State of Utah Prison Relocation Commission

August 3, 2015

Preliminary Geotechnical Investigation:

I-80/7200 West Expanded

CONFIDENTIAL

Relocation of Utah State Prison, Draper

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Preliminary Geotechnical Investigation:
I-80/7200 West Expanded
State of Utah Prison Relocation Commission
Salt Lake City, Utah

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1.0 EXECUTIVE SUMMARY

Below is a summary of the site findings based on phase 1 of the geotechnical investigation for comparative analysis only and not for construction.

1. The geological history of the soil deposits observed during the field work are from the younger lacustrine and deltaic deposits (sands, silts and clays) from the Holocene and to Upper Pleistocene epoch deposited during the Lake Bonneville period with some associated deposits from the Great Salt Lake period with small berms and deltas. The project site is located west of the Granger fault which is part of the West Valley fault zone which consists of both the Granger fault and Taylorsville fault. The site is 8 miles east of the Wasatch fault zone which consists of the East Bench fault, Virginia Street fault, and Warm Springs fault to the east as seen in Appendix A – Figure 38. The nearest segment of fault is part of the Granger fault segment and is approximately 2 mile east of this site.

2. The site is covered with approximately six to 24-inches of topsoil varying throughout the site with the thickest topsoil at BH-02, BH-08, TP-09 and TP-10. Possible variable depths of topsoil should be expected across the site and should be investigated during all foundation excavations and site grading.

3. The native soils below the topsoil consisted primarily of large CLAY strata with interbedded layers and smaller strata of sand mixes. Visual pinholes were observed and encountered throughout the site in varied elevations within the upper 7½-feet with varied collapse potentials. The percent collapse for the soils at this site ranged from 0.2% o 1.3% at a depth of 2-feet below the original site grade. The severity of the percent collapse for the soils at this site ranged from moderate concern at TP-03 (in the southwest corner of the site) to minimal concern at TP-01, TP-04, and TP-10 (southeast portion of the study area).

4. Low Standard Penetration Testing (SPT) blow counts obtained indicate the subsurface soils were very soft to soft cohesive soils and very loose to loose for granular soils within the upper 25-feet of each borehole. Higher SPT blow counts were obtained at depths below 25-feet indicating the cohesive soils to be medium stiff to stiff and granular soils to be medium dense to very dense. However, soft layers of cohesive soils were encountered in BH-02 at 35-feet, BH-03 at 40-feet and BH-06 at 45-feet. Low blow counts for cohesive soils indicate the cohesive soils to be very compressible. Groundwater table was observed in all boreholes and test pits during the time of the field investigation ranging from 4 to 9-feet below existing site grade.

5. Structural fill should consist of imported structural material meeting an A-1 classification, aggregate fill or any economical structural fill that will provide stability during and after construction, as well as ease of placement may be used below footings, flat work or pavements.

6. The near surface soils will likely be unstable upon exposure to any water or precipitation, due to the encountered native fine-grained soils. Rutting, shoving and pumping may be encountered in these soils during durations of the construction process.

7. Due to the levels of soluble sulfates, a type II Portland cement is recommended for construction. When ferrous metals are used in the building or any associated structures, Epic recommends that a qualified corrosion engineer be retained to provide assessment of any metal and concrete due to the high level of chlorides in the existing site soils.

8. The potential for liquefaction based on Epic's analysis is high, with estimated preliminary liquefaction induced settlement from approximately 4 to 7¼-inches. With the potential for liquefiable soils, the likelihood of seismically induced lateral spreading is considered high, with total lateral displacement estimation ranging from 23 to 131-inches.

9. Due to the native soil conditions encountered during the field investigation and estimated preliminary liquefaction settlement, deep foundations driven to depths of competent soils such as driven closed end pipe piles or tapered timber piles or a ground improvement modification method such as stone columns or Rammed Aggregate Piers® be used to help support of the proposed facilities buildings.

10. This site (marked as a simple rectangle) is located on Appendix A – Figure 45 (Radon-Hazard Potential Map) in a moderate area.

11. A mat foundation system should be placed on the load transfer platform and designed for an allowable bearing capacity of 1,500 psf and modulus of subgrade reaction of 100 psi/in (using 1ft by 1ft plate). 6-inch layer of free draining aggregate should be placed below the slab to break capillary action.

12. With a deep foundation system using closed pipe piles or tapered timber piles, column loads and slab loads could be supported thru the pile cap.

13. Storm water systems built on site should be built to extend a safe distance or at least 100 feet away from any adjacent structures and downstream of any buildings or preferably to the north or northeast corner of this project site. Infrastructure systems may need to be constructed to intercept, collect, and discharge groundwater away from wetlands as to avoid impacting potential areas.

14. The ground surface should be graded to drain away from the structures in all directions. We recommend a minimum fall of 12-inches in the first 10-feet for landscaped areas and 2-inches in the first 10-feet for paved surfaces.

15. With the preliminary assumptions listed in the report, the estimated additional foundation costs for this site range from approximately $61,250,000 to $97,090,000

16. Epic anticipates that if this site was chosen for further study as the location of the proposed Correctional Facility, the preliminary recommended buildable area is located in Green Rectangle on Figure 46. The green rectangle area is estimated to have less organic soils based on the field work, laboratory data and analysis.

17. If this site is recommended for additional geotechnical studies, Epic recommends the advancement of cone penetration tests (CPT) to a refusal depth or 200-feet and the performance of boreholes to depths of at least 100-feet, spaced every 200-feet within the estimated building areas and boreholes every 500-feet along fencing alignments based on IBC 2012 Section 1803.3.1.

2.0 INTRODUCTION

2.1 Background

The Utah State Legislature established the Prison Relocation Commission (PRC) in 2014 to lead the effort to develop new correctional facilities to replace those comprising the Utah State Correctional Facility located in Draper, Utah. The PRC's responsibilities include carefully and deliberately considering, studying, and evaluating how and where to move the Utah State Correctional Facility from its current location. The PRC's efforts and resources are focused on providing recommendations to the Governor and Legislature on where and how the correctional facility will be relocated. To assist with the planning for the new correctional facilities, the PRC assembled a team with representatives of the Utah Department of Corrections (UDC), the Utah Division of Facilities Construction and Management, the Commission on Criminal and Juvenile Justice, the Office of Legislative Research and General Counsel, and a group of consultants led by MGT of America, Inc. and including Epic Engineering, P.C. (Epic).

The PRC has been advancing the development of new correctional facilities since 2014 by identifying and evaluating prospective sites capable of being master planned for development and operation of a new, state-of-the-art correctional institution. Though the siting process is similar to siting a large school campus, medical complex, Business Park or industrial park, the unique issues and challenges surrounding correctional facility siting and development often make the process more complex, time consuming, and costly.

2.2 Description of Proposed Project

The proposed action under consideration is the development of a new replacement correctional facility with the capability to house 4,000 state inmates. The new correctional facility would ensure that Utah's criminal justice system functions in a high-quality manner while addressing the need for a state-of-the-art, efficient and cost-effective institution to house male and female offenders at all security levels.

The mission of the proposed correctional facility is to ensure public safety by effectively managing offenders while maintaining close collaboration with partner agencies and the community. The UDC is devoted to providing maximum opportunities for offenders to make lasting changes through accountability, treatment, education, and positive reinforcement within a safe environment.

2.3 Proposed Project Sites Undergoing Evaluation

The PRC is advancing the development of a new correctional facility by performing detailed evaluations of prospective sites including the I-80/7200 West Expanded Site located in Salt Lake City and the subject of this report. The Salt Lake City Site is an approximately 544-acre property located east of The Great Salt Lake, west of the Salt Lake International Airport, and north of the Oquirrh Mountains in Salt Lake County.

2.4 Scope of Work and Limitation of Liability

The MGT Team has undertaken geotechnical exploration programs at several prospective sites including the I-80 7200 West Expanded Site. Common to such investigations is the need to determine on-site features and building structure foundation systems as well as identify any unfavorable surface/subsurface conditions which may prohibit or restrict building, require additional stabilization or foundation techniques, or require soil remediation prior to construction. If this site is selected additional testing and studies are recommended in order to provide final foundation design guidelines. The information presented herein is not for design or construction purposes and only for comparative analysis.

This report presents the results of a preliminary subsurface investigation performed on April 20 – April 24, 2015 and May 4, 2015, conducted for the proposed construction of a new correctional facility located in part of Sections 17, 20, 29, 32, and 33 Township 1 North, Range 2 West, Salt Lake Base and Meridian, Salt Lake County, Utah. The general location of the site, with respect to existing roadways and structures, is shown on Appendix A - Figure 1 (Vicinity Map).

The purpose of this geotechnical investigations is to identify and characterize subsurface conditions, in particular the extent or absence of bedrock, problematic soils, or undocumented fills that may exist on the I-80/7200 West Expanded Site, and to assess and evaluate the preliminary design and approximate cost implications due to existing geologic conditions. The recommendations contained in this report are subject to the limitations presented in the "Limitations of Your Geotechnical Report" section of Appendix E - References in this report.

This report is only applicable for a preliminary understanding of the possible best placement for a preliminary proposed correction facility on this site. This report is only applicable for this project site and shall not be used for other nearby sites. Additional data collection is recommended prior to the final design. Users of this report are strongly cautioned not to use the recommendations presented below for design or construction. If this site is selected for further studies, additional testing and studies are recommended in order to provide further foundation design guidelines. The information presented herein is NOT for design or construction purposes and are intended for comparative purposes only.

2.5 Assumptions

As the final design of the new facility has not been completed, it is difficult to accurately determine the exact infrastructure improvement that will be required. As such, it was necessary to make certain assumptions in order to generate an effective estimate of the potential costs for various soil treatment and foundation designs.

Most of the proposed sites that have been evaluated, included I-80 7200 West Expanded Site, have explored a much larger area than will be required for the final development. The purpose of the expanded investigation is to determine the optimal location for the final development. Below is a summary of the assumptions used to generate the recommendations and opinions of probable cost.

Based on discussions with Rosser International (the team's Architectural Lead), we understand that the type of buildings that are estimated to be built for this project are listed in the following Table 1.

TABLE 1: PROPOSED CONSTRUCTION ASSUMPTIONS

Building Type	Number of Floors	Construction	Max. Strip Load	Max. Spot Load	Max. Slab Load
Housing Units	2	10-inch precast wall with a 8-inch CMU grout filled interior wall with a height of approximately 24 feet and approximately 45-foot roof spans	15 kips	150 kips	150 psf
Administration	2 to 3	8-inch CMU walls or precast walls and approximately 45-foot roof spans	20 kips	200 kips	150 psf
Warehouse	1	8-inch CMU walls or precast walls with approximately 45-foot roof spans, high ceilings, industrial racks and forklift traffic	12 kips	100 kips	250 psf

If structural loads are significantly greater, or if the project is different than described above, Epic should be notified so that our recommendations can be reviewed, and if needed, modified to encompass the proposed development.

If this site is selected for further study, Epic recommends the advancement of cone penetration tests (CPT) to a refusal depth or 200-feet and boreholes extended to depths of at least 150-feet spaced every 200-feet within the estimated building areas and boreholes every 500 feet along the alignment of fences following recommendation in IBC 2012 Section 1803.3.1.

- The locations, dimensions and numbers of buildings with the development are unknown at this time, and foot prints were assumed.
- All cost assumptions are based on the preliminary prototype concept provided by Rosser International, Utah Prison Prototype Diagram dated April 14, 2015 with 360 acres (3,580 ft by 4,380 ft at property line)
- Total Gross Sq Ft of Concept Correctional Facility is 1,330,000 Gross Square Feet
- Estimated Gross Sq Ft of Housing is 680,800 GSF
- 24 Percent of GSF housing is Mezzanine housing (24% * 680,800 GSF = 163,400 ft^2 of Mezzanine)
- Estimated Gross Sq Ft of Administration Building is 18,600 GSF with 50 Percent of GSF Administration is located on a 2^{nd} story level. (50% * 18,600 GSF = 9,300 ft^2)
- Ground Level Building Footprints consist of Total Gross Sq Ft of Concept minus all Mezzanine & 2^{nd} Story ft^2 (based on discussion with Rosser International as 1,330,000 GSF – 172,700 ft^2 = 1,160,000 ft^2)
- 50% of ground level building footprints could be Hard Scape (concrete flat work and access road to building) around buildings (based on discussion with Rosser International on June 16, 2015 which is estimated at 1,160,000 ft^2 * 50% = 578,650 ft^2)
- Estimated 10 Basketball Courts each at 120 feet by 80 feet equaling 96,000 ft^2
- Estimated 500 Parking spaces of Asphalt Pavement (scaled from Prototype Diagram) as approximately 300,000 ft^2
- Two Main Access roads as found on Prototype Diagram estimated at 1,000 linear feet at 24 feet width for each road equaling 48,000 ft^2
- Estimated Total ft^2 of basketball courts, parking areas, access roads that will need Settlement mitigation by over excavation and replacement by structural fill equals 1,023,000 ft^2
- Estimated Total ft^2 of structures that will need Deep Foundation or Ground Improvement Method equals 1,160,000 ft^2
- Assuming conservative 3 -feet over excavation and replacement of structural fill (a more accurate assumption of required over excavation and replacement is suggested once site is selected for further study and further information is available) as 6,549,000 ft^3 or 242,600 yd^3 of soil movement
- Site Grading Costs (raising or lowering of site for design purposes other than removal of topsoil below buildings, flat work and pavements) are not included in these estimated costs
- Estimated Cost for Lime: 18-inches in depth and $160 per ton with an estimated preliminary modification rate of 8 percent
- Costs are for Additional Foundation Improvements for only the above items and do not include entire site or any expansion buildings.
- Required allowable settlement is minimal in the housing buildings. Maximum security correctional facility doors and gates cannot handle any post construction settlement.

- The proposed correctional facility area should be raised to at-least 5-feet above the elevation of 4,217 feet above sea level.
- An Engineer's estimating multiplier of 1.2 was used on all costs and costs were rounded up to the $10,000

3.0 INVESTIGATION

3.1 Site Conditions

The site is an undeveloped parcel of land, approximately 544-acres, that is located east of The Great Salt Lake, west of the Salt Lake International Airport, and north of Oquirrh Mountains Section 17, 20, 29, 32, and 33 Township 1 North, Range 2 West, Salt Lake Base and Meridian, Salt Lake County, Utah. The undeveloped parcel of land slopes from the southernmost section line of the property and gradually continuing downward to the north and west. The site is irregular in shape and vegetated with short grasses and sagebrush. Cattle are currently grazing on site. The site is divided by a canal, with a majority of the acreage on the north side of the canal.

3.2 Field Investigation

A total of ten boreholes, three cone penetration tests (CPT), and ten test pits were advanced below current site grades at the approximate locations shown in Appendix A - Figure 2. The boreholes were advanced using a CME-75 truck mounted drill rig with a 3¼-inch hollow stem auger and a donut hammer. All boreholes were advanced to a depth of 51.5-feet below the current site grade, with the exception of BH-02 advanced to a depth of 47-feet. The test pits were excavated using a Case 580 backhoe to depths ranging from 4 to 10-feet below the current site grade. The majority of the test pits had rapid rise in water level and/or side walls began to collapse due to this rise in water levels. The CPT investigation extended to a depth of 125 feet. The boreholes and test pits were logged by a qualified member of Epic's geotechnical staff to the full extent of each borehole and test pit.

For each borehole, subsurface soil samples were obtained at intervals of 2.5-feet below the current site grade to a depth of 15-feet below the current site grade. After a depth of 15-feet was reached, samples were obtained at 5-foot intervals until the bottom of each respective borehole. For each test pit, three to four samples were obtained at various intervals and depths and where changes in the soil stratigraphy occurred or unsuitable soils were observed. Groundwater was encountered during the field investigation at depths as shallow as 4-feet below the ground surface and as deep as 9-feet below the ground surface. In the CPTs, calculated groundwater depths ranged from 1.2-feet to 3.8-feet below the existing ground surface. Soil samples were obtained by using Grab sampling, split spoon sampling, thin wall Shelby tube sampling, and 6-inch brass thin wall sampling techniques. Split spoon sampling was used in coordination with the standard penetration test and corrected to N_{60} blow counts labeled on the borelogs. The samples were sealed and labeled in the field and brought back to Epic's and

Intermountain GeoEnvironmental Services' (IGES) laboratory for analysis. Both disturbed and undisturbed samples were obtained and returned to both laboratories for testing.

The field investigation was completed in accordance with the approved scope. Minor variations were required due to variable field conditions.

3.3 Laboratory Testing

Samples collected during the field investigation were sealed and returned to Epic's laboratory and IGES' laboratory. Selected samples obtained during the field investigation were assigned geotechnical laboratory tests based on the proposed construction and soil characteristics observed in the field. Laboratory testing for this project included;

- ASTM D2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
- ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- ASTM D6913 – Standard Test Methods for Particle-Size (Gradation) of Soils Using Sieve Analysis.
- ASTM D4546-14 Standard Test Method for One-Dimensional Swell or Collapse of Soils.
- ASTM D2435 Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading.
- ASTM D4767-11 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
- ASTM D4186/D4186-12e1 Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading
- ASTM D2974 – Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
- SM 4500 - Soluble Chlorides, Soluble Sulfates, pH
- SM 2510B - Resistivity.

This information along with professional engineering experience and judgement was used to interpret and provide the final borehole and test pit logs. The results of the testing are presented in Appendix C and summarized below.

3.4 Literature Review

In preparation of this report, Epic has reviewed the following literature:

Utah Geological Survey's *Utah Geologic Map Index*, *Geologic-Hazard Resources for Consultants & Design Professionals, Interim Geologic Map of Bailey's Lake 7.5' Quadrangle, Salt Lake County, Utah 2014, Earthquake Fault Map of a Portion of Salt Lake County, Utah, Surface Fault Rupture Special Study Areas 2008,, Geographic Information System Database Showing Geologic-Hazard Special-Study Areas Landslide*

Special Study Areas, 2008, Major Levels of Great Salt Lake and Lake Bonneville, 1984, Ground-shaking map for a magnitude 7.0 earthquake on the Wasatch fault, Salt Lake City, Utah, metropolitan area, 2002, Radon-Hazard Potential, Landslide Maps of Utah, 2008.

United States Geological Survey's *U.S. Seismic Design Maps, Fault number 2386b, West Valley fault zone, Granger section, in Quaternary fault and fold database of the United States and 2014 Seismic Hazard Map.*

Paula L. Gori (Edited by), Walter W. Hays, Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah.

Hylland, M.D., DuRoss, C.B., McDonald, G.N., Olig, S.S., Oviatt, C.G., Mahan, S.A., Crone, A.J., and Personius, S.F., Late Quaternary paleoseismology of the West Valley fault zone—insights from the Baileys Lake trench site.

See Appendix E – References for more information on the data sources reviewed for this report.

3.5 Subsurface Conditions

Based on the investigation described above, this site is covered with approximately six to 24-inches of topsoil varying throughout the site with the thickest topsoil at BH-02, BH-08, TP-09, and TP-10. The native soils below the topsoil consisted primarily of large mixes of Clay strata with interbedded layers and smaller strata of Sand mixes. Visual pinholes were observed in subsurface soils at test pit locations throughout the site at varied elevations within the upper 7½-feet with minimal to moderate collapse potential. In general, within the upper 25-feet of each borehole, low Standard Penetration Testing (SPT) blow counts obtained indicate the subsurface soils were very soft to soft for cohesive soils and very loose to loose for granular samples.

Below 25 feet Higher SPT blow counts obtained indicate the cohesive soils to be medium stiff to stiff and granular soils to be medium dense to very dense. However, soft layers of cohesive soils were encountered in BH-02 at 35-feet, BH-03 at 40-feet and BH-06 at 45-feet. Low blow counts for cohesive soils indicate the cohesive soils to be compressive to very compressible soils. Groundwater was observed in all of the boreholes and test pits at various depths during the time of the field investigation as shown in Table 2. Due to the seasonal fluctuation of groundwater, the depths of groundwater are expected to vary seasonally.

TABLE 2: DEPTHS OF GOUNDWATER AT EACH BOREHOLE AND TEST PIT

Borehole or Test Pit No.	Depth to Groundwater (ft)	Borehole or Test Pit No.	Depth to Groundwater (ft)	Borehole or Test Pit No.	Depth to Groundwater (ft)	Borehole or Test Pit No.	Depth to Groundwater (ft)
BH-01	4.5	BH-06	4.5	TP-01	5	TP-06	7.5
BH-02	4.5	BH-07	5	TP-02	7	TP-07	7.5
BH-03	5	BH-08	4.5	TP-03	4	TP-08	4
BH-04	9	BH-09	5	TP-04	5.5	TP-09	6
BH-05	4.5	BH-10	5	TP-05	6	TP-10	5

Graphical representations of the soil conditions encountered are shown on the borehole and test pit logs, Appendix A – Figures 3 thru 32. The stratification lines shown on the logs represent the approximate boundaries between soil units. The actual transition between boundaries may be gradual.

3.6 <u>Cone Penetration Test Results</u>

Subsurface field testing outlined in Section 3.2 included the advancement of 3 cone penetration tests (CPTs). Cone penetration tests is an in-situ test used to determine the subsurface soil behavior type by assessing the subsurface stratigraphy while advancing a cone with an apex angle of 60 degrees face down into the ground. The CPT test uses electronic data acquisition systems to obtain data relative to the cone's tip resistance, friction, pore pressure, and friction ratio. Results from these tests indicate layers of Sand and Gravelly Sand soil behavior and are shown in Table 3. These results are indicative of soil behavior types and may not be the actual soil at these locations.

TABLE 3: DEPTHS AND THICKNESS OF SAND OR GRAVELLY SAND BEHAVIOR FROM CPT TEST RESULTS

CPT Sounding	Soil Behavior Type	Top of Depth (ft)	Bottom of Depth (ft)	Thickness (ft)
CPT-01	Sand/Gravelly Sand	57	61	4
CPT-02	Sand	33	38	5
CPT-03	Sand	38	40	2
CPT-03	Sand	56	65	9
CPT-03	Gravelly Sand and Sand	81	89	8
CPT-03	Gravelly Sand	123	125	2

During the advancement of CPTs, the test is halted and a pore pressure dissipation test is performed. This pore pressure dissipation tests provides estimate of ground water conditions, estimates of equilibrium pore pressures, and other soil characteristics. Results for calculated phreatic surface and estimated pore pressure equilibrium are shown in Table 4.

TABLE 4: CALCULATED PHREATIC SURFACE AND ESTIMATED PORE PRESSURE EQUILIBRIUM RESULTS FROM CPT TESTS

CPT Sounding	Test Depth (ft)	Estimated Equilibrium Pore Pressure (ft)	Calculated Phreatic Surface (ft)
CPT-01	33.63	31.6	2.0
CPT-01	121.72	122.0	-0.3
CPT-02	56.43	55.3	1.2
CPT-02	102.53	102.3	0.2
CPT-03	37.40	33.6	3.8
CPT-03	87.76	83.7	4.1

The estimated groundwater depths ranged from 0.2 to 3.8-feet below existing site grade as shown in Appendix B.

3.7 Subsurface Laboratory Testing Results

Subsurface samples obtained from the field investigation outlined in Section 3.2 were tested using procedures outlined in Section 3.3. Subsurface soil parameters used for evaluating the subsurface conditions include organic content, consolidation settlement, and stability.

3.7.1 Organics

Organic soils are soft and highly compressible in nature with poor engineering properties. They may be identified in the field by their color, odor, and texture and tested in the laboratory for organic content. A sample was obtained at TP-07 at 10-feet below the ground surface during the field investigation. The sample appeared to be organic in nature due the color, odor, and texture of the soil. This sample was tested for moisture, ash, and organic matter following the procedures outlined in ASTM D2974 – Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils. The sample tested had a moisture content of 60.9%, ash content of 95%, and an organic content of 5%. Per FHWA-RD-89-198, the soil is considered aggressive if the organic content is greater than 1%.

3.7.2 Preliminary Estimation of Consolidation Settlement

Consolidation settlement is a phenomenon which is associated with soft cohesive soils. This phenomenon occurs as excess pore water pressures are pushed out of the void spaces when load is placed on the soil causing the soil to decrease in volume while transferring the load to the soil skeleton. The rate at which primary consolidation settlement occurs is directly related to the rate of excess pore pressure dissipation. The rate at which excess pore pressures dissipates may take months, years, or decades for the soil to reach equilibrium.

Preliminary estimations of primary consolidation settlement of cohesive layers were analyzed using layers of cohesive soils indicated by CPT test results at locations of CPT-01, CPT-02, and CPT-03 and the proximity of each borehole to the closest CPT sounding. Geotechnical parameters used in the analysis were based on the field investigation data and results from laboratory tests. Preconsolidation stresses were obtained using CasaGrande's method for determining the preconsolidation stress. Compression and recompression indices were obtained from one-dimensional constant rate of strain results and one-dimensional incremental loading oedometer tests. Results for these parameters can be seen in Table 5.

TABLE 5: SETTLEMENT PARAMETERS OBTAINED FROM LABORATORY TEST RESULTS

Borehole/Test Pit No.	Depth (ft)	Preconsolidation Stress (psf)	$C_{c\varepsilon}$	$C_{r\varepsilon}$
BH-02	15	2600	0.25	0.027
BH-03	10	2500	0.19	0.043
BH-03	25	4000	0.20	0.051
BH-04	10	2900	0.11	0.044
BH-05	7.5	4100	0.33	0.044
BH-05	15	2800	0.15	0.057
BH-06	20	3800	0.19	0.036
BH-07	12.5	2900	0.28	0.042
BH-07	50	8000	0.15	0.033
BH-08	12.5	2200	0.41	0.037
BH-09	45	6000	0.14	0.029
BH-10	20	3400	0.20	0.048

Preliminary estimations of primary consolidation settlements within the upper 50-feet of the subsurface soils and assuming a change in vertical stress equal to a bearing capacity of 1,500 psf with no soil modification methods or wick drains and at boreholes BH-03, BH-04, BH-05, BH-06, BH-07, BH-08, and BH-09 ranged from 7.5-inches to 10.4-inches at these locations.

3.7.3 Strength and Stability Parameters

Drained and undrained strength and stability parameters include the cohesion of the subsurface soil and the angle of internal friction. These parameters were determined by performing ASTM D 4767 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils. Results for strength testing are shown in Table 6.

TABLE 6: STRENGTH AND STABILITY PARAMETERS EVALUATED AT BH-01 AND BH-09

Borehole Number	Depth (ft)	Total Stress Cohesion (psf)	Friction Angle	Effective Stress Cohesion (psf)	Effective Friction Angle
BH-01	12.5	160	24.8	128	31.3
BH-09	25	465	25.3	0	34.6

4.0 SITE CONSIDERATIONS

4.1 Geological Hazards & Considerations

Geological hazards can be defined as an event or condition in or upon the crust of the earth that pose a threat to life and property. These hazards may include, but not limited to, collapsible soils, expansive soils, earthquakes, flooding, liquefaction, and corrosive soils. During the evaluation process of the project site, the following hazards that should be considered were encountered through the field investigation, laboratory investigation, and research.

4.2 Geology of Site and Faults

The geological history of the soil deposits observed during the field work are from the younger lacustrine and deltaic deposits from the Holocene and to upper Pleistocene periods associated during the Lake Bonneville time period and some associated deposits to the Great Salt Lake time period with small berms and deltas. The project site is located approximately 2 miles west of the Granger Fault which is part of the West Valley Fault Zone which consists of both the Granger Fault and Taylorsville Fault. The site is 8 miles east of the Wasatch Fault Zone which consists of the East Bench Fault, Virginia Street Fault, and Warm Springs Fault to the east as shown in Appendix A, Figure 38.

The nearest segment of fault zone is part of the Granger Fault Segment and is approximately 2 miles east of this site. From the USGS *Fault number 2386b, West Valley fault zone, Granger section, in Quaternary fault and fold database of the United States:* "Movement of the West Valley Fault zone may be independent or directly tied to the Salt Lake City section of the Wasatch Fault Zone. The age of the most recent events on the Granger faults are similar to those for the last two events on the Salt Lake section."

4.3 Liquefaction

Liquefaction is a phenomenon where soils lose their intergranular strength due to an increase of pore pressure during a dynamic event such as an earthquake. The potential for liquefaction is based on several factors, including 1) the grain size distribution of the soil, 2) the plasticity of the fine fraction of the soil (material passing the No. 200 sieve), 3) relative density of the soil, 4) earthquake strength, magnitude and duration, and 5) overburden pressures (pressure exhibited on the soil from above). In addition, the soils must be near saturation for liquefaction to occur. This area is mapped as "High" according to Christenson's liquefaction evaluation of the Wasatch Front and Nearby Areas (see Appendix D - References).

To confirm the liquefaction potential on the referenced map, Epic performed a site specific liquefaction potential analysis based on the following parameters obtained from CPT-01, SCPT-02, and CPT-03. Soil parameters used for analysis include; 1) tip resistance, 2) friction ratio 3) depth of groundwater table before and during earthquake (estimated at 4-feet), 4) unit weight of the soil, 5) design spectral acceleration (pga) taken as Ss/2.5 (1.239/2.5 = 0.50g) (ASCE 7 Section 11.8.3.2), and 6) moment magnitude of earthquake (7.0M for the Wasatch Fault Zone). Ground water was observed to be between 4 and 9-feet below the ground surface during the field investigation. **The potential for liquefaction based on Epic's analysis is very high, with estimated preliminary liquefaction induced settlement from approximately 4 to 7¼-inches. LiqIt, by GeoLogismiki, a soil liquefaction assessment software was used for estimated liquefaction and lateral spreading potential estimates.**

Lateral spreading occurs during a seismic even when liquefied soils move in a lateral direction in either a direct cut or a low sloping terrain. This site has a gentle sloping terrain and the estimated average slope of 0.5% was used for preliminary lateral spread analysis on gently sloping ground without free face. **With the potential for liquefiable soils, the likelihood of seismically induced lateral spreading is considered high. The total lateral displacement estimation ranging from 23 to 36-inches. If the canal was left in place with the site having a gentle sloping terrain, a free face from the canal, an estimated depth of 13 feet and estimated nearest building within 100 feet of the canal, estimated potential for lateral spreading could range from 77 to 131-inches.** More detailed liquefaction and lateral spreading calculations as analyzed on the CPT-01, SCPT-02, and CPT-03 in Appendix D – Estimated Liquefaction, Lateral Spreading Potentials and Preliminary Pile Design.

4.4 Collapsible Soils

Collapsible soils were visually identified during the advancement of test pits during the field investigation and tested for collapse potential or percent collapse on this site. These soils were noted with visual identification of pin-holes above the groundwater table consisting of silts, clays, or mixes of silt and clay soils. Soils were tested following procedures outlined in ASTM D4546-14 Standard Test Method for One-Dimensional Swell or Collapse of Soils. Collapsible soils often include soil deposits with high void ratios, low unit weights, and consist of pin holes or a honey comb structure in the soil matrix. These soils are unsaturated or partially saturated and undergo a large volume change due to loading and changes in saturation. Possible types of wetting that could trigger collapse of soils in this proposed project are:

- Rise in groundwater table
- Local, shallow wetting from pipelines or drainage of surface water during construction
- Intense, deep local wetting of the soil by irrigation
- Gradual increase moisture content from condensation or accumulation of moisture (for example if the ground is covered by concrete or asphalt)

The percent collapse from laboratory testing of the soils at this site ranged from 0.2% at a depth of 2 ¼-feet below the original site grade to 1.3% at a depth of 2-feet below the original site grade. The severity of the percent collapse for the soils at this site ranged from minimal concern at TP-01, TP-04, and TP-10 to moderate concern at TP-08. The following table illustrates the tested values of collapse potential on this site.

TABLE 7: COLLAPSE TESTING AND POTENTIAL VALUES PER ASTM D 4546-14

Location	Depth	Percent Collapse (%)	Collapse Potential (%)	Severity	Options to Build
TP-01	2ft	0.3	0.3	Minimal	None Anticipated
TP-04	2 1/4ft	0.2	0.2	Minimal	None Anticipated
TP-08	2ft	1.3	1.3	Moderate Concern	Over-Dig and Replace with 2 feet of Structural Fill
TP-10	2ft	0.4	0.4	Minimal	None

4.5 Flooding

Flooding is a phenomenon where more precipitation occurs than what the soils can absorb causing high amounts of water runoff and water levels to increase dramatically. This phenomenon will stimulate above normal ground water results in areas prone to flooding. The potential for flooding is based on several factors, including 1) the grain size distribution of the soil, 2) the permeability of the soil, 3) location to open water areas, 4) historical knowledge of flooding in the areas, and 5) expert interpolation. This site currently shows known FEMA flood data such as the 100 year flood plain as seen on Appendix A - Figure 42, "I-80/7200 West Expanded Flood Plain Map". The northern section of the site borders the 100 year flood plain according to published data.

4.6 Radon Potential

Radon is a naturally occurring gas from the decomposition of geologic materials such as: uranium ores, uranium enriched rocks such as volcanic and metamorphic rocks (shale, granite, gneiss, schist) and soils derived from these uranium enriched rocks. This gas when inhaled has been linked as cause of lung cancer according to research done since the 1980's. The accumulation of radon gas indoor happens through the lowest level in contact with the ground and may find its way into the building thru areas such as: construction joints, cracks and gaps around service pipes. **This site (marked as a simple rectangle) is located on Appendix A – Figure 45 (Radon-Hazard Potential Map) in a moderate area**.

4.7 Corrosion

Corrosion testing was performed on the native soils that were obtained from BH-01 at 5-feet, BH-04 at 25-feet, BH-07 at 7.5-feet, BH-08 at 20-feet, and BH-10 at 7.5-feet. The values of the samples tested for pH, resistivity, soluble chloride, and soluble sulfates are in the following Table 8.

TABLE 8: CORROSION TESTING VALUES

	BH-01 @ 5ft	BH-04 @ 25ft	BH-07 @ 7.5ft	BH-08 @ 20ft	BH-10 @ 7.5ft	Concerns
pH	9.23	9.26	9.42	9.80	8.90	Minimal Concern
Resistivity (ohm-cm)	695	211	135	362	465	Extreme Concern for ferrous metals
Soluble Chlorides (mg/kg dry)	875	890	1,640	649	370	Severe Concern for concrete and metals
Soluble Sulfates (mg/kg dry)	384	471	574	318	217	Severe Concern for concrete

Due to the levels of soluble sulfates, a type II Portland cement is recommended for construction. When ferrous metals are used in the building or any associated structures, Epic recommends that a qualified corrosion engineer be retained to provide assessment of any metal and concrete due to the high level of chlorides and low level of resistivity in the existing site soils.

5.0 SOIL REMEDIATION OPTIONS

The soils underlying the foundation consist primarily of Clays and Silts with interbedded layers and seams of Sand. The cohesive soils exhibited soft and highly compressible characteristics, while granular soils exhibited loose characteristics. **Due to the native soil conditions encountered during the field investigation and estimated preliminary liquefaction settlement, Epic recommends either deep foundations or a ground improvement modification method be used to support of the proposed buildings.**

5.1 Driven Steel Piles

Driven steel piles are steel piles which extend beyond problematic soils to a depth of competent subsurface conditions. Driven steel piles consist of pipe piles or H-section piles. Steel pipe piles can be driven into the ground with open or closed ends. When open ended pipe steel piles are driven, soil is allowed to enter into the pile through the bottom. Closed end steel pipe piles consist of a steel plate or tapered bottom and may be filled with concrete. Steel pipe piles typically have higher bearing capacity than equivalent sized H-piles. Steel pipe piles can be driven to depths where stiffer soils are encountered and have the ability to support large loads. Driven steel piles can be an option for building support at this site. However, due to the costs associated with driven steel pile, other alternatives for deep foundation or ground improvement method may be necessary.

