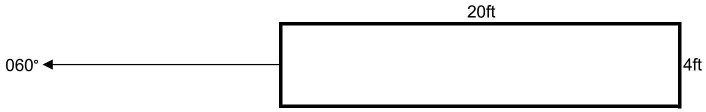
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.5	Topsoil	
			SAND (SM), silty, fine grained, poorly graded, brown, damp	
2.5				
	LD-1 3.5 - 5ft	3.5	SILT (ML), sandy, trace fine gravel, nonplastic, grayish brown, damp	
5.0		5.0	SAND (SM), silty, fine grained, poorly graded, brown, damp	
7.5				
		8.0	SAND (SP), some gravel, trace silt, trace clay lenses, fine grained, poorly graded, subrounded to rounded, cross bedded, brown, moist	
		9.0		
10.0				
12.5				
15.0	SD-1 14 - 15ft			
17.5		18.0	clay lenses @ 18.0ft	
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-50**

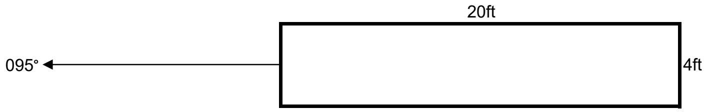
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/2/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 202,330.32 E: 507,237.83
Elevation: 1,396.30ft
Total Pit Depth: 20.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	No Samples Collected	0.6	Topsoil	
2.5		2.6	SILT (ML), sandy, nonplastic, brown, damp	
		3.4	CLAY (CH), some silt, high plastic, reddish brown, moist	
5.0 7.5		9.0	SAND (SP-SM), with silt, fine grained, poorly graded, brown, moist	
10.0		11.0	SAND (SP), gravelly, trace silt, fine grained, poorly graded, subrounded to rounded, brown, moist	
12.5 15.0 17.5 20.0			no gravel @ 11.0ft	Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-51**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,313.76 E: 507,694.19

Elevation: 1,399.30ft

Total Pit Depth: 19.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

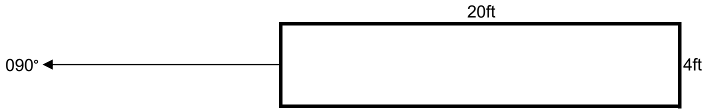
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.4	Topsoil	
2.5	LD-1 2 - 4ft		SILT (ML), with sand, trace clay and fine gravel, nonplastic, brown, damp	
		3.0	CLAY (CL), some silt, medium plastic, reddish brown, moist	
5.0		4.0	SAND (SM), silty, fine grained, poorly graded, brown, moist	
7.5				
10.0		8.0	SAND (SP), some gravel, trace silt, fine grained, poorly graded, brown, moist Gravelly @ 9.5 - 11ft	
12.5	SD-1 11 - 12ft	11.0	Trace gravel @ 11ft Gravelly @ 12.5 - 14ft	
15.0				
17.5				
20.0				Test pit terminated at 19.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-52**

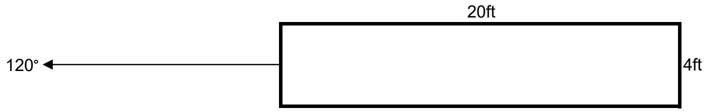
Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/5/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 202,316.53 E: 509,475.94
Elevation: 1,419.40ft
Total Pit Depth: 12.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
		 	0.2	Topsoil	
				SILT (ML), some clay and sand, light brown, damp	
				CLAY (CL), silty, trace fine sand, medium plastic, light gray, damp caliche @ 2.0ft	
2.5			2.5	SAND (SP), some gravel, trace silt, fine, angular to subrounded, planar and lenticular and cross bedded, brown, damp	
5.0					Pit sidewalls collapsing @ 5ft
7.5					
10.0					
12.5					Total Depth terminated due to collapsing sidewalls in loose sand
15.0					
17.5					
20.0					Test pit terminated at 12.0ft depth due to collapsing sidewalls in loose sand

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-53**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,896.45 E: 510,854.70

Elevation: 1,438.10ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
0 – 2.0	SD-1 0 - 2ft	 2.0	SILT (ML), clayey and sandy, nonplastic, light brown and light gray, damp caliche 0.5 - 2ft	too dry for field PI test
2.5 – 9.0	SD-2 5 - 8ft	9.0	SAND (SM), silty, fine grained, poorly graded, light brown, damp	
10.0 – 12.0	LD-1 9 - 11ft	12.0	CLAY (CL), sandy, with silt and sand lenses, poorly graded, medium plastic, brown, moist silt lenses @ 12ft	hard digging @ 9ft
12.5 – 20.0	SD-3 19ft		CLAY (CH), trace silt and fine sand, high plastic, brown, moist	Test pit terminated at 20.0ft depth due to machine limits

Depth scale: 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-54**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,903.95 E: 510,365.38

Elevation: 1,407.80ft

Total Pit Depth: 19.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

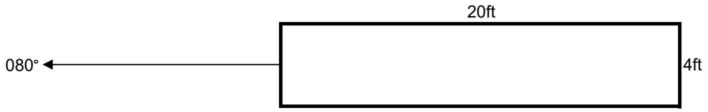
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		 1.5	SAND (SM), silty, fine grained, poorly graded, light gray, damp some gravel and clay @ 1.5ft, subangular, maximum particle size 0.1ft, oxide staining	rootlets to 1ft
2.5		3.0	SAND (SP-SM), with silt, trace fine gravel, fine grained, poorly grained, cross bedded, brown, moist	
5.0				
7.5				
10.0				
		11.5	CLAY (CL), trace silt and fine sand, rootlets, medium to high plastic, slightly mottled, brown and reddish orange and light gray, moist	
12.5	LD-1 12 - 13ft			
15.0				
17.5				
20.0				Test pit terminated at 19.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-55**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,884.98 E: 509,928.53

Elevation: 1,415.30ft

Total Pit Depth: 19.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

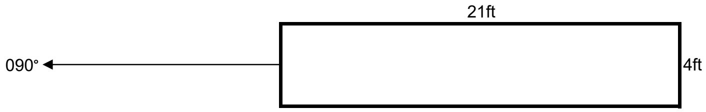
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.8	Topsoil	
		1.5	SAND (SM), silty, trace clay, caliche, poorly graded, nonplastic, brown, moist	
2.5	LD-1 2 - 3ft	3.0	CLAY (CL), some fine sand, low plastic, light brown, moist	
5.0				hard digging @ 5ft
7.5			CLAY (CL), trace silt and sand, with sand lenses, trace rootlets, medium to high plastic, slightly mottled, orangish brown and light gray, moist	
10.0	SD-1 9 - 11ft			
		11.5		
12.5				
15.0				very hard digging @ 14ft
17.5				
20.0				Test pit terminated at 19.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-56**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/2/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 202,875.94 E: 508,540.47
Elevation: 1,415.70ft
Total Pit Depth: 21.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile		Description	Additional Notes
			0.6	Topsoil	
			1.0	SILT (ML), some clay, trace fine sand, caliche 1 -3ft , nonplastic, brown, damp	
2.5	LD-1 2 - 3ft		3.0		
5.0					
7.5					
			8.5	SAND (SP), trace silt, fine grained, poorly graded, subrounded to rounded, cross bedded, brown, damp	
10.0	SD-1 9 - 11ft				
			11.5		
12.5					
15.0					
17.5				grayish brown @ 17ft	
20.0				clay lens @ 19.5ft	Test pit terminated at 19.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-57**

Project: Magnum Future Pond Expansion Geotechnical Investigation
Project No.: 475.0093.011
Project Location: Phase I North Area; Delta, Utah
Date: 11/2/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 202,882.94 E: 508,230.74
Elevation: 1,410.50ft
Total Pit Depth: 21.0ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: Yes

Depth (ft)	**Sample** (depth & type)	**Pit Wall Profile**	**Description**	**Additional Notes**
		 0.8	Topsoil SILT (ML), some clay, trace fine sand, nonplastic, brown, damp	
2.5				
5.0				
7.5				
		9.5	SAND (SP), trace silt, fine grained, poorly graded, subrounded to rounded, cross bedded, brown, damp	
10.0				
12.5				
15.0			rounded gravels @ 16ft	
17.5	SD-1 17ft			
20.0				Test pit terminated at 21.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-58**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,906.64 E: 507,754.80

Elevation: 1,411.40ft

Total Pit Depth: 19.5ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
		0.6	Topsoil	
2.5			SILT (ML), sandy to some sand, nonplastic, brown, damp	
5.0	LD-1 5 - 7ft	5.0	CLAY (CL), silty, trace fine sand, medium plastic, mottled, brown and reddish orange and light gray, moist	
7.5		7.0	SAND (SM), silty, fine grained, poorly graded, tan, moist	
10.0 12.5 15.0		9.5	SAND (SP), trace silty and fine gravel, fine grained, poorly graded, subrounded to rounded, brown, moist	
17.5 20.0	SD-1 17 - 18ft	16.5	CLAY (CL), silty, rootlets, root casts with halite infill, medium plastic, brown, moist	Test pit terminated at 19.5ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

NewFields

Pit ID: **TP16-59**

Project: Magnum Future Pond Expansion Geotechnical Investigation

Project No.: 475.0093.011

Project Location: Phase I North Area; Delta, Utah

Date: 11/2/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 202,938.30 E: 507,325.94

Elevation: 1,402.70ft

Total Pit Depth: 20.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

Backfilled: Yes

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
0.6		0.6	Topsoil	
			SAND (SM), silty, nonplastic, brown, damp	
2.5			clayey @ 2ft	
	LD-1 3 - 4ft		sand lenses at 3ft	
5.0				
7.5				
10.0		10.0	SAND (SP), trace silt and fine gravel, fine grained, poorly graded, subrounded to rounded, brown, moist	
12.5				
15.0			clay lenses @ 16ft	
17.5				
20.0				Test pit terminated at 20.0ft depth due to machine limits

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)

ATTACHMENT 3

EVAPORATION POND AREA TEST PIT LOGS

NewFields

Pit ID: TP16-EVP-01

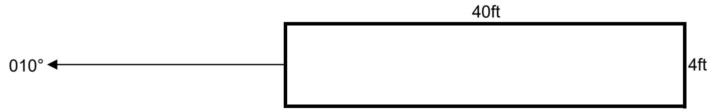
Project: Magnum Evaporation Pond Investigation
Project No.: 475.0093.012
Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah
Date: 11/8/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 196,663 E: 507,235
Elevation: 1,405ft
Total Pit Depth: 5.5ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-2ft		SILT (ML), clayey, with sand, trace fine gravel, rootlets, planar thinly bedded, medium plastic, damp Caliche @ 1.5-1.8ft	Topsoil 0.1ft
1.0				
2.0	LD-2 2-2.5ft	1.8	SAND (SC-SM), silty, clayey, trace gravel, fine grained, poorly graded, medium plastic, brown, moist	Gravels are at lower contact
		2.2 2.4	CLAY (CL), silty, trace fine and coarse sand and gravel, medium plastic, light gray, damp	Clay bed thickness statistics: Average = 0.3ft Maximum = 0.5ft Minimum = 0.0ft 18 measuring points at random across 35ft
			Gradational contact approximately 2ft thick, coarsening down section: silty sand-sand with silt-trace silt	
3.0				
4.0		4.4	SAND (SP), some gravel, trace silt, fine grained, poorly graded, maximum particle size 0.04ft, brown, damp Silt lens @ 5ft	
5.0				Test pit terminated at 5.5ft depth in sand
6.0				
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-EVP-02**

Project: Magnum Evaporation Pond Investigation

Project No.: 475.0093.012

Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah

Date: 11/7/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 195,263 E: 508,139

Elevation: 1,407ft

Total Pit Depth: 6.5ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

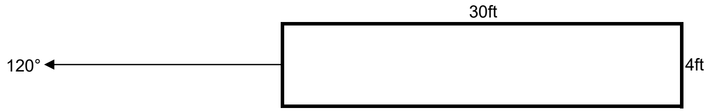
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-1.5ft		SILT (ML), clayey, with sand, very small root casts, medium plastic, brown, damp, some cemented fragments(halite) interbedded with SAND (SC), clayey, trace gravel, fine grained, poorly graded, subrounded to rounded, maximum particle size 0.05ft, medium plastic, brown, damp	Topsoil 0.1ft
1.0				
		1.8	SAND (SC), clayey, trace gravel, maximum particle size 0.09ft, roots in upper 0.2ft of bed, low plastic, light gray, damp	
2.0	LD-2 2-3.5ft			
3.0				
4.0		4.0	SAND (SP-SM), with silt, trace gravel, fine and coarse grained, poorly graded, subangular to subrounded, maximum particle size 0.11ft, brown, moist	
5.0				
			Silt lens @ 5.5ft	
6.0		6.0		
				Test pit terminated at 6.5ft depth in sand
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-EVP-03**

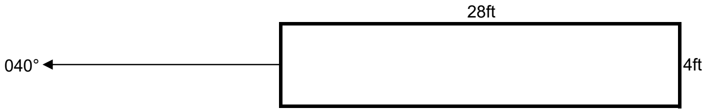
Project: Magnum Evaporation Pond Investigation
Project No.: 475.0093.012
Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah
Date: 11/8/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 196,544 E: 510,702
Elevation: 1,409ft
Total Pit Depth: 5.8ft
Shoring (if used): None
Surface Condtions: Gently sloping southeast, sparse vegetation
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-1.4ft		SILT (ML), clayey, some sand, rootlets and rootcasts, light gray clay laminae, medium plastic, light brown, damp	
1.0				
	LD-2 1.4-3.1ft	1.4	CLAY (CL), silty, medium plastic, light gray, damp	
		1.6	SAND (SM), silty, fine grained, poorly graded, brown, moist Coarse sand lens @ 2ft Clay lens @ 2.1ft Clay laminae @ 2.7-2.8ft	
2.0				
		2.8	SAND (SP), some silt, fine to coarse grained, moderately graded, subrounded to rounded, cross bedded ripples symmetrical with a period of approximately 1ft, apparent flow direction 060°, brown, moist	
3.0	LD-3 3.1-4.3ft			
		3.2	SILT (ML), clayey, trace fine sand, medium plastic, light brown, damp	
4.0				
		4.2	SAND (SP), some gravel, trace silt, planar (thin) and cross bedded (thick), thin to thickly cross bedded, roots, fine grained, poorly graded, maximum particle size 0.06ft, brown, moist	
5.0				
		5.8		Test pit terminated at 5.8ft depth in sand
6.0				
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-EVP-04**

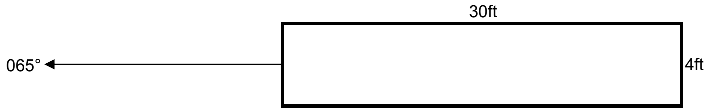
Project: Magnum Evaporation Pond Investigation
Project No.: 475.0093.012
Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah
Date: 11/8/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 195,224 E: 511,882
Elevation: 1,409ft
Total Pit Depth: 4.8ft
Shoring (if used): None
Surface Condtions: Flat, very sparse vegetation
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-0.8ft		SILT (ML), clayey, trace fine sand, planar, thinly bedded, rootlets, some caliche, light brown, damp	0.08ft clay crust on surface
		0.8	CLAY (CL), some sand, medium to high plastic, light gray, moist	
1.0	LD-2 1-4ft			
			Trace silt, high plastic from 1.8ft	
2.0				
			Silt lens @ 2.4ft	
3.0				
4.0				
			Silty sand lens @ 4.2ft	
		4.8		Test pit terminated at 4.8ft depth in clay
5.0				
6.0				
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-EVP-05**

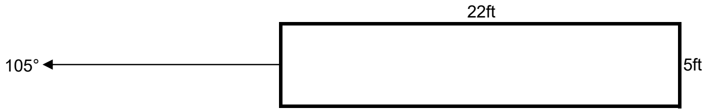
Project: Magnum Evaporation Pond Investigation
Project No.: 475.0093.012
Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah
Date: 11/8/2016
Equipment: CAT 320 Excavator
Contractor: Westside Grading
Logged by: J. Roberts
Local Grid Coordinates: N: 196,481 E: 513,784
Elevation: 1,419ft
Total Pit Depth: 3.2ft
Shoring (if used): None
Surface Condtions: Flat, sparse vegetation
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-1.4ft		SILT (ML), sandy, some clay, rootlets, planar, thinly bedded, non plastic, light brown, damp Interbedded clays 0.6-1.0ft	
1.0	LD-2 1.4-1.8ft	1.4	CLAY (CL), silty, with sand, trace fine gravel, medium plastic, light gray, damp	Clay bed thickness statistics: Average = 0.4ft Maximum = 0.6ft Minimum = 0.1ft 14 measuring points at random across 16 ft of south pit wall
2.0	SD-1 2.5-3ft	1.8	SAND (SP), some to trace fine gravel and silt, fine and coarse grained, with limonite staining, poorly graded, subangular to subrounded, max particle size 0.08ft, orangish brown, moist Trace gravel, fine grained, no limonite staining, planar, thickly bedded, brown, moist from 2.1ft	
3.0		3.2		Test pit terminated at 3.2ft depth in sand
4.0				
5.0				
6.0				
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



NewFields

Pit ID: **TP16-EVP-06**

Project: Magnum Evaporation Pond Investigation

Project No.: 475.0093.012

Project Location: South of Existing Sawtooth Brine Pond 2; Delta, Utah

Date: 11/8/2016

Equipment: CAT 320 Excavator

Contractor: Westside Grading

Logged by: J. Roberts

Local Grid Coordinates: N: 195,212 E: 515,280

Elevation: 1,420ft

Total Pit Depth: 5.0ft

Shoring (if used): None

Surface Condtions: Flat, sparse vegetation

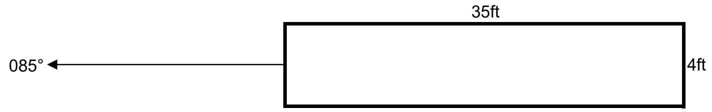
Backfilled: No

Depth (ft)	Sample (depth & type)	Pit Wall Profile	Description	Additional Notes
	LD-1 0-3ft		SILT (ML), clayey, trace fine sand, medium plastic, light brown, hematite staining at 0.8ft	
		0.8	CLAY (CL), silty, medium plastic, brown, damp Halite precipitate 1-1.9ft	
1.0				
2.0				
		2.6	Gradational contact: decrease silt fraction 2.6-3.5ft	
3.0	LD-2 3-5ft			
		3.6	CLAY (CH), trace silt and sand, halite precipitate in shrinkage cracks, high plastic, brown, moist	
4.0				
5.0		5.0		Test pit terminated at 5.0ft depth in clay
6.0				
7.0				
8.0				

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and azimuth)



ATTACHMENT 4

TABLE 1 – 2016 LABORATORY TEST RESULTS SUMMARY

TABLE 1 - 2016 LAB TEST RESULTS SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	
TP-16-01	5-6.5	Poorly Graded sand with silt	SP-SM		7.7	0.1	91.7	8.2	NP	NP	NP																
TP-16-04	0-1	Silty sand	SM		6.3	0	52.1	47.9																			
TP-16-06	1-2	Lean clay	CL		21.6	0	6.9	93.1	22	44	22																
TP-16-08	1.5-2.5	Clayey SAND	SC		6.3	1.2	65.7	33.1	14	24	10																
TP-16-08	8.5-9	Poorly graded sand	SP		1.4	1.7	96.7	1.5	NP	NP	NP																
TP-16-11	7-8	Lean Clay	CL		19.2	2.3	13	84.7	14	33	19			115.8	14.4												2.4E-07
TP-16-12	5-6	Silt	ML		15.3	0.1	12.7	87.2						111.3	15.9												
TP-16-15	6.5-7	Lean Clay	CL		24.4	1.3	30.9	67.8	19	44	25			107.3	18.6					30.0	226.0						
TP-16-16	5-6	Silty Sand	SM		6.9	2.6	81.4	16.0	NP	NP	NP																
TP-16-18	5-6	Lean Clay with sand	CL		19.0	0.1	17.5	82.4	14	35	21																
TP-16-19	0.5-2				15.1																						
TP-16-19	3-5	Sandy Lean CLAY	CL		11.2	0.5	34.3	65.2	14	30	16																
TP-16-19	11-12				3.3																						
TP-16-21	6-7	Lean Clay	CL		22.4	0	2.1	97.9	20	39	19			113.6	14.6					28.3	339.0						
TP-16-25	5-6	Lean Clay	CL		22.3	0	4.4	95.6	16	42	26																
TP-16-27	3-4	Sandy Lean Clay	CL		10.8	2.2	39.2	58.6	12	25	13																
TP-16-27	7-8	Lean Clay	CL		23.3	0	15.4	84.6	14	32	18																
TP-16-29	5-6	Silty Sand	SC		14.1	1.1	54	44.9	13	25	12																
TP-16-30	2-3	Clayey Sand	SC		10.5	0.0	60.6	39.4	13	25	12			122.7	12.1					36.4	1112.0						
TP-16-33	5-6	Silty Sand	SM		8.6	1.9	79.7	18.4	NP	NP	NP																
TP-16-34	7-8	Poorly Graded SAND with Silt	SP-SM		2.8	2.6	91.7	5.7	NP	NP	NP																
TP-16-35	1-2	Lean Clay with sand	CL		10.2	0.5	27.6	71.9	13	25	16																
TP-16-36	16-17	Lean clay	CL		23.5	0.0	3.5	96.5	17	27	10																
TP-16-38	3-4	Fat clay with sand	CH		17.9	0.2	15.8	84	21	64	43																
TP-16-39	1-2	Clayey sand	SC		6.4	0.8	64.3	34.9	14	29	15																
TP-16-40	5.5-7	Lean Clay	CL		22.5	0	2	98	16	31	15																
TP-16-41	9-10.5	Lean Clay	CL		19.8	0.0	9.8	90.2	16	44	28																
TP-16-42	1-2	Sandy Lean CLAY	CL		8.3	0.2	46	53.8	18	43	25																
TP-16-42	11-12	Silty sand	SM		8.5	0	62.8	37.2	NP	NP	NP																
TP-16-44	6-7	Silty sand	SM		8.4	0.0	55.1	44.9	NP	NP	NP																
TP-16-45	2-4.5	Clayey SAND	SC		7.4	1.3	50.1	48.6	14	22	8																
TP-16-45	6-7	Poorly graded sand	SP		2.7	6.9	90.0	3.1	19	29	10																
TP-16-48	9.5-10.5	Lean Clay with sand	CL		21.5	0.9	23.2	75.9	14	37	23																
TP-16-48	17-18	Lean clay with sand	CL		18.3	0.5	23	76.5	13	23	10																
TP-16-49	3.5-5	Sandy Silt	ML		11.8	0.6	39.9	59.5	NP	NP	NP																
TP-16-51	2-4	Silt with sand	ML		13.0	0.1	15.7	84.2																			
TP-16-51	11-12	Poorly graded sand	SP		2.3	1.5	96.9	1.6	NP	NP	NP																
TP-16-54	12-13	Lean clay	CL		24.4	0	1.3	98.7	16	47	31			113.6	15					30.7	241.0						

TABLE 1 - 2016 LAB TEST RESULTS SUMMARY

SAMPLE LOCATION		UNIFIED SOILS CLASSIFICATION (USCS)	USCS ABBREVIATION	NATURAL DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	GRADATION (%)			ATTERBERG LIMITS			PROCTOR				TRIAXIAL SHEAR (CU)				DIRECT SHEAR				SWELL-COLLAPSE POTENTIAL			PERMEABILITY (cm/s)
Sample ID	Depth (ft)					Gravel >#4	Sand	Silt & Clay <#200	Plastic Limit	Liquid Limit	Plasticity Index	Standard Maximum Dry Density (pcf)	SMDD Optimum Moisture Content (%)	Modified Maximum Dry Density (pcf)	MMDD Optimum Moisture Content (%)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Total Stress Friction Angle (deg)	Total Stress Cohesion (lb/ft2)	Effective Friction Angle (Peak) (deg)	Cohesion (Peak) (lb/ft2)	Effective Friction Angle (Residual) (deg)	Cohesion (Residual) (lb/ft2)	Swell (%)	Collapse (%)	Pressure (psf)	
TP-16-55	2-3				14.7																						
TP-16-57	17	Poorly graded sand	SP		2.9	3.1	94.1	2.8	NP	NP	NP																
TP-16-59	3-4	Silty sand	SM		9.0	0.0	65.3	34.7																			
TP16-EVP-01	2-2.5	Silty Clayey sand	SC-SM		7.7	0.7	57.1	42.2	13	18	5																
TP16-EVP-02	2-3.5	Clayey sand	SC		14.6	1.7	63.4	34.9	19	28	9																
TP16-EVP-03	1.4-3.1	Silty sand	SM		7.3	0.0	63.0	26.7	NP	NP	NP																
TP16-EVP-04	1-4	Lean clay	CL		30.8	0.0	14.4	85.6	16	47	31			115	16.1												6.2E-08
TP16-EVP-05	1.4-1.8	Lean clay with sand	CL		8.9	2.8	26.4	70.8	17	27	10																
TP16-EVP-06	3-5	Fat clay	CH		30.0	0.0	1.7	98.3	24	54	30																

Notes:

NP Non Plastic

USCS classifications based on field descriptions in absense of gradation lab test data

ATTACHMENT 5

PHASE I EXPANSION AREA LABORATORY TEST RESULTS

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

Client:	Magnum NGLS Solution Mining	**Location:**	
Project Title:	Magnum Future Brine Pond Expansion	**Elevation:**	
Project Number:	475.0093.011	**Test Start Date:**	
Project Engineer:	John Roberts	**Tested By:**	
Field Sample ID:	16-283	**Checked By:**	

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.	16-283-01	16-283-02	16-283-03	16-283-04	16-283-05
Location	TP16-01	TP16-04	TP16-06	TP16-08	TP16-08
Depth	5-6'	0-1'	1-2'	8.5-9'	1.5-2.5'
Soil Description					
(USCS)					
Trial No.	**1**	**2**	**3**	**4**	**5**
Tare No.					
Tare + Wet Soil **A**	741	521.3	912.3	602.9	1092
Tare + Dry Soil **B**	706.5	501.8	803.6	597.3	1038.6
Tare **C**	261.3	190.9	300	188.7	189.2
Wt. of Water **D= A-B**	34.5	19.5	108.7	5.6	53.4
Dry Soil, Ws **E= B-C**	445.2	310.9	503.6	408.6	849.4
Moisture Content, (%) **(D/E) x100**	7.7	6.3	21.6	1.4	6.3

Sample No.	16-283-06	16-283-07	16-283-08	16-283-09	16-283-10
Location	TP16-11	TP16-12	TP16-15	TP16-16	TP16-18
Depth	7-8'	5-6'	6.5-7'	5-6'	5-6'
Soil Description					
(USCS)					
Trial No.	**6**	**7**	**8**	**9**	**10**
Tare No.					
Tare + Wet Soil **A**	868	792.7	897.9	769.9	1188.8
Tare + Dry Soil **B**	757.9	717.3	746.2	731.3	1044.9
Tare **C**	184.5	223.1	125.7	173.1	285.9
Wt. of Water **D= A-B**	110.1	75.4	151.7	38.6	143.9
Dry Soil, Ws **E= B-C**	573.4	494.2	620.5	558.2	759
Moisture Content, (%) **(D/E) x100**	19.2	15.3	24.4	6.9	19.0

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Magnum NGLS Solution Mining	**Location:**	
Project Title:	Magnum Future Brine Pond Expansion	**Elevation:**	
Project Number:	475.0093.011	**Test Start Date:**	
Project Engineer:	John Roberts	**Tested By:**	
Field Sample ID:	16-283	**Checked By:**	

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		16-283-11	16-283-12	16-283-13	16-283-14	16-283-15
Location		TP16-19	TP16-19	TP16-19	TP16-21	TP16-25
Depth		0.5-2'	3-5'	11-12'	6-7'	5-6'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	1067.5	723.3	1004.9	757.2	468.1
Tare + Dry Soil	**B**	963	662.4	978.6	641.5	404.9
Tare	**C**	268.7	120.7	192.7	124.2	121.1
Wt. of Water	**D= A-B**	104.5	60.9	26.3	115.7	63.2
Dry Soil, Ws	**E= B-C**	694.3	541.7	785.9	517.3	283.8
Moisture Content, (%)	**(D/E) x100**	15.1	11.2	3.3	22.4	22.3

Sample No.		16-283-16	16-283-17	16-283-18	16-283-19	16283-20
Location		TP16-27	TP16-27	TP16-29	TP16-30	TP16-33
Depth		3-4'	7-8'	5-6'	2-3'	5-6'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	535.1	854.9	481.5	897.3	526.6
Tare + Dry Soil	**B**	501.7	744.7	437.3	829.8	499.5
Tare	**C**	193.4	271	124.3	186.1	183.7
Wt. of Water	**D= A-B**	33.4	110.2	44.2	67.5	27.1
Dry Soil, Ws	**E= B-C**	308.3	473.7	313	643.7	315.8
Moisture Content, (%)	**(D/E) x100**	10.8	23.3	14.1	10.5	8.6

Remarks:

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client:	Magnum NGLS Solution Mining	**Location:**	
Project Title:	Magnum Future Brine Pond Expansion	**Elevation:**	
Project Number:	475.0093.011	**Test Start Date:**	
Project Engineer:	John Roberts	**Tested By:**	
Field Sample ID:	16-283	**Checked By:**	

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		16-283-21	16-283-22	16-283-23	16-283-24	16-283-25
Location		TP16-34	TP16-35	TP16-36	TP16-38	TP16-39
Depth		7-8'	1-2'	16-17'	3-4'	1-2'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	577.5	494.3	603.9	706.8	882.5
Tare + Dry Soil	**B**	567.6	459.9	539.7	628.8	845.6
Tare	**C**	216.7	123.3	267	192.6	266.8
Wt. of Water	**D= A-B**	9.9	34.4	64.2	78	36.9
Dry Soil, Ws	**E= B-C**	350.9	336.6	272.7	436.2	578.8
Moisture Content, (%)	**(D/E) x100**	2.8	10.2	23.5	17.9	6.4

Sample No.		16-283-26	16-283-27	16-283-28	16-283-29	16-283-30
Location		TP16-40	TP16-41	TP16-42	TP16-42	TP16-44
Depth		5.5-7'	9-10.5'	1-2'	11-12'	6-7'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	541.1	573	648.7	877.8	707
Tare + Dry Soil	**B**	463.9	518.2	611.7	830.1	673.1
Tare	**C**	120.3	241.2	164.3	268.2	267.5
Wt. of Water	**D= A-B**	77.2	54.8	37	47.7	33.9
Dry Soil, Ws	**E= B-C**	343.6	277	447.4	561.9	405.6
Moisture Content, (%)	**(D/E) x100**	22.5	19.8	8.3	8.5	8.4

Remarks:

Client:	Magnum NGLS Solution Mining	**Location:**	
Project Title:	Magnum Future Brine Pond Expansion	**Elevation:**	
Project Number:	475.0093.011	**Test Start Date:**	
Project Engineer:	John Roberts	**Tested By:**	
Field Sample ID:	16-283	**Checked By:**	

Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		16-283-31	16-283-32	16-283-33	16-283-34	16-283-35
Location		TP16-45	TP16-45	TP16-48	TP16-48	TP16-49
Depth		2-4.54'	6-7'	9.5-10.5'	17-18'	3.5-5'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	729.8	977.2	1046	398.7	647.1
Tare + Dry Soil	**B**	692.9	956.6	894.6	356.3	606
Tare	**C**	191	194.7	188.8	124.1	258.9
Wt. of Water	**D= A-B**	36.9	20.6	151.4	42.4	41.1
Dry Soil, Ws	**E= B-C**	501.9	761.9	705.8	232.2	347.1
Moisture Content, (%)	**(D/E) x100**	7.4	2.7	21.5	18.3	11.8

Sample No.		16-283-36	16-283-37	16-283-38	16-283-39	16-283-40
Location		TP16-51	TP16-51	TP16-54	TP16-55	TP16-57
Depth		2-4'	11-12'	12-13'	2-3'	17'
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	653.1	781.9	803.7	658.1	923.4
Tare + Dry Soil	**B**	598.8	767.3	682.3	597.8	902.9
Tare	**C**	182.5	122.4	185	186.3	190.2
Wt. of Water	**D= A-B**	54.3	14.6	121.4	60.3	20.5
Dry Soil, Ws	**E= B-C**	416.3	644.9	497.3	411.5	712.7
Moisture Content, (%)	**(D/E) x100**	13.0	2.3	24.4	14.7	2.9

Remarks:

Client:	Magnum NGLS Solution Mining	**Location:**	
Project Title:	Magnum Future Brine Pond Expansion	**Elevation:**	
Project Number:	475.0093.011	**Test Start Date:**	
Project Engineer:	John Roberts	**Tested By:**	
Field Sample ID:	16-283	**Checked By:**	

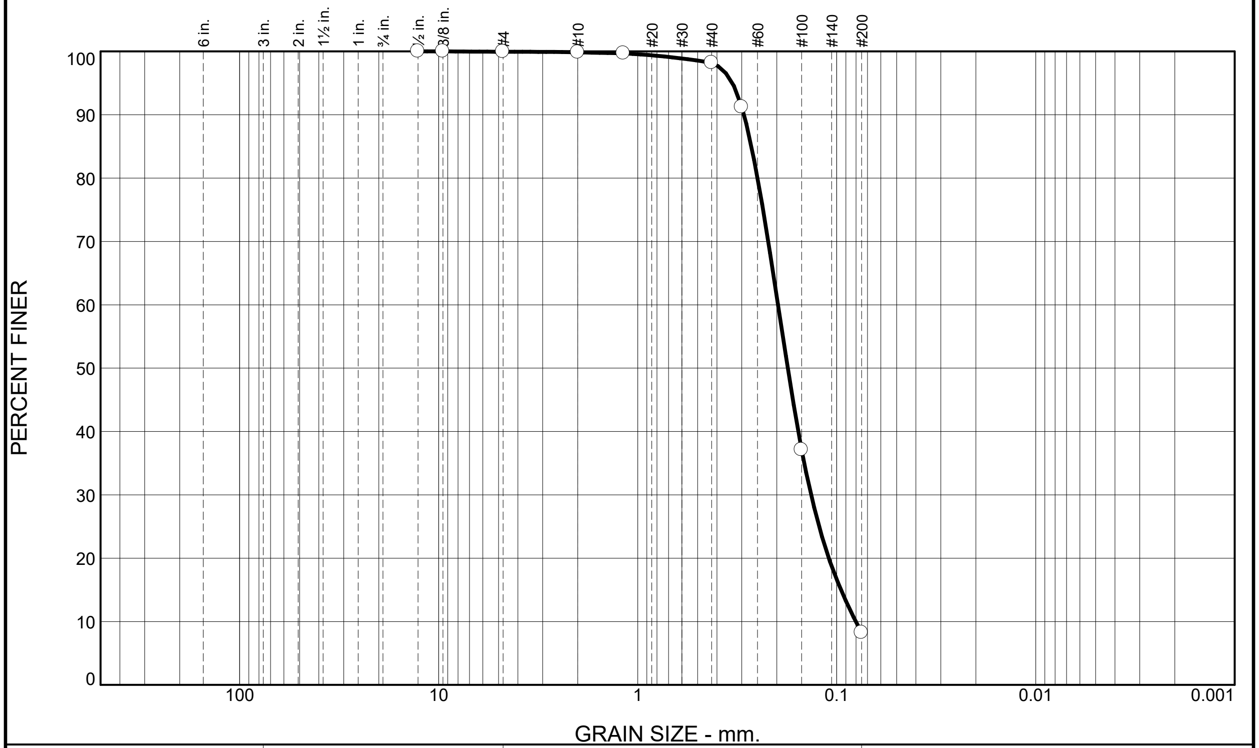
Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		16-283-41				
Location		TP16-59				
Depth		3-4'				
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	528.6				
Tare + Dry Soil	**B**	500.7				
Tare	**C**	190.6				
Wt. of Water	**D= A-B**	27.9				
Dry Soil, Ws	**E= B-C**	310.1				
Moisture Content, (%)	**(D/E) x100**	9.0				

Sample No.						
Location						
Depth						
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**					
Tare + Dry Soil	**B**					
Tare	**C**					
Wt. of Water	**D= A-B**					
Dry Soil, Ws	**E= B-C**					
Moisture Content, (%)	**(D/E) x100**					

Remarks:

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	1.6	90.0	8.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	99.9		
#10	99.8		
#16	99.7		
#40	98.2		
#50	91.2		
#100	37.1		
#200	8.2		

* (no specification provided)

Material Description

Brown poorly graded sand with silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.2924 D_{85}= 0.2683 D_{60}= 0.1972
D_{50}= 0.1762 D_{30}= 0.1345 D_{15}= 0.0952
D_{10}= 0.0801 C_u= 2.46 C_c= 1.15

Classification

USCS= SP-SM AASHTO= A-3

Remarks

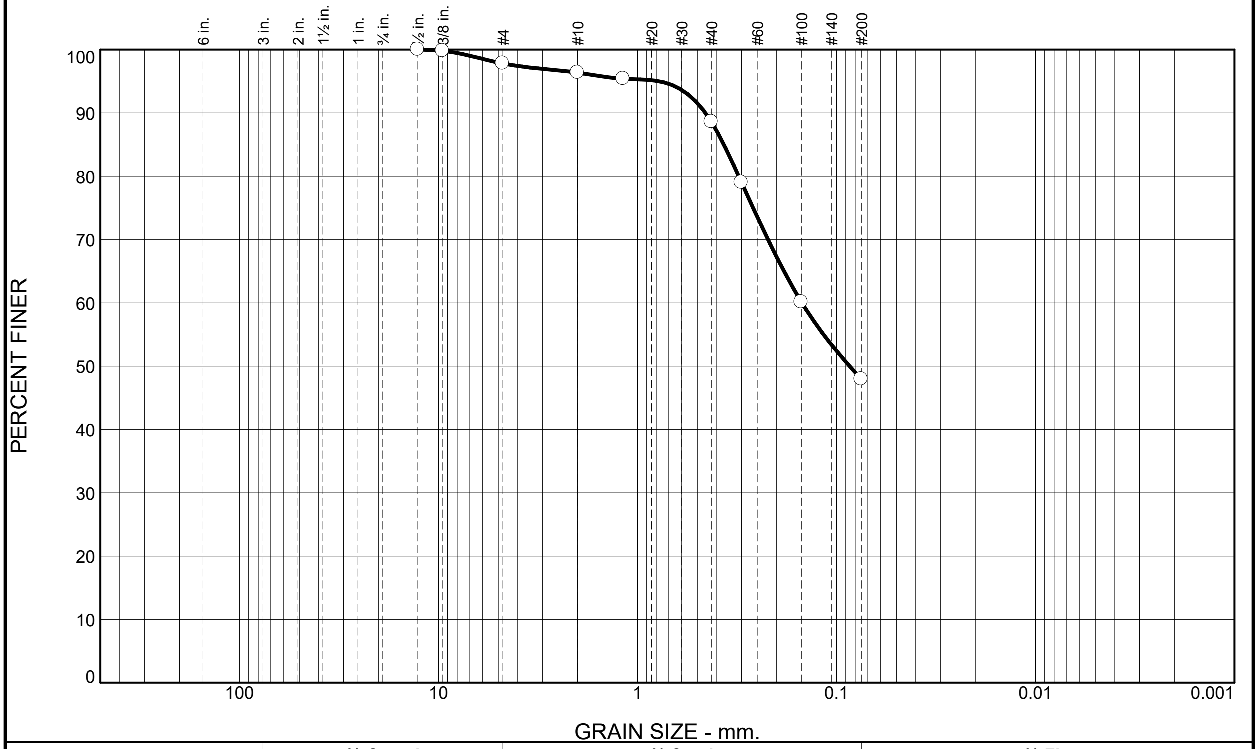
Location: TP16-01
Sample Number: 16-283-01 **Depth:** 5-6' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-01

Tested By: AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.2	1.4	7.8	40.7	47.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375"	99.8		
#4	97.8		
#10	96.4		
#16	95.4		
#40	88.6		
#50	79.0		
#100	60.1		
#200	47.9		

* (no specification provided)

Material Description

Grey silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4558 D_{85}= 0.3682 D_{60}= 0.1493
D_{50}= 0.0858 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

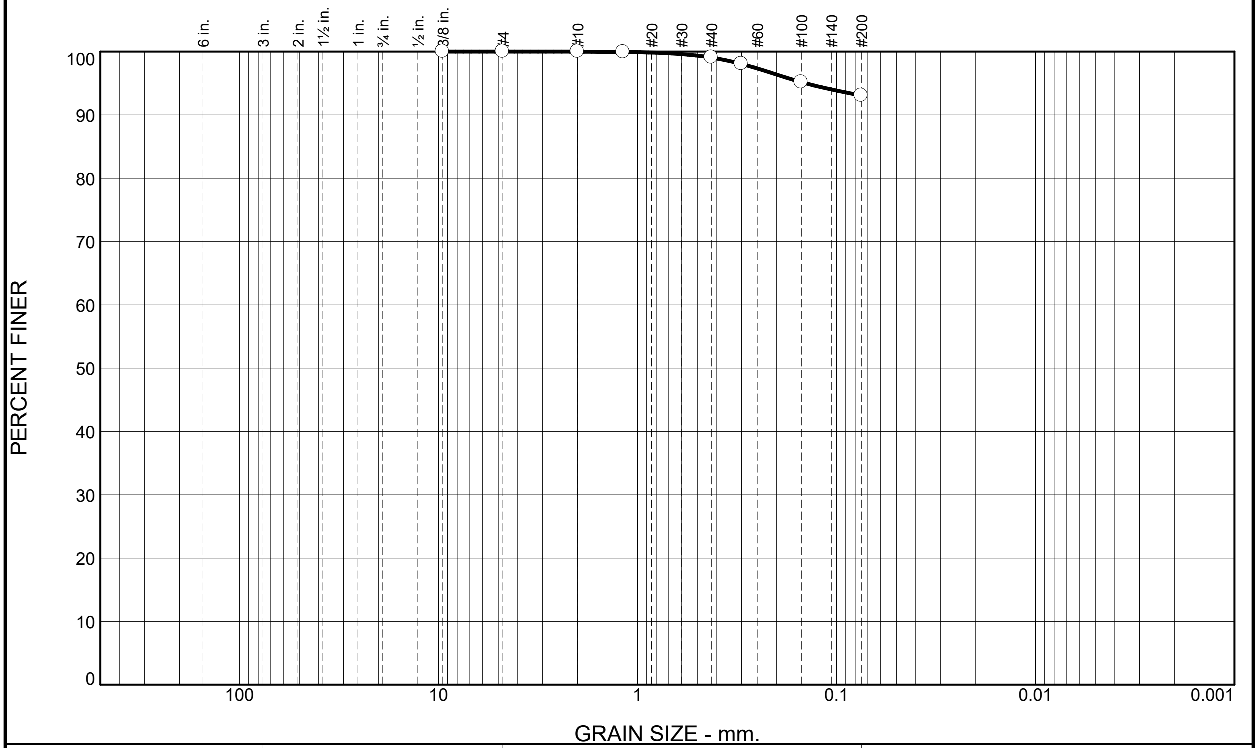
Location: TP16-04
Sample Number: 16-283-02 **Depth:** 0-1' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-02

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.9	6.0	93.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	99.9		
#40	99.1		
#50	98.1		
#100	95.2		
#200	93.1		

* (no specification provided)

Material Description

Tan lean clay

Atterberg Limits

PL= 22 LL= 44 PI= 22

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(22)

Remarks

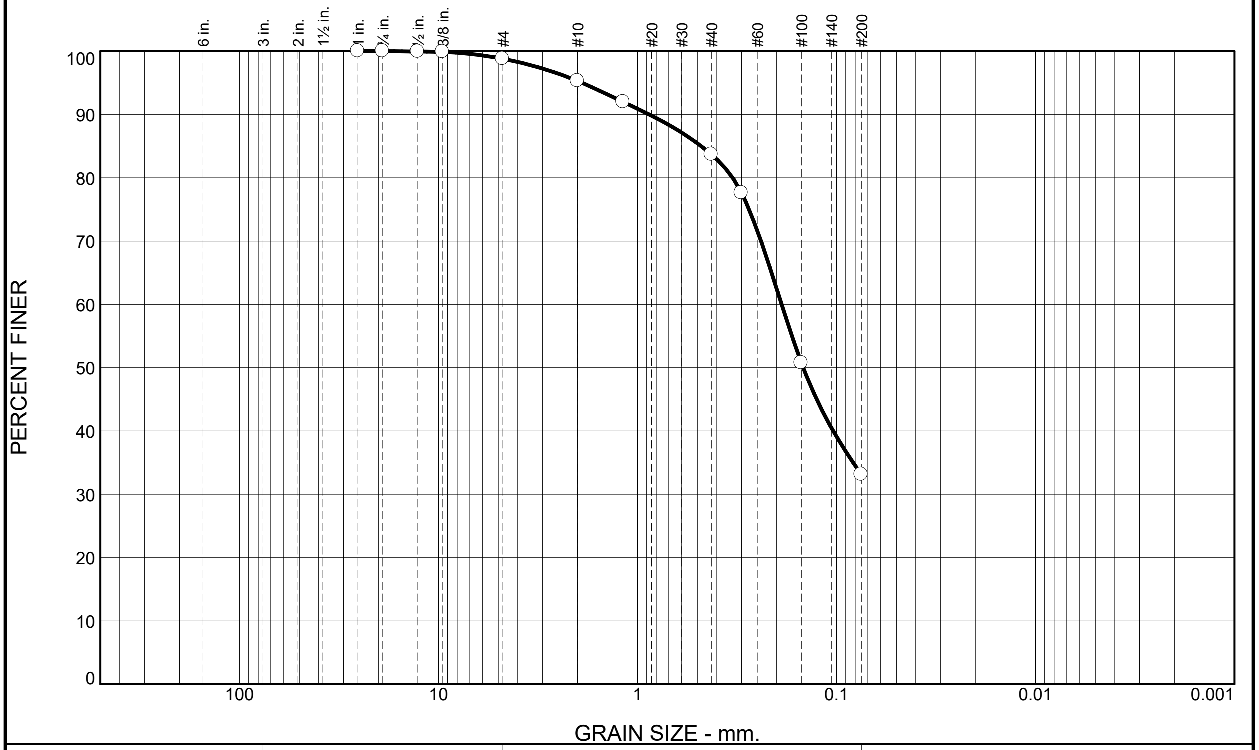
Location: TP16-06
Sample Number: 16-283-03 **Depth:** 1-2' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-03

Tested By: TS **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.2	3.5	11.6	50.6	33.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	99.9		
.375	99.9		
#4	98.8		
#10	95.3		
#16	92.0		
#40	83.7		
#50	77.6		
#100	50.7		
#200	33.1		

* (no specification provided)

Material Description

Light Brown clayey sand

Atterberg Limits

PL= 14 LL= 24 PI= 10

Coefficients

D_{90}= 0.8750 D_{85}= 0.4793 D_{60}= 0.1887
D_{50}= 0.1469 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

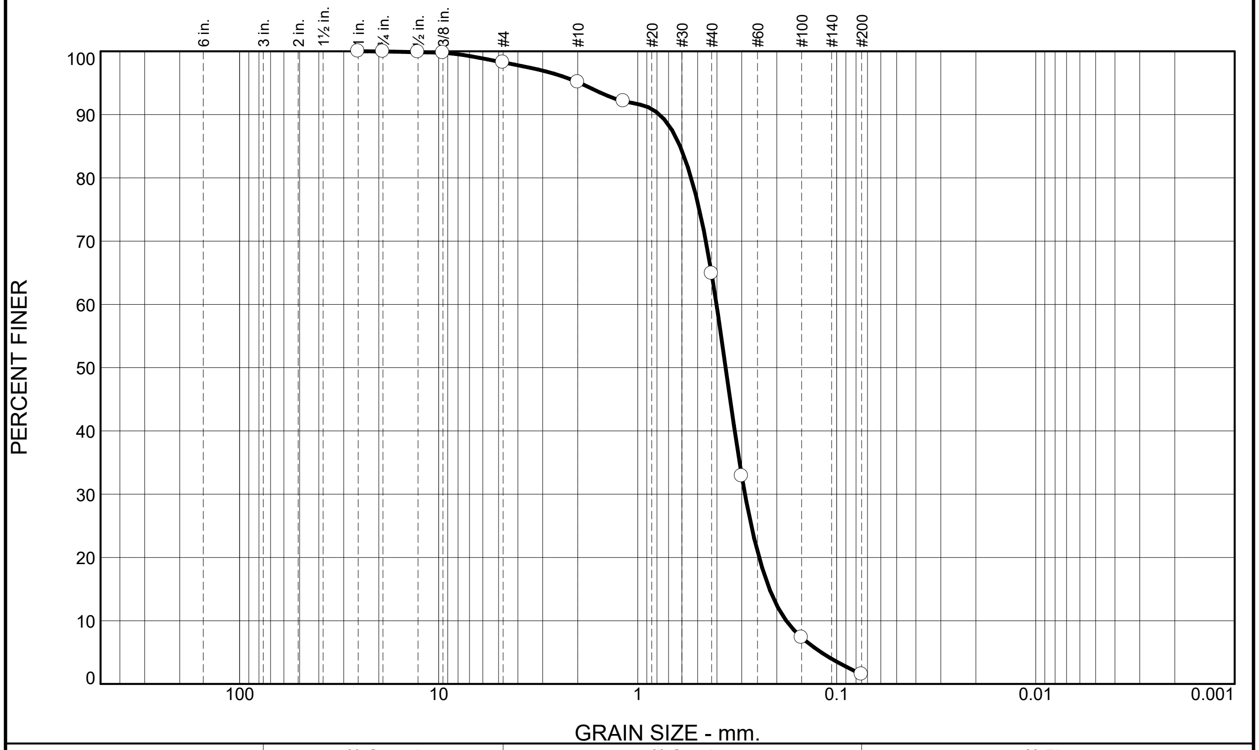
Location: TP16-08
Sample Number: 16-283-05 **Depth:** 1.5-2.5' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-05

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	3.2	30.2	63.4	1.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	99.9		
.375	99.8		
#4	98.3		
#10	95.1		
#16	92.1		
#40	64.9		
#50	32.9		
#100	7.4		
#200	1.5		

* (no specification provided)

Material Description

Brown poorly graded sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.7759 D_{85}= 0.6125 D_{60}= 0.4017
D_{50}= 0.3615 D_{30}= 0.2891 D_{15}= 0.2176
D_{10}= 0.1795 C_u= 2.24 C_c= 1.16

Classification

USCS= SP AASHTO= A-3

Remarks

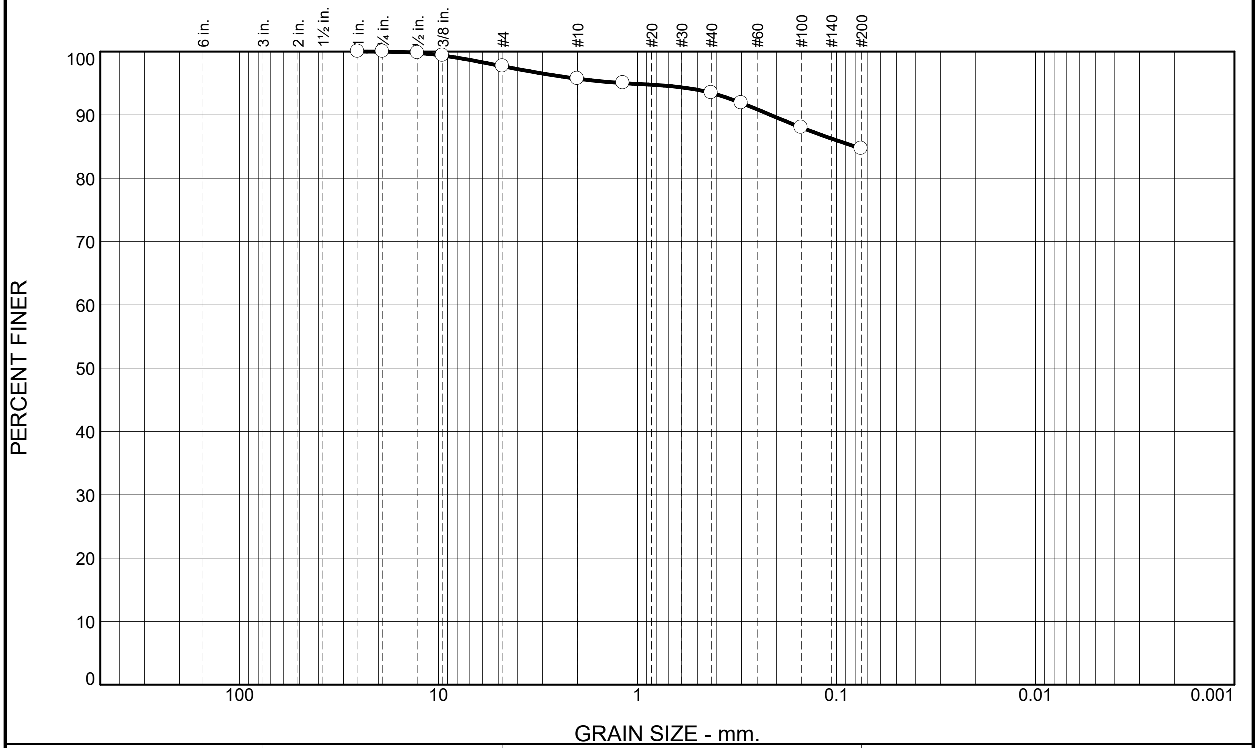
Location: TP16-08
Sample Number: 16-283-04 **Depth:** 8.5-9' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-04

Tested By: AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.3	2.0	2.2	8.8	84.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	99.8		
.375	99.4		
#4	97.7		
#10	95.7		
#16	95.0		
#40	93.5		
#50	91.9		
#100	88.0		
#200	84.7		

* (no specification provided)

Material Description

Brown lean clay

Atterberg Limits

PL= 14 LL= 33 PI= 19

Coefficients

D_{90}= 0.2144 D_{85}= 0.0803 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(15)

Remarks

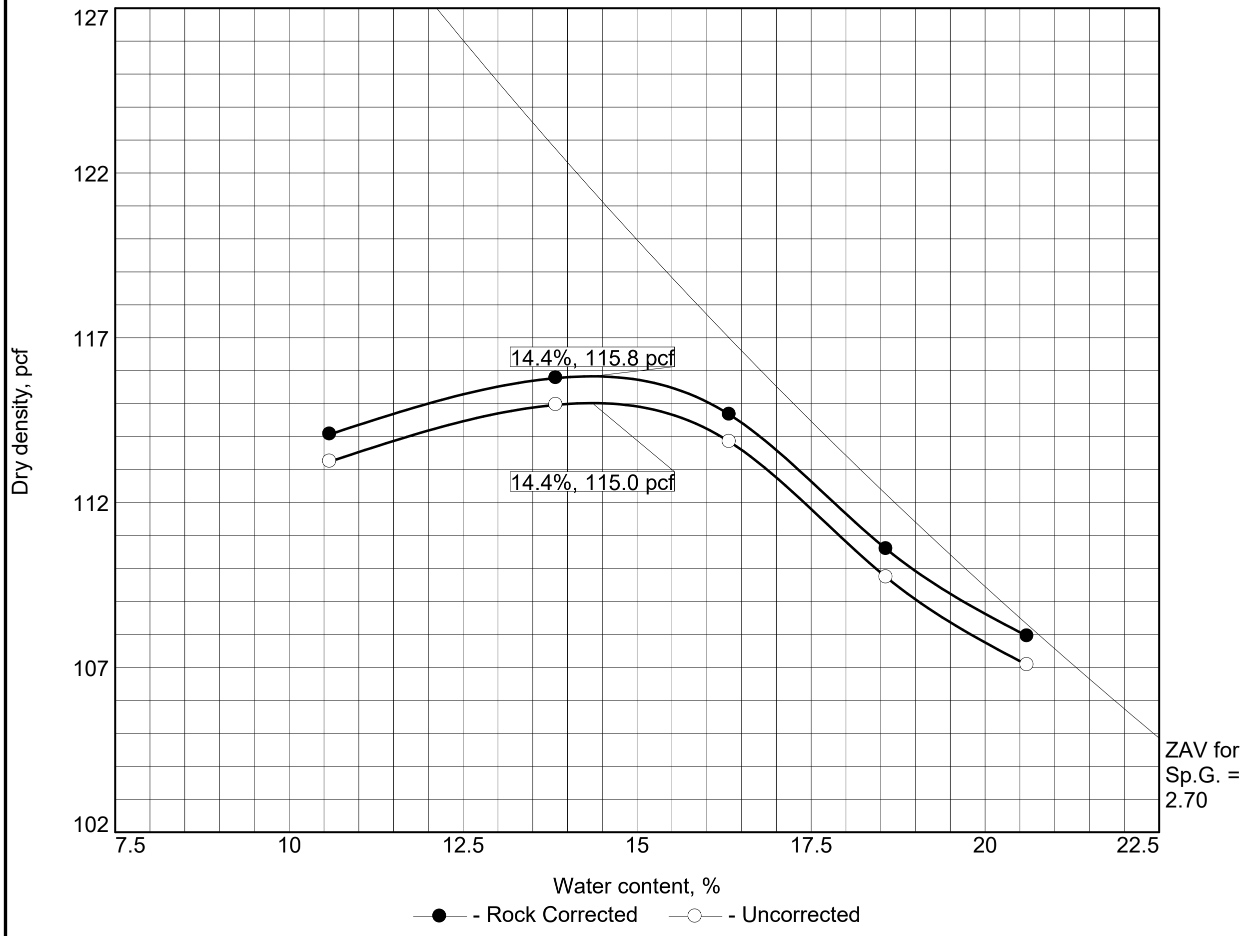
Location: TP16-11
Sample Number: 16-283-06 **Depth:** 7-8' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-06

Tested By: TS **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
7-8'	CL	A-6(15)		2.65	33	19	2.3	84.7

ROCK CORRECTED TEST RESULTS	UNCORRECTED
Maximum dry density = 115.8 pcf	115.0 pcf
Optimum moisture = 14.4 %	14.4 %

MATERIAL DESCRIPTION

Brown lean clay

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

○**Location:** TP16-11 **Sample Number:** 16-283-06

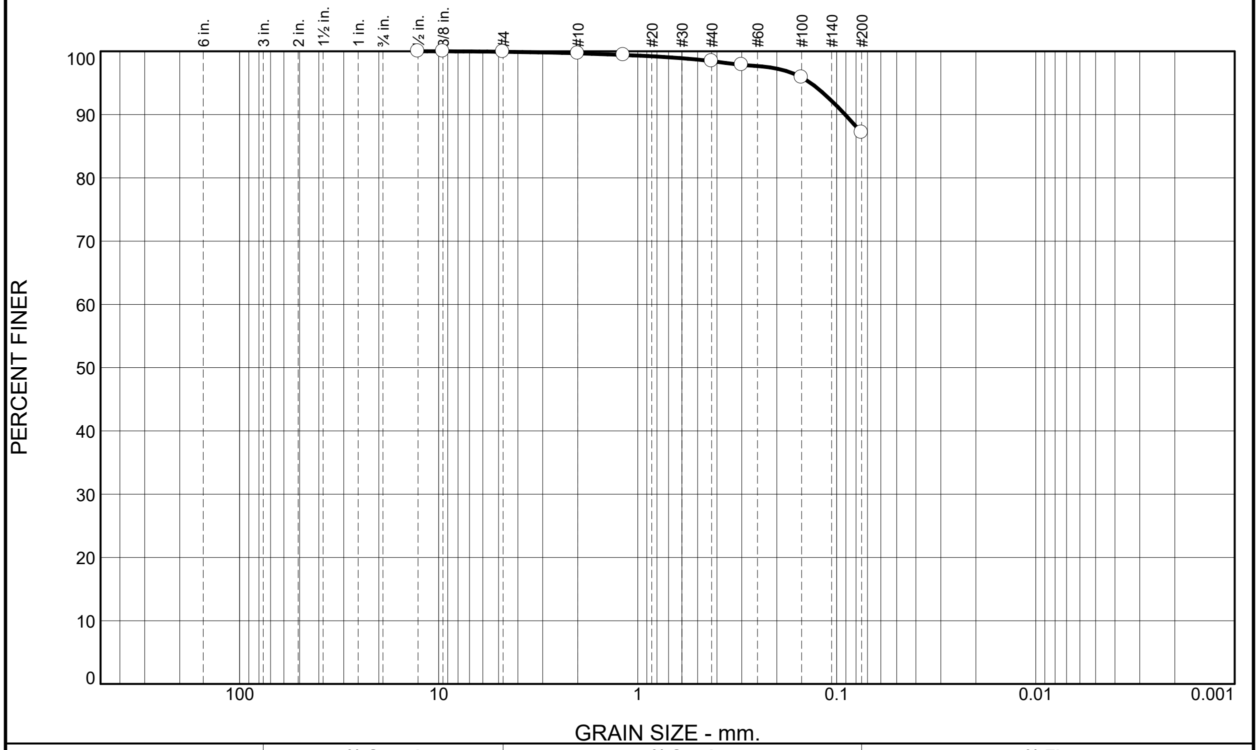
NewFields

Remarks:

Figure 16-283-06

Tested By: JG **Checked By:** TW

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.2	1.3	11.2	87.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	99.9		
#10	99.7		
#16	99.4		
#40	98.4		
#50	97.9		
#100	95.9		
#200	87.2		

* (no specification provided)

Material Description

Tan silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.0907 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Location: TP16-12
Sample Number: 16-283-07 **Depth:** 5-6' **Date:** 1/9/17

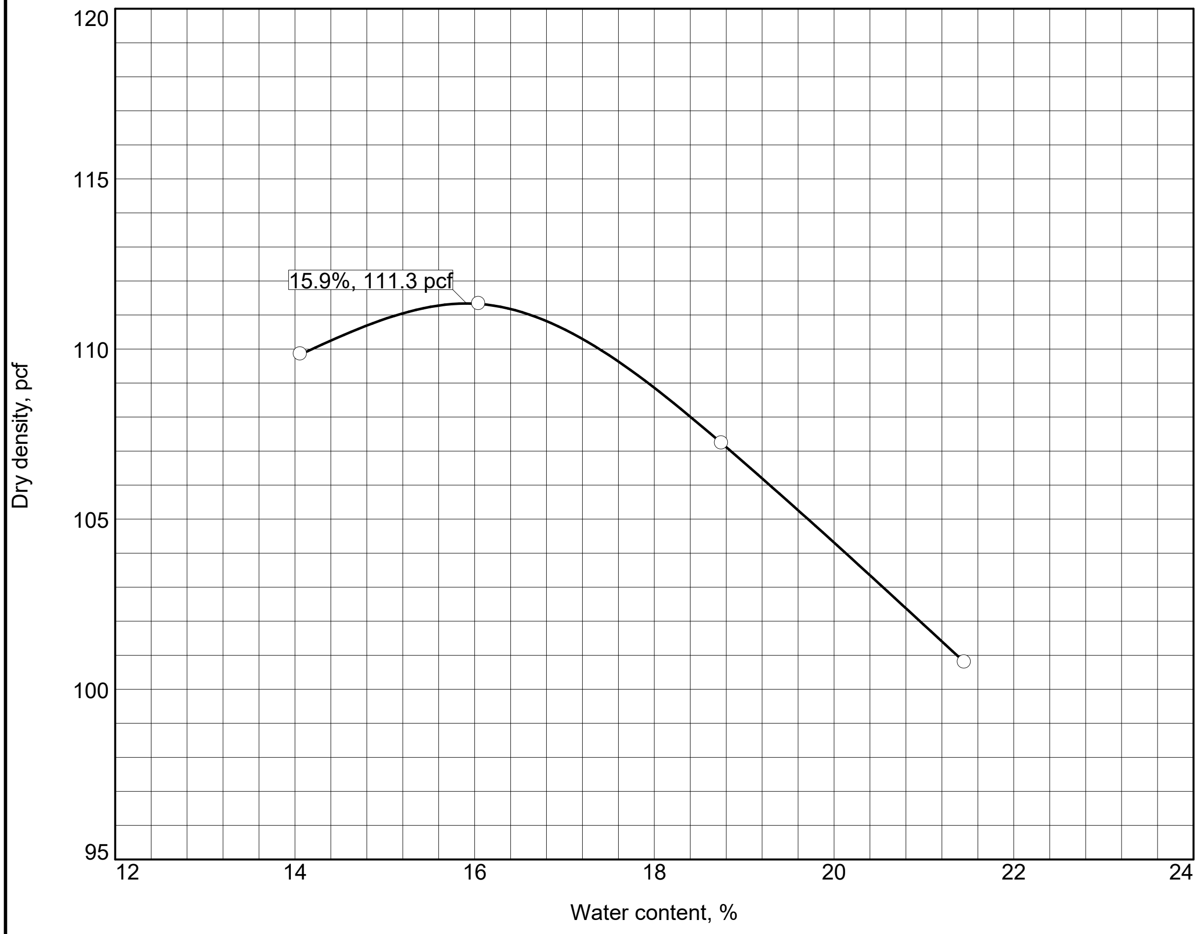
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-07

Tested By: AH **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
5-6'	ML	A-4(0)			NP	NP	0.0	87.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 111.3 pcf Optimum moisture = 15.9 %	Tan silt

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

○**Location:** TP16-12 **Sample Number:** 16-283-07

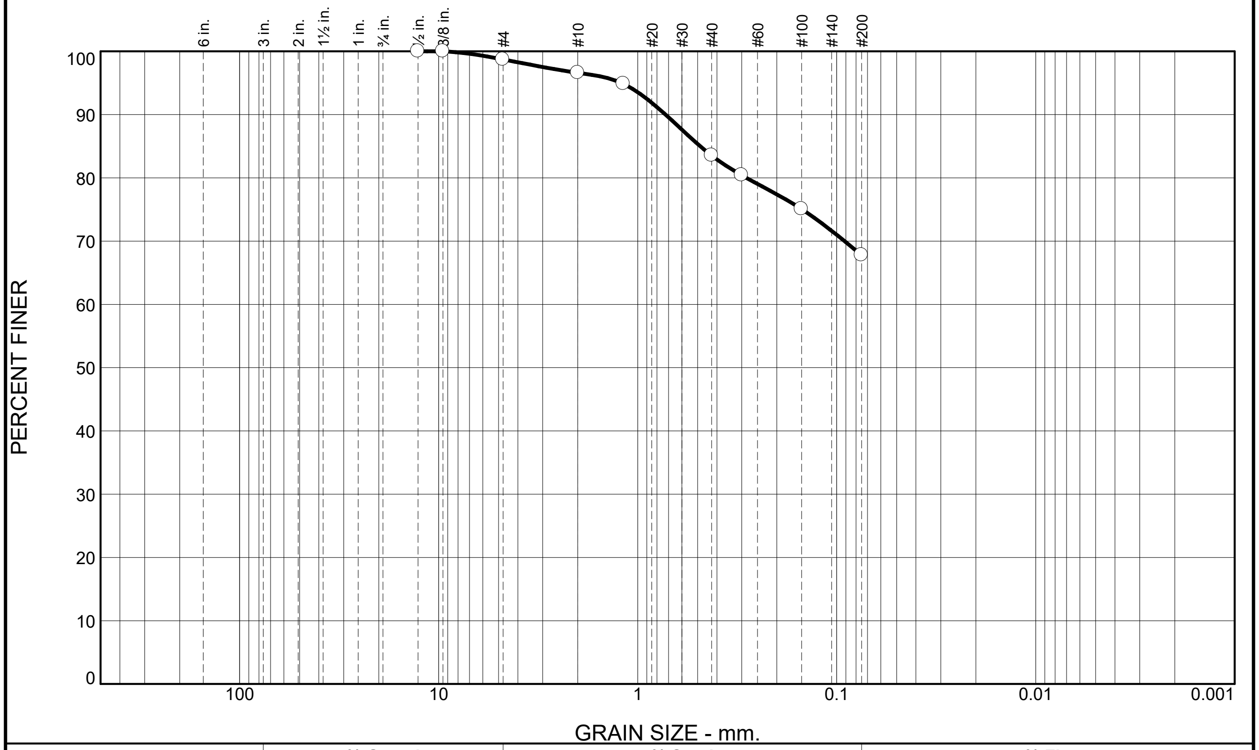
NewFields

Remarks:

Figure 16-283-07

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	2.1	13.1	15.7	67.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	98.7		
#10	96.6		
#16	94.9		
#40	83.5		
#50	80.4		
#100	75.1		
#200	67.8		

* (no specification provided)

Material Description

sandy lean clay

Atterberg Limits

PL= 19 LL= 44 PI= 25

Coefficients

D_{90}= 0.7252 D_{85}= 0.4850 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(15)

Remarks

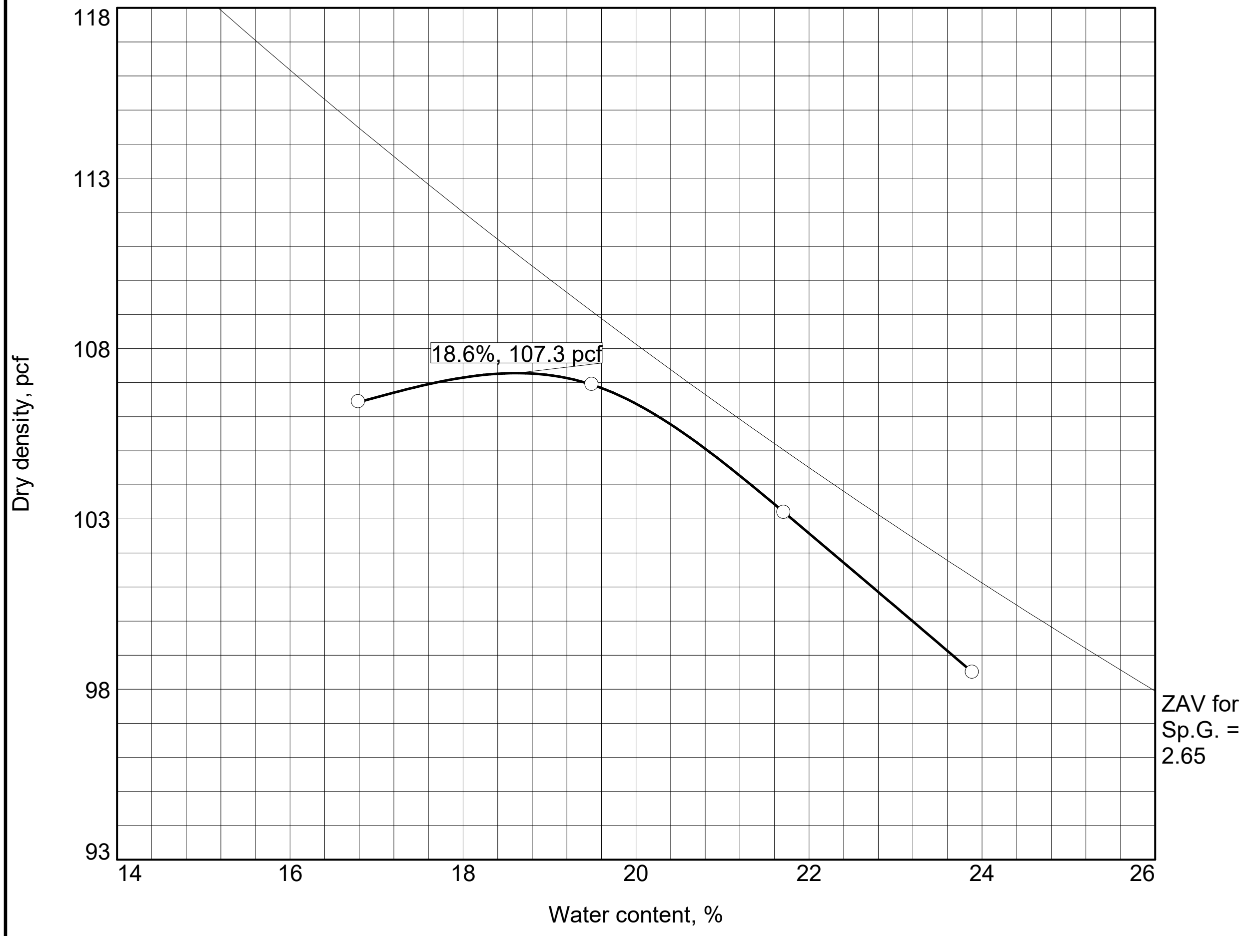
Location: TP16-15
Sample Number: 16-283-08 **Depth:** 6.5-7' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-08