Preliminary pile design was evaluated on BH-01 (softest profile with laboratory testing), with All-Pile software created by CivilTech was used for calculating/modeling the preliminary pile foundations and using an effective stress friction angle of 31 degrees obtained from consolidated undrained triaxial testing to estimate lateral earth pressure coefficients. The lateral earth coefficients for active, at-rest, and passive conditions are estimated to be 0.32, 0.48, and 3.12. Equivalent fluid densities were estimated to be 38.4, 57.6, and 374.4 pcf for active, at-rest, and passive conditions. A coefficient of friction on 0.30 is recommended for soil steel interaction.

Based on preliminary field investigations, possible bearing layers range vary from 35 to 50 feet below site grade across the site. Preliminary analysis of a 12-inch closed end pipe pile based on BH-01 soils, the allowable capacity of a 50-foot long single pile is estimated to be approximately 22 kips. Additional field work is recommended for identification of bearing layers and efficient pile design across the estimated facility campus, if this site is selected for further studies. A pile cap will be required to transfer the loads from the building to the driven pipe pile foundation.

5.2 Driven Timber Piles

Timber piles are wood piles (logs) with a tapered bottom which extend beyond problematic soils to a depth of competent subsurface conditions. The diameter of the tapered timber piles should vary gradually from the top to the bottom, and should have a diameter greater than 6-inches at tip. Tapering of the pile provides higher resistance. To qualify for use of a pile, the timber should be straight, sound, and without any defects. Splicing of timber piles should be avoided.

Preliminary analysis of an 8-inch tip and 12-inch butt tapered timber pile based on BH-01 soils, the allowable capacity of a 50-foot long single pile is estimated to be approximately 17 kips. Additional field work is recommended for identification of bearing layers and efficient pile design across the estimated facility campus, if this site is selected for further studies. A pile cap will be required to transfer the loads from the building to the driven tapered timber pile foundation. It should be noted that timber piles maybe a viable option; however, they are infrequently used in the Salt Lake Area.

5.3 Stone Columns

In this method, water is jetted with a vibratory probe making a circular hole that extends to a firmer soil beyond the soft clay layer. The hole is then filled with imported gravel or stone that is gradually compacted as the vibrator is withdrawn with the purpose of; 1) Increasing the ultimate bearing capacity, 2) Reducing the magnitude of settlement, 3) Increasing the rate of settlement, 4) Reducing liquefaction potential, and 5) Increasing stability by improving the shear resistance. Densification of the gravel or stone then aids in further transmitting vibrational energy to the surrounding soil and causing densification of the surrounding soils. The stone column and the in situ soil form an integrated system with low compressibility and high shear strength. The densities of the soils are improved and conventional shallow footing systems can then be placed on exposed stone columns. This is often a very economical technique to mitigate liquefiable soils for densification process. Based on preliminary estimations of liquefaction potential based on CPTs, stone columns would need to extend beyond liquefiable soils.

Based on preliminary estimations of liquefaction potentials based on CPTs, stone columns extend beyond liquefiable soils or create a cap of densified soils that liquefaction settlement would not extend thru estimated at 40-feet. An estimated minimum 10-foot thick load transfer platform should be constructed above stone columns. This platform will help distribute the loads from the buildings to the stone columns. This platform should consist of granular structural fill with 3 to 4 layers of geogrid.

5.4 Rammed Aggregate Piers

Rammed aggregate piers (RAPs) work similar to the stone columns described above, but, are constructed by drilling a cylindrical cavity into the soil, placing aggregate at the bottom of the hole, and compacted repeatedly by ramming using high frequency low amplitude energy. RAPs provide; 1) An increase in ultimate bearing capacity, 2) A reduction in magnitude of settlement, 3) An increase in the rate of settlement, 4) An uplift resistance, 5) An increase in lateral resistance, 6) a reduction in liquefaction potential, and 7) Increase the shear resistance.

Based on preliminary estimations of liquefaction potentials based on CPTs, Rammed Aggregate Piers® extend beyond liquefiable soils or create a cap of densified soils that liquefaction settlement would not extend thru estimated at 40-feet. An estimated minimum 10-foot thick load transfer platform should be constructed above stone columns. This platform will help distribute the loads from the buildings to the stone columns. This platform should consist of granular structural fill with 3 to 4 layers of geogrid.

5.5 Site Consolidation

Soft soils were encountered throughout the site. A common method prevent building and other critical structures from settling is to initiate the primary consolidation process by placing (preloading) a heavy weight on the soils for a period of time prior to construction and installing soil drains to promote settling prior to construction. Typically structural fill is used as heavy weight to load these critical areas. After the consolidation process is complete the structural fill remains on site as to raise the site elevation and provide a stable building platform.

5.5.1 Preloading

Preloading is the placement of additional surcharge fill or material on top of a weaker soil beyond the final effective vertical stress with the purpose of increasing the strength and stiffness of the underlying soil and inducing the consolidation process. Once the consolidation in the soil has occurred, the preloading fill is removed and construction begins. Based on the current architectural design an estimated 15-feet of preloading fill will be required to sufficiently preload the soils over the proposed building footprint. This method is applicable to subsurface conditions where soft cohesive soils are prevalent, and is often used in conjunction with prefabricated vertical drains and field instrumentation. The drains allow the water to exit the soil faster reducing the time required to reach settlement, while the instrumentation provides for monitoring of the process such that construction can begin as soon as the site has stabilized.

5.5.2 Prefabricated Vertical Drains

Prefabricated vertical drains, commonly known as wick drains, are flexible light-weight, vertical drains inserted into the ground to accelerate drainage of excess water from the native soils. A triangular wick drain pattern spaced at 5-feet is recommended for the soil encountered during this investigation. Wick drains should be inserted underneath building footprint areas plus 10-feet on all sides, extend to an estimated depth of 50-feet below the ground surface into a granular soil strata to provide double drainage.

The wick drains should extend thru a 2-foot high drainage layer placed on top of the native soils once all topsoil or unsuitable soil has been removed. This drainage layer should be placed over a separation fabric and consist of an economic free-draining aggregate with minimal fines. The aggregate layer should consist of free-draining gravel with no rocks larger than 4-inches in nominal size.

5.5.3 Geotechnical Field Instrumentation

Oftentimes during the construction of large projects on soft cohesive soils, geotechnical field instrumentation is required to monitor soil behavior during and after the consolidation process. Geotechnical field instrumentation may include settlement plates, settlement manometers, slope indicators, vibrating wire (VW) piezometers, standpipe piezometers, and magnetic extensometers. Soil behaviors often monitored through these types of instrumentation include magnitude of total settlement (settlement from distortion, primary consolidation, and secondary consolidation), excess pore pressures, stability, potential shear failure of soft soils and/or deep seated shear failure and the time required for completion of primary consolidation.

Data obtained through various field instrumentations should be analyzed to determine the changes that occur in geotechnical parameters during the consolidation process. These parameters include the change in the in situ vertical and horizontal stress, vertical and horizontal deformation, and excess pore pressures. It is estimated for each of the 6 different building areas that each have the following: 4 VW settlement cells, 4 settlement plates, 6 settlement markers, 4 VW deep piezometer, 4 VW shallow piezometer, 1 VW pressure cell, 1 vertical inclinometer, and 9 data loggers.

5.5.4 Settlement

Based on a preliminary analysis of only preload and wick drains at location of SCPT-2 and BH-09, total settlement across a building pad on this site is approximately 8½-inches below the original site grade and can be reached within 1 to 2 years after preloading has begun. After the preload has been removed, the soils on this site will begin to rebound/heave until the soils have experienced the building loads equal to the stress induced by the preload. Once equalized, final amount of primary consolidation settlement will be induced. A mat foundation is suggested for the ability to resist deformation from the settlement across the entire building pad area until total settlement has been reached. If driven piles, stone columns or Rammed Aggregate Piers® are installed, the time rate of settlement may change.

6.0 DESIGN CONSIDERATIONS

6.1 General Site Grading

The site is located in close proximity to the Great Salt Lake, the water surface of the Lake varies seasonally and over time with wet and dry climatic cycles. A series of engineering controls have been established to maintain the water surface below approximately 4,217 feet above sea level. Epic recommends the facility be constructed at an elevation of 4,222 or greater which will require approximately 3 to 5 feet of fill.

Variable depths of topsoil should be expected across the site and should be looked for during all foundation excavations and site grading. Six inches to twenty-four-inches of topsoil was observed in the boreholes and test pits at the time of the subsurface investigation. Prior to construction and the site being raised in elevation, native vegetation, unsuitable soils, and undocumented backfill should be completely removed from below all areas which will support structural loads. This includes areas below foundations, floor slabs and exterior concrete flatwork. Unsuitable soils consist of topsoil, frozen soils, organic soils, sulfate/salty soils, undocumented fill, soft, loose or disturbed native soils, collapsible soils, and any other deleterious materials.

6.2 Excavations

Epic recommends that temporary construction slopes for excavations into the native soils less than 5-feet in depth, not be made steeper than 1:1 (Horizontal: Vertical). Excavations deeper than 5-feet should be designed by a Utah Professional Engineer due to the high water tables observed and shoring and bracing per OSHA requirements. If unstable conditions or groundwater seepage are encountered, flatter slopes or shoring and bracing are recommended. All excavations should meet applicable OSHA Health and Safety Standards for Type C soils. Site grading should be graded to drain away from any open excavations and any ponded water in an excavation should be removed promptly.

6.3 Structural Fill

All structural fill installed below structures should be placed at optimal moisture conditions and in suitable lifts for the compaction equipment. Fill deeper than 6-feet in depth should be compacted to at least 98% compaction of the dry density using a Modified Proctor (ASTM D1557). Fill in other areas should be compacted to at least 95% compaction of the dry density using a Modified Proctor (ASTM 1557). **Structural fill should consist of imported structural material meeting an AASHTO A-1 classification, aggregate fill or any economical structural fill that will provide stability during and after construction, as well as ease of placement may be used below footings, flat work or pavements.**

Quarry run-off, Recycled Concrete aggregate (RCA) or similar materials can be more economical than imported structural fill for the proposed facility.

Epic recommends that prior to placement of any structural fill on this site, a separation fabric be placed between the structural fill and the fine grained native soils. This will prohibit structural fill movement into the fine grained native soils and the loss of support from the movement of the structural fill.

6.4 Soil Stabilizations

The near surface soils will likely be unstable upon exposure to any water or precipitation, due to the encountered native fine-grained soils. Rutting, shoving and pumping may be encountered in these soils during durations of the construction process. If the soils are wetted or subjected to repetitive construction traffic, unstable subgrade conditions could be exacerbated. Because of these conditions, bid documents should address the probable need for soil stabilization and the contractor should be prepared to handle potentially wet, soft subgrade conditions throughout the construction process.

To provide a working platform on which to begin construction of the proposed project, the use of a geogrid or geotextile separation/stabilization fabric may be required. Large cobble sized rock could also be used and worked into the soft subgrade soils to provide a working platform. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

6.5 Preliminary Foundation Design

Once the deep foundation system or soil modification system is installed and primary consolidation settlement has occurred, we anticipate that this site will be capable of supporting the proposed correctional facility. The recommendations presented in this report should be followed with additional field sampling and testing of the native soils within the placement of the buildings or campus. The recommendations presented below should be utilized during design and construction of this project:

1. **Conventional shallow foundation system including spread footings for walls and columns are not recommended for this site due to the excessive settlement even after soil modification efforts.**

2. **A mat foundation is recommended for support of the proposed correctional facility once a deep foundation system (piles) or ground improvement method (stone columns or Rammed Aggregate Piers®) has been installed and primary consolidation has taken place. A mat foundation system should be placed on the load transfer platform and designed for an allowable bearing capacity of 1,500 psf.** A one-third increase is allowed for short term transient loads such as wind and seismic events.

3. **With a deep foundation system using closed pipe piles or tapered timber piles, column loads and slab loads could be supported thru the pile cap.**

4. The bottom of exterior footings should be placed below frost depth which is often determined by local building codes. A minimum of 30-inches should be used for this area. Interior footings, not subject to frost (i.e. in a heated structure) should extend at least 18-inches below the lowest adjacent final grade and be placed on the same amount of compacted structural fill.

If footings/foundation systems are designed and constructed in accordance with the recommendations presented above, the risk of post construction settlement and differential settlement should be minimal. Minimal settlement should be expected during a strong seismic event or prolonged saturation conditions.

6.6 Preliminary Floor Slabs

Either a structural slab supported on driven steel pipe piles, or driven tapered timber piles, or slab-on-grade supported on stone columns or Rammed Aggregate Piers® through a Load Transfer Platform (LTP), will be required. If the slab-on-grade resting on LTP is elected, a modulus of subgrade of reaction of k = 100 psi/inch (using 1ft by 1ft plate) can be used in conceptual/preliminary design for the native soils and at least a 6-inch layer of free draining aggregate should be placed below the slab to break capillary action. Structural floor slabs should be designed by a structural engineer who determines what measures are appropriate to control shrinkage and stress cracking and provide required support.

If a floor slab is to receive a floor covering or coatings/sealers or other moisture sensitive finishes or house equipment, slabs should be underlain by 6-mil Visqueen (or equivalent) moisture barrier with a minimum of 1-inch of sand between the slab and the moisture retarder and to include 2-inches of sand below the barrier should be placed on compacted subgrade. Moisture retarders can retard, but not eliminate the moisture vapor moving from the soil up thru the slab. Epic recommends that the floor covering designer/contactor be consulted prior to attempting application of moisture sensitive flooring.

6.7 Preliminary Pavement Design

For this preliminary phase, Epic does not know how many roads or the assumed traffic. We assume that if this site is selected for further analysis, a more detailed pavement section could be designed. Based on the native soils encountered during the field and laboratory investigation, an assumed California Bearing Ratio (CBR) of 2.0 may be used for the native soft clay soils. We suggest that once the correctional facility has been designed and pavement areas located, CBR testing should be performed. If the site is raised 3-feet from the 4217 historic water elevations, an assumed CBR of 5.0 should be used for the structural fill for preliminary pavement design.

6.8 Surface and Subsurface Drainage Recommendations

Wetting/drying of the foundation soils may cause some degree of volume change within the soil at this site and should be prevented during and after construction. With the soils on this site, special attention should be paid to surface and subsurface drainage as to not influence or compromise any foundation elements within the buildings or campus.

Storm water systems built on site should be built to extend a safe distance or at least 100 feet away from any adjacent structures and downstream of any buildings or preferably to the north or northeast section of this project site. In these general areas, the native soils are clay that grade to sandy clay below 5-feet. Water migration or percolation should be considered to be slow with the native soils in this area of the site. This area should pose minimal hazards to the rest of the site for storm water management as the site slopes downward to the north

Groundwater was encountered during the field investigation. Surface water from weather and surface flow through relatively loose backfill may influence soils under footings, pavements, and any exterior concrete flat work. Epic recommends that the following precautions be taken at this site.

1. **The ground surface should be graded to drain away from the structures in all directions. We recommend a minimum fall of 12-inches in the first 10-feet for landscaped areas and 2-inches in the first 10-feet for paved surfaces.**
2. Sprinkler heads (if used) should be designed to prevent water spraying on foundation walls and kept at least 24-inches from foundation walls.
3. Provide adequate compaction of foundation backfill (i.e. a minimum of 90 percent of ASTM D-1557) as loose backfill may channel water to foundation levels. Water consolidation methods should not be used for backfill compaction.
4. Roof runoff should be collected in rain gutters with down spouts designed to discharge well outside of the backfill limits with cobbles and large gravels to impede the soil erosion process.
5. Other precautions which may become evident during design and construction should be taken to control all drainage from the buildings and pavements.

6.9 Seismic Design Criteria

Due to the potential for liquefaction for this site, this site may be considered as Site Class F. Based on ASCE 7-10 Section 11.4.7, a site specific seismic response spectrum spectral acceleration response analysis shall be performed. However for comparative purposes only, according to ASCE 7-10 Section 21.3 design spectral response acceleration at any period shall not be taken as less than 80 percent of Sa (Spectral Response Acceleration at any given moment) determined by Site Class E. MCE seismic response spectrum spectral acceleration values for this site are based on section 1613 of the 2012 IBC Site Class E with soft clay soil having N60 blow counts less than 15, undrained shear strength less than 500 psf, and Building Risk category III (jail or detention center). The short (SDS) and 1-second (SD1) spectral response acceleration were determined by the location of the project site , a probabilistic occurrence of a seismic event having a 2% probability of exceedance in 50 years, and the U.S. Seismic

Design Maps, Web Application (USGS, 2014). Values for seismic design criteria are shown below in Table 9.

TABLE 9: MCE SEISMIC RESPONSE SPECTRUM SPECTRAL ACCELERATION VALUES

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class E*	
Site Location: Latitude: 40.80355 Longitude: -112.09637	**Site Class E Site Coefficients: Fa = 0.900 Fv = 2.400**
Parameters *	**Response Spectrum Spectral Acceleration (g)**
S_{MS}	1.239xFa = 1.115
S_{M1}	0.420xFv = 1.008
Design Parameters	Design Spectral Response Acceleration (g)
S_{DS}	= 2/3 x S_{MS} = 0.743
S_{D1}	= 2/3 x S_{M1} = 0.672
*IBC 1615.1.3 recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values.	

7.0 PRELIMINARY COST ANALYSIS BASED ON ADDITIONAL DESIGN

The costs and estimated quantities are preliminary. This site requires a deep foundation or ground improvement method and significant over excavation and replacement with structural fill. The closest pit for import of structural fill is the Staker & Parson Pit located at 1730 Beck St, Salt Lake City, UT (approximately 8 miles east of the site) and these include their rough estimates of cost for an Engineered Structural fill that would be close to an AASHTO A-1 material, having a maximum particle size of 3-inches. At this time, the foundations of concrete flat work, pavements, and footings that will need over excavation and replace with structural fill for the proposed project of the current Utah Prison Prototype Diagram size (approximately 360 acres). The following items are the preliminary assumptions for the estimated additional engineering costs and analysis based on additional foundation work on this site and do not include traditional estimated building costs for the proposed correctional facility.

A deep foundation or ground improvement method will be required to mitigate the estimated potential for liquefaction, preliminary control of settlement issues associated with soft soils, and transfer of the loads associated with the proposed correctional facility at I-80/7200 West Expanded site to the subsurface soils. Deep foundation or ground improvement methods include for example: driven closed end pipe piles, tapered timber piles, stone columns, and Rammed Aggregate Piers® (Geopiers®) or a combination of these four methods. The cost associated with each of systems is based on Section 2.5 and on the following assumptions:

- A treatment depth of 50-feet for driven closed end steel pipe piles, tapered timber piles and a treatment depth of 40-feet for stone columns, and Rammed Aggregate Piers®

- Center to center spacing of 11-feet for driven closed end pipe piles
- Center to center spacing of 7-feet for tapered timber piles, stone columns, and Rammed Aggregate Piers
- Cost per linear foot per install and Mobilization fee
- The removed preload material is suggested to be reused as structural fill material for basketball courts, parking areas, access roads, perimeter fence, lamp posts, etc.

TABLE 10: PRELIMINARY COST ESTIMATIONS FOR DEEP FOUNDATION OR GROUND IMPROVEMENT METHODS

Method	Cost per Linear Foot	Number of Locations	Total Linear Feet	Cost	Wick Drains/Preload/ Instrumentation	Mobilization Cost	Total Cost
Driven Pipe Piles (50ft)	$90.00	9,587	479,350	$43,140,000	$15,600,000	$1,000,000	$59,740,000
Removal and Disposal of Preload Materials			$6.00 per yd^3	12-feet depth	525,203 yd^3	$3,150,000	$3,150,000
Pile Cap	$80.00 for 12-inch thick pad per yd^2		133,713 yd^2	$10,700,000	NA	NA	$10,700,000
						Subtotal:	$73,590,000
						Total:	$88,310,000
Timber Piles	$35.00	23,673	1,183,650	$41,430,000	$15,600,000	$1,000,000	$58,030,000
Removal and Disposal of Preload Materials			$6.00 per yd^3	12-feet depth	525,203 yd^3	$3,150,000	$3,150,000
Pile Cap	$80.00 for 12-inch thick pad per yd^2		133,713 yd^2	$10,700,000	NA	NA	$10,700,000
						Subtotal:	$71,880,000
						Total:	$86,260,000
Stone Columns	$25.00	23,673	946,920	$23,670,000	$15,600,000	$1,000,000	$40,270,000
Load Transfer Platform		Geogrid	$6.00 per yd^2	534,852 yd^2	$2,140,000	Use preload material	$2,140,000
Removal and Disposal of Preload Materials			$6.00 per yd^3	5-feet depth	218,835 yd^3	$1,310,000	$1,310,000
						Subtotal:	$43,720,000
						Total:	$52,460,000
Rammed Aggregate Piers®	$31.45	23,673	946,920	$29,780,000	$15,600,000	$1,000,000	$46,380,000
Load Transfer Platform		Geogrid	$6.00 per yd^2	534,852 yd^2	$2,140,000	Use preload material	$2,140,000
Removal and Disposal of Preload Materials			$6.00 per yd^3	5-feet depth	218,835 yd^3	$1,310,000	$1,310,000
						Subtotal:	$49,830,000
						Total:	$59,800,000

If placement of preload and installation is an option for the proposed correctional facility, a geotechnical field instrumentation program is needed to monitor geotechnical parameters during construction process. Parameters measured should include primary consolidation settlement, excess pore pressures, increase in vertical stress, and horizontal deformation. A preliminary cost estimate based on type of instrumentation and quantity of instrumentation per pad is shown in Table 11.

TABLE 11: PRELIMINARY COST ESTIMATION FOR WICK DRAINS, PRELOADING, AND GEOTECHNICAL FIELD INSTRUMENTATION

Method	Cost Per Linear Foot	Number of Locations	Total Linear	Cost	Mobilization	Total Cost
Wick Drains	$0.50	54,300	2,715,000 ft	$1,360,000	$1,000,000	$2,360,000
Free-Draining Aggregate	$26.00 to $30.00 per yd^3	1,203,410 ft^2	2 ft depth	89,142 yd^3	N/A	$2,320,000 to $2,670,000
Preload Material	$9.00/ton	1,131,000 tons	N/A	$10,180,000	N/A	$10,180,000
Instrumentation	Number of Instruments	Cost per Pad	Quantity of Building Pads		$390,000	
	33	$64,880	6			
SUB-TOTAL: Wick Drains + Preload + Field Instrumentation =						$15,600,000

A deep foundation system method may be required to mitigate the estimated potential for liquefaction, preliminary control of settlement issues associated with soft soils, and transfer of the loads associated for light posts and perimeter fencing at the proposed correctional facility at I-80/7200 West Expanded site to the subsurface soils. The cost associated with each of systems is based on Section 2.5 and on the following assumptions:

- Proposed lighting poles are outside the perimeter of the exterior fence by 5-feet and set at one every 150-feet of center
- Double fence around perimeter of proposed correctional facility
- Single fences are proposed for delineation between buildings with a 10% contingency on additional fencing
- Proposed lighting poles and fence posts are supported by timber piles at a treatment depth of 50-feet
- An Engineer's estimating multiplier of 1.2 was used on all costs and costs were rounded up to the $10,000

TABLE 12: PRELIMARY COST ESTIMATION ASSOCIATED WITH LIGHT POLES AND FENCING

Item	Cost Per Linear Foot	Number of Locations	Total Linear Feet	Sub-Total	Cost
Light Poles	$35.00	134	6,700	$240,000	$290,000
Fencing	$35.00	4,043	202,150	$7,080,000	$8,500,000

8.0 PRELIMINARY PLACEMENT ON THE EXPANDED SITE

We anticipate that if this site was chosen for further study as the location of the proposed Correctional Facility and based on the findings per the Phase I Preliminary Geotechnical study, Epic recommends the best buildable area is located in green rectangle shown on Figure 46. Soft soils are contained on this site, and will be unavoidable during the construction. The primary consolidation settlements are estimated to be lower on the southern end of this site. The image of a preliminary layout provided to us on April 14, 2015 was scaled onto the image below and placed based on areas with less organic soils. Placement of the proposed correctional facility becomes difficult to place on the project site due to the canal intersecting the site and geometry of the proposed facility. The canal may need to be rerouted and reevaluated upon further investigation. This site has soils that would make restraining settlement difficult and deep bearing layers that make costs increase.

9.0 RECOMMENDATIONS FOR ADDITIONAL INVESTIGATONS

Epic recommends that once a site is selected for additional investigations, we recommend that more Geotechnical field work and analysis be done to fine tune the placement of an updated campus design on this site. **Epic recommends the advancement of cone penetration tests (CPT) to a refusal depth or 200-feet and the performance of boreholes to depths of at least 100-feet spaced every 200-feet within the estimated building areas based on IBC 2012 Section 1803.3.1.**

Once architectural and structural design is finalized or further along in the design process if this site is selected, we recommend that more Geotechnical field work and analysis be done for exact placement of all the buildings footings, fences, roadways, parking, detention basins, walls and any other associated areas that will be influenced by subsurface soils.

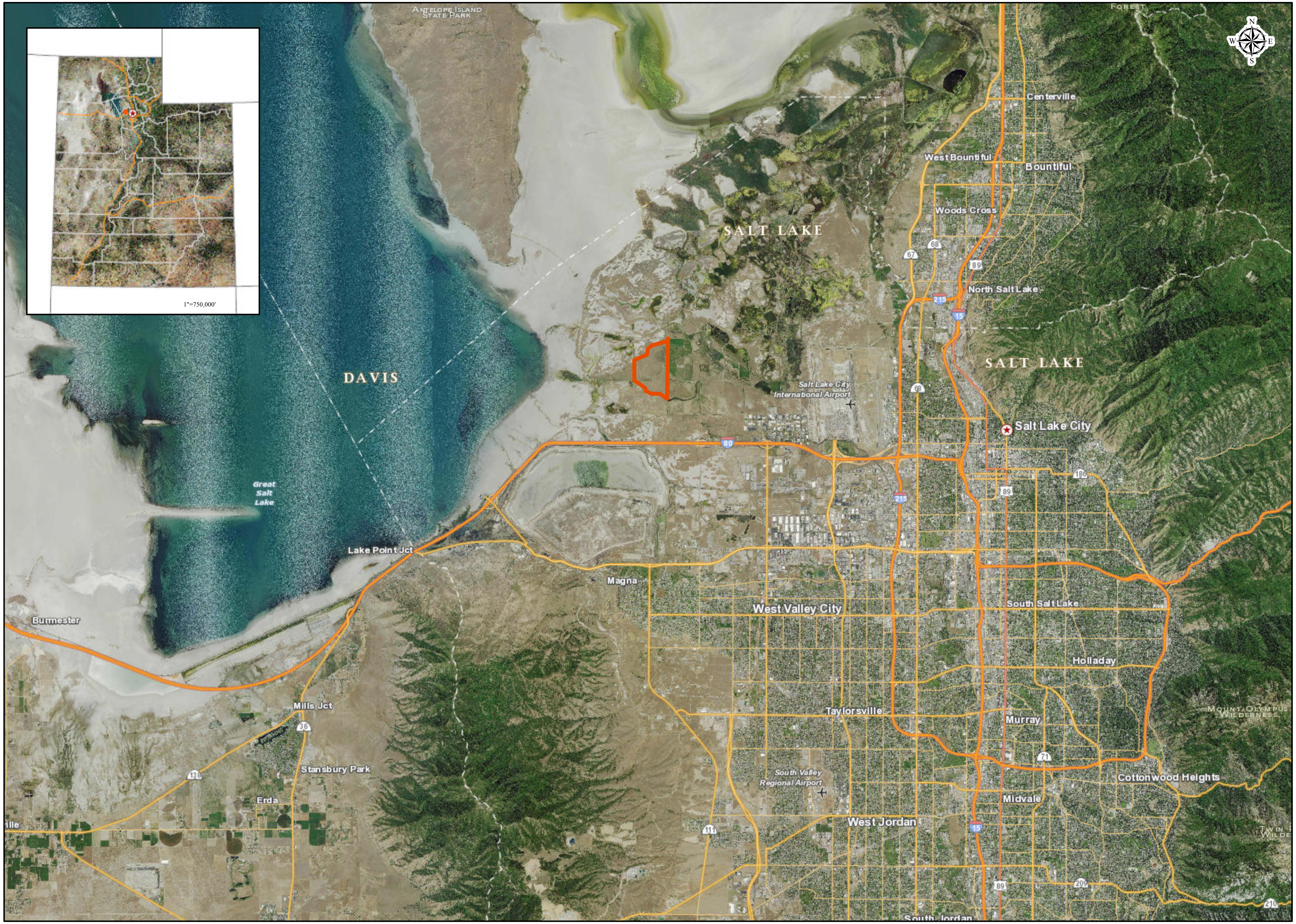
10.0 GENERAL CONDITIONS

This report provides Epic Engineering's preliminary geotechnical recommendations for the proposed correctional facility. This report is only applicable for the preliminary placement of the proposed correctional facility and shall not be used for other nearby sites. Since geotechnical conditions can change in a short distance, Epic Engineering recommends that all properties be evaluated on a site-specific basis.

The recommendations for presented herein are based on the observations and evaluations of the subsurface conditions located at I-80 and 7200 West in Salt Lake City, along with previous geotechnical engineering experience. This report represents phase 1 of the geotechnical study and is intended for comparative purposes only. The recommendations herein are not intended for final design or construction.

APPENDIX A
FIGURES

epic ENGINEERING



LEGEND

STUDY AREA

SOURCE: UTAH AGRC IMAGERY

DATE

7/7/15

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

SCALES

HORIZ: 1"= 15,000'
(11"X17")

0 1/2"

PROJECT NAME:

MGT OF AMERICA SITE INVESTIGATION

SHEET TITLE:

I-80/7200 WEST EXPANDED VICINITY MAP

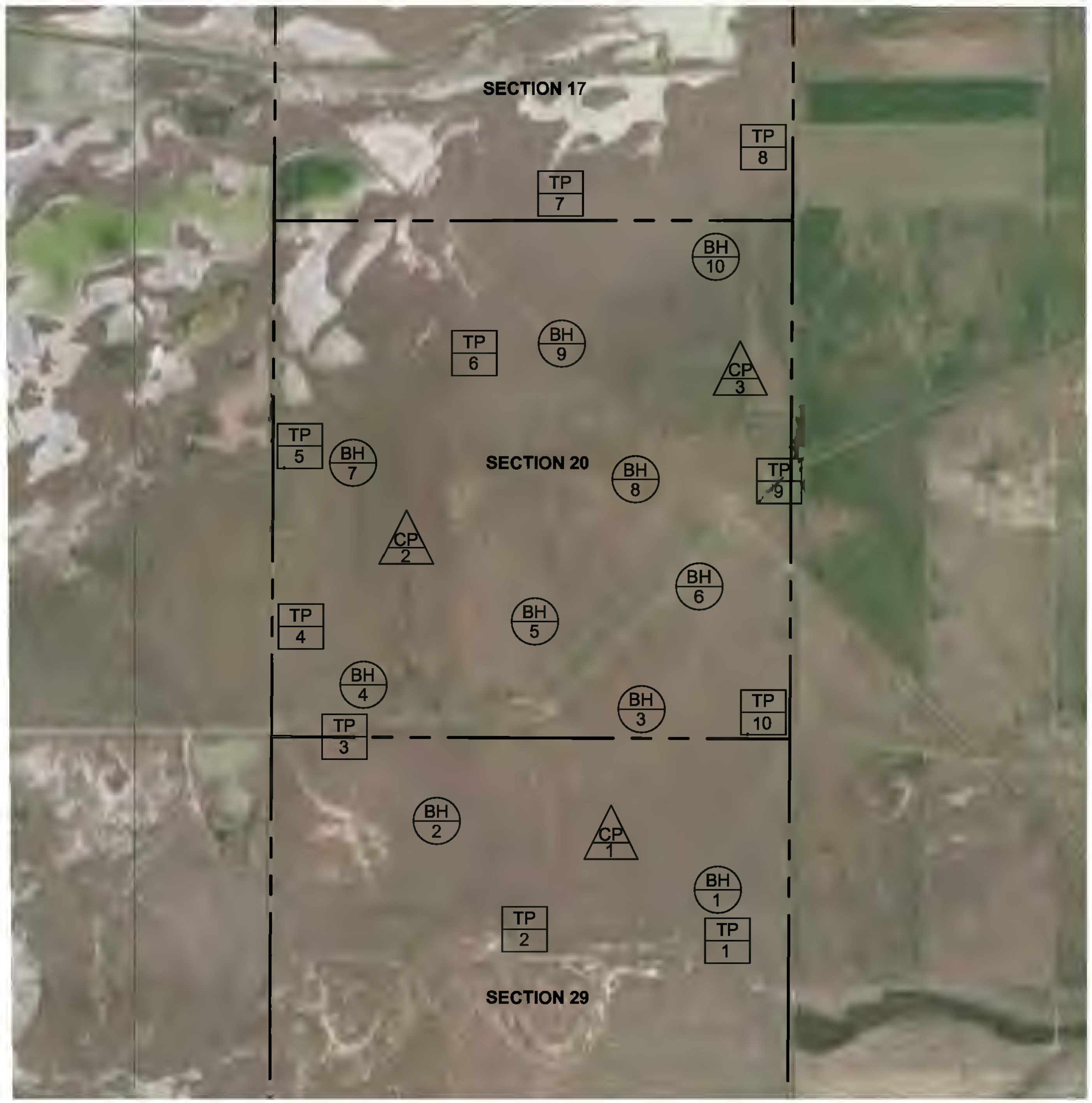
PLAN SET: PRELIM.