Tested By: AH **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
6.5-7'	CL	A-4(3)		2.65	27	8	0.0	67.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 107.3 pcf Optimum moisture = 18.6 %	sandy lean clay

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

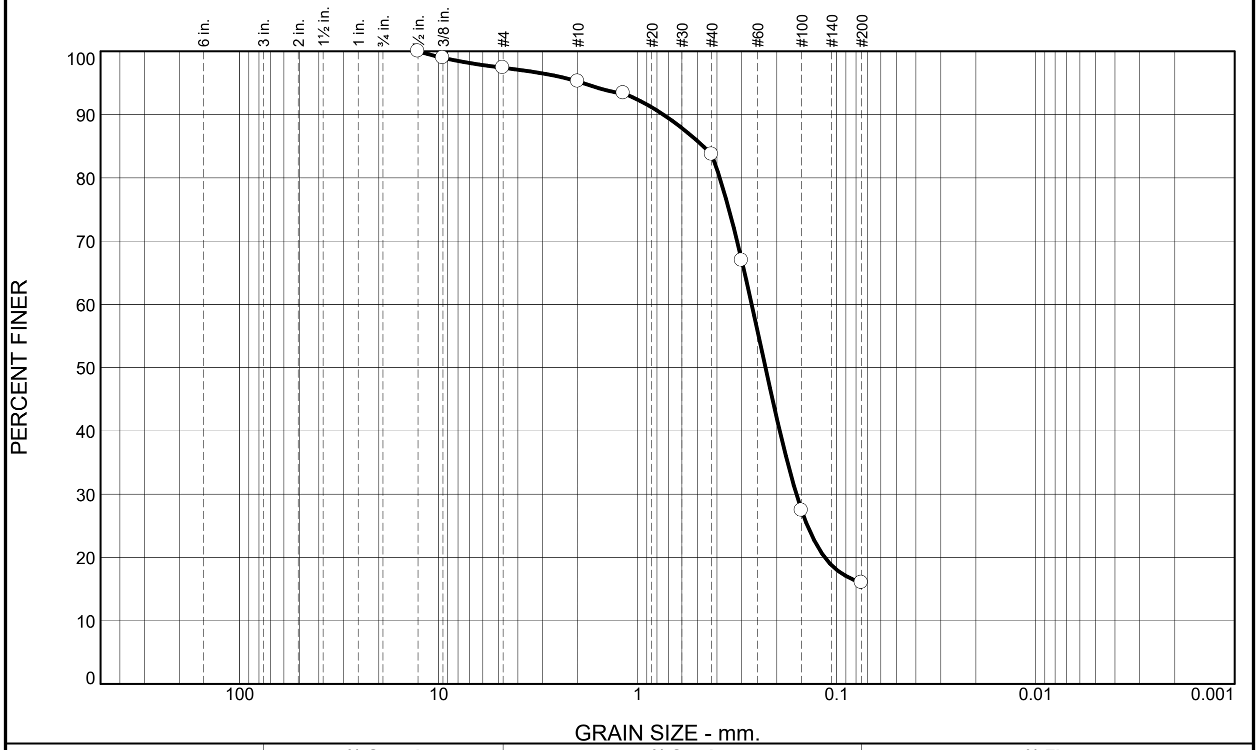
○**Location:** TP16-15 **Sample Number:** 16-283-08

NewFields

Remarks:

Figure 16-283-08

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.6	2.2	11.5	67.7	16.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.0		
#4	97.4		
#10	95.2		
#16	93.4		
#40	83.7		
#50	66.9		
#100	27.4		
#200	16.0		

* (no specification provided)

Material Description

Tan silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7436 D_{85}= 0.4693 D_{60}= 0.2674
D_{50}= 0.2280 D_{30}= 0.1595 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

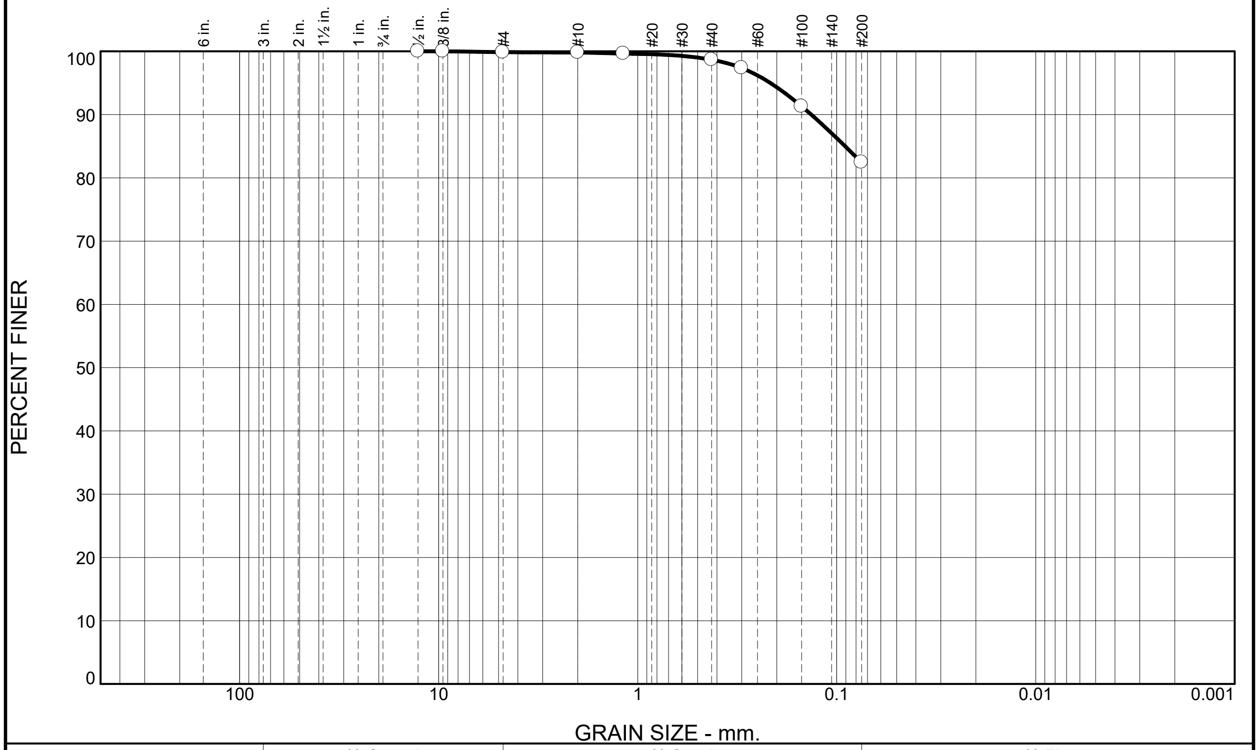
Location: TP16-16
Sample Number: 16-283-09 **Depth:** 5-6' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-09

Tested By: AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	1.1	16.3	82.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375"	100.0		
#4	99.9		
#10	99.8		
#16	99.6		
#40	98.7		
#50	97.4		
#100	91.3		
#200	82.4		

* (no specification provided)

Material Description

Light Brown lean clay with sand

Atterberg Limits

PL= 14 LL= 35 PI= 21

Coefficients

D_{90}= 0.1342 D_{85}= 0.0908 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(16)

Remarks

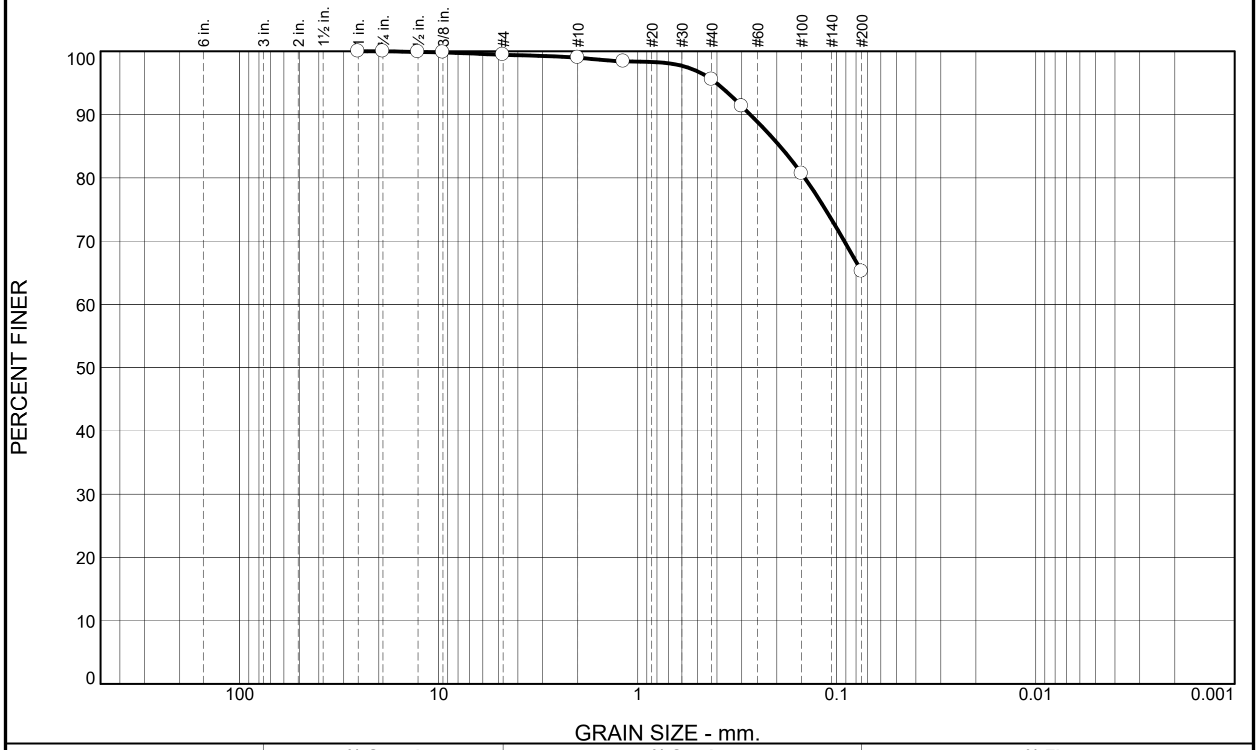
Location: TP16-18
Sample Number: 16-283-10 **Depth:** 5-6' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-10

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.5	3.4	30.4	65.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	99.9		
.375	99.8		
#4	99.5		
#10	99.0		
#16	98.4		
#40	95.6		
#50	91.3		
#100	80.7		
#200	65.2		

* (no specification provided)

Material Description

Brown sandy lean clay

Atterberg Limits

PL= 14 LL= 30 PI= 16

Coefficients

D_{90}= 0.2721 D_{85}= 0.1928 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(8)

Remarks

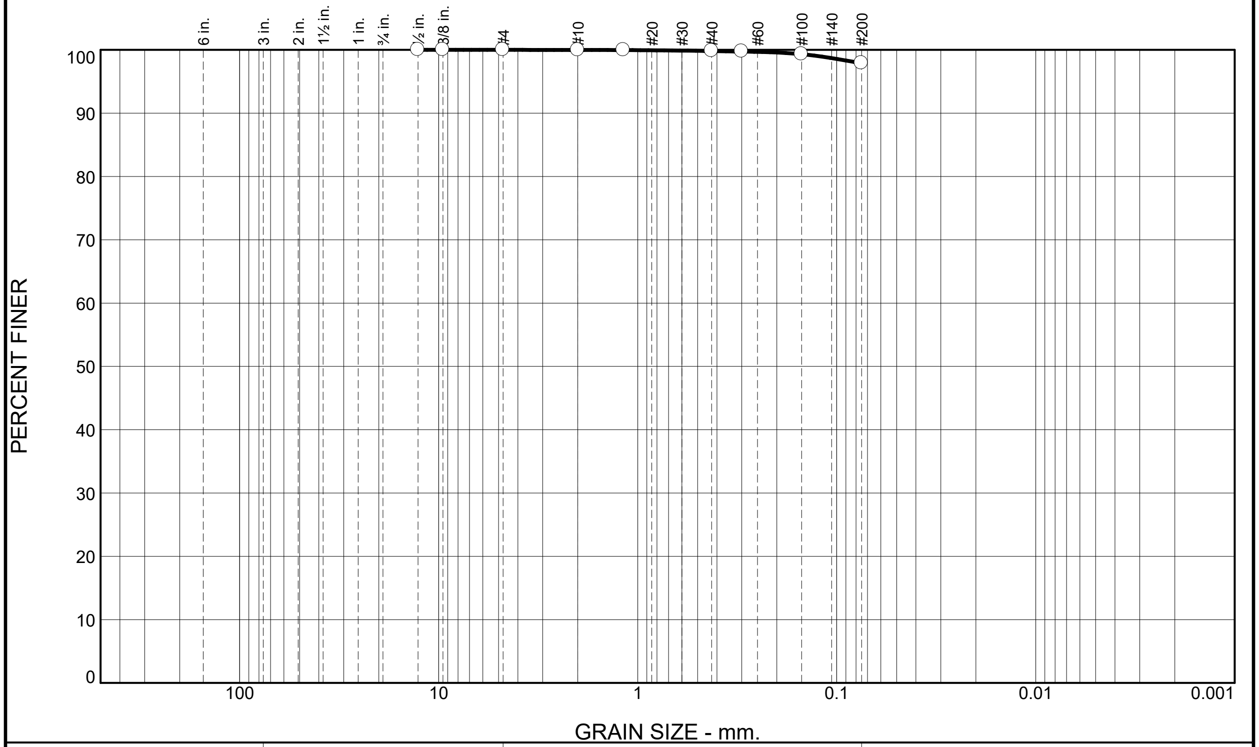
Location: TP16-19
Sample Number: 16-283-12 **Depth:** 3-5' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-12

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	1.9	97.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	99.8		
#50	99.7		
#100	99.3		
#200	97.9		

* (no specification provided)

Material Description

Brown lean clay

Atterberg Limits

PL= 20 LL= 39 PI= 19

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(20)

Remarks

Location: TP16-21
Sample Number: 16-283-14 **Depth:** 6-7' **Date:** 1/9/17

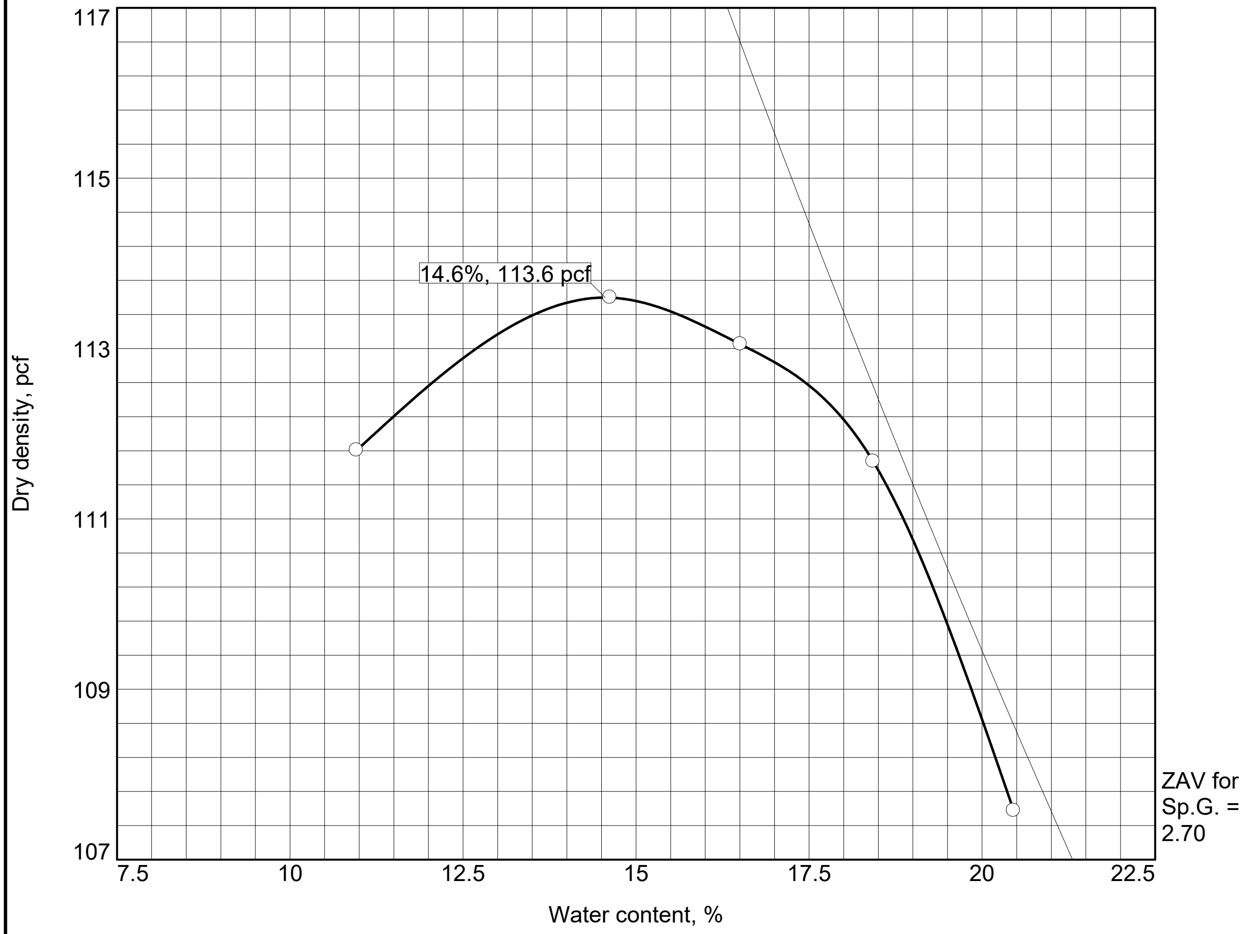
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-14

Tested By: AH **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
6-7'	CL	A-6(20)		2.65	39	19	0.0	97.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 113.6 pcf Optimum moisture = 14.6 %	Brown lean clay

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

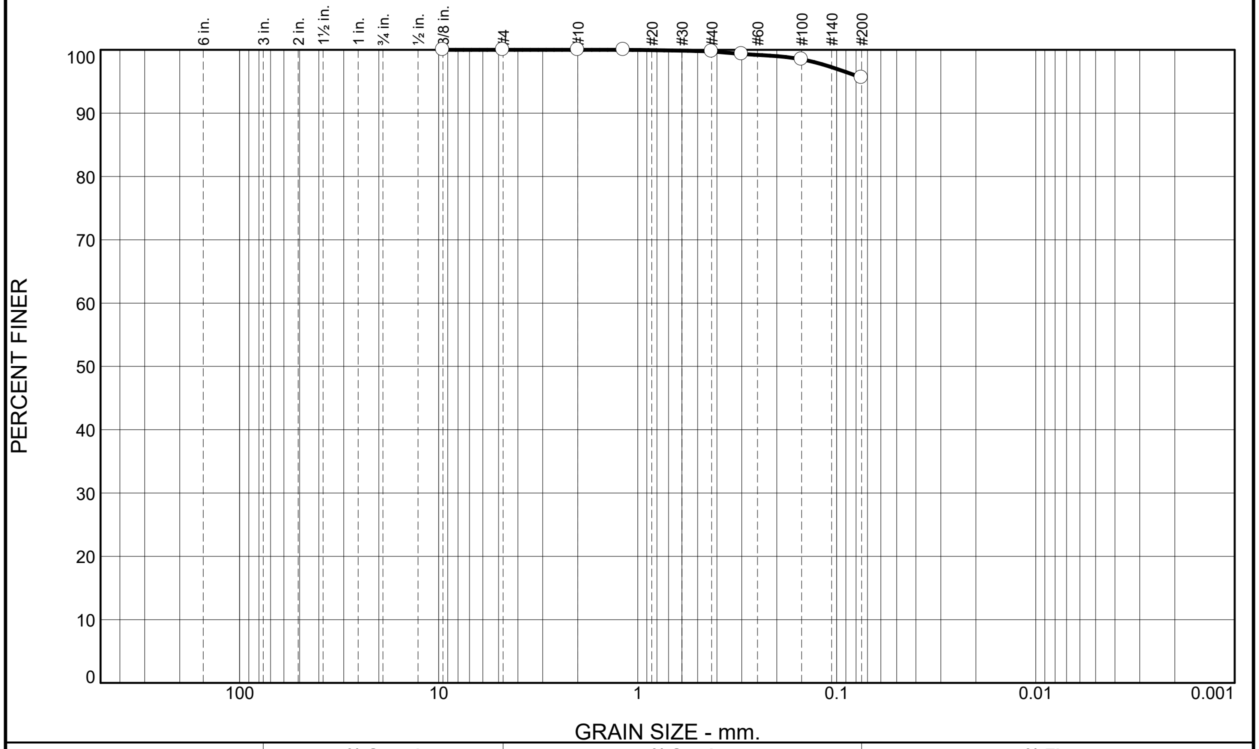
○**Location:** TP16-21 **Sample Number:** 16-283-14

NewFields

Remarks:

Figure 16-283-14

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	4.2	95.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	99.8		
#50	99.4		
#100	98.5		
#200	95.6		

* (no specification provided)

Material Description

Grey lean clay

Atterberg Limits

PL= 16 LL= 42 PI= 26

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(26)

Remarks

Location: TP16-25
Sample Number: 16-283-15 **Depth:** 5-6' **Date:** 1/9/17

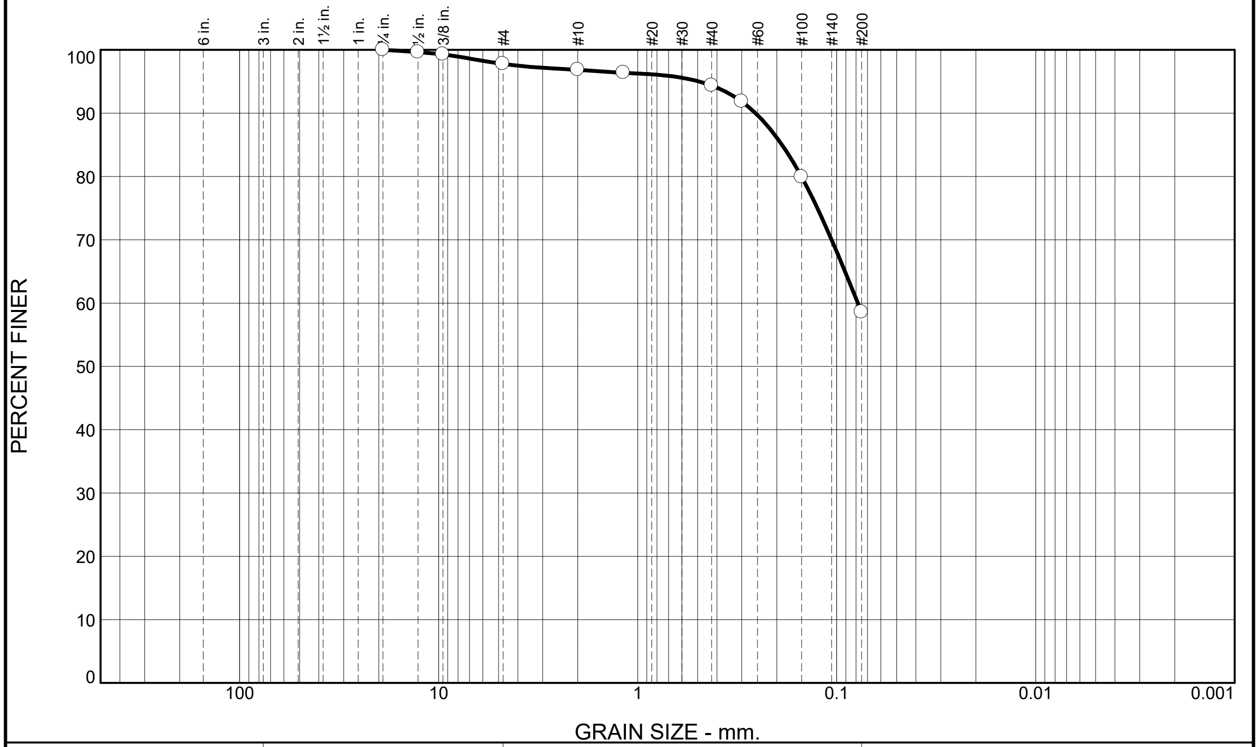
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-15

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.2	1.0	2.4	35.8	58.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.6		
.375	99.3		
#4	97.8		
#10	96.8		
#16	96.4		
#40	94.4		
#50	91.8		
#100	79.9		
#200	58.6		

* (no specification provided)

Material Description

Light Brown sandy lean clay

Atterberg Limits

PL= 12 LL= 25 PI= 13

Coefficients

D_{90}= 0.2559 D_{85}= 0.1883 D_{60}= 0.0783
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(4)

Remarks

Location: TP16-27
Sample Number: 16-283-16 **Depth:** 3-4' **Date:** 1/9/17

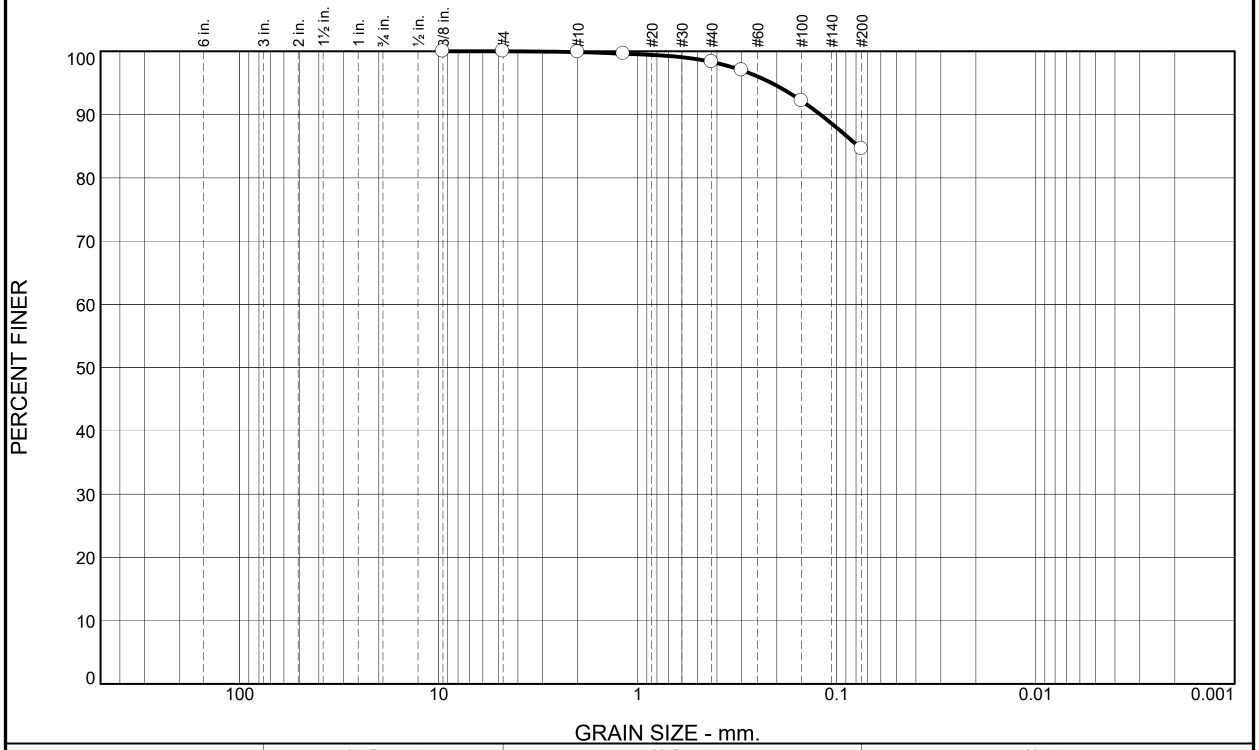
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-16

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.6	13.7	84.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	99.9		
#16	99.6		
#40	98.3		
#50	97.0		
#100	92.2		
#200	84.6		

* (no specification provided)

Material Description

Tanish grey lean clay

Atterberg Limits

PL= 14 LL= 32 PI= 18

Coefficients

D_{90}= 0.1207	D_{85}= 0.0777	D_{60}=
D_{50}=	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= CL AASHTO= A-6(14)

Remarks

Location: TP16-27
Sample Number: 16-283-17 **Depth:** 7-8' **Date:** 1/9/17

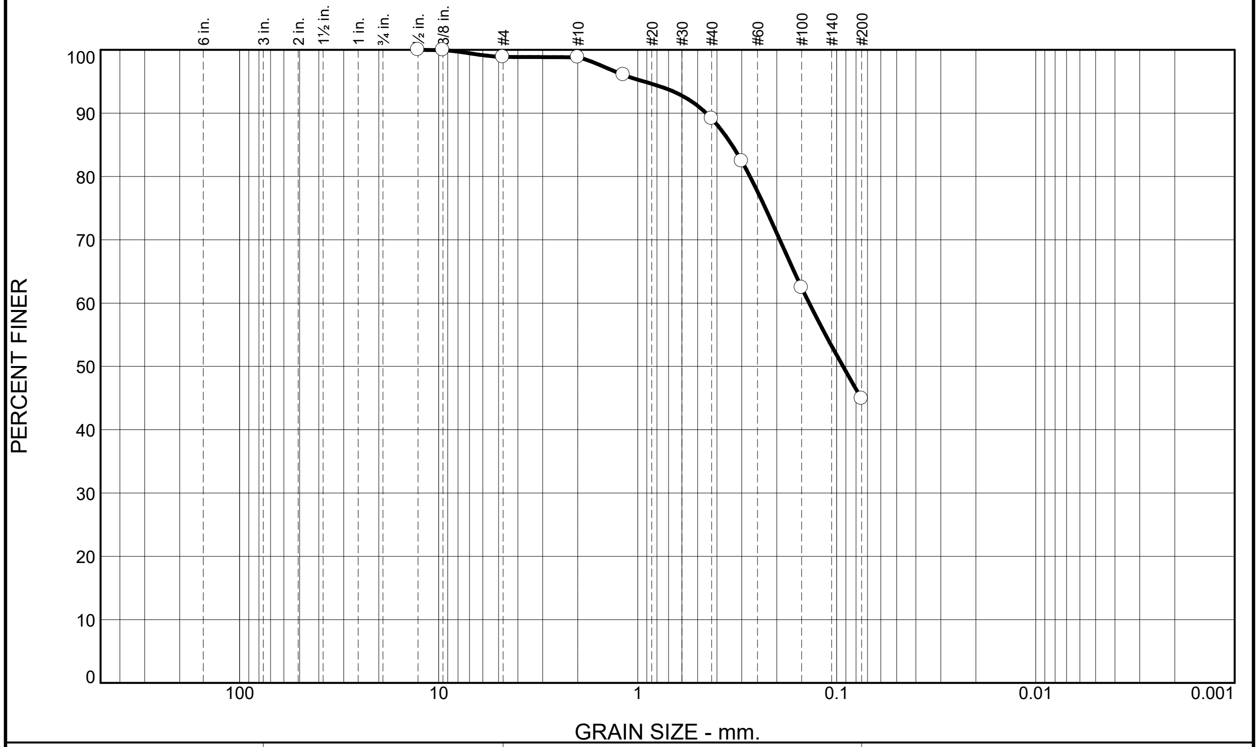
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-17

Tested By: TS **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	0.1	9.7	44.2	44.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	98.9		
#10	98.8		
#16	96.0		
#40	89.1		
#50	82.4		
#100	62.4		
#200	44.9		

* (no specification provided)

Material Description

Light brown clayey sand

Atterberg Limits

PL= 13 LL= 25 PI= 12

Coefficients

D_{90}= 0.4522 D_{85}= 0.3364 D_{60}= 0.1375
D_{50}= 0.0929 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Location: TP16-29
Sample Number: 16-283-18 **Depth:** 5-6' **Date:** 1/9/17

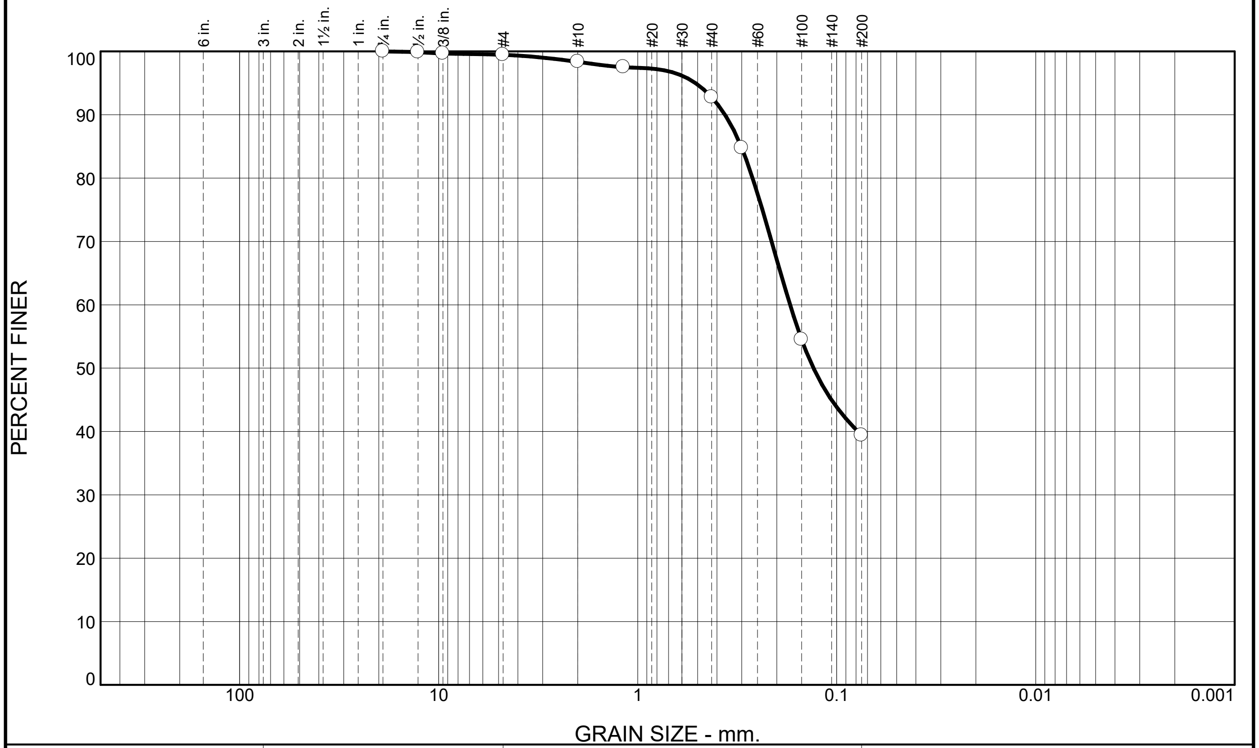
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-18

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	1.1	5.6	53.4	39.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.9		
.375	99.7		
#4	99.5		
#10	98.4		
#16	97.5		
#40	92.8		
#50	84.8		
#100	54.5		
#200	39.4		

* (no specification provided)

Material Description

Tan clayey sand

Atterberg Limits

PL= 13 LL= 25 PI= 12

Coefficients

D_{90}= 0.3641 D_{85}= 0.3022 D_{60}= 0.1715
D_{50}= 0.1308 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(1)

Remarks

Location: TP16-30
Sample Number: 16-283-19 **Depth:** 2-3' **Date:** 1/9/17

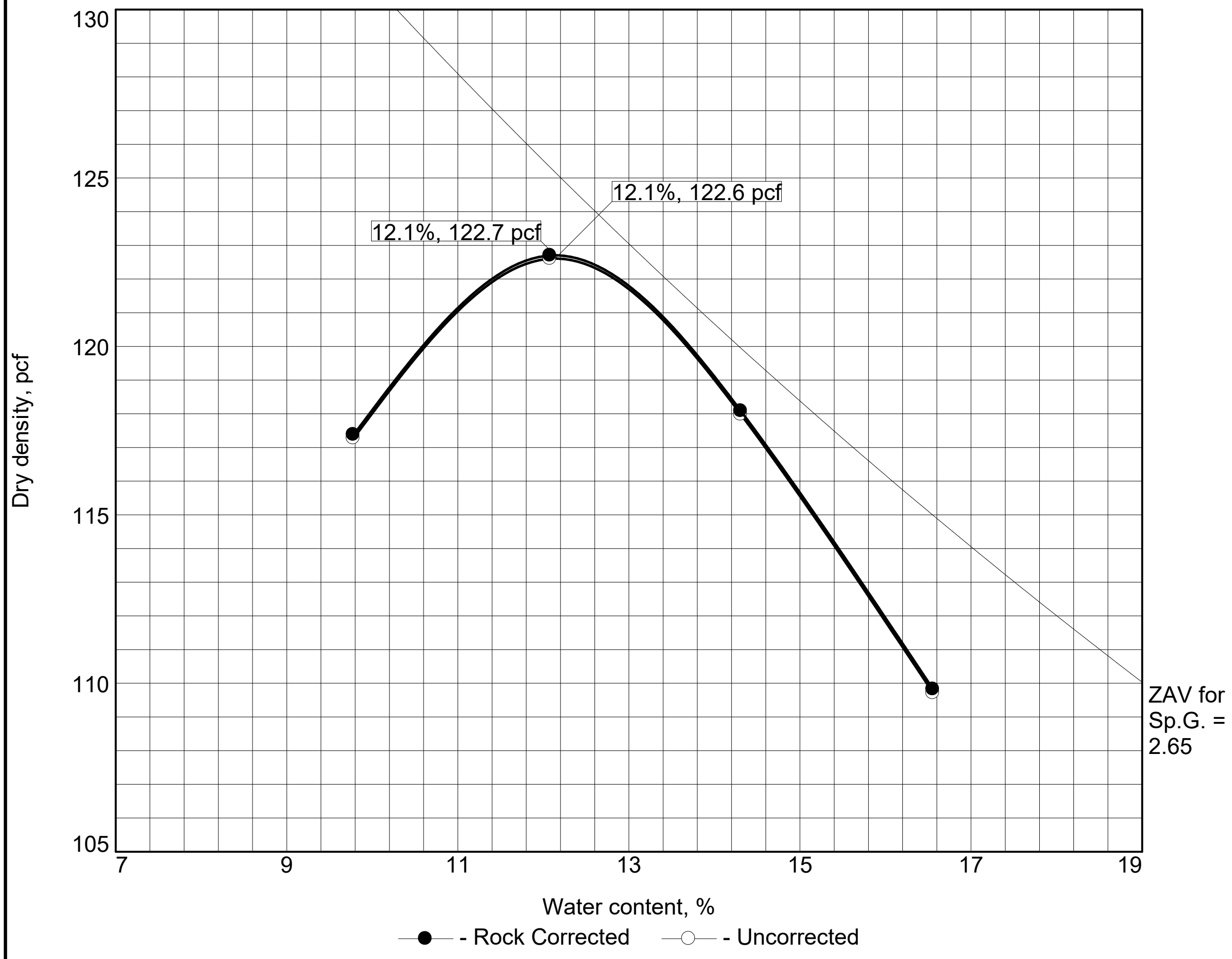
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-19

Tested By: AH **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/	Classification		Nat.	Sp.G.	LL	PI	% >	% <
Depth	USCS	AASHTO	Moist.				3/8 in.	No.200
2-3'	SC	A-6(1)		2.65	25	12	0.3	39.4

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 122.7 pcf	122.6 pcf	Tan clayey sand
Optimum moisture = 12.1 %	12.1 %	

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

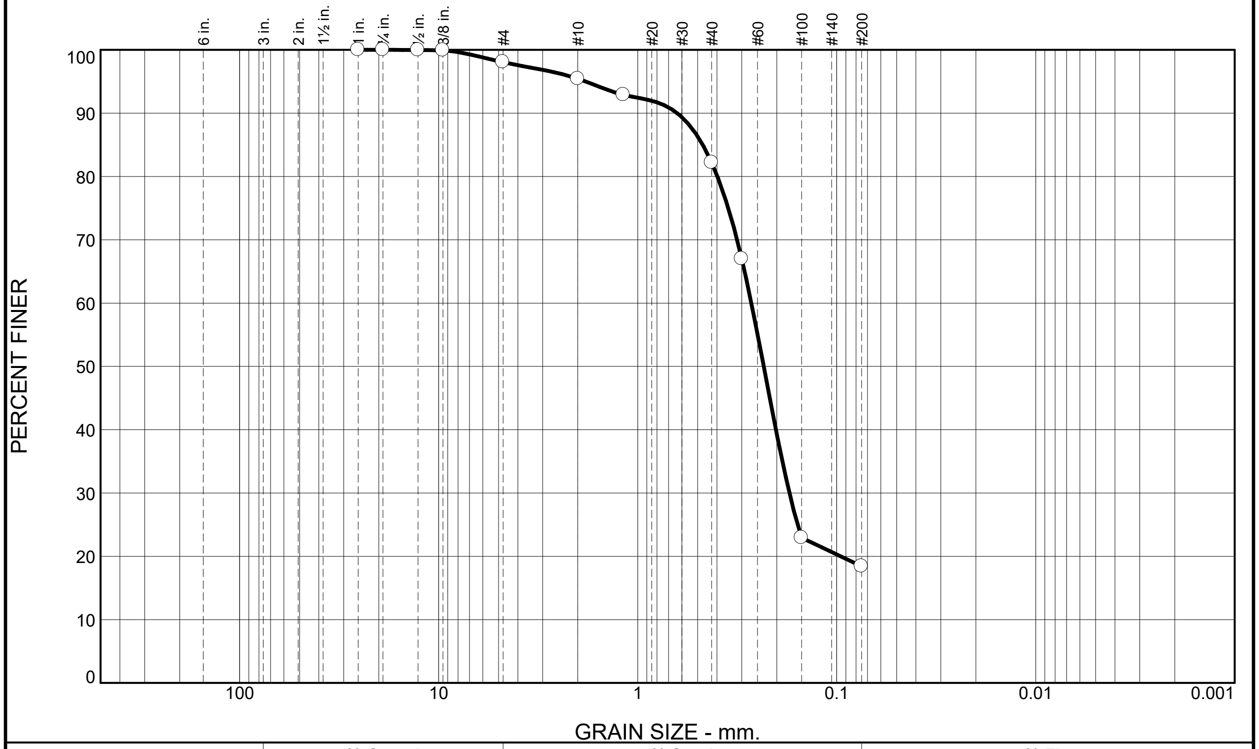
○**Location:** TP16-30 **Sample Number:** 16-283-19

NewFields

Remarks:

Figure 16-283-19

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.9	2.7	13.2	63.8	18.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	100.0		
.375	99.9		
#4	98.1		
#10	95.4		
#16	92.9		
#40	82.2		
#50	67.0		
#100	22.9		
#200	18.4		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6330 D_{85}= 0.4713 D_{60}= 0.2685
D_{50}= 0.2327 D_{30}= 0.1729 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Location: TP16-33
Sample Number: 16-283-20 **Depth:** 5-6' **Date:** 1/9/17

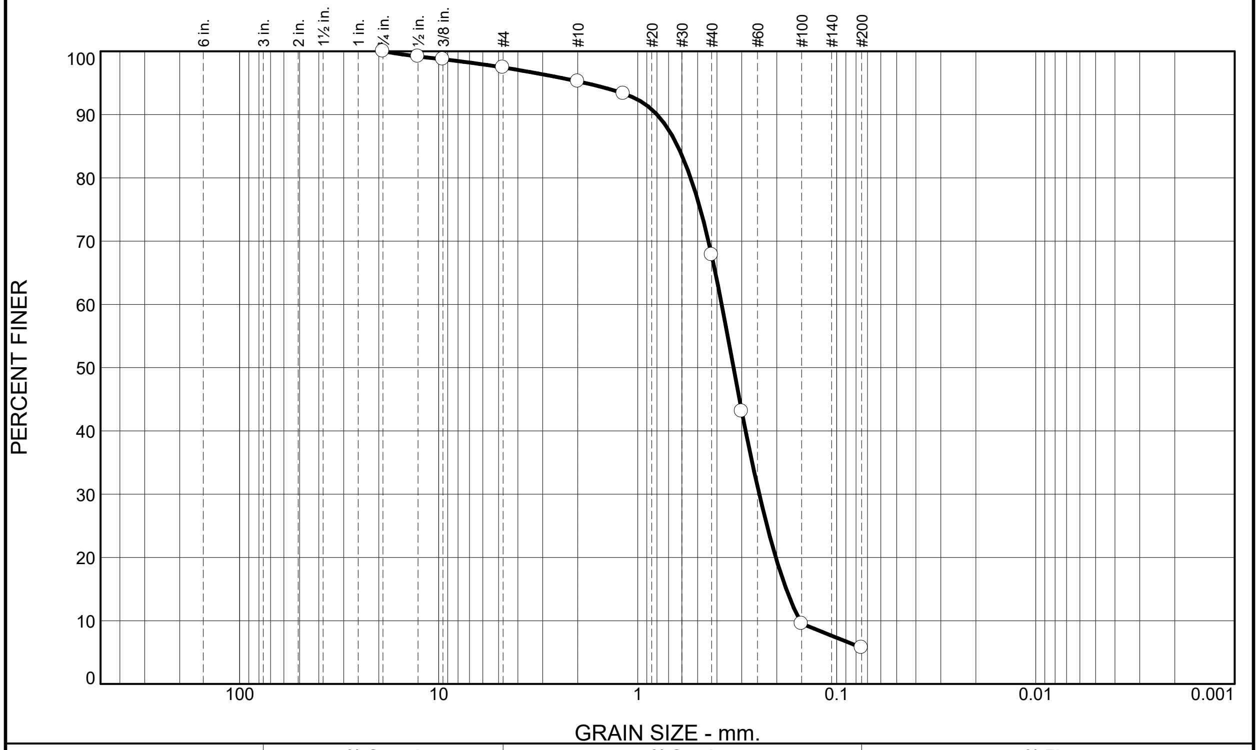
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-20

Tested By: AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.6	2.1	27.5	62.1	5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.2		
.375	98.7		
#4	97.4		
#10	95.3		
#16	93.3		
#40	67.8		
#50	43.1		
#100	9.5		
#200	5.7		

* (no specification provided)

Material Description

Tan poorly graded sand with silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7994 D_{85}= 0.6294 D_{60}= 0.3783
D_{50}= 0.3300 D_{30}= 0.2450 D_{15}= 0.1794
D_{10}= 0.1529 C_u= 2.47 C_c= 1.04

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Location: TP16-34
Sample Number: 16-283-21 **Depth:** 7-8' **Date:** 1/9/17

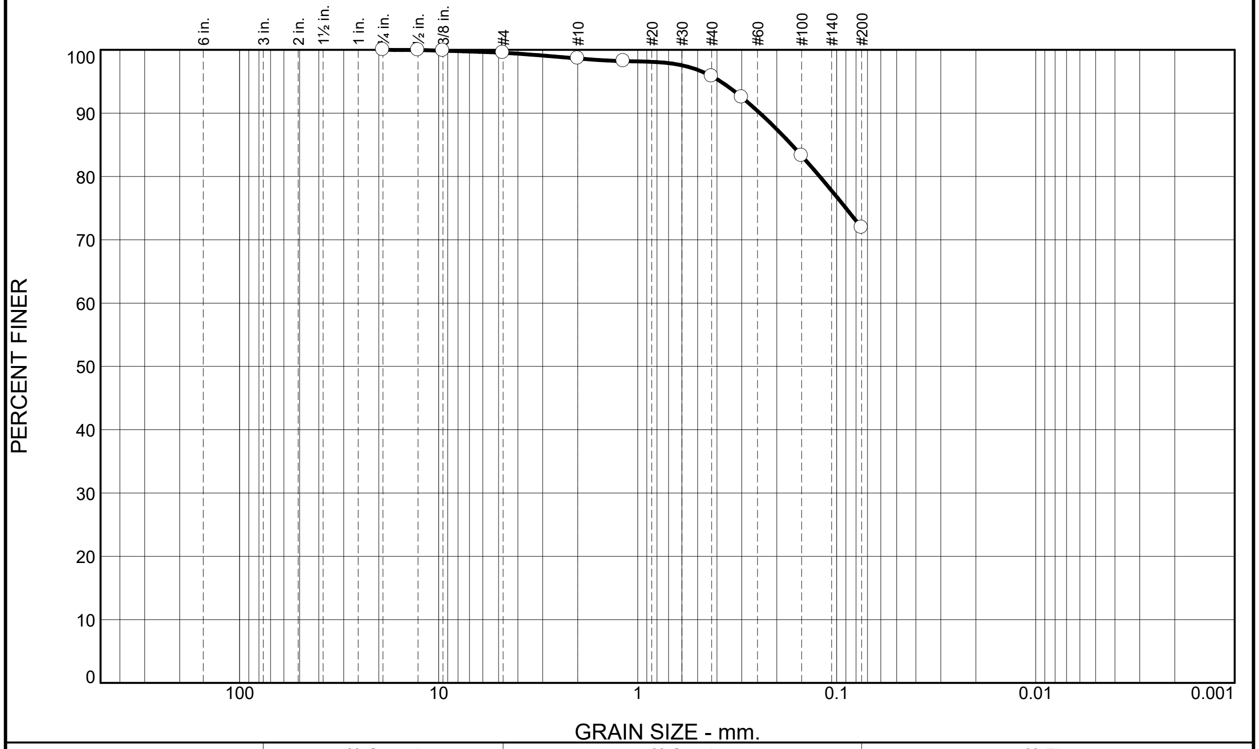
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-21

Tested By: AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.9	2.8	23.9	71.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	100.0		
.375	99.9		
#4	99.5		
#10	98.6		
#16	98.2		
#40	95.8		
#50	92.5		
#100	83.3		
#200	71.9		

* (no specification provided)

Material Description

Light Brown lean clay with sand

Atterberg Limits

PL= 13 LL= 29 PI= 16

Coefficients

D_{90}= 0.2429 D_{85}= 0.1683 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(9)

Remarks

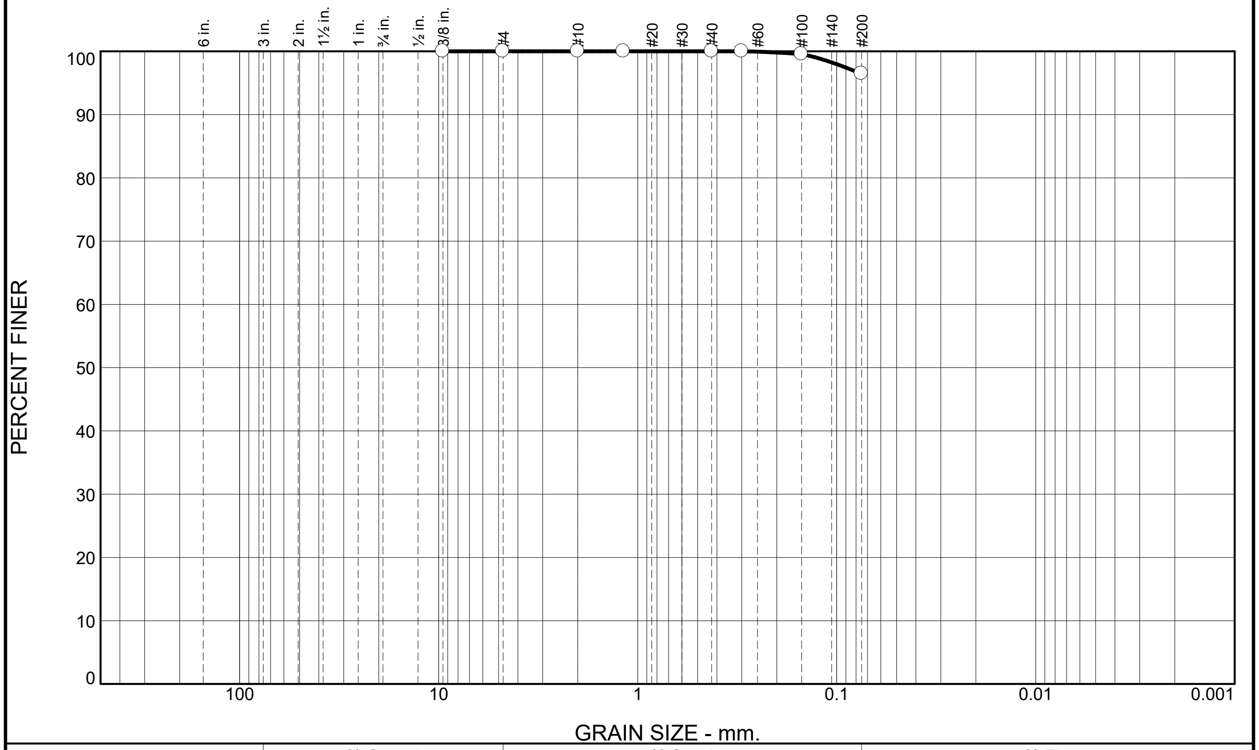
Location: TP16-35
Sample Number: 16-283-22 **Depth:** 1-2' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-22

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	3.5	96.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	100.0		
#50	100.0		
#100	99.6		
#200	96.5		

* (no specification provided)

Material Description

Brown lean clay

Atterberg Limits

PL= 17 LL= 27 PI= 10

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(8)

Remarks

Location: TP16-36
Sample Number: 16-283-23 **Depth:** 16-17' **Date:** 1/9/17

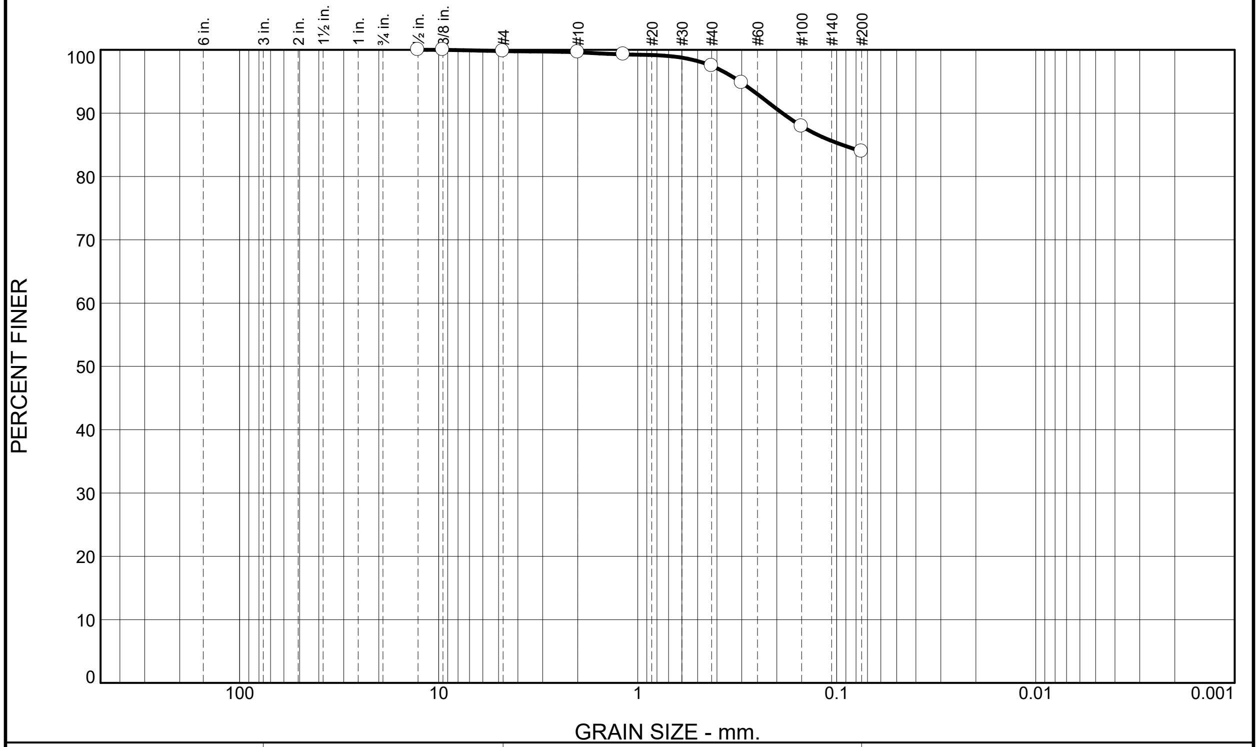
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-23

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.2	2.1	13.5	84.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	99.8		
#10	99.6		
#16	99.3		
#40	97.5		
#50	94.8		
#100	87.9		
#200	84.0		

* (no specification provided)

Material Description

Tan fat clay with sand

Atterberg Limits

PL= 21 LL= 64 PI= 43

Coefficients

D_{90}= 0.1873 D_{85}= 0.0941 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(38)

Remarks

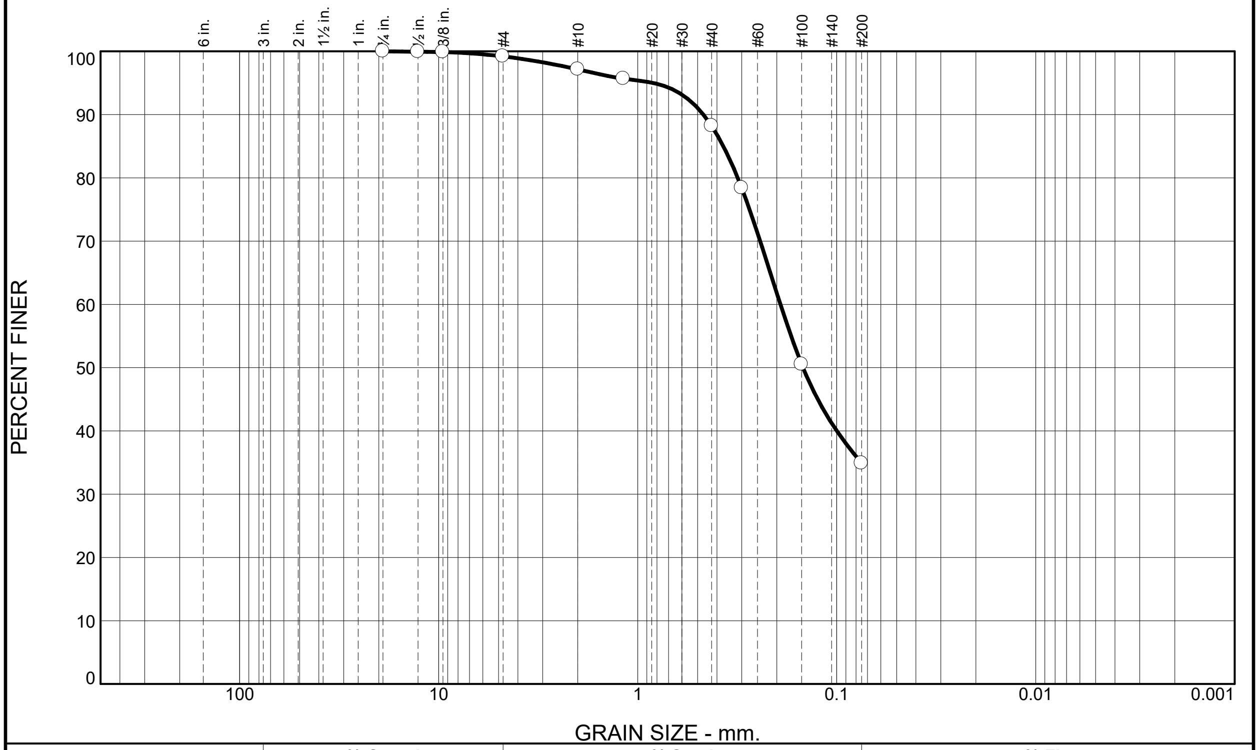
Location: TP16-38
Sample Number: 16-283-24 **Depth:** 3-4' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-24

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	2.0	9.0	53.3	34.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75"	100.0		
.5"	99.9		
.375"	99.9		
#4	99.2		
#10	97.2		
#16	95.7		
#40	88.2		
#50	78.4		
#100	50.5		
#200	34.9		

* (no specification provided)

Material Description

Brown clayey sand

Atterberg Limits

PL= 14 LL= 29 PI= 15

Coefficients

D_{90}= 0.4677 D_{85}= 0.3711 D_{60}= 0.1918

D_{50}= 0.1477 D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

Location: TP16-39

Sample Number: 16-283-25 **Depth:** 1-2' **Date:** 1/9/2017

NewFields

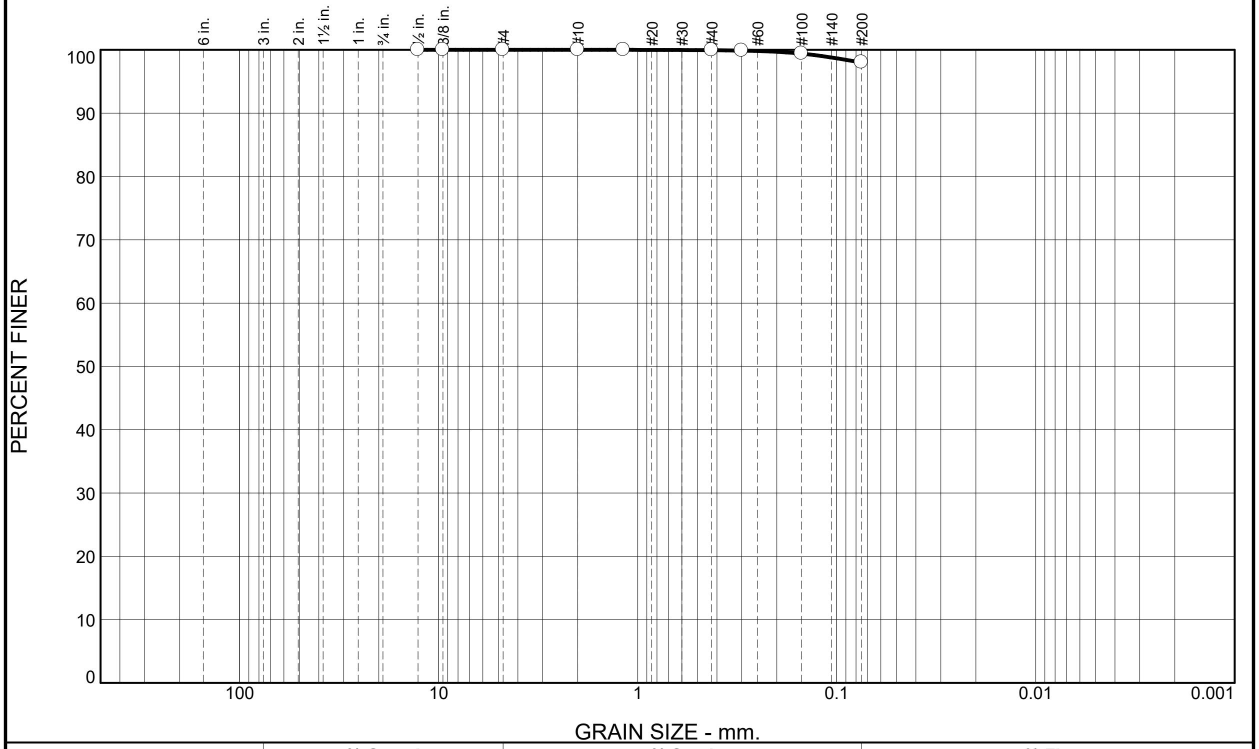
Client: Magnum NGLS Solution Mining LLC

Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-25

Tested By: AH **Checked By:** TW

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	2.0	98.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#16	100.0		
#40	100.0		
#50	99.9		
#100	99.4		
#200	98.0		

* (no specification provided)

Material Description

Tan lean clay

Atterberg Limits

PL= 16 LL= 31 PI= 15

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(14)

Remarks

Location: TP16-40
Sample Number: 16-283-26 **Depth:** 5.5-7' **Date:** 1/9/17

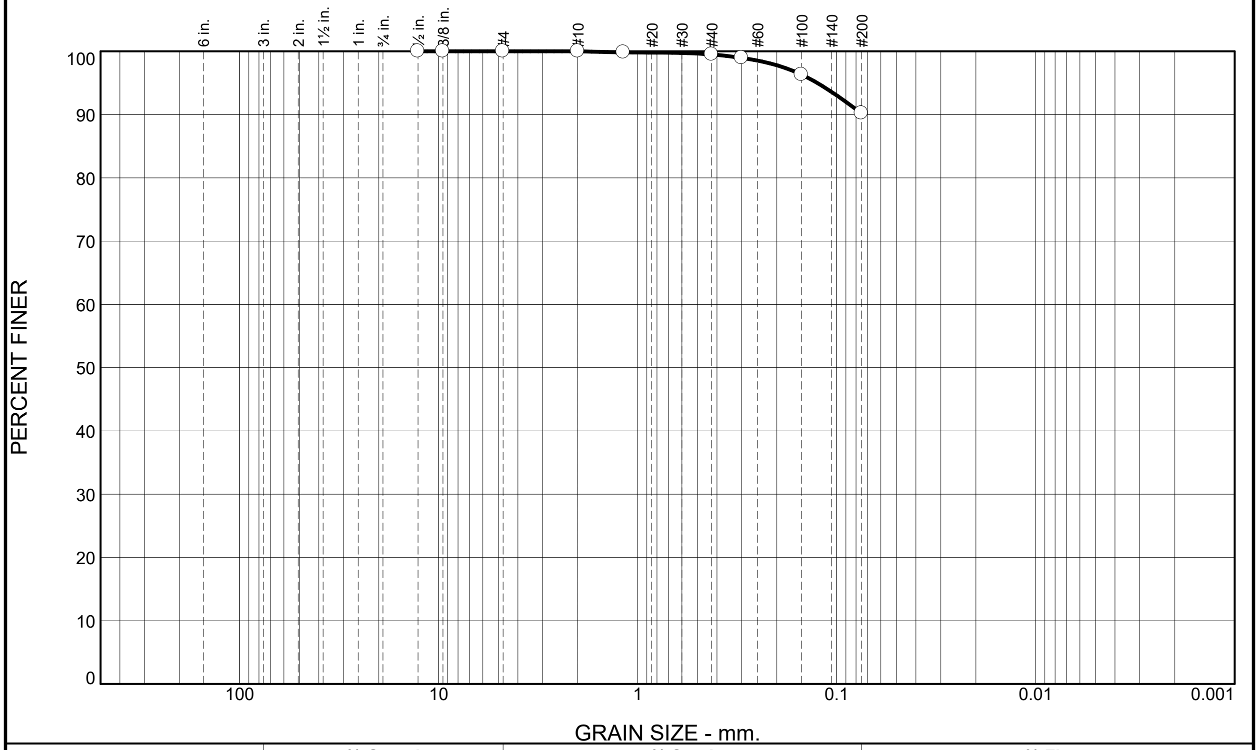
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-26

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	9.3	90.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#16	99.8		
#40	99.5		
#50	99.0		
#100	96.3		
#200	90.2		

* (no specification provided)

Material Description

Light Brown lean clay

Atterberg Limits

PL= 16 LL= 44 PI= 28

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(26)

Remarks

Location: TP16-41
Sample Number: 16-283-27 **Depth:** 9-10.5' **Date:** 1/9/17

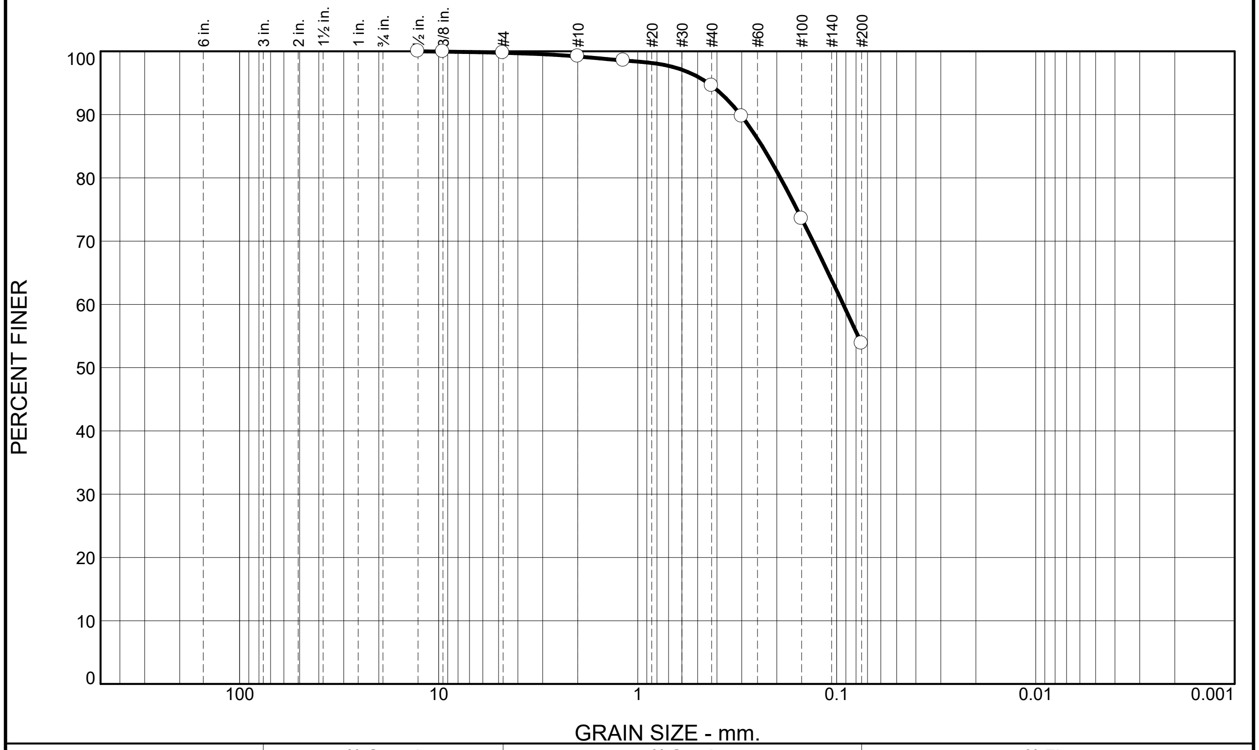
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-27

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.6	4.6	40.8	53.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	99.9		
#4	99.8		
#10	99.2		
#16	98.6		
#40	94.6		
#50	89.7		
#100	73.5		
#200	53.8		

* (no specification provided)

Material Description

Tan sandy lean clay

Atterberg Limits

PL= 18 LL= 43 PI= 25

Coefficients

D_{90}= 0.3047 D_{85}= 0.2368 D_{60}= 0.0928
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(10)