FIGURE: 1

I-80 / 7200 WEST EXPANDED
BOREHOLE AND TEST PIT EXHIBIT

LOCATED IN SECTIONS 17, 20 AND 29,
TOWNSHIP 1 NORTH, RANGE 2 WEST
SALT LAKE BASE AND MERIDIAN,
SALT LAKE COUNTY, UTAH

NORTH
NTS



Test Pit & Bore Hole Locations (Project Coordinate System)

Description	Northing	Easting	Elevation	Latitude	Longitude
BH-01	7458497.29	1478475.76	4220.32	40°47'38.33035"	-112°05'05.39336"
BH-02	7459195.27	1475598.27	4219.94	40°47'45.03801"	-112°05'42.85698"
BH-03	7460238.81	1477694.35	4219.53	40°47'55.48376"	-112°05'15.69931"
BH-04	7460603.54	1474860.47	4218.23	40°47'58.90132"	-112°05'52.56986"
BH-05	7461248.04	1476608.47	4218.46	40°48'05.38292"	-112°05'29.90197"
BH-06	7461604.73	1478283.83	4219.62	40°48'09.01553"	-112°05'08.15266"
BH-07	7462867.82	1474719.93	4216.91	40°48'21.26009"	-112°05'54.59384"
BH-08	7462638.20	1477640.15	4218.00	40°48'19.18314"	-112°05'16.60895"
BH-09	7464078.10	1476884.27	4214.72	40°48'33.35825"	-112°05'26.55955"
BH-10	7464966.06	1478455.11	4217.43	40°48'42.23212"	-112°05'06.21183"
CPT-01	7458991.79	1477385.31	4219.44	40°47'43.14476"	-112°05'19.61000"
CPT-02	7462000.45	1475298.50	4216.87	40°48'12.72983"	-112°05'46.99676"
CPT-03	7463726.36	1478686.98	4219.40	40°48'30.00048"	-112°05'03.09183"
TP-01	7458070.05	1478558.46	4220.41	40°47'34.11514"	-112°05'04.28213"
TP-02	7458110.37	1476504.13	4221.00	40°47'34.37995"	-112°05'30.98842"
TP-03	7459980.10	1474670.73	4218.67	40°47'52.73001"	-112°05'54.98225"
TP-04	7461195.16	1474145.42	4217.97	40°48'04.69838"	-112°06'01.91697"
TP-05	7463035.60	1474215.06	4215.98	40°48'22.88414"	-112°06'01.17223"
TP-06	7463984.12	1475989.05	4214.82	40°48'32.37123"	-112°05'38.19066"
TP-07	7465489.72	1476868.73	4214.75	40°48'47.30216"	-112°05'26.88287"
TP-08	7466082.85	1479154.12	4215.99	40°48'53.30955"	-112°04'57.21789"
TP-09	7462678.64	1479096.49	4220.69	40°48'19.67678"	-112°04'57.67893"
TP-10	7460136.55	1479107.05	4221.35	40°47'54.56488"	-112°04'57.32637"

VICINITY MAP

I-80 / 7200 WEST EXPANDED
BOREHOLE & TEST PIT EXHIBIT
SECTIONS 17, 20 AND 29,
T1N, R2W, SLB&M, SALT LAKE COUNTY, UTAH

LEGEND

- TEST PIT — TP #
- BOREHOLE — BH #
- CONE PENETRATION — CP #
- SECTION LINE

epic ENGINEERING

NTS

DRAWN: BJ

CHECKED: PC

PROJECT #: 15MGT004.01

DATE: 6/24/2015

FIGURE #2

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 20 & 21, 2015

Project Address : Salt Lake City, Utah Time: 2:30 p.m. Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 1

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 18-inches						
2													
3		Split Spoon	1	1	1	17%	SAND (SP) - Very loose, moist, brown						
4													
5							▼						
6		Split Spoon	WR	WR	1	17%	CLAY (CL) - Very soft, wet, light gray, pH = 9.23, soluble sulfate						
7							= 384 mg/kg-dry resistivity = 695 ohm-cm, soluble chloride = 875 mg/kg-dry						
8		Split Spoon	WR	WR	WR	100%	Light brown below 7.5-feet						
9													
10													
11		Thin Walled Shelby					Dark gray below 10-feet						
12													
13		Thin Walled Shelby											
14						100%							
15													
16		Split Spoon	WR	1	3	100%	CLAY with Sand (CL) - wet and soft below 15-feet						
17													
18													
19													
20													
21		Split Spoon	WR	1	1	100%							
22													
23													
24													
25													

WR = weight of rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7458497.29 Easting: 1478475.76** **Logged By:** **M. Platt and T. Copfer**

Elevation: **4220.32 feet** **Reviewed By:** **J. White**

FIGURE 3

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 20 & 21, 2015

Project Address : Salt Lake City, Utah Time: 2:30 p.m. Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 1

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26	SM	Split Spoon	1	1	3	100%	Silty SAND (SM) - Very loose to loose, wet, dark gray	32.5	NP	NP	0	72.2	27.8
27													
28													
29													
30													
31		Split Spoon	2	3	5	100%							
32	CL						Sandy CLAY (CL) - Medium stiff, wet, dark gray						
33													
34													
35													
36	ML	Split Spoon	7	10	13	100%	Sandy SILT (ML) - Very stiff, wet, dark gray	25.3	NP	NP	0	45.9	54.1
37	CL						Sandy CLAY (CL) - Wet, dark gray						
38													
39													
40													
41		Split Spoon	15	13	14	61%							
42													
43													
44													
45													
46	SM	Split Spoon	15	28	35		Silty SAND (SM) - Dense to very dense, wet, dark gray	22.4	NP	NP	0.4	83.8	15.8
47													
48							End of borehole at 47-feet						
49													
50													
51													
52													

WR = weight of rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ⊠ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7458497.29 Easting: 1478475.76** **Logged By:** **M. Platt and T. Copfer**

Elevation: **4220.32 feet** **Reviewed By:** **J. White** FIGURE 4

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 20, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 2

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 24-inches						
2													
3			1	1	1	28%	CLAY (CL) - Soft, moist, brown, traces of organics						
4													
5													
6			1	1	1	67%	Sandy SILT (ML) - Soft, wet, gray	30.4	28	5	5.3	24.7	70
7													
8			WR	WR	WR	17%	CLAY (CL) - Very soft, wet, gray						
9													
10													
11			1	1	1	72%	Soft, wet, dark gray below 10-feet						
12													
13			WR	WR	1		Very soft, black below 12.5-feet						
14													
15													
16						100%	Soft, dark gray						
17													
18													
19													
20													
21			3	2	5	78%	Medium stiff, dark gray to gray						
22							SAND (SP) - Medium dense, wet, dark gray						
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ⊠ = Split Spoon Sampler; Modified California Sampler; Thin Walled Shelby

Location: **Northing: 7459195.27 Easting: 1475598.27** **Logged By:** **M. Platt**

Elevation: **4219.94 feet** **Reviewed By:** **J. White**

FIGURE 5

50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 20, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 2

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26		Split Spoon	4	1	3	100%	Sandy CLAY (CL) - Medium stiff, wet, gray						
27													
28													
29													
30													
31		Split Spoon	2	4	8	100%	CLAY (CL) - Medium stiff to stiff, wet, gray						
32							SAND (SP) - Medium dense, wet, gray						
33													
34													
35													
36		Thin Walled Shelby					CLAY (CL) - Soft, wet, transitioning to sand						
37													
38													
39													
40													
41		Split Spoon	14	34	34		SAND (SP) - Very dense, wet, gray						
42													
43													
44													
45													
46		Split Spoon	23	30	29	94%	Silty SAND (SM) - Very dense, wet, gray	21.3	NP	NP	0.4	82.4	17.2
47													
48													
49													
50							CLAY (CL) - Stiff, wet, gray						
51		Split Spoon	5	11	18	100%	SAND (SP) - Medium dense, wet, gray						
52							End of borehole at 51.5-feet						

WR = weight of rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7459195.27 Easting: 1475598.27** **Logged By:** **M. Platt**

Elevation: **4219.94 feet** **Reviewed By:** **J. White**

FIGURE 6

50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 21, 2015

Project Address : Salt Lake City, Utah Time: 8:30 a.m. Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 3

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0–2							Topsoil - Approximately 18-inches						
2–5		Split Spoon	2	1	1	78%	Sandy SILT (ML) - Soft, moist, light brown						
5–7		Split Spoon	1	2	5	67%	Silty SAND (SM) - Loose, wet, brown						
7–10		Split Spoon	WR	WR	WR	100%	CLAY (CL) - Very soft, wet, light brown						
10–12		Thin Walled Shelby					Gray below 10-feet						
12–15		Split Spoon	1	1	1		SAND (SP) - Very loose, wet, brown						
15–20		Split Spoon	1	1	1	100%	CLAY (CL) - Soft, wet, bluish gray						
20–25		Split Spoon	3	1	1	50%							

WR = Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ⊠ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7460238.81 Easting: 1477694.35** **Logged By:** **T. Copfer**

Elevation: **4219.53 feet** **Reviewed By:** **M. Platt**

FIGURE 7

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 21, 2015

Project Address : Salt Lake City, Utah Time: 8:30 a.m. Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 3

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26–30		Thin Walled Shelby					Dark gray below 25-feet						
31–35		Split Spoon	5	9	5	67%	Sandy SILT (ML) - Stiff, wet, dark gray	26.2	NP	NP	0	30.9	69.1
36–40		Split Spoon	6	15	20	100%	Silty SAND (SM) - Dense, wet, dark gray						
41–45		Split Spoon	WR	WR	WR	33%	CLAY (CL) - Very soft, wet, dark gray						
46–50		Split Spoon	15	28	29	100%	Silty SAND (SM) - Very dense, wet, dark gray						
51		Split Spoon	14	29	35	100%	very dense below 50-feet	24.3	NP	NP	0	82.3	17.7
52							End of borehole at 51.5-feet						

WR = weight of rod
Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7460238.81 Easting: 1477694.35** **Logged By:** **T. Copfer**

Elevation: **4219.53 feet** **Reviewed By:** **M. Platt**

FIGURE 8

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 23, 2015

Project Address : Salt Lake City, Utah Time: 8:45 am Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 4

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 12-inches						
2													
3		Split Spoon	1	1	2	94%	SAND (SP) - Loose, moist, light brown						
4							SILT (ML) - Soft, moist, yellow brown, trace organics						
5													
6		Split Spoon	3	4	4	72%	SAND (SP) - Loose, moist, yellow brown						
7													
8		Split Spoon	WR	WR	WR	100%	CLAY (CL) - Very soft, moist, brownish gray						
9							▼						
10													
11		Thin Walled Shelby					Wet, gray below 10-feet						
12													
13													
14													
15													
16		Split Spoon	2	2	2	100%	Black						
17							Sandy CLAY (CL) - Medium stiff, wet, gray						
18													
19													
20													
21		Split Spoon	1	1	1	100%	Lean CLAY (CL) - Soft, wet, dark gray	34.7	37	12	0	10.3	89.7
22													
23													
24													
25													

WR = weight of rod
Groundwater (ft.below grade): 9

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7460603.54 Easting: 1474860.47** **Logged By:** **L. Minck**

Elevation: **4218.23 feet** **Reviewed By:** **M. Platt**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date April 23, 2015

Project Address : Salt Lake City, Utah Time: 8:45 am Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 4

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26–30		Split Spoon	1	2	3		SAND (SP) - Loose, wet, dark gray, pH = 9.26, soluble sulfate = 471 mg/kg-dry, resistivity = 211 ohm-cm, soluble chloride = 890 mg/kg-dry						
31–35		Split Spoon	5	8	4	50%	Sandy CLAY (CL) - Stiff, wet, gray						
36–40		Thin Walled Shelby					SAND (SP) - Wet, dark gray						
41–45		Split Spoon	21	31	32	94%	Poorly graded SAND with Silt (SP-SM) - Very dense, wet, dark gray	22.2	NP	NP	0	88.5	11.5
46–50		Split Spoon	13	24	38	67%	SAND (SP) - Very dense, wet, dark gray						
51		Split Spoon	2	5	8	100%	Sandy CLAY (CL) - Stiff, wet, dark gray						
52							End of borehole at 51.5-feet						

WR = Weight of Rod
Groundwater (ft.below grade): 9

G = Grab Sample; ⊠ = Split Spoon Sampler; ◩ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7460603.54 Easting: 1474860.47** **Logged By:** **L. Minck**

Elevation: **4218.23 feet** **Reviewed By:** **M. Platt**

FIGURE 10

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 22, 2015

Project Address : Salt Lake City, Utah Time: 12:30 p.m. Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 5

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 18-inches						
2													
3		Split Spoon	4	4	2	100%	Silty SAND (SM) - Loose, moist, brown						
4							▼						
5													
6		Split Spoon	2	1	1		Sandy Silty CLAY (CL-ML) - Soft, wet, light brown	22.7	27	6	0.2	29.3	70.5
7													
8		Thin Walled Shelby					CLAY (CL) - soft, wet, light brown						
9													
10													
11		Split Spoon	1	1	1	100%	Soft						
12													
13		Split Spoon	WR	1	1	100%	Black to dark gray below 12.5-feet						
14													
15													
16		Thin Walled Shelby											
17													
18													
19													
20													
21		Split Spoon	1	WR	1	100%	Dark gray						
22													
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 4.5
G = Grab Sample; ⊠ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7461248.04 Easting: 1476608.47** **Logged By:** **T. Copfer**

Elevation: **4218.46 feet** **Reviewed By:** **M. Platt**

FIGURE 11

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 22, 2015

Project Address : Salt Lake City, Utah Time: 12:30 p.m. Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 5

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26–30		☒	2	2	14	67%	Clayey SAND (SC) - Medium dense, wet, dark gray						
31–35		☒	5	3	3	67%	SILT (ML) - Medium stiff, wet, dark gray	30.8	25	4	0	8.6	91.4
36–40		☒	4	3	6	100%	Sandy CLAY (CL) - Stiff, wet, black to dark gray						
41–45		☒	20	32	28	89%	Silty SAND (SM) - Very dense, wet, dark gray						
46–50		☒	6	5	4	100%	SILT with Sand (ML) - Stiff, wet, dark gray	25.9	NP	NP	0	18.5	81.5
51		☒	5	5	12		Clayey SAND (SC) - Medium dense, wet, dark gray						
52							End of borehole at 51.5-feet						

WR = Weight of Rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7461248.04 Easting: 1476608.47**

Logged By: **T. Copfer**

Elevation: **4218.46 feet**

Reviewed By: **M. Platt**

FIGURE 12

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 21, 2015

Project Address : Salt Lake City, Utah Time: 3:00 p.m. Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 6

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 18-inches						
2													
3		Split Spoon	1	1	1	67%	Sandy CLAY (CL) - Soft, moist, light brown						
4							▼						
5													
6		Split Spoon	2	2	1	67%	Silty SAND (SM) - Very loose, wet, brown						
7													
8		Thin Walled Shelby											
9							CLAY (CL) - Soft, wet, light brown						
10													
11		Split Spoon	2	1	1	100%							
12													
13		Split Spoon	WR	WR	WR	100%	Very soft, black below 12.5-feet						
14													
15													
16		Split Spoon	WR	WR	1	100%							
17													
18													
19													
20													
21		Thin Walled Shelby					Dark gray below 20-feet						
22													
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7461604.73 Easting: 1478283.83** **Logged By:** **T. Copfer**

Elevation: **4219.62 feet** **Reviewed By:** **M. Platt**

FIGURE 13

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 21, 2015

Project Address : Salt Lake City, Utah Time: 3:00 p.m. Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 6

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26–30		Split Spoon	2	1	1	100%	CLAY (CL) - wet, soft, dark gray						
31–35		Split Spoon	2	2	2	100%	Silty CLAY with Sand (CL-ML) - Soft, wet, dark gray	30.4	28	7	0	23	77
36–40		Split Spoon	5	19	19		Silty SAND (SM) - Dense, wet, dark gray						
41–45		Split Spoon	15	23	24	83%	Gray below 40-feet						
46–50		Split Spoon	3	1	1	56%	Sandy CLAY (CL) - Soft, wet, greenish gray						
51		Split Spoon	3	5	8	100%	Stiff below 50-feet						
52							End of borehole at 51.5-feet						

Groundwater (ft.below grade): 4.5

G = Grab Sample; ⊠ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7461604.73 Easting: 1478283.83** **Logged By: T. Copfer**

Elevation: **4219.62 feet** **Reviewed By: M. Platt**

FIGURE 14

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 23, 2015

Project Address : Salt Lake City, Utah Time: 1:20 pm Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 7

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 12-inches						
2–5		Split Spoon	1	1	1	67%	CLAY (CL) - Soft, moist, yellow brown (groundwater symbol at 5)						
6–7		Split Spoon	1	1	2	44%	Sandy CLAY (CL) - Soft, wet, yellow brown, some organics, pH = 9.42, soluble sulfate = 574 mg/kg-dry, resistivity = 135 ohm-cm, soluble chloride = 1,640 mg/kg-dry						
8–10		Split Spoon	WR	WR	1	83%	Very soft, reddish brown, below 7.5-feet						
11–12		Split Spoon	1	1	1		CLAY (CL) - Soft, wet, reddish brown to yellow brown						
13–15		Thin Walled Shelby					Gray below 12.5-feet						
16–20		Split Spoon	2	4	10	83%	SAND (SP) - Medium dense, wet, dark gray						
21–25		Split Spoon	9	5	4	33%	Silty SAND (SM) - Loose, wet, dark gray	24.3	NP	NP	0	86.4	13.6

Wr= Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ⊠ = Split Spoon Sampler; = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7462867.81 Easting: 1474719.93** **Logged By:** **L. Minck**

Elevation: **4216.91 feet** **Reviewed By:** **M. Platt**

FIGURE 15

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 23, 2015

Project Address : Salt Lake City, Utah Time: 1:20 pm Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 7

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26–30		Thin Walled Shelby					Silty Sand (SM) - Loose, wet, dark gray						
31–35		Split Spoon Sampler	8	8	6	28%	SAND (SP) - Medium dense, wet, dark gray						
36–40		Split Spoon Sampler	6	8	22		Silty Clayey SAND (SC-SM) - Medium dense, wet, dark gray	21.8	24	6	0	72.6	27.4
41–45		Split Spoon Sampler	19	21	11	56%	Dense, gray below 40-feet						
46–50		Split Spoon Sampler	5	4	4		CLAY (CL) - Stiff, wet, gray						
51		Thin Walled Shelby											
52							End of borehole at 51.5-feet						

WR = Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7462867.81 Easting: 1474719.93** **Logged By:** **L. Minck**

Elevation: **4216.91 feet** **Reviewed By:** **M. Platt**

FIGURE 16

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 22, 2015

Project Address : Salt Lake City, Utah Time: 7:00 a.m. Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 8

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 24-inches						
2													
3		Split Spoon	2	3	2	56%	Sandy Silty CLAY (CL-ML) - Medium stiff, moist, light brown	15	21	4	3.4	35.8	60.8
4							▼						
5													
6		Split Spoon	1	WR	1	89%	CLAY (CL) - Very soft, wet, light brown						
7													
8		Split Spoon	WR	1	WR	89%							
9													
10													
11		Split Spoon	WR	WR	1	100%							
12													
13		Thin Walled Shelby					Brown to black to brown below 12.5-feet						
14													
15													
16		Split Spoon	1	1	1	100%	Soft and black below 15-feet						
17													
18													
19													
20													
21		Split Spoon	1	1	1	100%	Dark gray, pH = 9.80, soluble sulfate = 318 mg/kg-dry,						
22							resistivity = 362 ohm-cm, soluble chloride = 649 mg/kg-dry						
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7462638.20 Easting: 1477640.15** **Logged By:** **T.Copfer**

Elevation: **4218.00 feet** **Reviewed By:** **M. Platt**

FIGURE 17

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 22, 2015

Project Address : Salt Lake City, Utah Time: 7:00 a.m. Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 8

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26		Split Spoon	3	4	3	33%	CLAY (CL) - Medium stiff, wet, dark gray						
27													
28													
29													
30													
31		Split Spoon	5	8	13	33%	Silty SAND (SM) - Medium dense, wet, dark gray						
32													
33													
34													
35													
36		Split Spoon	17	28	32	100%	Dense below 35-feet	22.3	NP	NP	0.1	83.1	16.8
37													
38													
39													
40													
41		Thin Walled Shelby					Attempted but not able to sample						
42													
43													
44													
45													
46		Split Spoon	8	8	9		Sandy Silty CLAY (CL-ML) - Very stiff, wet, gray						
47													
48													
49													
50													
51		Split Spoon	5	13	5								
52							End of borehole at 51.5-feet						

WR = Weight of Rod
Groundwater (ft.below grade): 4.5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7462638.20 Easting: 1477640.15** **Logged By:** **T.Copfer**

Elevation: **4218.00 feet** **Reviewed By:** **M. Platt** FIGURE 18

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: April 24, 2015

Project Address : Salt Lake City, Utah Time: 8:30 am Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 9

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 12-inches						
2													
3		Split Spoon	1	1	1	67%	CLAY (CL) - Soft, moist, yellow brown, some gravel						
4													
5							▼						
6		Thin Walled Shelby					Wet below 5-feet						
7													
8		Split Spoon	1	1	2	67%							
9													
10													
11		Split Spoon	1	WR	1	100%	Very soft below 10-feet						
12							8-inches black at 11.25-feet						
13		G				33%	SILT (ML) - Wet, dark gray		26	6			
14							Attempted Shelby sample - no sample retrieved						
15													
16		G					Attempted Shelby sample - no sample retrieved						
17													
18													
19													
20													
21		Split Spoon	WR	WR	1		CLAY (CL) - Very soft, wet, dark gray						
22													
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7464078.10 Easting: 1476884.27** **Logged By:** **L. Minck**

Elevation: **4214.72 feet** **Reviewed By:** **M. Platt**

FIGURE 19

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date April 24, 2015

Project Address : Salt Lake City, Utah Time: 8:30 am Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 9

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in)			Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
			0/6	6/12	12/18								
26		Thin Walled Shelby					CLAY (CL) - soft, wet, dark gray						
27													
28													
29													
30													
31		Split Spoon	9	4	3	11%	Stiff to medium stiff below 30-feet						
32													
33													
34													
35													
36		Split Spoon	6	8	14	94%	Silty SAND (SM) - Medium dense, wet, gray						
37													
38													
39													
40													
41		Split Spoon	10	5	3	100%		22	NP	NP	0.9	77.8	21.3
42							CLAY (CL) - 10 inches Medium stiff, wet, yellow brown						
43													
44													
45													
46		Thin Walled Shelby											
47													
48													
49													
50													
51		Split Spoon	3	3	7	100%	Stiff, gray below 50-feet						
52							End of borehole at 51.5-feet						

Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◪ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7464078.10 Easting: 1476884.27** **Logged By:** **L. Minck**

Elevation: **4214.72 feet** **Reviewed By:** **M. Platt**

epic ENGINEERING

50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date April 24, 2015

Project Address : Salt Lake City, Utah Time: 1:00 pm Sheet: 1 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 10

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
1							Topsoil - Approximately 18-inches						
2													
3		Split Spoon	2	2	2	94%	CLAY (CL) - soft, moist, gray						
4							SAND (SP) - Loose, moist, yellow brown						
5							▼						
6		Split Spoon	1	1	1	33%	Very loose, wet, yellow brown, with gravel below 5-feet						
7													
8		Split Spoon	1	1	1	83%	CLAY (CL) - Soft, wet, light gray green, trace organics						
9							pH = 8.90, soluble sulfate = 217 mg/kg-dry, resistivity = 465 ohm-cm,						
10							soluble chloride = 370 mg/kg-dry						
11		Thin Walled Shelby											
12													
13		Split Spoon	WR	WR	1	100%	Sandy CLAY (CL) - 2-inches, wet, gray						
14							CLAY (CL) - Very soft, wet, reddish tan and gray						
15													
16		Split Spoon	1	3	2	100%	Medium stiff, gray with red below 15-feet						
17													
18													
19													
20													
21		Thin Walled Shelby											
22													
23													
24													
25													

WR = Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7464966.06 Easting: 1478455.11** **Logged By:** **L. Minck**

Elevation: **4217.43 feet** **Reviewed By:** **M. Platt**

FIGURE 21

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

BOREHOLE FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date April 24, 2015

Project Address : Salt Lake City, Utah Time: 1:00 pm Sheet: 2 of 2

Driller / Type of Equipment : Great Basin Drilling - CME 75, Donut Hammer BH # : 10

Depth Ft Below Grade	SOIL	TYPE	Corrected Blow on Sampler (in) 0/6	6/12	12/18	Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
26		☒	1	1	1	100%	SILT with Sand (ML) - Soft, wet, black, organic odor	25.5	NP	NP	0	20.5	79.5
27													
28													
29													
30													
31		☒	7	4	3	100%	Stiff to medium stiff, gray, with gravel below 30-feet						
32													
33													
34													
35													
36		☒	6	10	4	56%	Clayey SAND (SC) - Medium dense, wet, dark gray						
37													
38													
39													
40													
41		☒	8	3	1	100%	SAND (SP) - 9-inches, medium dense, wet, black						
42							Silty CLAY with Sand (CL-ML) - Medium stiff, wet, tannish gray	20.9	23	4	0	22.2	77.8
43													
44													
45													
46		☒	5	5	5	100%	Sandy CLAY (CL) - Stiff, wet, dark gray, with gravel						
47													
48													
49													
50													
51		☒	5	4	5		CLAY (CL) - Stiff, wet, gray, with gravel and organics						
52							End of borehole at 51.5-feet						

WR = Weight of Rod
Groundwater (ft.below grade): 5

G = Grab Sample; ☒ = Split Spoon Sampler; ◣ = Modified California Sampler; ■ = Thin Walled Shelby

Location: **Northing: 7464966.06 Easting: 1478455.11** **Logged By:** **L. Minck**

Elevation: **4217.43 feet** **Reviewed By:** **M. Platt**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 01

Depth Ft Below Grade	SOIL	TYPE			Recovery %	DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5						Topsoil - Approximatley 18-inches						
1.0												
1.5												
2.0		G				Silty SAND (SM) - Loose, moist, brownish gray						
2.5		Undisturbed Thin Wall Sample				Collapse potential = 0.3%	22.7					
3.0												
3.5		G				CLAY (CL) - Soft, moist, gray						
4.0												
4.5												
5						▼ Wet below 5-feet						
5.5												
6.0						End of test pit at 5.5-feet due to wall collapse and rapid rise of water level						
6.5												
7.0												
7.5												
8.0												
8.5												
9.0												
9.5												
10												
10.5												
11.0												
11.5												
12.0												
12.5												

Groundwater (ft.below grade): 5 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7458070.05 Easting: 1478558.46** **Logged by :** **M. Platt**

Elevation: **4220.41 feet** **Reviewed by:** **J. White**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 02

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - Brown, 18-inches						
1.0													
1.5													
2.0		G					SAND (SP) - Moist, gray						
2.5		G					Sandy SILT (ML) - Moist, mottled gray	21.3	NP	NP	14	35.1	50.9
3.0													
3.5													
4.0													
4.5													
5													
5.5		G					SAND (SP) - Moist, mottled gray						
6.0													
6.5							▼						
7.0							Silty SAND (SM) - Wet, gray						
7.5							End of test pit at 7-feet due to wall collapse and rapid rise of water level						
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 6.5 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7458110.37 Easting: 1476504.13** **Logged by :** **M. Platt**

Elevation: **4221.00 feet** **Reviewed by:** **J. White**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 03

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil 12-inches						
1.0													
1.5							Silty CLAY (CL) - Moist, gray						
2.0		G					CLAY (CL) - Moist, brown						
2.5													
3.0		G					SAND (SP) - Moist, brown						
3.5													
4.0							▼ Wet below 4-feet						
4.5													
5							End of test pit at 4.5-feet due to wall collapse and rapid rise of water level						
5.5													
6.0													
6.5													
7.0													
7.5													
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 4 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7459980.10 Easting: 1474670.73** **Logged by :** **M. Platt**

Elevation: **4218.67 feet** **Reviewed by:** **J. White**

FIGURE 25

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 04

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - 15-inches, Brown, roots						
1.0													
1.5		G					Silty SAND (SM) - Moist, light brown						
2.0													
2.5													
3.0		■					CLAY (CL) - Moist, brownish gray, pinholes						
3.5							Collapse potential = 0.2%	31.8					
4.0													
4.5													
5													
5.5							▼ Sandy CLAY (CL) - Wet, gray						
6.0													
6.5							End of test pit at 6-feet due to rapid rise of water level						
7.0													
7.5													
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 5.5 | G Grab sample | ☒ Block | ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7461195.16 Easting: 1474145.42** **Logged by :** **M. Platt**

Elevation: **4217.97 feet** **Reviewed by:** **J. White**

FIGURE 26

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 05

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - 12-inches, brown, roots						
1.0													
1.5		G					Silty SAND (SM) - Moist, reddish brown						
2.0		G					CLAY (CL) - Moist, brown						
2.5													
3.0		Undisturbed Thin Wall Sample					SILT (ML) - Moist, brownish gray		38	13			
3.5													
4.0		G					CLAY (CL) - Moist, mottled gray to light gray, iron coloring						
4.5													
5													
5.5													
6.0							▼ Wet below 6-feet						
6.5													
7.0							End of test pit at 6.5-feet due to rapid rise in water level						
7.5													
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 6 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7463035.60 Easting: 1474215.06** **Logged by :** **M. Platt**

Elevation: **4215.98 feet** **Reviewed by:** **J. White**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 06

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - 12-inches, brown, roots						
1.0													
1.5		G					SAND (SP) - Moist, gray						
2.0													
2.5		G					Silty SAND (SM) - Moist, brown						
3.0													
3.5		G					Brownish gray, traces of fines, traces of pinholes	13.5	NP	NP	2.2	55.3	42.5
4.0													
4.5		G					CLAY (CL) - Moist, gray						
5													
5.5													
6.0													
6.5													
7.0		G					Brown below 6.5-feet						
7.5							▼ Wet below 7.5 feet						
8.0													
8.5							End of test pit at 8-feet due to rapid rise in water level						
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 7.5 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7463984.11 Easting: 1475989.05** **Logged by :** **M. Platt**

Elevation: **4214.82 feet** **Reviewed by:** **J. White**

FIGURE 28

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 07

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil -18-inches, brown, roots						
1.0													
1.5													
2.0							Clayey SAND (SC) - Moist, brownish gray						
2.5													
3.0													
3.5													
4.0													
4.5							CLAY (CL) - Moist, gray						
5													
5.5							Brown below 5-feet						
6.0													
6.5													
7.0													
7.5							▼						
8.0		G					Wet, black below 7.5-feet						
8.5													
9.0													
9.5													
10							Odor below 9.5-feet Organic Matter = 5.0%, Ash Content = 95.0%	60.9					
10.5							End of test pit at 10-feet						
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 7.5 G Grab sample ☒ Block ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7465489.72 Easting: 1476868.73** **Logged by :** **M. Platt**

Elevation: **4214.76 feet** **Reviewed by:** **J. White**

FIGURE 29

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 08

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - 15-inches, Brown, roots						
1.0													
1.5		G					Silty Clayey SAND (SC-SM) - Loose, moist, gray						
2.0													
2.5		■											
3.0							Silt (ML) - Moist, brown, Collapse potential = 1.3%	15.6					
3.5													
4.0							▼ Wet, light gray, below 4-feet						
4.5													
5							End of test pit at 4-feet due to wall collapse and rapid rise of water level						
5.5													
6.0													
6.5													
7.0													
7.5													
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 4 | G Grab sample | ☒ Block | ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7466082.85 Easting: 1479154.12** **Logged by :** **M. Platt**

Elevation: **4215.99 feet** **Reviewed by:** **J. White**

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 09

Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5 – 2.0							Topsoil - 24-inches, brown, roots						
2.5 – 3.0		G					Clayey SAND (SC) - Moist, gray						
3.5 – 5		G					SILT with Sand (ML) - Moist, mottled gray and brown, some fines	24.2	28	7	0.5	24.5	75.0
5.5 – 6.5		G					SAND (SP) - Moist, iron coloring ▼ Wet below 6-feet						
7.0 – 12.5							End of test pit at 6.5-feet due to rapid rise in water level						

Groundwater (ft.below grade): 6 — G Grab sample — ☒ Block — ■ Undisturbed Thin Wall Sample

GPS location: **Northing: 7462678.64 Easting: 1479096.49** **Logged by :** **M. Platt**

Elevation: **4220.69 feet** **Reviewed by:** **J. White**

FIGURE 31

epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

TEST PIT FIELD LOG SHEET

Project Name : I-80/7200 West Expanded Preliminary Geotechnical Invest. Project Number: 15MGT004 Date: May 4, 2015

Project Address : Salt Lake City, Utah Time: Sheet: 1 of 1

Driller / Type of Equipment : Newman Construction/Trackhoe 312EL TP # : 10

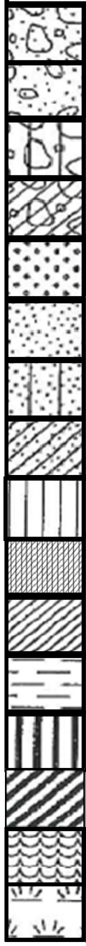
Depth Ft Below Grade	SOIL	TYPE			Recovery %		DESCRIPTION OF SOIL AND ROCK (and other notes)	Moisture Content %	Liquid Limit %	Plasticity Index %	Gravel %	Sand %	Fines %
0.5							Topsoil - 24-inches, brown, roots						
1.0													
1.5													
2.0													
2.5		■					CLAY with Sand (CL) - Moist, pinholes, brown						
3.0							Collapse potential = 0.4%	26.6					
3.5							Roots, organics, iron coloring						
4.0													
4.5		G					SAND (SP) - Moist, mottled gray and brown						
5		G					▼ CLAY (CL) - moist, gray, wet						
5.5													
6.0							End of test pit at 5.5-feet due to rapid rise in water level						
6.5													
7.0													
7.5													
8.0													
8.5													
9.0													
9.5													
10													
10.5													
11.0													
11.5													
12.0													
12.5													

Groundwater (ft.below grade): 5   G Grab sample   ☒ Block   ■ Undisturbed Thin Wall Sample

GPS location: Northing: 7460136.55 Easting: 1479107.05 **Logged by : M. Platt**

Elevation: 4221.36 feet **Reviewed by: J. White**

Unified Soil Classification System



Symbol	Description	Group	Division
GW	Clean **GRAVELS** with < 12% Fines	**GRAVEL** % gravel > % sand	**Coarse-Grained** (More than 50% Retained on No. 200 Sieve)
GP	Clean **GRAVELS** with < 12% Fines	**GRAVEL** % gravel > % sand	**Coarse-Grained**
GM	**GRAVELS** with > 12% Fines	**GRAVEL** % gravel > % sand	**Coarse-Grained**
GC	**GRAVELS** with > 12% Fines	**GRAVEL** % gravel > % sand	**Coarse-Grained**
SW	Clean **SANDS** with < 12% Fines	**SAND** % sand > % gravel	**Coarse-Grained**
SP	Clean **SANDS** with < 12% Fines	**SAND** % sand > % gravel	**Coarse-Grained**
SM	**SANDS** with > 12% Fines	**SAND** % sand > % gravel	**Coarse-Grained**
SC	**SANDS** with > 12% Fines	**SAND** % sand > % gravel	**Coarse-Grained**
ML	**SILTS** and **CLAYS** (Liquid Limit < 50)		**Fine-Grained** (More than 50% passes the No. 200 sieve)
CL-ML	**SILTS** and **CLAYS** (Liquid Limit < 50)		**Fine-Grained**
CL	**SILTS** and **CLAYS** (Liquid Limit < 50)		**Fine-Grained**
OL	**SILTS** and **CLAYS** (Liquid Limit < 50)		**Fine-Grained**
MH	**SILTS** and **CLAYS** (Liquid Limit >= 50)		**Fine-Grained**
CH	**SILTS** and **CLAYS** (Liquid Limit >= 50)		**Fine-Grained**
OH	**SILTS** and **CLAYS** (Liquid Limit >= 50)		**Fine-Grained**
PT	**SILTS** and **CLAYS** (Liquid Limit >= 50)		**Fine-Grained**

Apparent/Relative Density Coarse-Grained & Non Cohesive Soils

Apparent Density	SPT (# blows per foot)	Modified California Sampler (# blows per foot)	Relative Density (%)	Field Test for Test Pits
Very Loose	< 4	< 4	0-15	Easily penetrate with 1/2 inches reinforcing rod pushed by hand.
Loose	4-10	5-12	15-35	Difficult to penetrate with 1/2 inches reinforcing rod pushed by hand.
Medium Dense	10-30	12-35	35-65	Easily penetrated a foot with 1/2 inches reinforcing rod driven with 5 lb hammer.
Dense	30-50	35-60	65-85	Difficult to penetrate with 1/2 inches reinforcing rod driven with a 5 lb hammer.
Very Dense	> 50	> 60	85-100	Penetrated only a few inches with 1/2 inches reinforcing rod driven with a 5 lb hammer.