Remarks

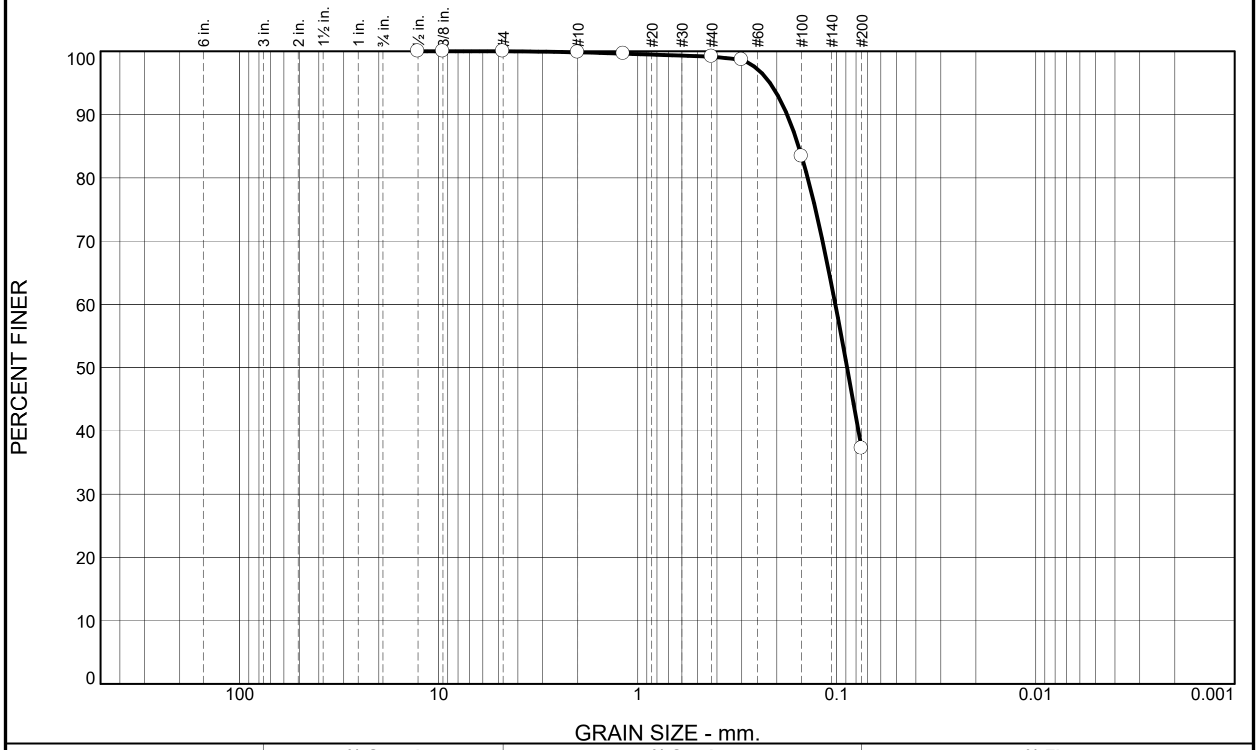
Location: TP16-42
Sample Number: 16-283-28 **Depth:** 1-2' **Date:** 1/9/2017

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-28

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	0.6	62.0	37.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	100.0		
#10	99.8		
#16	99.6		
#40	99.2		
#50	98.7		
#100	83.4		
#200	37.2		

* (no specification provided)

Material Description

Light Browm silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1776 D_{85}= 0.1554 D_{60}= 0.1016
D_{50}= 0.0886 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: TP16-42
Sample Number: 16-283-29 **Depth:** 11-12' **Date:** 1/9/17

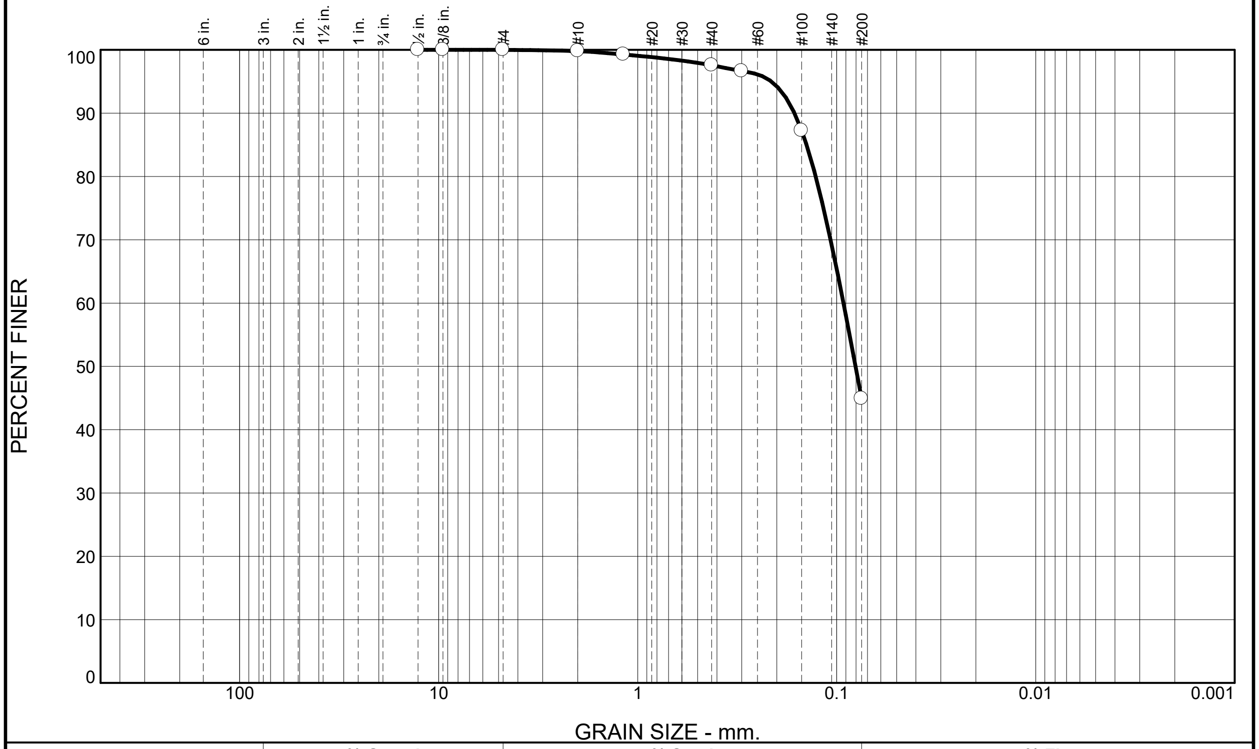
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-29

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	2.2	52.7	44.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	100.0		
#10	99.8		
#16	99.3		
#40	97.6		
#50	96.7		
#100	87.3		
#200	44.9		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1630 D_{85}= 0.1418 D_{60}= 0.0925
D_{50}= 0.0804 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Location: TP16-44
Sample Number: 16-283-30 **Depth:** 6-7' **Date:** 1/9/17

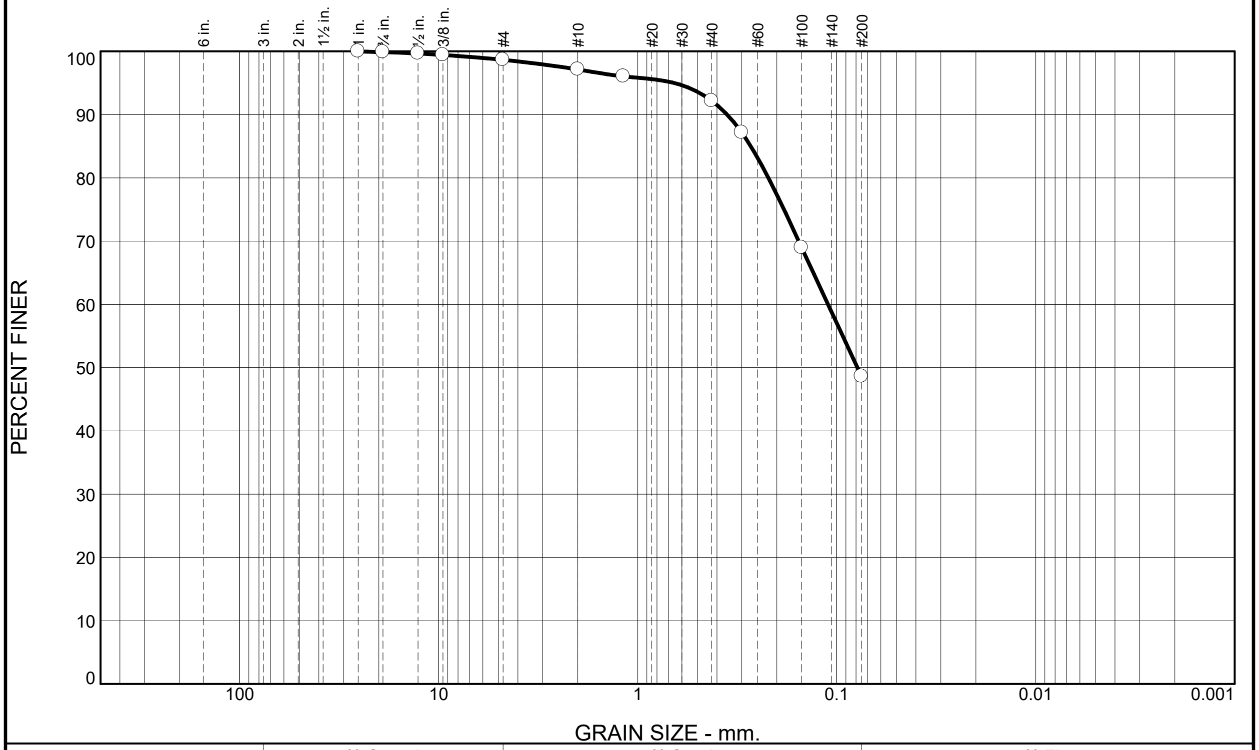
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-30

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	1.2	1.6	4.9	43.6	48.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	99.9		
.5	99.7		
.375	99.4		
#4	98.7		
#10	97.1		
#16	96.0		
#40	92.2		
#50	87.2		
#100	69.0		
#200	48.6		

* (no specification provided)

Material Description

Tan clayey sand

Atterberg Limits

PL= 14 LL= 22 PI= 8

Coefficients

D_{90}= 0.3555 D_{85}= 0.2703 D_{60}= 0.1106
D_{50}= 0.0786 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-4(1)

Remarks

Location: TP16-45
Sample Number: 16-283-31 **Depth:** 2-4.5' **Date:** 1/9/17

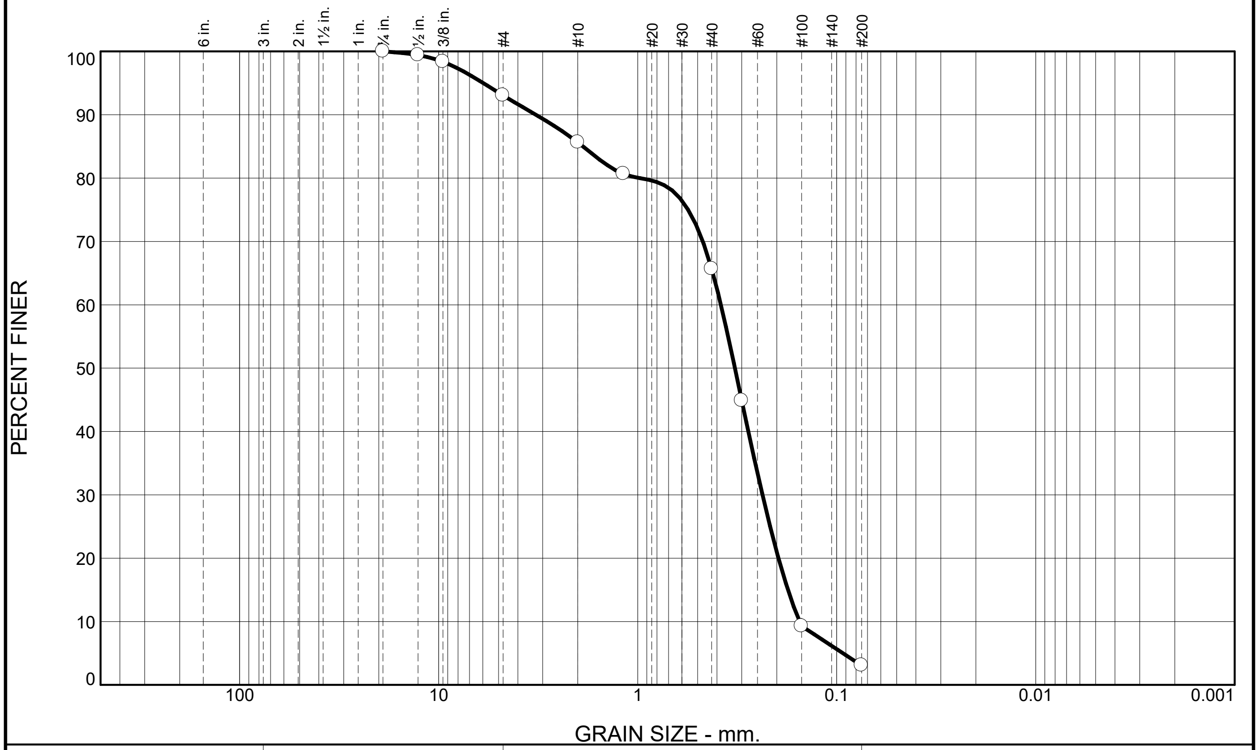
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-31

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.9	7.5	19.9	62.6	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.4		
.375	98.4		
#4	93.1		
#10	85.6		
#16	80.7		
#40	65.7		
#50	44.9		
#100	9.3		
#200	3.1		

* (no specification provided)

Material Description

Light Brown poorly graded sand

Atterberg Limits

PL= 19 LL= 29 PI= 10

Coefficients

D_{90}= 3.2485 D_{85}= 1.8845 D_{60}= 0.3817
D_{50}= 0.3247 D_{30}= 0.2360 D_{15}= 0.1759
D_{10}= 0.1536 C_u= 2.49 C_c= 0.95

Classification

USCS= SP AASHTO= A-2-4(0)

Remarks

Location: TP16-45
Sample Number: 16-283-32 **Depth:** 6-7' **Date:** 1/9/17

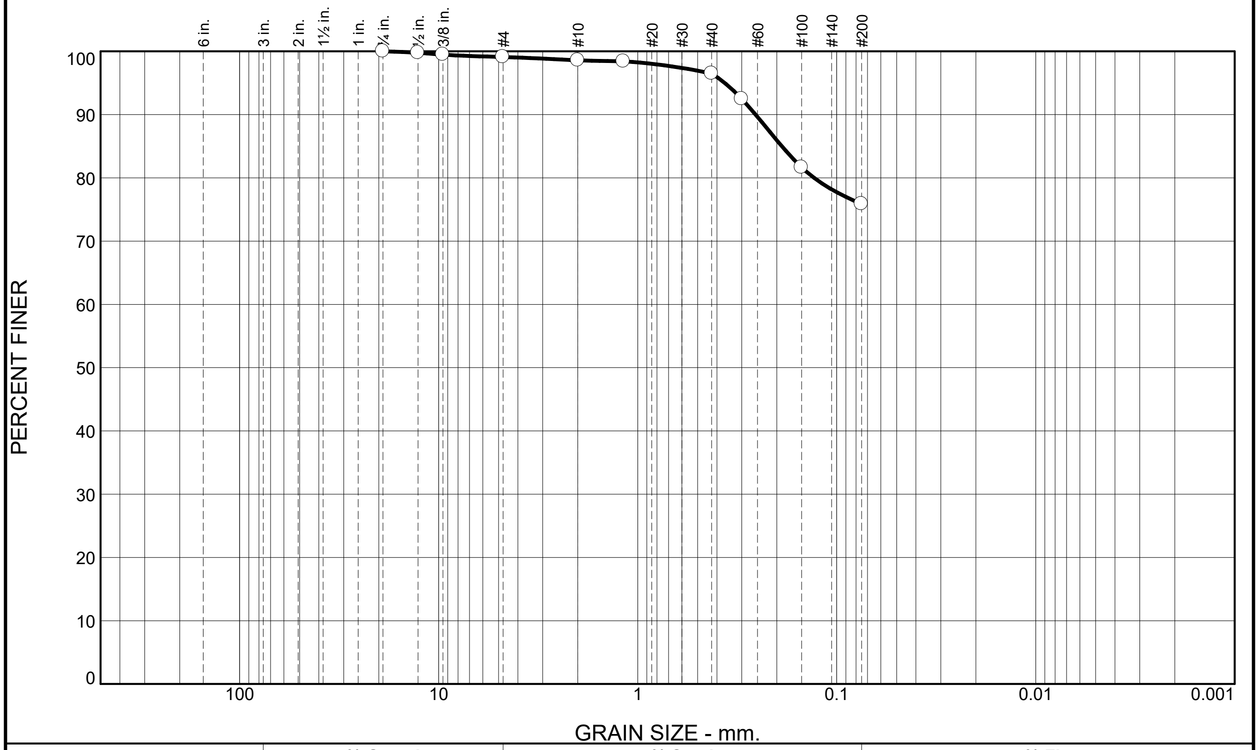
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-32

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	0.5	2.1	20.6	75.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.8		
.375	99.5		
#4	99.1		
#10	98.6		
#16	98.4		
#40	96.5		
#50	92.5		
#100	81.7		
#200	75.9		

* (no specification provided)

Material Description

Grey lean clay with sand

Atterberg Limits

PL= 14 LL= 37 PI= 23

Coefficients

D_{90}= 0.2557 D_{85}= 0.1886 D_{60}=

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(16)

Remarks

Location: TP16-48

Sample Number: 16-283-33 **Depth:** 9.5-10.5' **Date:** 1/9/17

NewFields

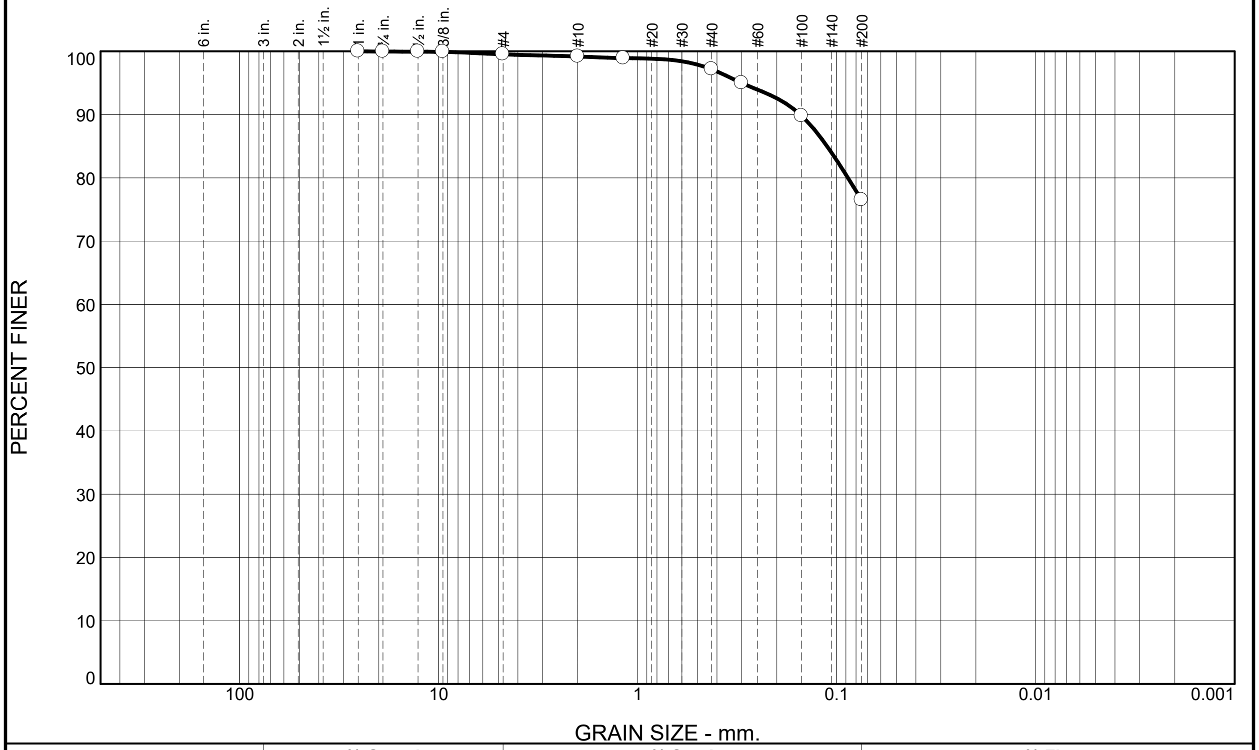
Client: Magnum NGLS Solution Mining LLC

Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-33

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.3	2.0	20.7	76.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	100.0		
.5	99.9		
.375	99.9		
#4	99.5		
#10	99.2		
#16	98.9		
#40	97.2		
#50	95.0		
#100	89.8		
#200	76.5		

* (no specification provided)

Material Description

Brown lean clay with sand

Atterberg Limits

PL= 13 LL= 23 PI= 10

Coefficients

D_{90}= 0.1525 D_{85}= 0.1118 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(5)

Remarks

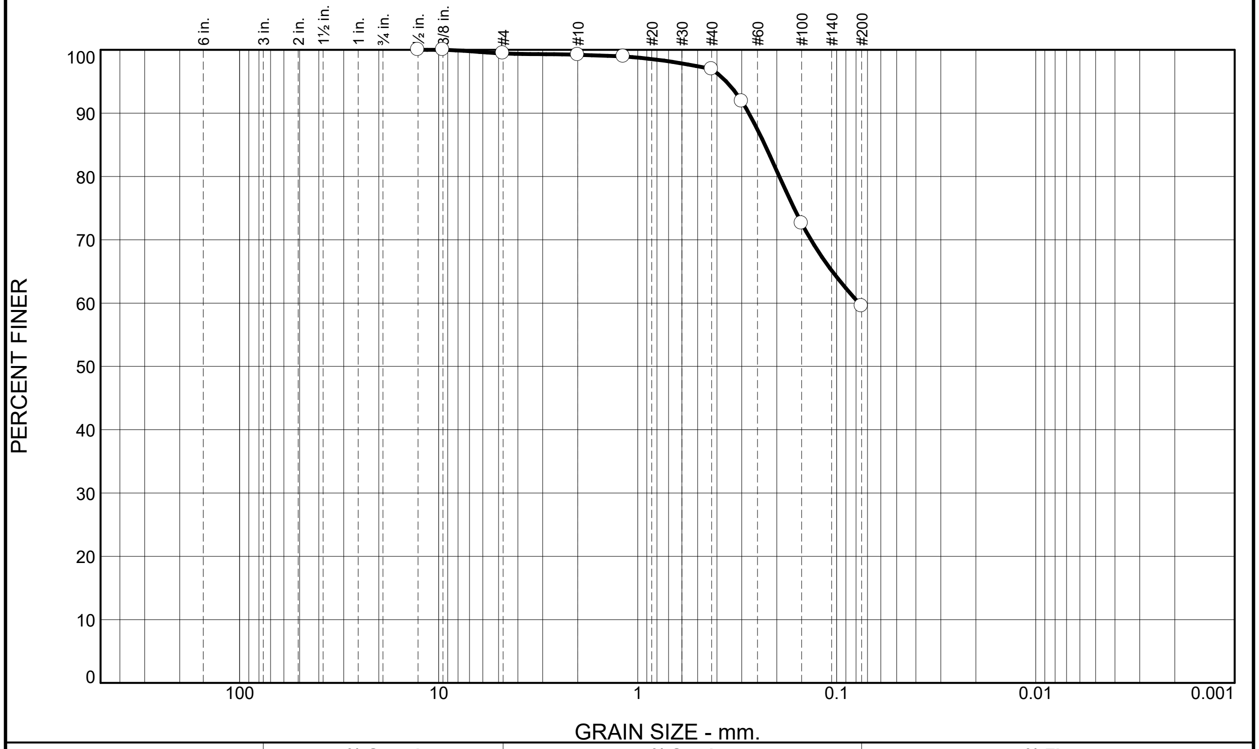
Location: TP16-48
Sample Number: 16-283-34 **Depth:** 17-18' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-34

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	0.2	2.2	37.5	59.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	99.4		
#10	99.2		
#16	99.0		
#40	97.0		
#50	91.9		
#100	72.6		
#200	59.5		

* (no specification provided)

Material Description

Grey sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.2764 D_{85}= 0.2297 D_{60}= 0.0774

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Location: TP16-49

Sample Number: 16-283-35 **Depth:** 3.5-5' **Date:** 1/9/17

NewFields

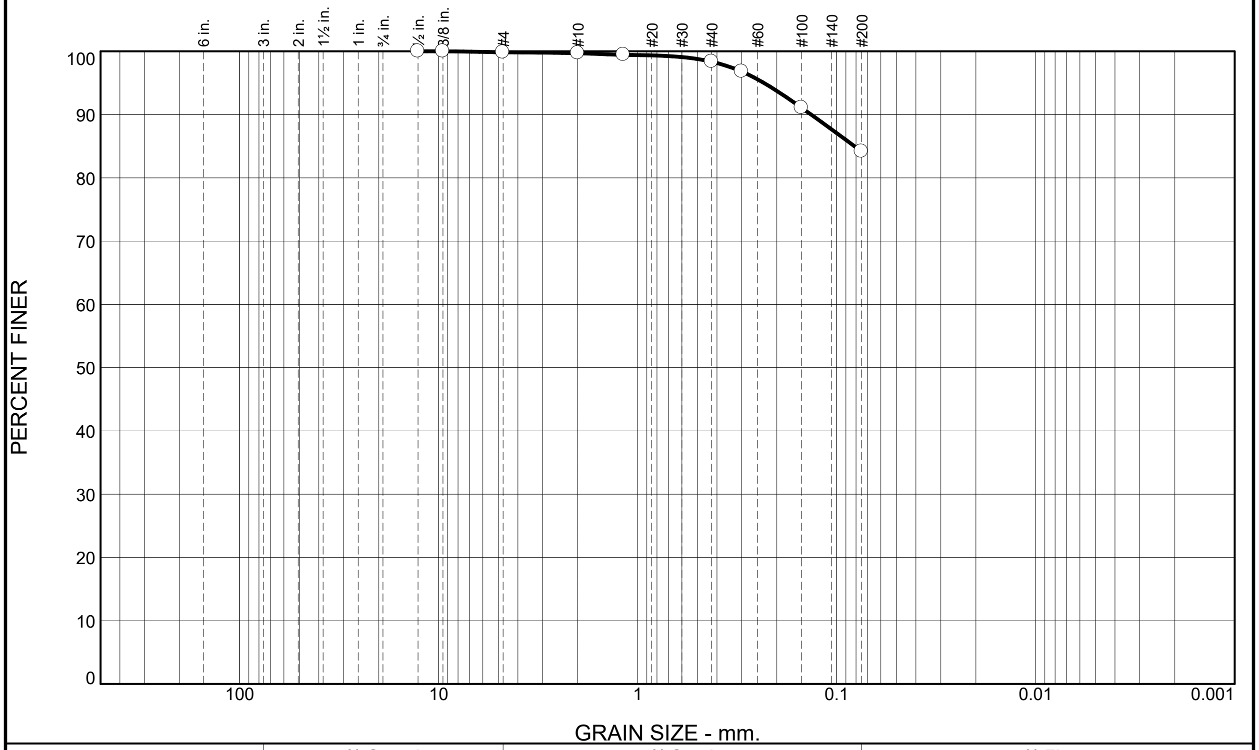
Client: Magnum NGLS Solution Mining LLC

Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-35

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.2	1.3	14.2	84.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	100.0		
#4	99.9		
#10	99.7		
#16	99.5		
#40	98.4		
#50	96.8		
#100	91.1		
#200	84.2		

* (no specification provided)

Material Description

Brown silt with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1345 D_{85}= 0.0814 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Location: TP16-51
Sample Number: 16-283-36 **Depth:** 2-4' **Date:** 1/9/17

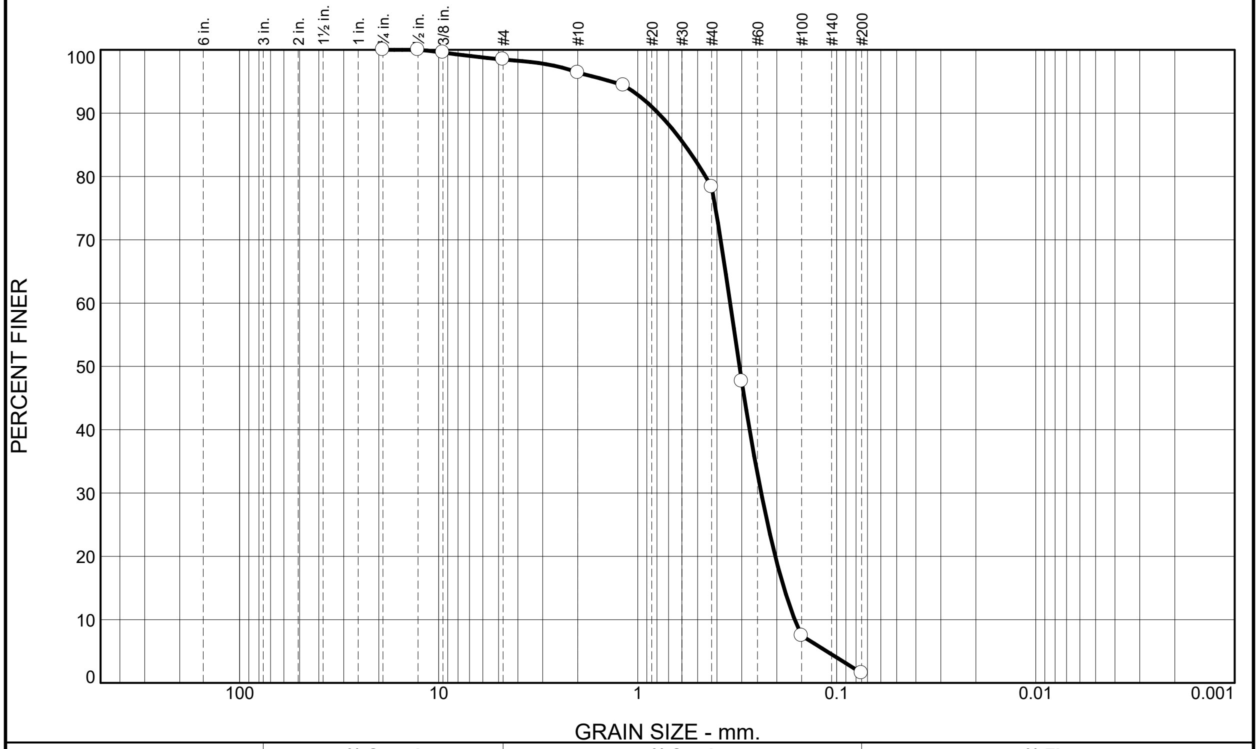
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-36

Tested By: BN **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	2.1	18.0	76.8	1.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	100.0		
.375	99.6		
#4	98.5		
#10	96.4		
#16	94.4		
#40	78.4		
#50	47.6		
#100	7.5		
#200	1.6		

* (no specification provided)

Material Description

Grey poorly graded sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7882 D_{85}= 0.5812 D_{60}= 0.3430

D_{50}= 0.3080 D_{30}= 0.2396 D_{15}= 0.1841

D_{10}= 0.1626 C_u= 2.11 C_c= 1.03

Classification

USCS= SP AASHTO= A-3

Remarks

Location: TP16-51
Sample Number: 16-283-37 **Depth:** 11-12' **Date:** 1/9/17

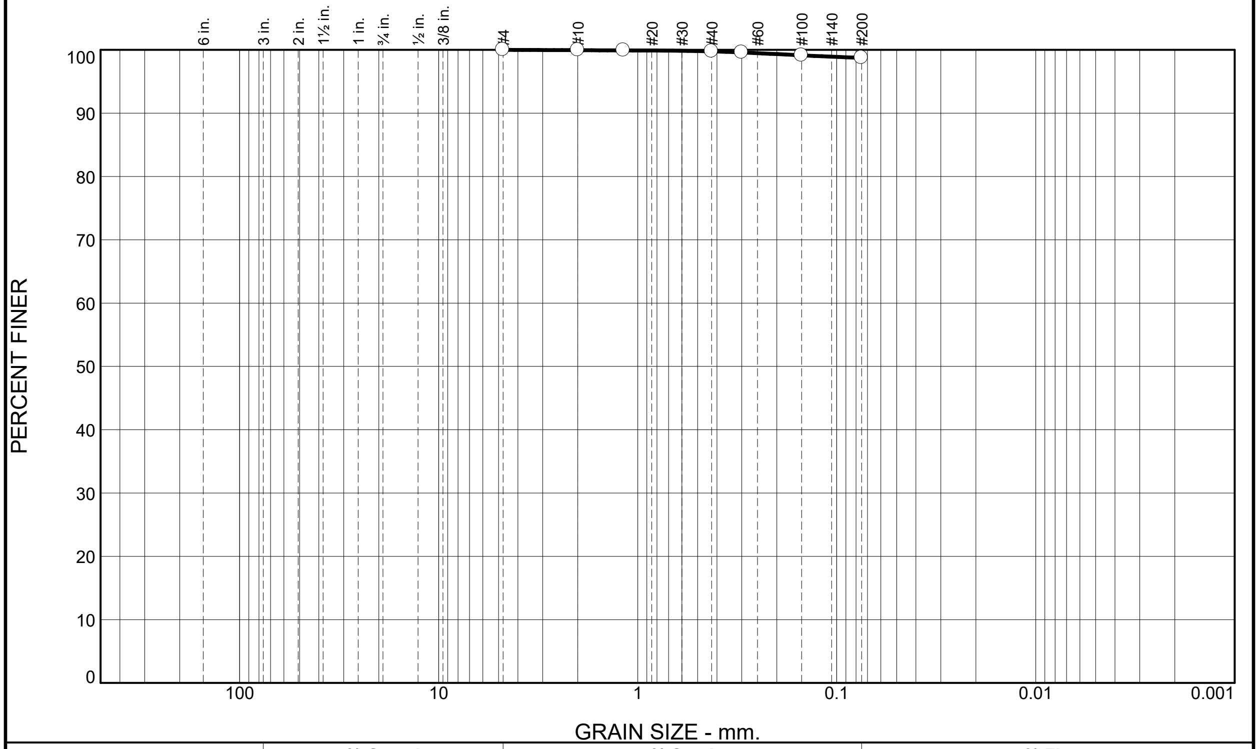
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-37

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.1	1.1	98.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#16	99.9		
#40	99.8		
#50	99.6		
#100	99.1		
#200	98.7		

* (no specification provided)

Material Description

Light brown lean clay

Atterberg Limits

PL= 16 LL= 47 PI= 31

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(33)

Remarks

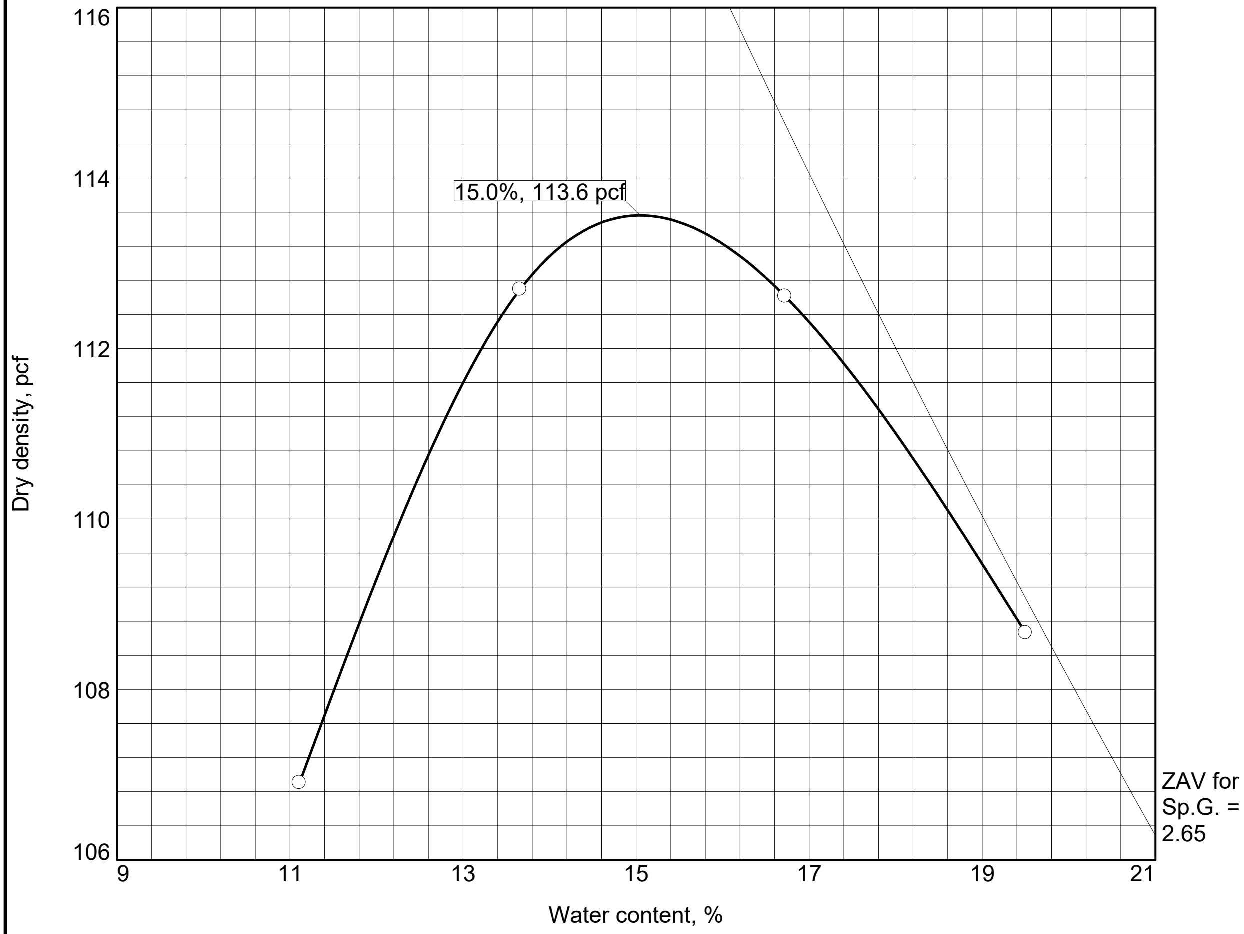
Location: TP16-54
Sample Number: 16-283-38 **Depth:** 12-13' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 12-283-38

Tested By: JG **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
12-13'	CL	A-7-6(33)		2.65	47	31	0.0	98.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 113.6 pcf Optimum moisture = 15.0 %	Light brown lean clay

Project No. 475.0093.011 **Client:** Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

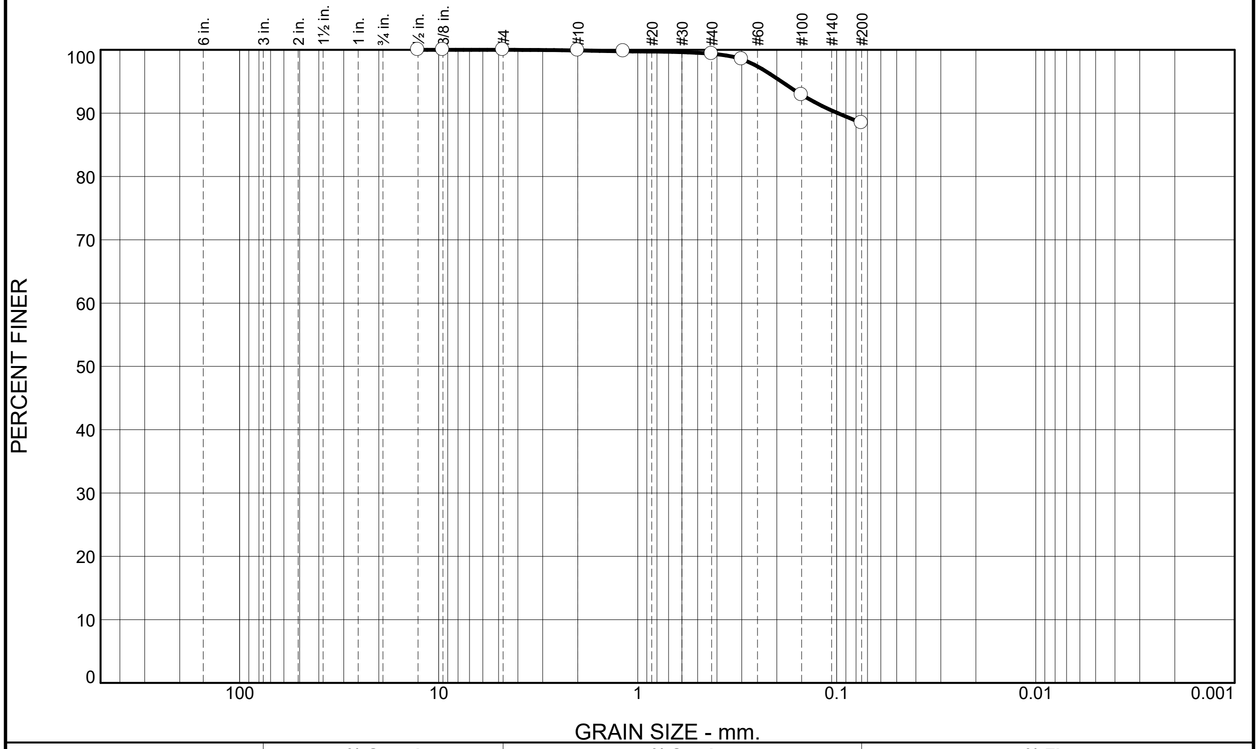
○**Location:** TP16-54 **Sample Number:** 16-283-38

NewFields

Remarks:

Figure 16-283-38

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.5	10.9	88.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
0.375	100.0		
#4	100.0		
#10	99.9		
#16	99.8		
#40	99.4		
#50	98.5		
#100	92.9		
#200	88.5		

* (no specification provided)

Material Description

Light Brown lean clay

Atterberg Limits

PL= 14 LL= 26 PI= 12

Coefficients

D_{90}= 0.0987 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(8)

Remarks

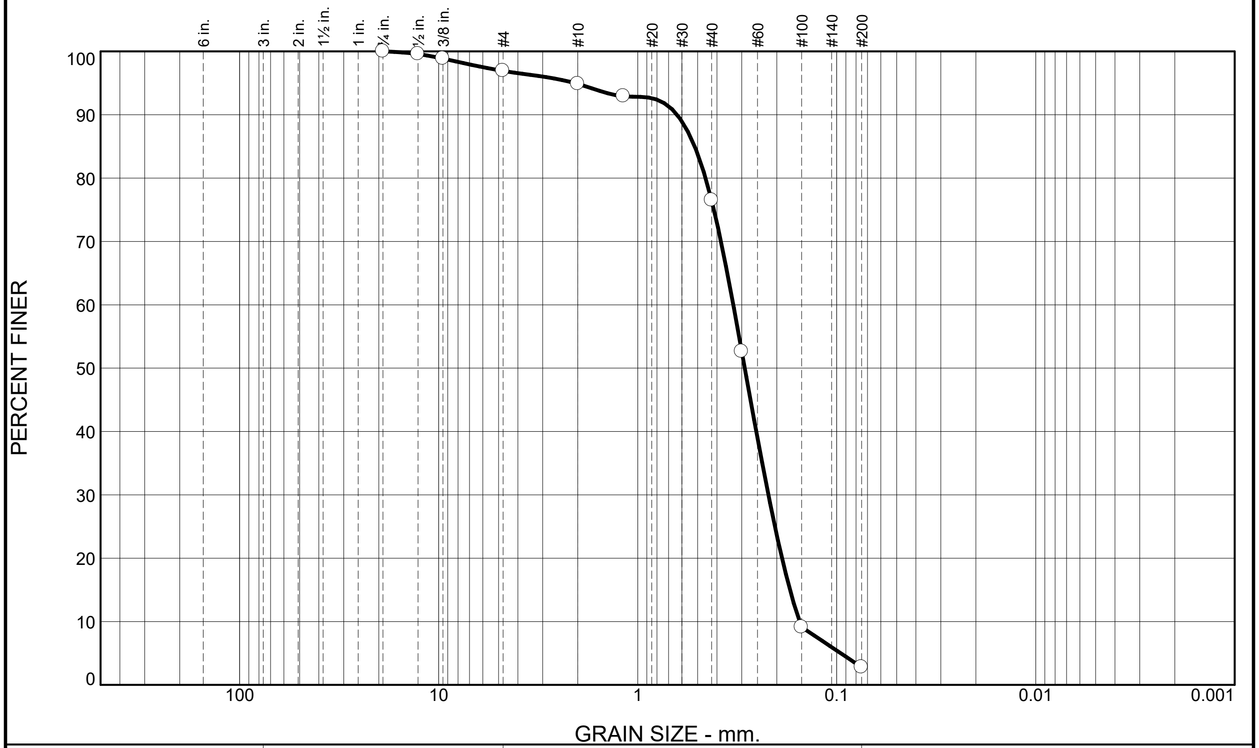
Location: TP16-55
Sample Number: 16-283-39 **Depth:** 2-3' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-39

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	2.0	18.4	73.7	2.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.6		
.375	98.9		
#4	96.9		
#10	94.9		
#16	92.9		
#40	76.5		
#50	52.6		
#100	9.1		
#200	2.8		

* (no specification provided)

Material Description

Grey poorly graded sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6342 D_{85}= 0.5172 D_{60}= 0.3310
D_{50}= 0.2898 D_{30}= 0.2204 D_{15}= 0.1718
D_{10}= 0.1536 C_u= 2.15 C_c= 0.96

Classification

USCS= SP AASHTO= A-3

Remarks

Location: TP16-57
Sample Number: 16-283-40 **Depth:** 17' **Date:** 1/9/17

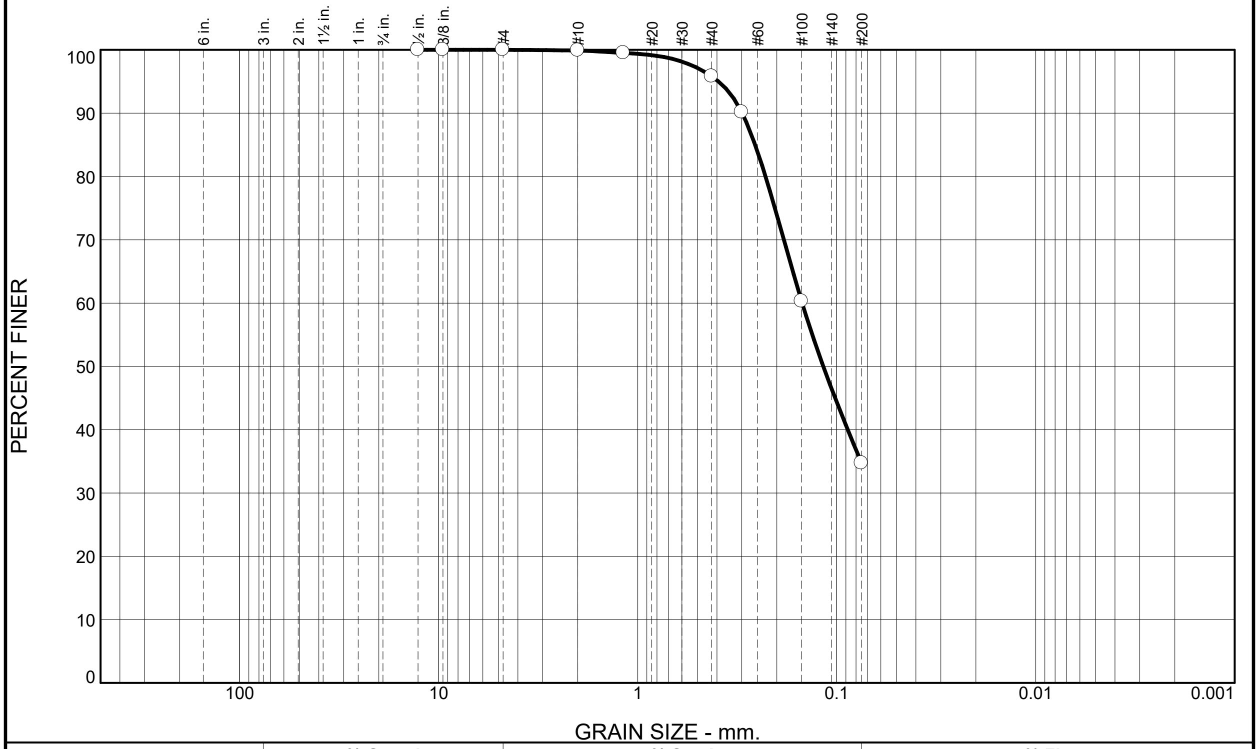
NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion

Project No: 475.0093.011 **Figure** 16-283-40

Tested By: JG **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	4.1	61.1	34.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375"	100.0		
#4	100.0		
#10	99.9		
#16	99.5		
#40	95.8		
#50	90.1		
#100	60.3		
#200	34.7		

* (no specification provided)

Material Description

Tanish Grey silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.2985 D_{85}= 0.2570 D_{60}= 0.1491
D_{50}= 0.1168 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Location: TP16-59
Sample Number: 16-283-41 **Depth:** 3-4' **Date:** 1/9/17

NewFields

Client: Magnum NGLS Solution Mining LLC
Project: Magnum Future Brine Pond Expansion
Project No: 475.0093.011 **Figure** 16-283-41

Tested By: BN **Checked By:** AR

Flexible Wall Permeability
ASTM D5084

Client:	Magnum NFLS Solution Mining LLC	Lab Sample No.:	16-283-06
Project:	Magnum Future Brine Pond Expansion	Field Sample No.:	TP16-11
Project No.:	475.0093.011	Location:	TP16-11
Phase:	0	Elevation/Depth:	7'-8'
Requested By:	Kevin Jennings	Tested By:	RF
Test Started:	1/16/2017	Checked By:	TW
Test Finished:	1/18/2017	Sample Description:	Brown lean clay

Test Boundary Conditions	
Type of Permeant	De-aired Bottled
Magnitude of Back pressure (psi)	40
Saturated (Y/N):	Yes
Stage 1: Effective Stress (psi)	5
Sample Type	Remolded
Burrete Area (cm^2)	0.877

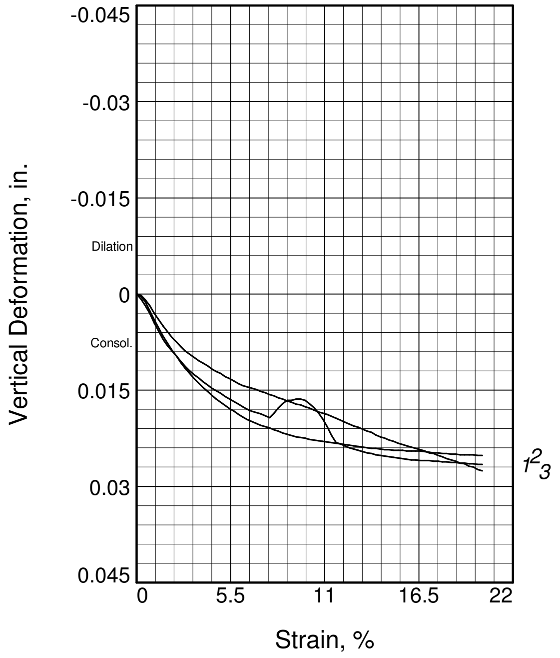
Test Specimen Data	Before Test	After Test
Wet Soil + Tare (g)	613.3	837.39
Dry Soil + Tare (g)	536.57	706.53
Tare (g)	0.0	169.46
Wt. of Water (g)	76.73	130.86
Dry Soil (g)	537.07	537.07
Moisture Content (%)	14.3	24.4
Volume (ft^3)	0.0107	0.0106
Dry Density (pcf)	110.1	110.8
Wet Density (pcf)	125.9	132.5
Saturation (%)	72.8	100.0

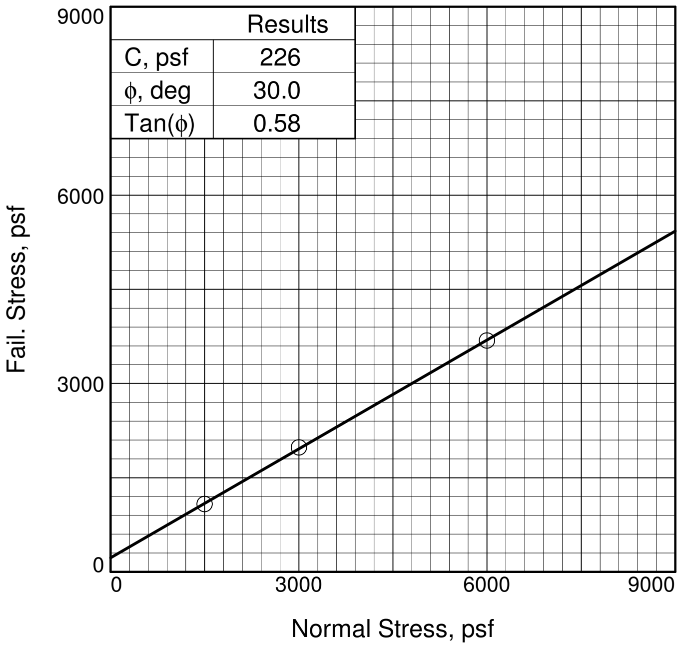
Initial Height (in)	3.024
Initial Diameter (in)	2.796
Initial Area (in^2)	6.138
Consolidated Height (in)	3.013
Area After Consolidation (in^2)	6.093
Diameter During Perm (in)	2.785
Change in Height (in)	0.011
Moisture Content after Consolidation (%)	19.0%
Specific Gravity*	2.70

*Specific gravity is assumed

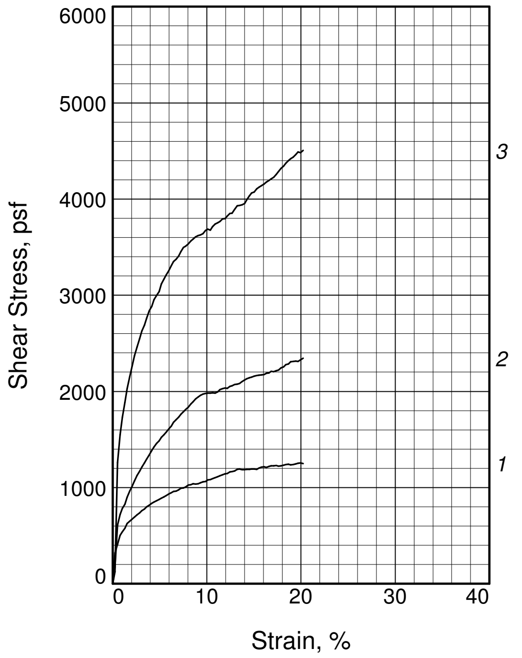
Maximum Dry Density: ASTM D 1557

Maximum Dry Density (pcf):	115.8	
Remolded Density (pcf):	110.1	
Percent Compaction:	95%	
Void Ratio:	0.514	
Optimum Moisture Content(%):	14.3	
Initial Water Content (%):	14.3	
Confining Pressure (psi):	5.0	
Permeability (k cm/s):	**2.4E-07**	
Gradient Range (h/L):	4.8	4.8





Results	
C, psf	226
ϕ, deg	30.0
Tan(ϕ)	0.58



Specimen No.		1	2	3
Initial	Water Content, %	18.7	18.9	18.9
	Dry Density, pcf	102.1	102.1	102.2
	Saturation, %	77.8	78.3	78.5
	Void Ratio	0.6508	0.6506	0.6491
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	22.0	19.0	17.9
	Dry Density, pcf	105.8	111.4	113.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5939	0.5126	0.4832
	Diameter, in.	1.93	1.93	1.93
	Height, in.	0.97	0.92	0.90
Normal Stress, psf		1500	3000	6000
Fail. Stress, psf		1078	1981	3686
Strain, %		10.1	10.1	10.1
Ult. Stress, psf				
Strain, %				
Strain rate, %/min.		0.05	0.05	0.05

Sample Type: Remolded

Description: sandy lean clay

Assumed Specific Gravity= 2.7

Remarks: Failure chosen at 10% strain. Test was inundated. Area correction applied per client.

Figure _______

Client: NewFields

Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011

Location: TP16-15

Depth: 6.5-7.0'

Proj. No.: 108-305/06 **Date Sampled:** 2/13/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

2/17/2017

Date: 2/13/17
Client: NewFields
Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011
Project No.: 108-305/06
Location: TP16-15
Depth: 6.5-7.0'
Description: sandy lean clay
Remarks: Failure chosen at 10% strain. Test was inundated. Area correction applied per client.
Type of Sample: Remolded
Assumed Specific Gravity=2.7 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.110		482.840
Moisture content: Dry soil+tare, gms.	78.410		465.590
Moisture content: Tare, gms.	0.000		387.180
Moisture, %	18.7	22.0	22.0
Moist specimen weight, gms.	93.1		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet density, pcf	121.2	129.0	
Dry density, pcf	102.1	105.8	
Void ratio	0.6508	0.5939	
Saturation, %	77.8	100.0	

Test Readings for Specimen No. 1

Load ring constant = 49.2 lbs. per input unit
Normal stress = 1500 psf
Strain rate, %/min. = 0.05
Strength calculations use strain adjusted areas
Fail. Stress = 1078 psf **at reading no.** 39

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.1321	6.5	0.3	321	-0.0007
2	0.0100	0.1686	8.3	0.5	411	-0.0017
3	0.0150	0.2052	10.1	0.8	502	-0.0029
4	0.0200	0.2194	10.8	1.0	538	-0.0044
5	0.0250	0.2336	11.5	1.3	575	-0.0057
6	0.0300	0.2540	12.5	1.6	627	-0.0070
7	0.0350	0.2621	12.9	1.8	650	-0.0080
8	0.0400	0.2702	13.3	2.1	672	-0.0088
9	0.0450	0.2783	13.7	2.3	695	-0.0096
10	0.0500	0.2865	14.1	2.6	717	-0.0104
11	0.0550	0.2926	14.4	2.8	735	-0.0112

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
12	0.0600	0.3007	14.8	3.1	758	-0.0119
13	0.0650	0.3068	15.1	3.4	776	-0.0125
14	0.0700	0.3149	15.5	3.6	800	-0.0130
15	0.0750	0.3210	15.8	3.9	818	-0.0136
16	0.0800	0.3271	16.1	4.1	836	-0.0141
17	0.0850	0.3312	16.3	4.4	850	-0.0146
18	0.0900	0.3352	16.5	4.7	863	-0.0150
19	0.0950	0.3393	16.7	4.9	877	-0.0154
20	0.1000	0.3433	16.9	5.2	890	-0.0159
21	0.1050	0.3474	17.1	5.4	904	-0.0163
22	0.1100	0.3515	17.3	5.7	918	-0.0167
23	0.1150	0.3555	17.5	6.0	932	-0.0171
24	0.1200	0.3596	17.7	6.2	946	-0.0175
25	0.1250	0.3637	17.9	6.5	960	-0.0179
26	0.1300	0.3637	17.9	6.7	963	-0.0182
27	0.1350	0.3677	18.1	7.0	978	-0.0184
28	0.1400	0.3718	18.3	7.3	992	-0.0186
29	0.1450	0.3718	18.3	7.5	995	-0.0189
30	0.1500	0.3738	18.4	7.8	1005	-0.0192
31	0.1550	0.3799	18.7	8.0	1025	-0.0185
32	0.1600	0.3799	18.7	8.3	1028	-0.0177
33	0.1650	0.3819	18.8	8.5	1038	-0.0170
34	0.1700	0.3799	18.7	8.8	1036	-0.0165
35	0.1750	0.3799	18.7	9.1	1040	-0.0165
36	0.1800	0.3819	18.8	9.3	1049	-0.0163
37	0.1850	0.3840	18.9	9.6	1059	-0.0163
38	0.1900	0.3840	18.9	9.8	1063	-0.0165
39	0.1950	0.3880	19.1	10.1	1078	-0.0170
40	0.2000	0.3880	19.1	10.4	1082	-0.0176
41	0.2050	0.3901	19.2	10.6	1092	-0.0184
42	0.2100	0.3921	19.3	10.9	1102	-0.0194
43	0.2150	0.3941	19.4	11.1	1112	-0.0206
44	0.2200	0.3962	19.5	11.4	1122	-0.0220
45	0.2250	0.3982	19.6	11.7	1132	-0.0231
46	0.2300	0.4002	19.7	11.9	1142	-0.0233
47	0.2350	0.4002	19.7	12.2	1147	-0.0236
48	0.2400	0.4043	19.9	12.4	1163	-0.0239
49	0.2450	0.4043	19.9	12.7	1167	-0.0241
50	0.2500	0.4043	19.9	13.0	1172	-0.0243
51	0.2550	0.4084	20.1	13.2	1188	-0.0245
52	0.2600	0.4084	20.1	13.5	1193	-0.0247
53	0.2650	0.4043	19.9	13.7	1186	-0.0248
54	0.2700	0.4023	19.8	14.0	1184	-0.0250
55	0.2750	0.4023	19.8	14.2	1189	-0.0251
56	0.2800	0.4002	19.7	14.5	1188	-0.0252
57	0.2850	0.4002	19.7	14.8	1193	-0.0253
58	0.2900	0.3982	19.6	15.0	1191	-0.0254

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
59	0.2950	0.3962	19.5	15.3	1190	-0.0255
60	0.3000	0.3982	19.6	15.5	1201	-0.0256
61	0.3050	0.4002	19.7	15.8	1212	-0.0257
62	0.3100	0.4002	19.7	16.1	1217	-0.0258
63	0.3150	0.3962	19.5	16.3	1210	-0.0258
64	0.3200	0.3982	19.6	16.6	1221	-0.0259
65	0.3250	0.3982	19.6	16.8	1226	-0.0259
66	0.3300	0.3962	19.5	17.1	1225	-0.0259
67	0.3350	0.3962	19.5	17.4	1230	-0.0260
68	0.3400	0.3921	19.3	17.6	1222	-0.0260
69	0.3450	0.3921	19.3	17.9	1227	-0.0261
70	0.3500	0.3921	19.3	18.1	1233	-0.0261
71	0.3550	0.3921	19.3	18.4	1238	-0.0262
72	0.3600	0.3921	19.3	18.7	1243	-0.0262
73	0.3650	0.3880	19.1	18.9	1235	-0.0263
74	0.3700	0.3880	19.1	19.2	1241	-0.0263
75	0.3750	0.3880	19.1	19.4	1246	-0.0264
76	0.3800	0.3880	19.1	19.7	1251	-0.0264
77	0.3850	0.3880	19.1	19.9	1257	-0.0265
78	0.3900	0.3840	18.9	20.2	1249	-0.0265

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.210		486.170
Moisture content: Dry soil+tare, gms.	78.420		471.210
Moisture content: Tare, gms.	0.000		392.420
Moisture, %	18.9	19.0	19.0
Moist specimen weight, gms.	93.2		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.92	
Net decrease in height, in.		0.08	
Wet density, pcf	121.4	132.6	
Dry density, pcf	102.1	111.4	
Void ratio	0.6506	0.5126	
Saturation, %	78.3	100.0	

Test Readings for Specimen No. 2

Load ring constant = 49.2 lbs. per input unit

Normal stress = 3000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 1981 psf **at reading no.** 39

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.0711	3.5	0.3	173	-0.0003
2	0.0100	0.2499	12.3	0.5	609	-0.0011
3	0.0150	0.2946	14.5	0.8	721	-0.0025
4	0.0200	0.3190	15.7	1.0	783	-0.0039
5	0.0250	0.3352	16.5	1.3	825	-0.0052
6	0.0300	0.3637	17.9	1.6	898	-0.0065
7	0.0350	0.3880	19.1	1.8	962	-0.0076
8	0.0400	0.4084	20.1	2.1	1016	-0.0087
9	0.0450	0.4287	21.1	2.3	1070	-0.0096
10	0.0500	0.4490	22.1	2.6	1124	-0.0106
11	0.0550	0.4652	22.9	2.8	1169	-0.0115
12	0.0600	0.4815	23.7	3.1	1214	-0.0123
13	0.0650	0.4957	24.4	3.4	1254	-0.0131
14	0.0700	0.5099	25.1	3.6	1295	-0.0138
15	0.0750	0.5262	25.9	3.9	1341	-0.0145
16	0.0800	0.5424	26.7	4.1	1387	-0.0151
17	0.0850	0.5546	27.3	4.4	1423	-0.0157
18	0.0900	0.5668	27.9	4.7	1459	-0.0163
19	0.0950	0.5749	28.3	4.9	1485	-0.0168
20	0.1000	0.5871	28.9	5.2	1522	-0.0173
21	0.1050	0.5953	29.3	5.4	1549	-0.0178
22	0.1100	0.6034	29.7	5.7	1576	-0.0182
23	0.1150	0.6135	30.2	6.0	1608	-0.0187
24	0.1200	0.6237	30.7	6.2	1640	-0.0191
25	0.1250	0.6359	31.3	6.5	1678	-0.0195
26	0.1300	0.6440	31.7	6.7	1706	-0.0198

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
27	0.1350	0.6521	32.1	7.0	1734	-0.0201
28	0.1400	0.6603	32.5	7.3	1762	-0.0204
29	0.1450	0.6684	32.9	7.5	1790	-0.0206
30	0.1500	0.6745	33.2	7.8	1813	-0.0208
31	0.1550	0.6806	33.5	8.0	1836	-0.0211
32	0.1600	0.6908	34.0	8.3	1870	-0.0213
33	0.1650	0.6968	34.3	8.5	1893	-0.0216
34	0.1700	0.7050	34.7	8.8	1923	-0.0218
35	0.1750	0.7090	34.9	9.1	1941	-0.0220
36	0.1800	0.7131	35.1	9.3	1959	-0.0222
37	0.1850	0.7151	35.2	9.6	1972	-0.0223
38	0.1900	0.7151	35.2	9.8	1980	-0.0224
39	0.1950	0.7131	35.1	10.1	1981	-0.0226
40	0.2000	0.7111	35.0	10.4	1983	-0.0227
41	0.2050	0.7090	34.9	10.6	1985	-0.0228
42	0.2100	0.7050	34.7	10.9	1981	-0.0229
43	0.2150	0.7070	34.8	11.1	1994	-0.0230
44	0.2200	0.7131	35.1	11.4	2019	-0.0231
45	0.2250	0.7131	35.1	11.7	2027	-0.0232
46	0.2300	0.7131	35.1	11.9	2035	-0.0233
47	0.2350	0.7090	34.9	12.2	2031	-0.0234
48	0.2400	0.7131	35.1	12.4	2051	-0.0235
49	0.2450	0.7131	35.1	12.7	2059	-0.0236
50	0.2500	0.7151	35.2	13.0	2073	-0.0237
51	0.2550	0.7131	35.1	13.2	2075	-0.0238
52	0.2600	0.7131	35.1	13.5	2083	-0.0239
53	0.2650	0.7172	35.3	13.7	2103	-0.0240
54	0.2700	0.7192	35.4	14.0	2118	-0.0240
55	0.2750	0.7212	35.5	14.2	2132	-0.0241
56	0.2800	0.7212	35.5	14.5	2141	-0.0242
57	0.2850	0.7212	35.5	14.8	2149	-0.0242
58	0.2900	0.7212	35.5	15.0	2158	-0.0243
59	0.2950	0.7212	35.5	15.3	2167	-0.0243
60	0.3000	0.7192	35.4	15.5	2169	-0.0243
61	0.3050	0.7172	35.3	15.8	2172	-0.0244
62	0.3100	0.7151	35.2	16.1	2175	-0.0244
63	0.3150	0.7172	35.3	16.3	2190	-0.0244
64	0.3200	0.7151	35.2	16.6	2193	-0.0244
65	0.3250	0.7172	35.3	16.8	2208	-0.0245
66	0.3300	0.7131	35.1	17.1	2204	-0.0246
67	0.3350	0.7131	35.1	17.4	2214	-0.0247
68	0.3400	0.7131	35.1	17.6	2223	-0.0247
69	0.3450	0.7172	35.3	17.9	2245	-0.0248
70	0.3500	0.7172	35.3	18.1	2254	-0.0248
71	0.3550	0.7212	35.5	18.4	2277	-0.0249
72	0.3600	0.7212	35.5	18.7	2286	-0.0249
73	0.3650	0.7253	35.7	18.9	2309	-0.0250

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
74	0.3700	0.7233	35.6	19.2	2313	-0.0250
75	0.3750	0.7212	35.5	19.4	2316	-0.0250
76	0.3800	0.7172	35.3	19.7	2313	-0.0250
77	0.3850	0.7192	35.4	19.9	2329	-0.0251
78	0.3900	0.7212	35.5	20.2	2346	-0.0251

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.310		484.720
Moisture content: Dry soil+tare, gms.	78.490		470.670
Moisture content: Tare, gms.	0.000		392.180
Moisture, %	18.9	17.9	17.9
Moist specimen weight, gms.	93.3		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.90	
Net decrease in height, in.		0.10	
Wet density, pcf	121.5	134.0	
Dry density, pcf	102.2	113.6	
Void ratio	0.6491	0.4832	
Saturation, %	78.5	100.0	

Test Readings for Specimen No. 3

Load ring constant = 49.2 lbs. per input unit

Normal stress = 6000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 3686 psf **at reading no.** 39

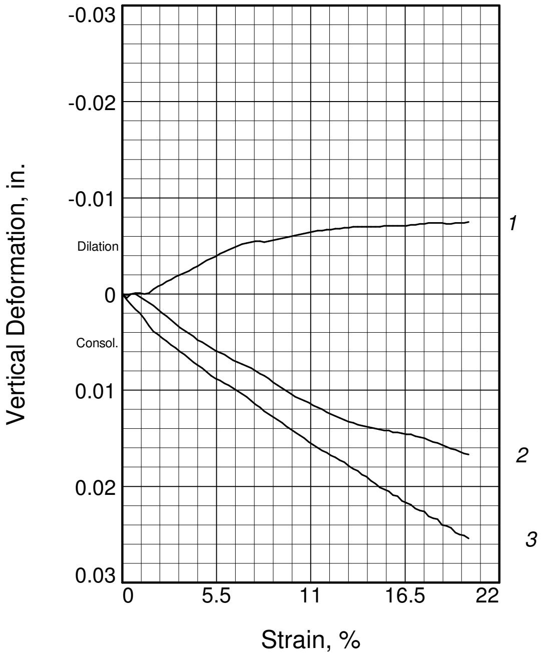
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.0508	2.5	0.3	123	-0.0002
2	0.0100	0.5160	25.4	0.5	1258	-0.0009
3	0.0150	0.6339	31.2	0.8	1550	-0.0018
4	0.0200	0.7050	34.7	1.0	1730	-0.0030
5	0.0250	0.7659	37.7	1.3	1886	-0.0040
6	0.0300	0.8208	40.4	1.6	2028	-0.0050
7	0.0350	0.8675	42.7	1.8	2150	-0.0059
8	0.0400	0.9122	44.9	2.1	2269	-0.0068
9	0.0450	0.9508	46.8	2.3	2373	-0.0075
10	0.0500	0.9833	48.4	2.6	2462	-0.0082
11	0.0550	1.0138	49.9	2.8	2548	-0.0089
12	0.0600	1.0422	51.3	3.1	2628	-0.0094
13	0.0650	1.0625	52.3	3.4	2688	-0.0099
14	0.0700	1.0869	53.5	3.6	2760	-0.0104
15	0.0750	1.1133	54.8	3.9	2836	-0.0108
16	0.0800	1.1275	55.5	4.1	2883	-0.0112
17	0.0850	1.1519	56.7	4.4	2955	-0.0117

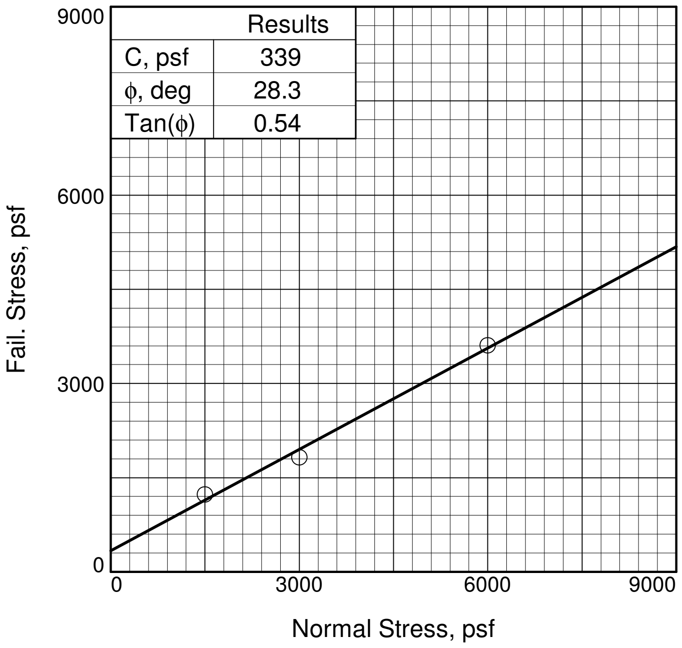
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
18	0.0900	1.1641	57.3	4.7	2997	-0.0121
19	0.0950	1.1763	57.9	4.9	3039	-0.0124
20	0.1000	1.2027	59.2	5.2	3118	-0.0129
21	0.1050	1.2169	59.9	5.4	3166	-0.0132
22	0.1100	1.2291	60.5	5.7	3209	-0.0136
23	0.1150	1.2413	61.1	6.0	3253	-0.0140
24	0.1200	1.2576	61.9	6.2	3307	-0.0143
25	0.1250	1.2698	62.5	6.5	3351	-0.0145
26	0.1300	1.2738	62.7	6.7	3374	-0.0147
27	0.1350	1.2820	63.1	7.0	3408	-0.0149
28	0.1400	1.2941	63.7	7.3	3453	-0.0152
29	0.1450	1.3063	64.3	7.5	3498	-0.0154
30	0.1500	1.3063	64.3	7.8	3511	-0.0157
31	0.1550	1.3104	64.5	8.0	3534	-0.0159
32	0.1600	1.3165	64.8	8.3	3564	-0.0162
33	0.1650	1.3185	64.9	8.5	3583	-0.0164
34	0.1700	1.3226	65.1	8.8	3607	-0.0167
35	0.1750	1.3226	65.1	9.1	3620	-0.0169
36	0.1800	1.3206	65.0	9.3	3628	-0.0172
37	0.1850	1.3206	65.0	9.6	3642	-0.0173
38	0.1900	1.3266	65.3	9.8	3672	-0.0176
39	0.1950	1.3266	65.3	10.1	3686	-0.0178
40	0.2000	1.3185	64.9	10.4	3677	-0.0181
41	0.2050	1.3266	65.3	10.6	3714	-0.0184
42	0.2100	1.3307	65.5	10.9	3740	-0.0186
43	0.2150	1.3307	65.5	11.1	3754	-0.0188
44	0.2200	1.3307	65.5	11.4	3768	-0.0191
45	0.2250	1.3348	65.7	11.7	3794	-0.0194
46	0.2300	1.3307	65.5	11.9	3797	-0.0197
47	0.2350	1.3348	65.7	12.2	3824	-0.0200
48	0.2400	1.3388	65.9	12.4	3850	-0.0203
49	0.2450	1.3348	65.7	12.7	3854	-0.0206
50	0.2500	1.3429	66.1	13.0	3892	-0.0208
51	0.2550	1.3510	66.5	13.2	3931	-0.0211
52	0.2600	1.3470	66.3	13.5	3935	-0.0214
53	0.2650	1.3429	66.1	13.7	3938	-0.0216
54	0.2700	1.3429	66.1	14.0	3954	-0.0220
55	0.2750	1.3510	66.5	14.2	3994	-0.0223
56	0.2800	1.3592	66.9	14.5	4034	-0.0225
57	0.2850	1.3632	67.1	14.8	4062	-0.0228
58	0.2900	1.3612	67.0	15.0	4073	-0.0230
59	0.2950	1.3673	67.3	15.3	4107	-0.0233
60	0.3000	1.3673	67.3	15.5	4124	-0.0235
61	0.3050	1.3673	67.3	15.8	4141	-0.0237
62	0.3100	1.3673	67.3	16.1	4158	-0.0239
63	0.3150	1.3673	67.3	16.3	4175	-0.0241
64	0.3200	1.3673	67.3	16.6	4192	-0.0243

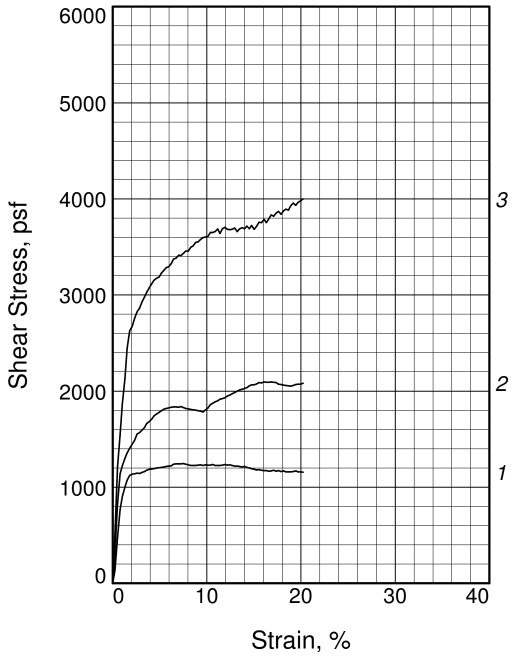
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
65	0.3250	1.3673	67.3	16.8	4209	-0.0245
66	0.3300	1.3673	67.3	17.1	4227	-0.0248
67	0.3350	1.3713	67.5	17.4	4257	-0.0249
68	0.3400	1.3754	67.7	17.6	4288	-0.0252
69	0.3450	1.3795	67.9	17.9	4318	-0.0254
70	0.3500	1.3815	68.0	18.1	4343	-0.0257
71	0.3550	1.3856	68.2	18.4	4374	-0.0259
72	0.3600	1.3876	68.3	18.7	4399	-0.0261
73	0.3650	1.3876	68.3	18.9	4418	-0.0264
74	0.3700	1.3876	68.3	19.2	4437	-0.0265
75	0.3750	1.3896	68.4	19.4	4462	-0.0269
76	0.3800	1.3917	68.5	19.7	4488	-0.0270
77	0.3850	1.3835	68.1	19.9	4481	-0.0274
78	0.3900	1.3856	68.2	20.2	4507	-0.0276





Results	
C, psf	339
ϕ, deg	28.3
Tan(ϕ)	0.54



Specimen No.		1	2	3
Initial	Water Content, %	15.5	15.5	15.5
	Dry Density, pcf	107.1	107.0	107.9
	Saturation, %	73.1	72.9	74.7
	Void Ratio	0.5745	0.5755	0.5620
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	21.2	19.9	19.4
	Dry Density, pcf	107.3	109.7	110.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5714	0.5361	0.5230
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.00	0.97	0.97
Normal Stress, psf		1500	3000	6000
Fail. Stress, psf		1231	1823	3607
Strain, %		10.1	10.1	10.1
Ult. Stress, psf				
Strain, %				
Strain rate, %/min.		0.05	0.05	0.05

Sample Type: Remolded

Description: Brown lean clay

Assumed Specific Gravity= 2.7

Remarks: Failure chosen at 10% strain. Test was inundated. Area correction applied per client.