Consistency - Fine-Grained and Cohesive Soils

Consistency	SPT (#blows per foot)	Torvane Undrained Shear Strength (tsf)	Pocket Pen-etrometer Unconfined Compressive Strength (tsf)	Field Test (Test Pits)
Very Soft	< 2	< 0.125	< 0.125	Easily Penetrated several inches by thumb. Exudes between thumb & finger when squeezed.
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" 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" 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.

Moisture Content

Dry	Absence of moisture, dusty, dry to the touch
Slightly Moist	Not dusty dry, but not really damp
Moist	Damp, but no visible water
Wet	Visible free water

Modifiers of Sand and Gravel

Description	% (Based on Weight)
Trace	< 15
Some	15-29
With	> 12

Modifiers of Fine Grained Material

Description	% (Based on Weight)
Trace	< 5
Some	5-12
With	> 12

Plasticity

Term	Plasticity Index
Non-Plastic	0
Low	1-10
Medium	11-30
High	> 30

Type of Layer	Thickness
Parting	< 1/16 in.
Seam	1/16 in. to 0.5 in.
Layer	0.5 in. to 12 in.
Stratum	> 12 in.

Cementation

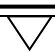
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

Particle Size Identification

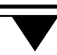
Boulders		over 12 inches
Cobbles		3 inches to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 to 3/4 inch
Sand	Coarse	No. 4 to No. 10
	Medium	No. 10 to No. 40
	Fine	No. 40 to No. 200
Silt		< No. 200, PI < 4 or below "A" line
Clay		< No. 200, PI >= 4 and on or above "A" line

General Notes

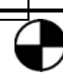
1. Lines representing stratification lines are approximate. Actual transitions between soils may be gradual.
2. No warranty is provided as to the continual soil conditions between individual sample locations.
3. Logs represent general soil conditions at the observed point and time of exploration on the data indicated.
4. USCS soil classifications made on logs were based using visual methods only. However, if laboratory tests were conducted, then results were shown and used



Water Table Level When First Encountered

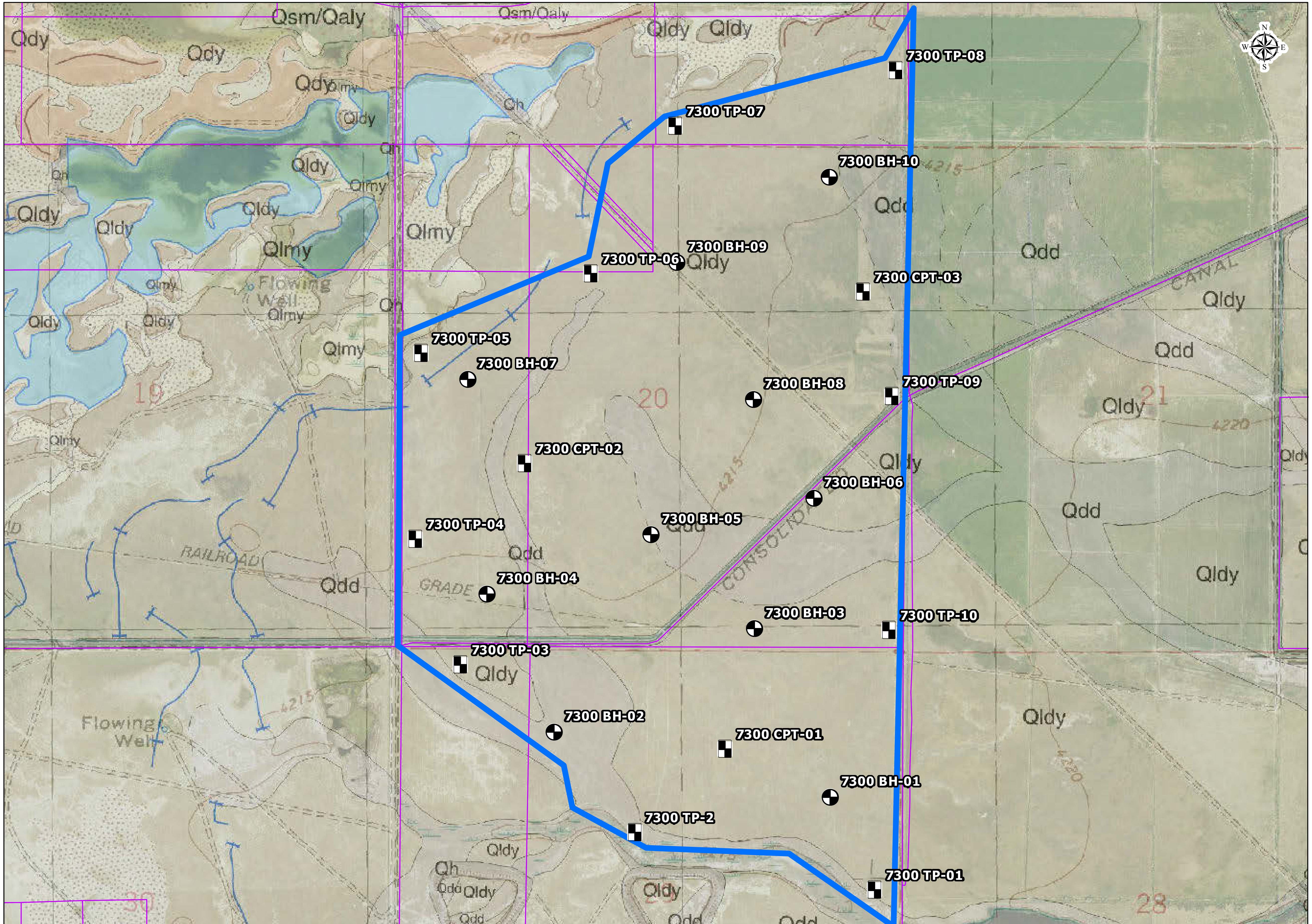


Water Table Level Upon Completion



Borehole Location

Test Pit Location



LEGEND

- SITE BOUNDARIES
- PARCELS
- BORE HOLE
- TEST PIT OR CONE PENETROMETER TESTING
- GREAT SALT LAKE BEACH RIDGE CREST

Qdd Distributary channel fill deposits (middle to lower Holocene)
Qdy Younger deltaic deposits (Holocene)
Qldy Young lacustrine and deltaic deposits (Holocene to upper Pleistocene)
Qlmy Young lacustrine mud deposits (Holocene to upper Pleistocene)
Qsm/Qaly Spring and marsh deposits over young stream deposits, undivided (Holocene to upper Pleistocene)

SOURCE INTERIM GEOLOGIC MAP OF THE BAILEYS LAKE QUADRANGLE 1:24,000 SCALE 2013

DATE
6/9/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 1,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 West Expanded
GEOLOGIC MAP

PLAN SET: PRELIM.
EXHIBIT: Figure 34

BEFORE TESTING
AT TP-01
LOOKING EAST

BEFORE TESTING
AT BH-03

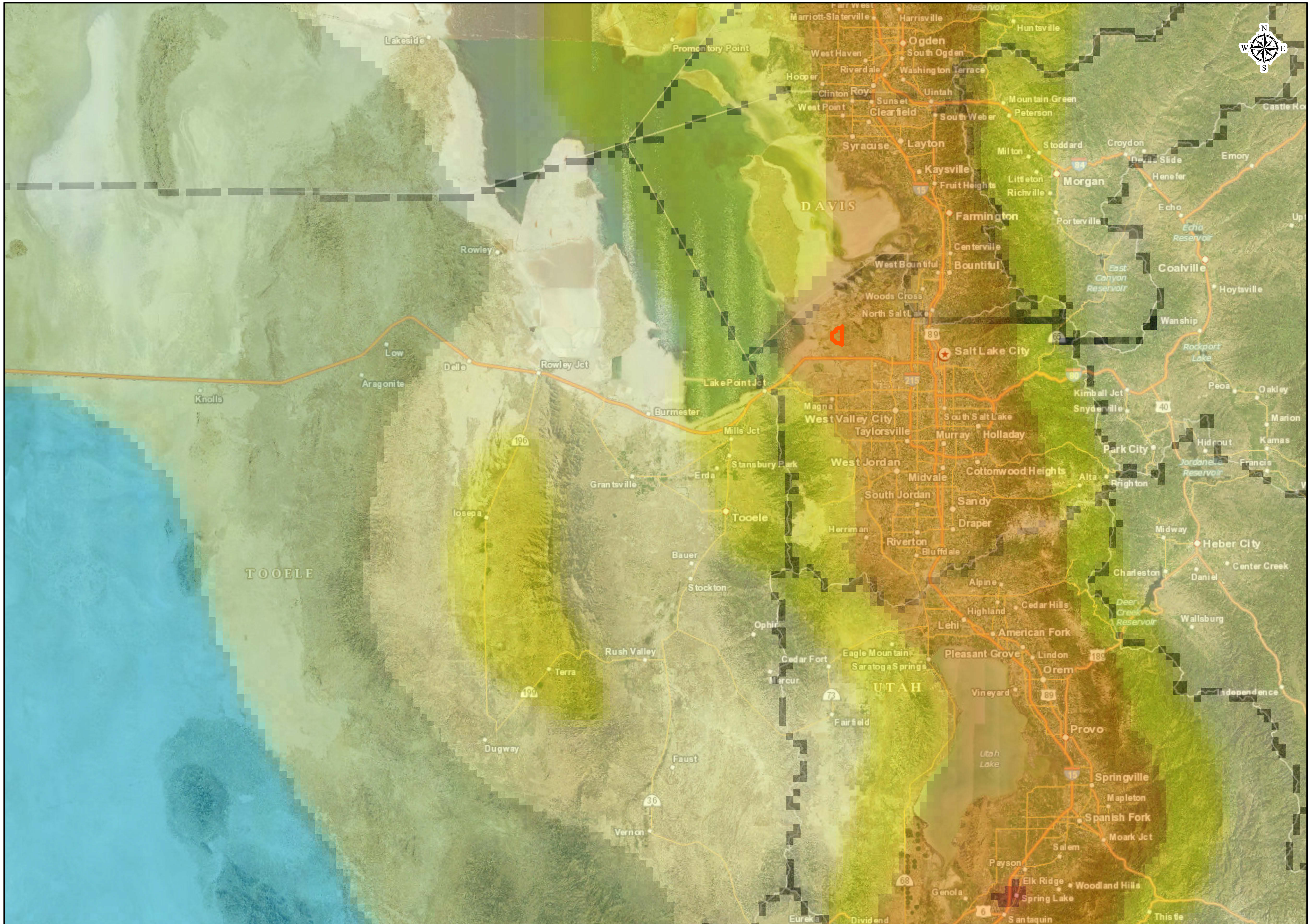
BEFORE TESTING
AT CPT-03
LOOKING NORTHWEST

Figure 35: EXAMPLE PHOTOS OF SITE

GEOTECHNICAL STUDY:

I-80/7200 West Expanded Site, Salt Lake City, Utah
Preliminary Geotechnical Investigation

Epic Job No. 15-MGT-004



LEGEND

STUDY AREA

US SEISMIC HAZARD 2% IN 50 YEARS PGA HAZARD (%g)

- 10-14
- 14-20
- 20-30
- 30-40
- 40-80
- >80

SOURCE: UTAH AGRC IMAGERY

UTAH SEISMIC HAZARD MAP
USGS EARTHQUAKE HAZARD
http://earthquake.usgs.gov/earthquakes/states/utah/hazards.php

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

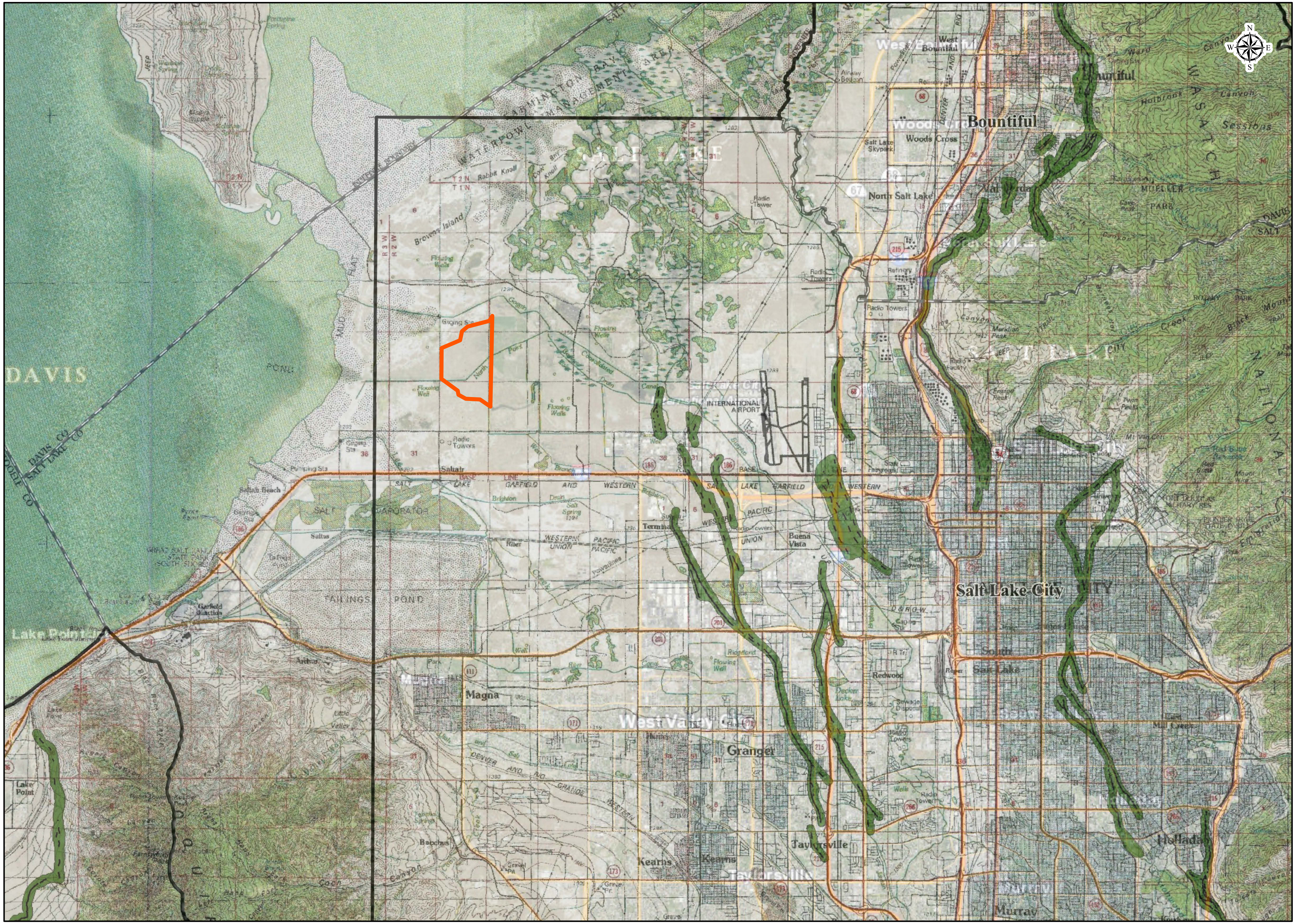
SCALES
HORIZ: 1"= 50,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED
SEISMIC HAZARD MAP

PLAN SET:
PRELIM.

FIGURE:
36



LEGEND

STUDY AREA

SOURCE: UTAH AGRC IMAGERY

SURFACE FAULT RUPTURE SPECIAL STUDY AREAS WASATCH FRONT AND NEARBY AREAS, UTAH 2008 COMPILED BY GARY CHRISTENSON & LUCAS SHAW

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

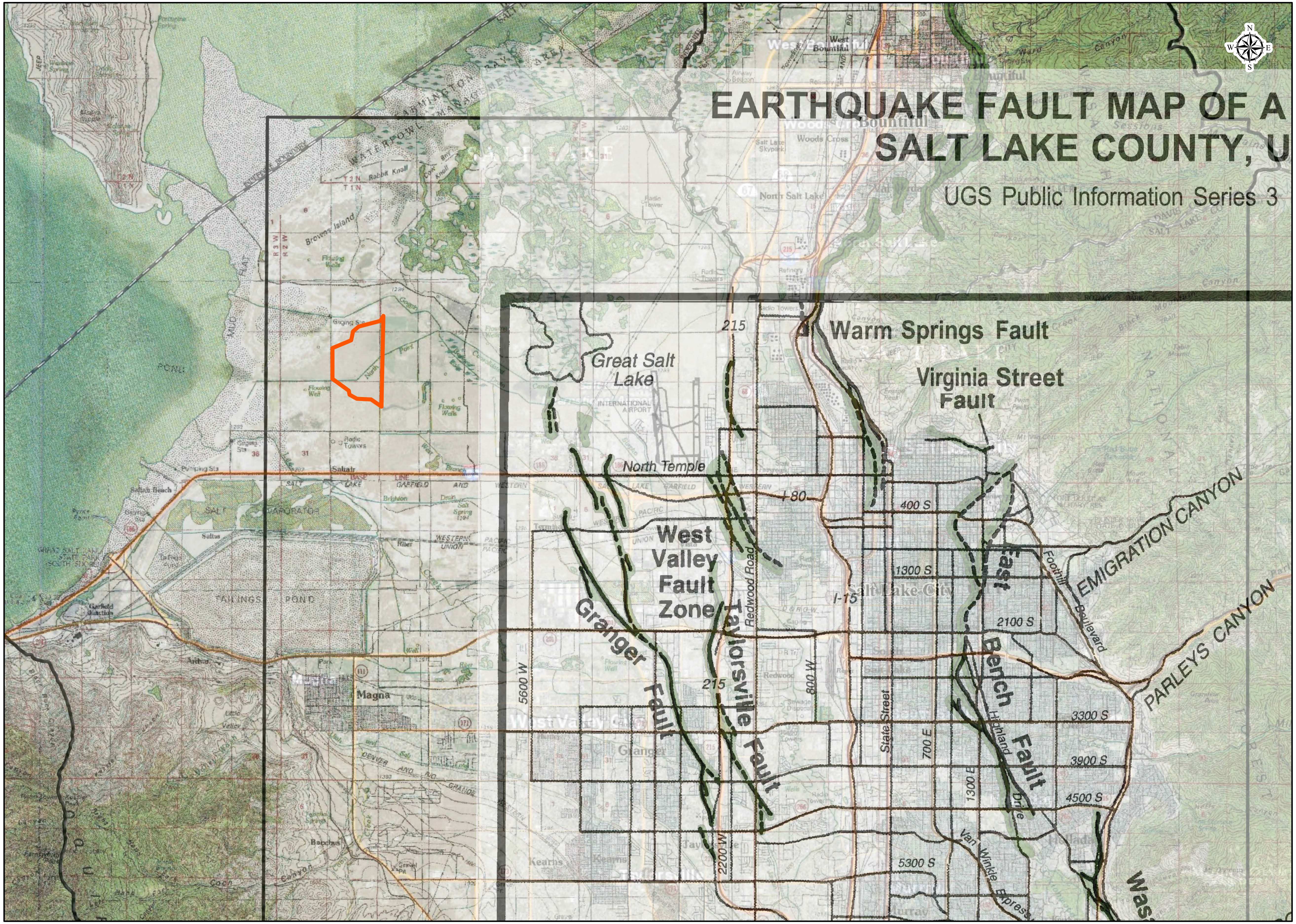
SCALES
HORIZ: 1"= 10,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED SURFACE FAULT RUPTURE MAP

PLAN SET: PRELIM.

FIGURE: 37



LEGEND

STUDY AREA

SOURCE: UTAH AGRC IMAGERY

SURFACE FAULT RUPTURE SPECIAL STUDY AREAS WASATCH FRONT AND NEARBY AREAS, UTAH 2008 COMPILED BY GARY CHRISTENSON & LUCAS SHAW

DATE

7/7/15

epic ENGINEERING

REVISIONS

1.

DRAWN: KMC

DESIGNER: MP

REVIEWED: JW

PROJECT #

15MGT004

SCALES

HORIZ: 1"= 10,000' (11"X17") 0 1/2"

PROJECT NAME:

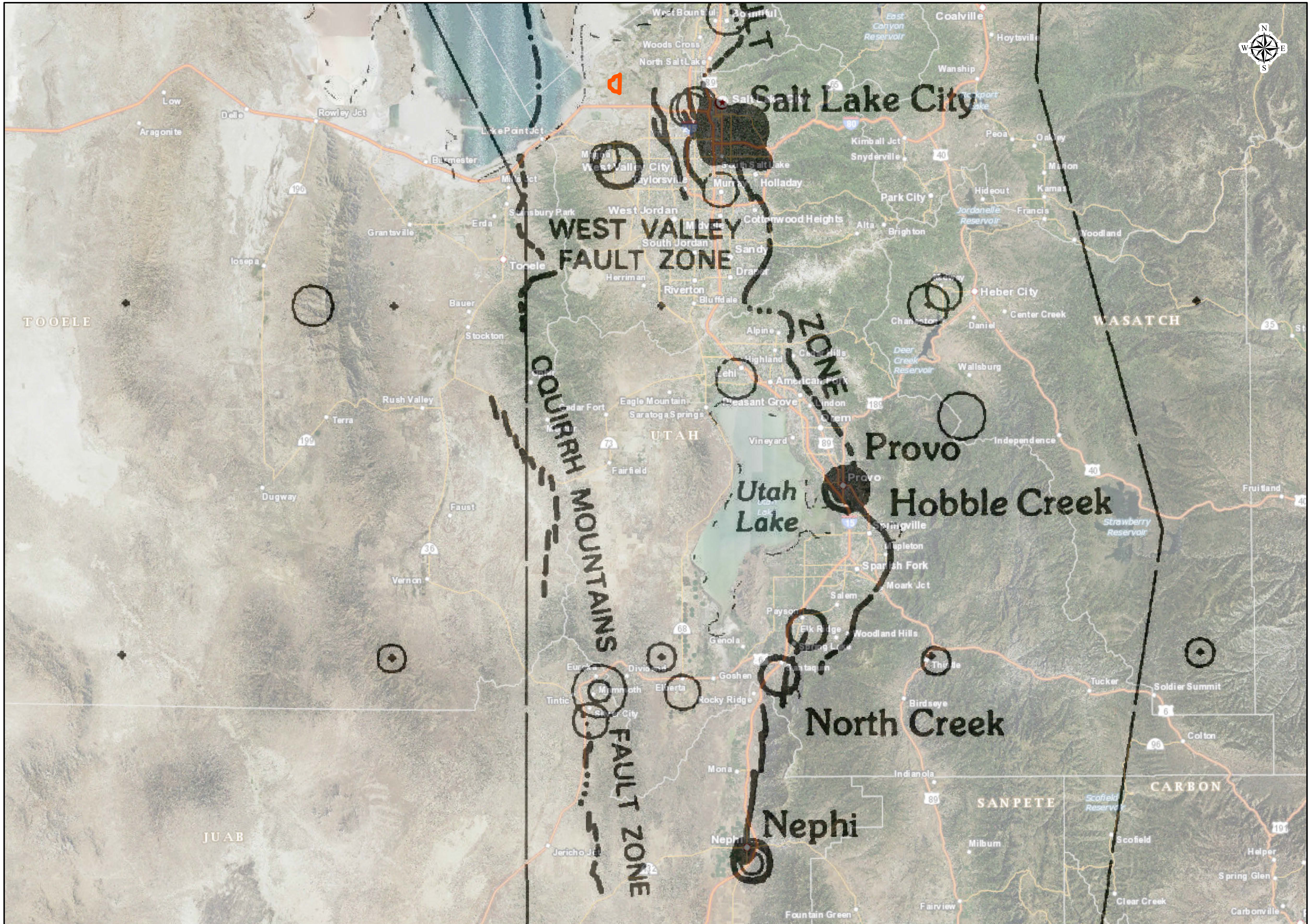
MGT OF AMERICA SITE INVESTIGATION

SHEET TITLE:

I-80/7200 WEST EXPANDED 2004 EARTHQUAKE FAULT MAP

PLAN SET: PRELIM.

FIGURE: 38



LEGEND

STUDY AREA

SOURCE: UTAH AGRC IMAGERY

ASSESSMENT OF REGIONAL EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH. 2000. USGS. PAULA GORI & WALTER HAYES.

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

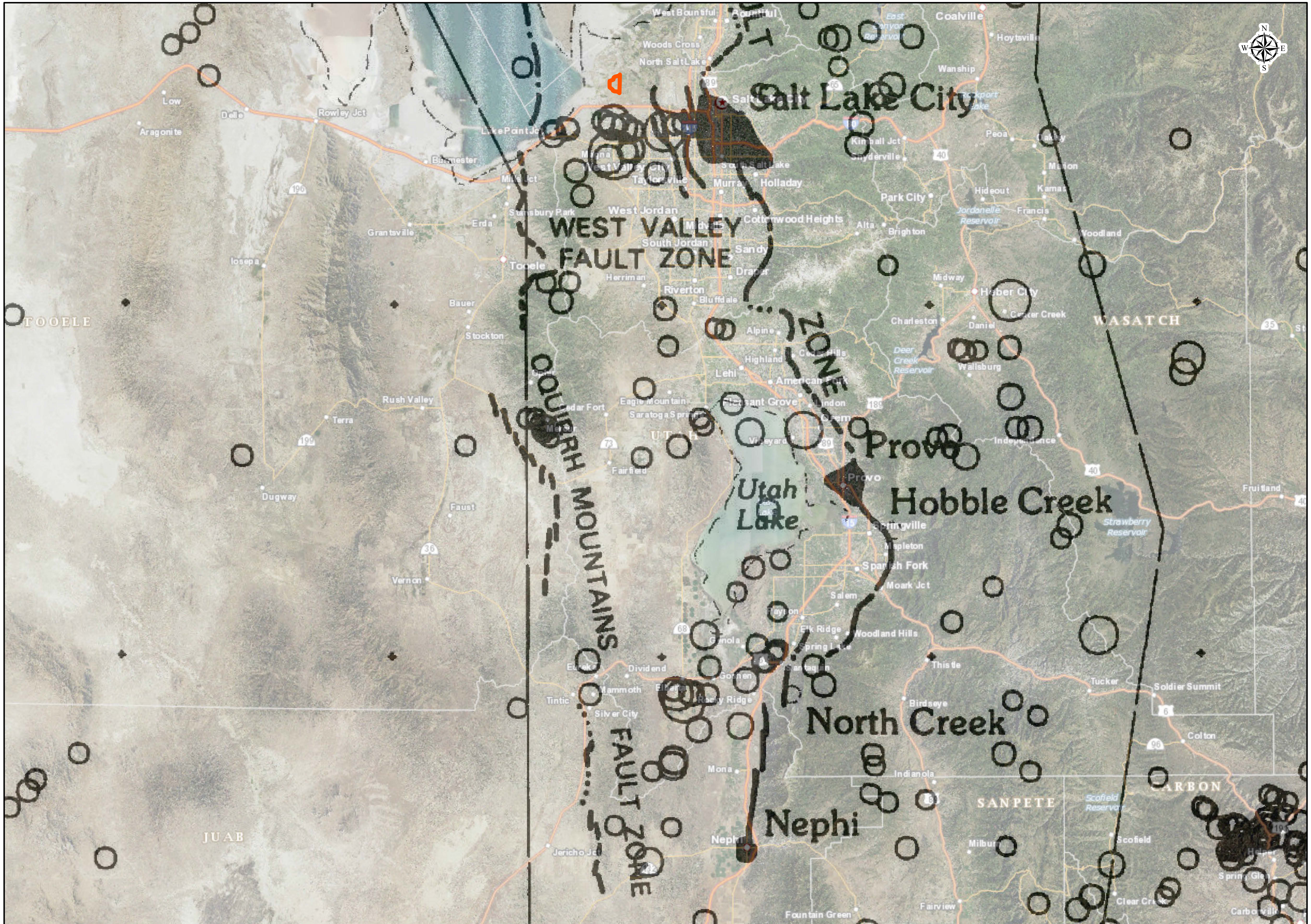
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 50,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED SEISMIC HISTORY MAP PRIOR TO 1962

PLAN SET: PRELIM.
FIGURE: 39



LEGEND

STUDY AREA

SOURCE: UTAH AGRC IMAGERY

ASSESSMENT OF REGIONAL EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH. 2000. USGS. PAULA GORI & WALTER HAYES.

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

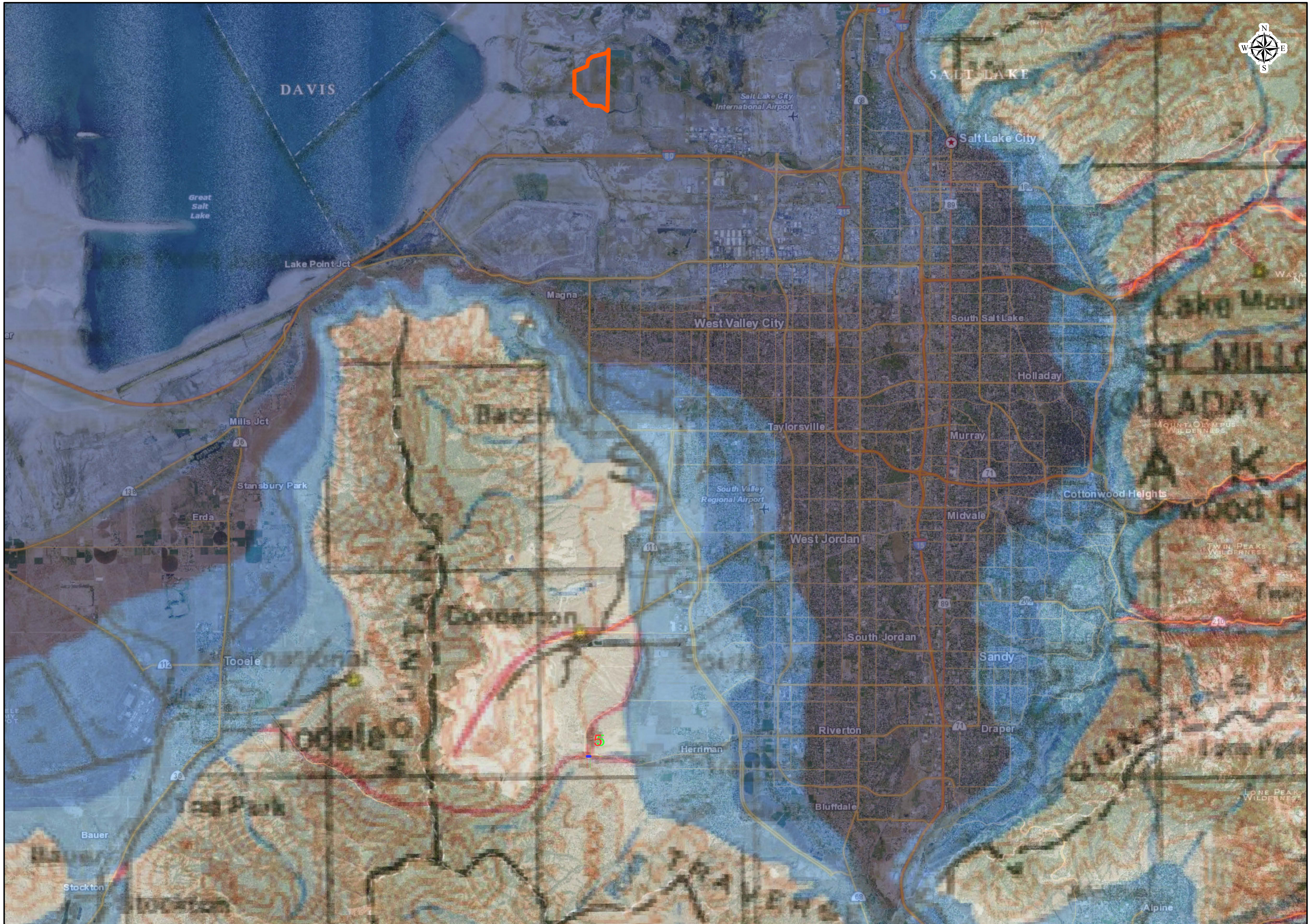
SCALES
HORIZ: 1"= 50,000'
(11"X17")

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED
SEISMIC HISTORY MAP
1962 to 1986

PLAN SET: PRELIM.

FIGURE: 40



LEGEND

STUDY AREA

BONNEVILLE

PROVO

STANSBURY

GILBERT

SOURCE: UTAH AGRC IMAGERY

MAJOR LEVEL OF GREAT SALT LAKE AND LAKE BONNEVILLE. 1984. DONALD CURREY, GENEVIEVE ATWOOD, AND DON MABEY

DATE
7/7/15

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

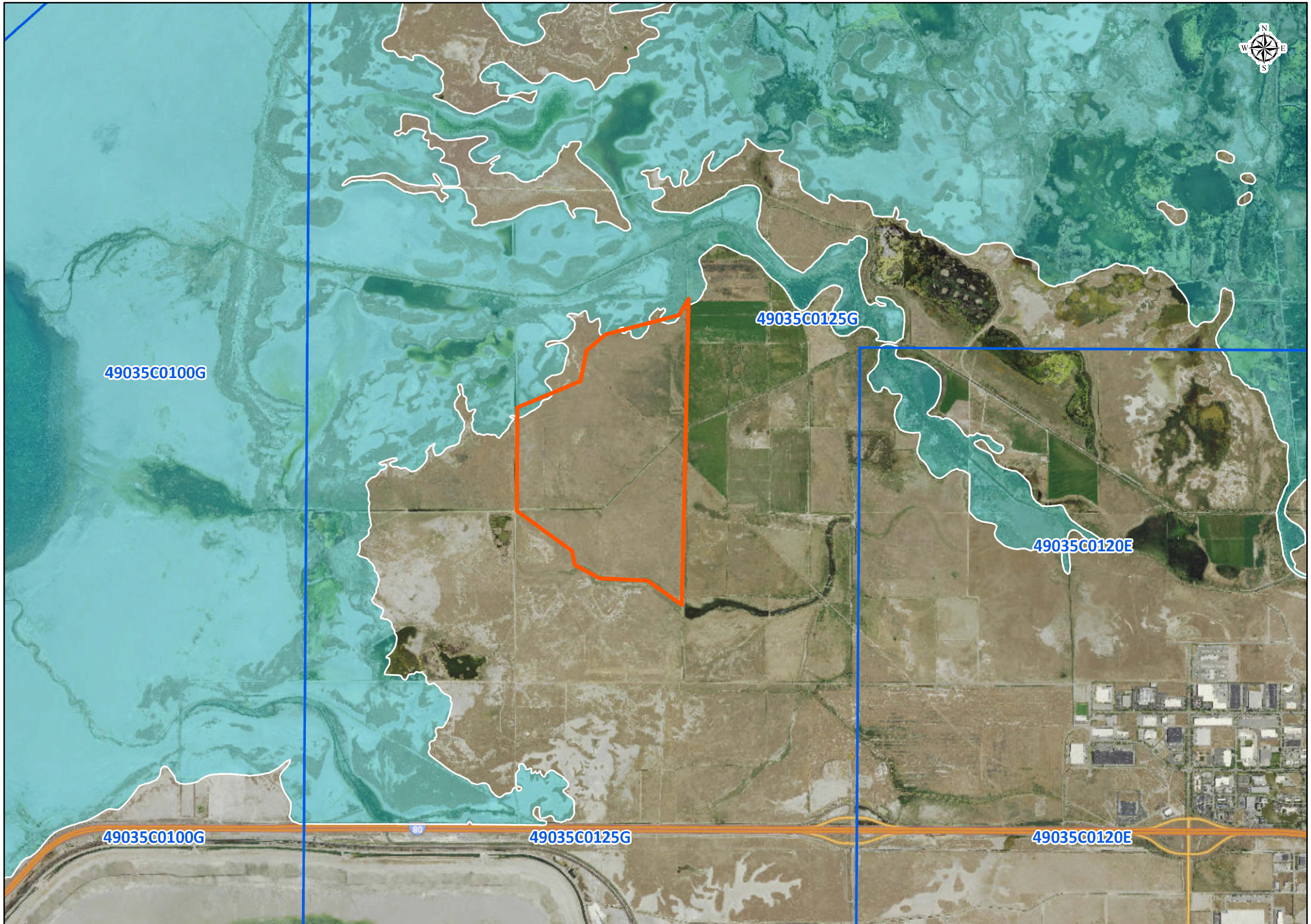
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 15,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED LAKE BONNEVILLE

PLAN SET: PRELIM.
FIGURE: 41



LEGEND

STUDY AREA

FIRM PANELS

100 YEAR ZONE A FLOOD PLAIN

SOURCE FEMA, UTAH AGRC IMAGERY

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

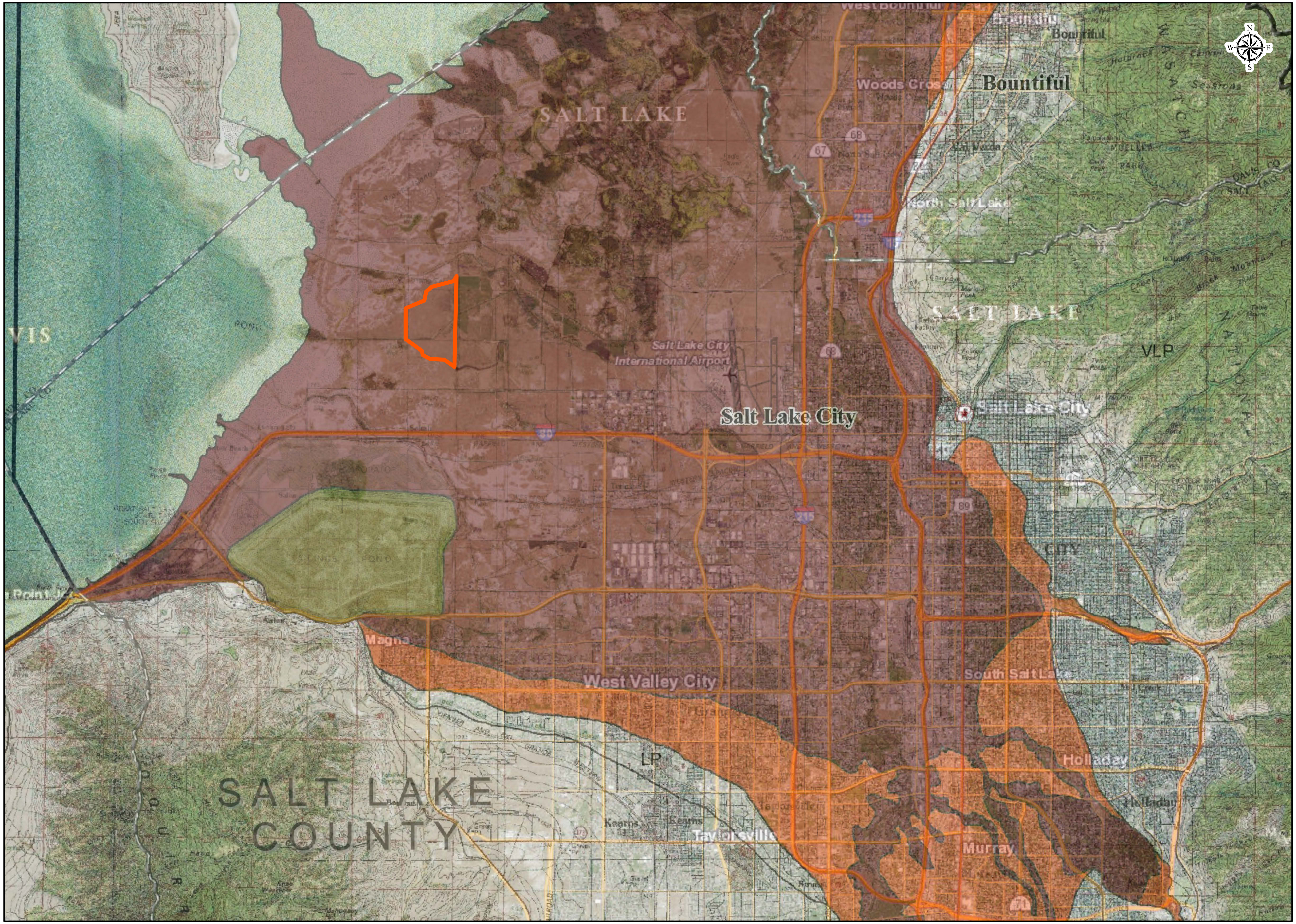
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 3,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED
FLOODPLAIN MAP

PLAN SET: PRELIM.
FIGURE: 42



LEGEND

- STUDY AREA
- HIGH SUSCEPTIBILITY
- HIGH TO MODERATE SUSCEPTIBILITY
- MODERATE SUSCEPTIBILITY
- MODERATE TO LOW SUSCEPTIBILITY
- TAILINGS PILE (NOT DETERMINED)

LS= LOW SUSCEPTIBILITY

VLS= VERY LOW SUSCEPTIBILITY

SOURCE: UTAH AGRC IMAGERY

LIQUEFACTION SPECIAL STUDY AREAS WASATCH FRONT AND NEARBY AREAS, UTAH 2008 COMPILED BY GARY CHRISTENSON & LUCAS SHAW

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

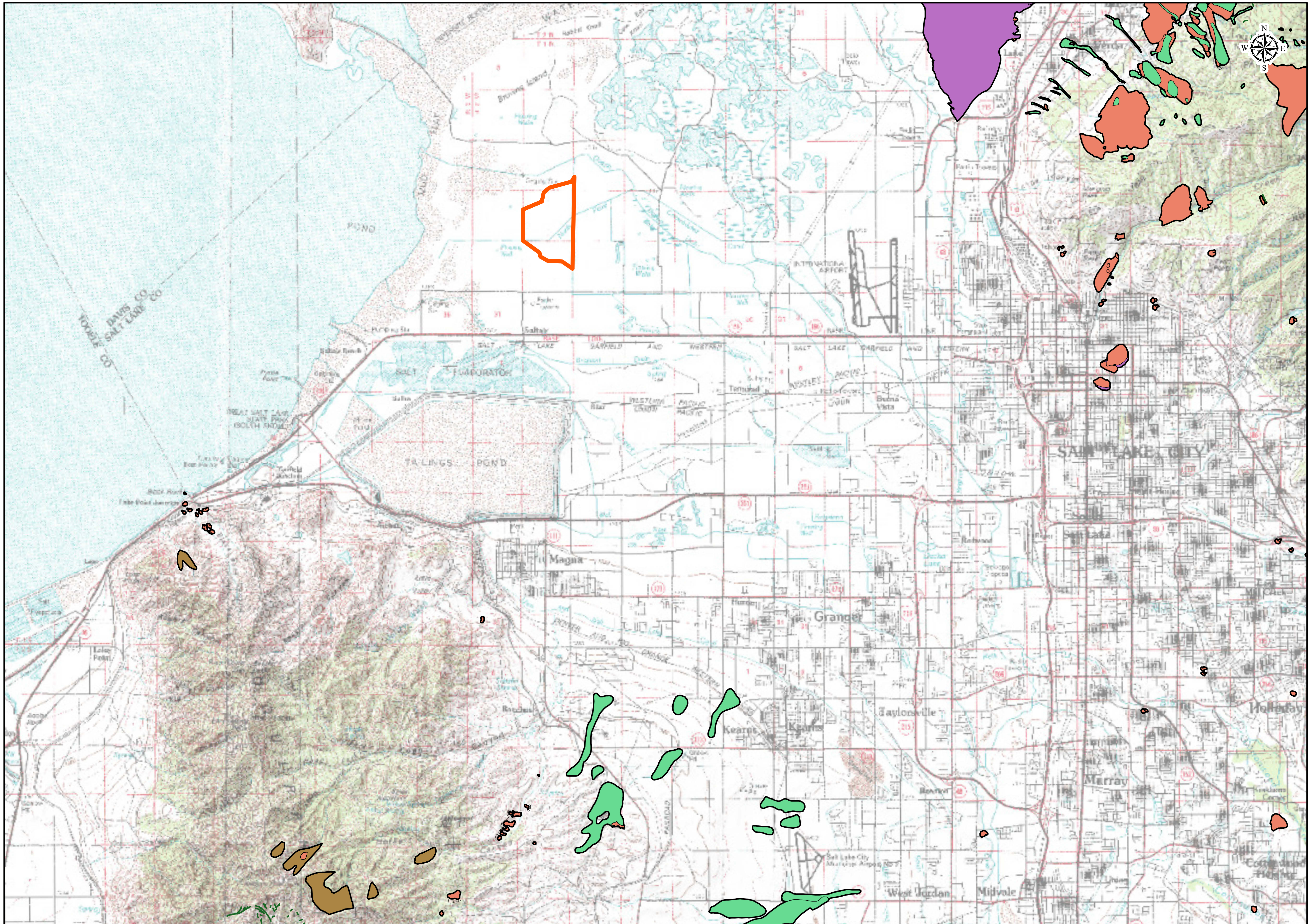
SCALES
HORIZ: 1"= 10,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED LIQUEFACTION SUSCEPTIBILITY MAP

PLAN SET: PRELIM.

FIGURE: 43



LEGEND

- STUDY AREA
- DEEP OR UNCLASSIFIED LANDSLIDE
- SHALLOW LANDSLIDE
- LANDSLIDE AND/OR UNDIFFERENTIATED FROM TALUS, ROCK-FALL, COLLUVIAL, GLACIAL, & SOIL-CREEP DEPOSITS
- LATERAL SPREAD AND/OR FLOW FAILURE

SOURCE: UTAH AGRC IMAGERY

LANDSLIDE MAPS OF UTAH. TOOELE 30'X60' QUADRANGLE BY ASHLEY ELLIOTT & KIMM HARTY. 2010.

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

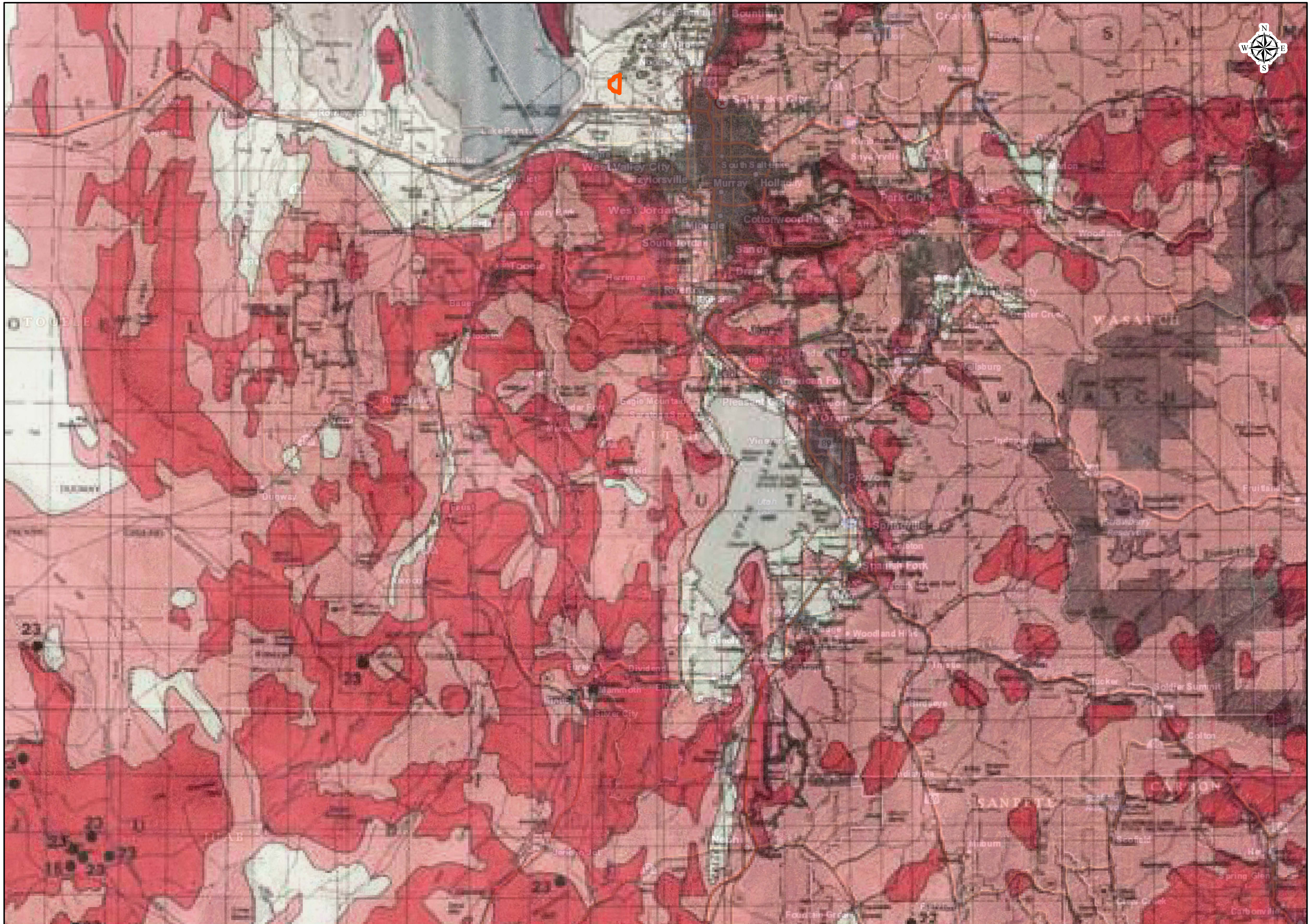
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 10,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED
LANDSLIDE MAP

PLAN SET: PRELIM.
FIGURE: 44



LEGEND

STUDY AREA

HIGH RADON POTENTIAL

MODERATE RADON POTENTIAL

LOW RADON POTENTIAL

SOURCE: UTAH AGRC IMAGERY

RADON-HAZARD POTENTIAL MAP OF UTAH. 1993. UTAH GEOLOGICAL SURVEY. BILL BLACK.

DATE
7/7/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

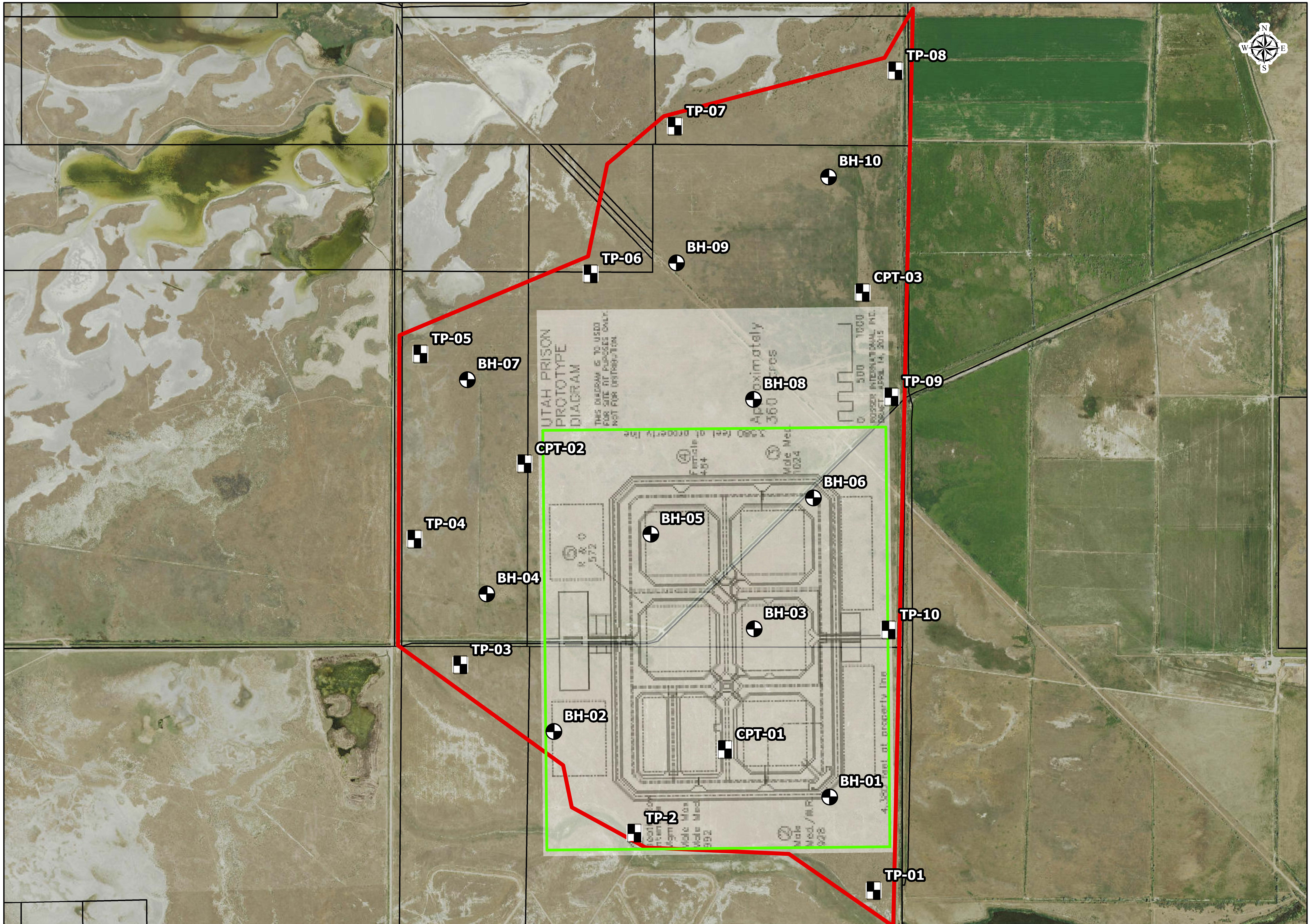
PROJECT #
15MGT004

SCALES
HORIZ: 1"= 50,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA
SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED RADON-HAZARD POTENTIAL MAP

PLAN SET: PRELIM.
FIGURE: 45



LEGEND

- BORE HOLE
- TEST PIT OR CONE PENETROMETER TESTING
- STUDY AREA
- PRELIMINARY RECOMMENDED BUILDABLE AREA
- PARCELS

SOURCE SALT LAKE COUNTY PARCELS

DATE
7/6/15

epic ENGINEERING

REVISIONS
1.

DRAWN: KMC
DESIGNER: MP
REVIEWED: JW

PROJECT #
15MGT004

SCALES
HORIZ: 1"= 1,000'
(11"X17")
0 1/2"

PROJECT NAME:
MGT OF AMERICA SITE INVESTIGATION

SHEET TITLE:
I-80/7200 WEST EXPANDED RECOMMENDED BUILDING LOCATION

PLAN SET: PRELIM.
EXHIBIT: 46

APPENDIX B
CONE PENETRATION TESTING RESULTS

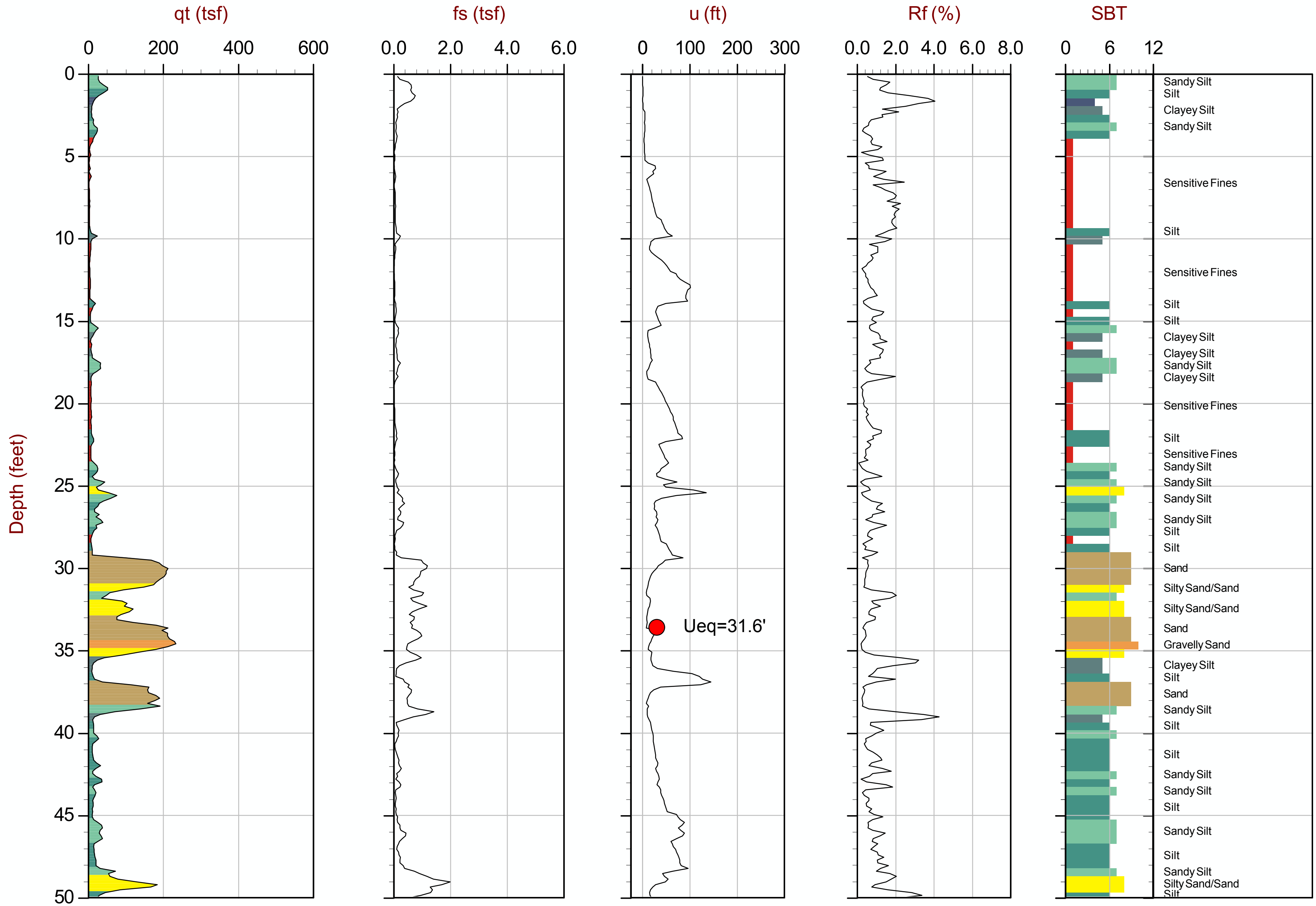
epic ENGINEERING

CONETEC

Epic Engineering

Job No: 15-52051
Date: 05:01:15 12:55
Site: I-80/7200 West Expanded

Sounding: CPT-01
Cone: 335:T1500F15U500



Max Depth: 37.750 m / 123.85 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_CP01.COR
Unit Wt: SBT Chart Soil Zones

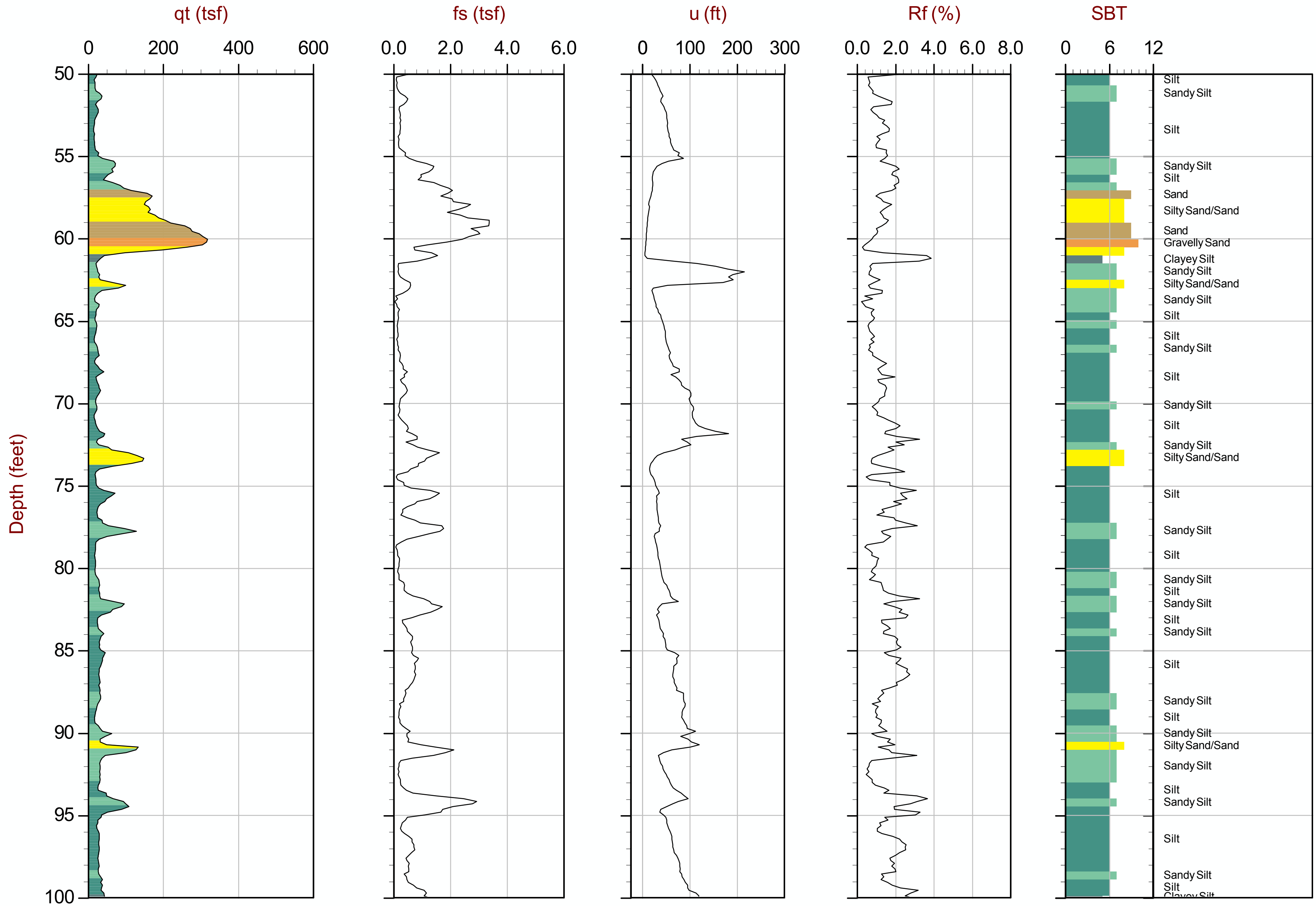
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.794330 Long: -112.088780
● Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 05:01:15 12:55
Site: I-80/7200 West Expanded

Sounding: CPT-01
Cone: 335:T1500F15U500



Max Depth: 37.750 m / 123.85 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

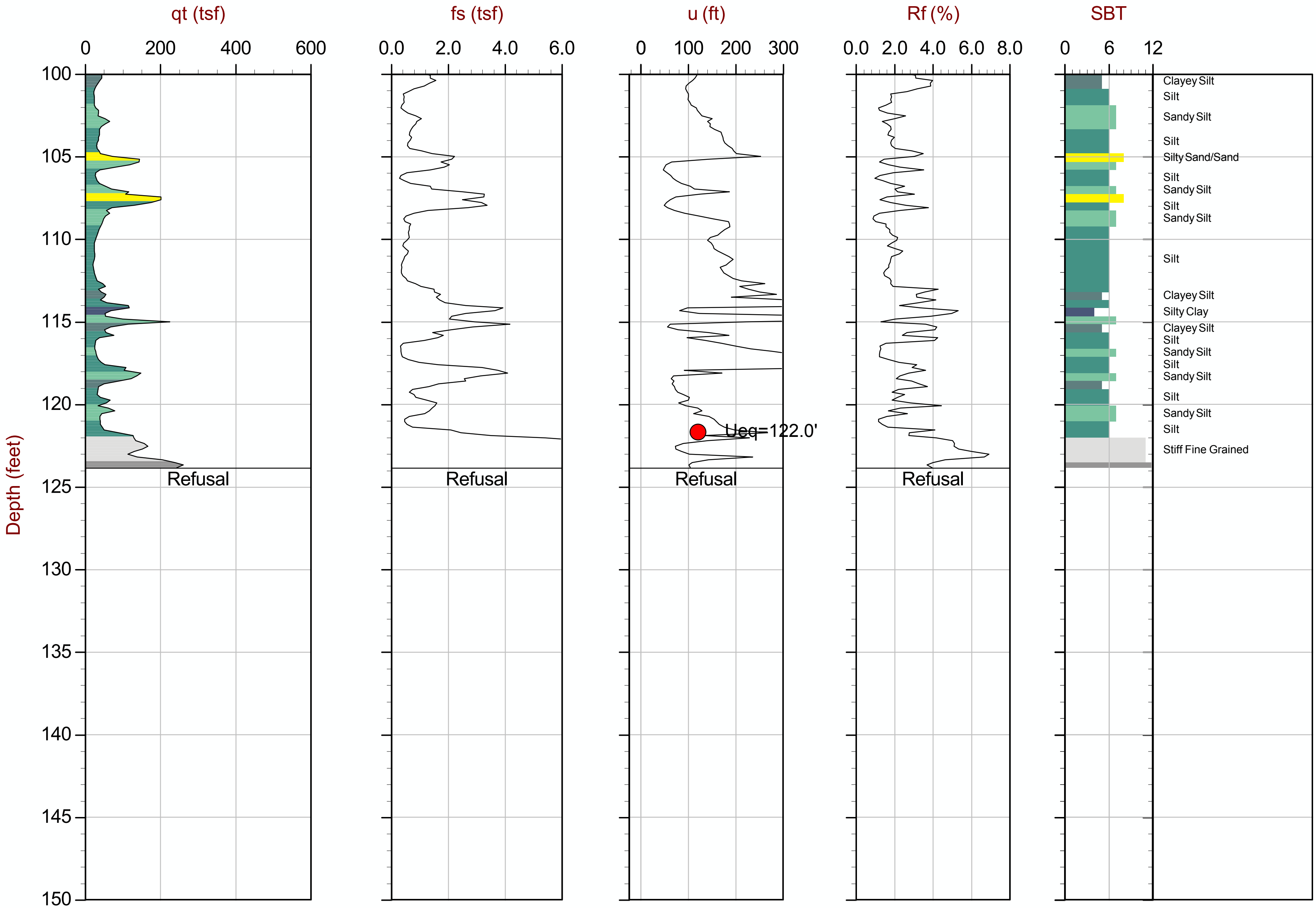
File: 15-52051_CP01.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.794330 Long: -112.088780
● Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 05:01:15 12:55
Site: I-80/7200 West Expanded
Sounding: CPT-01
Cone: 335:T1500F15U500



Max Depth: 37.750 m / 123.85 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_CP01.COR
Unit Wt: SBT Chart Soil Zones

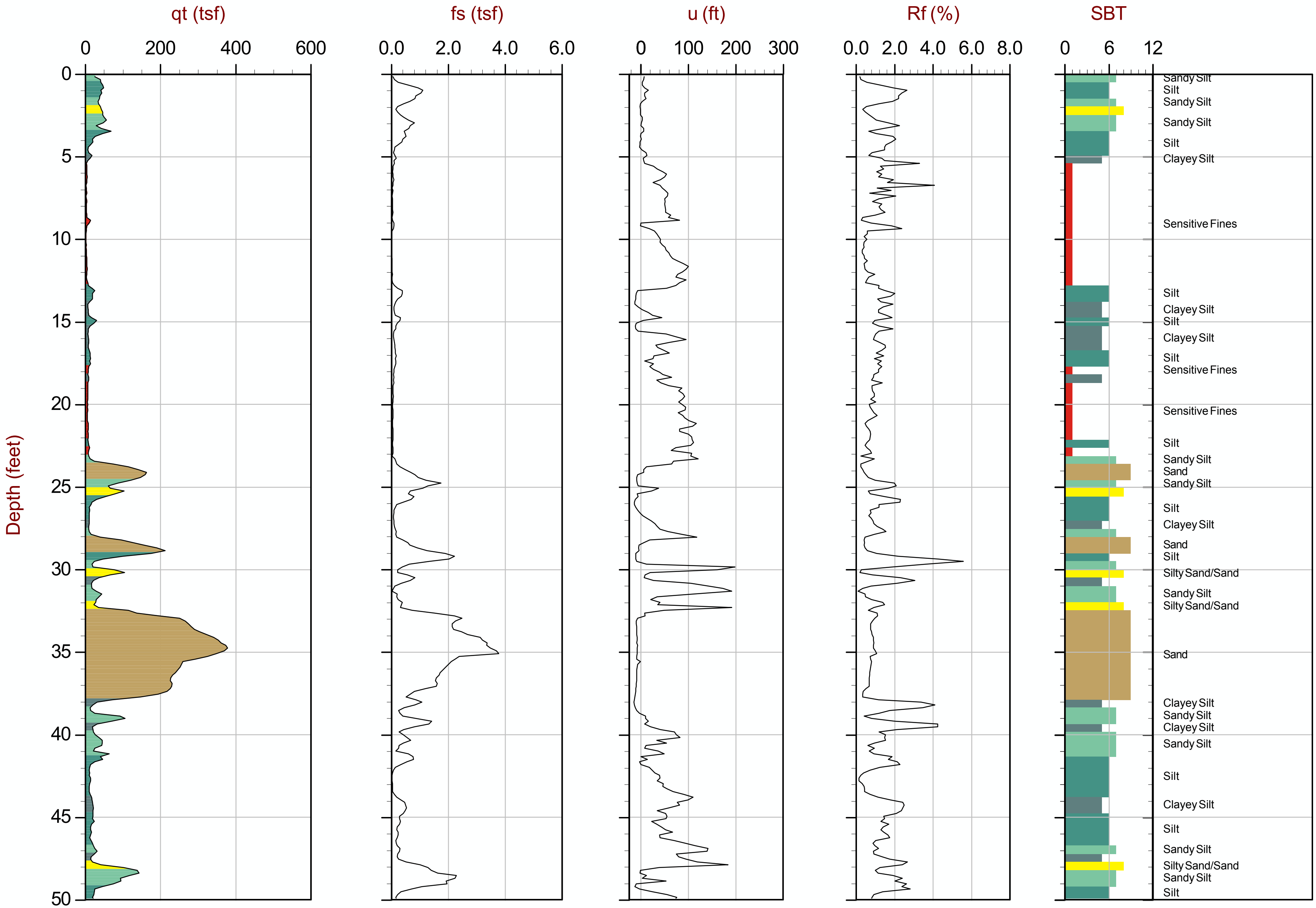
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.794330 Long: -112.088780
● Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded

Sounding: SCPT-02
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

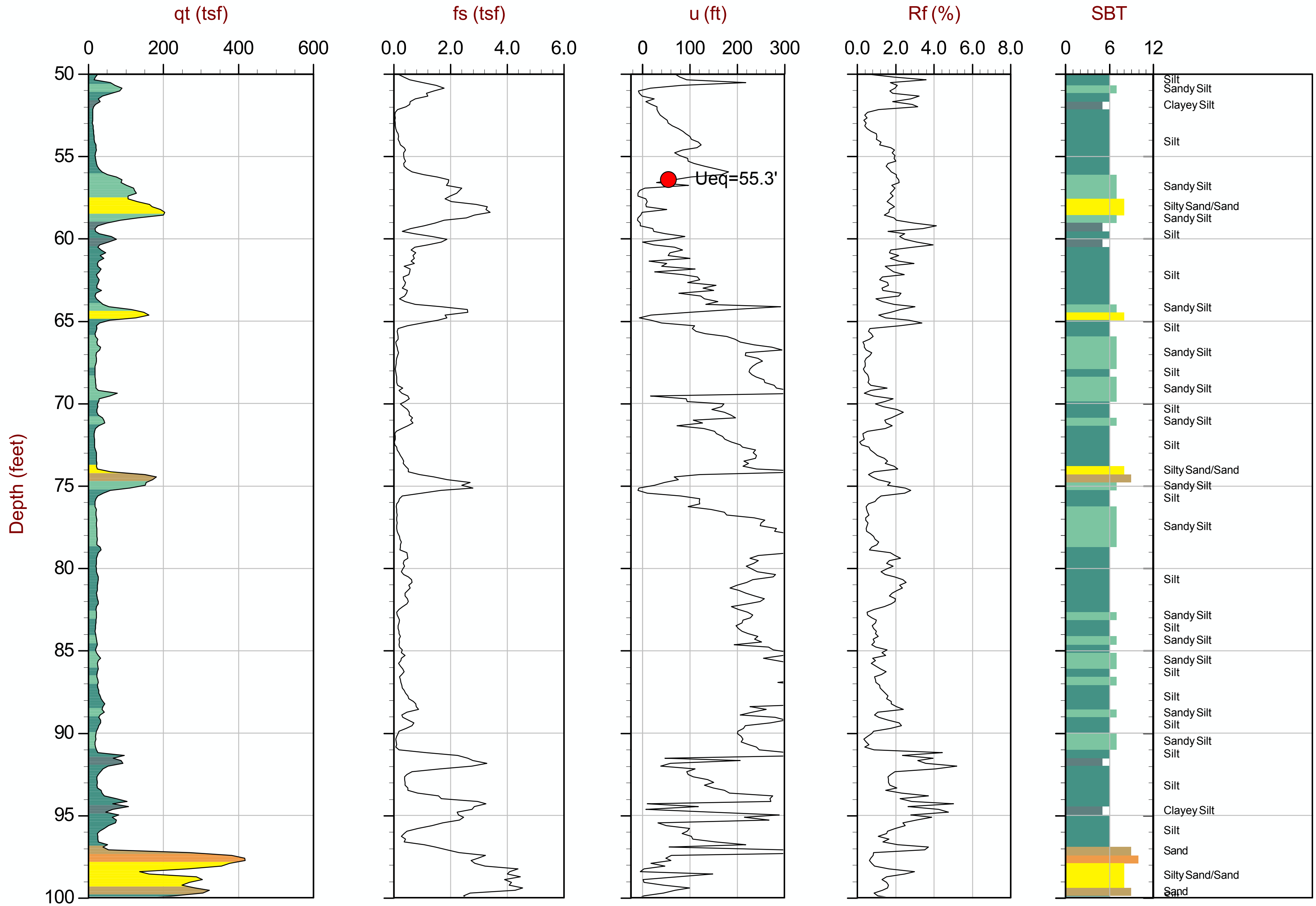
File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded
Sounding: SCPT-02
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

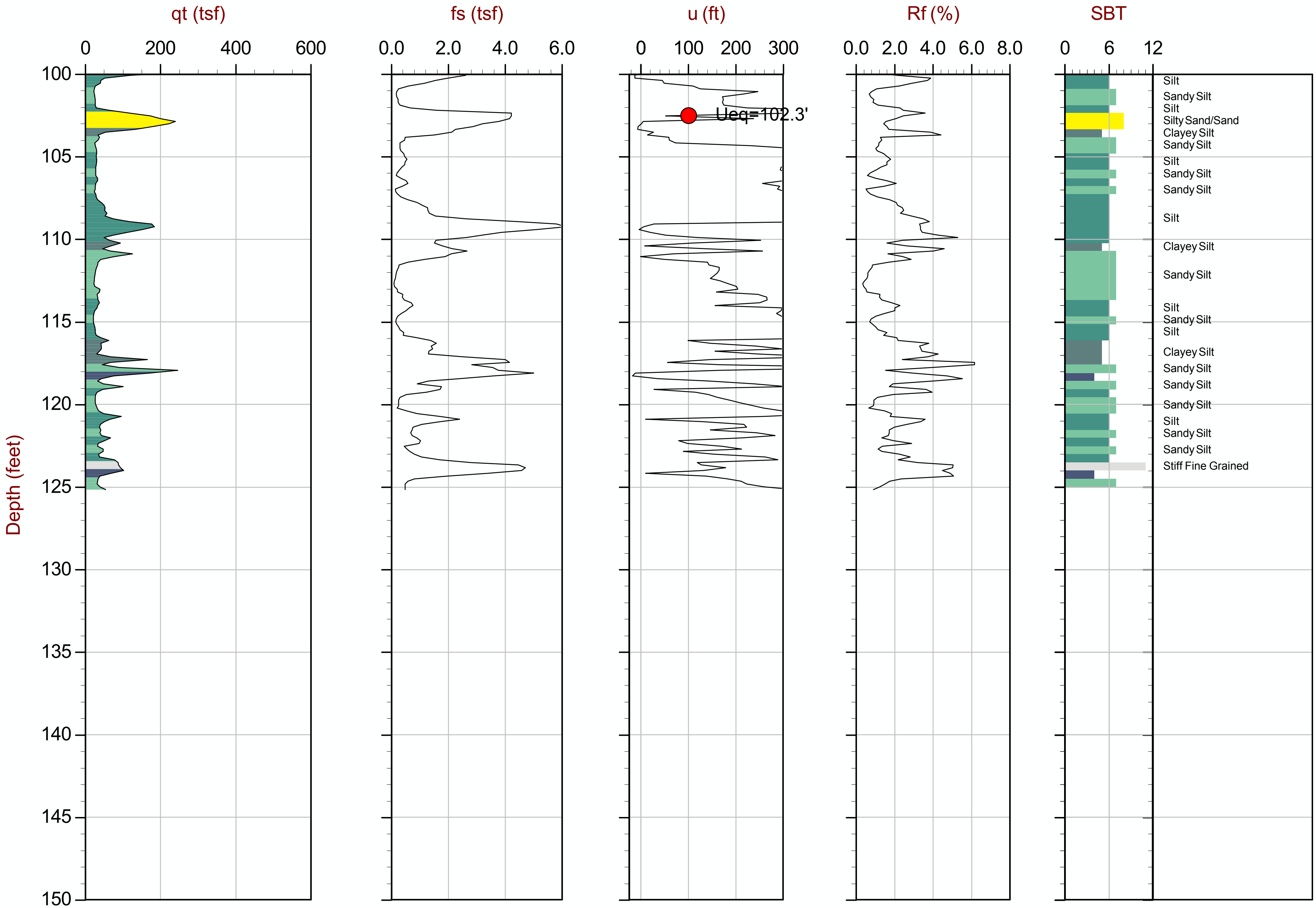
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
● Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded

Sounding: SCPT-02
Cone: 335:T1500F15U500



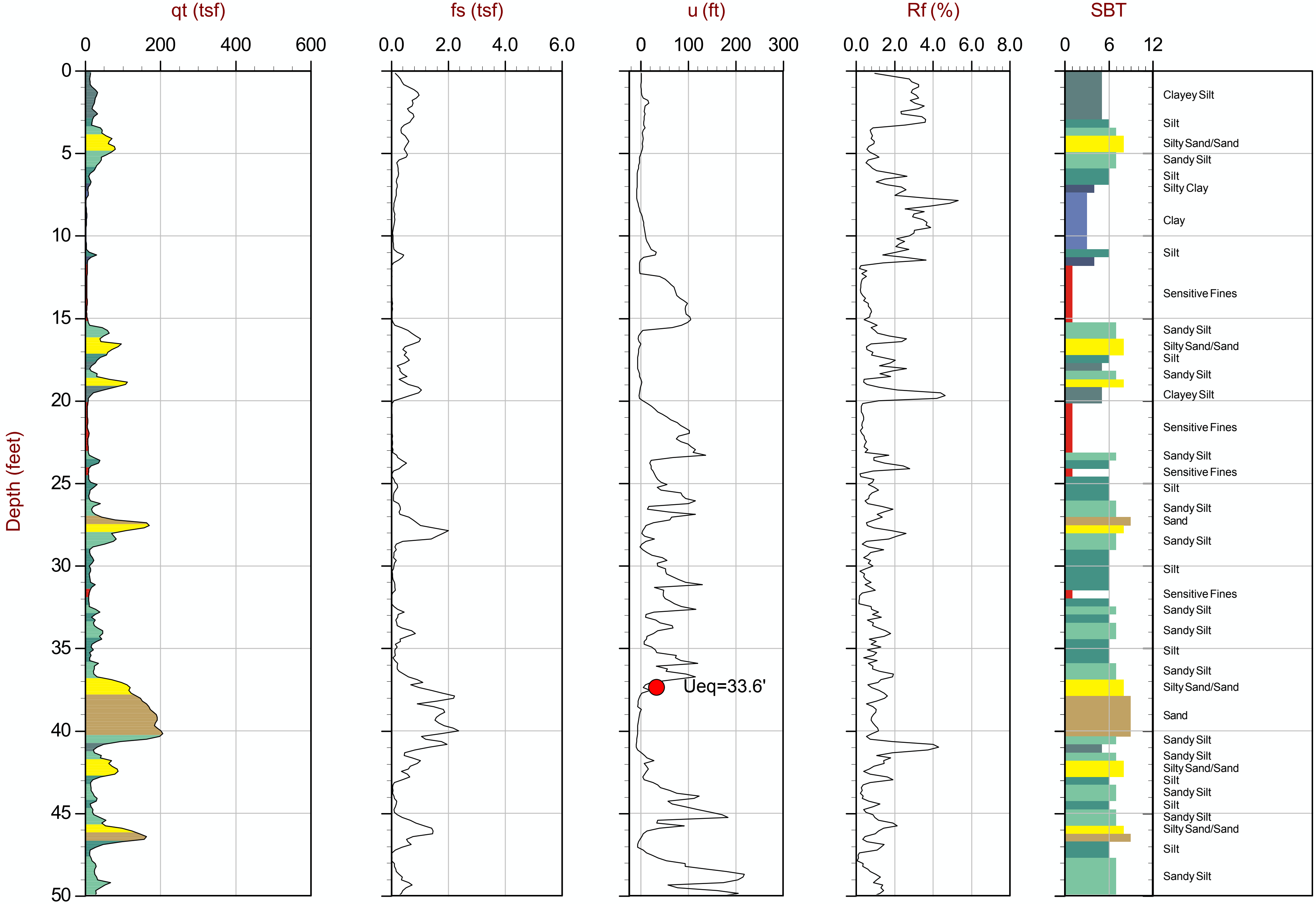
Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
Equilibrium Pore Pressure from Dissipation

Epic Engineering

Job No: 15-52051
Date: 04:30:15 14:08
Site: I-80/7200 West Expanded
Sounding: CPT-03
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

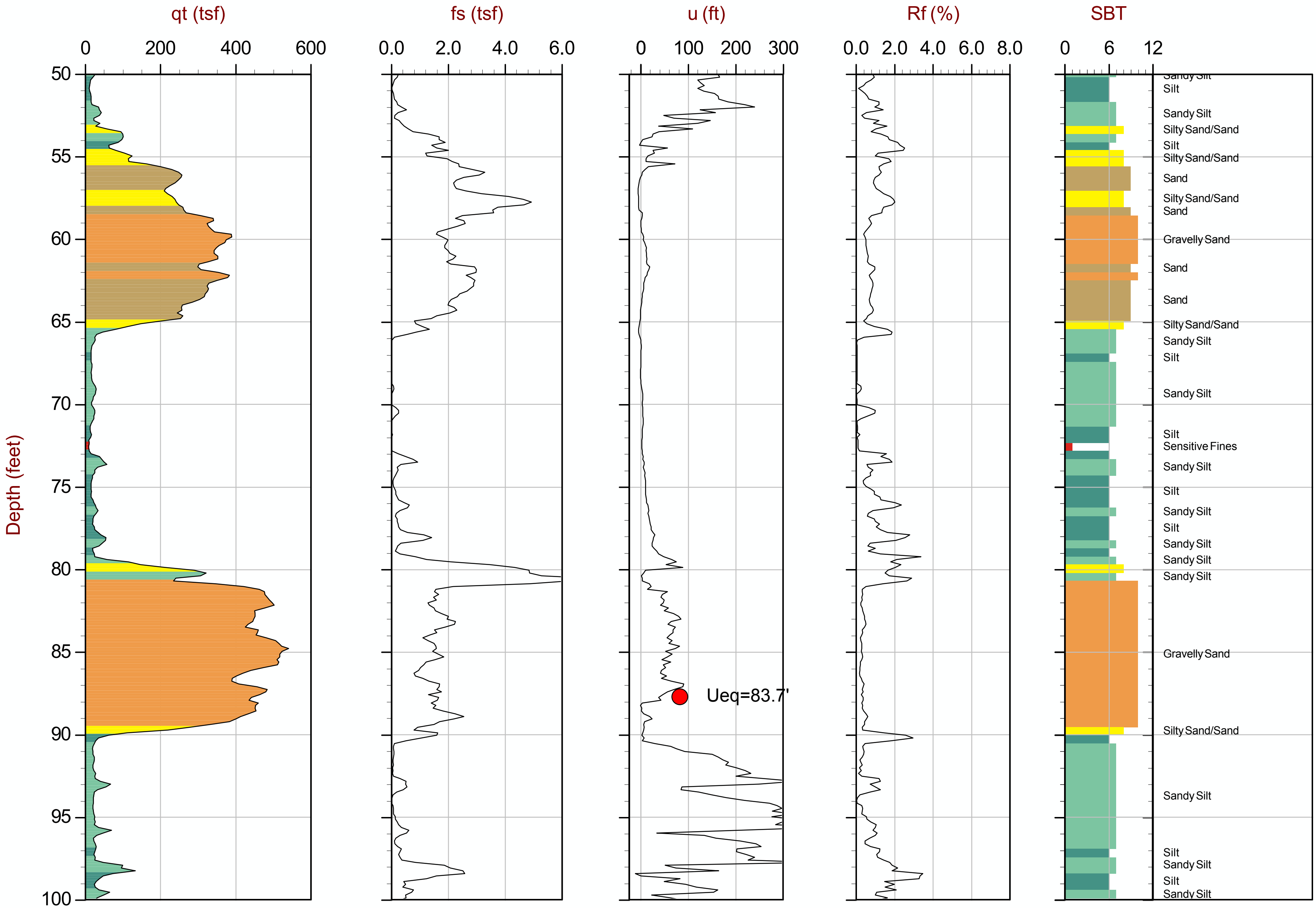
File: 15-52051_CP03.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.808330 Long: -112.084180
Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 14:08
Site: I-80/7200 West Expanded
Sounding: CPT-03
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_CP03.COR
Unit Wt: SBT Chart Soil Zones

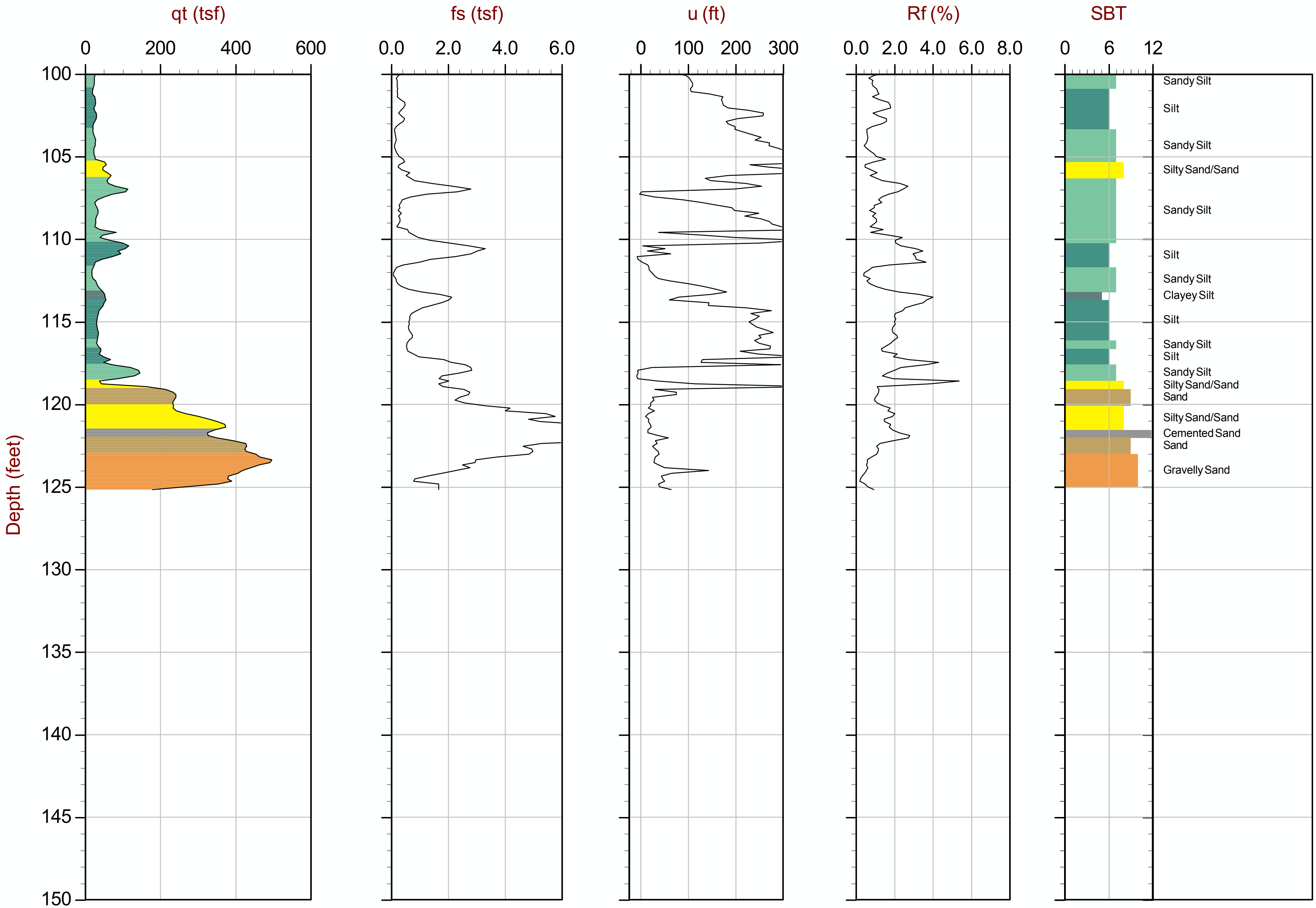
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.808330 Long: -112.084180
● Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 14:08
Site: I-80/7200 West Expanded

Sounding: CPT-03
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_CP03.COR
Unit Wt: SBT Chart Soil Zones

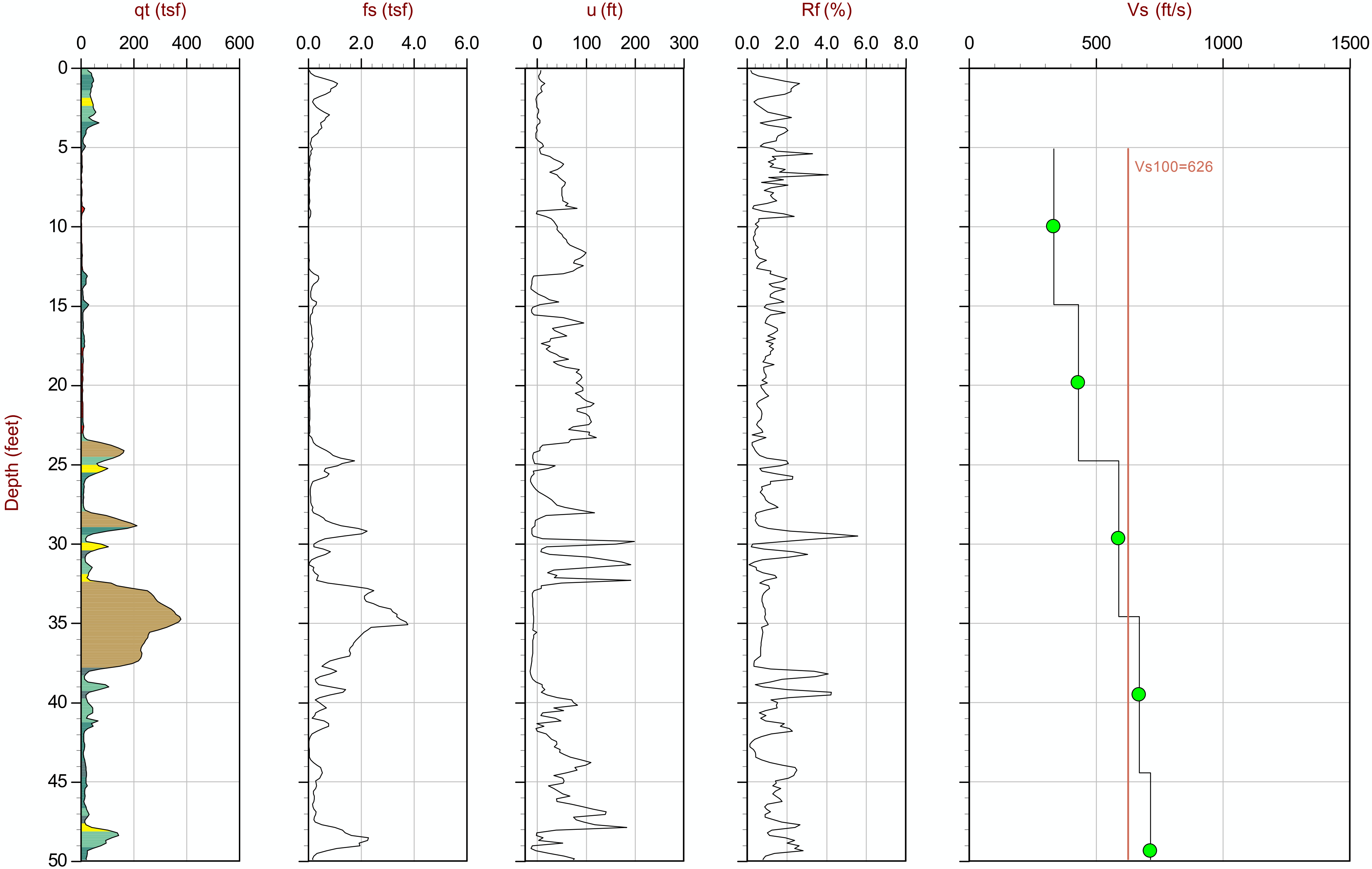
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.808330 Long: -112.084180
Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded

Sounding: SCPT-02
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

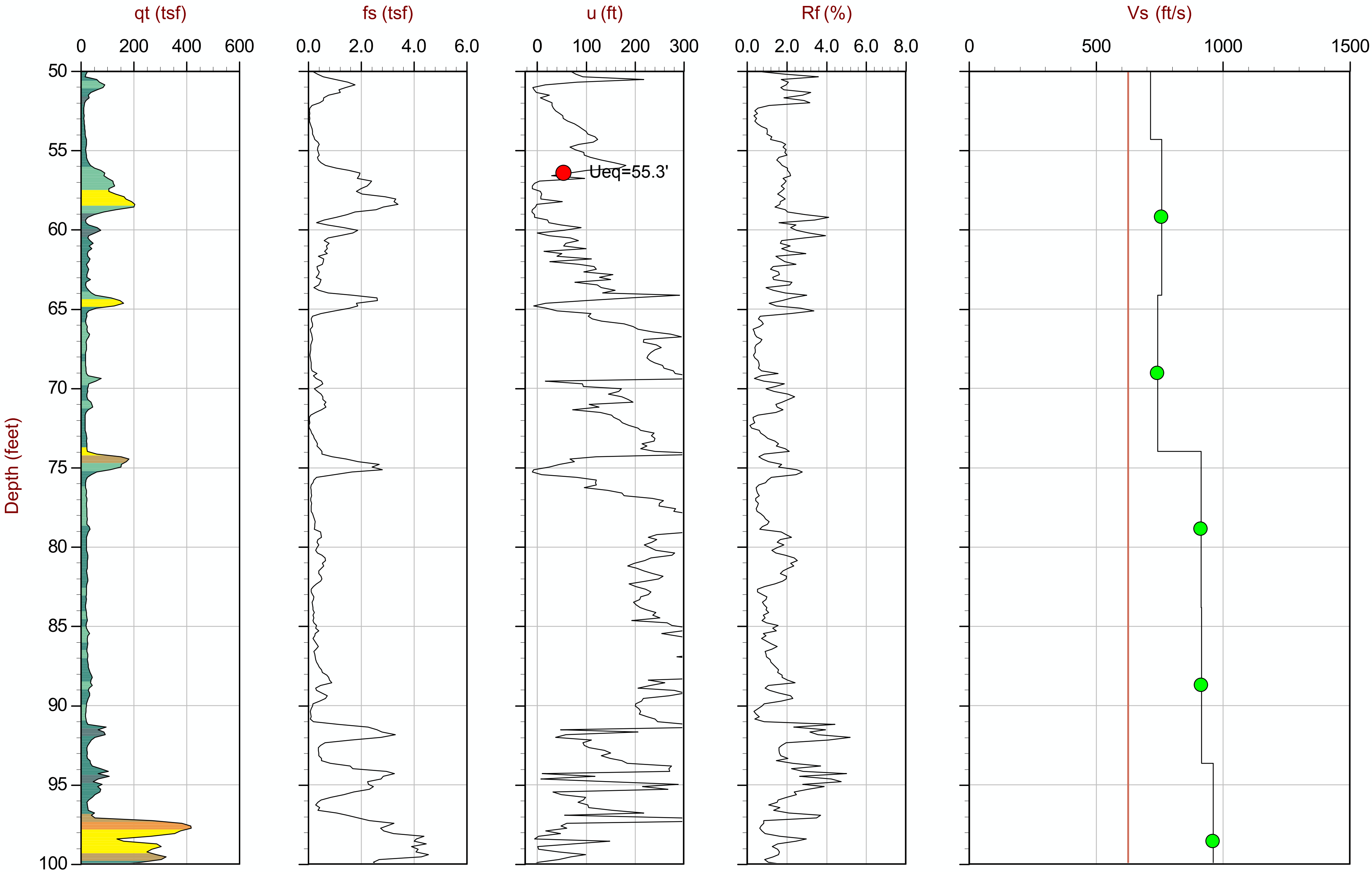
File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
Equilibrium Pore Pressure from Dissipation

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded

Sounding: SCPT-02
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

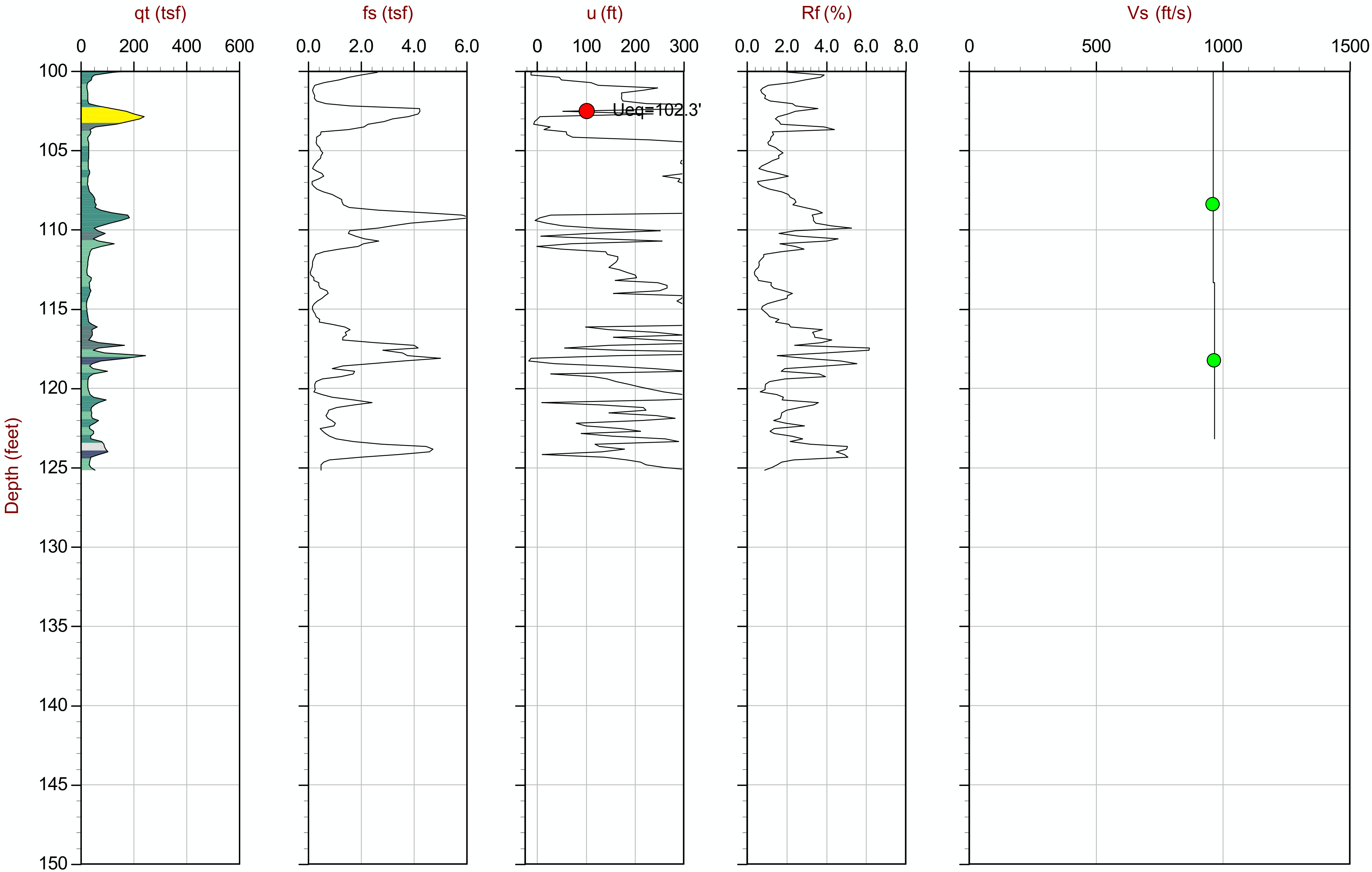
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
Equilibrium Pore Pressure from Dissipation

CONETEC

Epic Engineering

Job No: 15-52051
Date: 04:30:15 15:37
Site: I-80/7200 West Expanded

Sounding: SCPT-02
Cone: 335:T1500F15U500



Max Depth: 38.150 m / 125.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 15-52051_SP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.803550 Long: -112.096370
Equilibrium Pore Pressure from Dissipation

APPENDIX C
LABORATORY RESULTS

epic ENGINEERING

Sample ID	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Moisture Content	Dry Density (pcf)	Saturation	Void Ratio
BH-01	12.5							53.4%	67.7		
BH-01	25.0	NP	NP	NP	2.0	27.8	SM	32.5%			
BH-01	35.0	NP	NP	NP	0.6	54.1	ML	25.3%			
BH-01	45.0	NP	NP	NP	9.5	15.8	SM	22.4%			
BH-02	5.0	28	23	5	12.5	70.0	ML	43.6%			
BH-02	15.0							59.6%	66.63		
BH-02	45.0	NP	NP	NP	4.7	17.2	SM	21.3%			
BH-03	10.0							35.9%	79.7		
BH-03	25.0							31.2%	86.9		
BH-03	30.0	NP	NP	NP	2.4	69.1	ML	26.2%			
BH-03	50.0	NP	NP	NP	2.0	17.7	SM	24.3%			
BH-04	10.0							46.9%	74.6		
BH-04	20.0	37	25	12	2.0	89.7	CL	34.7%			
BH-04	40.0	NP	NP	NP	2.0	11.5	SP-SM	22.2%			
BH-05	5.0	27	21	6	9.5	70.5	CL-ML	29.3%			
BH-05	7.5							55.8%	66.8		
BH-05	15.0							37.5%	84.8		
BH-05	30.0	25	20	4	0.6	91.4	ML	30.8%			
BH-05	45.0	NP	NP	NP	0.6	81.5	ML	25.9%			
BH-06	20.0							37.7%	81.86		
BH-06	30.0	28	21	7	2.0	77.0	CL-ML	30.4%			
BH-07	12.5							49.8%	72.8		
BH-07	20.0	NP	NP	NP	0.6	13.6	SM	24.3%			
BH-07	35.0	24	18	6	2.0	27.4	SC-SM	21.8%			
BH-07	50.0							27.0%	96.48		
BH-08	2.5	21	17	4	12.5	60.8	CL-ML	17.6%			
BH-08	12.5							51.2%	71.26		
BH-08	35.0	NP	NP	NP	4.7	16.8	SM	22.3%			
BH-09	25.0							26.9%	96.8		
BH-09	40.0	NP	NP	NP	4.7	21.3	SM	22.0%			
BH-09	45.0							26.5%	96.46		
BH-10	20.0							43.2%	77.69		
BH-10	25.0	NP	NP	NP	0.6	79.5	ML	34.1%			
BH-10	40.0	23	19	4	2.0	77.8	CL-ML	20.9%			
TP-02	2.5	NP	NP	NP	16.0	50.9	ML	21.3%			
TP-05	2.5	38	25	13			ML				
TP-06	3.0	NP	NP	NP	12.5	42.5	SM	13.5%			
TP-09	3.0	28	21	7	2.4	75.0	ML	24.2%			
TP-01	2.0	Collapse Potential		=0.3%				22.7%	102.62		
TP-04	2.3	Collapse Potential		=0.2%				31.8%	87.58		
TP-08	2.0	Collapse Potential		=1.3%				15.6%	94.5		
TP-10	2.0	Collapse Potential		=0.4%				26.6%	89.82		