Figure _______

Client: NewFields

Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011

Location: TP-16-21

Depth: 6-7'

Proj. No.: 108-305/06 **Date Sampled:** 2/20/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

2/23/2017

Date:	2/20/17
Client:	NewFields
Project:	Magnum Future Brine Pond Expansion NewFields#475.0093.011
Project No.:	108-305/06
Location:	TP-16-21
Depth:	6-7'
Description:	Brown lean clay
Remarks:	Failure chosen at 10% strain. Test was inundated. Area correction applied per client.
Type of Sample:	Remolded

Assumed Specific Gravity=2.7 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	369.800		502.390
Moisture content: Dry soil+tare, gms.	345.190		485.010
Moisture content: Tare, gms.	186.900		402.900
Moisture, %	15.5	21.2	21.2
Moist specimen weight, gms.	95.0		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	1.00	
Net decrease in height, in.		0.00	
Wet density, pcf	123.7	130.0	
Dry density, pcf	107.1	107.3	
Void ratio	0.5745	0.5714	
Saturation, %	73.1	100.0	

Test Readings for Specimen No. 1

Load ring constant = 49.2 lbs. per input unit

Normal stress = 1500 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 1231 psf **at reading no.** 39

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.0569	2.8	0.3	138	0.0000
2	0.0100	0.1950	9.6	0.5	475	0.0001
3	0.0150	0.3129	15.4	0.8	765	0.0002
4	0.0200	0.3677	18.1	1.0	902	0.0002
5	0.0250	0.4063	20.0	1.3	1001	0.0001
6	0.0300	0.4348	21.4	1.6	1074	0.0002
7	0.0350	0.4531	22.3	1.8	1123	0.0006
8	0.0400	0.4571	22.5	2.1	1137	0.0009
9	0.0450	0.4571	22.5	2.3	1141	0.0011
10	0.0500	0.4571	22.5	2.6	1145	0.0014
11	0.0550	0.4551	22.4	2.8	1144	0.0016

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
12	0.0600	0.4571	22.5	3.1	1153	0.0019
13	0.0650	0.4591	22.6	3.4	1162	0.0021
14	0.0700	0.4632	22.8	3.6	1176	0.0023
15	0.0750	0.4652	22.9	3.9	1185	0.0025
16	0.0800	0.4652	22.9	4.1	1189	0.0028
17	0.0850	0.4652	22.9	4.4	1194	0.0030
18	0.0900	0.4652	22.9	4.7	1198	0.0033
19	0.0950	0.4652	22.9	4.9	1202	0.0036
20	0.1000	0.4652	22.9	5.2	1206	0.0038
21	0.1050	0.4652	22.9	5.4	1210	0.0040
22	0.1100	0.4652	22.9	5.7	1215	0.0043
23	0.1150	0.4652	22.9	6.0	1219	0.0045
24	0.1200	0.4652	22.9	6.2	1223	0.0047
25	0.1250	0.4693	23.1	6.5	1239	0.0049
26	0.1300	0.4693	23.1	6.7	1243	0.0051
27	0.1350	0.4673	23.0	7.0	1242	0.0053
28	0.1400	0.4652	22.9	7.3	1241	0.0054
29	0.1450	0.4652	22.9	7.5	1246	0.0055
30	0.1500	0.4612	22.7	7.8	1239	0.0056
31	0.1550	0.4571	22.5	8.0	1233	0.0056
32	0.1600	0.4531	22.3	8.3	1226	0.0055
33	0.1650	0.4510	22.2	8.5	1225	0.0056
34	0.1700	0.4490	22.1	8.8	1224	0.0057
35	0.1750	0.4490	22.1	9.1	1229	0.0058
36	0.1800	0.4490	22.1	9.3	1234	0.0059
37	0.1850	0.4449	21.9	9.6	1227	0.0060
38	0.1900	0.4449	21.9	9.8	1232	0.0061
39	0.1950	0.4429	21.8	10.1	1231	0.0062
40	0.2000	0.4409	21.7	10.4	1230	0.0063
41	0.2050	0.4409	21.7	10.6	1234	0.0064
42	0.2100	0.4368	21.5	10.9	1228	0.0065
43	0.2150	0.4348	21.4	11.1	1226	0.0066
44	0.2200	0.4327	21.3	11.4	1225	0.0067
45	0.2250	0.4327	21.3	11.7	1230	0.0067
46	0.2300	0.4327	21.3	11.9	1235	0.0068
47	0.2350	0.4287	21.1	12.2	1228	0.0068
48	0.2400	0.4287	21.1	12.4	1233	0.0069
49	0.2450	0.4246	20.9	12.7	1226	0.0069
50	0.2500	0.4205	20.7	13.0	1219	0.0070
51	0.2550	0.4185	20.6	13.2	1218	0.0070
52	0.2600	0.4165	20.5	13.5	1217	0.0071
53	0.2650	0.4124	20.3	13.7	1210	0.0071
54	0.2700	0.4124	20.3	14.0	1214	0.0071
55	0.2750	0.4084	20.1	14.2	1207	0.0071
56	0.2800	0.4043	19.9	14.5	1200	0.0071
57	0.2850	0.4002	19.7	14.8	1193	0.0071
58	0.2900	0.3962	19.5	15.0	1185	0.0071

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
59	0.2950	0.3921	19.3	15.3	1178	0.0072
60	0.3000	0.3921	19.3	15.5	1183	0.0072
61	0.3050	0.3880	19.1	15.8	1175	0.0072
62	0.3100	0.3860	19.0	16.1	1174	0.0072
63	0.3150	0.3840	18.9	16.3	1172	0.0072
64	0.3200	0.3799	18.7	16.6	1165	0.0072
65	0.3250	0.3799	18.7	16.8	1170	0.0073
66	0.3300	0.3799	18.7	17.1	1174	0.0073
67	0.3350	0.3758	18.5	17.4	1167	0.0074
68	0.3400	0.3758	18.5	17.6	1172	0.0074
69	0.3450	0.3718	18.3	17.9	1164	0.0075
70	0.3500	0.3718	18.3	18.1	1169	0.0075
71	0.3550	0.3677	18.1	18.4	1161	0.0075
72	0.3600	0.3657	18.0	18.7	1159	0.0075
73	0.3650	0.3637	17.9	18.9	1158	0.0074
74	0.3700	0.3637	17.9	19.2	1163	0.0074
75	0.3750	0.3637	17.9	19.4	1168	0.0075
76	0.3800	0.3596	17.7	19.7	1160	0.0075
77	0.3850	0.3576	17.6	19.9	1158	0.0075
78	0.3900	0.3555	17.5	20.2	1157	0.0076

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	369.800		492.430
Moisture content: Dry soil+tare, gms.	345.190		476.300
Moisture content: Tare, gms.	186.900		395.080
Moisture, %	15.5	19.9	19.9
Moist specimen weight, gms.	94.9		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet density, pcf	123.6	131.5	
Dry density, pcf	107.0	109.7	
Void ratio	0.5755	0.5361	
Saturation, %	72.9	100.0	

Test Readings for Specimen No. 2

Load ring constant = 49.2 lbs. per input unit

Normal stress = 3000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 1823 psf **at reading no.** 39

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0001
1	0.0050	0.1321	6.5	0.3	321	-0.0003
2	0.0100	0.3393	16.7	0.5	827	0.0001
3	0.0150	0.4652	22.9	0.8	1138	0.0001
4	0.0200	0.4977	24.5	1.0	1222	-0.0002
5	0.0250	0.5282	26.0	1.3	1301	-0.0005
6	0.0300	0.5485	27.0	1.6	1355	-0.0008
7	0.0350	0.5668	27.9	1.8	1405	-0.0011
8	0.0400	0.5831	28.7	2.1	1450	-0.0015
9	0.0450	0.5953	29.3	2.3	1486	-0.0019
10	0.0500	0.6196	30.5	2.6	1552	-0.0022
11	0.0550	0.6237	30.7	2.8	1567	-0.0026
12	0.0600	0.6318	31.1	3.1	1593	-0.0030
13	0.0650	0.6400	31.5	3.4	1619	-0.0034
14	0.0700	0.6542	32.2	3.6	1661	-0.0037
15	0.0750	0.6603	32.5	3.9	1682	-0.0040
16	0.0800	0.6684	32.9	4.1	1709	-0.0043
17	0.0850	0.6786	33.4	4.4	1741	-0.0047
18	0.0900	0.6847	33.7	4.7	1763	-0.0049
19	0.0950	0.6887	33.9	4.9	1779	-0.0052
20	0.1000	0.6928	34.1	5.2	1796	-0.0055
21	0.1050	0.6968	34.3	5.4	1813	-0.0058
22	0.1100	0.6968	34.3	5.7	1820	-0.0060
23	0.1150	0.6968	34.3	6.0	1826	-0.0062
24	0.1200	0.6968	34.3	6.2	1833	-0.0065
25	0.1250	0.6948	34.2	6.5	1834	-0.0068
26	0.1300	0.6928	34.1	6.7	1835	-0.0070

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
27	0.1350	0.6887	33.9	7.0	1831	-0.0072
28	0.1400	0.6887	33.9	7.3	1837	-0.0074
29	0.1450	0.6826	33.6	7.5	1828	-0.0076
30	0.1500	0.6765	33.3	7.8	1818	-0.0079
31	0.1550	0.6725	33.1	8.0	1814	-0.0082
32	0.1600	0.6684	32.9	8.3	1809	-0.0084
33	0.1650	0.6643	32.7	8.5	1805	-0.0087
34	0.1700	0.6603	32.5	8.8	1801	-0.0091
35	0.1750	0.6562	32.3	9.1	1796	-0.0094
36	0.1800	0.6521	32.1	9.3	1792	-0.0097
37	0.1850	0.6461	31.8	9.6	1782	-0.0100
38	0.1900	0.6521	32.1	9.8	1805	-0.0103
39	0.1950	0.6562	32.3	10.1	1823	-0.0106
40	0.2000	0.6664	32.8	10.4	1859	-0.0108
41	0.2050	0.6684	32.9	10.6	1871	-0.0110
42	0.2100	0.6725	33.1	10.9	1890	-0.0112
43	0.2150	0.6725	33.1	11.1	1897	-0.0115
44	0.2200	0.6765	33.3	11.4	1916	-0.0117
45	0.2250	0.6765	33.3	11.7	1923	-0.0119
46	0.2300	0.6765	33.3	11.9	1931	-0.0122
47	0.2350	0.6806	33.5	12.2	1950	-0.0124
48	0.2400	0.6806	33.5	12.4	1957	-0.0126
49	0.2450	0.6826	33.6	12.7	1971	-0.0128
50	0.2500	0.6847	33.7	13.0	1984	-0.0130
51	0.2550	0.6867	33.8	13.2	1998	-0.0132
52	0.2600	0.6887	33.9	13.5	2012	-0.0133
53	0.2650	0.6887	33.9	13.7	2020	-0.0135
54	0.2700	0.6887	33.9	14.0	2028	-0.0136
55	0.2750	0.6887	33.9	14.2	2036	-0.0137
56	0.2800	0.6928	34.1	14.5	2056	-0.0138
57	0.2850	0.6928	34.1	14.8	2064	-0.0139
58	0.2900	0.6908	34.0	15.0	2067	-0.0140
59	0.2950	0.6908	34.0	15.3	2075	-0.0141
60	0.3000	0.6928	34.1	15.5	2090	-0.0141
61	0.3050	0.6887	33.9	15.8	2086	-0.0143
62	0.3100	0.6887	33.9	16.1	2094	-0.0143
63	0.3150	0.6847	33.7	16.3	2091	-0.0144
64	0.3200	0.6826	33.6	16.6	2093	-0.0145
65	0.3250	0.6806	33.5	16.8	2095	-0.0145
66	0.3300	0.6765	33.3	17.1	2091	-0.0147
67	0.3350	0.6725	33.1	17.4	2088	-0.0148
68	0.3400	0.6643	32.7	17.6	2071	-0.0149
69	0.3450	0.6603	32.5	17.9	2067	-0.0151
70	0.3500	0.6562	32.3	18.1	2063	-0.0153
71	0.3550	0.6521	32.1	18.4	2059	-0.0154
72	0.3600	0.6481	31.9	18.7	2055	-0.0156
73	0.3650	0.6440	31.7	18.9	2050	-0.0158

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
74	0.3700	0.6440	31.7	19.2	2059	-0.0160
75	0.3750	0.6440	31.7	19.4	2068	-0.0161
76	0.3800	0.6420	31.6	19.7	2070	-0.0163
77	0.3850	0.6400	31.5	19.9	2073	-0.0165
78	0.3900	0.6400	31.5	20.2	2082	-0.0166

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	369.800		491.950
Moisture content: Dry soil+tare, gms.	345.190		475.880
Moisture content: Tare, gms.	186.900		392.880
Moisture, %	15.5	19.4	19.4
Moist specimen weight, gms.	95.8		
Diameter, in.	1.93	1.93	
Area, in.^{2}	2.93	2.93	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet density, pcf	124.7	132.1	
Dry density, pcf	107.9	110.7	
Void ratio	0.5620	0.5230	
Saturation, %	74.7	100.0	

Test Readings for Specimen No. 3

Load ring constant = 49.2 lbs. per input unit

Normal stress = 6000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 3607 psf **at reading no.** 39

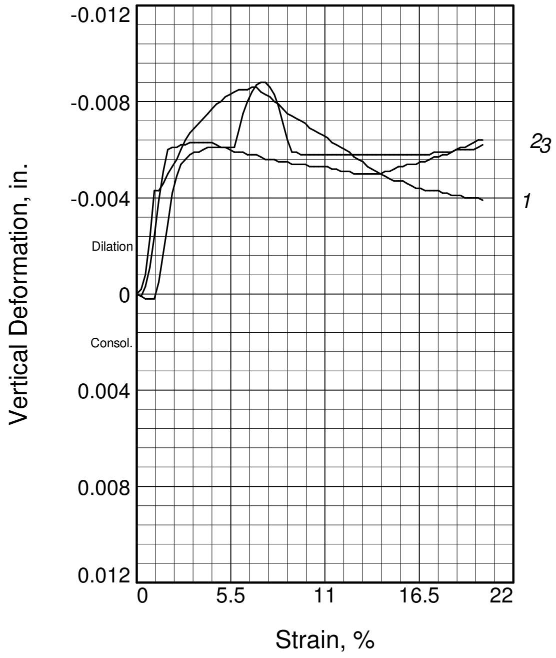
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0002
1	0.0050	0.2154	10.6	0.3	523	-0.0008
2	0.0100	0.4977	24.5	0.5	1213	-0.0013
3	0.0150	0.6318	31.1	0.8	1545	-0.0018
4	0.0200	0.7619	37.5	1.0	1870	-0.0022
5	0.0250	0.8634	42.5	1.3	2126	-0.0028
6	0.0300	0.9894	48.7	1.6	2444	-0.0035
7	0.0350	1.0605	52.2	1.8	2629	-0.0041
8	0.0400	1.0747	52.9	2.1	2673	-0.0044
9	0.0450	1.1032	54.3	2.3	2753	-0.0048
10	0.0500	1.1275	55.5	2.6	2824	-0.0051
11	0.0550	1.1397	56.1	2.8	2864	-0.0055
12	0.0600	1.1601	57.1	3.1	2925	-0.0058
13	0.0650	1.1763	57.9	3.4	2976	-0.0062
14	0.0700	1.1926	58.7	3.6	3028	-0.0065
15	0.0750	1.2068	59.4	3.9	3075	-0.0069
16	0.0800	1.2190	60.0	4.1	3116	-0.0073
17	0.0850	1.2291	60.5	4.4	3153	-0.0076

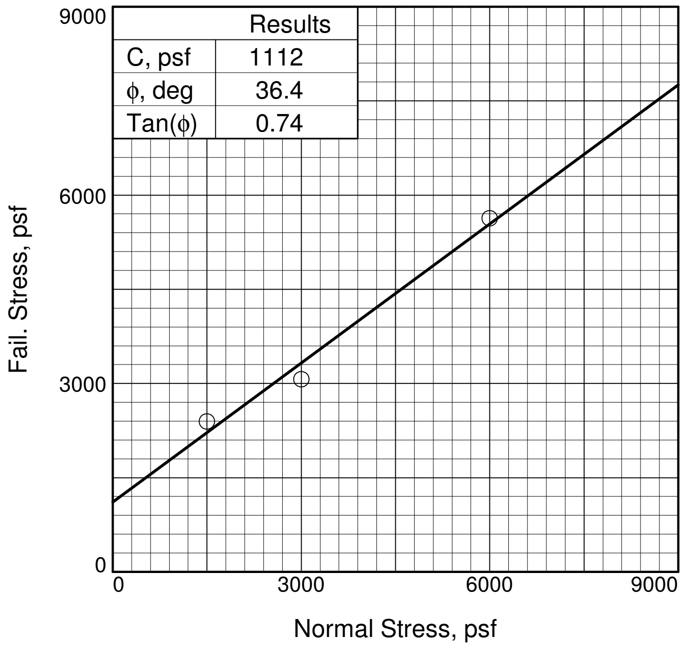
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
18	0.0900	1.2332	60.7	4.7	3175	-0.0079
19	0.0950	1.2332	60.7	4.9	3186	-0.0083
20	0.1000	1.2454	61.3	5.2	3229	-0.0087
21	0.1050	1.2515	61.6	5.4	3256	-0.0090
22	0.1100	1.2576	61.9	5.7	3284	-0.0092
23	0.1150	1.2576	61.9	6.0	3295	-0.0095
24	0.1200	1.2657	62.3	6.2	3328	-0.0097
25	0.1250	1.2779	62.9	6.5	3373	-0.0100
26	0.1300	1.2779	62.9	6.7	3385	-0.0103
27	0.1350	1.2840	63.2	7.0	3413	-0.0106
28	0.1400	1.2779	62.9	7.3	3409	-0.0109
29	0.1450	1.2820	63.1	7.5	3433	-0.0113
30	0.1500	1.2860	63.3	7.8	3456	-0.0117
31	0.1550	1.2820	63.1	8.0	3458	-0.0120
32	0.1600	1.2921	63.6	8.3	3498	-0.0124
33	0.1650	1.2921	63.6	8.5	3511	-0.0127
34	0.1700	1.3002	64.0	8.8	3546	-0.0130
35	0.1750	1.2982	63.9	9.1	3554	-0.0133
36	0.1800	1.3023	64.1	9.3	3578	-0.0136
37	0.1850	1.3043	64.2	9.6	3597	-0.0140
38	0.1900	1.3023	64.1	9.8	3605	-0.0143
39	0.1950	1.2982	63.9	10.1	3607	-0.0146
40	0.2000	1.3084	64.4	10.4	3649	-0.0149
41	0.2050	1.3043	64.2	10.6	3652	-0.0152
42	0.2100	1.3023	64.1	10.9	3660	-0.0156
43	0.2150	1.3063	64.3	11.1	3685	-0.0159
44	0.2200	1.2860	63.3	11.4	3642	-0.0162
45	0.2250	1.2982	63.9	11.7	3690	-0.0165
46	0.2300	1.2982	63.9	11.9	3705	-0.0167
47	0.2350	1.2860	63.3	12.2	3684	-0.0170
48	0.2400	1.2799	63.0	12.4	3681	-0.0172
49	0.2450	1.2759	62.8	12.7	3684	-0.0175
50	0.2500	1.2759	62.8	13.0	3698	-0.0177
51	0.2550	1.2576	61.9	13.2	3659	-0.0181
52	0.2600	1.2616	62.1	13.5	3686	-0.0184
53	0.2650	1.2616	62.1	13.7	3700	-0.0186
54	0.2700	1.2535	61.7	14.0	3691	-0.0190
55	0.2750	1.2576	61.9	14.2	3718	-0.0192
56	0.2800	1.2434	61.2	14.5	3690	-0.0196
57	0.2850	1.2494	61.5	14.8	3723	-0.0199
58	0.2900	1.2312	60.6	15.0	3684	-0.0203
59	0.2950	1.2373	60.9	15.3	3717	-0.0205
60	0.3000	1.2454	61.3	15.5	3756	-0.0207
61	0.3050	1.2393	61.0	15.8	3753	-0.0211
62	0.3100	1.2454	61.3	16.1	3787	-0.0212
63	0.3150	1.2291	60.5	16.3	3753	-0.0217
64	0.3200	1.2373	60.9	16.6	3793	-0.0219

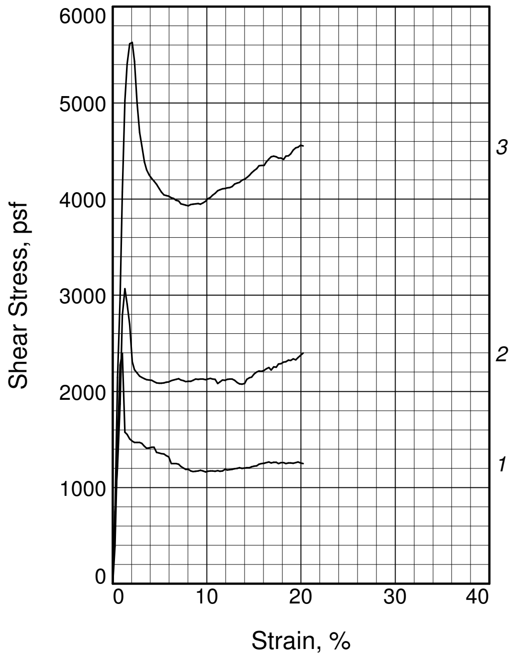
Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
65	0.3250	1.2454	61.3	16.8	3834	-0.0221
66	0.3300	1.2352	60.8	17.1	3819	-0.0225
67	0.3350	1.2413	61.1	17.4	3853	-0.0227
68	0.3400	1.2413	61.1	17.6	3870	-0.0228
69	0.3450	1.2271	60.4	17.9	3841	-0.0233
70	0.3500	1.2332	60.7	18.1	3877	-0.0235
71	0.3550	1.2332	60.7	18.4	3893	-0.0236
72	0.3600	1.2251	60.3	18.7	3884	-0.0242
73	0.3650	1.2332	60.7	18.9	3926	-0.0243
74	0.3700	1.2373	60.9	19.2	3956	-0.0245
75	0.3750	1.2251	60.3	19.4	3934	-0.0250
76	0.3800	1.2291	60.5	19.7	3964	-0.0252
77	0.3850	1.2291	60.5	19.9	3981	-0.0253
78	0.3900	1.2291	60.5	20.2	3998	-0.0256





Results	
C, psf	1112
ϕ, deg	36.4
Tan(ϕ)	0.74



	Specimen No.	1	2	3
Initial	Water Content, %	13.4	13.3	13.5
	Dry Density, pcf	110.3	109.9	109.6
	Saturation, %	68.4	67.2	67.5
	Void Ratio	0.5288	0.5338	0.5379
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.03	1.03	1.04
At Test	Water Content, %	19.6	19.2	18.0
	Dry Density, pcf	110.1	111.0	113.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5303	0.5191	0.4867
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.03	1.02	1.01
	Normal Stress, psf	1500	3000	6000
	Fail. Stress, psf	2393	3067	5629
	Strain, %	1.0	1.3	2.1
	Ult. Stress, psf			
	Strain, %			
	Strain rate, %/min.	0.05	0.05	0.05

Sample Type: Remolded

Description: clayey sand

Assumed Specific Gravity= 2.7

Remarks: Failure chosen at peak shear stress. Test was inundated. Area correction applied per client. Unable to achieve target density.

Figure _______

Client: NewFields

Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011

Location: TP16-30

Depth: 2-3'

Proj. No.: 108-305/06 **Date Sampled:** 2/3/17

Knight Piésold
CONSULTING

Tested By: JHK **Checked By:** JDB

DIRECT SHEAR TEST

2/17/2017

Date: 2/3/17
Client: NewFields
Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011
Project No.: 108-305/06
Location: TP16-30
Depth: 2-3'
Description: clayey sand
Remarks: Failure chosen at peak shear stress. Test was inundated. Area correction applied per client.
Unable to achieve target density.
Type of Sample: Remolded
Assumed Specific Gravity=2.7 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	98.900		497.230
Moisture content: Dry soil+tare, gms.	87.210		480.100
Moisture content: Tare, gms.	0.000		392.890
Moisture, %	13.4	19.6	19.6
Moist specimen weight, gms.	98.9		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.03	1.03	
Net decrease in height, in.		0.00	
Wet density, pcf	125.0	131.8	
Dry density, pcf	110.3	110.1	
Void ratio	0.5288	0.5303	
Saturation, %	68.4	100.0	

Test Readings for Specimen No. 1

Load ring constant = 49.2 lbs. per input unit
Normal stress = 1500 psf
Strain rate, %/min. = 0.05
Strength calculations use strain adjusted areas
Fail. Stress = 2393 psf **at reading no.** 4

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.1585	7.8	0.3	385	0.0002
2	0.0100	0.5831	28.7	0.5	1421	0.0008
3	0.0150	0.9305	45.8	0.8	2276	0.0023
4	0.0200	0.9752	48.0	1.0	2393	0.0043
5	0.0250	0.6400	31.5	1.3	1576	0.0043
6	0.0300	0.6278	30.9	1.6	1551	0.0046
7	0.0350	0.6075	29.9	1.8	1506	0.0050
8	0.0400	0.5953	29.3	2.1	1481	0.0053
9	0.0450	0.5892	29.0	2.3	1470	0.0056
10	0.0500	0.5871	28.9	2.6	1470	0.0060

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
11	0.0550	0.5851	28.8	2.8	1470	0.0064
12	0.0600	0.5790	28.5	3.1	1460	0.0067
13	0.0650	0.5648	27.8	3.4	1429	0.0069
14	0.0700	0.5546	27.3	3.6	1408	0.0071
15	0.0750	0.5546	27.3	3.9	1413	0.0073
16	0.0800	0.5546	27.3	4.1	1418	0.0075
17	0.0850	0.5526	27.2	4.4	1418	0.0077
18	0.0900	0.5303	26.1	4.7	1365	0.0079
19	0.0950	0.5262	25.9	4.9	1359	0.0080
20	0.1000	0.5221	25.7	5.2	1354	0.0082
21	0.1050	0.5181	25.5	5.4	1348	0.0083
22	0.1100	0.5099	25.1	5.7	1331	0.0084
23	0.1150	0.5038	24.8	6.0	1320	0.0085
24	0.1200	0.4754	23.4	6.2	1250	0.0085
25	0.1250	0.4734	23.3	6.5	1249	0.0085
26	0.1300	0.4713	23.2	6.7	1248	0.0086
27	0.1350	0.4673	23.0	7.0	1242	0.0086
28	0.1400	0.4571	22.5	7.3	1220	0.0084
29	0.1450	0.4490	22.1	7.5	1202	0.0083
30	0.1500	0.4429	21.8	7.8	1190	0.0082
31	0.1550	0.4409	21.7	8.0	1189	0.0080
32	0.1600	0.4327	21.3	8.3	1171	0.0079
33	0.1650	0.4287	21.1	8.5	1165	0.0077
34	0.1700	0.4287	21.1	8.8	1169	0.0075
35	0.1750	0.4287	21.1	9.1	1173	0.0074
36	0.1800	0.4287	21.1	9.3	1178	0.0073
37	0.1850	0.4246	20.9	9.6	1171	0.0072
38	0.1900	0.4205	20.7	9.8	1164	0.0071
39	0.1950	0.4205	20.7	10.1	1169	0.0069
40	0.2000	0.4205	20.7	10.4	1173	0.0068
41	0.2050	0.4185	20.6	10.6	1172	0.0067
42	0.2100	0.4165	20.5	10.9	1170	0.0066
43	0.2150	0.4165	20.5	11.1	1175	0.0065
44	0.2200	0.4124	20.3	11.4	1168	0.0063
45	0.2250	0.4124	20.3	11.7	1172	0.0062
46	0.2300	0.4165	20.5	11.9	1189	0.0061
47	0.2350	0.4124	20.3	12.2	1181	0.0060
48	0.2400	0.4124	20.3	12.4	1186	0.0059
49	0.2450	0.4124	20.3	12.7	1191	0.0057
50	0.2500	0.4124	20.3	13.0	1195	0.0056
51	0.2550	0.4124	20.3	13.2	1200	0.0055
52	0.2600	0.4124	20.3	13.5	1205	0.0053
53	0.2650	0.4084	20.1	13.7	1198	0.0052
54	0.2700	0.4084	20.1	14.0	1202	0.0051
55	0.2750	0.4084	20.1	14.2	1207	0.0050
56	0.2800	0.4063	20.0	14.5	1206	0.0049
57	0.2850	0.4084	20.1	14.8	1217	0.0048

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
58	0.2900	0.4084	20.1	15.0	1222	0.0047
59	0.2950	0.4084	20.1	15.3	1227	0.0047
60	0.3000	0.4124	20.3	15.5	1244	0.0047
61	0.3050	0.4124	20.3	15.8	1249	0.0046
62	0.3100	0.4124	20.3	16.1	1254	0.0045
63	0.3150	0.4124	20.3	16.3	1259	0.0044
64	0.3200	0.4124	20.3	16.6	1264	0.0044
65	0.3250	0.4084	20.1	16.8	1257	0.0043
66	0.3300	0.4084	20.1	17.1	1262	0.0043
67	0.3350	0.4063	20.0	17.4	1261	0.0043
68	0.3400	0.4002	19.7	17.6	1248	0.0043
69	0.3450	0.4023	19.8	17.9	1259	0.0042
70	0.3500	0.4002	19.7	18.1	1258	0.0042
71	0.3550	0.3962	19.5	18.4	1251	0.0041
72	0.3600	0.3962	19.5	18.7	1256	0.0041
73	0.3650	0.3941	19.4	18.9	1255	0.0041
74	0.3700	0.3921	19.3	19.2	1254	0.0040
75	0.3750	0.3921	19.3	19.4	1259	0.0040
76	0.3800	0.3921	19.3	19.7	1264	0.0040
77	0.3850	0.3880	19.1	19.9	1257	0.0040
78	0.3900	0.3840	18.9	20.2	1249	0.0039

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	98.850		505.960
Moisture content: Dry soil+tare, gms.	87.260		489.180
Moisture content: Tare, gms.	0.000		401.920
Moisture, %	13.3	19.2	19.2
Moist specimen weight, gms.	98.8		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.03	1.02	
Net decrease in height, in.		0.01	
Wet density, pcf	124.5	132.3	
Dry density, pcf	109.9	111.0	
Void ratio	0.5338	0.5191	
Saturation, %	67.2	100.0	

Test Readings for Specimen No. 2

Load ring constant = 49.2 lbs. per input unit

Normal stress = 3000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 3067 psf **at reading no.** 5

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.3068	15.1	0.3	745	-0.0001
2	0.0100	0.5018	24.7	0.5	1223	0.0003
3	0.0150	0.7639	37.6	0.8	1868	0.0011
4	0.0200	1.1357	55.9	1.0	2787	0.0024
5	0.0250	1.2454	61.3	1.3	3067	0.0039
6	0.0300	1.1763	57.9	1.6	2906	0.0051
7	0.0350	1.0869	53.5	1.8	2694	0.0060
8	0.0400	0.9284	45.7	2.1	2309	0.0061
9	0.0450	0.8919	43.9	2.3	2226	0.0061
10	0.0500	0.8756	43.1	2.6	2193	0.0062
11	0.0550	0.8594	42.3	2.8	2160	0.0062
12	0.0600	0.8512	41.9	3.1	2146	0.0063
13	0.0650	0.8431	41.5	3.4	2133	0.0063
14	0.0700	0.8350	41.1	3.6	2120	0.0063
15	0.0750	0.8309	40.9	3.9	2117	0.0063
16	0.0800	0.8269	40.7	4.1	2114	0.0063
17	0.0850	0.8187	40.3	4.4	2101	0.0063
18	0.0900	0.8106	39.9	4.7	2087	0.0062
19	0.0950	0.8066	39.7	4.9	2084	0.0061
20	0.1000	0.8045	39.6	5.2	2086	0.0061
21	0.1050	0.8025	39.5	5.4	2088	0.0060
22	0.1100	0.8025	39.5	5.7	2095	0.0059
23	0.1150	0.8005	39.4	6.0	2098	0.0059
24	0.1200	0.8025	39.5	6.2	2110	0.0059
25	0.1250	0.8025	39.5	6.5	2118	0.0058
26	0.1300	0.8025	39.5	6.7	2126	0.0058

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
27	0.1350	0.8025	39.5	7.0	2133	0.0058
28	0.1400	0.7944	39.1	7.3	2119	0.0057
29	0.1450	0.7883	38.8	7.5	2111	0.0056
30	0.1500	0.7822	38.5	7.8	2102	0.0056
31	0.1550	0.7801	38.4	8.0	2104	0.0056
32	0.1600	0.7781	38.3	8.3	2106	0.0055
33	0.1650	0.7781	38.3	8.5	2114	0.0055
34	0.1700	0.7801	38.4	8.8	2128	0.0055
35	0.1750	0.7761	38.2	9.1	2124	0.0054
36	0.1800	0.7740	38.1	9.3	2127	0.0054
37	0.1850	0.7720	38.0	9.6	2129	0.0054
38	0.1900	0.7659	37.7	9.8	2120	0.0054
39	0.1950	0.7659	37.7	10.1	2128	0.0053
40	0.2000	0.7659	37.7	10.4	2136	0.0053
41	0.2050	0.7598	37.4	10.6	2127	0.0053
42	0.2100	0.7558	37.2	10.9	2124	0.0053
43	0.2150	0.7375	36.3	11.1	2080	0.0053
44	0.2200	0.7415	36.5	11.4	2100	0.0052
45	0.2250	0.7456	36.7	11.7	2120	0.0052
46	0.2300	0.7415	36.5	11.9	2116	0.0051
47	0.2350	0.7415	36.5	12.2	2124	0.0051
48	0.2400	0.7395	36.4	12.4	2127	0.0051
49	0.2450	0.7375	36.3	12.7	2129	0.0050
50	0.2500	0.7294	35.9	13.0	2114	0.0050
51	0.2550	0.7192	35.4	13.2	2093	0.0050
52	0.2600	0.7111	35.0	13.5	2077	0.0050
53	0.2650	0.7070	34.8	13.7	2074	0.0050
54	0.2700	0.7070	34.8	14.0	2082	0.0050
55	0.2750	0.7192	35.4	14.2	2126	0.0050
56	0.2800	0.7212	35.5	14.5	2141	0.0051
57	0.2850	0.7212	35.5	14.8	2149	0.0051
58	0.2900	0.7294	35.9	15.0	2182	0.0052
59	0.2950	0.7334	36.1	15.3	2203	0.0053
60	0.3000	0.7334	36.1	15.5	2212	0.0053
61	0.3050	0.7294	35.9	15.8	2209	0.0054
62	0.3100	0.7294	35.9	16.1	2218	0.0054
63	0.3150	0.7314	36.0	16.3	2233	0.0054
64	0.3200	0.7334	36.1	16.6	2249	0.0055
65	0.3250	0.7212	35.5	16.8	2220	0.0055
66	0.3300	0.7294	35.9	17.1	2255	0.0056
67	0.3350	0.7253	35.7	17.4	2252	0.0057
68	0.3400	0.7334	36.1	17.6	2286	0.0057
69	0.3450	0.7314	36.0	17.9	2290	0.0058
70	0.3500	0.7334	36.1	18.1	2306	0.0058
71	0.3550	0.7314	36.0	18.4	2309	0.0059
72	0.3600	0.7334	36.1	18.7	2325	0.0060
73	0.3650	0.7294	35.9	18.9	2322	0.0061

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
74	0.3700	0.7314	36.0	19.2	2338	0.0061
75	0.3750	0.7253	35.7	19.4	2329	0.0062
76	0.3800	0.7294	35.9	19.7	2352	0.0063
77	0.3850	0.7334	36.1	19.9	2375	0.0064
78	0.3900	0.7375	36.3	20.2	2399	0.0064

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	99.500		496.930
Moisture content: Dry soil+tare, gms.	87.700		481.120
Moisture content: Tare, gms.	0.000		393.420
Moisture, %	13.5	18.0	18.0
Moist specimen weight, gms.	99.5		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.04	1.01	
Net decrease in height, in.		0.03	
Wet density, pcf	124.3	133.8	
Dry density, pcf	109.6	113.4	
Void ratio	0.5379	0.4867	
Saturation, %	67.5	100.0	

Test Readings for Specimen No. 3

Load ring constant = 49.2 lbs. per input unit

Normal stress = 6000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 5629 psf **at reading no.** 8

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.2844	14.0	0.3	691	-0.0001
2	0.0100	0.8797	43.3	0.5	2145	-0.0002
3	0.0150	1.2129	59.7	0.8	2967	-0.0002
4	0.0200	1.6598	81.7	1.0	4073	-0.0002
5	0.0250	2.0397	100.4	1.3	5023	0.0005
6	0.0300	2.1881	107.7	1.6	5406	0.0017
7	0.0350	2.2653	111.5	1.8	5615	0.0029
8	0.0400	2.2632	111.4	2.1	5629	0.0042
9	0.0450	2.1759	107.1	2.3	5431	0.0049
10	0.0500	1.9971	98.3	2.6	5001	0.0054
11	0.0550	1.8671	91.9	2.8	4692	0.0056
12	0.0600	1.8061	88.9	3.1	4554	0.0058
13	0.0650	1.7330	85.3	3.4	4385	0.0059
14	0.0700	1.6944	83.4	3.6	4302	0.0059
15	0.0750	1.6680	82.1	3.9	4250	0.0060
16	0.0800	1.6476	81.1	4.1	4212	0.0061
17	0.0850	1.6314	80.3	4.4	4185	0.0061

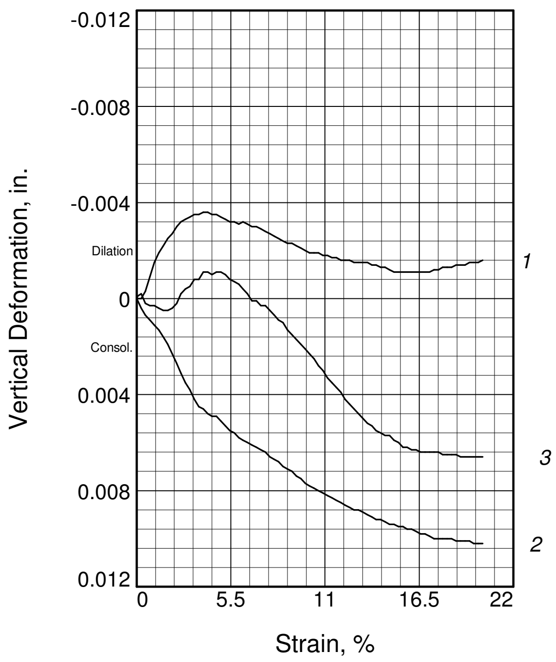
Test Readings for Specimen No. 3

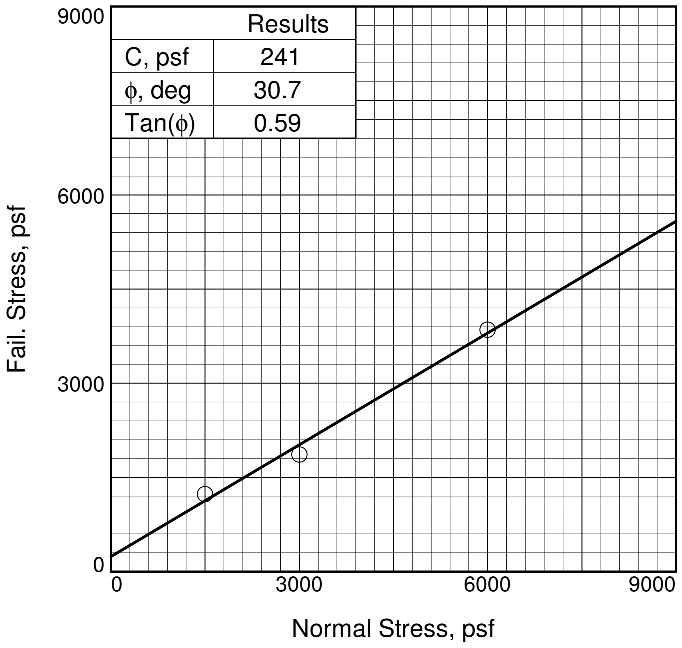
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
18	0.0900	1.6131	79.4	4.7	4153	0.0061
19	0.0950	1.5908	78.3	4.9	4110	0.0061
20	0.1000	1.5704	77.3	5.2	4072	0.0061
21	0.1050	1.5542	76.5	5.4	4044	0.0061
22	0.1100	1.5461	76.1	5.7	4037	0.0061
23	0.1150	1.5379	75.7	6.0	4030	0.0068
24	0.1200	1.5257	75.1	6.2	4012	0.0075
25	0.1250	1.5176	74.7	6.5	4005	0.0080
26	0.1300	1.5054	74.1	6.7	3987	0.0084
27	0.1350	1.4973	73.7	7.0	3980	0.0087
28	0.1400	1.4810	72.9	7.3	3951	0.0088
29	0.1450	1.4729	72.5	7.5	3944	0.0088
30	0.1500	1.4648	72.1	7.8	3936	0.0086
31	0.1550	1.4567	71.7	8.0	3929	0.0083
32	0.1600	1.4567	71.7	8.3	3943	0.0078
33	0.1650	1.4526	71.5	8.5	3947	0.0071
34	0.1700	1.4485	71.3	8.8	3950	0.0064
35	0.1750	1.4445	71.1	9.1	3954	0.0059
36	0.1800	1.4364	70.7	9.3	3946	0.0059
37	0.1850	1.4364	70.7	9.6	3961	0.0058
38	0.1900	1.4364	70.7	9.8	3976	0.0058
39	0.1950	1.4404	70.9	10.1	4002	0.0058
40	0.2000	1.4404	70.9	10.4	4017	0.0058
41	0.2050	1.4424	71.0	10.6	4038	0.0058
42	0.2100	1.4445	71.1	10.9	4059	0.0058
43	0.2150	1.4485	71.3	11.1	4086	0.0058
44	0.2200	1.4465	71.2	11.4	4096	0.0058
45	0.2250	1.4445	71.1	11.7	4106	0.0058
46	0.2300	1.4404	70.9	11.9	4110	0.0058
47	0.2350	1.4364	70.7	12.2	4115	0.0058
48	0.2400	1.4323	70.5	12.4	4119	0.0058
49	0.2450	1.4303	70.4	12.7	4129	0.0058
50	0.2500	1.4343	70.6	13.0	4157	0.0058
51	0.2550	1.4323	70.5	13.2	4168	0.0058
52	0.2600	1.4282	70.3	13.5	4172	0.0058
53	0.2650	1.4303	70.4	13.7	4195	0.0058
54	0.2700	1.4282	70.3	14.0	4205	0.0058
55	0.2750	1.4282	70.3	14.2	4222	0.0058
56	0.2800	1.4303	70.4	14.5	4245	0.0058
57	0.2850	1.4343	70.6	14.8	4274	0.0058
58	0.2900	1.4364	70.7	15.0	4298	0.0058
59	0.2950	1.4364	70.7	15.3	4315	0.0058
60	0.3000	1.4404	70.9	15.5	4345	0.0058
61	0.3050	1.4364	70.7	15.8	4350	0.0058
62	0.3100	1.4303	70.4	16.1	4349	0.0058
63	0.3150	1.4364	70.7	16.3	4386	0.0058
64	0.3200	1.4404	70.9	16.6	4416	0.0058

Test Readings for Specimen No. 3

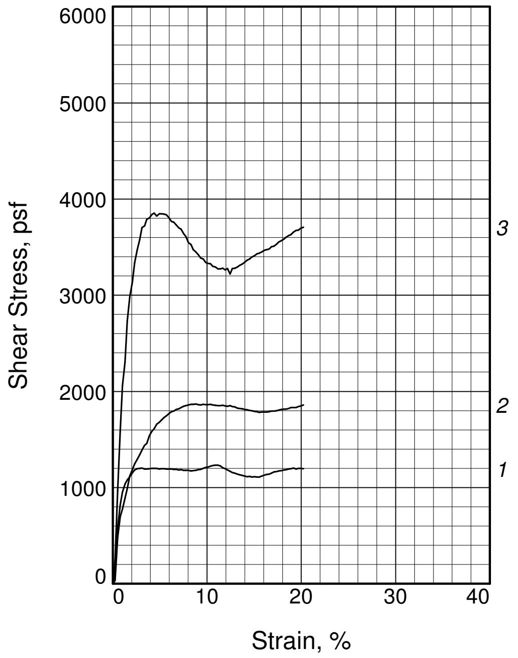
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
65	0.3250	1.4424	71.0	16.8	4441	0.0058
66	0.3300	1.4384	70.8	17.1	4447	0.0058
67	0.3350	1.4303	70.4	17.4	4440	0.0059
68	0.3400	1.4201	69.9	17.6	4427	0.0059
69	0.3450	1.4140	69.6	17.9	4426	0.0059
70	0.3500	1.4038	69.1	18.1	4413	0.0059
71	0.3550	1.4079	69.3	18.4	4445	0.0059
72	0.3600	1.4038	69.1	18.7	4451	0.0060
73	0.3650	1.4038	69.1	18.9	4469	0.0060
74	0.3700	1.4099	69.4	19.2	4508	0.0060
75	0.3750	1.4120	69.5	19.4	4534	0.0060
76	0.3800	1.4079	69.3	19.7	4540	0.0060
77	0.3850	1.4079	69.3	19.9	4560	0.0061
78	0.3900	1.3998	68.9	20.2	4553	0.0062

Cursory interpretations provided require review by a professional engineer. Knight Piesold accepts no responsibility in subsequent analyses.





Results	
C, psf	241
ϕ, deg	30.7
Tan(ϕ)	0.59



	Specimen No.	1	2	3
Initial	Water Content, %	15.6	15.8	16.0
	Dry Density, pcf	109.5	108.1	107.9
	Saturation, %	78.4	76.3	76.8
	Void Ratio	0.5389	0.5591	0.5627
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	21.0	20.3	19.2
	Dry Density, pcf	107.5	108.9	111.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5673	0.5473	0.5188
	Diameter, in.	1.93	1.93	1.93
	Height, in.	1.02	0.99	0.97
	Normal Stress, psf	1500	3000	6000
	Fail. Stress, psf	1233	1867	3852
	Strain, %	10.9	8.8	4.4
	Ult. Stress, psf			
	Strain, %			
	Strain rate, %/min.	0.05	0.05	0.05

Sample Type: Remolded
Description: Light brown lean clay

Assumed Specific Gravity= 2.7
Remarks: Failure chosen at peak deviator stress. Test was inundated. Area correction applied per client.

Figure _______

Client: NewFields

Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011
Location: TP16-54
Depth: 12-13'
Proj. No.: 108-305/06 **Date Sampled:** 2/17/17

Knight Piésold
CONSULTING

Tested By: EAG **Checked By:** JDB

DIRECT SHEAR TEST

Date: 2/17/17
Client: NewFields
Project: Magnum Future Brine Pond Expansion
NewFields#475.0093.011
Project No.: 108-305/06
Location: TP16-54
Depth: 12-13'
Description: Light brown lean clay
Remarks: Failure chosen at peak deviator stress. Test was inundated. Area correction applied per client.
Type of Sample: Remolded
Assumed Specific Gravity=2.7 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	97.270		214.880
Moisture content: Dry soil+tare, gms.	84.110		197.210
Moisture content: Tare, gms.	0.000		113.100
Moisture, %	15.6	21.0	21.0
Moist specimen weight, gms.	97.3		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	1.02	
Net decrease in height, in.		-0.02	
Wet density, pcf	126.7	130.1	
Dry density, pcf	109.5	107.5	
Void ratio	0.5389	0.5673	
Saturation, %	78.4	100.0	

Test Readings for Specimen No. 1

Load ring constant = 49.2 lbs. per input unit
Normal stress = 1500 psf
Strain rate, %/min. = 0.05
Strength calculations use strain adjusted areas
Fail. Stress = 1233 psf **at reading no.** 42

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	0.0000
1	0.0050	0.0447	2.2	0.3	109	0.0000
2	0.0100	0.2377	11.7	0.5	579	0.0003
3	0.0150	0.3352	16.5	0.8	820	0.0009
4	0.0200	0.3880	19.1	1.0	952	0.0015
5	0.0250	0.4205	20.7	1.3	1036	0.0019
6	0.0300	0.4368	21.5	1.6	1079	0.0022
7	0.0350	0.4490	22.1	1.8	1113	0.0025
8	0.0400	0.4632	22.8	2.1	1152	0.0027
9	0.0450	0.4734	23.3	2.3	1181	0.0030
10	0.0500	0.4774	23.5	2.6	1196	0.0032
11	0.0550	0.4774	23.5	2.8	1200	0.0033

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
12	0.0600	0.4774	23.5	3.1	1204	0.0034
13	0.0650	0.4713	23.2	3.4	1193	0.0035
14	0.0700	0.4693	23.1	3.6	1192	0.0035
15	0.0750	0.4693	23.1	3.9	1196	0.0036
16	0.0800	0.4693	23.1	4.1	1200	0.0036
17	0.0850	0.4673	23.0	4.4	1199	0.0035
18	0.0900	0.4652	22.9	4.7	1198	0.0035
19	0.0950	0.4612	22.7	4.9	1191	0.0034
20	0.1000	0.4612	22.7	5.2	1196	0.0033
21	0.1050	0.4591	22.6	5.4	1195	0.0032
22	0.1100	0.4571	22.5	5.7	1194	0.0032
23	0.1150	0.4551	22.4	6.0	1192	0.0031
24	0.1200	0.4531	22.3	6.2	1191	0.0032
25	0.1250	0.4510	22.2	6.5	1190	0.0031
26	0.1300	0.4490	22.1	6.7	1189	0.0030
27	0.1350	0.4449	21.9	7.0	1183	0.0030
28	0.1400	0.4449	21.9	7.3	1187	0.0029
29	0.1450	0.4409	21.7	7.5	1180	0.0028
30	0.1500	0.4388	21.6	7.8	1179	0.0027
31	0.1550	0.4368	21.5	8.0	1178	0.0026
32	0.1600	0.4327	21.3	8.3	1171	0.0025
33	0.1650	0.4327	21.3	8.5	1176	0.0024
34	0.1700	0.4327	21.3	8.8	1180	0.0023
35	0.1750	0.4327	21.3	9.1	1185	0.0023
36	0.1800	0.4327	21.3	9.3	1189	0.0022
37	0.1850	0.4348	21.4	9.6	1199	0.0021
38	0.1900	0.4368	21.5	9.8	1209	0.0020
39	0.1950	0.4368	21.5	10.1	1214	0.0019
40	0.2000	0.4388	21.6	10.4	1224	0.0019
41	0.2050	0.4388	21.6	10.6	1229	0.0019
42	0.2100	0.4388	21.6	10.9	1233	0.0018
43	0.2150	0.4368	21.5	11.1	1232	0.0018
44	0.2200	0.4327	21.3	11.4	1225	0.0017
45	0.2250	0.4246	20.9	11.7	1207	0.0017
46	0.2300	0.4185	20.6	11.9	1194	0.0016
47	0.2350	0.4124	20.3	12.2	1181	0.0016
48	0.2400	0.4063	20.0	12.4	1169	0.0016
49	0.2450	0.4002	19.7	12.7	1155	0.0015
50	0.2500	0.3962	19.5	13.0	1148	0.0015
51	0.2550	0.3921	19.3	13.2	1141	0.0015
52	0.2600	0.3880	19.1	13.5	1134	0.0015
53	0.2650	0.3840	18.9	13.7	1126	0.0014
54	0.2700	0.3799	18.7	14.0	1119	0.0014
55	0.2750	0.3758	18.5	14.2	1111	0.0013
56	0.2800	0.3758	18.5	14.5	1116	0.0013
57	0.2850	0.3718	18.3	14.8	1108	0.0012
58	0.2900	0.3718	18.3	15.0	1112	0.0011

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
59	0.2950	0.3698	18.2	15.3	1111	0.0011
60	0.3000	0.3677	18.1	15.5	1109	0.0011
61	0.3050	0.3698	18.2	15.8	1120	0.0011
62	0.3100	0.3718	18.3	16.1	1131	0.0011
63	0.3150	0.3718	18.3	16.3	1135	0.0011
64	0.3200	0.3718	18.3	16.6	1140	0.0011
65	0.3250	0.3738	18.4	16.8	1151	0.0011
66	0.3300	0.3758	18.5	17.1	1162	0.0011
67	0.3350	0.3758	18.5	17.4	1167	0.0012
68	0.3400	0.3758	18.5	17.6	1172	0.0012
69	0.3450	0.3758	18.5	17.9	1177	0.0013
70	0.3500	0.3758	18.5	18.1	1182	0.0013
71	0.3550	0.3758	18.5	18.4	1186	0.0013
72	0.3600	0.3758	18.5	18.7	1192	0.0014
73	0.3650	0.3758	18.5	18.9	1197	0.0014
74	0.3700	0.3758	18.5	19.2	1202	0.0014
75	0.3750	0.3718	18.3	19.4	1194	0.0015
76	0.3800	0.3718	18.3	19.7	1199	0.0015
77	0.3850	0.3698	18.2	19.9	1198	0.0015
78	0.3900	0.3677	18.1	20.2	1196	0.0016

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	96.130		246.480
Moisture content: Dry soil+tare, gms.	83.020		229.660
Moisture content: Tare, gms.	0.000		146.640
Moisture, %	15.8	20.3	20.3
Moist specimen weight, gms.	96.1		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.99	
Net decrease in height, in.		0.01	
Wet density, pcf	125.2	131.0	
Dry density, pcf	108.1	108.9	
Void ratio	0.5591	0.5473	
Saturation, %	76.3	100.0	

Test Readings for Specimen No. 2

Load ring constant = 49.2 lbs. per input unit

Normal stress = 3000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 1867 psf **at reading no.** 34

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0050	0.0142	0.7	0.3	35	-0.0005
2	0.0100	0.1971	9.7	0.5	480	-0.0008
3	0.0150	0.2844	14.0	0.8	696	-0.0010
4	0.0200	0.3169	15.6	1.0	778	-0.0012
5	0.0250	0.3616	17.8	1.3	890	-0.0014
6	0.0300	0.4002	19.7	1.6	989	-0.0017
7	0.0350	0.4531	22.3	1.8	1123	-0.0020
8	0.0400	0.4774	23.5	2.1	1188	-0.0024
9	0.0450	0.4998	24.6	2.3	1247	-0.0028
10	0.0500	0.5160	25.4	2.6	1292	-0.0032
11	0.0550	0.5343	26.3	2.8	1343	-0.0036
12	0.0600	0.5506	27.1	3.1	1388	-0.0039
13	0.0650	0.5689	28.0	3.4	1439	-0.0043
14	0.0700	0.5749	28.3	3.6	1460	-0.0046
15	0.0750	0.6034	29.7	3.9	1537	-0.0047
16	0.0800	0.6196	30.5	4.1	1584	-0.0049
17	0.0850	0.6278	30.9	4.4	1611	-0.0050
18	0.0900	0.6440	31.7	4.7	1658	-0.0050
19	0.0950	0.6501	32.0	4.9	1680	-0.0052
20	0.1000	0.6562	32.3	5.2	1701	-0.0054
21	0.1050	0.6643	32.7	5.4	1729	-0.0056
22	0.1100	0.6684	32.9	5.7	1745	-0.0057
23	0.1150	0.6745	33.2	6.0	1767	-0.0059
24	0.1200	0.6806	33.5	6.2	1790	-0.0060
25	0.1250	0.6806	33.5	6.5	1796	-0.0061
26	0.1300	0.6847	33.7	6.7	1813	-0.0062

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
27	0.1350	0.6847	33.7	7.0	1820	-0.0063
28	0.1400	0.6867	33.8	7.3	1832	-0.0064
29	0.1450	0.6887	33.9	7.5	1844	-0.0065
30	0.1500	0.6887	33.9	7.8	1851	-0.0067
31	0.1550	0.6887	33.9	8.0	1858	-0.0068
32	0.1600	0.6887	33.9	8.3	1864	-0.0069
33	0.1650	0.6867	33.8	8.5	1866	-0.0071
34	0.1700	0.6847	33.7	8.8	1867	-0.0072
35	0.1750	0.6806	33.5	9.1	1863	-0.0073
36	0.1800	0.6765	33.3	9.3	1859	-0.0075
37	0.1850	0.6765	33.3	9.6	1866	-0.0076
38	0.1900	0.6725	33.1	9.8	1861	-0.0078
39	0.1950	0.6704	33.0	10.1	1863	-0.0079
40	0.2000	0.6684	32.9	10.4	1864	-0.0080
41	0.2050	0.6643	32.7	10.6	1860	-0.0081
42	0.2100	0.6603	32.5	10.9	1856	-0.0082
43	0.2150	0.6562	32.3	11.1	1851	-0.0083
44	0.2200	0.6542	32.2	11.4	1853	-0.0084
45	0.2250	0.6521	32.1	11.7	1854	-0.0085
46	0.2300	0.6481	31.9	11.9	1849	-0.0086
47	0.2350	0.6440	31.7	12.2	1845	-0.0087
48	0.2400	0.6440	31.7	12.4	1852	-0.0088
49	0.2450	0.6379	31.4	12.7	1842	-0.0089
50	0.2500	0.6339	31.2	13.0	1837	-0.0089
51	0.2550	0.6278	30.9	13.2	1827	-0.0090
52	0.2600	0.6237	30.7	13.5	1822	-0.0091
53	0.2650	0.6196	30.5	13.7	1817	-0.0092
54	0.2700	0.6156	30.3	14.0	1813	-0.0093
55	0.2750	0.6115	30.1	14.2	1808	-0.0093
56	0.2800	0.6075	29.9	14.5	1803	-0.0094
57	0.2850	0.6034	29.7	14.8	1798	-0.0095
58	0.2900	0.5993	29.5	15.0	1793	-0.0095
59	0.2950	0.5953	29.3	15.3	1788	-0.0096
60	0.3000	0.5912	29.1	15.5	1783	-0.0096
61	0.3050	0.5892	29.0	15.8	1784	-0.0097
62	0.3100	0.5871	28.9	16.1	1785	-0.0097
63	0.3150	0.5851	28.8	16.3	1787	-0.0098
64	0.3200	0.5831	28.7	16.6	1788	-0.0099
65	0.3250	0.5831	28.7	16.8	1795	-0.0099
66	0.3300	0.5810	28.6	17.1	1796	-0.0100
67	0.3350	0.5790	28.5	17.4	1797	-0.0101
68	0.3400	0.5790	28.5	17.6	1805	-0.0101
69	0.3450	0.5790	28.5	17.9	1813	-0.0101
70	0.3500	0.5770	28.4	18.1	1814	-0.0101
71	0.3550	0.5749	28.3	18.4	1815	-0.0101
72	0.3600	0.5749	28.3	18.7	1823	-0.0102
73	0.3650	0.5749	28.3	18.9	1830	-0.0102

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
74	0.3700	0.5729	28.2	19.2	1832	-0.0102
75	0.3750	0.5709	28.1	19.4	1833	-0.0102
76	0.3800	0.5709	28.1	19.7	1841	-0.0103
77	0.3850	0.5709	28.1	19.9	1849	-0.0103
78	0.3900	0.5709	28.1	20.2	1857	-0.0103

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	96.080		259.150
Moisture content: Dry soil+tare, gms.	82.830		243.240
Moisture content: Tare, gms.	0.000		160.410
Moisture, %	16.0	19.2	19.2
Moist specimen weight, gms.	96.1		
Diameter, in.	1.93	1.93	
Area, in.²	2.93	2.93	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet density, pcf	125.1	132.3	
Dry density, pcf	107.9	111.0	
Void ratio	0.5627	0.5188	
Saturation, %	76.8	100.0	

Test Readings for Specimen No. 3

Load ring constant = 49.2 lbs. per input unit

Normal stress = 6000 psf

Strain rate, %/min. = 0.05

Strength calculations use strain adjusted areas

Fail. Stress = 3852 psf **at reading no.** 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
0	0.0000	0.0000	0.0	0.0	0	-0.0001
1	0.0010	0.0000	0.0	0.1	0	0.0000
2	0.0050	0.1036	5.1	0.3	252	0.0001
3	0.0100	0.3962	19.5	0.5	966	-0.0003
4	0.0150	0.6481	31.9	0.8	1585	-0.0004
5	0.0200	0.8391	41.3	1.0	2059	-0.0004
6	0.0250	0.9366	46.1	1.3	2306	-0.0005
7	0.0300	1.1052	54.4	1.6	2731	-0.0006
8	0.0350	1.2047	59.3	1.8	2987	-0.0006
9	0.0400	1.2616	62.1	2.1	3138	-0.0005
10	0.0450	1.3368	65.8	2.3	3336	-0.0003
11	0.0500	1.3856	68.2	2.6	3470	0.0001
12	0.0550	1.4242	70.1	2.8	3579	0.0003
13	0.0600	1.4689	72.3	3.1	3704	0.0004
14	0.0650	1.4709	72.4	3.4	3722	0.0007
15	0.0700	1.4932	73.5	3.6	3791	0.0007
16	0.0750	1.4932	73.5	3.9	3804	0.0010
17	0.0800	1.5014	73.9	4.1	3838	0.0010

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
18	0.0850	1.5014	73.9	4.4	3852	0.0009
19	0.0900	1.4851	73.1	4.7	3823	0.0010
20	0.0950	1.4892	73.3	4.9	3847	0.0010
21	0.1000	1.4831	73.0	5.2	3845	0.0009
22	0.1050	1.4770	72.7	5.4	3843	0.0007
23	0.1100	1.4689	72.3	5.7	3835	0.0006
24	0.1150	1.4526	71.5	6.0	3806	0.0005
25	0.1200	1.4323	70.5	6.2	3767	0.0003
26	0.1250	1.4242	70.1	6.5	3759	0.0001
27	0.1300	1.4079	69.3	6.7	3729	-0.0002
28	0.1350	1.3917	68.5	7.0	3699	-0.0002
29	0.1400	1.3815	68.0	7.3	3686	-0.0004
30	0.1450	1.3592	66.9	7.5	3639	-0.0004
31	0.1500	1.3429	66.1	7.8	3609	-0.0006
32	0.1550	1.3145	64.7	8.0	3545	-0.0008
33	0.1600	1.3023	64.1	8.3	3525	-0.0010
34	0.1650	1.2779	62.9	8.5	3472	-0.0011
35	0.1700	1.2657	62.3	8.8	3452	-0.0014
36	0.1750	1.2494	61.5	9.1	3420	-0.0016
37	0.1800	1.2332	60.7	9.3	3388	-0.0018
38	0.1850	1.2251	60.3	9.6	3378	-0.0020
39	0.1900	1.2068	59.4	9.8	3341	-0.0022
40	0.1950	1.1987	59.0	10.1	3331	-0.0024
41	0.2000	1.1926	58.7	10.4	3326	-0.0026
42	0.2050	1.1783	58.0	10.6	3299	-0.0029
43	0.2100	1.1722	57.7	10.9	3294	-0.0031
44	0.2150	1.1601	57.1	11.1	3273	-0.0034
45	0.2200	1.1560	56.9	11.4	3274	-0.0036
46	0.2250	1.1540	56.8	11.7	3280	-0.0038
47	0.2300	1.1438	56.3	11.9	3264	-0.0040
48	0.2350	1.1438	56.3	12.2	3277	-0.0043
49	0.2400	1.1194	55.1	12.4	3219	-0.0045
50	0.2450	1.1357	55.9	12.7	3279	-0.0047
51	0.2500	1.1316	55.7	13.0	3280	-0.0049
52	0.2550	1.1316	55.7	13.2	3293	-0.0051
53	0.2600	1.1336	55.8	13.5	3312	-0.0053
54	0.2650	1.1336	55.8	13.7	3325	-0.0054
55	0.2700	1.1357	55.9	14.0	3344	-0.0056
56	0.2750	1.1377	56.0	14.2	3363	-0.0057
57	0.2800	1.1377	56.0	14.5	3377	-0.0058
58	0.2850	1.1397	56.1	14.8	3396	-0.0058
59	0.2900	1.1397	56.1	15.0	3410	-0.0060
60	0.2950	1.1418	56.2	15.3	3430	-0.0061
61	0.3000	1.1397	56.1	15.5	3438	-0.0063
62	0.3050	1.1397	56.1	15.8	3452	-0.0063
63	0.3100	1.1397	56.1	16.1	3466	-0.0064
64	0.3150	1.1377	56.0	16.3	3474	-0.0064

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress psf	Vertical Def. Dial in.
65	0.3200	1.1357	55.9	16.6	3482	-0.0065
66	0.3250	1.1377	56.0	16.8	3503	-0.0065
67	0.3300	1.1357	55.9	17.1	3511	-0.0065
68	0.3350	1.1377	56.0	17.4	3532	-0.0065
69	0.3400	1.1397	56.1	17.6	3553	-0.0065
70	0.3450	1.1397	56.1	17.9	3568	-0.0066
71	0.3500	1.1397	56.1	18.1	3583	-0.0066
72	0.3550	1.1418	56.2	18.4	3604	-0.0066
73	0.3600	1.1418	56.2	18.7	3620	-0.0066
74	0.3650	1.1397	56.1	18.9	3629	-0.0067
75	0.3700	1.1438	56.3	19.2	3657	-0.0067
76	0.3750	1.1438	56.3	19.4	3673	-0.0067
77	0.3800	1.1397	56.1	19.7	3676	-0.0067
78	0.3850	1.1418	56.2	19.9	3698	-0.0067
79	0.3900	1.1397	56.1	20.2	3707	-0.0067

ATTACHMENT 6

EVAPORATION POND AREA LABORATORY TEST RESULTS

NewFields

MOISTURE CONTENT
(ASTM D 2216 / ASTM D 4643)
LABORATORY WORKSHEET

NF Form #15

Client: Magnum NGLS Solution Mining	**Location: See Below**
Project Title: Magnum Evaporation Ponds	**Elevation: See Below**
Project Number: 475.0093.012	**Test Start Date:**
Project Engineer: Kevin Jennings	**Tested By:**
Field Sample ID: 16-280	**Checked By:**

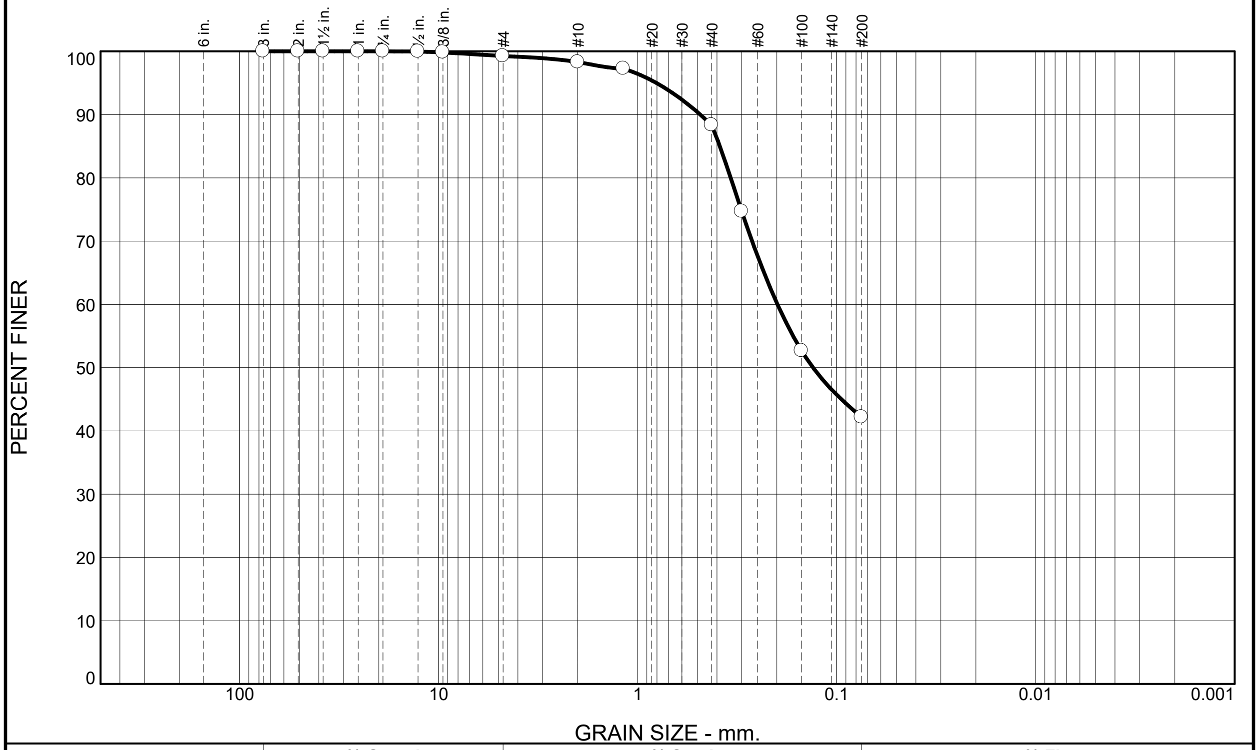
Drying Conditions: 60 deg C / 110 deg C Method: Oven (O) / Microwave (M) / Hot Plate (H)

Sample No.		16-280-01	16-280-02	16-280-03	16-280-04	16-280-05
Location		TP16-EVP-01	TP16-EVP-02	TP16-EVP-03	TP16-EVP-04	TP16-EVP-05
Depth		2'-2.5'	2'-3.5'	1.4'-3.1'	1'-4'	1.4'-1.8'
Soil Description						
(USCS)						
Trial No.		**1**	**2**	**3**	**4**	**5**
Tare No.						
Tare + Wet Soil	**A**	889.3	933.2	1086.4	871.6	770.3
Tare + Dry Soil	**B**	839.8	829.5	1025.7	710.6	722.9
Tare	**C**	193.6	120.5	189.4	188.4	189.5
Wt. of Water	**D= A-B**	49.5	103.7	60.7	161	47.4
Dry Soil, Ws	**E= B-C**	646.2	709	836.3	522.2	533.4
Moisture Content, (%)	**(D/E) x100**	7.7	14.6	7.3	30.8	8.9

Sample No.		16-280-06				
Location		TP16-EVP-06				
Depth		3'-5'				
Soil Description						
(USCS)						
Trial No.		**6**	**7**	**8**	**9**	**10**
Tare No.						
Tare + Wet Soil	**A**	732.7				
Tare + Dry Soil	**B**	591.2				
Tare	**C**	120.2				
Wt. of Water	**D= A-B**	141.5				
Dry Soil, Ws	**E= B-C**	471				
Moisture Content, (%)	**(D/E) x100**	30.0				

Remarks:

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	1.0	10.0	46.1	42.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.5	100.0		
.375	99.8		
#4	99.3		
#10	98.3		
#16	97.3		
#40	88.3		
#50	74.7		
#100	52.7		
#200	42.2		

* (no specification provided)

Material Description

Light Brown silty, clayey sand

Atterberg Limits

PL= 13 LL= 18 PI= 5

Coefficients

D_{90}= 0.4850 D_{85}= 0.3865 D_{60}= 0.1985
D_{50}= 0.1315 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

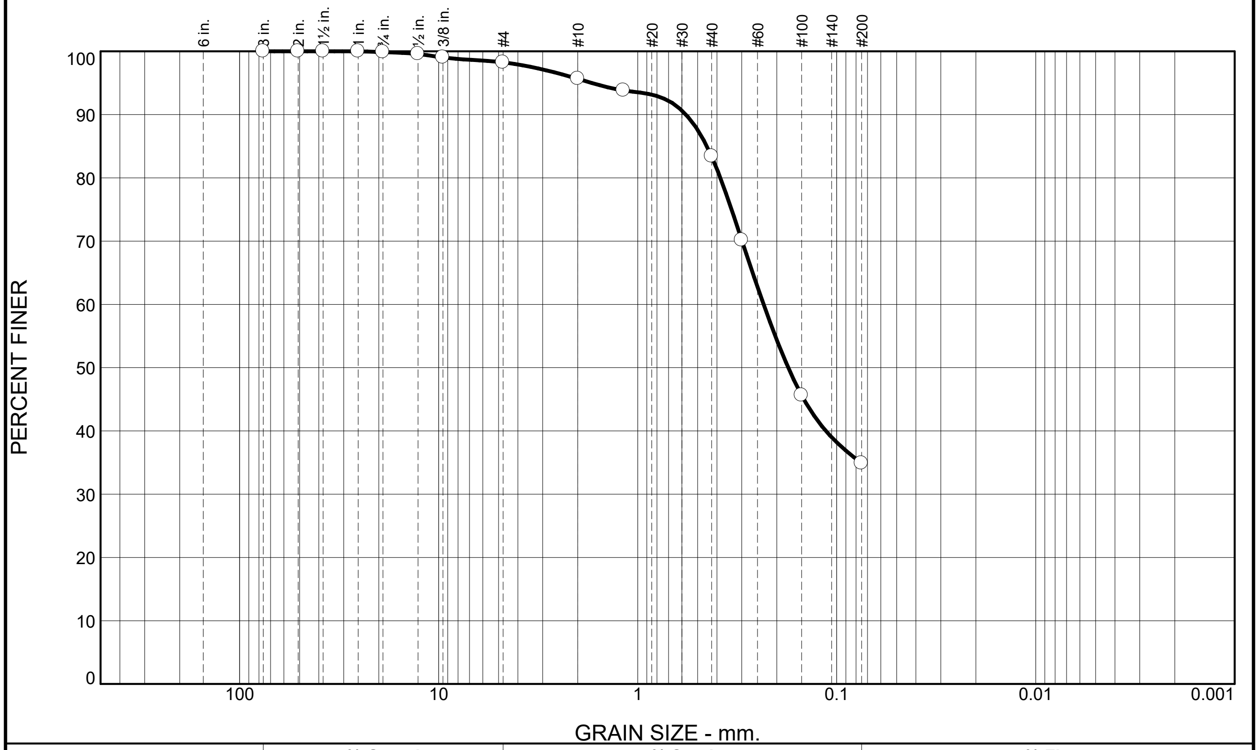
Location: TP16-EVP-01
Sample Number: 16-280-01 **Depth:** 2'-2.5' **Date:** 12/21/16

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-01

Tested By: BE **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	1.6	2.6	12.3	48.5	34.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	99.9		
.5	99.6		
.375	99.0		
#4	98.3		
#10	95.7		
#16	93.8		
#40	83.4		
#50	70.1		
#100	45.6		
#200	34.9		

* (no specification provided)

Material Description

Tan clayey sand

Atterberg Limits

PL= 19 LL= 28 PI= 9

Coefficients

D_{90}= 0.5723 D_{85}= 0.4492 D_{60}= 0.2330
D_{50}= 0.1752 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

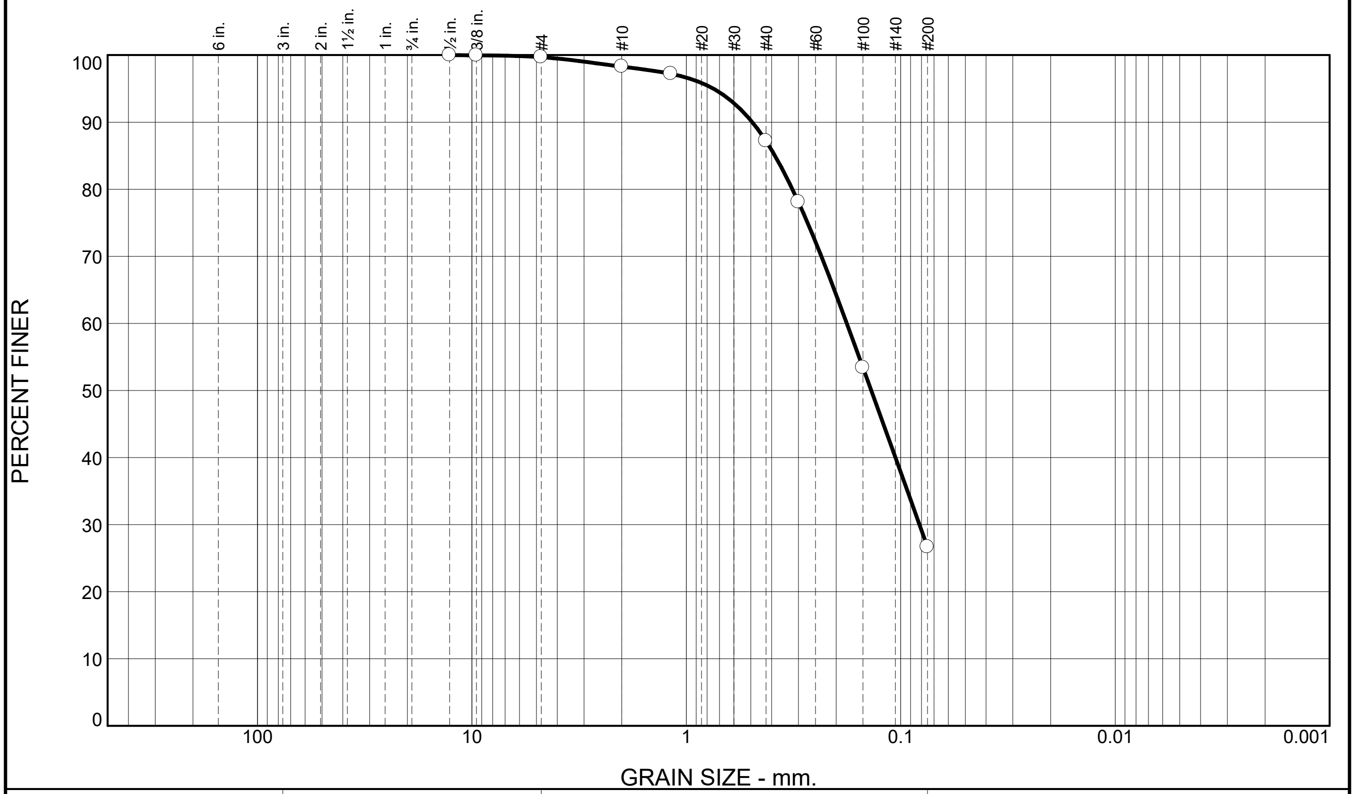
Location: TP16-EVP-02
Sample Number: 16-280-02 **Depth:** 2'-3.5' **Date:** 12/21/16

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-02

Tested By: BE **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.4	11.1	60.5	26.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375"	100.0		
#4	99.7		
#10	98.3		
#16	97.2		
#40	87.2		
#50	78.1		
#100	53.4		
#200	26.7		

* (no specification provided)

Material Description

Tan silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4924 D_{85}= 0.3859 D_{60}= 0.1784
D_{50}= 0.1373 D_{30}= 0.0818 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

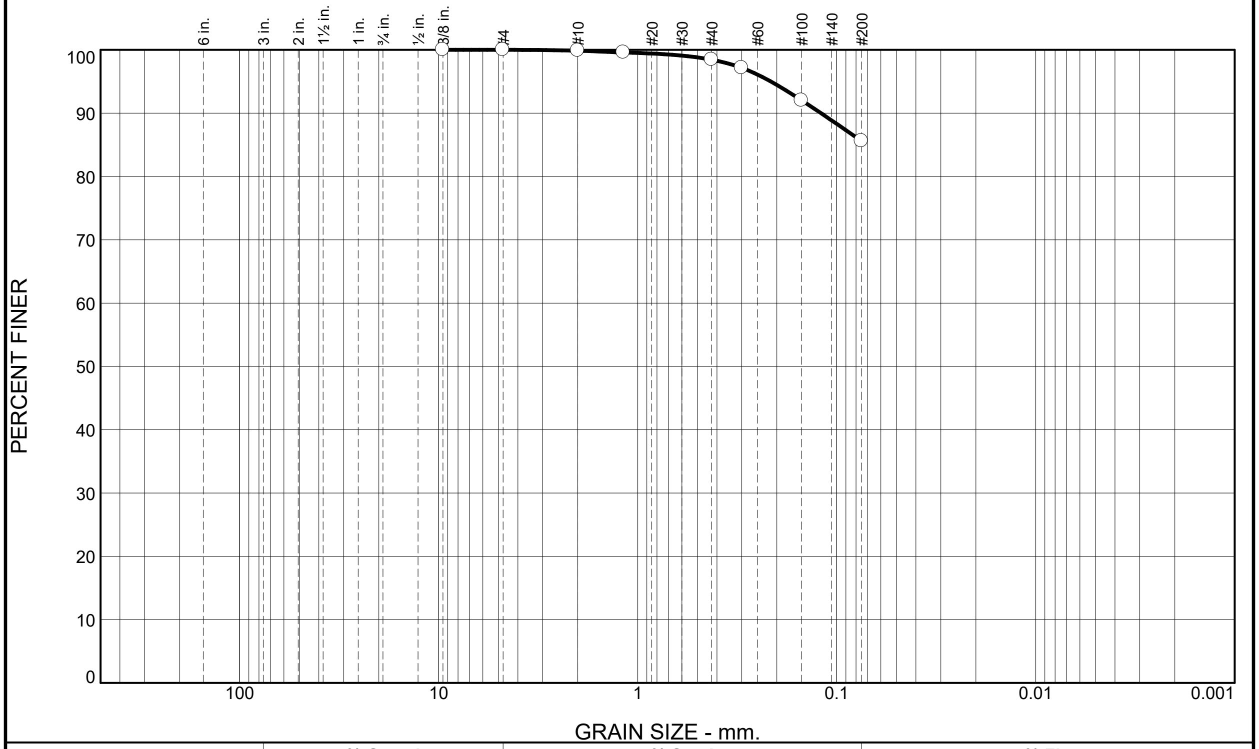
Location: TP16-EVP-03
Sample Number: 16-280-03 **Depth:** 1.4'-3.1' **Date:** 12/21/16

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-03

Tested By: BE/AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.5	12.8	85.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	99.9		
#16	99.6		
#40	98.4		
#50	97.2		
#100	92.0		
#200	85.6		

* (no specification provided)

Material Description

Light Brown W/ Red lean clay

Atterberg Limits

PL= 16 LL= 47 PI= 31

Coefficients

D_{90}= 0.1200 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(27)

Remarks

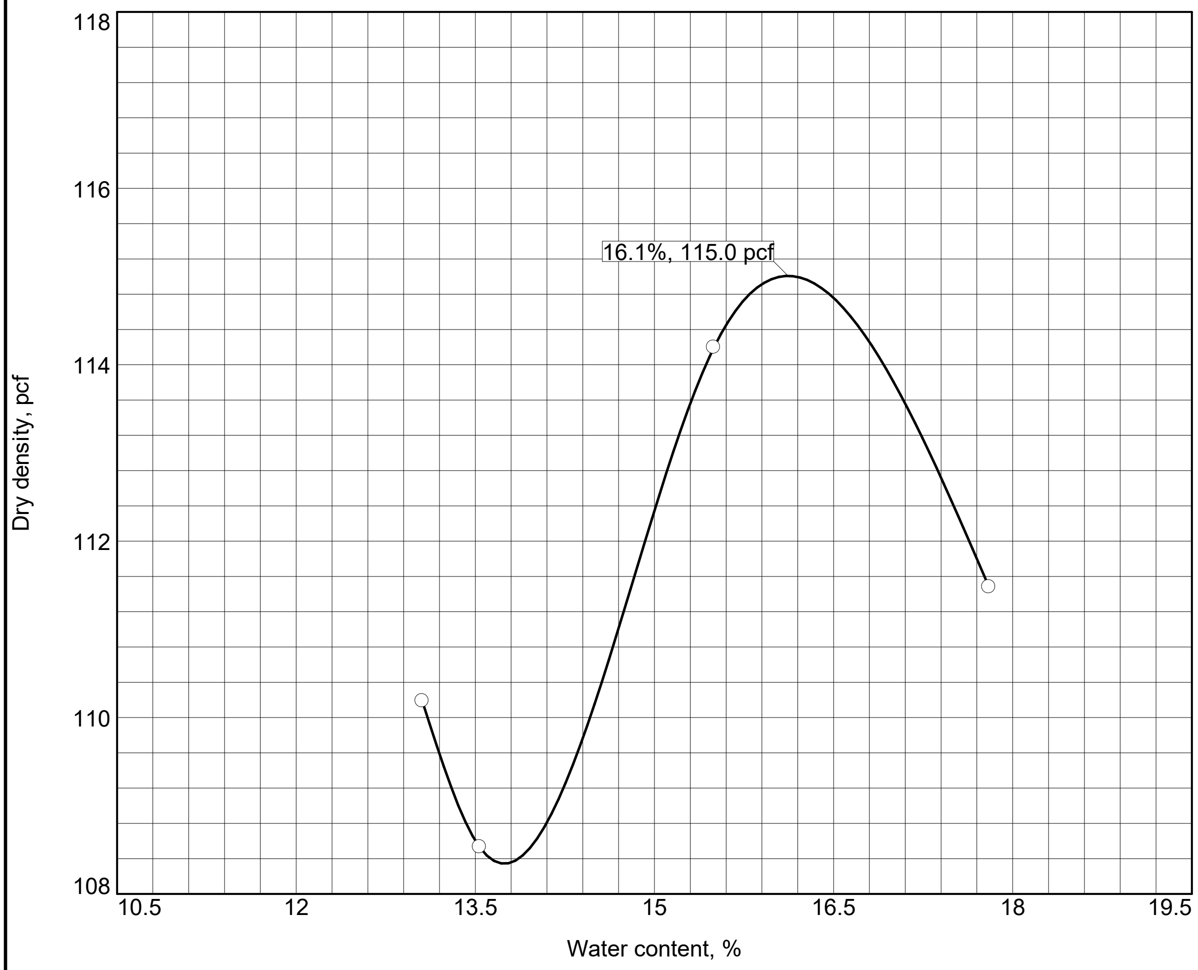
Location: TP16-EVP-04
Sample Number: 16-280-04 **Depth:** 1'-4' **Date:** 12/21

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-04

Tested By: BE/AH **Checked By:** AR

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
1'-4'	CL	A-7-6(27)			47	31	0.0	85.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 115.0 pcf Optimum moisture = 16.1 %	Light Brown W/ Red lean clay

Project No. 475.0093.012 **Client:** Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds

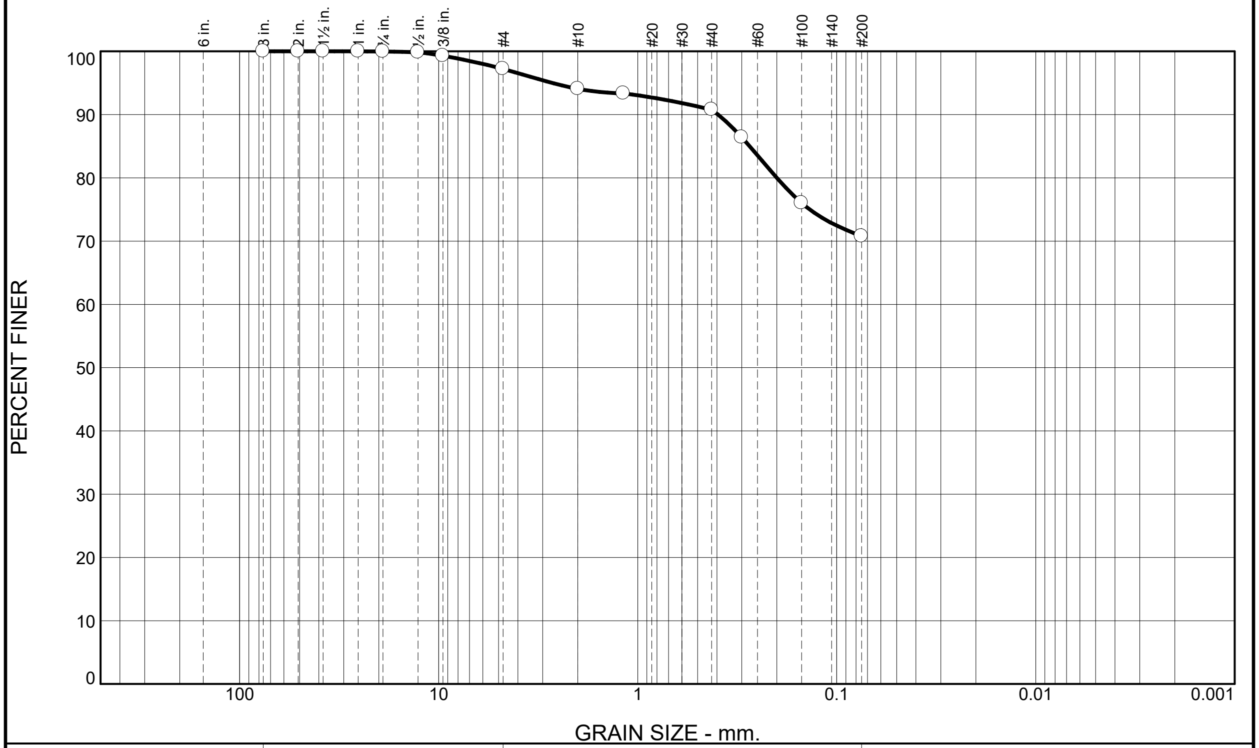
○**Location:** TP16-EVP-04 **Sample Number:** 16-280-04

NewFields

Remarks:

Figure 16-280-04

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.8	3.1	3.3	20.0	70.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.5	99.8		
.375	99.3		
#4	97.2		
#10	94.1		
#16	93.4		
#40	90.8		
#50	86.4		
#100	76.0		
#200	70.8		

* (no specification provided)

Material Description

Brown W/ White lean clay with sand

Atterberg Limits

PL= 17 LL= 27 PI= 10

Coefficients

D_{90}= 0.3944 D_{85}= 0.2739 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(5)

Remarks

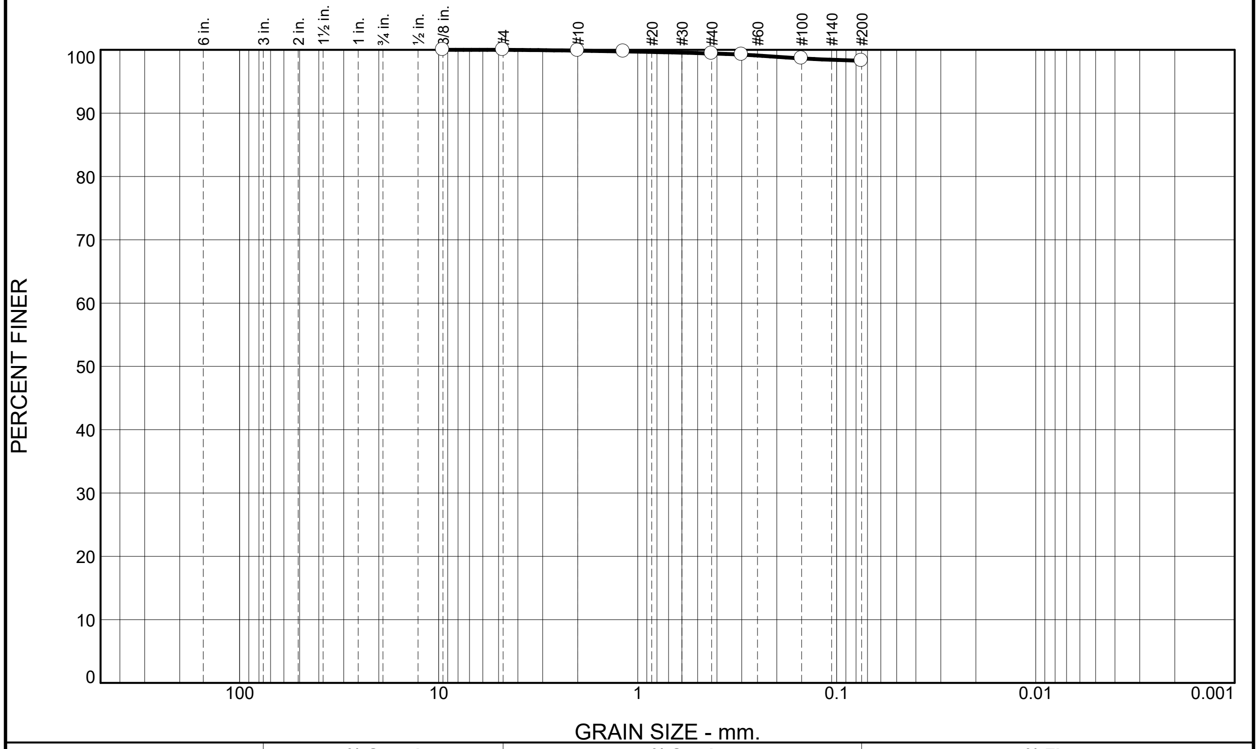
Location: TP16-EVP-05
Sample Number: 16-280-05 **Depth:** 1.4'-1.8' **Date:** 21/21/16

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-05

Tested By: BE/AH **Checked By:** AR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.5	1.1	98.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375"	100.0		
#4	100.0		
#10	99.9		
#16	99.8		
#40	99.4		
#50	99.2		
#100	98.6		
#200	98.3		

* (no specification provided)

Material Description

Dark Brown fat clay

Atterberg Limits

PL= 24 LL= 54 PI= 30

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(34)

Remarks

Location: TP16-EVP-06
Sample Number: 16-280-06 **Depth:** 3'-5' **Date:** 12/21/16

NewFields

Client: Magnum NGLS Solution Mining
Project: Magum Evaporation Ponds
Project No: 475.0093.012 / 000 **Figure** 16-280-06

Tested By: BE/AH **Checked By:** AR

NewFields

Flexible Wall Permeability
ASTM D5084

Client:	Magnum	Lab Sample No.:	16-280-04
Project:	Evaporation Ponds	Field Sample No.:	TP16-EVP-04
Project No.:	475.0093.12	Location:	TP16-EVP-04
Phase:	0	Elevation/Depth:	1'-4'
Requested By:	Kevin Jennings	Tested By:	TW
Test Started:	1/9/2017	Checked By:	TW
Test Finished:	1/13/2017	Sample Description:	Dark Brn clayey sand w gravel

Test Boundary Conditions	
Type of Permeant	De-aired Bottled
Magnitude of Back pressure (psi)	40
Saturated (Y/N):	Yes
Stage 1: Effective Stress (psi)	5
Sample Type	Remolded
Burrete Area (cm^2)	0.877

Test Specimen Data	Before Test	After Test
Wet Soil + Tare (g)	617.97	941.86
Dry Soil + Tare (g)	532.27	798.28
Tare (g)	0.0	266.81
Wt. of Water (g)	85.70	143.58
Dry Soil (g)	531.47	531.47
Moisture Content (%)	16.1	27.0
Volume (ft^3)	0.0108	0.0106
Dry Density (pcf)	108.9	109.6
Wet Density (pcf)	126.5	131.8
Saturation (%)	79.5	100.0

Initial Height (in)	3.044
Initial Diameter (in)	2.790
Initial Area (in^2)	6.115
Consolidated Height (in)	3.033
Area After Consolidation (in^2)	6.069
Diameter During Perm (in)	2.780
Change in Height (in)	0.011
Moisture Content after Consolidation (%)	19.6%
Specific Gravity*	2.70

*Specific gravity is assumed

Maximum Dry Density: ASTM D 1557

Maximum Dry Density (pcf):	115	
Remolded Density (pcf):	108.9	
Percent Compaction:	95%	
Void Ratio:	0.530	
Optimum Moisture Content(%):	16.1	
Initial Water Content (%):	16.1	
Confining Pressure (psi):	5.0	
Permeability (k cm/s):	**6.2E-08**	
Gradient Range (h/L):	0.8	1.0

ATTACHMENT 1 – BRINE POND 1, DETERMINISTIC SEISMIC HAZARD ASSESSMENT (AMEC 2011)

August 25, 2011
AMEC Project No. 74201409.00

Magnum Gas Storage, LLC
3165 East Millrock Drive
Suite 330
Holladay, Utah 84121

Re: Seismic Hazard Assessment
Magnum Gas Storage, LLC
Evaporation Ponds
Millard County, Utah

The results of a Seismic Hazard Assessment study, conducted by AMEC Earth & Environmental, Inc. (AMEC) for the Magnum Gas Storage, LLC Evaporation Ponds, are presented in this report. The purpose of this study was to evaluate the potential seismic hazard in the immediate vicinity of three planned evaporation ponds.

The following table shows a summary of the significant design parameters that were determined as a result of this study which will be used in a foundation soils liquefaction evaluation.

Seismic Events	MCE No. 2351	MCE No. 2437	Return Period of 4975-years
Mean Peak Ground Acceleration (PGA)	0.12	0.25	0.38
Modal Moment Magnitude (M_w)	8.2	5.8	6.2

Please do not hesitate to contact us if you have any questions concerning this report.

Respectfully submitted,

AMEC Earth & Environmental, Inc. Reviewed by:

Matt Haley

Sean Hulburt
Staff Geophysicist

Matthew Haley, PE
Senior Engineer

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1.0 INTRODUCTION

Magnum Gas Storage, LLC is developing deep underground caverns within a salt dome structure for compressed natural gas storage. Caverns within the salt dome will be developed using solution mining and produce a waste stream of brine requiring management via temporary storage and evaporation. Three evaporation ponds with a two-cavern storage capacity have been proposed for brine management. The site is located south of West Brush Wellman Road, 10 miles west of the intersection with US Highway 6, approximately 10 miles north of Delta, Utah (39.483153°N, -112.571716°W). The general location of the site is shown on Figure 1. The evaporation ponds are designed to be located in Sections 25 and 26 in Township 15 South and Range 7 West of the Salt Lake Base and Meridian.

The evaporation ponds are situated overtop a salt gypsum dome in the Sevier - Black Rock Desert in the Basin and Range physiographic province of Utah. The profile at the site consists of three units. The upper unit is comprised of fine-grained glacial lacustrine deposits consisting of deep-water calcareous silts and may contain younger alluvium up to 10 feet thick. The upper unit is underlain by pre-Lake Bonneville alluvium consisting of sand and sandy gravel beds, of which 5 feet is exposed. The complete thickness of this unit is unknown. The lower unit consists of alluvium, silt and sandy silt deposited in large low-gradient alluvial fans, river terraces, and abandoned river channels on the river delta. This unit ranges up to 30 feet in thickness. Topography at the project site is relatively flat with minor relief.

The purpose of this study was to evaluate the potential seismic hazard in the immediate vicinity of the three planned evaporation ponds.

2.0 GEOTECHNICAL CONDITIONS

Results of previous geotechnical investigations (IGES 2009 and IGES 2010) were reviewed and used as the basis for assigning the seismic site classification. Data from 32 hollow stem auger test borings and 30 test pits completed during the 2009-2010 geotechnical investigation were used in the site classification analysis. The boring logs reveal a geotechnical profile consisting of a mixture of sand, silt and clay with blow counts (N values) derived from standard penetration tests (SPTs) ranging from 10 to 100. The coarser-grained soils tend to have a medium dense to very dense consistency, whereas the fine grained soils tend to have a firm to hard consistency. Groundwater ranges from a depth of 15 feet below the ground surface in the southeast and southwest portions of the site to over 30 feet in the north and northeast portions of the site.

The applicable seismic site class was determined using the average SPT method (American Society of Civil Engineers 2006). The average STP N value procedure is summarized as follows:

- Use N values derived for all soil and rock layers in the upper 100 feet of the subsurface profile, with a single N value assigned to each distinct layer in the profile.

- Average or conservatively select N values from multiple borings to characterize each distinct layer.
- Use a maximum N value of 100 when 100 or more blows are required to advance the sampler by 1 foot.
- When refusal occurs on a rock layer, assign the rock layer an N value of 100.

Based on a review of the boring logs, the average N values range from 15 to 50, resulting in the site being categorized as Site Class S_D—a stiff soil site. An average seismic shear wave velocity $(V_s)_{avg}$ of 366 meters per second was assigned to the soils within the upper 100 feet of the subsurface profile.

3.0 HISTORICAL SEISMICITY

3.1 Regional Seismicity

The project site is in the Basin and Range physiographic province of Utah, which extends to Nevada on the west and to the Colorado Plateau and Wasatch Range on the east. The province is an actively deforming region of Cenozoic extension and shear dominated by north-south-trending normal faults with strike-slip deformation throughout (Allmendinger and others 1983).

The seismicity of the eastern Basin and Range province is related to the Intermountain Seismic Belt (ISB). This zone of seismicity runs through the Intermountain West from northwestern Montana in the north, through Wyoming, Idaho and Utah, to southern Nevada/northern Arizona in the south. Within the ISB, the largest concentration of moderate- to large-magnitude earthquakes occurs within Utah. (Sbar and others 1972).

Although linear in overall extent, the ISB does not mark the trace of a single fault zone. Rather, surface ruptures have occurred along a series of individual faults distributed among dozens of similar Late Quaternary faults that cut across Late Cenozoic structural patterns of the eastern Basin and Range province. The Wasatch Fault Zone is the most influential and active fault zone in proximity to the evaporation ponds.

The following paragraphs are historical accounts of significant earthquakes based on data provided by the United States Geological Survey (USGS 2010) and the Utah Geological Survey (UGS 2011).

The earliest reported earthquake in Utah occurred in 1894 near Ogden. Many people reported cracked walls and dishes shaken from their tables according to the USGS (USGS 1974). The account states that many adobe houses were split in two and people were thrown from their beds.

Historic Utah earthquakes have resulted in surface ruptures; these include the earthquakes at Parowan and Richfield in 1901 and at Kosmo in 1934 (USGS 1974).

On November 13, 1901, a strong earthquake caused extensive damage from Parowan to Richfield. Brick buildings and many chimneys were damaged and rockslides were reported near Beaver. Earth cracks with the ejection of water and sand also were reported and some creeks experienced increased flow. The earthquake was felt over a 129,500 square kilometer area and intensity VI effects were observed over a 26,000 square kilometer area (Note: Intensity levels are based on the Modified Mercalli Intensity Scale and typically provided in parentheses). Aftershocks continued for several weeks, the strongest of which was on November 14. Considerable damage resulted at Pine Valley, St. George, and Santa Clara from an earthquake on November 17, 1902. Chimneys were destroyed (VII) at Pine Valley and Santa Clara; additional damage occurred at Pinto and Toquerville. Reports were also received of a felt earthquake at Salt Lake City 400 kilometers away.

The area around Ogden was strongly shaken on May 13, 1914. Windows were broken and chimneys thrown down (VII) at Ogden; near panic was reported at Central Junior High School. Dishes rattled and furniture moved at Farmington. The shock was felt from Collinston on the north to Riverton on the south, an area covering 20,700 square kilometers.

After several weeks of preliminary tremors, two strong earthquakes about 12 hours apart shook Elsinore, Monroe, and Richfield on September 29, 1921. The first shock, at 7:12 a.m., lasted 7 to 10 seconds and threw down scores of chimneys (VIII), tore plaster from ceilings, and fractured walls at Elsinore. In addition, gables of houses were thrown out and the foundation of a new school sank one foot, leaving gaps between the walls and the roof. Total damage was estimated at $100,000. Another shock of intensity VII occurred at 7:30 p.m. on the same day. On October 1, there was yet another strong tremor causing further damage at Elsinore. A number of brick and stone buildings were rendered uninhabitable by the earthquake (VIII). The Monroe City Hall, built of rock, was severely damaged. Large rock falls occurred on both sides of the Sevier Valley. Springs were discolored for hours with iron oxides. Aftershocks continued until December 20, the largest being those on October 27 and November 1, which were felt sharply at Richfield.

On March 12, 1934, an earthquake of intensity VIII originating near Kosmo, on the north shore of Great Salt Lake, affected an area of about 440,000 square kilometers, including much of northern Utah and parts of Idaho, Montana, Nevada and Wyoming. This earthquake, which measured magnitude 6.6, would have caused great damage in a densely populated area. Because of the sparse settlement in the region there was very little damage - mostly demolished chimneys and cracked walls in poorly constructed buildings. Two deaths were attributed to the earthquake. The outstanding feature of the earthquake, related to the Hansel Valley Fault, was the emission of large quantities of water from fissures and craterlets. Considerable faulting occurred in the epicentral region. Precise levelling revealed that areas sank to depths of up to 3.9 centimeters. The onset of the earthqauke was abrupt. There were no foreshocks, but aftershocks continued for two days. Only one aftershock was outstanding (magnitude 6.0). There was moderate damage over a broad area, including Salt Lake City, where plaster fell. All chimneys fell in Kosmo and Monument; fissures, holes, cracks, and springs appeared in connection with a belt of fractures at least 8 kilometers long. The second shock was slightly less severe than the main tremor. Intensities for the aftershock are very unreliable because many observers tried to describe both earthquakes in a single report. Another strong aftershock (magnitude 5.5) affected an area of about 45,000 square kilometers in northern Utah and southern Idaho on May 6. It was reported to be strongest in Salt Lake City and in Preston, Idaho, where the intensity reached VI.

Damages estimated at $1 million resulted from an August 30, 1962, earthquake in the East Valley Fault Zone. This magnitude 5.7 earthquake cause significant damage at Franklin, Lewiston, Logan, Preston and Richmond. Cache County was designated a disaster region by the Small Business Administration. The greatest damage occurred at Richmond (VII) where at least nine houses were declared unsafe for occupancy, one church was damaged beyond repair, numerous houses lost walls, and 75 percent of older brick chimneys fell. At Logan, principle building damage was cracked and twisted walls. At Lewiston, one brick wall fell and many chimneys were damaged. A sugar refinery near Lewiston sustained major damage when large pieces of cement coping fell, penetrating lower-level roofs. Four schools in Cache County were seriously damaged. The earthquake was felt over an area of approximately 168,000 square kilometers. Minor aftershocks, with slight additional damage, were reported through September 9.

On October 4, 1967, a magnitude 5.2 earthquake caused damage in the Marysvale area. Ceilings and walls cracked in numerous houses in Marysvale (VII). About 1 mile north of Marysvale, well water was badly muddied for 24 hours. At Koosharem, chimneys and plaster cracked and chimneys were partially knocked down at Joseph. Rockslides were reported in the Joseph, Junction City and Sevier areas. The earthquake was felt over 38,800 square kilometers of southern Utah and a few places in northern Arizona. Several aftershocks also were felt.

Slight damage was reported at a number of northern Utah towns from a March 28, 1975, earthquake centered near the Idaho - Utah border. Ridgedale (VIII) and Malad City (VII), Idaho sustained the most damage from this magnitude 6.1 earthquake. All of northern Utah felt the tremor; the 160,000 square kilometer area where the earthquake was felt includes parts of Idaho, Nevada and Wyoming, and a few places in northwestern Colorado.

3.2 Local Seismicity

Fault zones within 100 kilometers of the project site that the USGS has identified as potential seismic hazards are presented in Table 1 and Figure 1. There are no major fault zones listed in the USGS 2008 National Seismic Hazard Assessment within a 30 kilometer radius of the project site, although numerous minor Class A fault zones exist including the Sugarville Fault Zone located about 3.6 kilometers northwest of the planned evaporation ponds. There are three major USGS seismic hazard fault zones within a 100 kilometer radius of the project site. One of these fault zones, the Wasatch Fault Zone, contains three sections that fall within 100 kilometers of the site. A discussion of these four fault zones and the characteristic earthquake that each is capable of generating is presented below.

The recurrent fault or fracture networks of the Sugarville Fault Zone (USGS No.2437 Class A) are short northeast-trending normal faults in the Pleistocene deposits of Lake Bonneville. Liquefaction features, including injection dikes and distorted bedding, are present across the southeastern portion of the fault zone. The northwestern portion of the fault zone reveals stratigraphic evidence for two distinct surface-faulting events as well as complex faulting relationships. Lineaments and subtle relief in lake deposits with throws of up to 3.8 meters across one of the faults, combined with the short apparent rupture length, suggests that numerous small-displacement events occurred along this fault zone.

The Sugarville Fault Zone is 3.6 kilometers from the evaporation ponds and the closest source of potential seismicity. The fault zone is identified as a Class A fault, and is not included in the USGS 2008 National Seismic Hazard Assessment (Peterson 2008). A maximum characteristic earthquake was not assigned to this fault. Using empirical relationships for estimating earthquake magnitudes (Wells and Coppersmith 1994), and using a surface rupture length of 5 kilometers, a maximum moment magnitude of 5.8 was calculated. This earthquake represents a potential maximum credible earthquake (MCE) for the project site.

The Wasatch Fault Zone (USGS No. 2351) is the closest classified seismic hazard to the project site. At its closest point, the fault is 56.4 kilometers from the site (Peterson 2008). It is the longest and most technically-active normal fault in North America. The 306 kilometer-long Wasatch Fault Zone is separated into 10 independently behaving sections, with three sections (the Levau section, the Nephi section and the Provo section) occurring within 100 kilometers of the site. Generally, the zone is a north-trending, range-bounding, normal fault system along the western side of the Malad Range (Clarkston Mountain), Wellsville Mountains, Wasatch Range and San Pitch Mountains. The Wasatch Fault Zone marks the eastern boundary of the Basin and Range physiographic province in northern Utah. Alluvial fan sediments and deposits of Pleistocene Lake Bonneville dominate the surficial geology along the fault zone. The Wasatch Range is several kilometers higher than valleys to the west as a result of repeated fault movement in Cenozoic time (Machette and others 1991). Scarp morphology indicates several fault movements occurred during Pleistocene to Holocene time. The fault zone has a characteristic magnitude of 7.4 based on the USGS 2008 National Seismic Hazard Assessment (Peterson 2008).

The Stansbury Fault Zone is approximately 85 kilometers from the site. This north-trending normal fault zone has a characteristic magnitude of 7.1. Geomorphically, the surface trace complexity of the Stansbury Fault varies spatially from north to south, suggesting that the fault may consist of two independent events (Helm 1994). In the south, a single fault strand consisting of a main fault and a subsidiary antithetic fault cuts Quaternary alluvial fans and forms a narrow (about 20-meters-wide) graben along most of the fault trace (Helm 1994). North of Pass Canyon, the trace is a complex fault zone consisting of multiple synthetic and antithetic fault traces showing evidence of Quaternary movement. The timing of specific faulting has been debated, but early Holocene and Late Pleistocene timing are accepted for the two fault sections based on scarp morphology. Measured scarp heights range from 3.9 to 49.5 meters, although net tectonic displacement may be less.

The Oquirrh-Southern Oquirrh Mountains Fault Zone (USGS No. 2399) is a series of en echelon down-to-the-west normal faults bounding the western flank of the southern Oquirrh Mountains. The Oquirrh Mountains are the easternmost and highest of three distinctive north-south-trending mountain ranges in the Basin and Range province of Utah, west of the high central part of the Wasatch Range. Late Quaternary sedimentation along the southwestern side of the Oquirrh Mountains (which are mainly Pennsylvanian-Permian Oquirrh Formation) is dominated by alluvial fan sediments and Pleistocene Lake Bonneville deposits. Geomorphically, the fault zone displays up to 21.7 meters of maximum displacement (Hecker 1993). Scarp morphology has indicated the fault timing to be Late Pleistocene. The fault zone lies approximately 57 kilometers to the northeast of the evaporation ponds and has been classified as a characteristic magnitude of 7.2 based on the USGS 2008 National Seismic Hazard Assessment (Peterson 2008).

The historical seismicity in the vicinity of the project site was assessed using the USGS earthquake database. The search was performed using the USGS/NEIC 1973 – 2010 (PDE), the USGS/NEIC (PDE-Q) Most Recent Events (March 3 through July 22, 2011), and the Significant U.S. Earthquakes (1568 - 1989) (USHIS) databases. The search was performed for all historical earthquakes greater than or equal to magnitude 2.5 within a 100-kilometer radius of the project site (North 39.4832°, West -112.5717°). The results of the search are presented in Table 2. The search identified 309 earthquakes from 1868 through the middle of 2011 (141 with recorded magnitude) ranging in magnitude from 2.5 to 5.2. A summary of the earthquake data is presented in Figures 2 and 3.

4.0 RISK & RECURRENCE INTERVALS

Strong ground shaking from earthquakes occurring in moderate to close proximity to the evaporation ponds could result in damage to the facility depending on the magnitude, peak ground acceleration, duration of strong shaking and predominant period. Seismic design criteria for project facilities should consider both their operational life and post-closure conditions. The main concern, both for a static and seismic stability of evaporation ponds, is the stability of the embankments and pond liners. From a probabilistic point of view, an earthquake with a 2,475-year return period is usually considered appropriate for design of a facility with a 25-year operational life. This corresponds to a probability of exceedance of 1 percent.

The Sugarville Fault Zone (No. 2437), the closest fault to the site has a calculated MCE of 5.8 and a mean peak ground acceleration (PGA) of 0.25g. However, based on the inactive, small-scale nature of the Sugarville Fault Zone, it is very unlikely a MCE would be generated from this fault zone. A more realistic scenario may be a MCE generated by the most tectonically active USGS seismic hazard classified fault zone in proximity to the project site. An 8.2 magnitude MCE along the Wasatch Fault Zone (No.2351) would result in a mean PGA of 0.12g. This event is recommended for post-closure design.

The acceptable level of seismic risk for design of major structures is usually prescribed by regulatory agencies or is the responsibility of the owner. Acceptable levels of risk are often prescribed based on the consequences of failure or damage to the facility. It is AMEC's opinion that the levels of risk considered for the project are reasonably conservative and are therefore provided as guidelines for use in design.

5.0 SEISMIC DESIGN PARAMETERS

A probabilistic seismic hazard assessment was conducted for the proposed evaporation ponds at the Magnum Gas Storage Site. This assessment was conducted using the 2009 USGS Seismic Hazard Deaggregation procedure available on its Earthquake Hazards Program Internet site (USGS 2010). The analysis considers that the site is a stiff soil Site Class (S_D) with an average shear wave velocity $(V_s)_{avg}$ of 366 meters per second. Analyses were conducted for earthquake return periods ranging from 72 to 4,975 years. Values of peak horizontal ground accelerations obtained from the analyses are tabulated in Table 3 and plotted on Figure 4.

A deterministic analysis was conducted to establish the MCE for the closest fault zone in the general vicinity of the facility and the MCE for the closet classified USGS seismic hazard fault zone to the site. Mean and mean plus one sigma values of peak horizontal ground accelerations for stiff soil conditions were estimated for the MCE using attenuation relationships developed by Pankow and Pechman (2004) for extensional tectonic regimes such as Utah. Design criteria for both the operational and post-closure seismic events are summarized in Table 3.

The MCE criteria in Table 3 present three possible scenarios. The first scenario, MCE No. 2437, represents a maximum credible earthquake along the Sugarville Fault Zone located 3.6 kilometers from the project site. The PGA for this event is less than the 4,975 year event PGA from the probabilistic analysis. The formational nature of the Sugarville Fault Zone is interpreted to be the reason for this low MCE value. The IGES 2009 report suggests the Sugarville Fault Zone is caused by salt dome uplift rather than basin wide extensional tectonics. Consequently, the fault dimensions and low maximum earthquake potential reflect the small scale stress field associated with the salt dome deformation. MCE No. 2351i represents the Levan Section of the Wasatch Fault Zone. The low PGA value associated with this fault is mainly due to the distance from the project site, as a portion of the energy from the earthquake will be attenuated. MCE No. 2351 represents the MCE for a major event along the entire Wasatch Fault Zone. The PGA for an 8.2 modal magnitude quake is less than the probabilistic 4,975 year event, again due to the distance of the fault from the project site.

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TABLE 1

Major Faults Located within 100 Kilometers of Project Site

Fault ID	Name	Characteristic Magnitude	Distance from Site (km)	Fault Length (km)
2351	Wasatch Fault Zone	7.4	56.37	306
2351i	Wasatch Fault Zone, Levan Section	6.9	56.37	32
2351h	Wasatch Fault Zone, Nephi Section	7.1	68.76	46
2395	Stansbury Fault Zone	7.09	85.38	54
2398_2399	Oquirrh-Southern Oquirrh Mountains Fault Zone	7.17	88.07	63
2351g	Wasatch Fault Zone, Provo Section	7.4	92.69	77

TABLE 2

Summary of Historical Earthquakes within 100 km of Project Site

US GEOLOGICAL SURVEY EARTHQUAKE DATABASE

FILE CREATED: Tue Jul 26 18:04:16 2011

Circle Search Earthquakes= 141

Circle Center Point Latitude: 39.483N Longitude: 112.571W

Radius: 100.000 km

Catalog Used: PDE, SRA, PDE-Q

Data Selection: Historical & Preliminary Data

Year	Month	Day	Time(hhmmss.mm) UTC	Latitude	Longitude	Magnitude	Depth (km)	Distance, km	Catalog
1921	10	15	1227	38.7	-112.1	5.2		98	SRA
1973	7	16	63642.8	39.149	-111.508	4.2	10	91	PDE
1978	12	9	145948.3	38.658	-112.527	3.3	4	92	PDE
1978	12	9	234908	38.649	-112.523	3.3	5	79	PDE
1979	10	6	101235.2	39.286	-111.687	3.2	7	72	PDE
1980	4	6	104504.1	39.952	-111.976	3.8	5	72	PDE
1980	5	24	100336.3	39.937	-111.966	4.2	5	97	PDE
1982	5	24	121327.04	38.706	-112.041	4	8	73	PDE
1983	1	22	114449.17	39.947	-111.952	2.8	4	64	PDE
1983	6	9	165715.45	39.857	-111.988	2.9	6	99	PDE
1983	12	9	85841.34	38.583	-112.582	3.6	7	58	PDE
1984	8	16	141921.82	39.383	-111.904	3.7	9	56	PDE
1986	3	24	223341.38	39.222	-112.006	3.3	0	55	PDE
1986	3	24	224023.48	39.236	-112.009	4.4	0	56	PDE
1986	3	25	24906.33	39.23	-112.006	2.8	0	56	PDE
1986	3	25	25301.24	39.223	-112.011	3.9	0	37	PDE
1986	5	28	1754.4	39.774	-112.79	2.8	1	96	PDE
1986	9	25	124531.31	38.614	-112.553	2.8	1	93	PDE
1986	10	5	154733.5	38.64	-112.559	3.3	1	37	PDE
1987	2	23	105716.98	39.392	-112.157	2.8	3	85	PDE
1987	3	11	131129.47	39.246	-111.629	2.8	0	84	PDE
1987	3	11	153102.98	39.25	-111.636	3	1	76	PDE
1987	11	11	44950.88	39.246	-111.74	2.8	5	84	PDE
1988	6	11	34931.12	40.233	-112.382	2.7	5	59	PDE
1988	7	11	114655.99	39.192	-111.988	3.1	1	73	PDE
1988	9	8	214210.08	39.941	-111.959	2.7	5	88	PDE
1988	12	31	139.12	39.946	-111.736	2.6	6	89	PDE
1989	7	23	103943.91	38.738	-112.184	3.7	10	90	PDE
1990	2	5	102325.23	39.504	-111.517	3.1	10	89	PDE
1990	5	16	201004.25	38.678	-112.583	2.9	0	89	PDE
1990	6	30	1123.67	38.677	-112.585	2.8	0	81	PDE
1991	2	21	112345.62	38.96	-111.901	3.4	1	61	PDE
1991	8	21	134706.25	39.364	-111.878	3	3	79	PDE
1992	3	4	1441	38.898	-112.034	2.7	4	43	PDE
1993	3	15	104849.86	39.552	-112.075	3.3	5	91	PDE
1993	7	20	35703.06	38.767	-112.056	3.6	2	82	PDE
1993	10	21	220716.34	38.979	-111.861	3.5	5	83	PDE

1994	2	27	55843.12	38.73	-112.587	2.6	5	91	PDE
1994	9	9	200640.69	39.555	-111.505	3.5	5	85	PDE
1994	9	9	201149.33	39.503	-111.577	2.8	5	92	PDE
1994	9	9	201328.57	39.5	-111.5	2.9	5	89	PDE
1994	9	9	204300.87	39.448	-111.527	2.6	5	90	PDE
1994	9	10	63341.76	39.468	-111.52	3.7	5	88	PDE
1994	9	10	74221.68	39.428	-111.549	2.8	5	91	PDE
1994	9	10	92333.25	39.496	-111.508	3.6	5	86	PDE
1994	9	10	95710.18	39.478	-111.566	2.6	5	90	PDE
1994	11	23	163048.95	39.5	-111.52	3.3	5	54	PDE
1995	3	31	212652.86	39.368	-111.952	3.2	5	94	PDE
1995	7	6	2223.31	39.926	-111.629	3.3	10	75	PDE
1995	12	31	121107.9	38.988	-111.974	3.1	1	86	PDE
1999	1	26	214928	38.71	-112.49	3.2	1	84	PDE
1999	1	26	220246	38.72	-112.49	3.1	1	86	PDE
1999	1	26	2334	38.71	-112.49	2.8	3	92	PDE
1999	4	19	144232	38.72	-112.14	3.5	0	91	PDE
1999	4	20	103437	38.73	-112.14	3.2	1	91	PDE
1999	4	20	133157	38.73	-112.13	3.1	1	92	PDE
1999	4	21	105127	38.72	-112.14	3.2	2	92	PDE
1999	4	21	112204	38.72	-112.13	3.2	1	86	PDE
1999	7	18	223420	38.86	-111.97	2.9	4	85	PDE
1999	7	18	232049	38.86	-111.98	3.5	6	85	PDE
1999	7	18	232328	38.87	-111.98	3.2	4	86	PDE
1999	7	19	326	38.86	-111.97	3	5	85	PDE
1999	9	7	12945	38.85	-112	2.9	4	86	PDE
1999	9	9	94420	38.85	-111.98	3.1	4	86	PDE
1999	9	9	100741	38.85	-111.98	3.6	4	85	PDE
1999	9	9	101121	38.86	-111.98	2.9	1	86	PDE
1999	9	9	101415	38.86	-111.97	3.5	3	85	PDE
1999	9	9	113843	38.86	-111.98	3.7	4	87	PDE
1999	9	9	193412	38.84	-111.98	3.1	3	93	PDE
1999	10	11	224315	38.76	-112.02	3.9	2	83	PDE
2000	3	8	150436	38.89	-111.98	2.8	4	86	PDE
2000	3	8	151706	38.86	-111.97	2.9	5	84	PDE
2000	3	8	152504	38.88	-111.98	3.4	3	84	PDE
2000	3	24	128	38.73	-112.44	2.5	0	86	PDE
2000	3	24	8	38.71	-112.44	2.6	3	85	PDE
2000	3	24	10423	38.72	-112.46	3.1	0	84	PDE
2000	3	24	10827	38.73	-112.45	2.7	1	84	PDE
2000	3	24	11314	38.73	-112.44	2.7	1	86	PDE
2000	3	24	20554	38.71	-112.43	2.8	3	76	PDE
2000	8	3	133412	39.58	-111.69	3.2	5	89	PDE
2000	11	8	204101	38.79	-112.04	2.8	0	89	PDE
2000	11	27	73415	38.79	-112.05	2.9	0	84	PDE
2001	2	10	105615	38.72	-112.55	3.4	0	95	PDE
2001	2	23	45623	40.07	-111.76	2.5	1	83	PDE
2001	2	23	214350	38.73	-112.56	4.1	0	83	PDE
2001	2	24	105440	38.73	-112.54	3.6	2	82	PDE
2001	2	24	105548	38.74	-112.54	3.1	1	84	PDE

2001	2	28	40946	38.72	-112.55	3.7	0	85	PDE
2001	2	28	74107	38.71	-112.55	2.5	1	85	PDE
2001	3	13	12726	38.71	-112.54	2.8	0	86	PDE
2001	3	13	45415	38.7	-112.54	2.8	1	84	PDE
2001	3	13	134304	38.72	-112.54	3.3	0	83	PDE
2001	5	9	101304.17	38.734	-112.546	3.5	1	73	PDE
2001	8	2	135946	39.94	-111.95	2.9	1	84	PDE
2002	3	10	160316	38.72	-112.55	2.8	1	72	PDE
2002	4	12	12653	39.06	-111.93	2.9	6	84	PDE
2002	11	9	80951	39.77	-111.66	3	3	91	PDE
2003	2	11	85904	38.696	-112.26	2.9	0	91	PDE
2003	2	11	90042	38.697	-112.259	3.3	0	77	PDE
2003	3	17	180812	39.016	-111.899	3	3	61	PDE
2003	4	17	10419	39.516	-111.857	4.7	0	56	PDE
2003	8	16	42315	39.47	-111.92	2.6	3	56	PDE
2003	12	12	210413.65	39.537	-111.923	3.3	2	79	PDE
2003	12	26	3306	38.98	-111.91	3	0	57	PDE
2003	12	27	3924	39.644	-111.929	3.8	1	56	PDE
2003	12	27	4040	39.639	-111.943	3.6	1	58	PDE
2003	12	27	4324	39.645	-111.92	3.8	3	55	PDE
2003	12	27	131901	39.645	-111.958	3	2	55	PDE
2004	2	23	92019	39.212	-112.034	3	0	57	PDE
2004	3	13	130447	39.66	-111.94	3.2	2	57	PDE
2004	3	18	145832	39.654	-111.939	3.3	0	58	PDE
2004	3	19	53908.07	39.647	-111.919	3.1	1	60	PDE
2004	3	19	142328.52	39.659	-111.909	3.1	1	58	PDE
2004	5	31	21946	39.74	-111.97	2.8	1	58	PDE
2005	3	14	53327	39.509	-111.895	3	1	42	PDE
2005	6	12	90854	39.205	-112.234	2.8	4	98	PDE
2005	7	20	70615	38.601	-112.691	3.5	1	87	PDE
2005	7	29	204618	38.784	-112.098	3.7	1	97	PDE
2005	9	9	173620	38.606	-112.655	3	0	91	PDE
2005	11	14	202552	39.476	-111.505	3	9	92	PDE
2005	11	14	203518	39.485	-111.491	3	0	92	PDE
2005	11	15	11706	39.49	-111.49	3.1	3	91	PDE
2006	7	25	202719	39.733	-111.534	2.9	7	60	PDE
2006	9	28	64453	39.21	-111.97	2.9	13	55	PDE
2006	12	7	150436	39.283	-111.978	2.7	5	53	PDE
2007	5	28	205554	39.32	-111.99	2.9	3	80	PDE
2007	11	5	2148	39.35	-111.65	3.8	5	86	PDE
2007	11	26	170846	39.28	-111.6	2.5	1	80	PDE
2008	4	20	221757	39.98	-111.89	2.8	2	55	PDE
2008	4	22	165950	39.324	-111.956	2.8	1	56	PDE
2010	1	23	154845	39.95	-111.89	3	1	45	PDE
2010	10	22	203929	38.76	-112.01	3	1	88	PDE-W
2010	11	19	113811	38.86	-111.93	3	5	67	PDE-W
2011	1	20	215912	39.16	-111.91	3.2	9	69	PDE-W
2011	3	9	102658.88	39.9	-111.97	2.2	0	81	PDE-Q
2011	7	5	32206	39.93	-111.82	3.2	6	81	PDE-Q
2011	7	22	70535	39.93	-111.82	3.6	5	81	PDE-Q

TABLE 3
Seismic Design Criteria
Magnum Gas Storage Evaporation Ponds

Return Period, years	Modal Moment Magnitude	Source to Site Distance, km	Peak Horizontal Ground Acceleration, g Class S_D- Stiff Soil Vs-366 m/s
72	5.2	33.8	0.04
224	5.2	16.8	0.08
475	5.2	18.4	0.12
975	5.2	15.1	0.17
2475	5.4	13	0.24
4975	6.2	14.7	0.38
			Mean (PGA, g)
MCE No. 2437	5.8	3.6	0.25
MCE No. 2351i	6.7	56.4	0.05
MCE No. 2351	8.2	56.4	0.12
			Mean + 1 σ
MCE No. 2437	5.8	3.6	0.46
MCE No. 2351i	6.7	56.4	0.25
MCE No. 2351	8.2	56.4	0.32

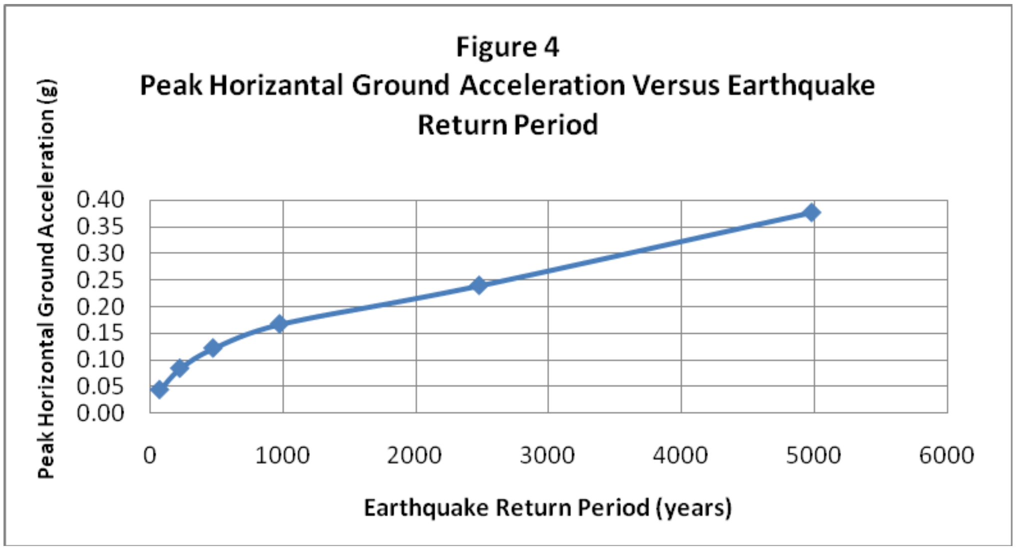
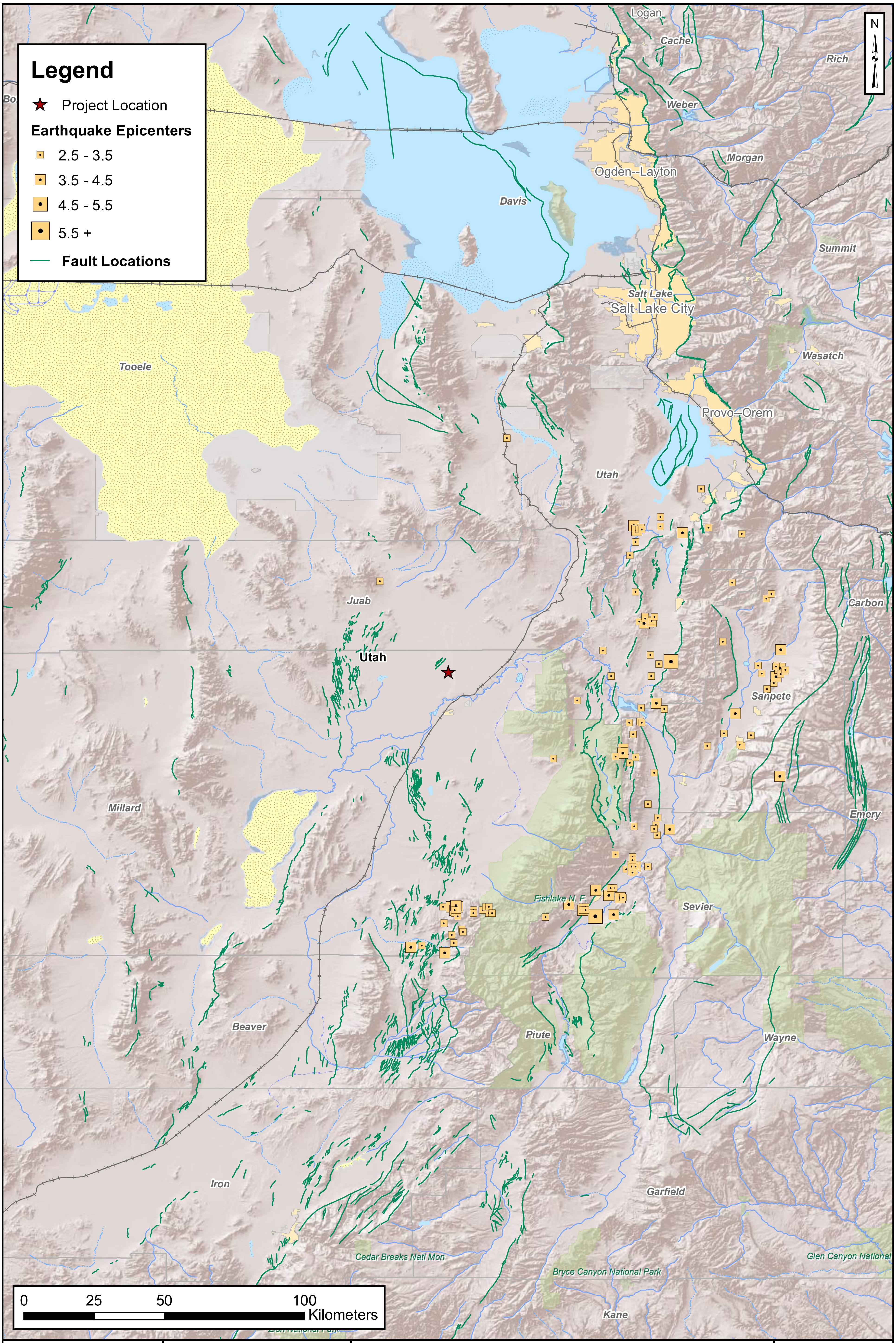


Figure 4
Peak Horizantal Ground Acceleration Versus Earthquake Return Period



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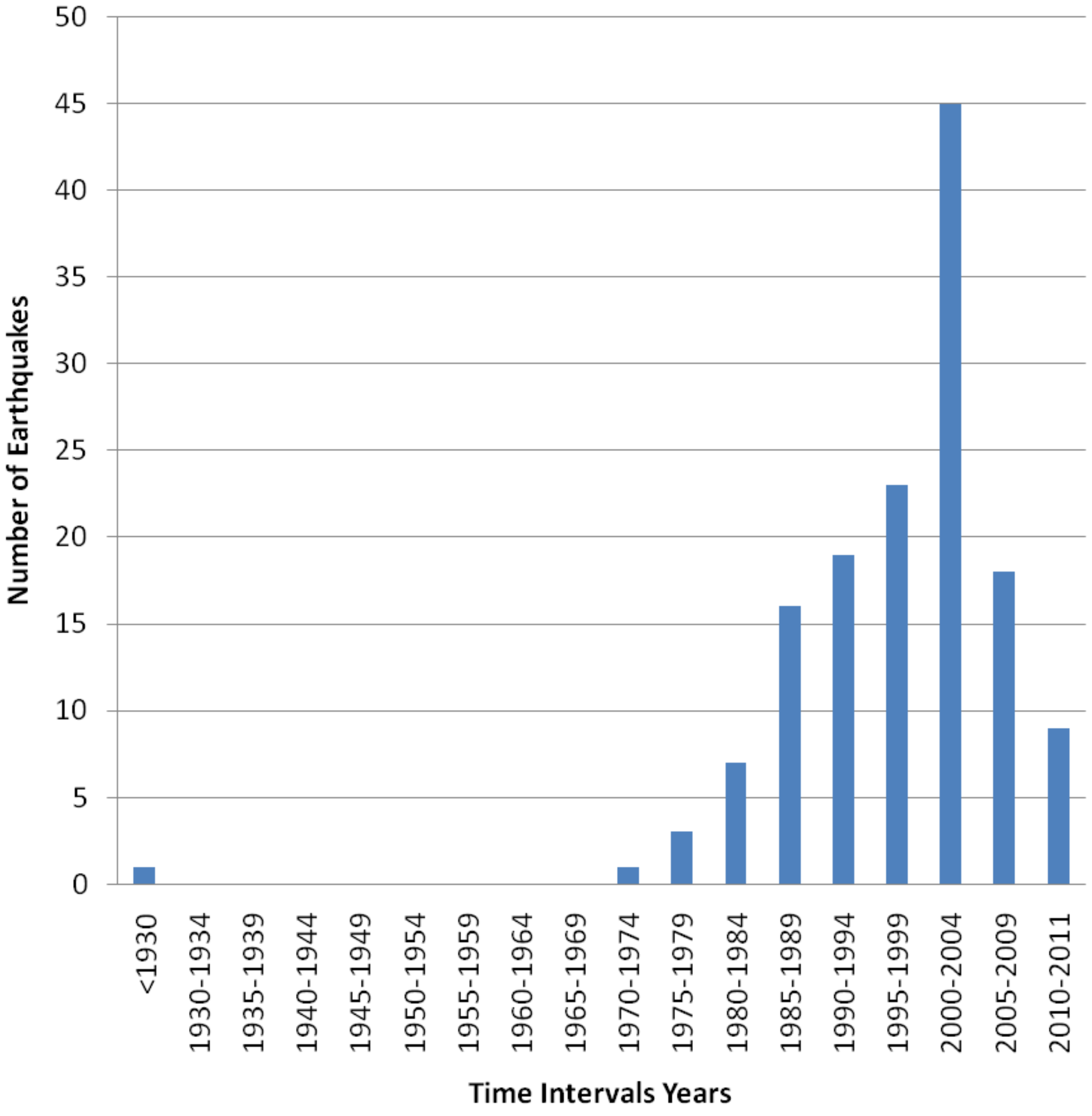
JOB NO.	7420140900
DESIGN:	TJF
DRAWN:	AMEC GIS
DATE:	08/01/2011
SCALE:	Graphical

Magnum Gas Storage, LLC Evaporation Ponds
Seismic Hazard Assessment

Earthquake Epicenter and Fault Locations

FIGURE
1

Figure 2
Distribution of Earthquakes Over Time



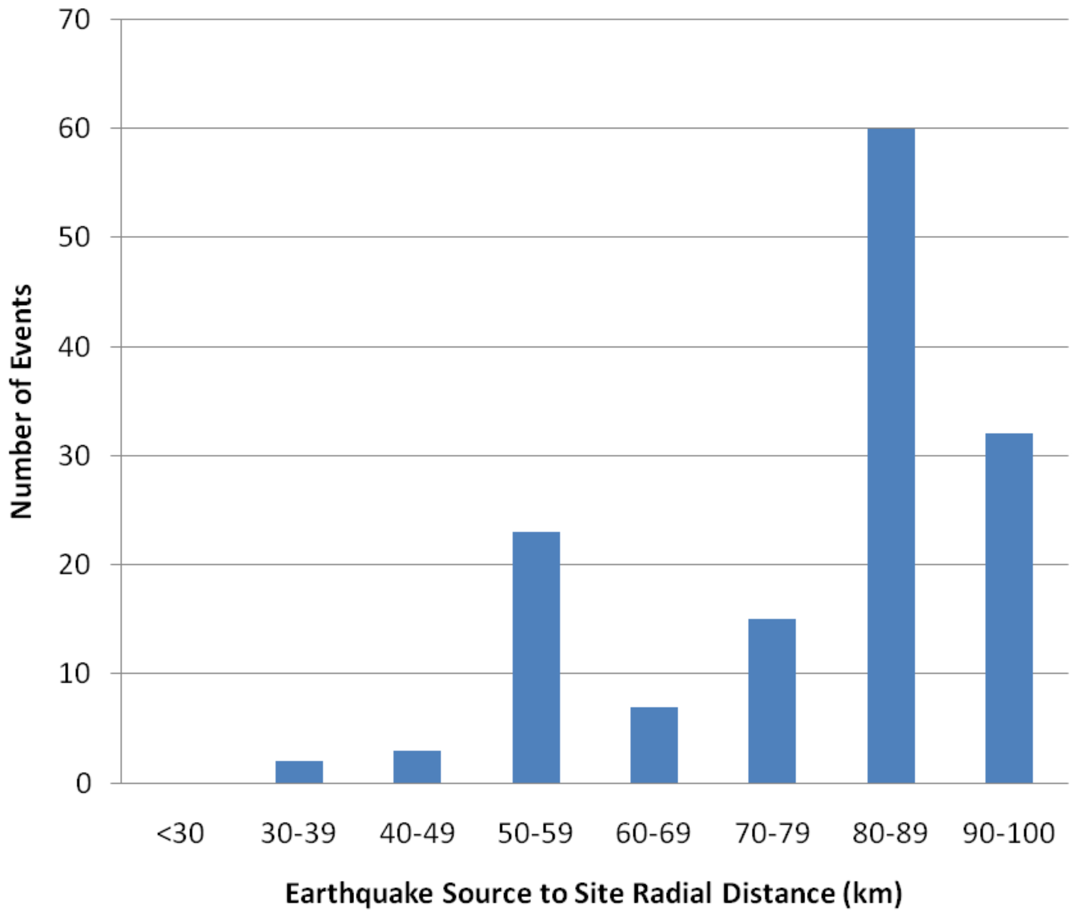


Figure 3
Distribution of Earthquake Radial Distance

ATTACHMENT 2 – SEED MIX

Seed Mix – Millard County Road Construction, Utah

Semi-Desert (8”-10” Ann. Precip.)