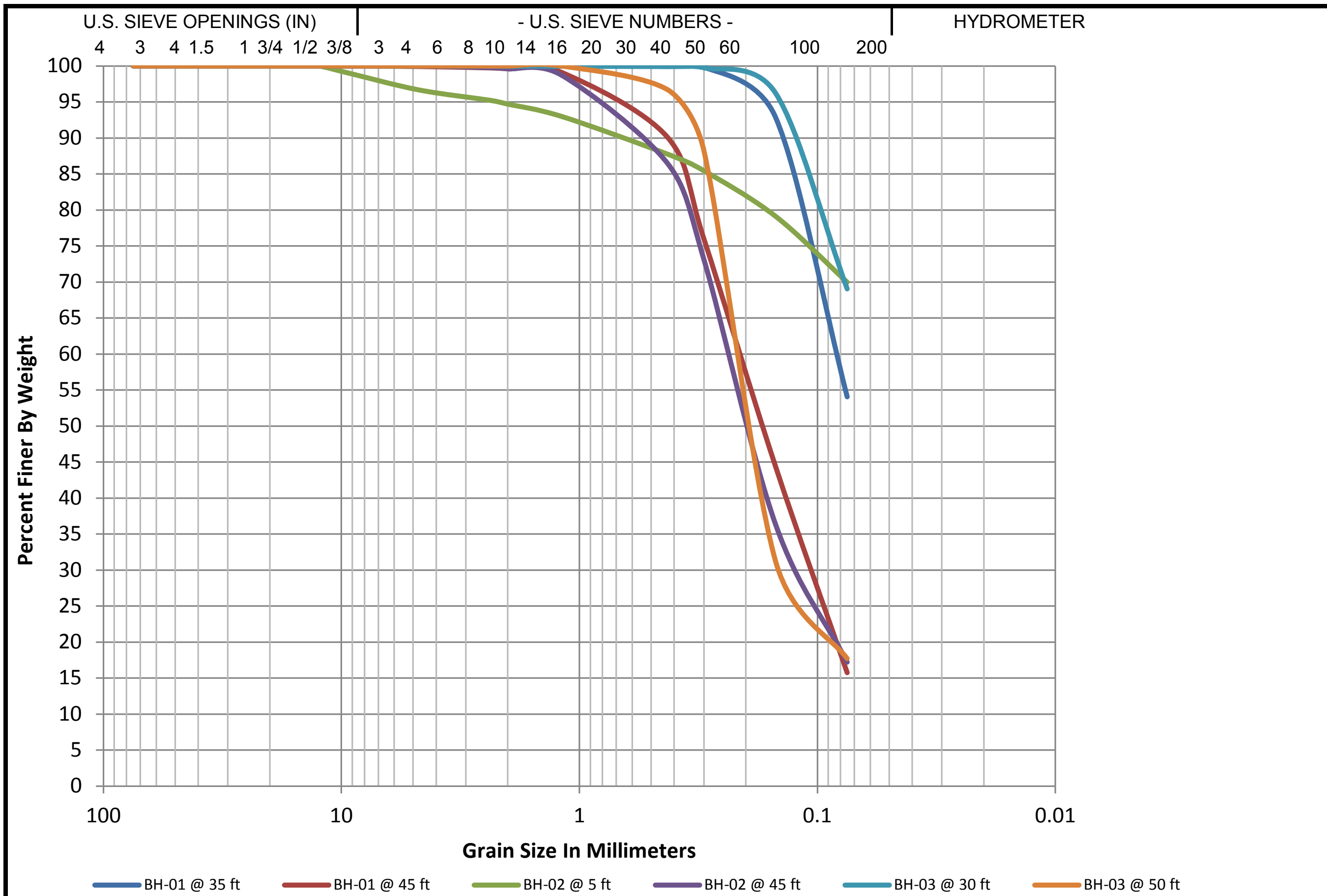
epic ENGINEERING

Summary of Laboratory Results

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15MGT004



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
BH-01	35.0	SANDY SILT (ML)	NP	NP	NP	1.44	6.23
BH-01	45.0	SILTY SAND (SM)	NP	NP	NP	1.18	4.71
BH-02	5.0	SANDY SILT (ML)	28	23	5	1.50	6.00
BH-02	45.0	SILTY SAND (SM)	NP	NP	NP	1.46	5.66
BH-03	30.0	SANDY SILT (ML)	NP	NP	NP	1.50	6.00
BH-03	50.0	SILTY SAND (SM)	NP	NP	NP	2.14	5.33

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
BH-01	35.0	0.59	0.09	0.04	0.01	0.0	45.9	54.1	A-4
BH-01	45.0	9.50	0.22	0.11	0.05	0.4	83.8	15.8	A-2-4
BH-02	5.0	12.50	0.06	0.03	0.01	5.3	24.7	70.0	A-4
BH-02	45.0	4.75	0.25	0.13	0.04	0.4	82.4	17.2	A-2-4
BH-03	30.0	2.36	0.07	0.03	0.01	0.0	30.9	69.1	A-4
BH-03	50.0	2.00	0.23	0.14	0.04	0.0	82.3	17.7	A-2-4

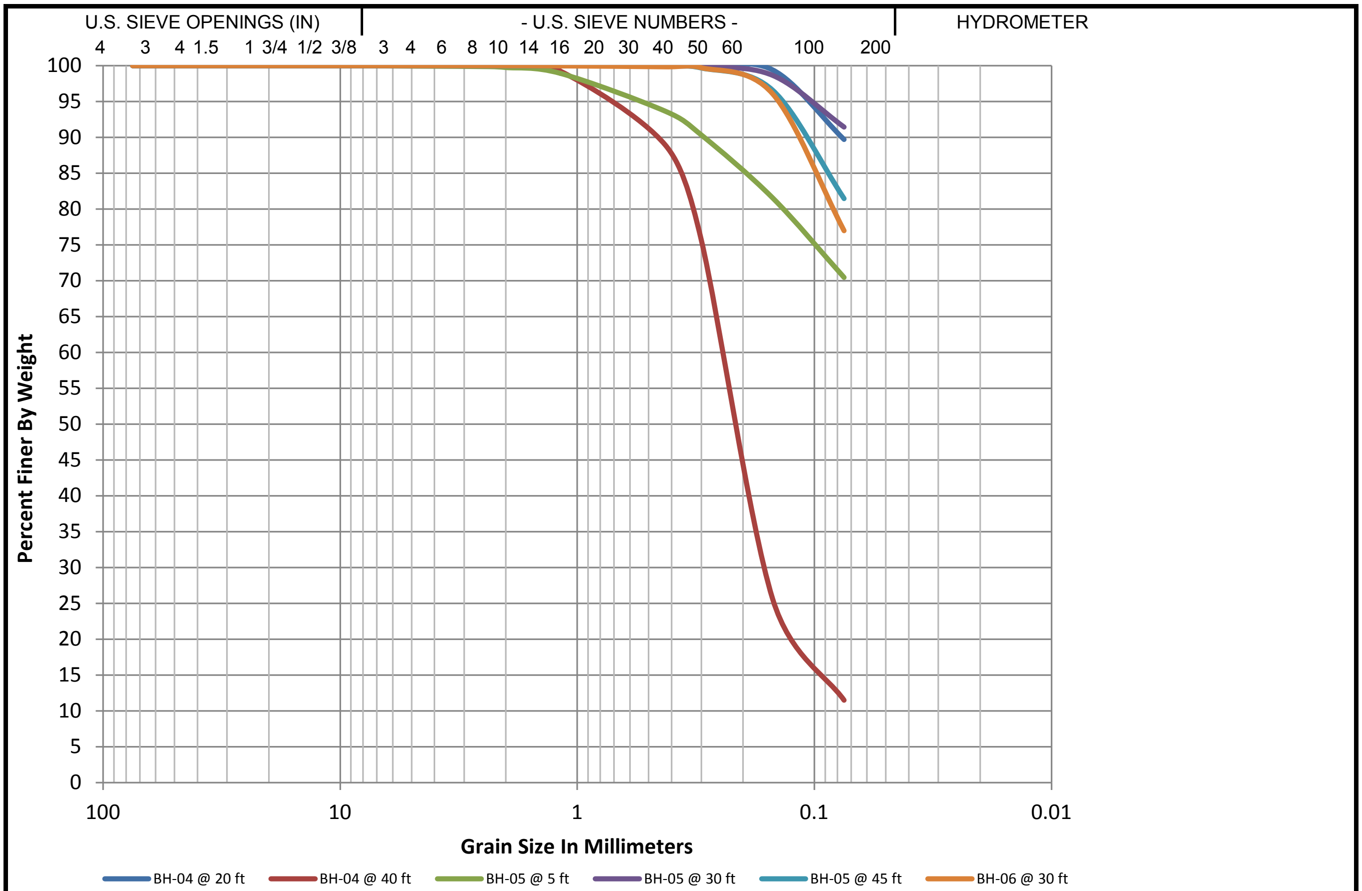
epic ENGINEERING
50 E 100 S Heber City Utah 84032
Ph 435-654-6600 Fax 435-654-6622

ASTM D6913 Particle Size Distribution

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15MGT004 Date: 4/21/2015



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
BH-04	20.0	LEAN CLAY (CL)	37	25	12	1.50	6.00
BH-04	40.0	POORLY-GRADED SAND with SILT (SP-SM)	NP	NP	NP	1.61	3.88
BH-05	5.0	SANDY SILTY CLAY (CL-ML)	27	21	6	1.50	6.00
BH-05	30.0	SILT (ML)	25	20	4	1.50	6.00
BH-05	45.0	SILT with SAND (ML)	NP	NP	NP	1.50	6.00
BH-06	30.0	SILTY CLAY with SAND (CL-ML)	28	21	7	1.50	6.00

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
BH-04	20.0	2.00	0.05	0.03	0.01	0.0	10.3	89.7	A-6
BH-04	40.0	2.00	0.25	0.16	0.07	0.0	88.5	11.5	A-2-4
BH-05	5.0	9.50	0.06	0.03	0.01	0.2	29.3	70.5	A-4
BH-05	30.0	0.59	0.05	0.02	0.01	0.0	8.6	91.4	A-4
BH-05	45.0	0.59	0.06	0.03	0.01	0.0	18.5	81.5	A-4
BH-06	30.0	2.00	0.06	0.03	0.01	0.0	23.0	77.0	A-4

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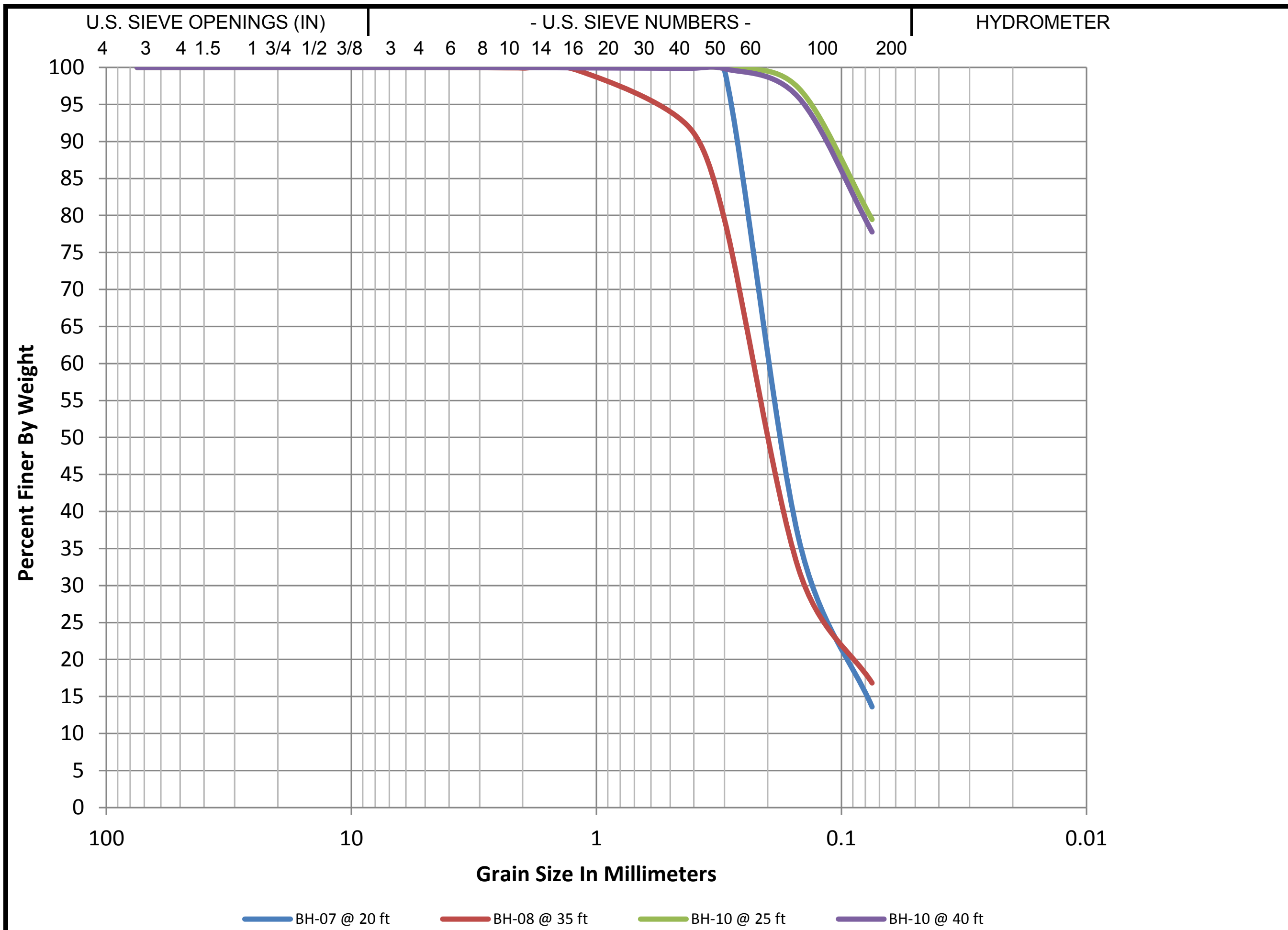
ASTM D6913 Particle Size Distribution

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15-MGT004 Date: 4/21/2015



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
BH-07	20.0	SILTY SAND (SM)	NP	NP	NP	1.46	3.73
BH-08	35.0	SILTY SAND (SM)	NP	NP	NP	1.81	5.34
BH-10	25.0	SILT with SAND (ML)	NP	NP	NP	1.50	6.00
BH-10	40.0	SILTY CLAY with SAND (CL-ML)	23	19	4	1.50	6.00

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
BH-07	20.0	0.59	0.21	0.13	0.06	0.0	86.4	13.6	A-2-4
BH-08	35.0	4.75	0.24	0.14	0.04	0.1	83.1	16.8	A-2-4
BH-10	25.0	0.59	0.06	0.03	0.01	0.0	20.5	79.5	A-4
BH-10	40.0	2.00	0.06	0.03	0.01	0.0	22.2	77.8	A-4

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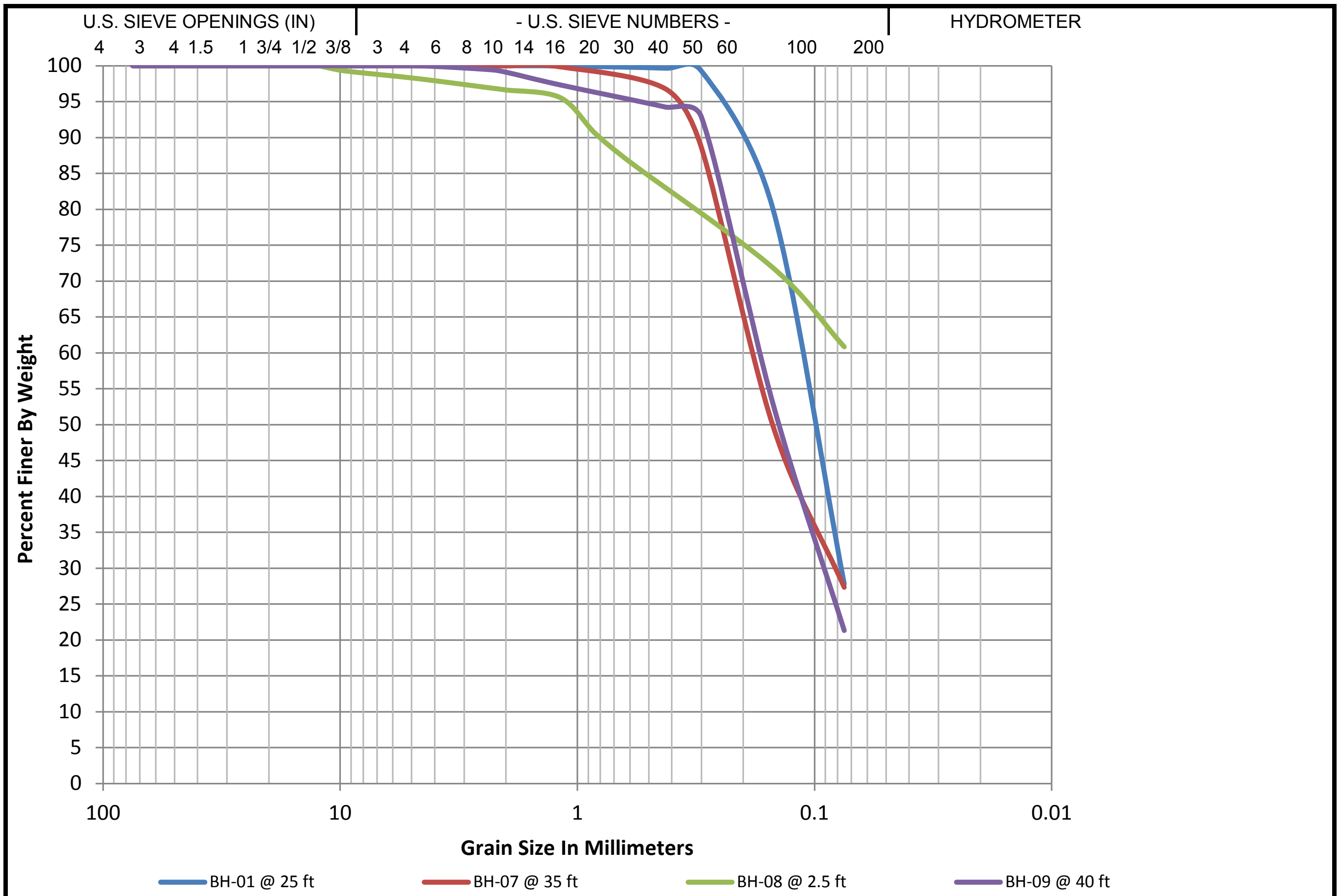
ASTM D6913 Particle Size Distribution

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15-MGT004 Date: 4/21/2015



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
BH-01	25.0	SILTY SAND (SM)	NP	NP	NP	1.87	4.49
BH-07	35.0	SILTY, CLAYEY SAND (SC-SM)	24	18	6	1.35	6.90
BH-08	2.5	SANDY SILTY CLAY (CL-ML)	21	17	4	1.50	6.00
BH-09	40.0	SILTY SAND (SM)	NP	NP	NP	1.47	5.02

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
BH-01	25.0	2.00	0.12	0.08	0.03	0.0	72.2	27.8	A-2-4
BH-07	35.0	2.00	0.19	0.08	0.03	0.0	72.6	27.4	A-2-4
BH-08	2.5	12.50	0.07	0.04	0.01	3.4	35.8	60.8	A-4
BH-09	40.0	4.75	0.18	0.10	0.04	0.9	77.8	21.3	A-2-4

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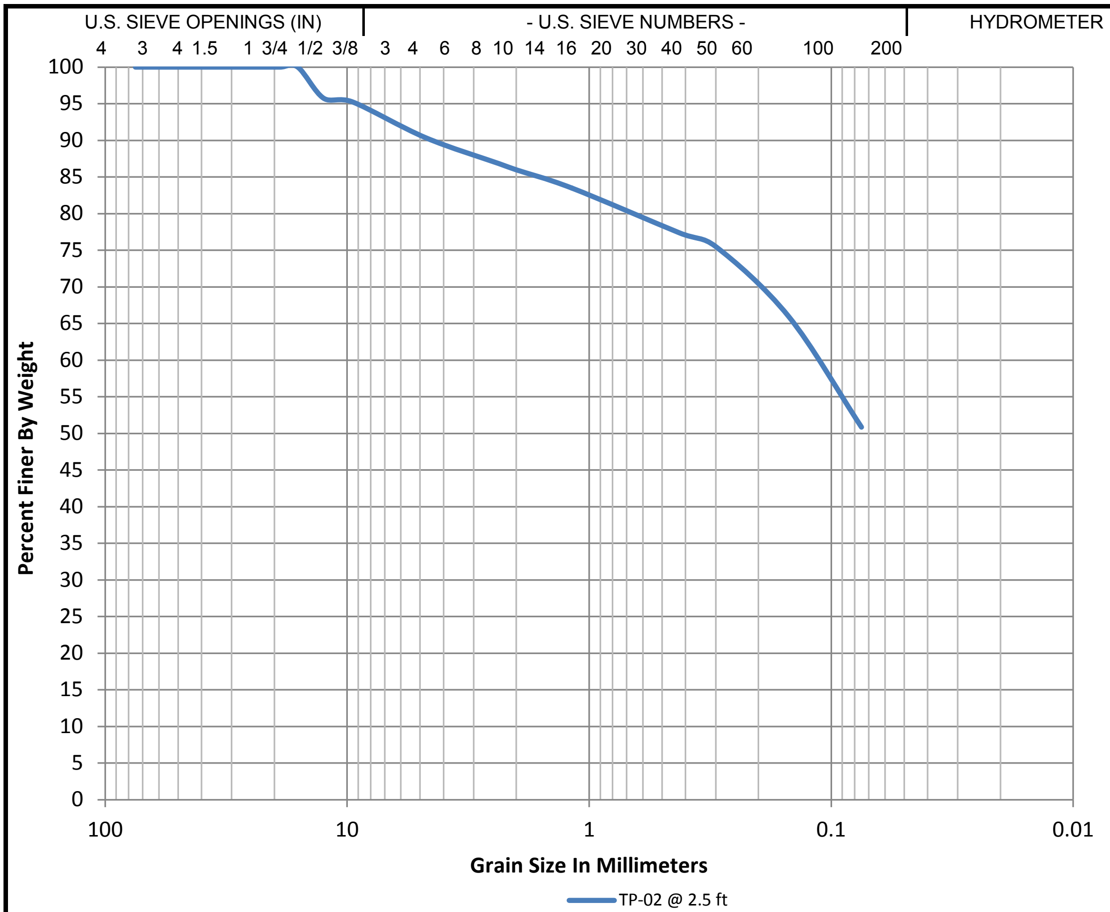
ASTM D6913 Particle Size Distribution

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15-MGT004 Date: 4/21/2015



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
TP-02	2.5	SANDY SILT (ML)	NP	NP	NP	1.10	8.16

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
TP-02	2.5	16.00	0.12	0.04	0.01	14.0	35.1	50.9	A-4

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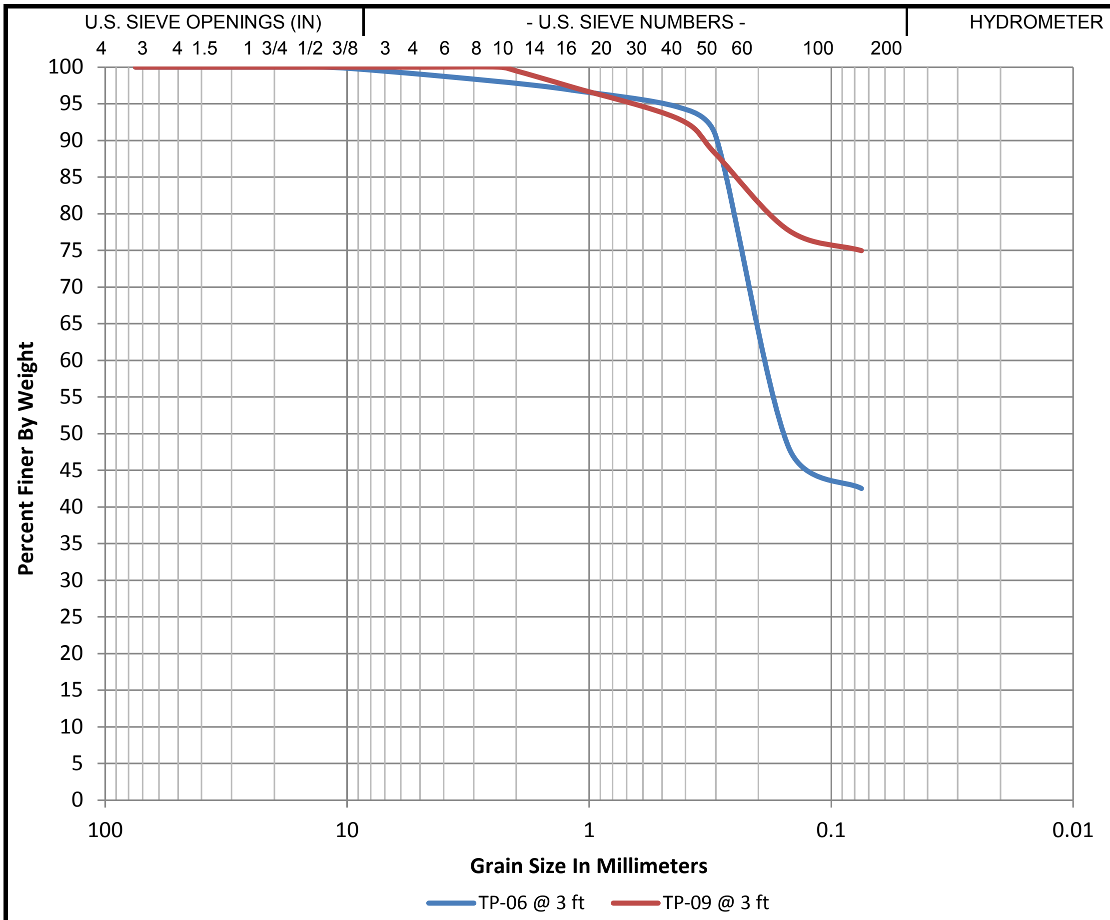
ASTM D6913 Particle Size Distribution

Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15MGT004 Date: 4/21/2015



COBBLES	GRAVEL		SAND			SILT AND CLAY
	course	fine	course	medium	fine	

Specimen ID	Depth	ASTM Classification	LL	PL	PI	Cc	Cu
TP-06	3.0	SILTY SAND (SM)	NP	NP	NP	0.83	10.88
TP-09	3.0	SILT with SAND (ML)	NP	NP	NP	1.50	6.00

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt/Clay	AASHTO
TP-06	3.0	12.50	0.19	0.05	0.02	2.2	55.3	42.5	A-4
TP-09	3.0	2.36	0.06	0.03	0.01	0.5	24.5	75.0	A-4

ASTM D6913 Particle Size Distribution

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Project: I-80/7200 West Expanded Site Preliminary Geotechnical Invest.

Location: Salt Lake City, Utah

Epic Job No: 15MGT004 Date: 5/4/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-01 **Depth:** 25 ft
Sample Description: Dark gray Silty SAND (SM)

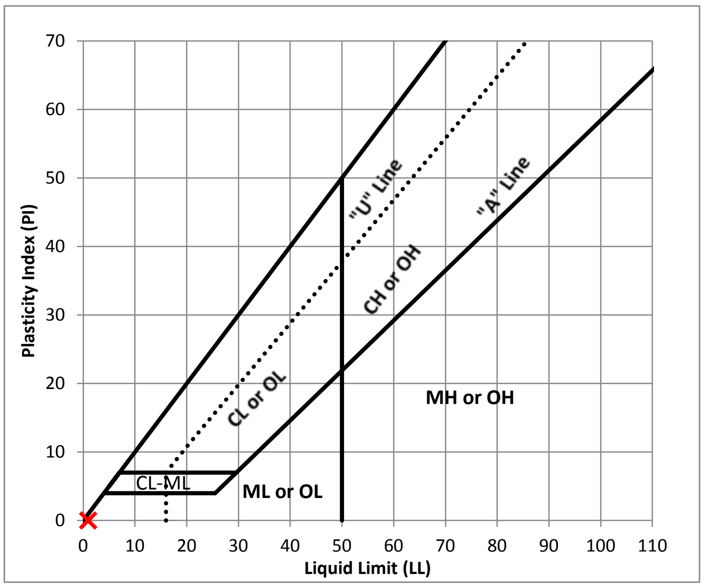
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

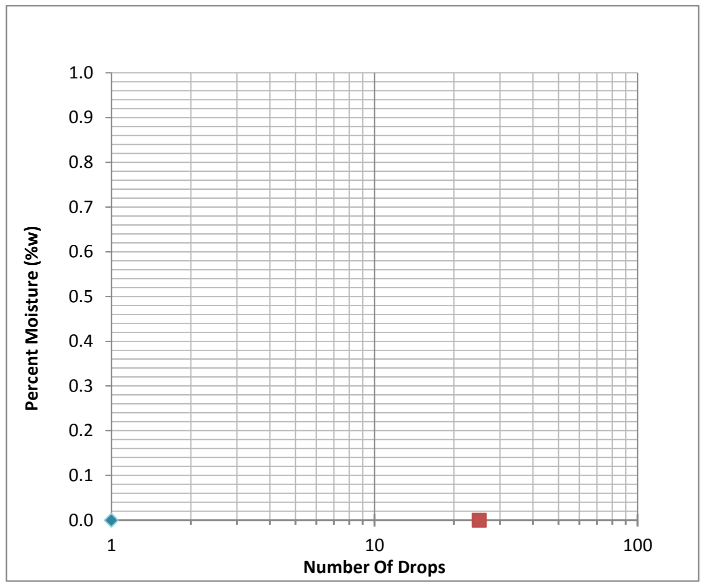
Liquid Limit	**LL**			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	**PL**		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 blows: **Non-Plastic**
PI = LL - PL: **Non-Plastic**





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/20/2015
Date Tested: 5/7/2015
Date Entered: 5/26/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-01 **Depth:** 35 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

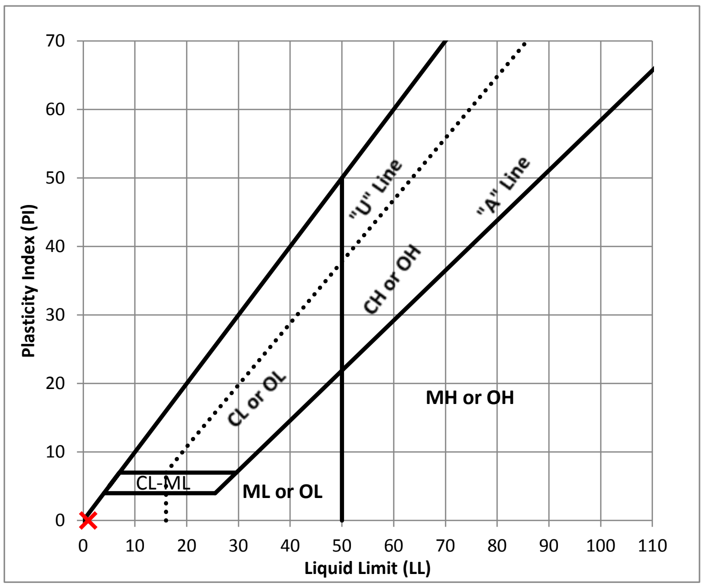
Sample Description: Dark gray Sandy SILT (ML)

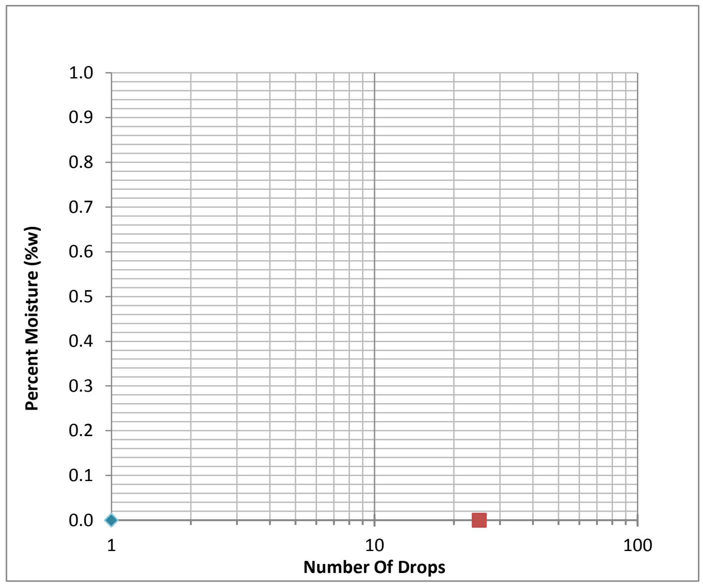
Liquid Limit	**LL**			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	**PL**		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 blows: Non-Plastic
PI = LL - PL: Non-Plastic





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-02 **Depth:** 5 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

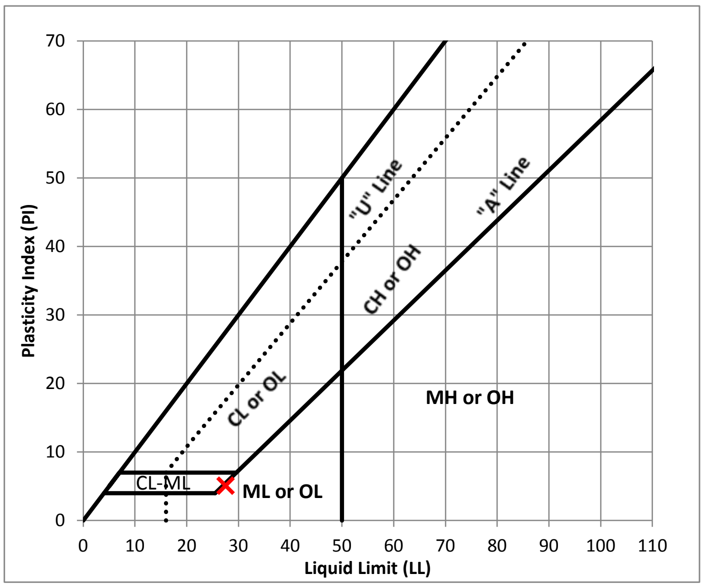
Sample Description: Gray Sandy SILT (ML)

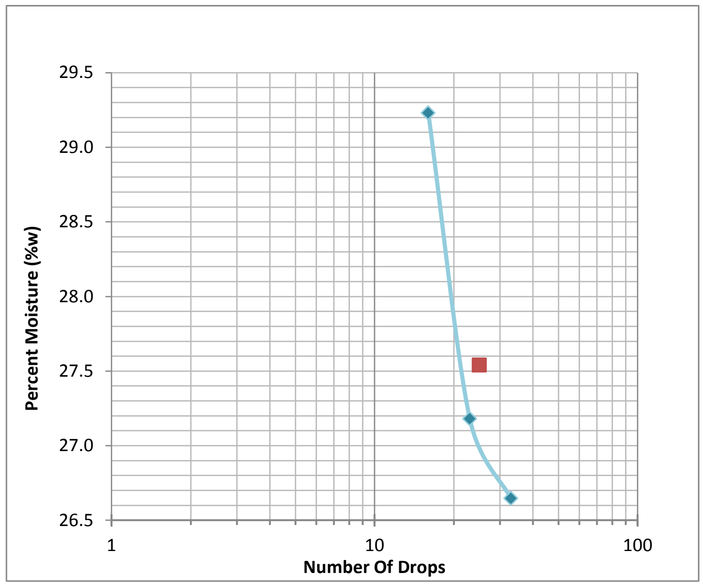
Liquid Limit	**LL**	SE 15	SE 14	SE 8
	can	13.77	13.52	13.78
	can+wet	30.69	33.78	30.89
	can+dry	27.13	29.45	27.02
	dry soil	13.36	15.93	13.24
	Mw	3.56	4.33	3.87
	w%	26.6	27.2	29.2
	drops	33	23	16

Preparation Method: Dry
Method: A
Comments: A-3

Plastic Limit	**PL**	B-2	D-2
	can	13.57	13.7
	can+wet	23.28	23.62
	can+dry	21.51	21.79
	dry soil	7.94	8.09
	Mw	1.77	1.83
	w%	22.3	22.6
	Average	22.5	