Based on – Intermountain Planting Guide (Page 28)

June 2014

The following are recommended rates for broadcast and drag. If seed is drilled, mixture can be reduced by 1/2. All rates are based on pure live seed (PLS). For best results, the seeding should take place between October and December. The following seeding costs are estimated:

	PLS lbs/ac.	$/lb.	$ Total
Achnatherum hymenoides – Indian ricegrass	5	6.00	30.00
Pascopyron smithii - Western wheatgrass	3	10.00	30.00
Sporobolus airoides - Alkali sacaton	2	20.00	40.00
Psathyrostachys juncea (Boziosky variety) - Russian wildrye	4	3.00	12.00
Elymus elemoides – Bottlebrush squirreltail	2	12.00	24.00
Sphaeralcea spp. – Scarlet Globemallow	2	20.00	40.00
Total	18 lbs/acre		$176.00

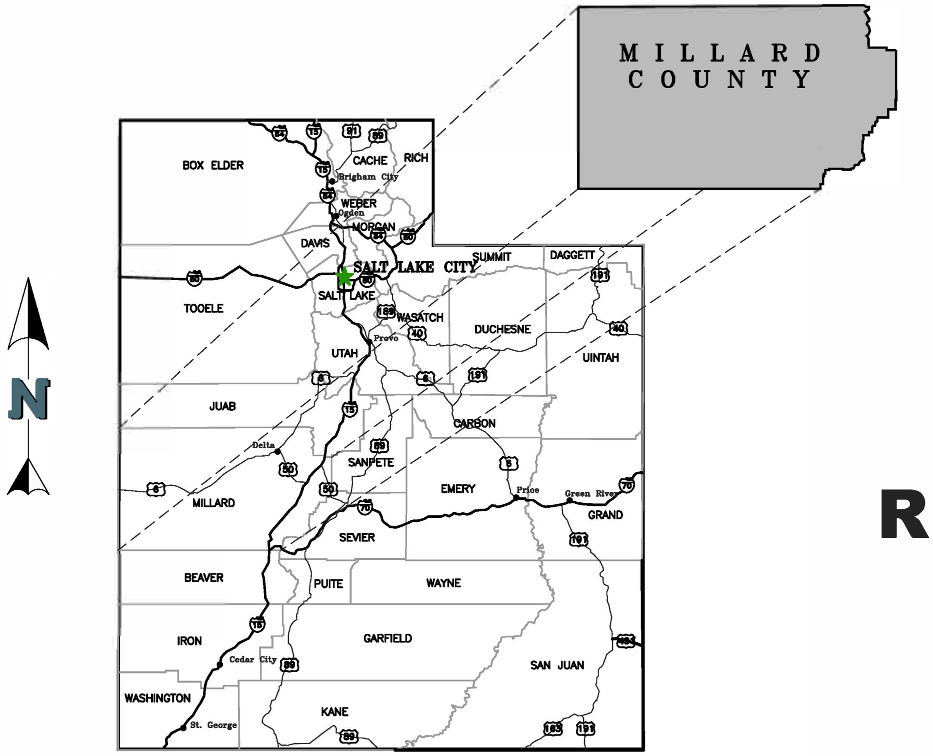
**any changes to the seed mix must be approved by SITLA and Division of Water Rights, Dam Safety.

DRAWINGS

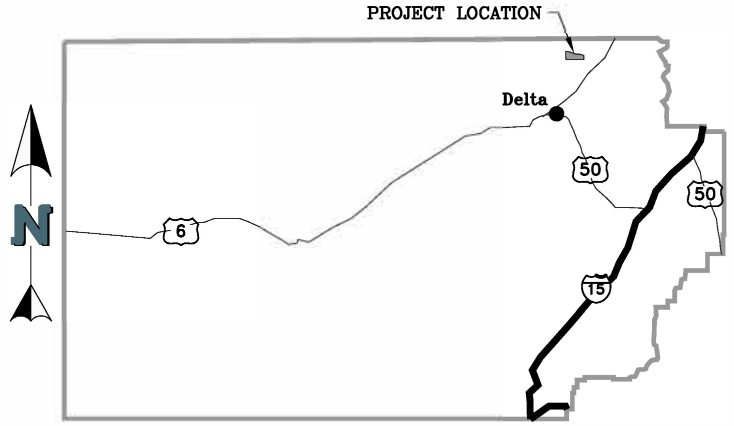
MAGNUM SOLUTION MINING, LLC

BRINE POND 4

RE-ISSUED FOR CONSTRUCTION
03/12/21



UTAH COUNTY MAP



MILLARD COUNTY VICINITY MAP

DRAWING LIST

DWG #	TITLE	REV
A000	COVER SHEET & DRAWING INDEX	2
A010	GENERAL ARRANGEMENT	1
A020	STAGE–STORAGE CURVES AND POND PROPERTIES	2
A050	GEOTECHNICAL INVESTIGATION LOCATIONS	0
A100	OVERALL GRADING PLAN	0
A105	OVERALL GRADING ISOPACH	0
A110	TYPICAL EMBANKMENT SECTIONS AND DETAILS SHEET 1 OF 2	0
A115	TYPICAL EMBANKMENT SECTIONS AND DETAILS SHEET 2 OF 2	1
A120	POND NO. 4 NORTHEAST ACCESS RAMP PLAN AND PROFILE	0
A135	POND NO. 4 SOUTHWEST ACCESS RAMP PLAN AND PROFILE	0
A140	BRINE RECOVERY SYSTEM SECTION AND DETAILS	0
A150	POND INLET PLAN	0
A160	POND INLET SECTIONS AND DETAILS	0
A200	POND BASIN PIPING PLAN	0
A205	POND BASIN PIPING SECTIONS AND DETAILS	0
A220	LEAK COLLECTION AND RECOVERY SYSTEM DETAILS	0
A230	PROCESS COLLECTION AND MONITORING SYSTEM PLAN	0
A300	POND SITE GROUNDWATER DEPTHS PLAN AND PROFILE	2
A400	STORMWATER DIVERSION AND SETTLEMENT MONUMENT PLAN	0
A500	BRINE RECOVERY MANIFOLD SECTIONS AND DETAILS	0
A600	WILDLIFE FENCE DETAILS	0

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
03/12/2021
STATE OF UTAH

OWNER'S ACCEPTANCE OF THE DRAWINGS

NAME	SIGNATURE	DATE
Michael J. Ducker	Michael J. Ducker	3/12/21

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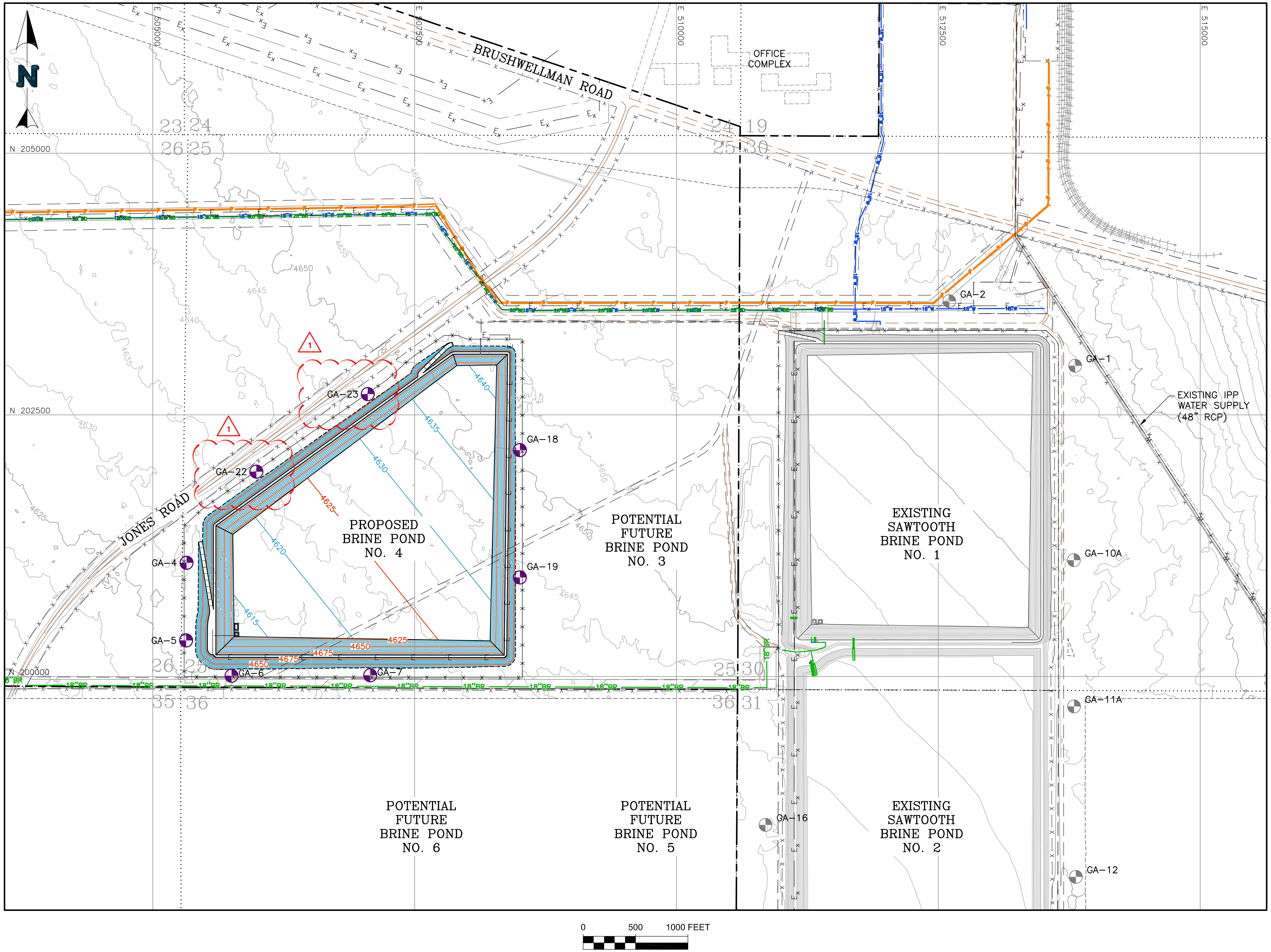
MAGNUM

MAGNUM SOLUTION MINING, LLC
3165 E MILLROCK DRIVE
SUITE 330 HOLLADAY, UT 84121
PHONE: 801-993-7001

NewFields

9400 Station Street, Suite 300, Lone Tree, CO 80124
Phone: (720) 508.3300 www.newfields.com



LEGEND:

EXISTING GROUND CONTOURS
PROPOSED GROUND CONTOURS
EXISTING ROADS/TRAILS
EXISTING EASEMENTS
MAGNUM SITE BOUNDARY
SITE BOUNDARY
SECTION LINES
20 SECTION NUMBER
—x—x— EXISTING FENCE
—x—x— PROPOSED WILDLIFE FENCE
18"BR EXISTING BRINE LINE
20"BD EXISTING BRINE LINE
Ex EXISTING POWER LINE
Wx EXISTING WATER LINE
P EXISTING PIPE
18"W EXISTING 18" WATER
4"W EXISTING 4" WATER
20"BD PROPOSED 20" HDPE DR11 BRINE INFLUENT LINE
GA-01 EXISTING GROUND WATER MONITORING WELLS TO REMAIN
GA-12 PROPOSED GROUND WATER MONITORING WELLS

NOTES:

1. STAGE-STORAGE CURVES AND POND PROPERTIES TABLE ARE SHOWN ON DRAWING A020.

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
03/12/2021

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REV	DATE	DESCRIPTION	TECH	ENG
1	03/12/21	RE-ISSUED FOR CONSTRUCTION	JLW	KNJ
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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PROJECT
BRINE POND 4

TITLE
GENERAL ARRANGEMENT

FILENAME
93.020.002M

DRAWING NO.
A010

REVISION
1

TABLE 1 – POND MATERIAL PROPERTIES AND TESTING FREQUENCY SUMMARY (SEE NOTE 4)

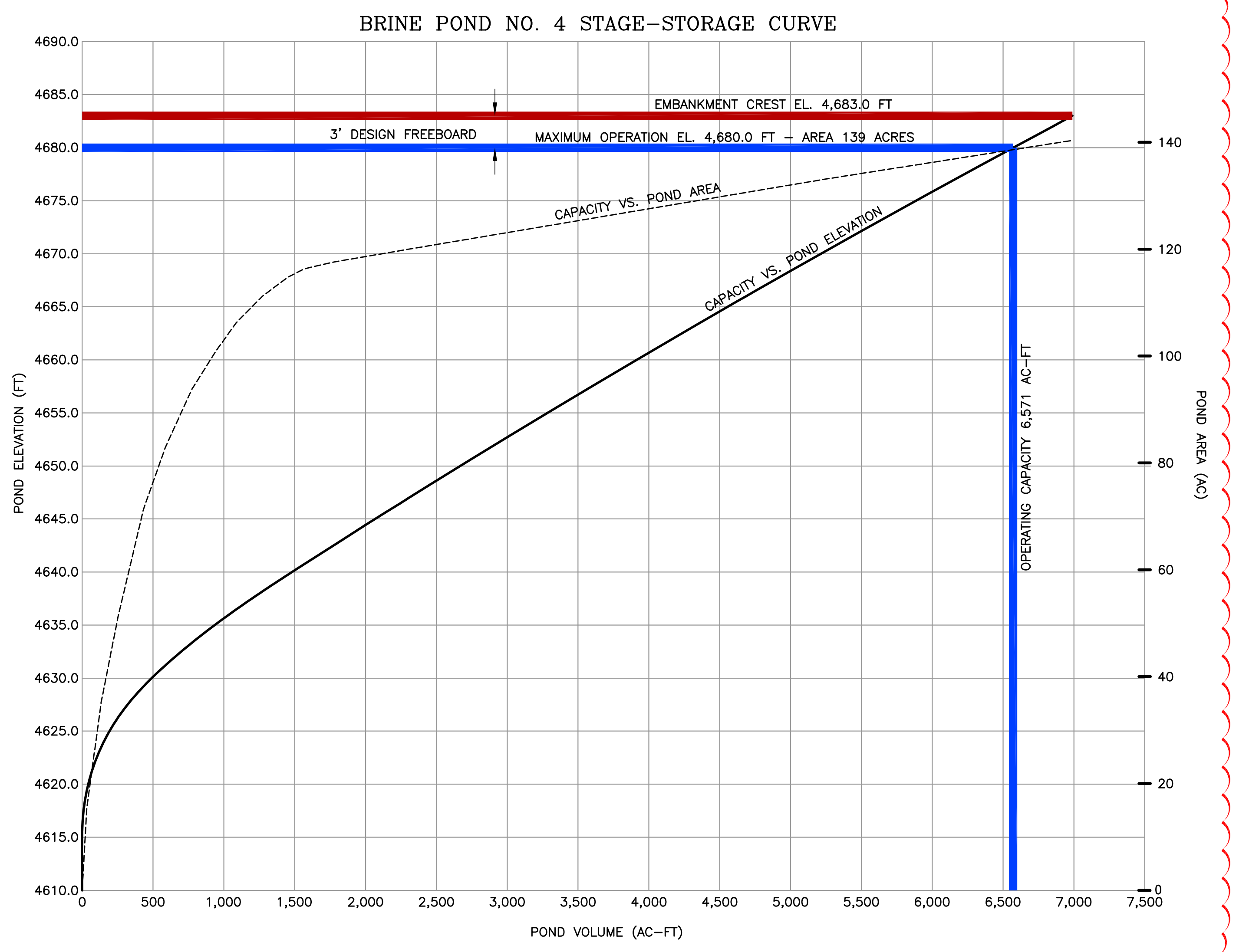
ASTM TEST (DESCRIPTION)	CONTROL & RECORD TEST No.	TESTING FREQUENCIES (ONE PER – SEE NOTE 2)					
		RANDOM FILL	SELECT GRAVEL	PIPE BEDDING/BACKFILL	ROAD WEARING COURSE	EMBANKMENT FOUNDATION	BASIN FOUNDATION
D4318 (ATTERBERG LIMITS)	C1, R1	10,000 yd^3	1,000 yd^3	SOIL TYPE/5,000 yd^3 OR 1 PER STRUCTURE	2,000 yd^3	SOIL TYPE/100,000 ft^2	SOIL TYPE/200,000 ft^2
D2216 (MOISTURE CONTENT)	C2, R2	1 PER LIFT PER DAY OR 2,000 yd^3	–	PER NUCLEAR DENSITY REQUIREMENTS	–	50,000 ft^2	100,000 ft^2
D422 (PARTICLE SIZE DISTRIBUTION)	C3, R3	10,000 yd^3	1,000 yd^3 OR MINIMUM OF 2 TESTS	5,000 yd^3 OR 1 PER STRUCTURE	2,000 yd^3	100,000 ft^2	200,000 ft^2
D698 (STANDARD PROCTOR)	C4, R4	SOIL TYPE/ 1 PER 10 FIELD DENSITY TESTS	–	SOIL TYPE/5,000 yd^3	–	SOIL TYPE/250,000 ft^2	SOIL TYPE/500,000 ft^2
D2922 (NUCLEAR DENSITY)	R5d^NOTE1	1 PER LIFT PER DAY OR 2,000 yd^3	–	GREATER OF 4 PER STRUCTURE OR 500 yd^3	–	50,000 ft^2	100,000 ft^2
REQUIRED COMPACTION VALUES AND RESULTS (SEE NOTE 1)	MOISTURE CONTENT	WITHIN 2% OF OPTIMUM MOISTURE CONTENT	–	SUFFICIENT TO OBTAIN ADEQUATE DENSITY	–	SUFFICIENT TO OBTAIN ADEQUATE DENSITY	SUFFICIENT TO OBTAIN ADEQUATE DENSITY
	MIN. COMPACTION PER ASTM D698	AT LEAST 95% OF MAX. DRY DENSITY	–	AT LEAST 95% OF MAXIMUM DRY DENSITY	–	95% M.D.D.	95% M.D.D.
	MAXIMUM LOOSE LIFT THICKNESS	8”	–	8”	8”	SUFFICIENT TO ACHIEVE A SMOOTH AND COMPACT SURFACE	
	MAXIMUM PARTICLE SIZE	4”	–		–		
D1556 (SAND CONE) OR D5030 (WATER REPLACEMENT)	R5b, R5c	1 PER 10 NUCLEAR DENSITY TESTS	–	EVERY 10 NUCLEAR DENSITY TESTS	–	1 PER 10 NUCLEAR DENSITY TESTS	1 PER 10 NUCLEAR DENSITY TESTS
D3080 (DIRECT SHEAR STRENGTH – SEE NOTE 3)	C6, R6	1 PER 1,000,000 yd^3	–	–	–	–	–

TABLE 2 – PARTICLE SIZE DISTRIBUTION SUMMARY (SEE NOTE 4)

SIEVE SIZE / MATERIAL	4”	3”	2”	1.5”	1”	0.75”	0.5”	#4	#16	#200	P.I.
SELECT GRAVEL			100	30–70	0– 15		0–5				
ROAD WEARING COURSE	100					50–70		35–50	15–40	2–10	
PIPE BACKFILL	100	90–100								0–20	<= 10
PIPE BEDDING				100		90–100		30–70		0–20	<= 10

NOTES:

1. IF 3 CONSECUTIVE TESTS FAIL FOR EITHER COMPACTION OR MOISTURE, THE TESTING FREQUENCY SHALL BE INCREASED TO 1 TEST PER 1,000 yd3/ UNTIL 6 CONSECUTIVE PASSING TESTS ARE RECORDED.
2. WHERE TWO CRITERIA ARE GIVEN, WHICHEVER CRITERIA RESULTS IN MORE FREQUENT TESTING SHALL BE OBSERVED.
3. D3080 (DIRECT SHEAR STRENGTH) REQUIREMENT IS A MINIMUM FRICTION ANGLE OF 30° AND A MINIMUM COHESION OF 300 PSF. IF RESULTS DO NOT ACHIEVE THESE MINIMUM CRITERIA, THE ENGINEER SHALL BE NOTIFIED TO RE–EVALUATE THE ANALYSIS.
4. THE INFORMATION PRESENTED ON THIS DRAWING IS AN INCOMPLETE SUMMARY OF THE TECHNICAL SPECIFICATIONS. THE FULL TECHNICAL SPECIFICATIONS ARE INCLUDED IN APPENDIX B OF THE FINAL DESIGN REPORT AND MUST BE REFERRED TO DURING CONSTRUCTION.



2

POND PROPERTIES

DESCRIPTION	POND NO. 4
CREST ELEVATION (FT)	4,683.0
OPERATING ELEVATION (FT)	4,680.0
TOTAL CAPACITY (AC–FT)	6,989
OPERATING CAPACITY (AC–FT)	6,571
FREEBOARD CAPACITY (AC–FT)	418

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
03/12/2021

REV	DATE	DESCRIPTION	TECH	ENG
2	03/12/21	RE–ISSUED FOR CONSTRUCTION	JLW	KNJ
1	01/29/21	RE–ISSUED FOR CONSTRUCTION	JLW	KNJ
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND 4

TITLE
STAGE–STORAGE CURVES AND
POND PROPERTIES

FILENAME
93.020.004D

DRAWING NO.
A020

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2

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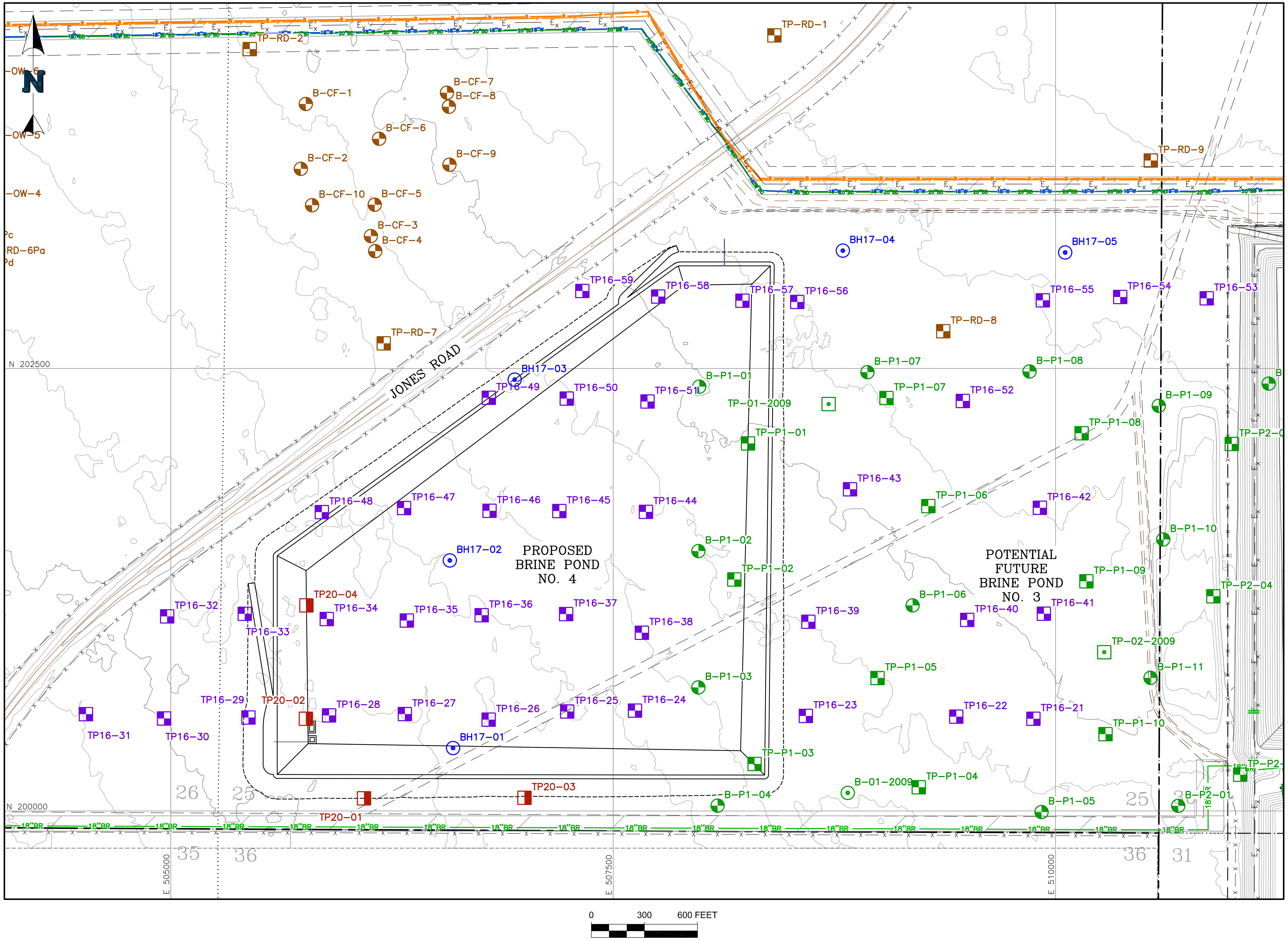

LEGEND:

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	EXISTING ROADS/TRAILS
	EXISTING EASEMENTS
	SITE BOUNDARY
	SECTION LINES
20	SECTION NUMBER
x	EXISTING FENCE
18"BR	EXISTING BRINE LINE
20"BD	EXISTING BRINE LINE
Ex	EXISTING POWER LINE
Wx	EXISTING WATER LINE
P	EXISTING PIPE
18"W	EXISTING 18" WATER
B-01-2009	BOREHOLE (IGES, 2009)
TP-01-2009	TEST PIT (IGES, 2009)
B-P1-01	BOREHOLE (IGES, 2010)
TP-P1-02	TEST PIT (IGES, 2010)
B-P1-01	BOREHOLE (IGES, 2010 PLANT SITE)
TP-P1-02	TEST PIT (IGES, 2010 PLANT SITE)
BH15-1	BOREHOLE (NEWFIELDS, 2015)
TP15-01	TEST PIT (NEWFIELDS, 2015)
TP16-01	PHASE I TEST PIT (NEWFIELDS, 2016)
BH17-01	BOREHOLE (NEWFIELDS, 2017)
TP20-01	TEST PIT (NEWFIELDS, 2020)

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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CLIENT: MAGNUM SOLUTION MINING, LLC

PROJECT: BRINE POND 4

TITLE: GEOTECHNICAL INVESTIGATION LOCATIONS

FILENAME: 93.020.006M
DRAWING NO.: A050
REVISION: 0

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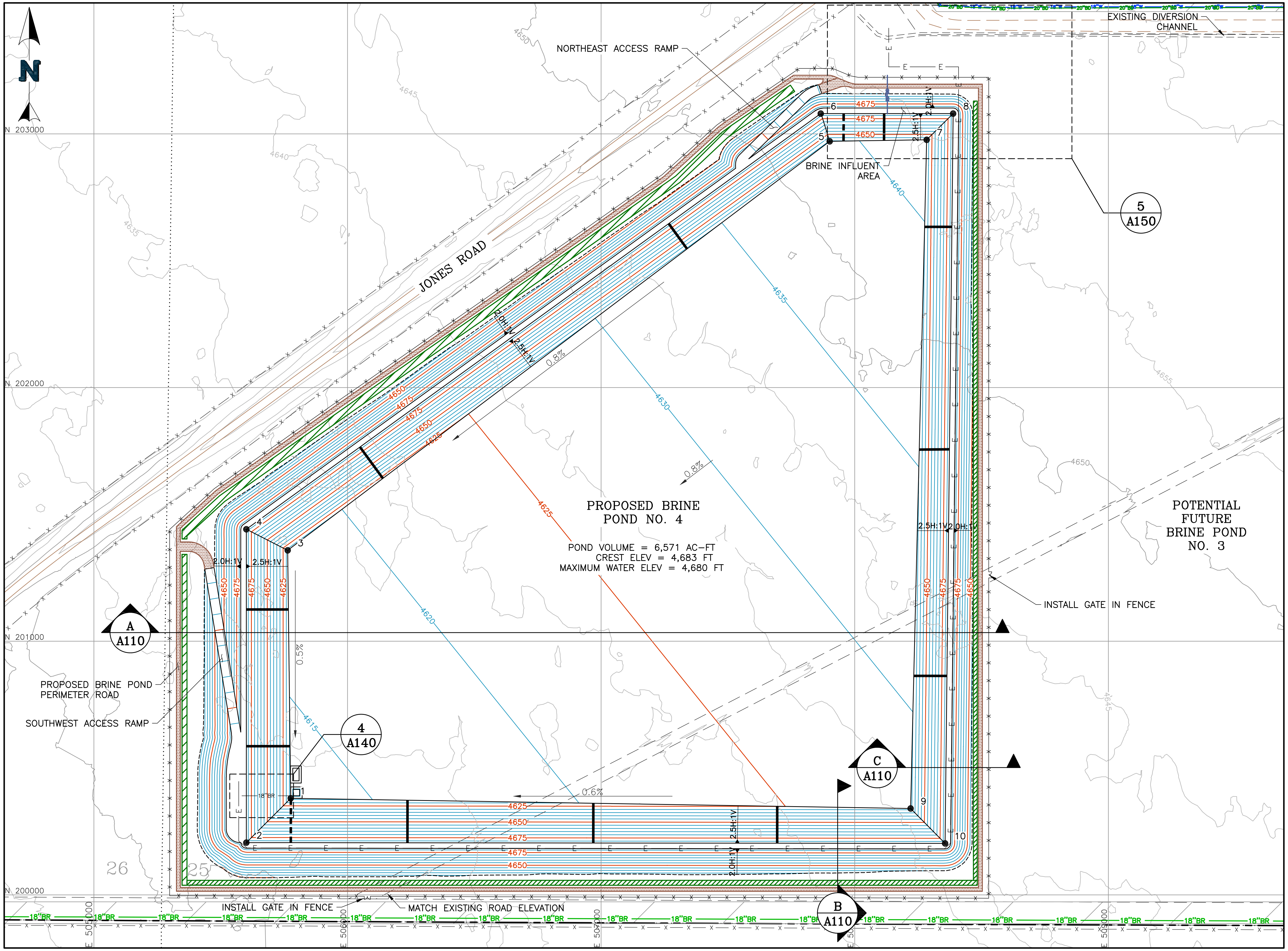

LEGEND:

EXISTING GROUND CONTOURS
PROPOSED GROUND CONTOURS
EXISTING ROADS/TRAILS
EXISTING EASEMENTS
SITE BOUNDARY
EXISTING FENCE
PROPOSED WILDLIFE FENCE
EXISTING BRINE LINE
EXISTING POWER LINE
PROPOSED POWER LINE
EXISTING WATER LINE
EXISTING 18" WATER
PROPOSED 20" BRINE DELIVERY LINE
VEGETATION WINDROW
PROPOSED PERIMETER ROAD
HDPE ACCESS LADDER WITH WHITE LINER STRIP FOR VISUAL IDENTIFICATION
WATER LEVEL GAUGE
SETTING OUT POINTS

SETTING OUT DATA

POINT	NORTHING	EASTING	ELEVATION
1	200,380.84	505,776.18	4,613.02
2	200,206.08	505,601.23	4,683.00
3	201,358.31	505,764.09	4,617.86
4	201,441.50	505,601.23	4,683.00
5	202,970.72	507,901.37	4,639.26
6	203,080.07	507,865.96	4,683.00
7	202,976.75	508,283.54	4,641.67
8	203,080.07	508,388.02	4,683.00
9	200,340.64	508,220.22	4,628.03
10	200,203.07	508,356.12	4,683.00

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

GEOSYNTHETIC LINER SYSTEM NOTE:

1. THE LINER SYSTEM SHALL BE A COMPOSITE SYSTEM WITH THE PRIMARY LINER CONSISTING OF 80–mil (2.0MM) SINGLE SIDED TEXTURED HDPE LINER UNDERLAIN BY A SECONDARY LINER CONSISTING OF A 60–mil (1.5MM) DRAIN LINER WITH 130–mil HEIGHT RAISED STUDS FACING UP. 250–mil GEONET MAY BE USED IN LIEU OF THE 130–mil HEIGHT RAISED STUDS.

0 200 400 FEET

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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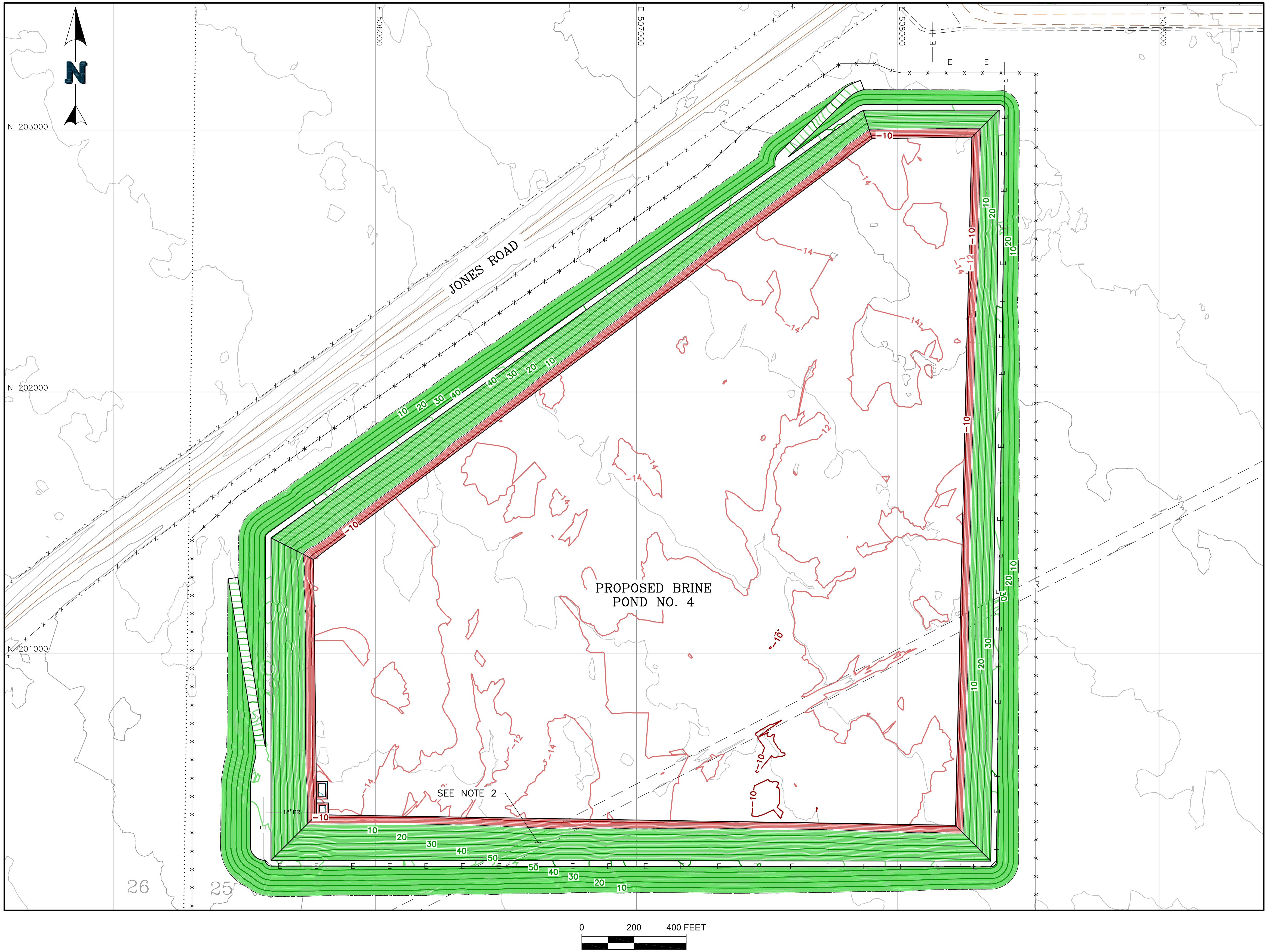
NewFields

CLIENT: MAGNUM SOLUTION MINING, LLC
PROJECT: BRINE POND 4
TITLE: OVERALL GRADING PLAN
FILENAME: 93.020.008M
DRAWING NO.: A100
REVISION: 0



LEGEND:

EXISTING GROUND CONTOURS
CUT DEPTH CONTOURS
FILL DEPTH CONTOURS
EXISTING ROADS/TRAILS
EXISTING EASEMENTS
MAGNUM SITE BOUNDARY
SITE BOUNDARY
20 SECTION NUMBER
—x—x— EXISTING FENCE
—×—×— PROPOSED WILDLIFE FENCE
—E— PROPOSED POWER LINE

POND EARTHWORKS	
DESCRIPTION	POND NO. 4
CUT (CY)	2,308,742
FILL (CY)	2,077,186
COMPACTION RATIO (ESTIMATED FROM BRINE PONDS 1 & 2 CONSTRUCTION)	11.1%

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020
STATE OF UTAH

P:\Projects\0093.020 Magnum Brine Pond 4 Revised Design\A-CAD\DWGS\93.020.010M.dwg-9/15/2020 8:50 AM

NOTES:

1. THE AVERAGE DEPTH OF TOPSOIL IS ASSUMED TO BE 3 INCHES FOR THE EARTHWORK BALANCE.
2. EXISTING ROAD WEARING COURSE MATERIAL TO BE REMOVED AND ROAD SURFACE TO BE SCARIFIED PRIOR TO PLACEMENT OF EMBANKMENT FILL. SEE TECHNICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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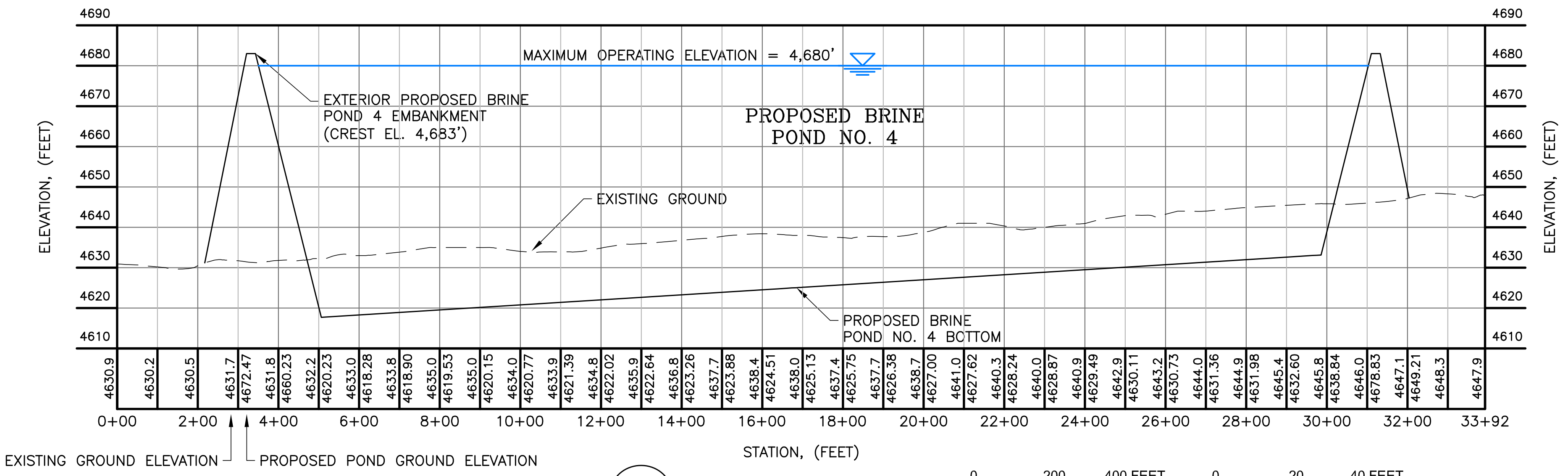
NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
OVERALL GRADING ISOPACH

FILENAME 93.020.010M
DRAWING NO. A105
REVISION 0

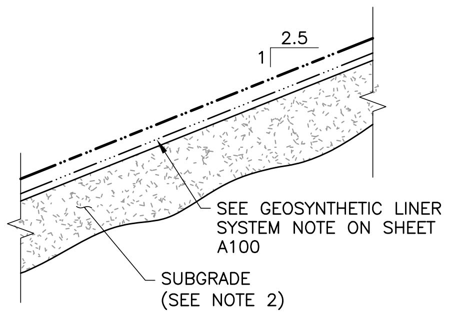


A
A100
TYPICAL POND SECTION

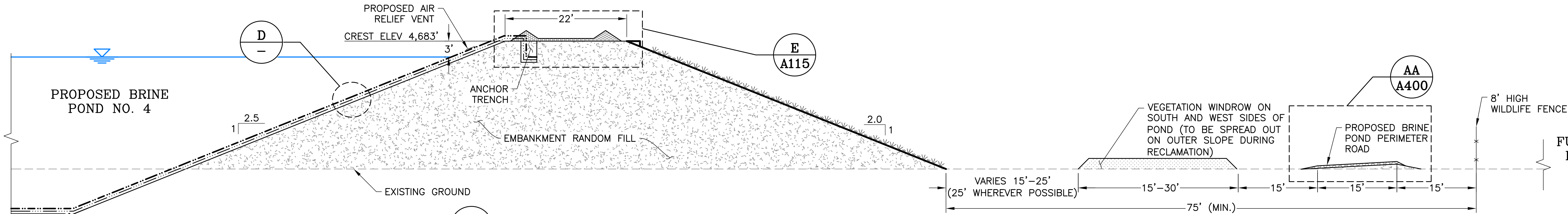
0 200 400 FEET
HORIZONTAL

0 20 40 FEET
VERTICAL

10X EXAGGERATION



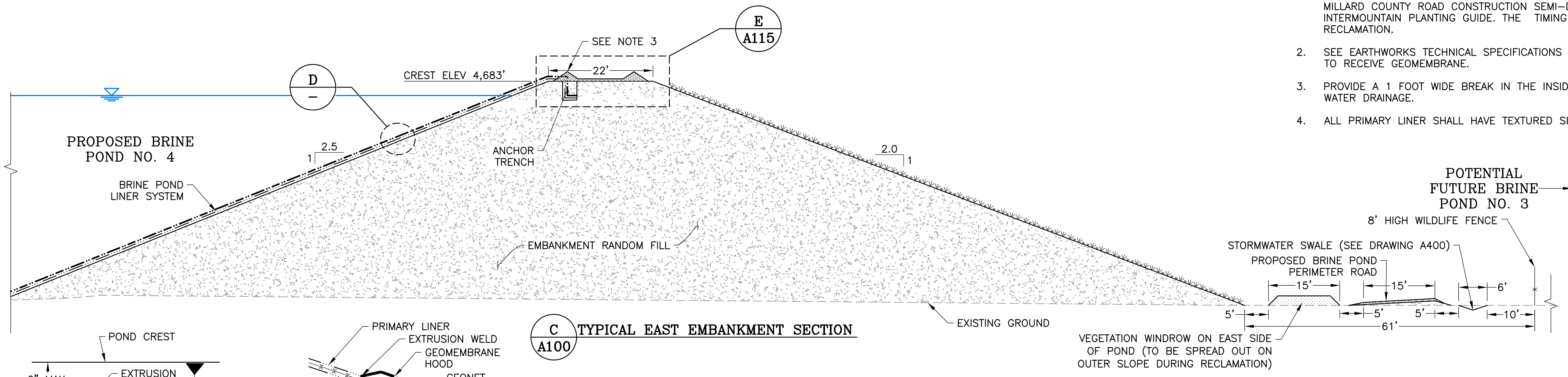
D
–
D
A115
TYPICAL GEOMEMBRANE LINED SLOPE



B
A100
TYPICAL SOUTH EMBANKMENT SECTION

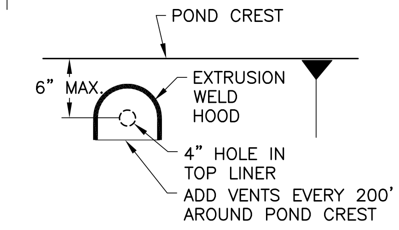
NOTES:

1. THE DOWNSTREAM EMBANKMENT SLOPES SHALL BE SEEDED IN ACCORDANCE WITH THE MILLARD COUNTY ROAD CONSTRUCTION SEMI–DESERT SEED MIX AS BASED ON THE INTERMOUNTAIN PLANTING GUIDE. THE TIMING OF THE SEEDING TO BE DONE WITH RECLAMATION.
2. SEE EARTHWORKS TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
3. PROVIDE A 1 FOOT WIDE BREAK IN THE INSIDE BERM EVERY 50 FEET FOR SURFACE WATER DRAINAGE.
4. ALL PRIMARY LINER SHALL HAVE TEXTURED SIDE FACING UP.

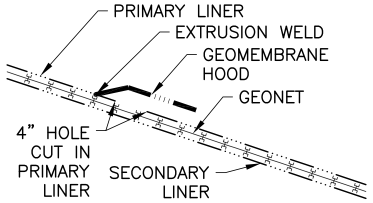


C
A100
TYPICAL EAST EMBANKMENT SECTION

Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020



VENT DETAIL PLAN VIEW



VENT DETAIL SECTION

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

NewFields
CLIENT: MAGNUM SOLUTION MINING, LLC
PROJECT: BRINE POND 4
TITLE: TYPICAL EMBANKMENT SECTIONS AND DETAILS
SHEET 1 OF 2
FILENAME: 93.020.012D
DRAWING NO.: A110
REVISION: 0

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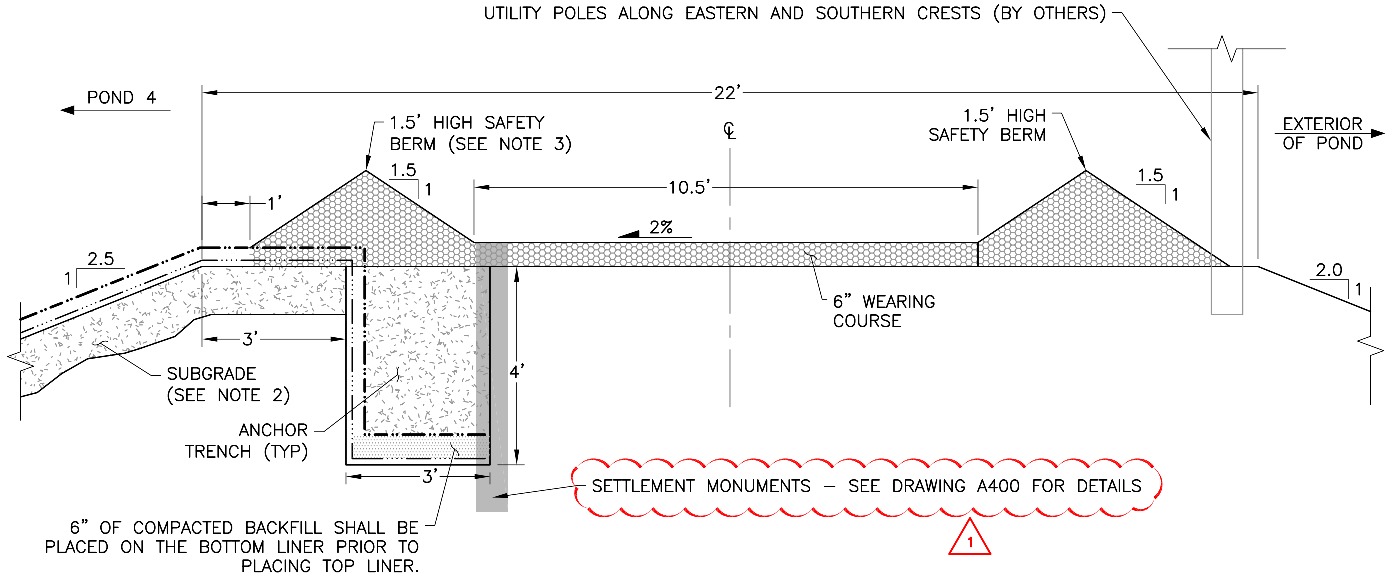

E A110 E A115 TYPICAL POND CREST

NOTES:

1. THE DOWNSTREAM EMBANKMENT SLOPES SHALL BE SEEDED IN ACCORDANCE WITH THE MILLARD COUNTY ROAD CONSTRUCTION SEMI–DESERT SEED MIX AS BASED ON THE INTERMOUNTAIN PLANTING GUIDE. THE TIMING OF THE SEEDING TO BE DONE WITH RECLAMATION.
2. SEE EARTHWORKS TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
3. PROVIDE A 1 FOOT WIDE BREAK IN THE INSIDE BERM EVERY 50 FEET FOR SURFACE WATER DRAINAGE.
4. ALL PRIMARY LINER SHALL HAVE TEXTURED SIDE FACING UP.

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
1/29/2021
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
1	01/29/21	RE–ISSUED FOR CONSTRUCTION	JLW	KNJ
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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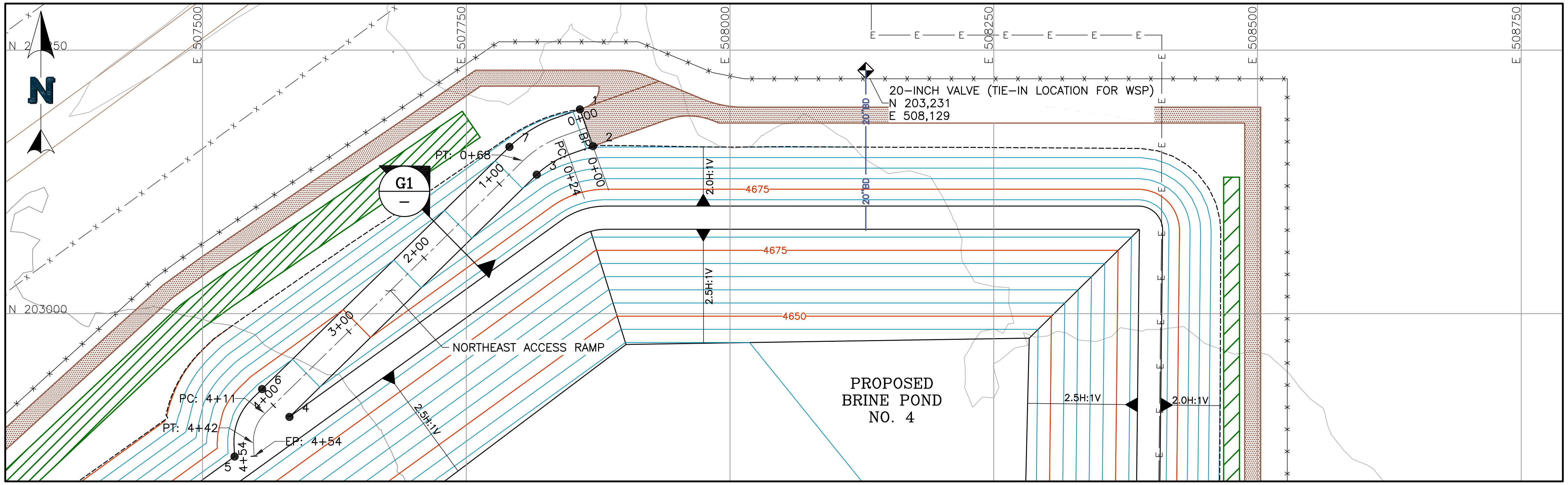
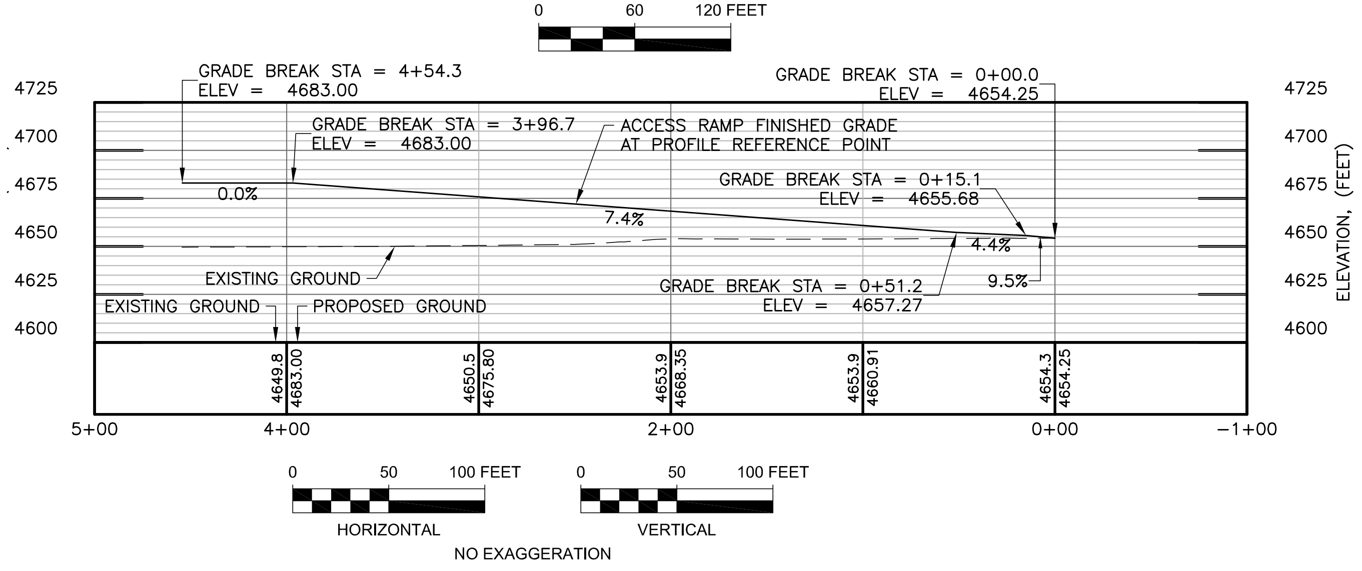
CLIENT: MAGNUM SOLUTION MINING, LLC
PROJECT: BRINE POND 4
TITLE: TYPICAL EMBANKMENT SECTIONS AND DETAILS SHEET 2 OF 2
FILENAME: 93.020.014D
DRAWING NO.: A115
REVISION: 1



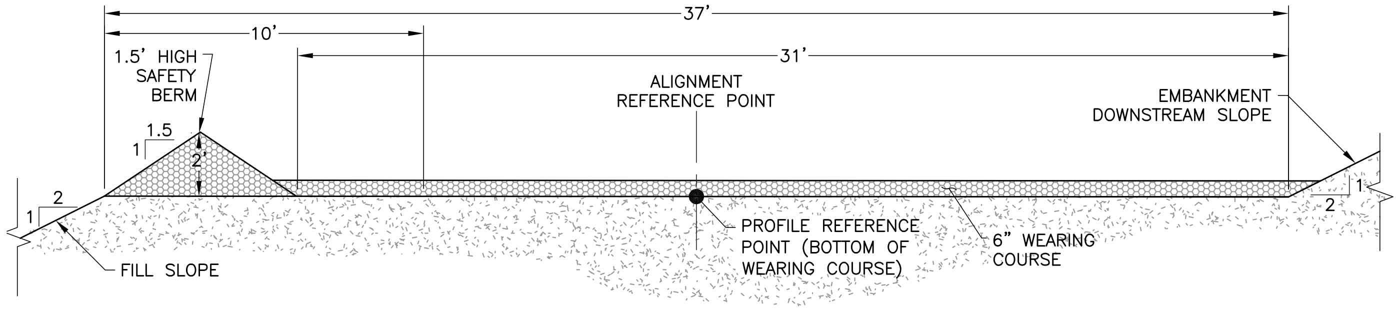
LEGEND:

- EXISTING GROUND CONTOURS
- PROPOSED BRINE POND GROUND CONTOURS
- –×–×– PROPOSED WILDLIFE FENCE
- — E — PROPOSED POWERLINE
- ▨ VEGETATION WINDROW
- ▨ PROPOSED PERIMETER ROAD
- —20"BD— PROPOSED 20" BRINE DELIVERY LINE
- ● 8 SETTING OUT POINTS

SETTING OUT DATA			
POINT	NORTHING	EASTING	ELEVATION
1	203,193.86	507,857.64	4,654.25
2	203,159.01	507,870.06	4,654.25
3	203,131.85	507,816.75	4,658.51
4	202,902.03	507,582.35	4,683.00
5	202,864.39	507,530.34	4,683.00
6	202,928.45	507,556.45	4,683.00
7	203,158.27	507,790.85	4,658.51



ALIGNMENT TABLE						
	STATION	NORTHING	EASTING	DELTA (D–M–S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	203,176.43	507,863.85			
PC	0+24.40	203,168.25	507,840.87	024–49–34	44.07	101.71
PT	0+68.47	203,145.06	507,803.80			
PC	4+10.97	202,905.28	507,559.24	048–22–02	31.11	36.85
PT	4+42.07	202,877.16	507,548.23			



G1 – G1 A135 TYPICAL ACCESS RAMP SECTION

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
POND NO. 4 NORTHEAST ACCESS RAMP PLAN AND PROFILE

FILENAME 93.020.015P
DRAWING NO. A120
REVISION 0

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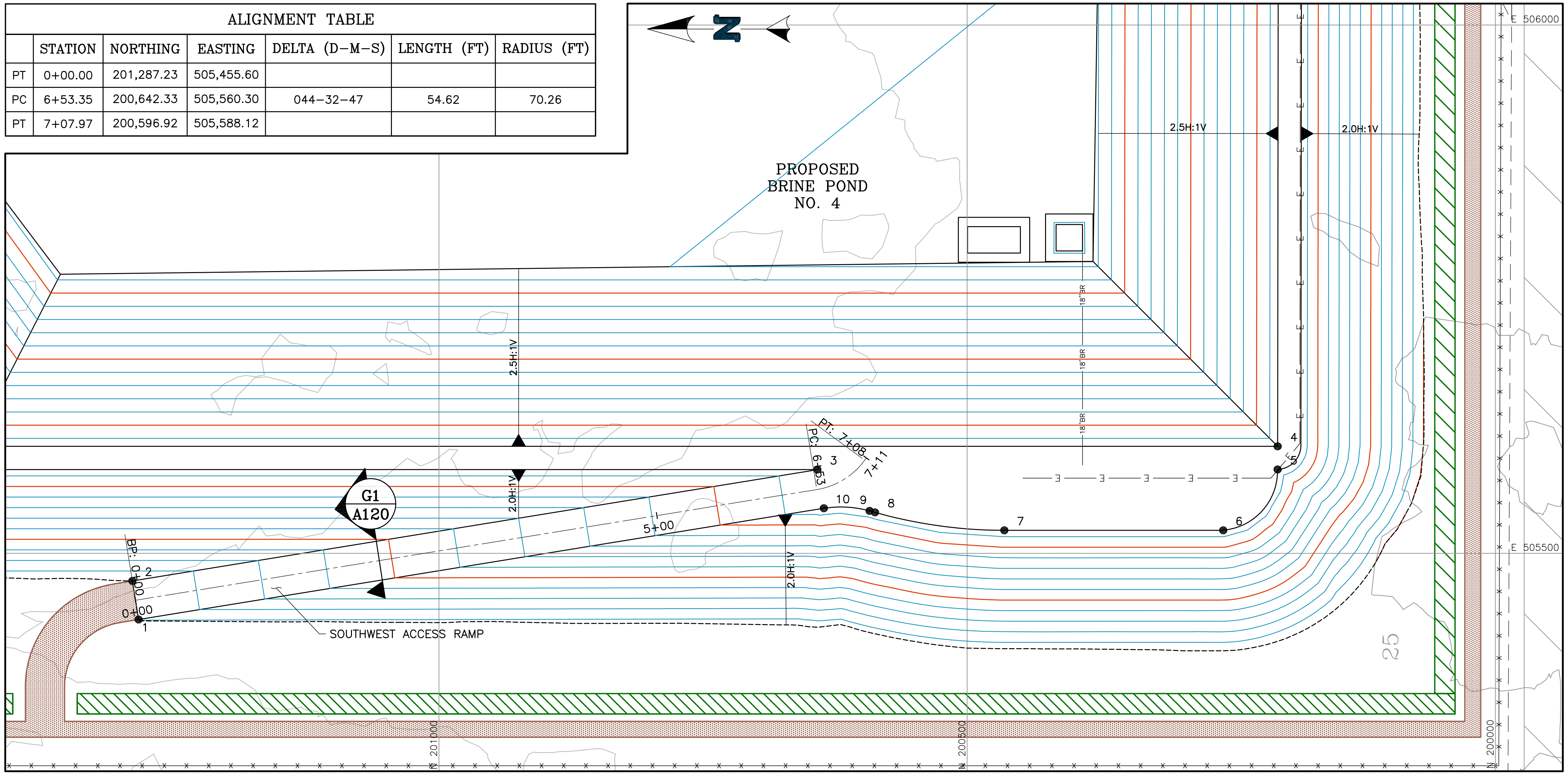
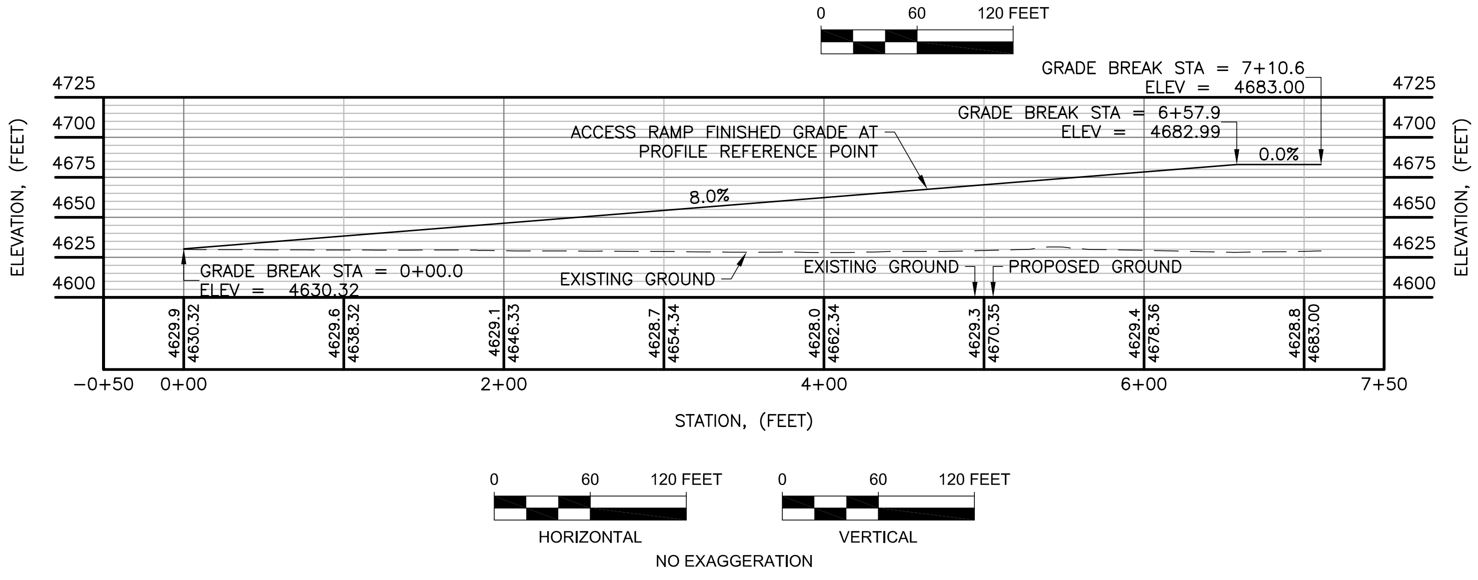
ALIGNMENT TABLE						
	STATION	NORTHING	EASTING	DELTA (D–M–S)	LENGTH (FT)	RADIUS (FT)
PT	0+00.00	201,287.23	505,455.60			
PC	6+53.35	200,642.33	505,560.30	044–32–47	54.62	70.26
PT	7+07.97	200,596.92	505,588.12			



LEGEND:

	EXISTING GROUND CONTOURS
	PROPOSED BRINE POND GROUND CONTOURS
— — — —	SITE BOUNDARY
—×—×—	PROPOSED WILDLIFE FENCE
—— E ——	PROPOSED POWERLINE
▨	VEGETATION WINDROW
▨	PROPOSED PERIMETER ROAD
● 8	SETTING OUT POINTS

SETTING OUT DATA			
POINT	NORTHING	EASTING	ELEVATION
1	201,284.27	505,437.34	4,630.32
2	201,290.20	505,473.86	4,630.32
3	200,641.78	505,579.26	4,683.00
4	200,206.08	505,601.23	4,683.00
5	200,206.13	505,579.31	4,683.00
6	200,257.64	505,521.75	4,683.00
7	200,464.80	505,521.74	4,683.00
8	200,587.25	505,538.73	4,683.00
9	200,592.36	505,540.17	4,683.00
10	200,635.59	505,542.65	4,682.91



No.9517180-2202
KEVIN N. JENNINGS
09/15/2020
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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CLIENT
MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND 4

TITLE
POND NO. 4 SOUTHWEST ACCESS RAMP
PLAN AND PROFILE

FILENAME
93.020.016P

DRAWING NO.
A135

REVISION
0

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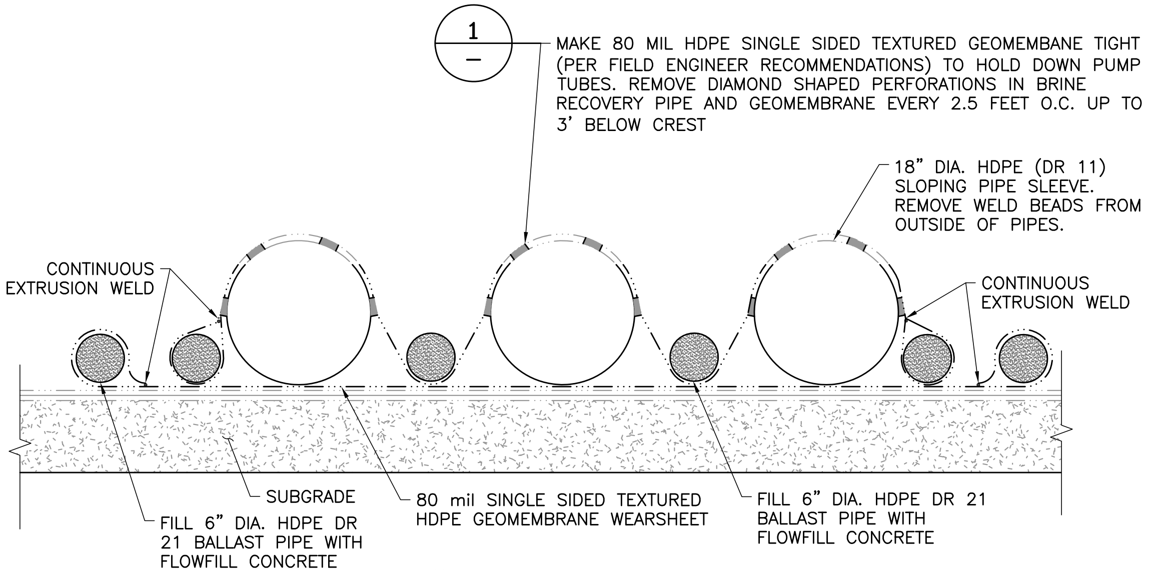
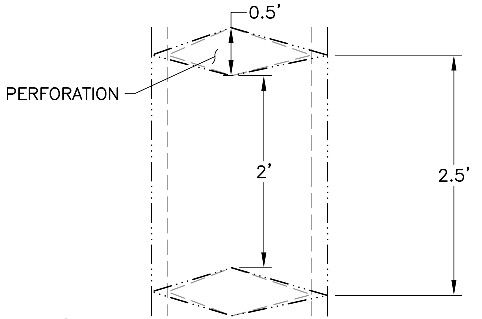
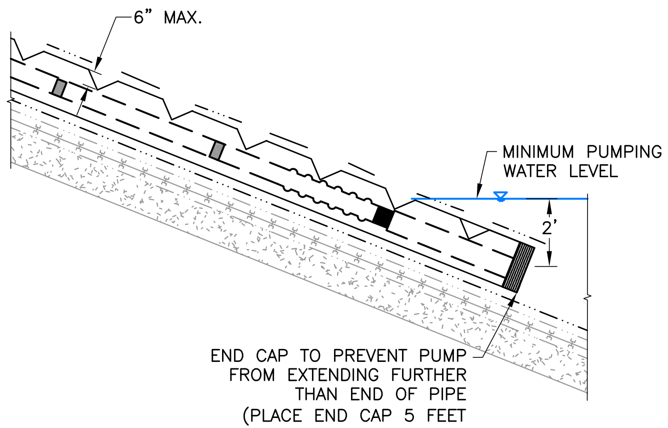


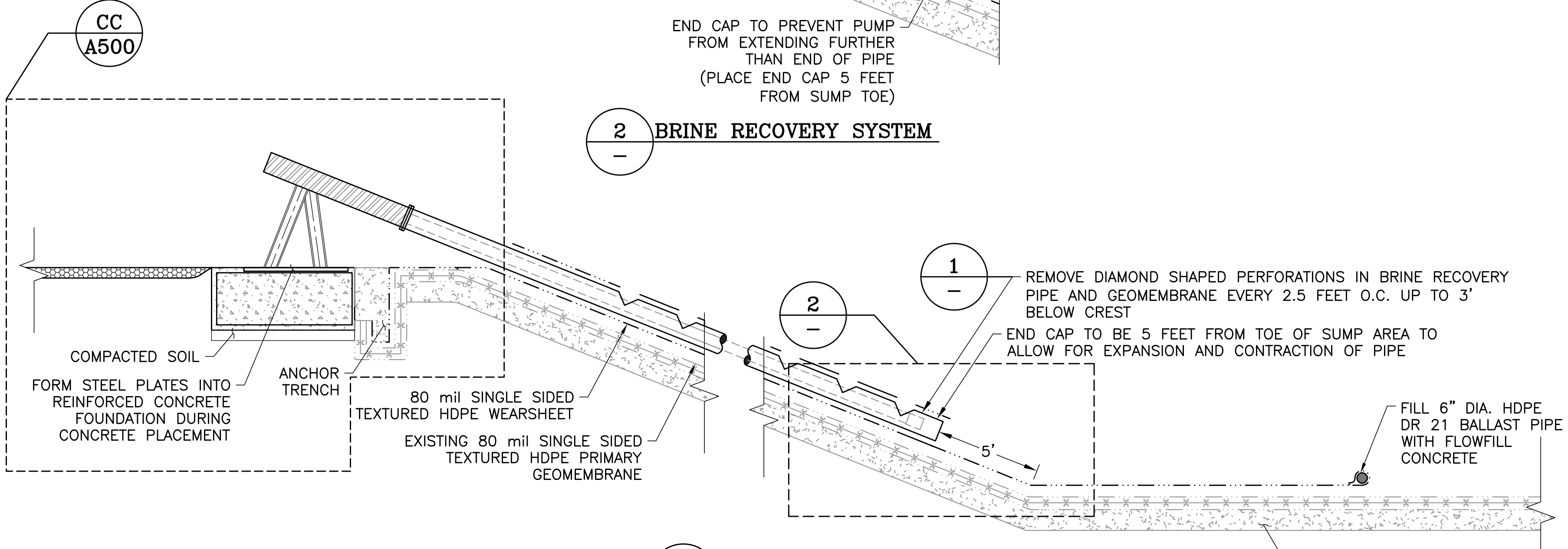
H — PIPE SLEEVE SECTION



1 — DIAMOND PERFORATION DETAIL



2 — BRINE RECOVERY SYSTEM



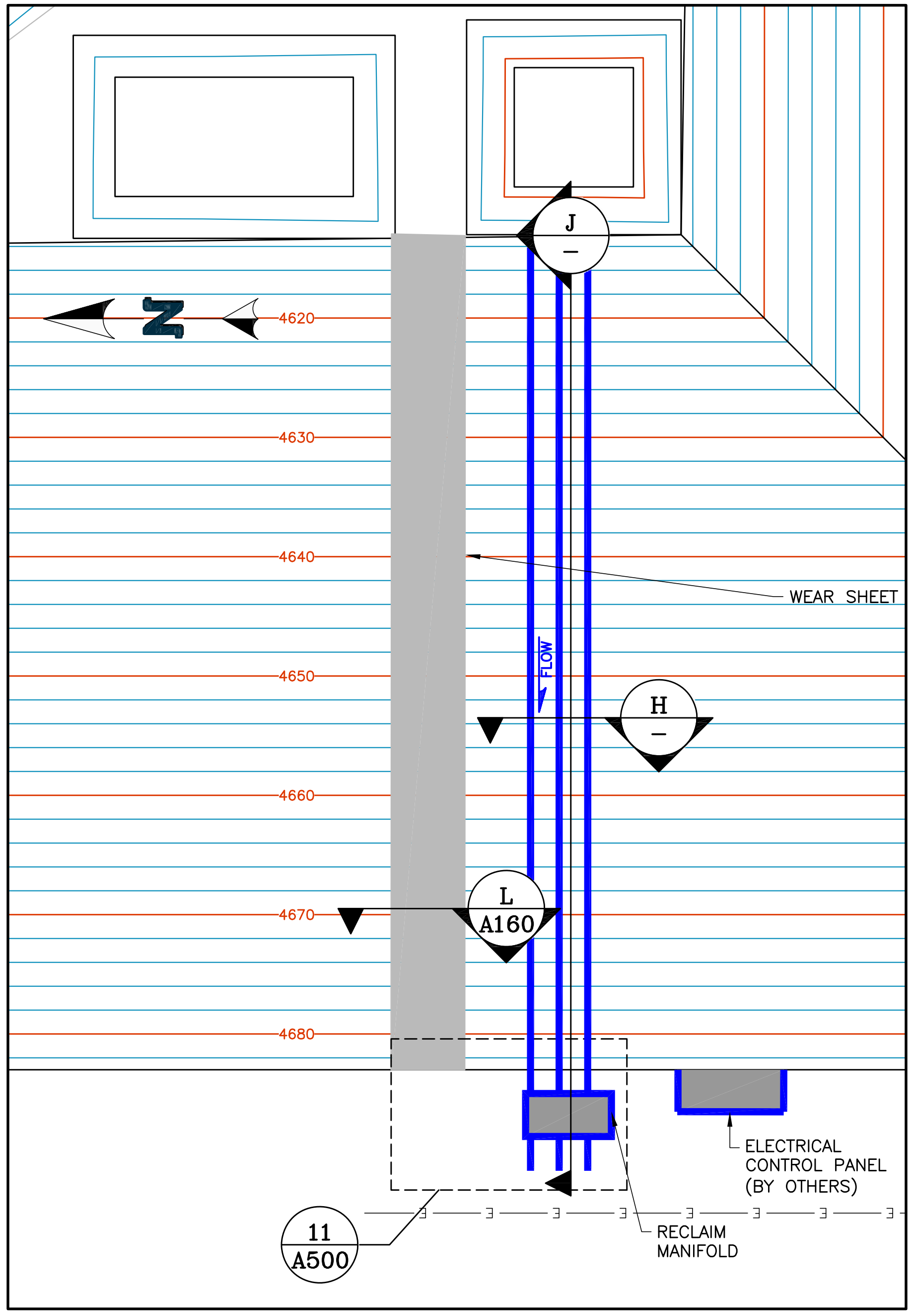
J — BRINE RECOVERY PIPE SYSTEM

NOTES:

1. STUB ENDS TO CONSIST OF SCRAP PIECE OF PIPE TO FUNNEL IN CONCRETE. TO BE REMOVED AFTER CONCRETE PLACEMENT.
2. CUT HOLE IN PIPE WALL TO FULL DIAMETER OF STUB END
3. 12-INCH-DIAMETER STUB END TO BE USED FOR POURING CONCRETE PLUG IN PIPE. PIPE FILLED UNTIL CONCRETE COMES OUT OF 6-INCH-DIAMETER PIPE.

LEGEND:

- EXISTING GROUND CONTOURS
- PROPOSED BRINE POND GROUND CONTOURS
- EXISTING ROADS/TRAILS
- 18 IN DIA. DR11 HDPE PIPE



4 A100 — POND 4 RECLAIM PUMPBACK SYSTEM PLAN

0 20 40 FEET

REGISTERED PROFESSIONAL ENGINEER
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020
STATE OF UTAH
Kevin Jennings

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

NewFields

CLIENT: MAGNUM SOLUTION MINING, LLC

PROJECT: BRINE POND 4

TITLE: BRINE RECOVERY SYSTEM SECTION AND DETAILS

FILENAME: 93.020.018D

DRAWING NO.: A140

REVISION: 0

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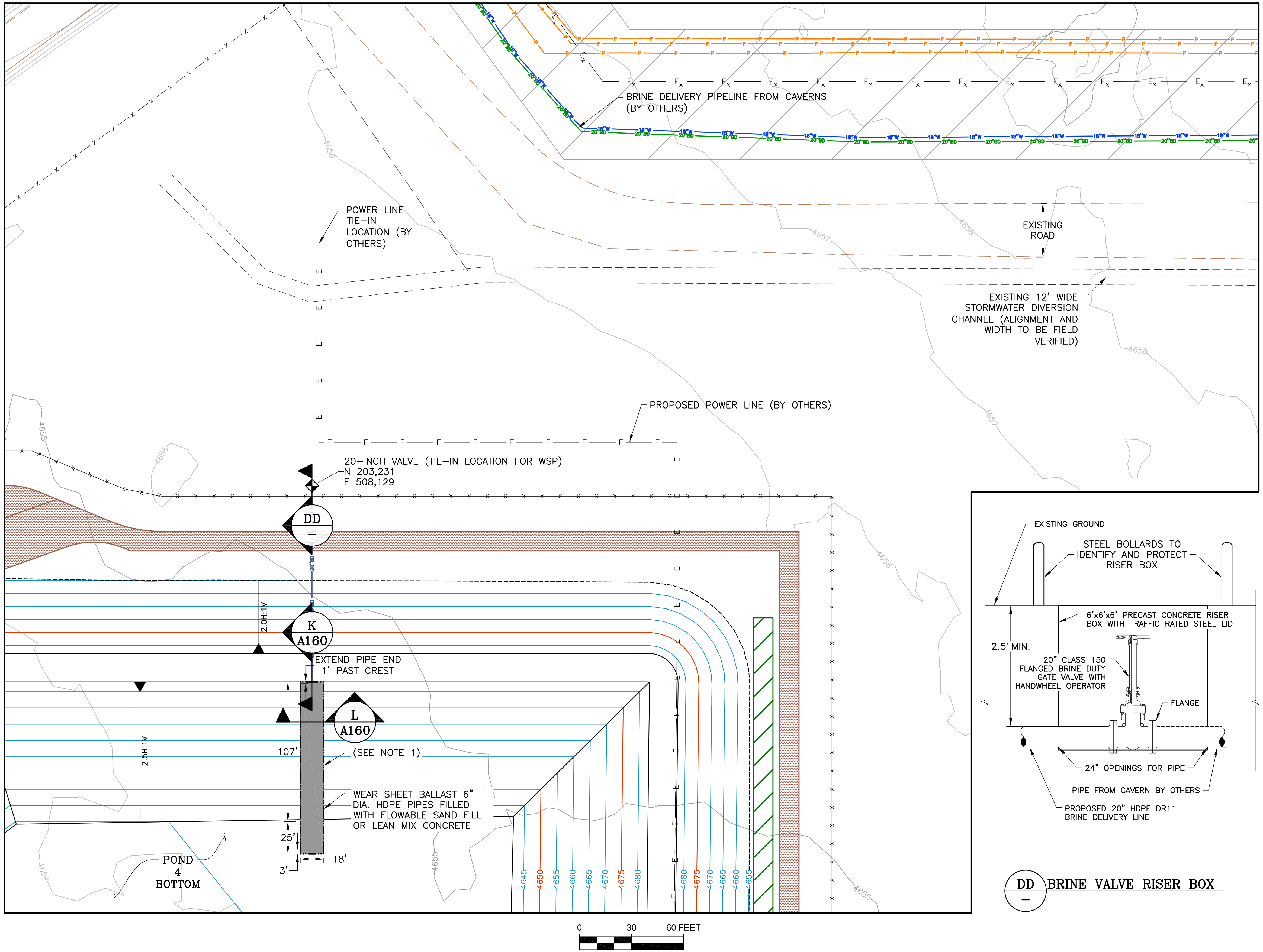

DD – BRINE VALVE RISER BOX

LEGEND:

〰	EXISTING GROUND CONTOURS
〰	PROPOSED GROUND CONTOURS
〰	EXISTING ROADS/TRAILS
〰	EXISTING EASEMENTS
— — —	SITE BOUNDARY
—x—x—	EXISTING FENCE
—×—×—	PROPOSED WILDLIFE FENCE
—18"BR—	EXISTING BRINE LINE
—Ex—	EXISTING POWER LINE
—E—	PROPOSED POWER LINE
—20"BD—	PROPOSED 20" HDPE DR11 BRINE DELIVERY LINE
▨	PROPOSED PERIMETER ROAD

NOTES:

1. PLACE GEOTEXTILE IN THE END OF THE PIPE BEFORE WELDING THE END CAP ON.
2. PIPE BALLASTS ANCHORED AT CREST OF SLOPE BEYOND THE EXTENTS OF THE GEOMEMBRANE.

Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

NewFields

CLIENT: MAGNUM SOLUTION MINING, LLC

PROJECT: BRINE POND 4

TITLE: POND INLET PLAN

FILENAME: 93.020.020D

DRAWING NO.: A150

REVISION: 0

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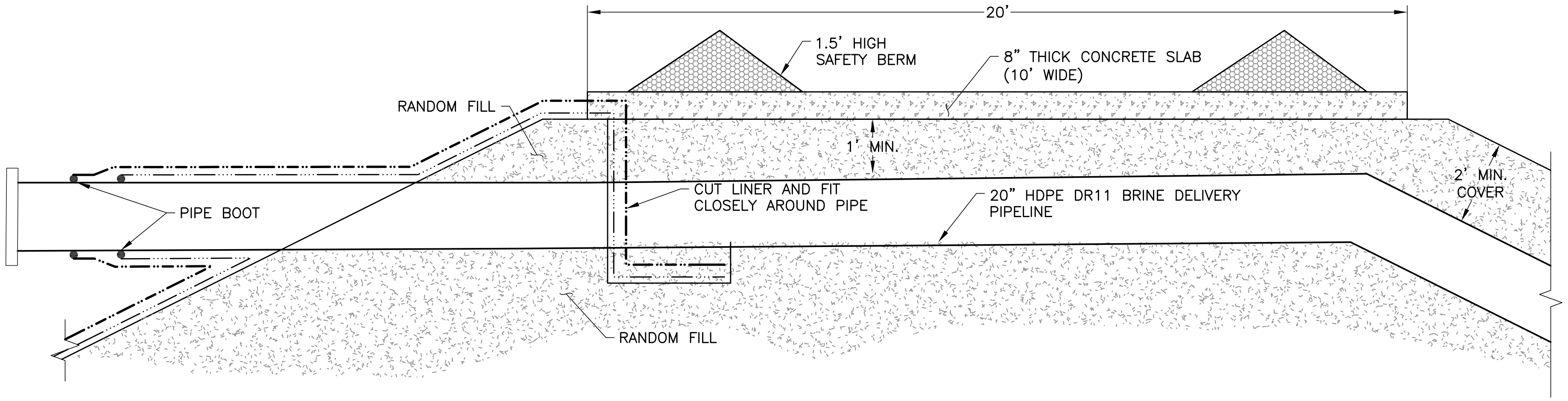
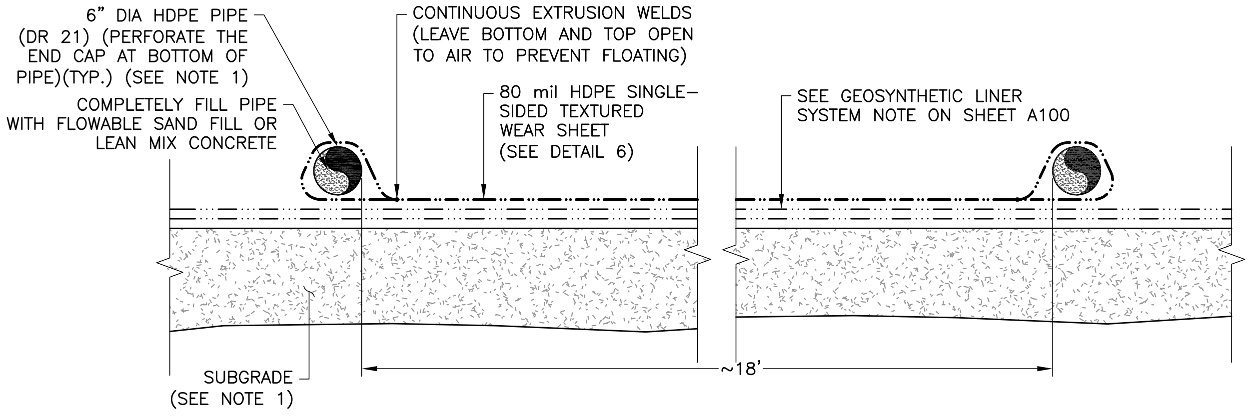
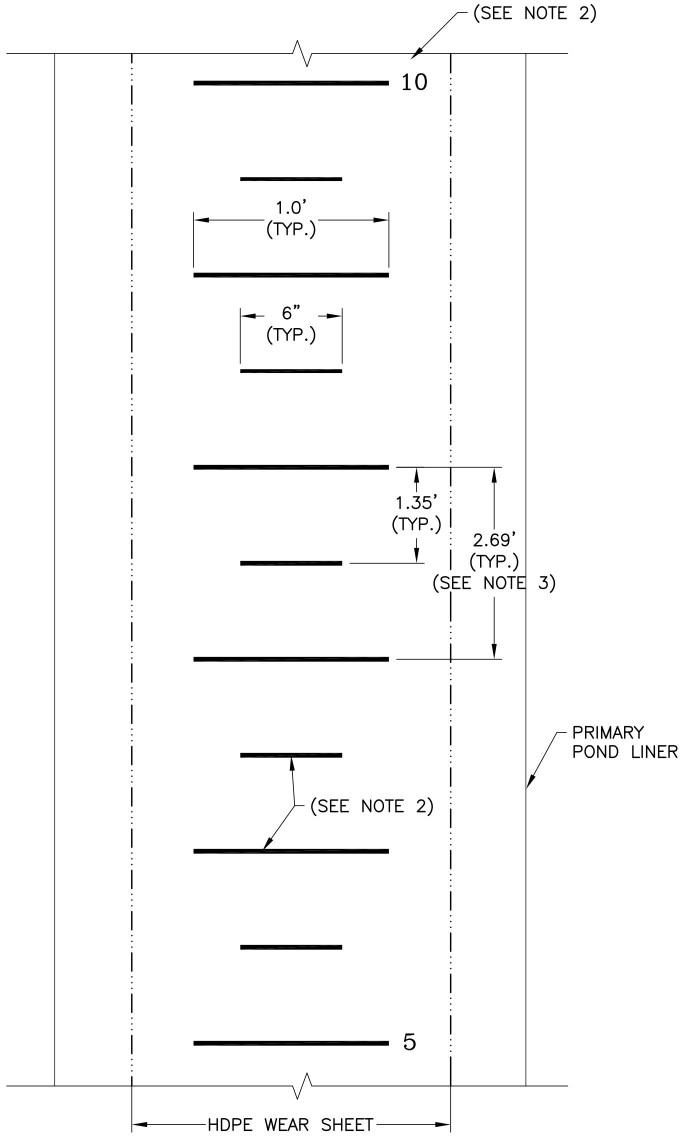


K / A150 PIPE CROSSING CONCRETE CAP



L / A140 L / A150 POND WEAR SHEET BALLASTING



6 / – WATER LEVEL GAUGE DETAIL

NOTE:

1. PIPE BALLASTS ANCHORED AT CREST OF SLOPE BEYOND THE EXTENTS OF THE GEOMEMBRANE.
2. EXTRUDE INCREMENTS ONTO HDPE WEARSHEET AND APPLY FLUORESCENT COLOR PAINT TO ALL INCREMENTS AND LABEL EVERY 5 FEET.
3. SLOPE DISTANCES SHOWN CORRELATE TO VERTICAL INCREMENTS OF 6" ON A 2.5:1 (HORZIONTAL:VERTICAL) SLOPE (TO BE FIELD VERIFIED BY SURVEY).

Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

NewFields

CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
POND INLET SECTIONS AND DETAILS

FILENAME 93.020.022D
DRAWING NO. A160
REVISION 0

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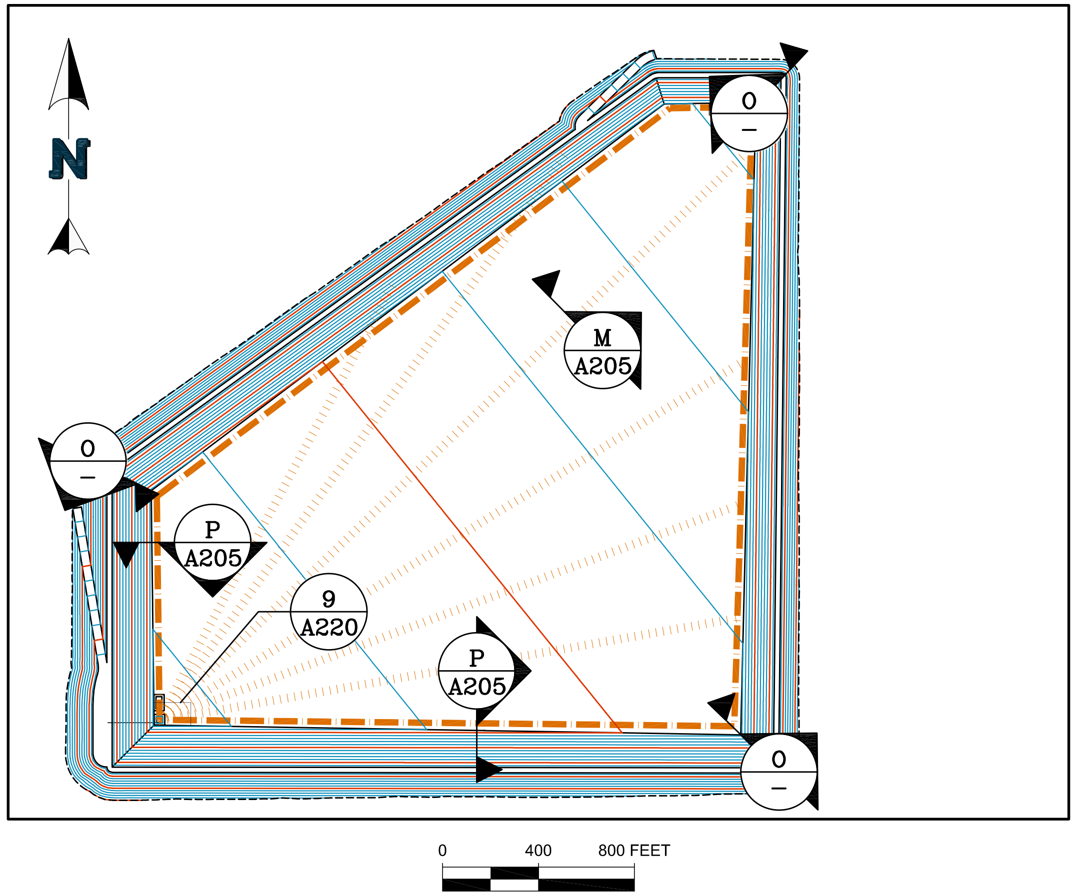
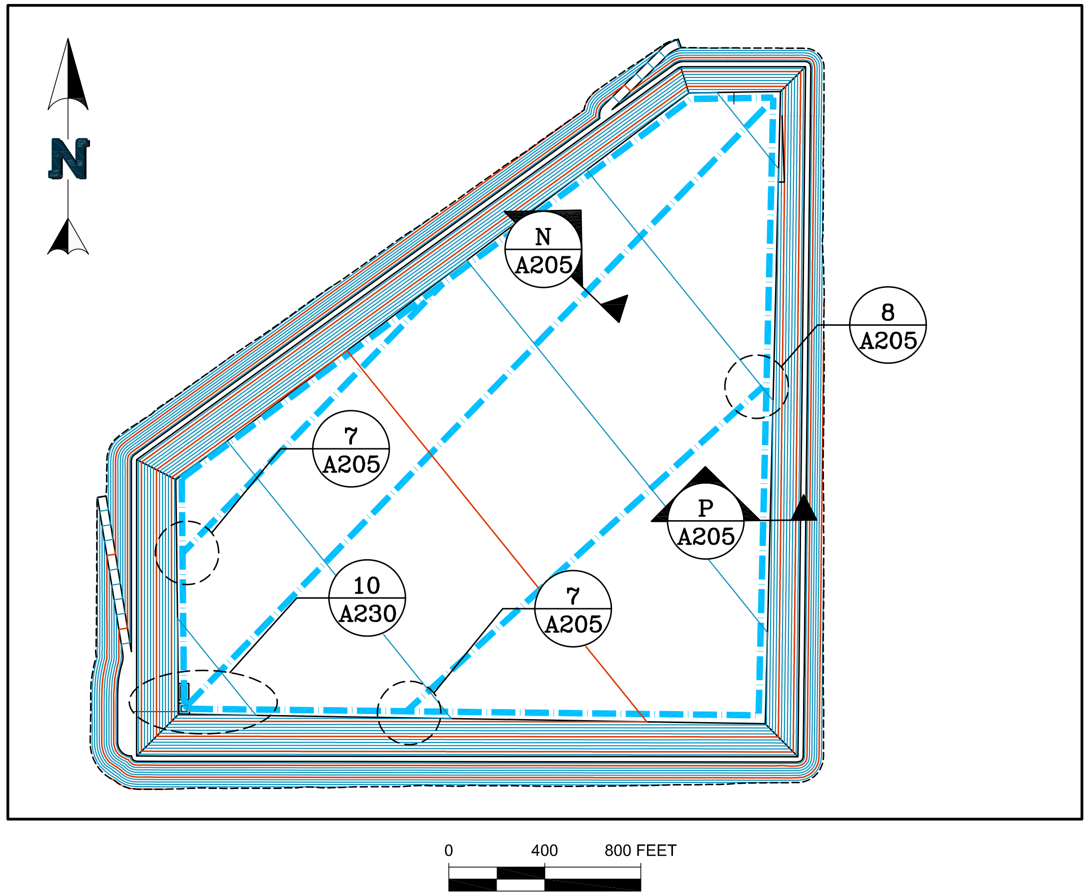


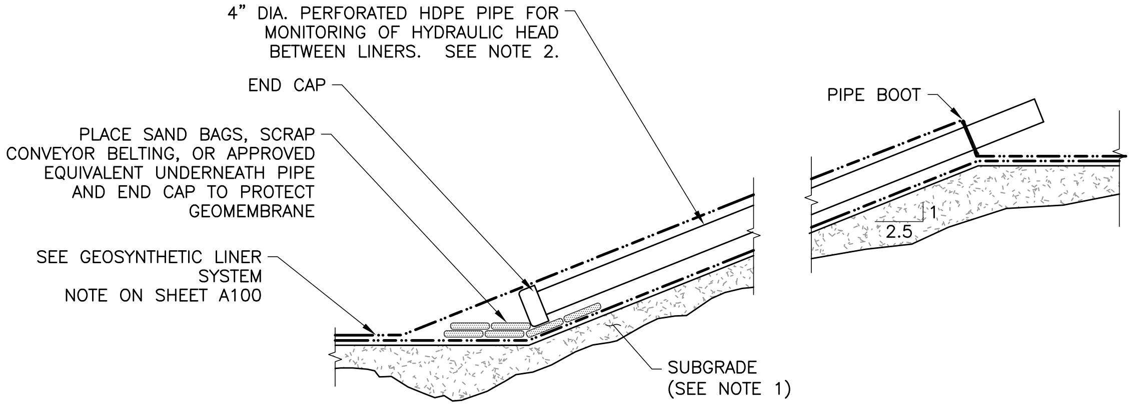
LCRS PIPING AND SUMPS



PCMS PIPING AND SUMPS

LEGEND:

- 〰 PROPOSED BRINE POND GROUND CONTOURS
- ‒ ‒ ‒ 4 IN DIA. PERFORATED HDPE DR17 COLLECTION LCRS PIPE
- ┆┆┆┆ LCRS 18" WIDE STRIP DRAIN
- ‒ ‒ ‒ 4 IN DIA. PERFORATED CPe COLLECTION PCMS PIPE



O – TYPICAL 4" HDPE MONITORING SLEEVE

NOTE:

1. SEE EARTHWORKS MATERIALS AND CONSTRUCTION TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
2. THE MONITORING SLEEVE SHALL BE PERFORATED IN THE SAME MANNER AS THE LCRS PIPES LOCATED ALONG THE INSIDE EMBANKMENT TOE. THE SLEEVES SHALL BE LOCATED AT THE EASTERN, NORTHEASTERN AND NORTHERN CORNERS OF THE POND.

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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CLIENT: MAGNUM SOLUTION MINING, LLC
PROJECT: BRINE POND 4
TITLE: POND BASIN PIPING PLAN
FILENAME: 93.020.024M
DRAWING NO.: A200
REVISION: 0

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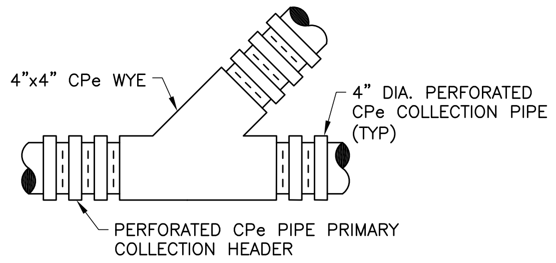
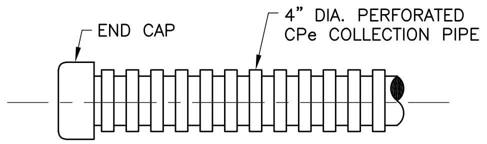
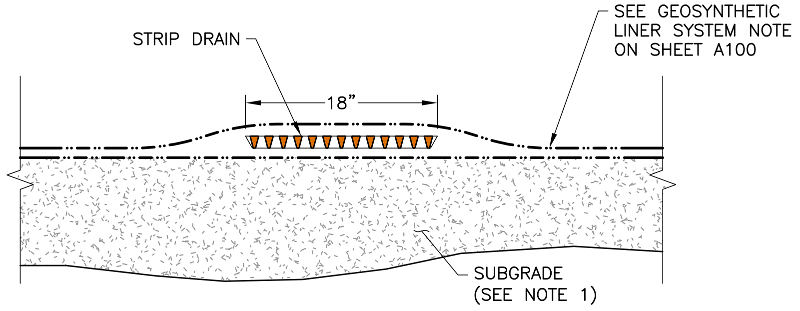


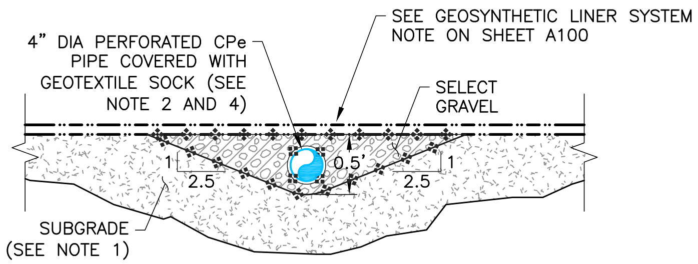
7 A200 COLLECTION PIPE CONNECTION



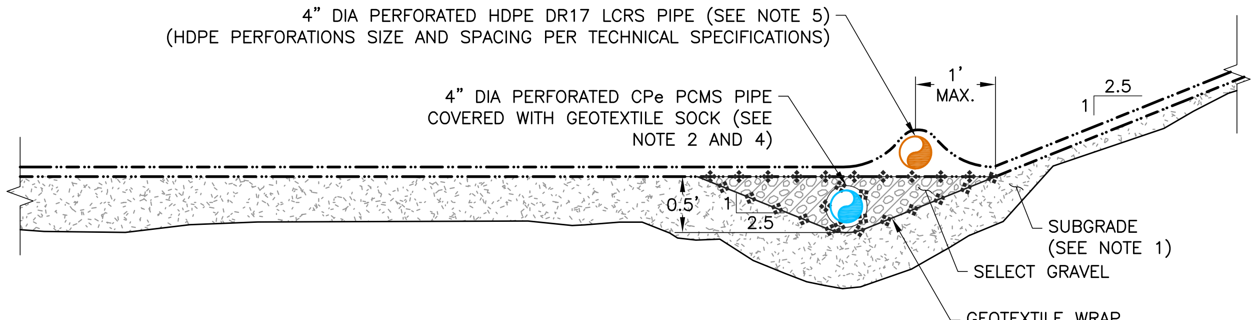
8 A200 TYPICAL COLLECTION PIPE TERMINATION



M A200 TYPICAL LEAK DETECTION STRIP DRAIN



N A200 PCMS CHANNEL



P A200 TYPICAL WEST AND SOUTH TOE DRAIN SECTION

NOTES:

1. SEE EARTHWORKS MATERIALS AND CONSTRUCTION TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
2. GEOTEXTILE SOCK SHALL BE NON-WOVEN 10 oz/yd^2.
3. ALL PRIMARY LINER SHALL HAVE TEXTURED SIDE FACING UP.
4. PIPE PERFORATIONS SHALL BE IN ACCORDANCE WITH CLASS II AASHTO M252 SPECIFICATION OR APPROVED EQUIVALENT. (SLOT LENGTH = 0.875 IN., WIDTH = 0.125 IN.)
5. ENSURE THE END OF THE PIPE EITHER HAS REDUCERS, OR OTHER MEANS APPROVED BY THE ENGINEER, TO PROTECT THE LINER FROM SHARP EDGES.

Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
POND BASIN PIPING SECTIONS AND DETAILS

FILENAME 93.020.026D
DRAWING NO. A205
REVISION 0

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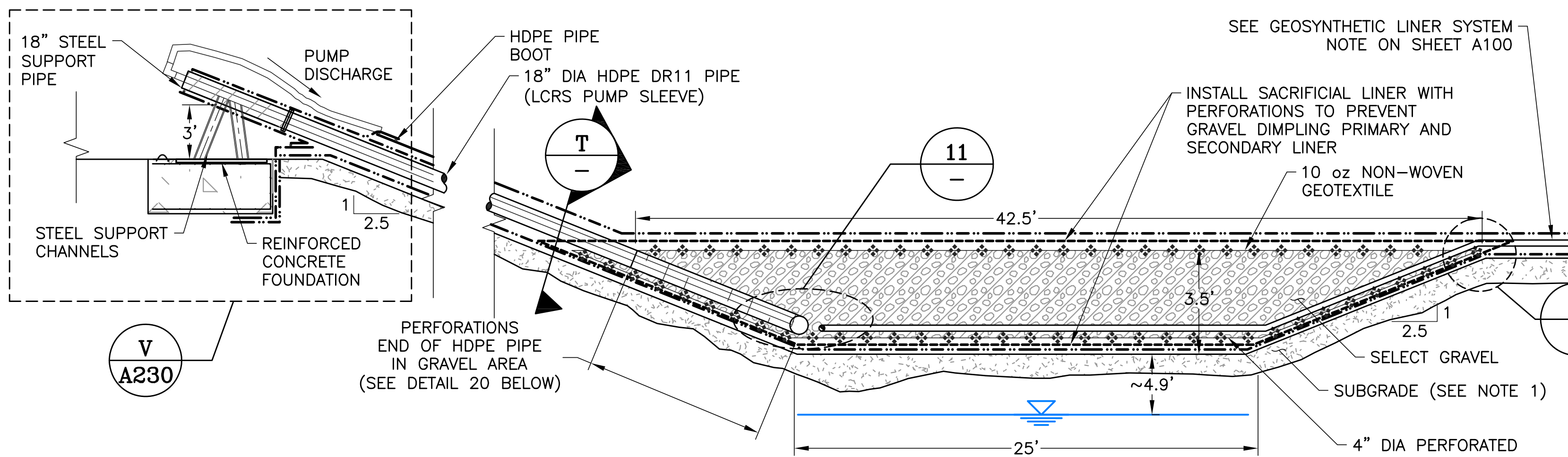
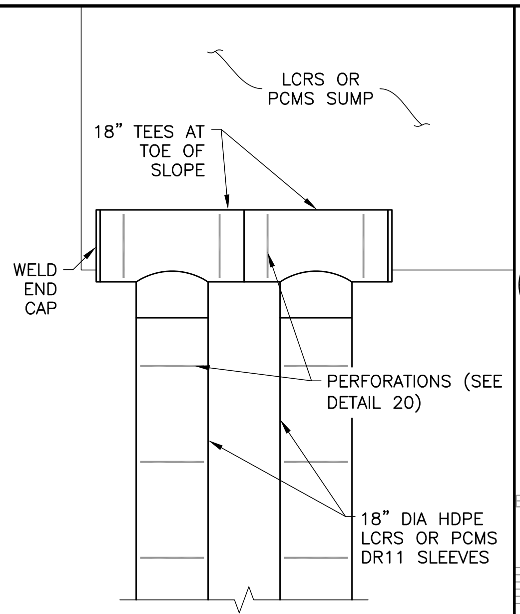
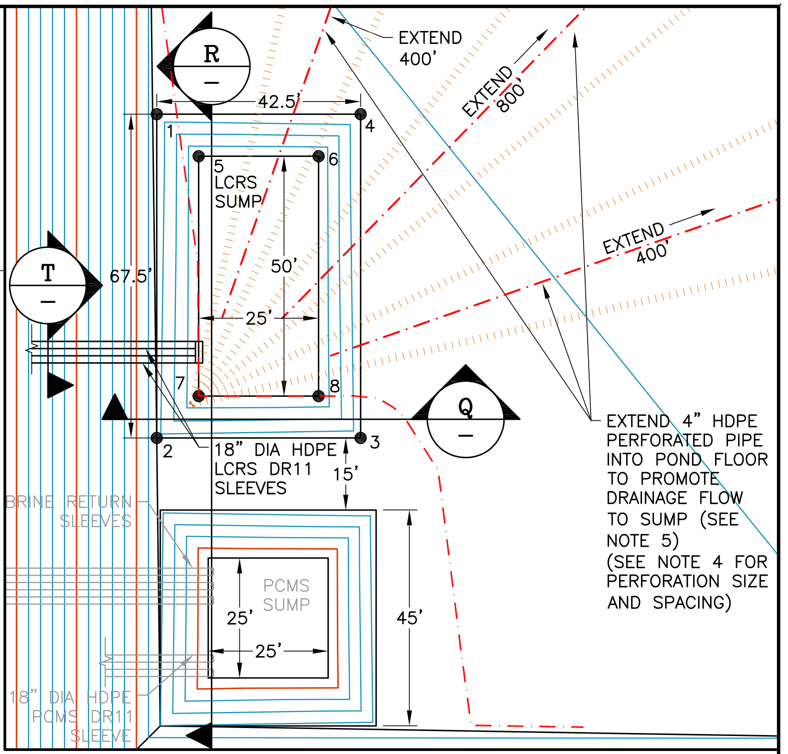


Q — TYPICAL LCRS SUMP SECTION

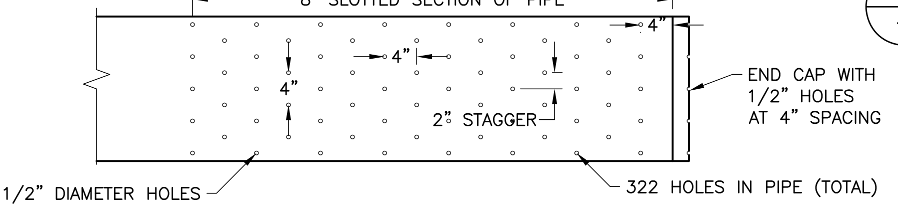


11 — 11 A230 LCRS OR PCMS SLEEVE MANIFOLD DETAIL

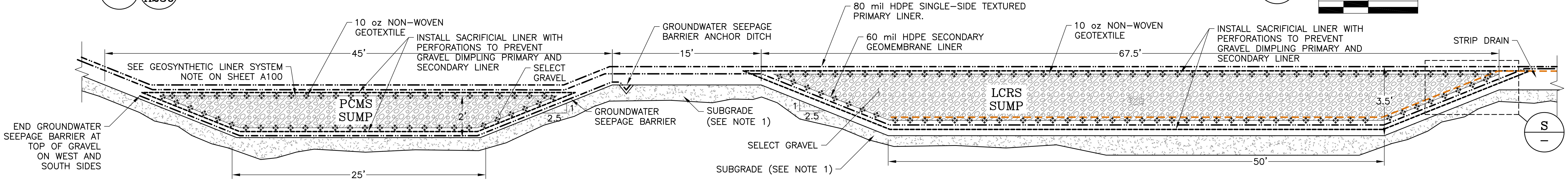


9 — A200 LCRS PIPING AND SUMP

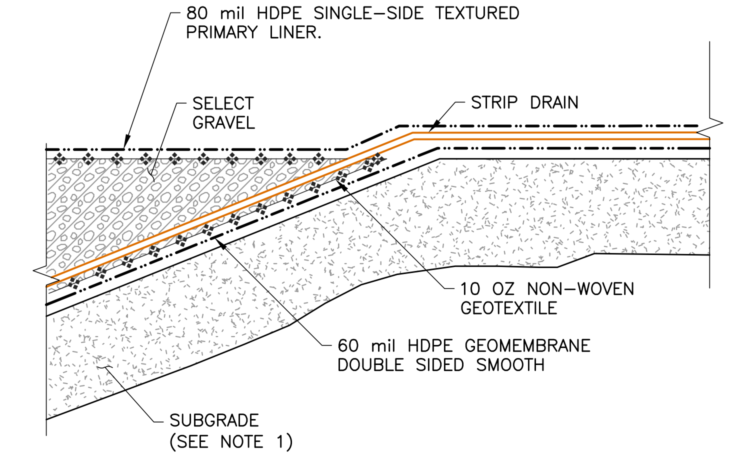
0 20 40 FEET



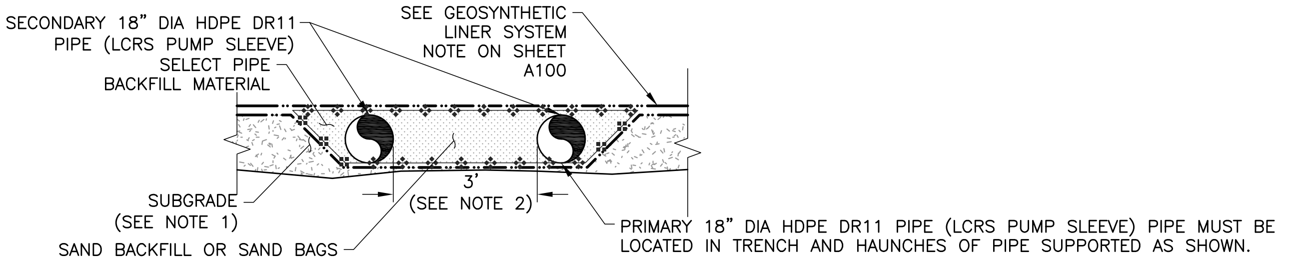
20 — 20 A230 PERFORATED 18" SLEEVE DETAIL



R — R A230 LCRS AND PCMS SECTION



S — LCRS GEOSYNTHETICS DETAIL



PRIMARY 18" DIA HDPE DR11 PIPE (LCRS PUMP SLEEVE) PIPE MUST BE LOCATED IN TRENCH AND HAUNCHES OF PIPE SUPPORTED AS SHOWN. PIPE CANNOT BE INSTALLED ABOVE PLANE OF EMBANKMENT FACE. PIPE ALIGNMENT SHALL BE SURVEYED BEFORE PLACING BACKFILL TO ENSURE PIPELINE DOES NOT DEVIATE MORE THAN 6 INCHES FROM CENTERLINE.

T — LCRS PIPE

POND 4 SETTING OUT DATA

POINT	NORTHING	EASTING	ELEVATION
1	200,508.35	505,775.44	4,613.66
2	200,440.85	505,775.44	4,613.32
3	200,440.85	505,817.94	4,613.58
4	200,508.35	505,817.94	4,613.92
5	200,499.60	505,784.19	4,610.16
6	200,499.60	505,809.19	4,610.20
7	200,449.60	505,784.19	4,610.08
8	200,449.60	505,809.19	4,610.12

No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

NOTES:

1. SEE EARTHWORKS MATERIALS AND CONSTRUCTION TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
2. PIPE SPACING CAN BE ADJUSTED TO ACCOMMODATE PIPE BOOT CONSTRUCTION AT THE CREST. PIPE ALIGNMENT TO BE SURVEYED DURING INSTALLATION AND BACKFILLING TO ENSURE STRAIGHTNESS.
3. ALL PRIMARY LINER SHALL HAVE TEXTURED SIDE FACING UP.
4. SEE TECHNICAL SPECIFICATIONS FOR PERFORATION SIZE AND SPACING.
5. ENDS OF PIPES EXTENDING 400' AND 800' INTO POND FLOOR SHALL EITHER HAVE REDUCERS OR OTHER MEANS (APPROVED BY THE ENGINEER) TO PROTECT THE LINER FROM SHARP EDGES.

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
LEAK COLLECTION AND RECOVERY SYSTEM DETAILS

FILENAME
93.020.028D
DRAWING NO.
A220
REVISION
0

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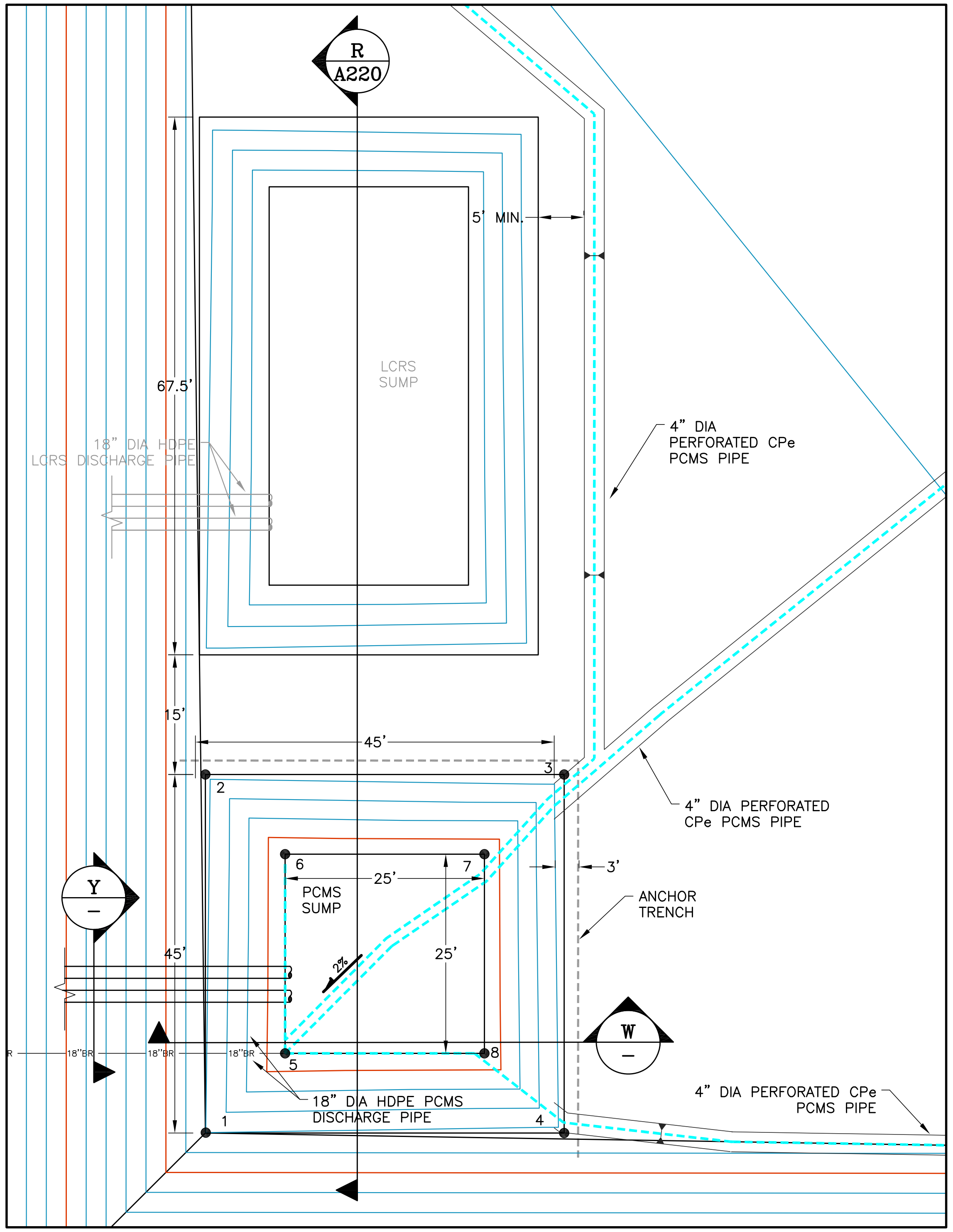


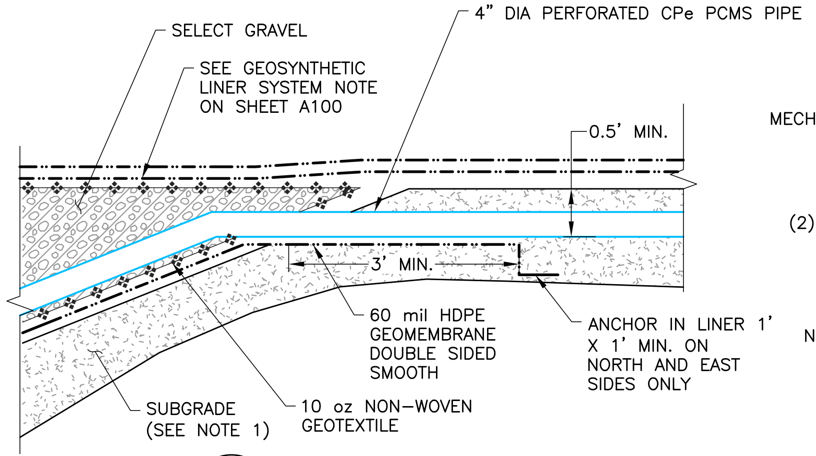
10 A200 PCMS PIPING AND SUMP

0 10 20 FEET

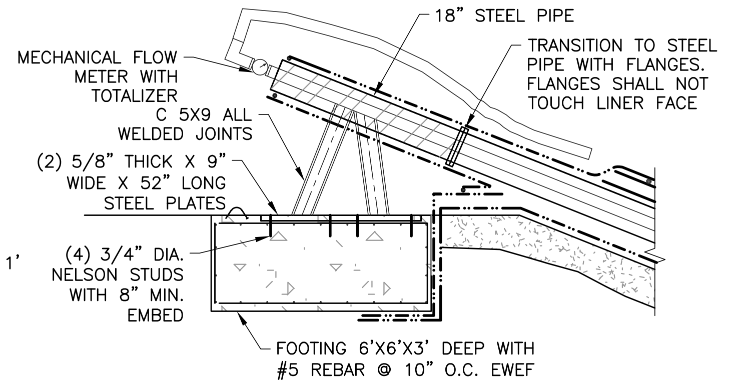
POND 4 SETTING OUT DATA			
POINT	NORTHING	EASTING	ELEVATION
1	200,380.89	505,776.23	4,613.00
2	200,425.84	505,776.18	4,613.25
3	200,425.84	505,821.18	4,613.53
4	200,380.84	505,821.18	4,613.30
5	200,390.84	505,786.18	4,609.10
6	200,415.84	505,786.18	4,609.14
7	200,415.84	505,811.18	4,609.18
8	200,390.84	505,811.18	4,609.14

NOTES:

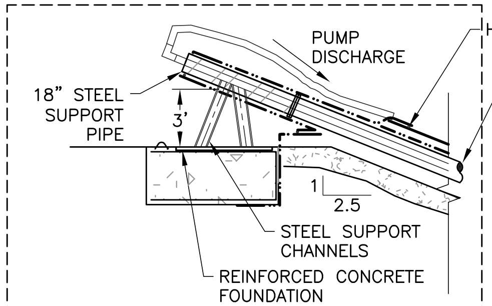
1. SEE EARTHWORKS MATERIALS AND CONSTRUCTION TECHNICAL SPECIFICATIONS SECTION 2.2.5 FOR PREPARING SURFACES TO RECEIVE GEOMEMBRANE.
2. GEOTEXTILE SOCK SHALL BE NON–WOVEN 10 oz/yd^2.
3. ALL PRIMARY LINER SHALL HAVE TEXTURED SIDE FACING UP.
4. PIPE PERFORATIONS SHALL BE IN ACCORDANCE WITH CLASS II AASHTO M252 SPECIFICATION OR APPROVED EQUIVALENT. (SLOT LENGTH = 0.875 IN., WIDTH = 0.125 IN.)



U – PCMS GEOSYNTHETICS DETAIL



V A220 V – PCMS AND LCRS SUPPORT AND ANCHOR DETAIL



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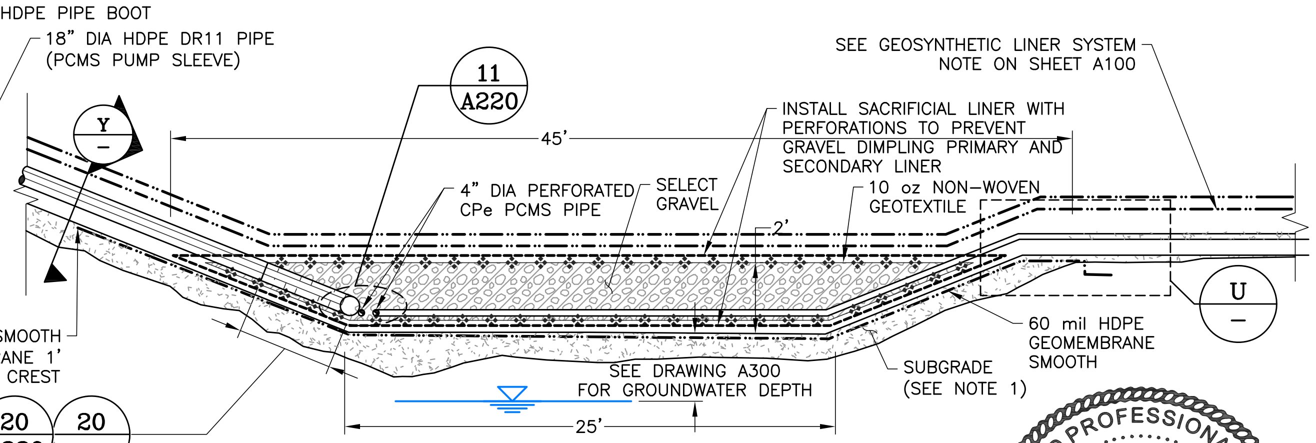
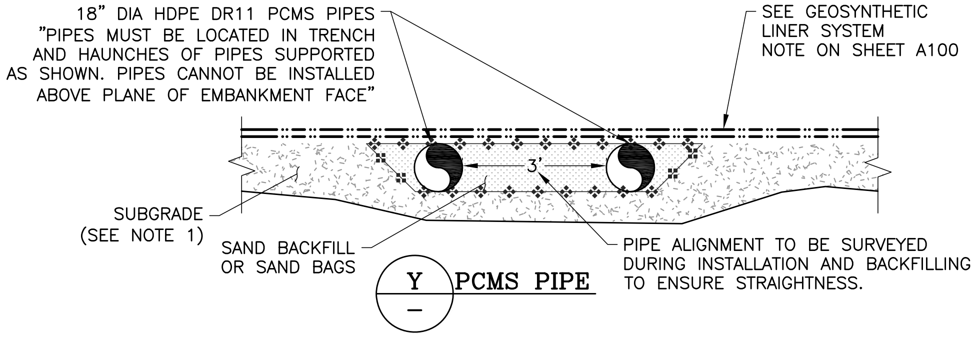


W A120 W – TYPICAL PCMS SUMP SECTION



Y – PCMS PIPE

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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CLIENT
MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND 4

TITLE
PROCESS COLLECTION AND MONITORING
SYSTEM PLAN

FILENAME
93.020.030D
DRAWING NO.
A230
REVISION
0

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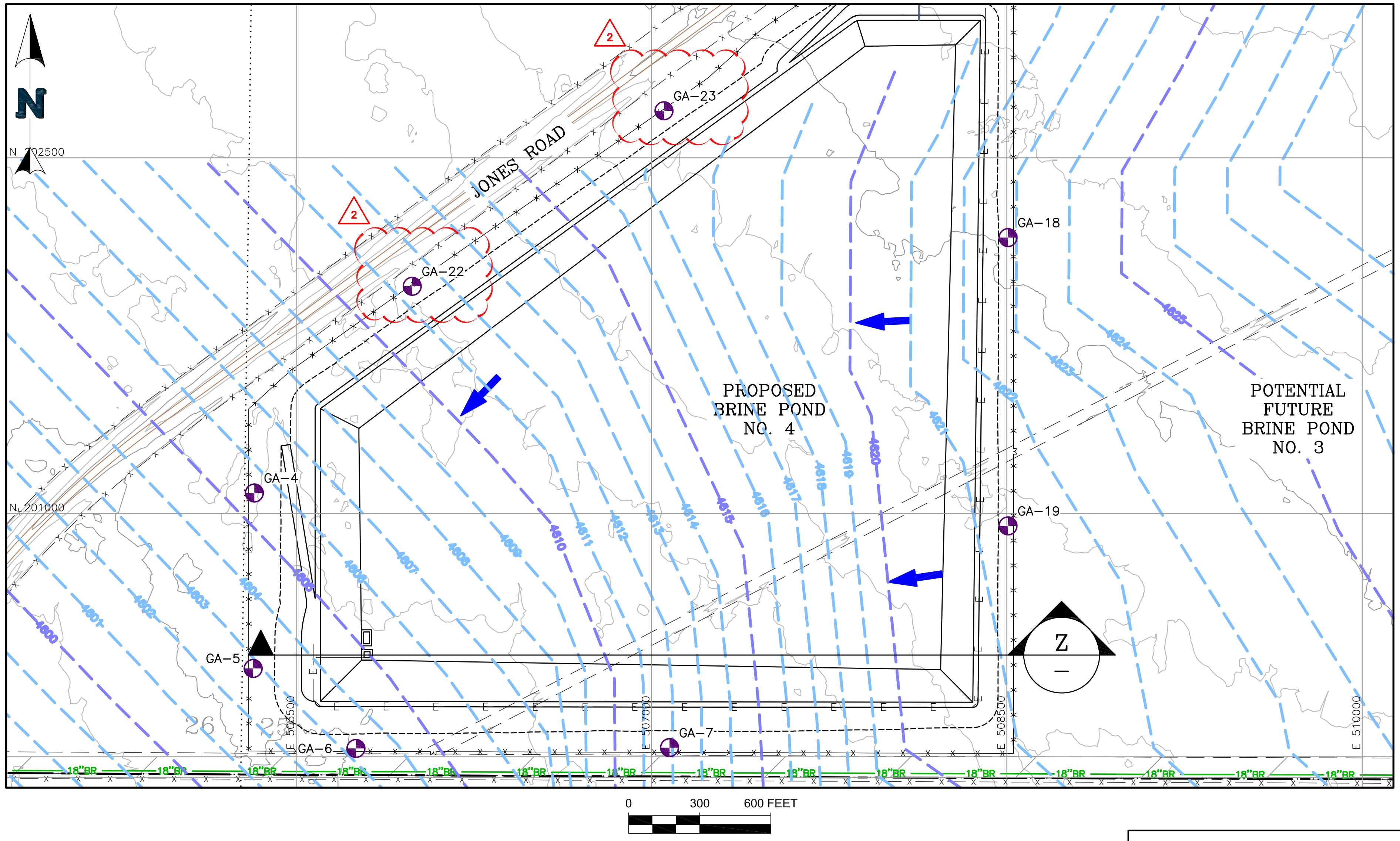
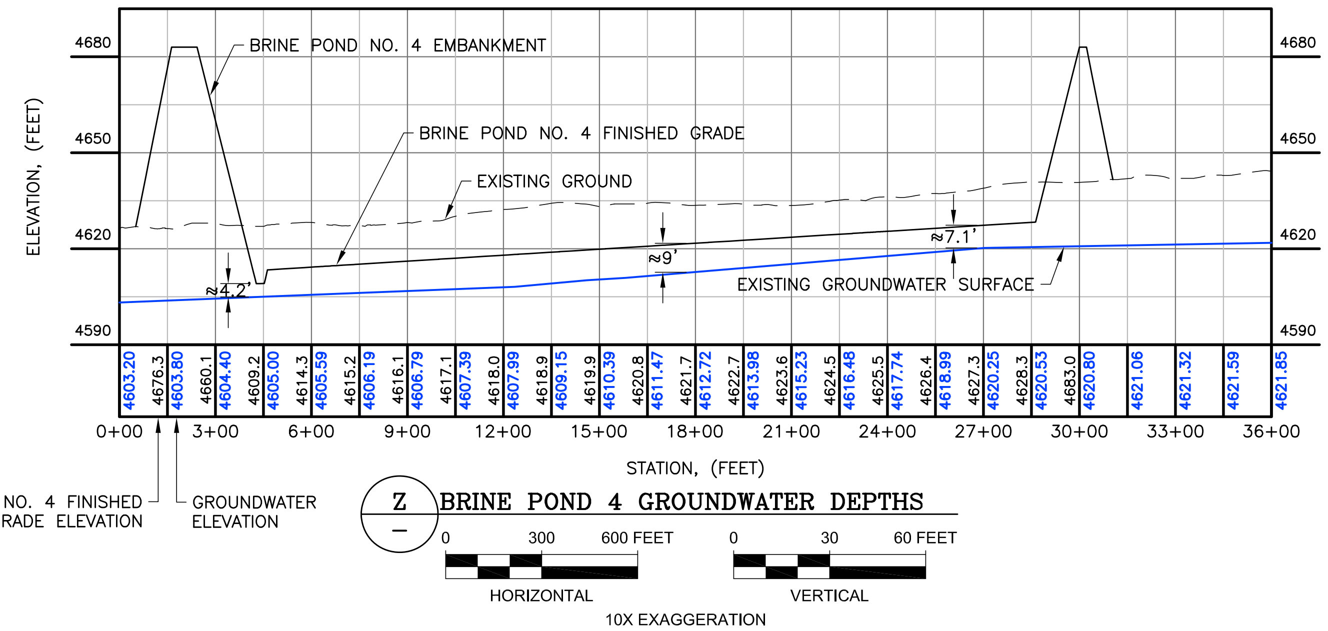


LEGEND:

	EXISTING GROUND CONTOURS
	APPROXIMATE GROUNDWATER CONTOURS BASED ON JUNE 2017 SITE INVESTIGATION, MARCH 2015 SITE INVESTIGATION, IGES 2011 SITE INVESTIGATION, AND NEWFIELDS 2020 SITE INVESTIGATION
	EXISTING ROADS/TRAILS
GA-01 ◔	EXISTING GROUND WATER MONITORING WELLS TO REMAIN
GA-12 ●	PROPOSED GROUND WATER MONITORING WELLS
➡	APPROXIMATE GROUNDWATER FLOW DIRECTION

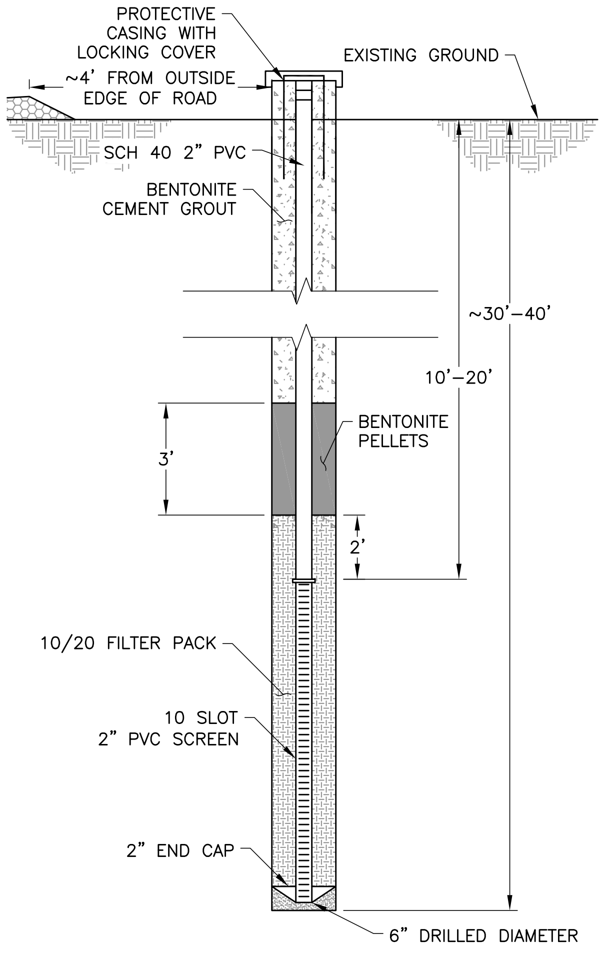
NOTES:

1. MONITORING WELLS WILL BE CONSTRUCTED IN COMPLIANCE WITH UTAH ADMINISTRATIVE RULE R655-4-15.
2. ESTIMATED DEPTH TO WATER IS APPROXIMATELY 15 TO 20 FEET BELOW EXISTING GROUND SURFACE.
3. HOLLOW STEM AUGER DRILLING METHOD IS PREFERRED; ALTHOUGH, OTHERS COULD BE CONSIDERED BASED ON RIG AVAILABILITY.
4. SCREEN LENGTH WILL BE SPECIFIED IN THE FIELD BASED ON SUBSURFACE CONDITIONS, BUT ANTICIPATED LENGTH IS 10 – 20 FEET.
5. FILTER PACK AND WELL SEALANTS WILL BE TREMIED IN PLACE FROM THE BOTTOM UP.
6. WELL DEVELOPMENT WILL BE COMPLETED THROUGH USE OF A BAILER OR PUMP.



Z – BRINE POND 4 GROUNDWATER DEPTHS

SETTING OUT DATA			
POINT	NORTHING	EASTING	ELEVATION
GA-4	201,086.18	505,322.74	4,630.00
GA-5	200,345.23	505,318.08	4,626.59
GA-6	200,007.73	505,751.69	4,625.59
GA-7	200,011.24	507,075.74	4,632.98
GA-18	202,163.53	508,504.91	4,650.93
GA-19	200,946.77	508,504.91	4,644.00
GA-22	201,957.73	505,989.22	4,635.83
GA-23	202,698.56	507,052.46	4,647.16



TYPICAL GROUNDWATER MONITORING WELL DETAIL

No.9517180-2202
KEVIN N. JENNINGS
03/12/2021
Kevin Jennings

2	03/12/21	RE-ISSUED FOR CONSTRUCTION	JLW	KNJ
1	01/29/21	RE-ISSUED FOR CONSTRUCTION	JLW	KNJ
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ
REV	DATE	DESCRIPTION	TECH	ENG

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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CLIENT
MAGNUM SOLUTION MINING, LLC

PROJECT
BRINE POND 4

TITLE
POND SITE GROUNDWATER DEPTHS
PLAN AND PROFILE

FILENAME 93.020.032D
DRAWING NO. A300
REVISION 2

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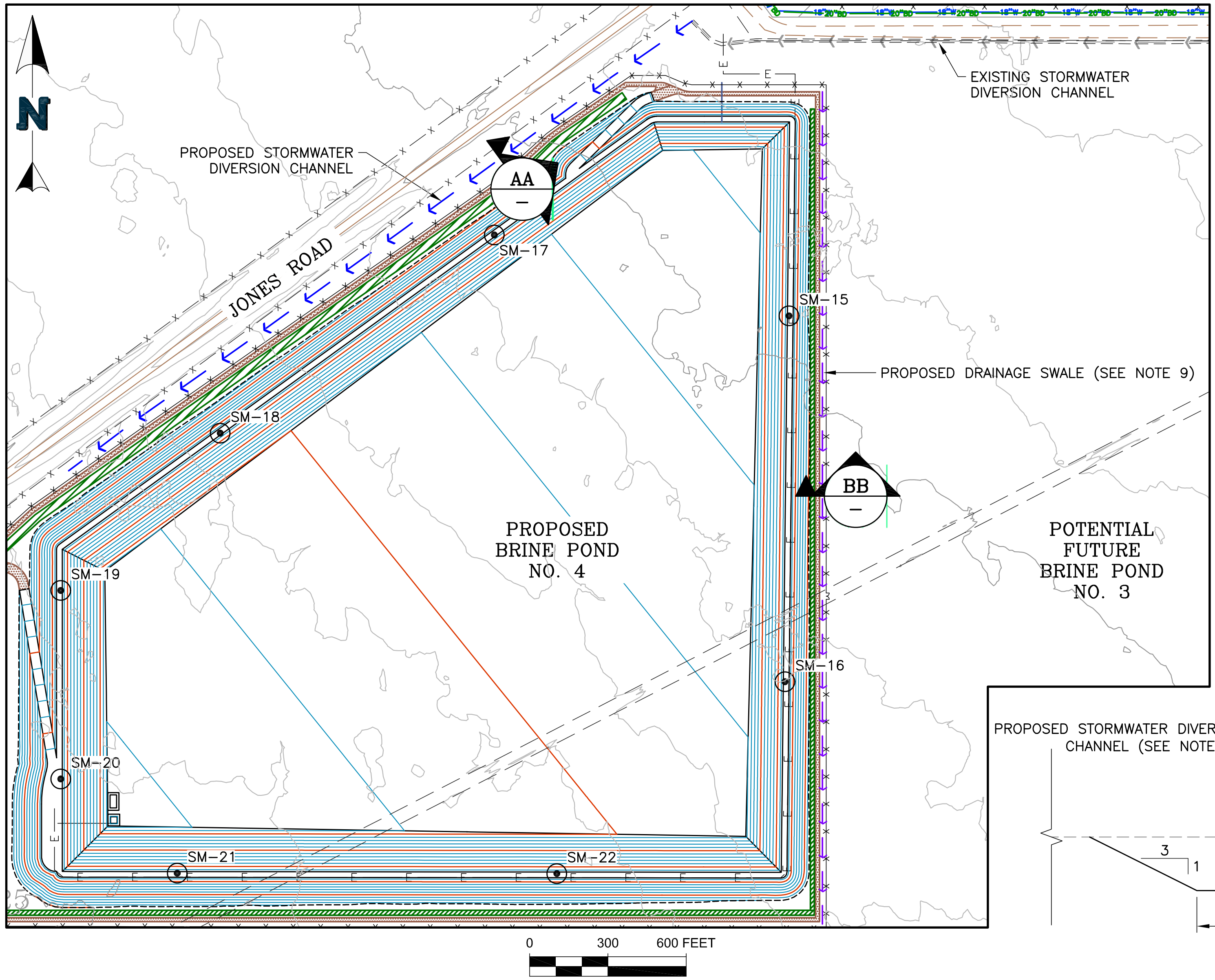


LEGEND:

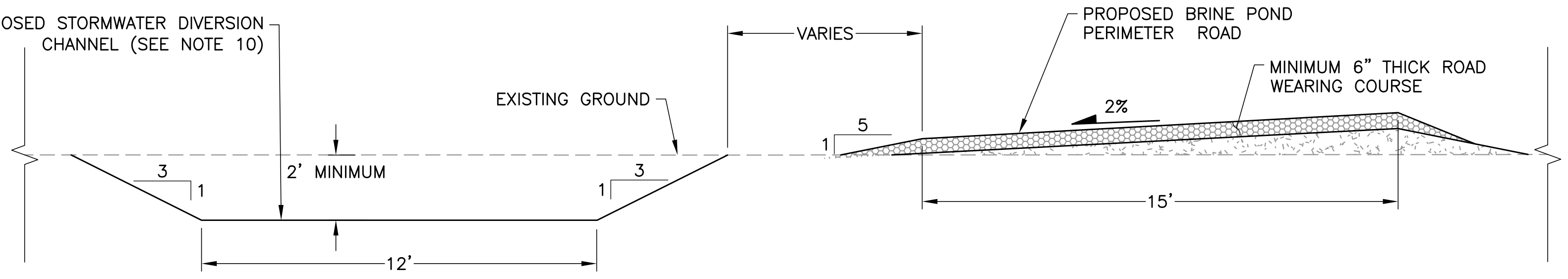
- EXISTING GROUND CONTOURS
- PROPOSED BRINE POND GROUND CONTOURS
- EXISTING ROADS/TRAILS
- → → — EXISTING STORMWATER DIVERSION CHANNEL
- → → — PROPOSED STORMWATER DIVERSION CHANNEL
- → → — PROPOSED DRAINAGE SWALE
- SM–9 ⊙ PROPOSED EMBANKMENT SETTLEMENT MONUMENTS (SEE NOTE 6)

SETTLEMENT MONUMENT SETTING OUT DATA

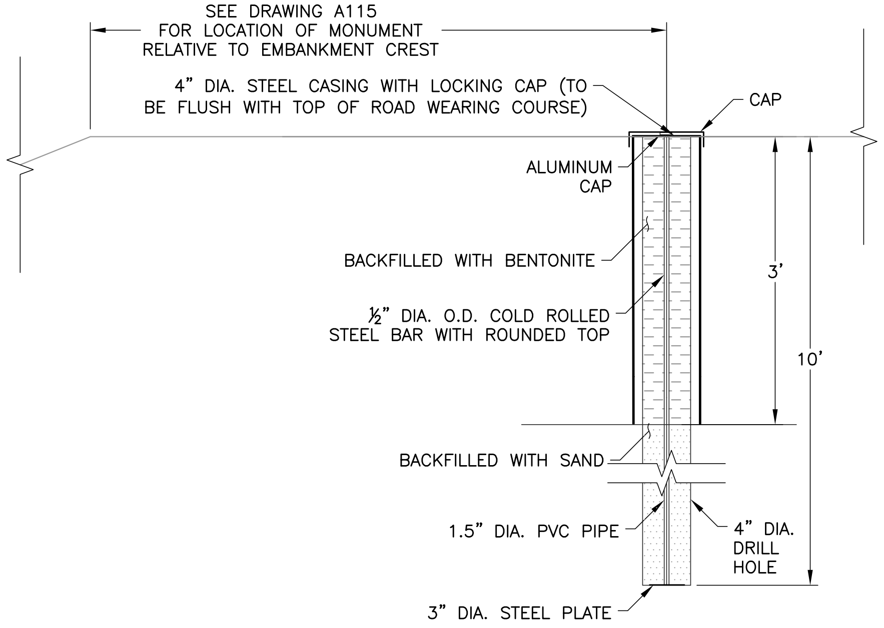
POINT	NORTHING	EASTING	ELEVATION
SM–15	202,336.65	508,385.78	4,683.00
SM–16	200,933.82	508,370.22	4,683.00
SM–17	202,646.69	507,256.73	4,683.00
SM–18	201,886.70	506,206.33	4,683.00
SM–19	201,283.62	505,595.23	4,683.00
SM–20	200,560.93	505,595.23	4,683.00
SM–21	200,199.60	506,041.64	4,683.00
SM–22	200,198.01	507,496.17	4,683.00

NOTES:

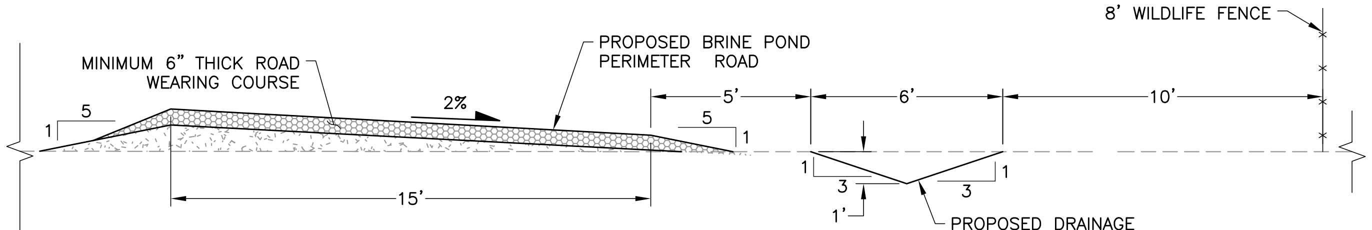
1. FINAL LOCATION OF ROAD AND DIVERSION CHANNEL TO BE DETERMINED DURING CONSTRUCTION BY THE FIELD ENGINEER.
2. DIVERSION CHANNELS SHALL BE CONSTRUCTED AT A MINIMUM 0.3% SLOPE TO MINIMIZE EARTHWORKS.
3. DIVERSION CHANNELS SHALL BE CONSTRUCTED WITH A MINIMUM 2 FOOT DEPTH.
4. BRINE POND PERIMETER ROAD SHALL BE CONSTRUCTED WITH A MINIMUM 6" THICK WEARING COURSE.
5. CULVERTS AND LOCAL DITCHES SHALL BE CONSTRUCTED AS REQUIRED TO MINIMIZE PONDING OF SURFACE WATER, LOCATIONS TO BE DETERMINED IN THE FIELD.
6. FINAL LOCATION OF SETTLEMENT MONUMENTS TO BE DETERMINED DURING CONSTRUCTION BY THE OWNER OR OWNER'S REPRESENTATIVE.
7. FIELD VERIFY AND EXTEND CHANNEL IF NECESSARY TO ALLOW PROPER DRAINAGE SLOPE.
8. THE DIVERSION CHANNEL SHALL BE GRADED AS SUCH TO OUTFALL INTO NATURAL DRAINAGE WAYS WHEN POSSIBLE.
9. A DRAINAGE SWALE SHOULD BE CONSTRUCTED ADJACENT TO THE EAST PERIMETER ROAD TO DIRECT STORM RUNOFF PAST THE SOUTHEAST CORNER OF THE POND.
10. THIS CHANNEL SECTION SHOULD CONTINUE SOUTHWEST UNTIL IT CAN DISCHARGE INTO THE EXISTING CHANNEL ALONG THE SOUTHEAST SIDE OF JONES ROAD.



AA
—
TYPICAL STORMWATER DIVERSION AND NORTHWEST PERIMETER ROAD SECTION



TYPICAL SETTLEMENT MONUMENT



BB
—
TYPICAL DRAINAGE SWALE AND EAST PERIMETER ROAD SECTION

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N. JENNINGS
09/15/2020
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

DISCLAIMER

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NewFields
CLIENT: MAGNUM SOLUTION MINING, LLC
PROJECT: BRINE POND 4
TITLE: STORMWATER DIVERSION AND SETTLEMENT MONUMENT PLAN
FILENAME: 93.020.034D
DRAWING NO.: A400
REVISION: 0

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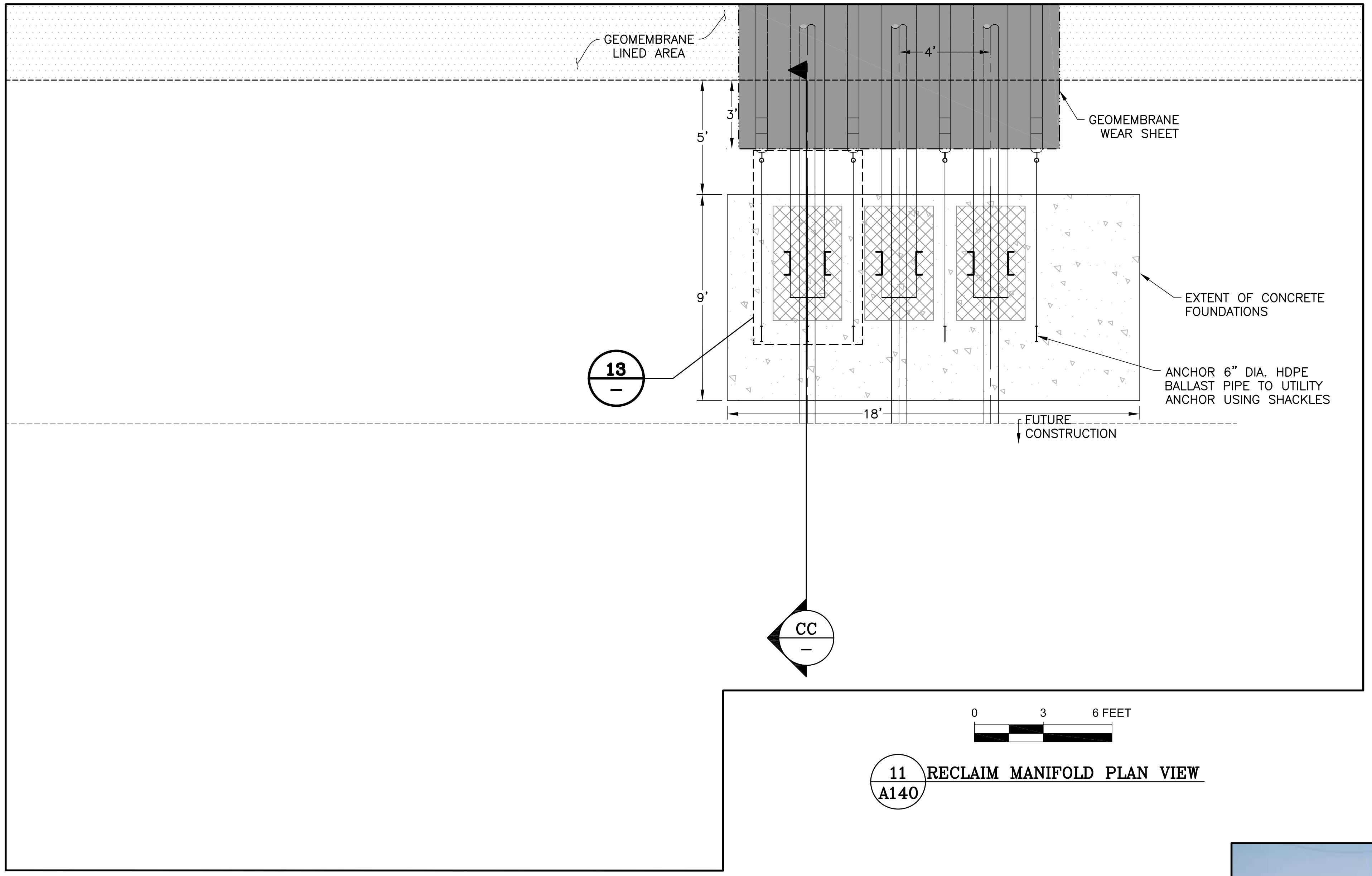
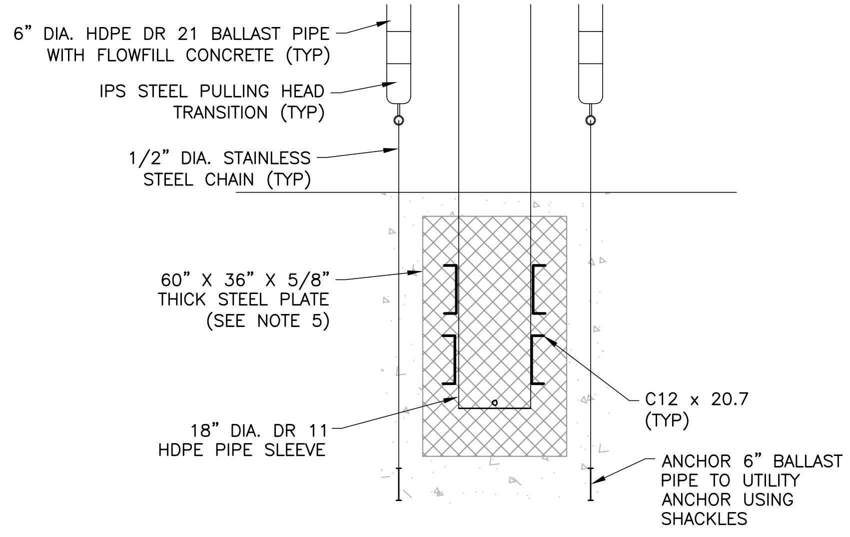


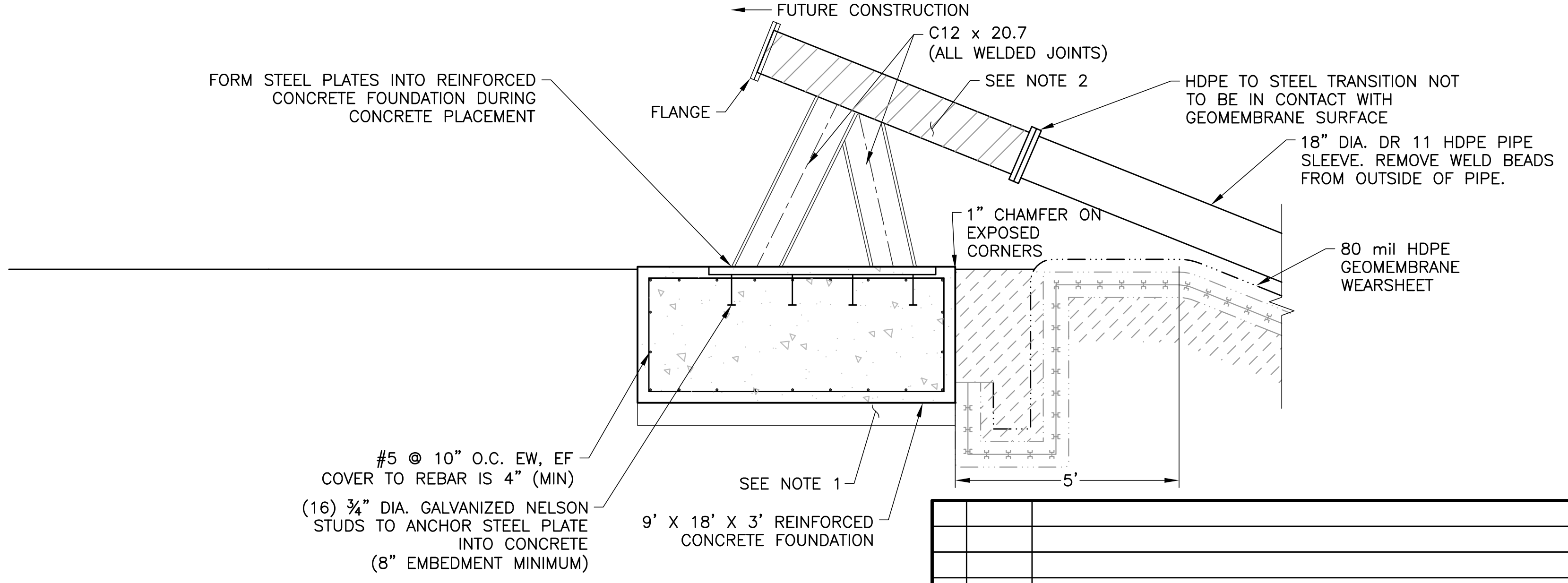
11 / A140 RECLAIM MANIFOLD PLAN VIEW

NOTES:

1. COMPACT SOIL TO 95% STANDARD PROCTOR DENSITY UNDER THE CONCRETE FOUNDATION FOOTPRINT.
2. COAT STEEL AND CONCRETE WITH TNEMEC EPOXOLINE SERIES 141 OR SIMILAR FOR CORROSION PROTECTION.
3. POSITION STEEL PLATE OR PLATES SO THAT CHANNEL LEGS CAN BE WELDED AT PLATE AND SLOPING PIPE SLEEVE.
4. FUTURE PIPING TO BE DETAIL DESIGNED IN FUTURE.



13 / – STEEL PLATE PLAN VIEW



CC / A140 CC / – BRINE RECOVERY MANIFOLD SECTION

EXISTING BRINE RECOVERY ANCHOR SYSTEM
FROM SAWTOOTH BRINE POND 1 FOR FABRICATION REFERENCE

No.9517180-2202
KEVIN N. JENNINGS
09/15/2020

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

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NewFields

CLIENT
MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND 4

TITLE
BRINE RECOVERY MANIFOLD
SECTIONS AND DETAILS

FILENAME
93.020.036D
DRAWING NO.
A500
REVISION
0

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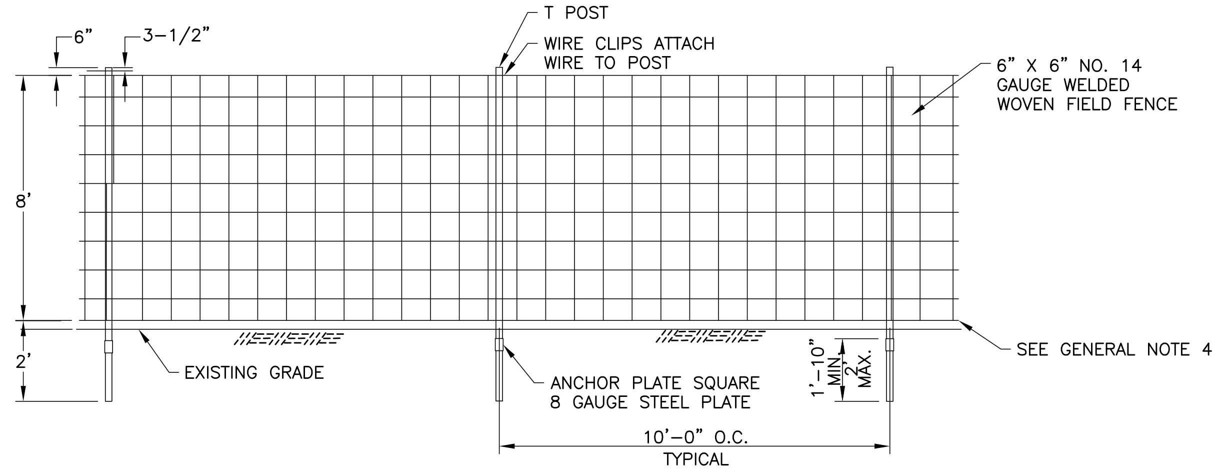
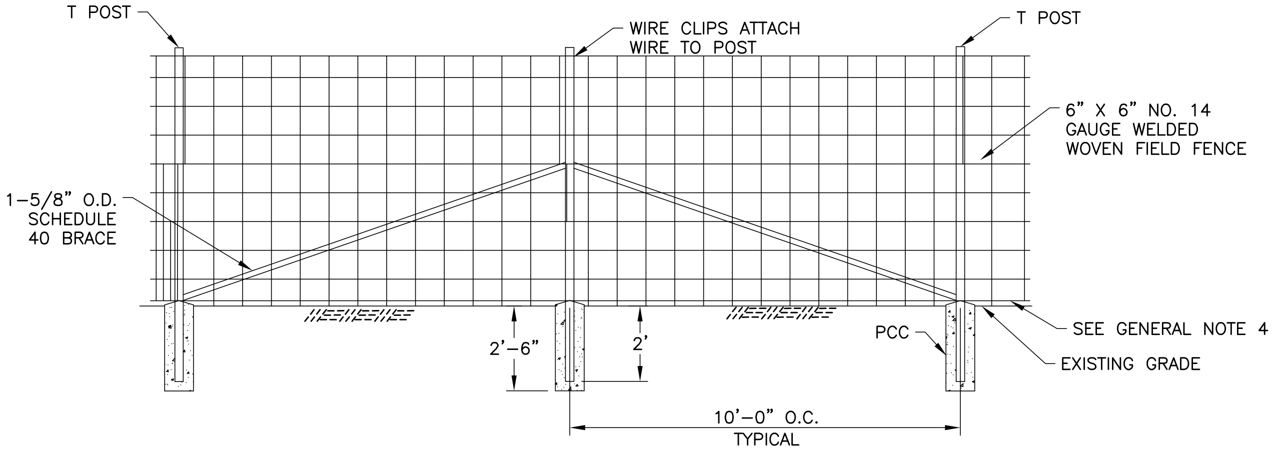


LINE PANELS



END PANEL

PANEL NOTES:

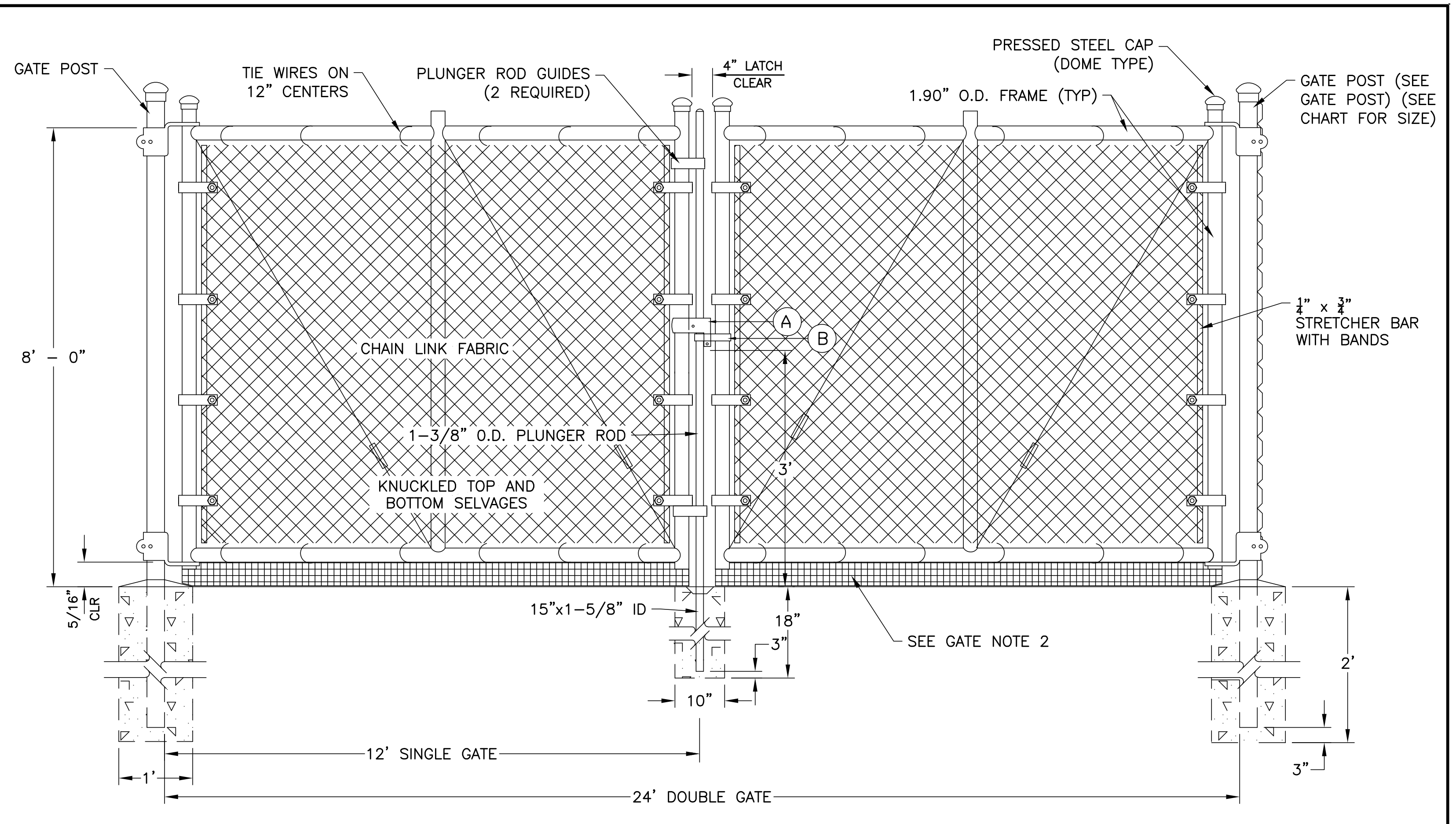
1. END PANELS SHALL BE PLACED EVERY 1000' ON TANGENTS.
2. END PANELS SHALL BE USED WHEREVER A BREAK IN THE FENCE OCCURS, (I.E. GATES, CATTLE GUARDS) AND AT THE BEGINNING AND END OF ALL CURVES
3. WIRES ARE TO BE TIED OFF AT STRETCH POINTS. WRAP AND SPLICE TO SELF WITH AT LEAST 4 TURNS AT OPPOSITE END OF PANELS.
4. FENCE SHALL BE INSTALLED TIGHT TO THE GROUND.

WILDLIFE FENCE

NTS

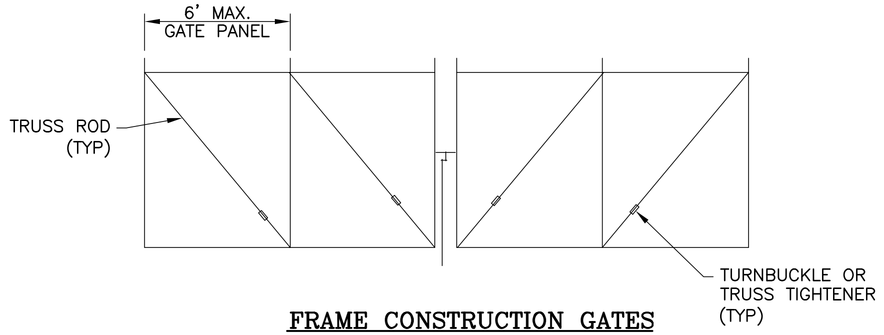
GATE POST

GATE OPENING IN FEET		ROUND GATE POLES O.D. (INCHES)	MIN. WEIGHT POUNDS/LIN. FEET	
SINGLE GATE	DOUBLE GATE		CLASS 1	CLASS 2
7 THRU 13	13 THRU 26	4.000	9.11	6.56



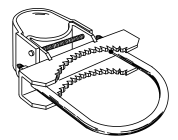
SWING GATE

NTS

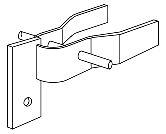


FRAME CONSTRUCTION GATES

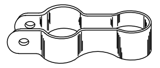
OVER 12'-0" TO 24'-0" OPENING



HINGE FOR TUBULAR POSTS



Ⓐ LOCK KEEPER



Ⓑ LOCK KEEPER GUIDE

GATE NOTES:

1. 3/8" ADJUSTABLE TRUSS RODS SHALL BE INSTALLED ON ALL GATES OVER 6 FEET IN WIDTH (SEE DETAIL B, SHEET C3.09, FOR TRUSS TIGHTENER DETAIL).
2. 1/2" X 1/2" NO. 12-1/2 GAUGE WIRE MESH OR 11-1/2 GAUGE CHAIN LINK FABRIC TO BE INSTALLED AT THE BOTTOM OF GATES AS REQUIRED TO CLOSE GAP BETWEEN GATE FRAME AND GROUND.

GENERAL NOTES:

1. DIAMETERS AND WEIGHTS LISTED ABOVE ARE MINIMUMS. LARGER SIZES MAY BE USED ON APPROVAL OF ENGINEER
2. 3-1/2" x 3-1/2" TYPE II POST (4.65 LBS/FT) CAN BE USED IN PLACE OF 2.875" O.D. ROUND GATE POST.
3. CONCRETE SHALL BE CLASS A OR AA.
4. FENCE FABRIC IS TO BE PLACED FLUSH WITH THE EXISTING GROUND.

REGISTERED PROFESSIONAL ENGINEER
Kevin Jennings
No.9517180-2202
KEVIN N.
JENNINGS
09/15/2020
STATE OF UTAH

REV	DATE	DESCRIPTION	TECH	ENG
0	09/15/20	ISSUED FOR CONSTRUCTION	JLW	KNJ

APPROVED BY: KNJ
CHECKED BY: JLW
DESIGNED BY: JLW
DRAWN BY: LE

NewFields

CLIENT
MAGNUM SOLUTION
MINING, LLC

PROJECT
BRINE POND 4

TITLE
WILDLIFE FENCE DETAILS

FILENAME 93.020.042D
DRAWING NO. A600
REVISION 0

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Appendix D

Groundwater Monitoring Plan

Groundwater Monitoring Plan

Draft

MAGNUM

Groundwater Monitoring Plan

Draft

March 12, 2021

Prepared by
NewFields
9400 Station Street, Suite 300
Lone Tree, CO 80124
Tel 720 508 3300   Fax 720 508 3339
www.newfields.com

Table of Contents

Tables

Figures

Appendices

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Section 1

Introduction

1.1 Plan Purpose

This Groundwater Monitoring Plan has been developed to describe the processes and procedures for groundwater monitoring and agency reporting for the Magnum Solution Mining, LLC (Company) hydrogen production and storage facility. The facility is located approximately ten miles north of Delta in Millard County, Utah on lands leased from the School and Institutional Trust Lands Administration (SITLA). The storage facility consists of a Storage Cavern Field; a series of electrolyzer banks, an approximately 168-acre brine pond; a substation with an associated electric distribution and high voltage system; office and warehouse buildings; water production wells; and associated buried piping and utilities. The monitoring procedures in this Plan pertain only to the monitoring of potential effects to groundwater relative to the construction and operation of storage caverns within the Storage Cavern Field and the operation of the brine pond.

The Company has committed to groundwater monitoring within the confines of the facility using a network of existing and proposed groundwater production, observation and monitoring wells. Groundwater monitoring activities for the facility are under the jurisdiction of the Department of Environmental Quality, Division of Water Quality (DWQ). The Plan is written to comply with the requirements of all project permits.

1.2 Local Hydrogeology

Groundwater beneath the hydrogen storage facility occurs in unconsolidated sediments within the Sevier Desert Basin aquifer system. Four aquifers units are of interest (from shallowest to deepest):

- The water table aquifer;
- The shallow artesian aquifer;
- The deep artesian aquifer; and
- The basement aquifer.

Table 1 provides a summary of the four aquifers. Figure 1 is a graphical depiction of the aquifers' hydrostratigraphy. The aquifers depths have been refined utilizing a geologic model constructed based on drilling data from wells constructed by the Company.

There is currently a network of groundwater production, observation and monitoring wells for monitoring groundwater levels and groundwater quality within the aquifers depicted in Figure 1. The Company also has permission from the adjacent landowners to monitor groundwater levels in their respective water production wells. Figure 2 depicts the location of the network of groundwater wells that will be used for groundwater monitoring.

Table 1: Summary of Local Hydrology

Depth (feet bgs)	Aquifer Name	Aquifer Description and Use
0 to 250	Water table aquifer	The water table aquifer is unconfined and generally not used within the area due to high total dissolved solids and poor quality conditions. (The Sawtooth GA and the Company's B-P wells are currently used to monitor water quality)
300 to 600	Shallow artesian aquifer	Confining zones vary in thickness and location and can include several hundred feet of the identified depths. This aquifer is generally used for agricultural and drinking water purposes. (The Sawtooth DA wells and Egg Farm off-site well are currently used to monitor water levels)
700 to 1,400	Deep artesian aquifer	Confining zones vary in thickness and location and can include several hundred feet of the identified depths. This aquifer is generally used for industrial and drinking water purposes. This is the aquifer from which water will be produced for the facility. (The Sawtooth DA wells and the IPP off-site well are currently used to monitor water levels)
> 1,650 to 3,000	Basement aquifer	This aquifer extends to bedrock or the salt structure and includes several small inter-bedded sand and gravel units within significant silt and clay zones. (Sawtooth currently owns and operates the MH wells to monitor water levels and quality and DA wells to monitor water levels)

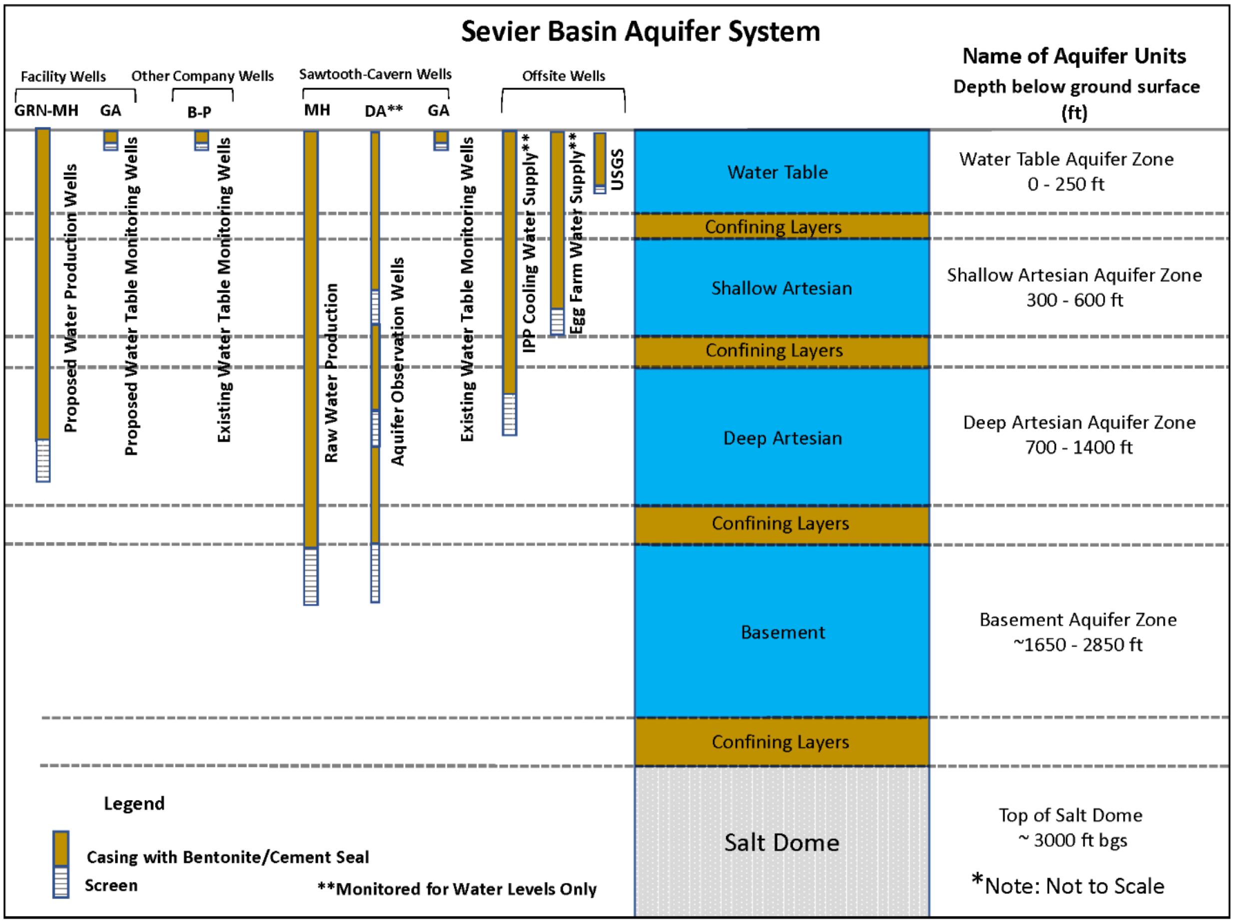


Figure 1 Hydrostratigraphy of the Project Area

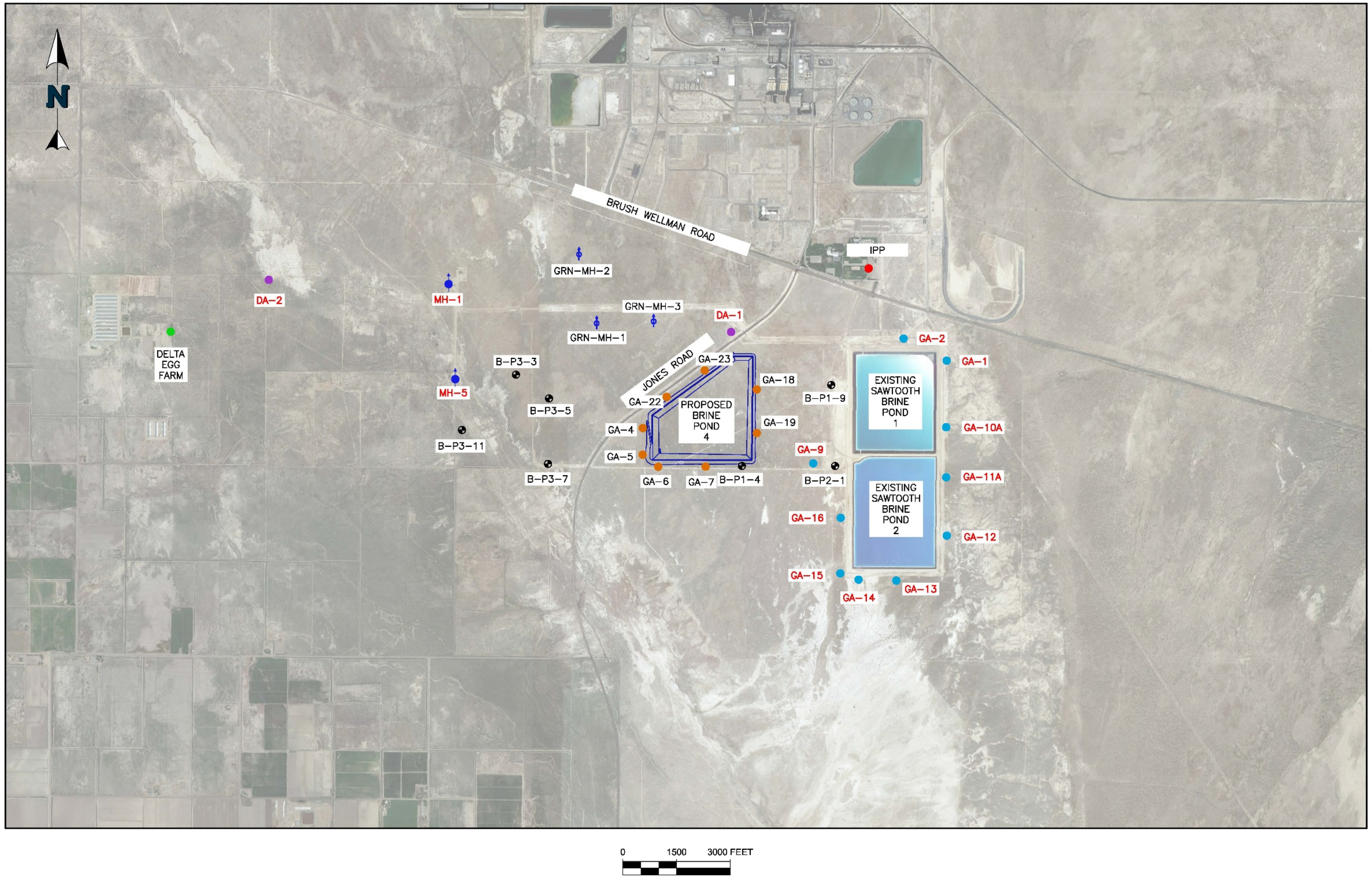
1.3 Storage Cavern Field Groundwater Monitoring

Groundwater monitoring activities associated with the storage caverns will entail both groundwater level and groundwater quality monitoring. The storage caverns will be constructed in a salt formation that is located approximately 3,000 feet below the ground surface (bgs) using standard solution mining technology. Water for the solution mining process will be obtained through off-site water supply agreements and/or from three proposed water production wells (GRN-MH-1, GRN-MH-2, and GRN-MH-3; see Figure 2). Water chemistry testing indicates that water from the basement aquifer is not suitable for all facility components (e.g.: cooling towers), therefore the Company is proposing to produce groundwater for this facility from the deep artesian aquifer. While multiple hydrological analyses indicate that Company's production from the deep artesian and basement aquifers will not drawdown the overlaying shallow artesian aquifers, the Company has committed to monitoring the shallow artesian, deep artesian, and basement aquifers to ensure groundwater levels are not negatively affected by solution mining activities (see Table 1 and Figure 1).

In addition to water level monitoring, the Company has also committed to monitoring groundwater quality in the deep artesian aquifer during solution mining and storage cavern operations.

1.4 Brine Evaporation Pond Groundwater Monitoring

Groundwater monitoring activities associated with the brine evaporation ponds will entail groundwater quality monitoring and leak detection system monitoring to protect the water table aquifer. The 168-acre pond will be constructed with a double geomembrane liner system with a leak detection system composed of a Leak Collection and Recovery System (LCRS) between the liners and a Process Component Monitoring System (PCMS) below the liners. The purpose of monitoring the leak detection system is to ensure that the system is working in accordance with the pond design, thereby reducing the potential for significant leaks through the bottom pond liner. In addition, groundwater monitoring wells around the perimeter and on the berms of the pond will be installed in the water table aquifer, as shown in Figure 2. The purpose of the monitoring wells is to monitor water level and for elevated conductivity, sodium, TDS, or chloride levels that could indicate a leak in the double liner system. In sum, the design provides for three levels of protection to ensure groundwater quality in the water table aquifer is not negatively affected by the brine pond: 1) the double geomembrane liner system; 2) the dual leak detection and collection system; and 3) the network of groundwater monitoring wells.



LEGEND:

▬	PROPOSED BRINE POND
● GA–4	PROPOSED WATER TABLE AQUIFER MONITORING WELL
● GRN–MH4	PROPOSED DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL

EXISTING SAWTOOTH WELLS:

● GA–1	WATER TABLE AQUIFER MONITORING WELL
● MH–1	BASEMENT AQUIFER WATER PRODUCTION WELL
● DA–2	MULTI–AQUIFER MONITORING WELL

OTHER WELLS:

● DELTA EGG FARM	SHALLOW ARTESIAN AQUIFER WATER PRODUCTION WELL
● IPP	DEEP ARTESIAN AQUIFER WATER PRODUCTION WELL
◕ B–P1–4	MAGNUM WATER TABLE AQUIFER MONITORING WELL

NOTES:

1. AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND IS DATED AUGUST 19, 2019

NewFields
CLIENT MAGNUM SOLUTION MINING, LLC
PROJECT BRINE POND 4
TITLE AQUIFER MONITORING WELL NETWORK
FILENAME 475.0093.020.GWDP.1–1
FIGURE NO. APP.D.2
REVISION B

Figure 2 - Aquifer Monitoring Well Network

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Section 2

Groundwater Monitoring Methods

Baseline data for the groundwater system that the facility will be producing from has been collected since 2009. Baseline data collection for groundwater level in the shallow artesian, deep artesian, and basement aquifers was first initiated in 2009 when MH-1 was first drilled and developed, and has continued as MH-5, DA-1 and DA-2 have been drilled and developed. (Water production wells MH-1 and MH-5, and the multi-aquifer monitoring wells DA-1 and DA-2, were previously owned by the Company). Data collection for groundwater level baseline conditions also includes data collected since 2009 from an Intermountain Power Agency (IPA) industrial water well, a private commercial water well owned by the Delta Egg Farm, and a well installed and monitored by the U.S. Geological Survey (USGS). Baseline data for groundwater levels and quality of the water table aquifer directly beneath the brine evaporation ponds have been collected since 2010. These baseline conditions are kept on file at the facility and are incorporated into the required agency reporting as necessary.

2.1 Storage Cavern Field Groundwater Level Monitoring Methods

The facility will conduct groundwater level monitoring in association with the storage caverns using a network of proposed and existing groundwater production and observation wells that are located both within the facility and off-site. The wells within the facility that will be used to monitor groundwater levels are the planned production wells GRN-MH-1 through GRN-MH-3 as they are drilled and put into service. The off-site wells that will be used to monitor groundwater levels include Sawtooth's MH-1 and MH-5 water production wells and observation wells DA-1 and DA-2, an industrial water well owned by the Intermountain Power Agency (IPA), and a private commercial water well owned by the Delta Egg Farm. Figure 2 depicts the location of all the wells that will be used for groundwater level monitoring. This network of wells will allow the Company to monitor groundwater levels in the shallow artesian, deep artesian, and basement aquifers. Figure 1 illustrates the individual well depths and monitoring points in relation to the groundwater system. Note that the Company will only be able to monitor the groundwater aquifer conditions from the off-site locations with landowner cooperation.

Existing monitoring wells are equipped with transducers to measure groundwater levels; future wells will be similarly equipped. The transducers are installed within monitoring tubes located within the production casings of the individual wells. Each of the Sawtooth, Delta Egg Farm and the IPA water wells each have a single monitoring tube installed to monitor the respective aquifer in which each well is completed. DA-1 and DA-2 are equipped with monitoring tubes that enable monitoring of shallow artesian, deep artesian, and basement aquifers.

The data loggers connected to each transducer have been set to record groundwater level measurements daily. Data from the transducers at each monitoring well will be downloaded and analyzed monthly during periods of solution mining. Groundwater level measurements will be documented to the nearest 0.1 foot. The functionality of transducers will be checked monthly the first year of operations and quarterly thereafter; adjustments to transducer settings will be made accordingly. Table 2 summarizes the groundwater level monitoring schedule as described above.

Table 2: Storage Cavern Field Groundwater Level Monitoring Schedule

Well	Aquifer Monitoring Point	Data Collection Interval	Data Download and Analysis Frequency[1]
GRN-MH-1 – GRN-MH-3 Water Production Wells[2]	Deep artesian	Daily	Monthly
Sawtooth DA-1 and DA-2 Observation Wells[3]	Shallow artesian, deep artesian, and basement	Daily	Monthly
Sawtooth MH-1 and MH-5	Basement	Daily	Monthly
IPA Water Production Well[4]	Deep artesian	Daily	Monthly
Delta Egg Farm Water Production Well[5]	Shallow artesian	Daily	Monthly
USGS Well	Shallow artesian	Daily	As available[6]

[1] Data will be downloaded and analyzed monthly during periods of solution mining, quarterly otherwise.
[23] Planned Company-owned wells.
[3] Wells owned by Sawtooth NGLs, LLC. Owner permission required to monitor.
[4] Well owned by Intermountain Power Agency. Owner permission required to monitor.
[5] Well owned by Delta Egg Farm. Owner permission required to monitor.
[6] Data recorded daily by USGS but made publicly available at irregular intervals, approximately every six months.

2.2 Storage Cavern Field Groundwater Quality Monitoring Methods

The Company will conduct groundwater quality monitoring in association with the hydrogen storage caverns using the planned production wells GRN-MH-1 through GRN-MH-3. These wells are proximal to the storage cavern field and will produce water from the deep artesian aquifer at elevations between 700 to 1,400 feet bgs (see Figures 1 and 2).

Groundwater samples will be collected monthly from GRN-MH-1, GRN-MH-2, and GRN-MH-3. Groundwater sampling methods will be per the Groundwater Sampling Quality Assurance Procedures included as Appendix A. The sampling methods include:

- Water samples will be collected from the sample port that is closest to each wellhead.
- A hand-held multi-gas meter will be used to monitor the headspace of each well for the presence of combustible gas, including but not limited to hydrogen and hydrocarbons, prior to sampling. If combustible gas is detected, subsequent analysis can be done.
- The water level will be measured prior to sampling.
- Samples will be collected directly into laboratory-provided containers and delivered per the laboratory-required protocols.
- Information pertinent to the sampling effort will be documented on preprinted field sheets.
- The handling of all samples collected will be traceable from the time of collection, through analysis, until final disposition. Documentation of the sample history is referred to as chain-of-custody.

- Samples will be sent to and analyzed by a State of Utah certified laboratory for the analysis of sodium, chloride, and total dissolved solids.

Table 3 summarizes the groundwater quality monitoring schedule associated with the storage caverns as described above.

Table 3: Storage Cavern Field Groundwater Quality Monitoring Schedule

Well	Aquifer Monitoring Point	Water Sample Frequency
GRN-MH-1 – GRN-MH-3 water production wells[1]	Deep artesian	Monthly

[1] Planned facility-owned wells.

2.3 Brine Evaporation Ponds Groundwater Quality Monitoring Methods

The Company will conduct groundwater quality monitoring of the water table aquifer in association with the brine evaporation ponds using the proposed monitoring wells GA-4, GA-5, GA-6, GA-7, GA-18, GA-19, GA-22 and GA-23. Following an accelerated sampling program and data evaluation, this list might be modified. These wells are placed in an array around and on the berms of the brine evaporation ponds (see Figure 2). All wells will be installed to a depth within the water table aquifer zone (see Figure 1 and Figure 2). GA-18 and GA-19 are intended to monitor upgradient groundwater quality of the ponds; GA-22 and GA-23 are intended to monitor side-gradient groundwater quality; the remaining wells are intended to monitor groundwater quality downgradient of the ponds. Water level measurements also will be taken during monitoring events.

Groundwater monitoring of the water table aquifer will be conducted in accordance with the requirements of the DWQ GWDP. The water table aquifer groundwater monitoring plan includes

- Monthly field parameter data collection for pH, temperature, TDS, and conductivity; and,
- Quarterly laboratory analysis for the parameters identified in Table 4.

In accordance with DWQ GWDP #(Insert New Permit Number), the Company will conduct field monitoring monthly for the parameters above. Monthly field monitoring will be conducted for a period of 24 months after the initiation of commercial operations. After the first 24 months of commercial operations, the frequency of field monitoring will be reduced to quarterly.

In addition, the DWQ GWDP requires Accelerated Background Monitoring on a quarterly basis for a period of 24 months to establish ground water protection levels for the storage facility. Accelerated Background Monitoring will initially include both the collection of field parameters and collection of groundwater samples for laboratory analysis on a quarterly basis for the parameters above. Analysis of all groundwater samples will be performed by laboratories certified by the Utah Department of Health, will follow methods cited in Utah Administrative Code (UAC) R317-6-6.3L, and will ensure that method detection limits are less than the Interim Ground Water Protection Levels for the water table aquifer zone described in Table 4.

After completion of the Accelerated Background Monitoring, the Company will submit an Accelerated Background Monitoring Report to the DWQ. After review and approval of the

Accelerated Background Monitoring Report, the Director of DWQ (the Director) will establish well-specific groundwater protection levels for each parameter in accordance with R317-6-4 of the Ground Water Quality Protection Rules. After specific well protection measures have been identified, sampling will be reduced to a semi-annual frequency.

Table 4: DWQ Interim Groundwater Protection Levels

Parameter	Protection Level (mg/L)
pH (units)	6.5 – 8.5[1]
Chloride	150
Sodium	200
Total Dissolved Solids	750

[1] Class II Groundwater Quality Standard

Table 5 summarizes the groundwater quality monitoring schedule for the evaluation of the DWQ Groundwater Quality Standards in the vicinity of the brine evaporation pond.

Table 5: Brine Evaporation Pond Groundwater Quality Monitoring Schedule

Well	Aquifer	Field Monitoring (0-24 mos.)	Field Monitoring (after 24 mos.)	Accelerated Background Monitoring (0-24 mos.)	Compliance Monitoring (after 24 mos.)
GA Monitoring Wells	Water table aquifer	Monthly	Quarterly	Quarterly	Semi-annual

2.3.1 Exceedances

Upon exceedance in a downgradient monitoring well of any one parameter listed in Table 4, the monitoring well(s) in which the exceedance was(were) detected will immediately be resampled for laboratory analysis of the exceeded protection level parameter(s). The analytical results will be submitted to the DWQ, and the Director will be notified of a probable out-of-compliance status within 30 days of the initial detection.

Upon exceedance of any one parameter listed in Table 4 for two consecutive sampling events, the Company will immediately notify the DWQ and Millard County and implement an accelerated schedule of monthly sampling and analysis. This monthly schedule will continue for at least two months or until the compliance status can be determined by the Director. Reports of the results of this sampling will be submitted to the Director as soon as they are available, but not later than 30 days from each date of sampling.

If the protection level for a parameter listed in Table 4 is exceeded in two consecutive samples from a compliance monitoring well, the well is out of compliance. The Director will be notified verbally of the exceedance within 24 hours of the receipt of data demonstrating out-of-compliance status; written notice will be provided within 5 days. Accelerated monthly groundwater monitoring will continue for at least two months, and until the facility is brought into compliance, or as determined by the Director.

Within 30 days after the written notice to the Director of out-of-compliance status, the Company will submit an assessment study plan and compliance schedule for:

1) Assessment of the source or cause of the contamination, and determination of steps necessary to correct the source.
2) Assessment of the extent of the ground water contamination and any potential dispersion.
3) Evaluation of potential remedial actions to restore and maintain ground water quality and ensure that the ground water standards will not be exceeded at the compliance monitoring wells.

Millard County will be immediately notified of any monitoring well that is out of compliance.

Section 3

Agency Reporting and Notification

3.1 Storage Cavern Field Groundwater Level Reporting and Notification

During the first year of solution mining, the Company will submit monthly water level measurement reports to Millard County during periods of solution mining. The reports will include water level as measured in depth to ground water from the surveyed casing measuring point, and ground water elevations as converted by casing measuring point elevations. The report will also include a graphical depiction of the water level data from all monitored wells. The Company will also submit an annual Water Rights and Water Usage Summary and Analysis to the State Engineer and Millard County by April 30 for the previous year in which solution mining activities have been conducted.

The facility managers will initiate a detailed internal review with a professional engineer/hydrogeologist if a sustained change in water levels greater than 12 feet below the historic recorded low is documented within the shallow and deep artesian aquifers in off-site monitoring wells. Once the internal review is complete, facility managers will meet with the owner of the off-site well, the Company or facility's professional engineer/hydrogeologist, and the State Engineer to review and coordinate any necessary action. The Company will notify Millard County of any official determination made by the State Engineer.

3.2 Storage Cavern Field Groundwater Quality Reporting and Notification

The Company will prepare and file quarterly groundwater quality monitoring reports with the required agencies. The reports will include the groundwater analysis results and groundwater level measurements for each monitoring well. Reports will be submitted per the following schedule:

- First Quarter Report (January, February, March) – Due April 30.
- Second Quarter Report (April, May, June) – Due July 31.
- Third Quarter Report (July, August, September) – Due October 31.
- Fourth Quarter Report (October, November, December) – Due Jan 31.

The Company will immediately consult with agencies on an appropriate course of action if:

- Sodium or chloride concentrations measured in a groundwater sample are higher than the baseline concentrations by a factor of two.
- Combustible gases traceable to storage products are detected in the headspace of a well.

3.3 Brine Evaporation Pond Groundwater Quality Reporting and Notification

Quarterly groundwater quality monitoring reports will be submitted to the required agencies per the following schedule:

- First Quarter Report (January, February, March) – Due April 30.

- Second Quarter Report (April, May, June) – Due July 31.
- Third Quarter Report (July, August, September) – Due October 31.
- Fourth Quarter Report (October, November, December) – Due Jan 31.

The Company will also submit an Accelerated Background Monitoring Report to the required agencies per the requirements of the DWQ GWDP after eight quarterly sample events have been completed. The report will include all field data sheets (see Appendix B), laboratory analytical reports, and the following statistical calculations by well, presented in spreadsheet format for the interim groundwater protection parameters listed in Table 4.

- Non-detect values converted to the detection limit times 0.25
- Mean concentration
- Standard deviation
- Mean concentration plus 2 standard deviations
- Mean total dissolved solids concentration times 1.25
- Mean concentration of all other parameters times 1.25
- Ground water quality standard times 1.25

After Accelerated Background Monitoring is completed and the Director establishes well-specific groundwater protections parameters, ongoing groundwater quality monitoring reports will include the following information:

- Field Data Sheets (see Appendix B), or copies thereof, including the field measurements required as identified in Section 3.3 above, and other pertinent field data, such as well name/number, date and time, names of sampling crew, depth to water, type of sampling pump or bail, volume of water purged before sampling.
- Laboratory Analytical Results, including date sampled, date received; and the results of analysis for each parameter, including the value or concentration, units of measurement, reporting limit (minimum detection limit for the examination), analytical method, and the date of the analysis.
- A summary table of the analytical results from the current and previous monitoring events, a discussion of whether the monitoring wells comply with groundwater protection parameters, an evaluation of temporal and spatial trends in the data, a discussion laboratory data quality assurance/quality control, and any other information pertinent to the monitoring even.

3.4 Brine Evaporation Pond Leak Detection System Reporting, Notification, and Corrective Action

Leak detection system (LCRS and PCMS) monitoring will be reported monthly. The reports will be submitted to the required agencies and will include:

- A verification that the inspection schedule is being maintained;
- A verification that the measured LCRS and PCMS Maximum Allowable Leakage rates in Table 6 below have not been exceeded;
- The volume of fluid pumped from the LCRS and PCMS sumps, tabulated either daily or monthly depending on the monitoring interval;
- The disposition of any fluids pumped from the LCRS and PCMS sumps; and,
- If the Maximum Allowable Leakage Rates have been exceeded, the Director will be notified verbally as soon as possible, but no later than 24 hours after the Company becomes aware of the exceedance. The report shall be made to the Utah Department of Environmental Quality 24-hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 536-4300, during normal business hours (Monday through Friday 8:00 am - 5:00 pm Mountain Time).
- Electronic and written submission will also be provided to the Director within five days of the time that the Company becomes aware of the exceedance. The electronic data in the format specified by the Director (e-mail, compact disc, or another approved transmittal mechanism). The written submission will contain:
    - A description of the exceedance and its cause;
    - The period of exceedance, including exact dates and times;
    - The estimated time the exceedance is expected to continue if it has not been corrected; and,
    - Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the exceedance.
- Out-of-compliance conditions will be evaluated by daily monitoring of pumping rates from the LCRS and PCMS sumps during the filling of the pond.
    - A sudden spike in flows indicates one or more leaks. Filling will be halted, and the pond will be inspected to determine the source of the leaks.
    - After the leak(s) is(are) identified and repaired, filling will continue, while continuing to monitor flows.
- After the pond has been filled and leakage rates stabilize or decline, the pumping rate of fluids pumped from the LCRS and PCMS sumps and returned to the pond will be monitored weekly and compared to the Maximum Allowable Leakage Rates.
- The maximum head in the LCRS sump will be managed by pumping leakage collected in sump back into the pond. Fluid will be pumped from the sump such that it is not necessary to pump at a rate greater than the Action Leakage Rates in Table 6 below.

- If a leak develops after filling the pond, the first step will be to monitor head in the space between the liners to narrow the location of the leak(s) to allow focused inspections and to confirm that head has been controlled between the liners.
    - If elevated head between the liners is identified as the source of leakage, head control will be reestablished as described in the Brine Evaporation Ponds Operating Manual.
    - If excessive leakage occurs because of a liner failure, the liner will be repaired prior to introducing additional fluids into the pond.

Table 6: Brine Evaporation Pond Maximum Allowable Leakage Rates

Monitoring System Component	Maximum Allowable Leakage Rate	Action Leakage Rate[1]
LCRS Sump	439 gallons per minute	351 gallons per minute
PCMS Sump	13.8 gallons per minute	11.0 gallons per minute

[1] The Action Leakage Rate for each component is 80 percent of the respective Maximum Allowable Leakage Rate.

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Section 4

Record Retention

4.1 Records

The Company will retain copies at the storage facility of all monitoring data sheets, laboratory analyses and agency reports associated with groundwater level, water quality, and leak detection system monitoring. These records will be kept for the operational life of the facility.

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Appendix A

Groundwater Sampling Quality Assurance Procedures

GROUNDWATER SAMPLING QUALITY ASSURANCE PROCEDURES

1.0 SAMPLING PROCEDURES

Groundwater samples will be collected monthly from production wells GRN-MH-1, GRN-MH-2, and GRN-MH-3, and analyzed for sodium, chloride, total dissolved solids, and dissolved gases. Groundwater samples from the water table aquifer monitoring wells GA-4, GA-5, GA-6, GA-7, GA-18, GA-19, GA-22, and GA-23 will be collected monthly initially, moving to semi-annually. Sampling events will be documented on field forms and reported in quarterly reports. Basic sampling procedures are as follows:

- Prior to sampling GRN-MH-1, GRN-MH-2, and GRN-MH-3, a hand-held multi-gas meter will be used to monitor the headspace of each well for the presence of combustible gases, including but not limited to hydrogen and hydrocarbons.
- Prior to sampling all monitoring wells, water levels also will be measured.
- Groundwater sampling will be performed by collecting a sample directly from the sample port that is closest to each wellhead in the case of GRN-MH-1, GRN-MH-2, and GRN-MH-3. In the case of the GA wells, sampling will be performed directly from the well.
- Each well will be purged prior to sampling. A minimum of three volumes of water in the well casing will be removed, unless the well runs dry. A well that runs dry will be revisited and sampled once the water level has recovered and sufficient water is available for sampling.
- Because exact flow rates are unknown, the well pumping and sampling point purge rates will be recorded.

2.0 SAMPLING QUALITY CONTROL

The quality control (QC) objective is to ensure that data are not biased by contamination or sampling error.

To meet this objective, the following QC samples will be collected in the field:

- Field duplicates will be collected with a minimum of 1 for every 10 samples. Field duplicates will be collected from the same source at the same time as the primary sample. The field duplicate will be labeled differently than the parent sample in order to appear as a separate sample to the analytical laboratory.

Matrix spike/matrix spike duplicate (MS/MSD) samples will not be collected. MS/MSDs will be analyzed by the analytical laboratory for each batch of samples run, but not necessarily from the samples collected at the site.

3.0 FIELD DOCUMENTATION

Information pertinent to the sampling effort will be documented on preprinted field sheets or bound logbooks. All entries will be made in indelible ink and all corrections will be made by drawing one line through the error and initialing and dating the correction.

At a minimum, entries on field documentation will include the following:

- Date,
- Project,
- Identification of sampling team members, and,
- Location and description of sampling points.
- Static water levels,
- Date and time of sample collection,
- Sample identification,
- Sampling methodology,
- Field observations, and
- Field instrument calibration results.

Documentation will contain sufficient information to reconstruct the sampling activity without relying on the sampler's memory. The field documentation will be kept on file at the sampling contractor's office.

4.0 DECONTAMINATION PROCEDURES

Because no field equipment will come into contact with groundwater samples, decontamination procedures are not required.

5.0 SAMPLE ANALYSIS AND CONTAINERS

Samples will be analyzed by a Utah certified laboratory for the following:

- Sodium by USEPA Method 200.7;
- Chloride by USEPA Method 300.0;
- Total Dissolved Solids by USEPA Method SM2540C; and
- Dissolved Gases by USEPA Method
- or equivalent.

6.0 SAMPLE HANDLING

At the time of sample collection, labels will be affixed to the sample containers. These labels will contain the following information:

- Sample identification number,
- Date and time of sampling,
- Preservative,

- Analyses requested, and
- Name of sampler.

Samples will be collected directly into laboratory-provided containers and placed on ice in an insulated cooler. All samples will be identified, labeled, and logged onto a chain-of-custody (COC) form, and handled under standard COC protocol. Samples will be considered to be under a person's custody if they remain:

- In a person's physical possession,
- In view of the person after he/she has taken possession,
- Secured by that person so that no one can tamper with the sample, or
- In a secure area accessible only to authorized personnel.

To establish the documentation necessary to trace sample possession from the time of collection, the COC record must be completed and accompany every sample shipment. At a minimum, COC records should contain the following information:

- Project name,
- Sample identification,
- Date and time of sample collection,
- Type of matrix,
- Number of containers,
- Preservative,
- Analyses requested,
- Method of shipment,
- Signature of sampler, and
- Date and time of each change in custody.

Each person who has custody of the samples will sign the record. The completed COC record will be sealed in a waterproof plastic bag and placed inside the sample cooler. The sampler will keep a copy of each COC record. Custody seals will be affixed to the front and back of the cooler and covered with clean tape during storage and shipping operations.

The laboratory will assess the integrity of the custody seals upon sample arrival. The laboratory will also verify and document the following information upon sample receipt:

- Condition of the shipping container,
- Condition of the sample container(s),
- Condition of the custody seals,
- Presence/absence of custody seals,
- Presence/absence of custody records,

- Presence/absence of sample labels,
- Agreement/non-agreement of documents,
- Cross-reference of laboratory numbers, and
- Temperature inside the shipping container.

The laboratory will document any problems or discrepancies with the samples or custody documents, contact the sampling organization, and document the resolution to the problems or discrepancies.

The laboratory completing chemical analyses will be required to maintain samples in a secure location with limited access from the time of sample receipt through sample disposal. Samples collected during this investigation will be either shipped to the laboratory via an overnight carrier or will be hand delivered to the analytical laboratory. If the samples are shipped via an overnight carrier, the following procedure will be used for packaging:

- Inert cushioning material will be placed in the bottom of the cooler.
- The cooler will be lined with a large plastic bag.
- Each sample container will be sealed in a resealable plastic bag and placed upright in the cooler.
- For all coolers containing samples that require 4°C preservation, blue ice or wet ice and additional packaging materials will be placed around the containers. Wet ice will be double bagged.
- A temperature blank will be included in each cooler containing samples that require 4°C preservation.
- Pertinent paperwork such as the COC form will be placed in a re-sealable plastic bag and taped to the inside lid of the cooler.
- Signed custody seal will be attached to the cooler in two places and covered with clear tape in such a way that the custody seal must be broken to open the cooler.
- The cooler will be sealed with packaging tape.

A shipping label will be affixed to the outside of the cooler.

Appendix B

Monitoring Forms

BRINE POND 4 MONITORING FORM
MAGNUM SOLUTION MINING, LLC
DELTA, UTAH

Well I.D. and Depth of Well (DOW)	DATE mm/dd/yy	DTW (feet)	Water Column Thickness	Total Gallons Removed	TEMP. (°C)	Specific Conductance (µS/cm^3)	Conductivity (ohms)	Salinity (ppt)	TDS (mg/L)	pH	NOTES
GA-4 (TBD)											
GA-5 (TBD)											
GA-6 (TBD)											
GA-7 (TBD)											
GA-18 (TBD)											
GA-19 (TBD)											

Brine Pond Sump Monitoring									
LCRS Sump									
Water Present Y / N	Conductivity (ohms)		Salinity (ppt)		Flow Rate (GPM)		Meter Reading (gal)		
PCMS Sump									
Water Present Y / N	Conductivity (ohms)		Salinity (ppt)		Flow Rate (GPM)		Meter Reading (gal)		
Sump Equipment Inspection and Performance Verified				Y / N	Allowable Leakage Rate for the Pond Liner System Verified				Y / N

Field Data Collection and Sample Collection Instructions

Field Data Parameter Collection Instructions

Step 1) Calibrate YSI meter prior to each use (follow instructions in manual)

Step 2) Measure depth to groundwater with water interface probe

Step 3) Calculate well volume to be removed from each well using Purge Volume Table and remove the calculated volume

Step 4) Collect field parameter readings upon completion of Step 3 and record any unusual circumstances in the "NOTES" column above

Step 5) Collect field parameter readings from sumps

Groundwater Sampling Instructions

Step 6) Upon completion of Step 4 collect groundwater samples from each well

Step 7) Fill appropriate laboratory provided containers

Step 8) Complete Laboratory Chain of Custody (see attached example)

Laboratory Analysis Requirements

Sodium by Method 200.7, Plastic Pint Container Preserved with HNO_3

Chloride by Method 300, Total Dissolved Solids (TDS) by Method SM-2540C, and pH, all collected in a 1/2 gallon plastic container with no preservative.

COMMENTS

BRINE POND 4 FIELD MONITORING FORM
MAGNUM SOLUTION MINING, LLC
DELTA, UTAH

Well I.D.	DATE mm/dd/yy	DTW (feet)	Flow Rate (gpm)	Draw Down (ft)	Headspace Gas (LEL)	TEMP. (°C)	Specific Conductance ($\mu S/cm^3$)	Conductivity (ohms)	Salinity (ppt)	TDS (mg/L)	pH	NOTES
GRN-MH-1												
GRN-MH-2												
GRN-MH-3												
DA-1 Shallow												
Deep												
Basement												
DA-2, Shallow												
Deep												
Basement												
Delta Egg Farm Well												
IPA												

Field Data Collection and Sample Collection Instructions

Field Data Parameter Collection Instructions

Step 1) Calibrate YSI meter prior to each use (follow instructions in the equipment manual)

Step 2) Calibrate combustible gas meter prior to each use (follow instructions in the equipment manual)

Step 3) Measure combustible gas levels inGS-MH-1, GS_MH-2, GS-MH-3, GS-MH-4, and GS-MH-5 with portable combustible gas meter

Step 4) Measure depth to groundwater manually using the water interface probe in GS-MH-1, GS_MH-2, GS-MH-3, GS-MH-4, and GS-MH-5

Step 5) Collect field parameter readings and record any unusual circumstances in the "NOTES" column above

Step 6) Confirm functionality of the water level transducers and download water table elevation data from each well to the laptop computer

Step 7) Manually record WTE data from DA wells, and the Egg Farm and IPA Wells

Groundwater Sampling Instructions

Step 7) Follow Steps 1-6 above. Collect groundwater samples from GS-MH-1, GS_MH-2, GS-MH-3, GS-MH-4, and GS-MH-5 in the laboratory-provided containers

Step 8) Complete Laboratory Chain of Custody (see attached example)

Laboratory Analysis Requirements

Sodium by Method 200.7, Plastic Pint Container Preserved with HNO_3

Chloride by Method 300, Total Dissolved Solids (TDS) by Method SM-2540C, and pH, all collected in a 1/2 gallon plastic container with no preservative.

Data Submittal

At the completion of each monthly data collection effort send electronic depth-to-water data to ATC Associates (jim.coletta@atcassociates.com).

COMMENTS