Liquid Limit @ 25	**28**	**blows**
PI = LL - PL	**5**	





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-02 **Depth:** 45 ft
Sample Description: Gray Silty SAND (SM)

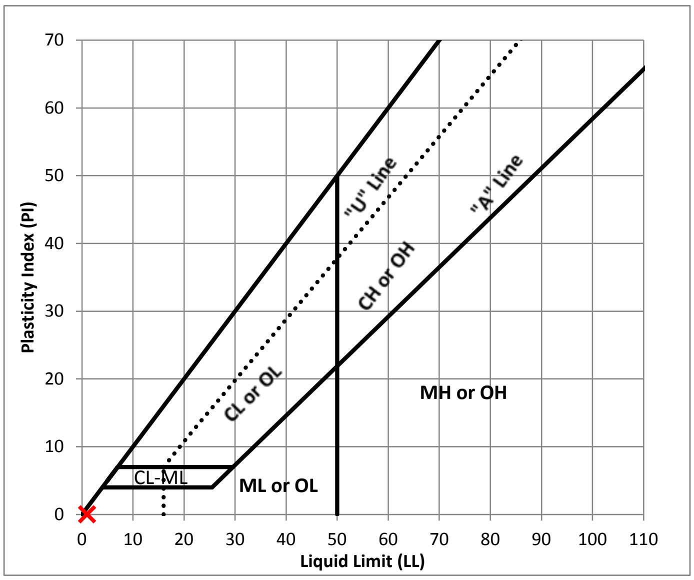
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

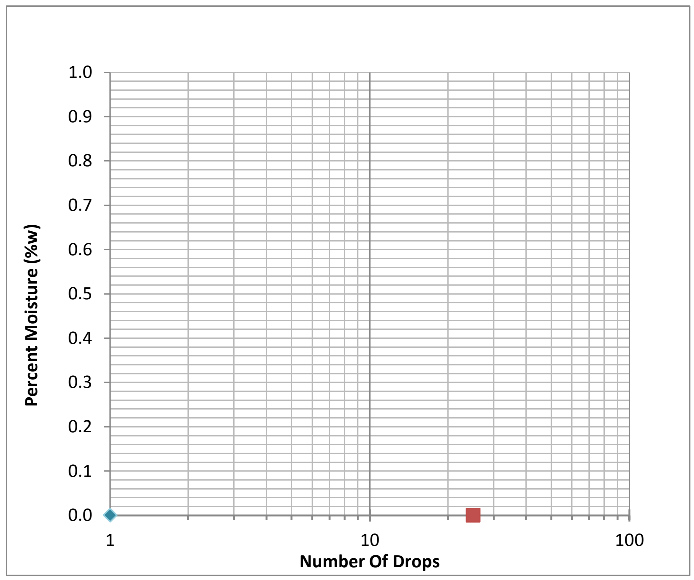
Liquid Limit	LL			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	PL		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 Non-Plastic **blows**
PI = LL - PL





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/21/2015
Date Tested: 4/27/2015
Date Entered: 5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-03 **Depth:** 30 ft
Sample Description: Dark gray Sandy SILT (ML)

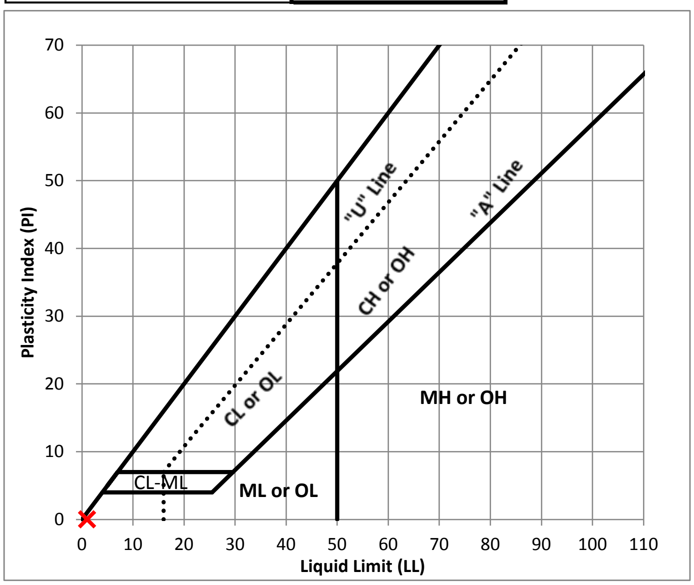
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

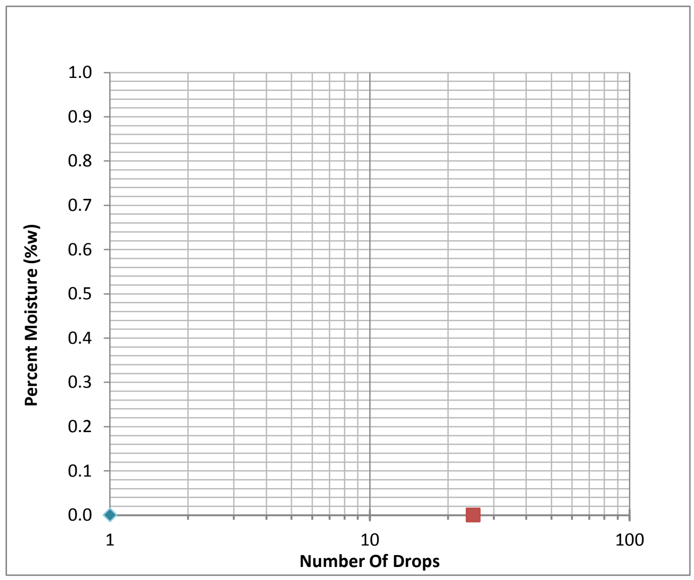
Liquid Limit	LL			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	PL		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 blows: Non-Plastic
PI = LL - PL





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/21/2015
Date Tested: 4/27/2015
Date Entered: 5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-03 **Depth:** 50 ft
Sample Description: Dark gray Silty SAND (SM)

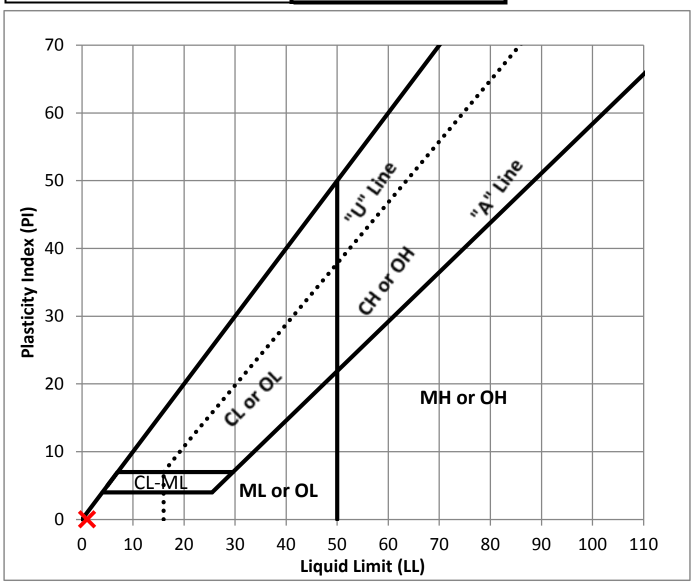
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

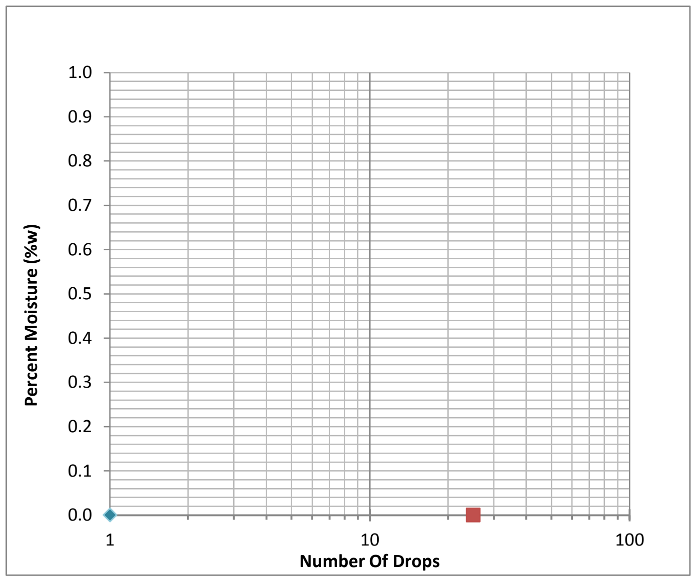
Liquid Limit	LL			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	PL		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 Non-Plastic **blows**
PI = LL - PL





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/21/2015
Date Tested: 4/27/2015
Date Entered: 5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-04 **Depth:** 20 ft
Sample Description: Dark gray SILT (ML)

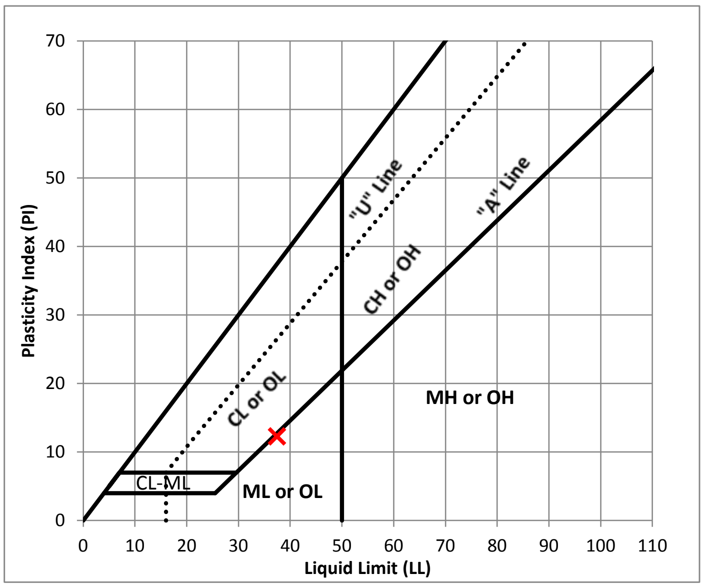
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

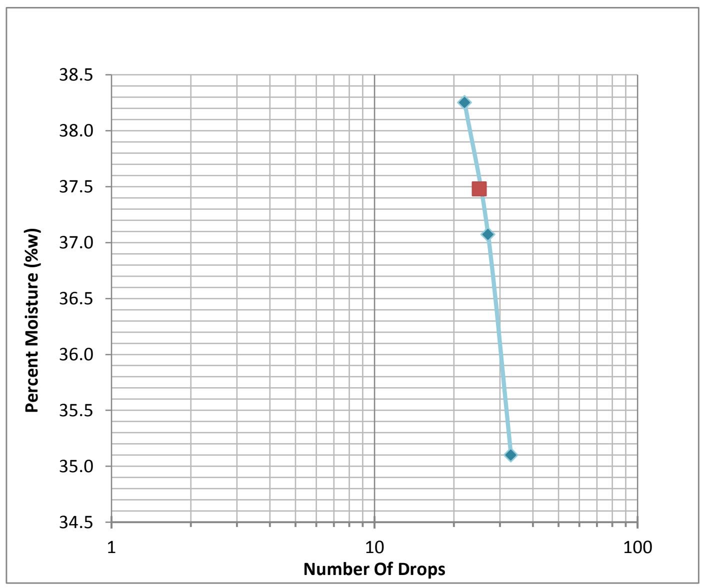
Liquid Limit	**LL**	SE-17	LT	I
	can	13.71	13.49	19.28
	can+wet	32.3	28.28	34.46
	can+dry	27.47	24.28	30.26
	dry soil	13.76	10.79	10.98
	Mw	4.83	4	4.2
	w%	35.1	37.1	38.3
	drops	33	27	22

Preparation Method: Dry
Method: A
Comments: H-1

Plastic Limit	**PL**	SE-6	SE-12
	can	13.65	13.61
	can+wet	24.08	23.5
	can+dry	21.99	21.5
	dry soil	8.34	7.89
	Mw	2.09	2
	w%	25.1	25.3
	Average	25.2	

Liquid Limit @ 25	**37**	**blows**
PI = LL - PL	**12**	





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-05 **Depth:** 5 ft
Sample Description: Light brown Silty CLAY (CL-ML)

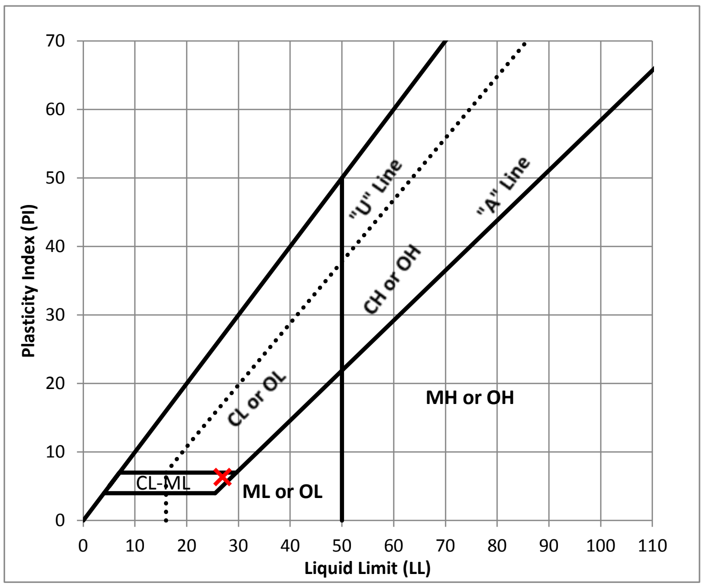
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

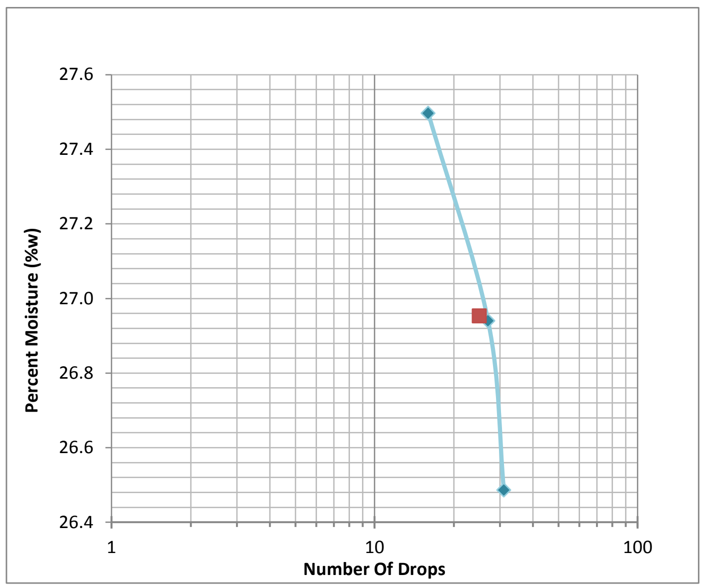
Liquid Limit	**LL**	I	SE-13	SE-18
	can	19.29	13.71	13.8
	can+wet	35.67	31.05	30.91
	can+dry	32.24	27.37	27.22
	dry soil	12.95	13.66	13.42
	Mw	3.43	3.68	3.69
	w%	26.5	26.9	27.5
	drops	31	27	16

Preparation Method: Dry
Method: A
Comments: RD-8

Plastic Limit	**PL**	SE-8	SE-4
	can	13.78	13.75
	can+wet	23.86	27
	can+dry	22.12	24.76
	dry soil	8.34	11.01
	Mw	1.74	2.24
	w%	20.9	20.3
	Average	20.6	

Liquid Limit @ 25	**27**	**blows**
PI = LL - PL	**6**	





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-05 **Depth:** 30 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

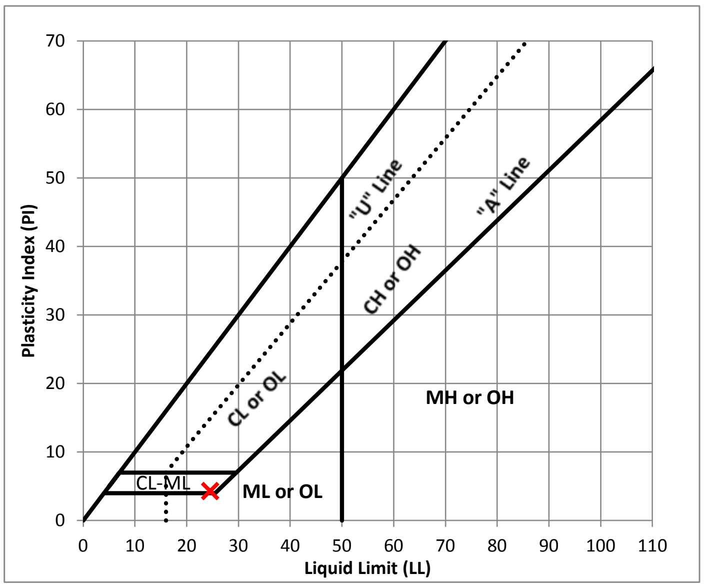
Sample Description: Dark gray Silty CLAY (CL-ML)

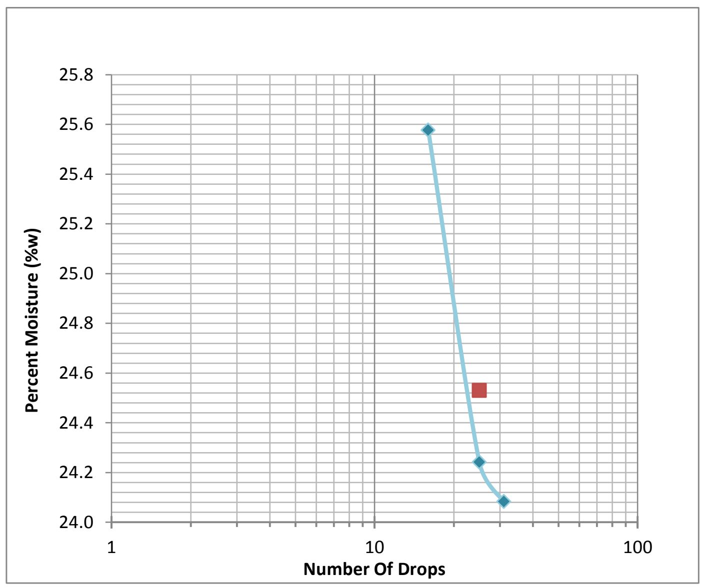
Liquid Limit	**LL**	SE-5	B2	H
	can	13.9	13.85	18.95
	can+wet	38.27	33.12	37.46
	can+dry	33.54	29.36	33.69
	dry soil	19.64	15.51	14.74
	Mw	4.73	3.76	3.77
	w%	24.1	24.2	25.6
	drops	31	25	16

Preparation Method: Dry
Method: A
Comments: RD-4

Plastic Limit	**PL**	SE-3	SE-1
	can	13.79	13.92
	can+wet	24.4	23.24
	can+dry	22.62	21.67
	dry soil	8.83	7.75
	Mw	1.78	1.57
	w%	20.2	20.3
	Average	20.2	

Liquid Limit @ 25 25 **blows**
PI = LL - PL 4





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/21/2015
Date Tested: 4/27/2015
Date Entered: 5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-05 **Depth:** 45 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

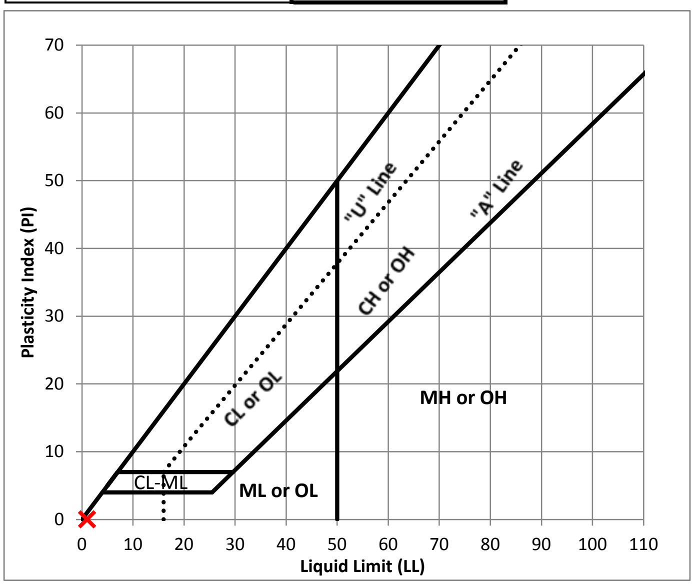
Sample Description: Dark gray SILT with Sand (ML)

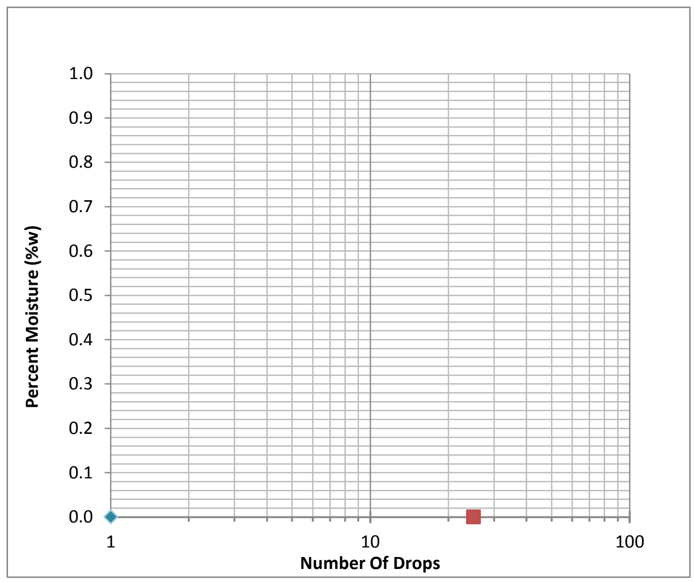
Liquid Limit	**LL**			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	**PL**		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 blows: Non-Plastic
PI = LL - PL: Non-Plastic





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

Headquarters
50 East 100 South
Heber City, Utah 84032
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Fax: (435) 654 6622

Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-06 **Depth:** 30 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

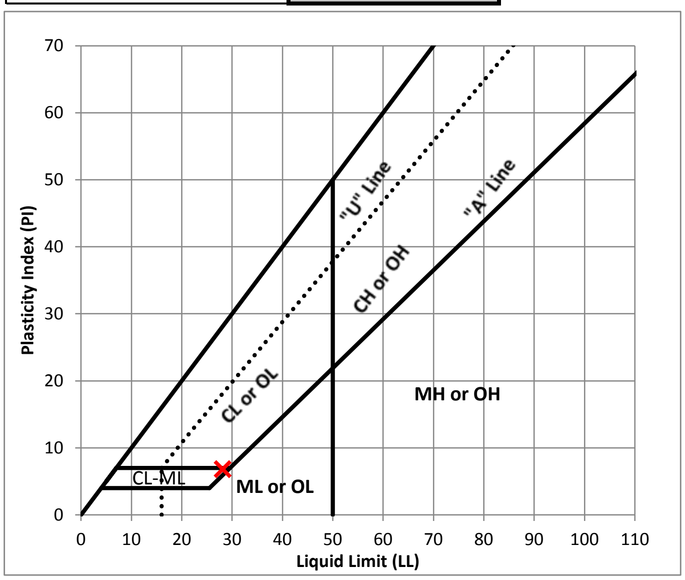
Sample Description: Dark gray Silty CLAY with Sand (CL-ML)

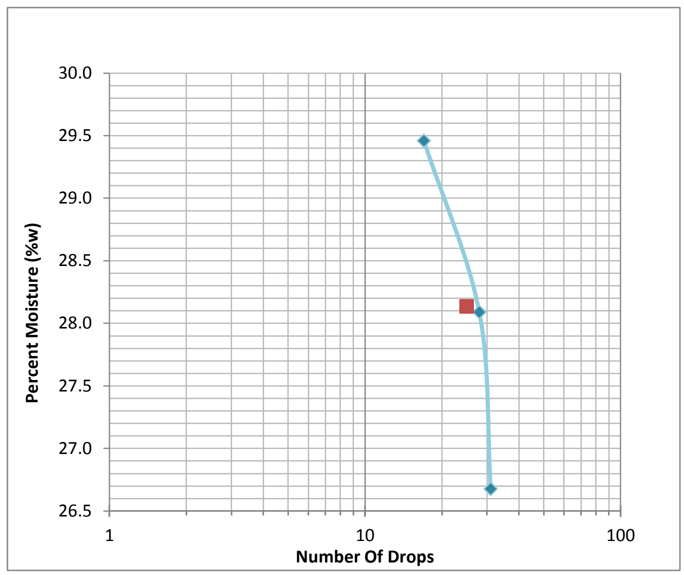
Liquid Limit	LL	SE-7	SE-18	SE-10
	can	13.65	13.82	13.74
	can+wet	30.84	31.24	29.78
	can+dry	27.22	27.42	26.13
	dry soil	13.57	13.6	12.39
	Mw	3.62	3.82	3.65
	w%	26.7	28.1	29.5
	drops	31	28	17

Preparation Method: Dry
Method: A
Comments: H-8

Plastic Limit	PL	SE-4	SE-13
	can	13.8	13.73
	can+wet	23.46	24.27
	can+dry	21.78	22.4
	dry soil	7.98	8.67
	Mw	1.68	1.87
	w%	21.1	21.6
	Average	21.3	

Liquid Limit @ 25	**28**	**blows**
PI = LL - PL	**7**	





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

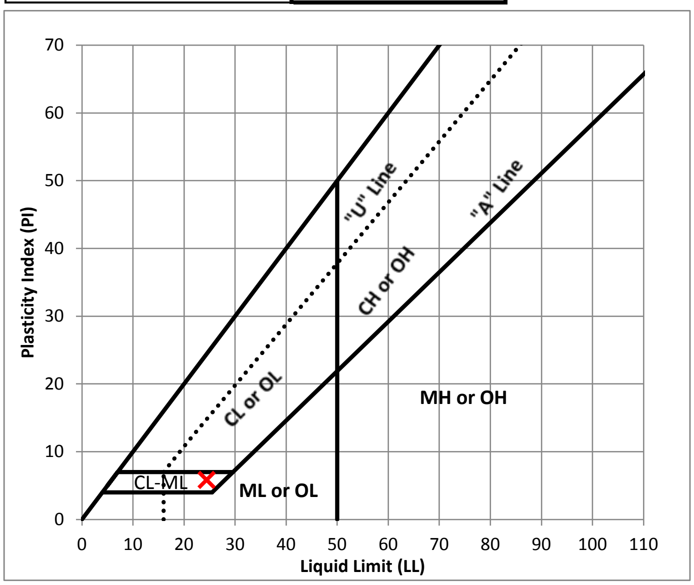
Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-07 **Depth:** 35 ft
Sample Description: Dark gray Silty CLAY (CL-ML)

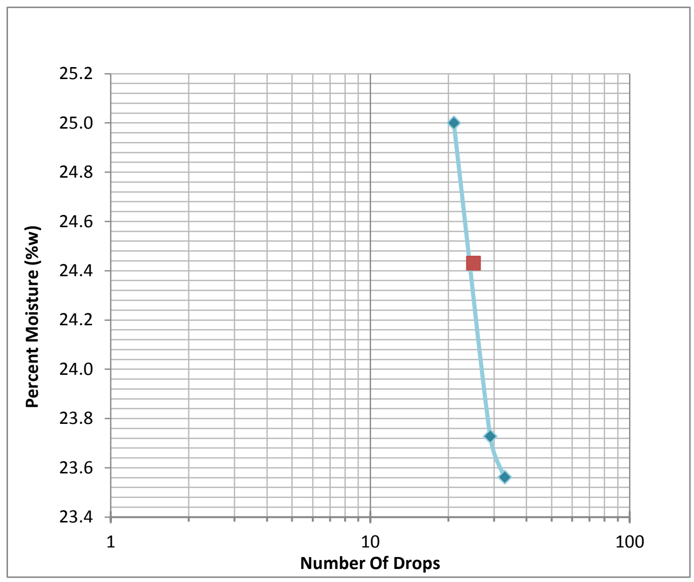
Liquid Limit	LL	LL-3	B-2	L-6
	can	13.57	13.58	13.93
	can+wet	24.95	24.27	27.53
	can+dry	22.78	22.22	24.81
	dry soil	9.21	8.64	10.88
	Mw	2.17	2.05	2.72
	w%	23.6	23.7	25.0
	drops	33	29	21

Preparation Method: Dry
Method: A
Comments: Cake-2

Plastic Limit	PL	B-3	A-3
	can	13.86	13.41
	can+wet	24.73	23.51
	can+dry	23.02	21.93
	dry soil	9.16	8.52
	Mw	1.71	1.58
	w%	18.7	18.5
	Average	18.6	

Liquid Limit @ 25	**24**	**blows**
PI = LL - PL	**6**	





Performed By:	LT	Date Sampled:	4/23/2015
Entered By:	LM	Date Tested:	5/7/2015
Reviewed By:	MP	Date Entered:	5/26/2015

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epic ENGINEERING

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-08 **Depth:** 2.5 ft
Sample Description: Light brown Sandy Silty CLAY (CL-ML)

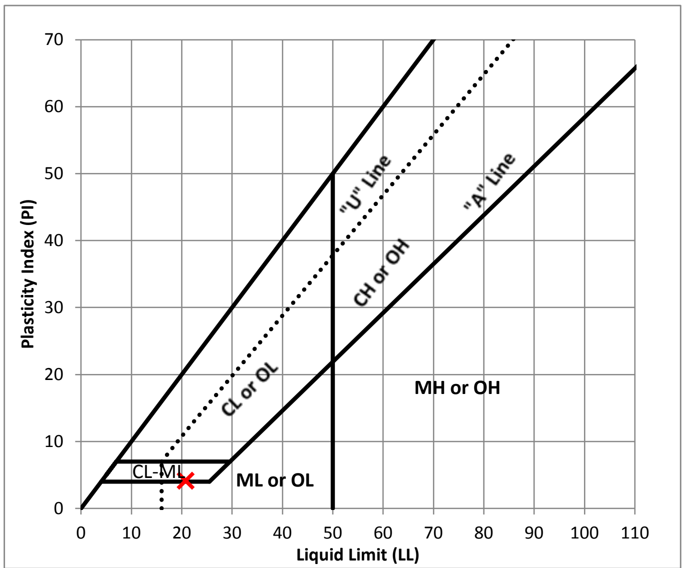
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

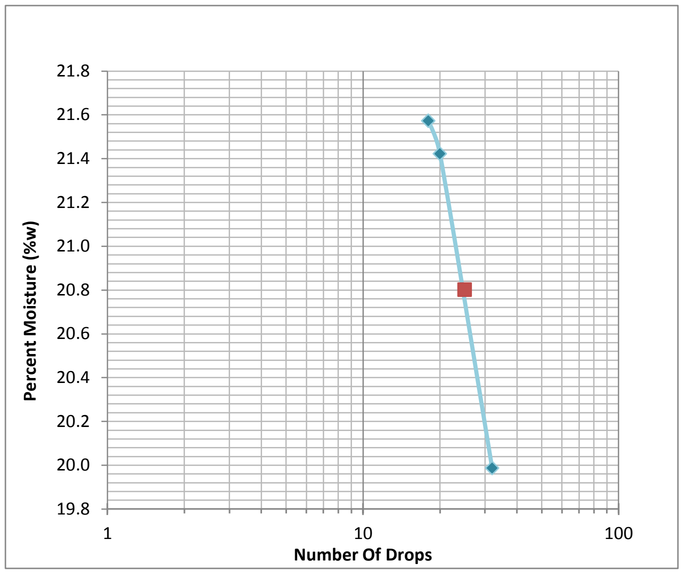
Liquid Limit	**LL**	SE-18	SE-17	SE-9
	can	13.81	13.71	13.78
	can+wet	31.58	26.35	30.01
	can+dry	28.62	24.12	27.13
	dry soil	14.81	10.41	13.35
	Mw	2.96	2.23	2.88
	w%	20.0	21.4	21.6
	drops	32	20	18

Preparation Method: Dry
Method: A
Comments: L-3

Plastic Limit	**PL**	SE-1	SE-12
	can	13.93	13.6
	can+wet	25.31	24.89
	can+dry	23.65	23.31
	dry soil	9.72	9.71
	Mw	1.66	1.58
	w%	17.1	16.3
	Average	16.7	

Liquid Limit @ 25	**21**	**blows**
PI = LL - PL	**4**	





Performed By:	RB	Date Sampled:	4/22/2015
Entered By:	LM	Date Tested:	5/7/2015
Reviewed By:	MP	Date Entered:	5/26/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-08 **Depth:** 35 ft
Sample Description: Dark gray Silty SAND (SM)

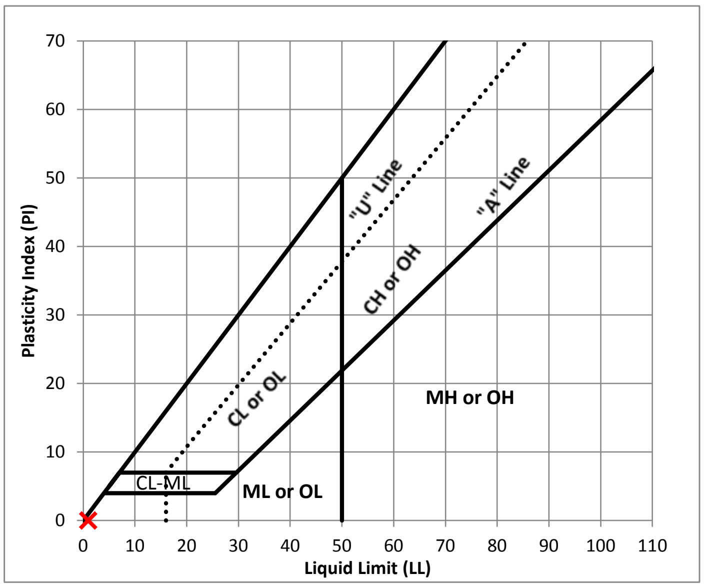
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

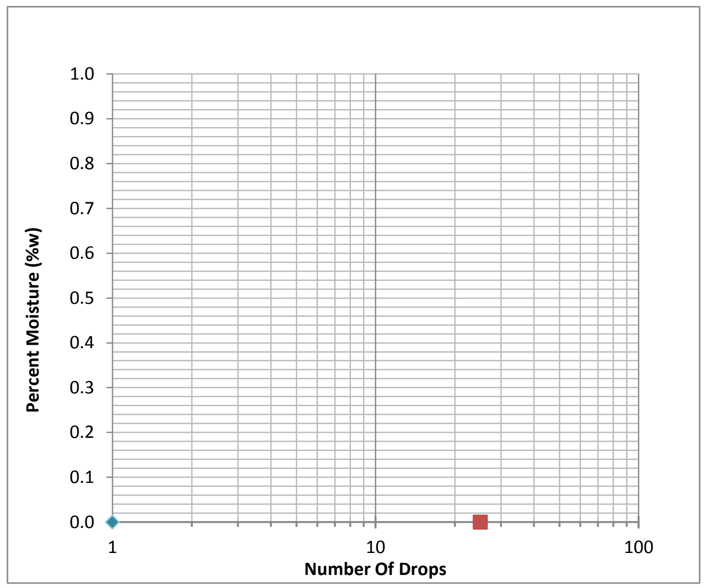
Liquid Limit	**LL**			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	**PL**		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 **Non-Plastic** **blows**
PI = LL - PL





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

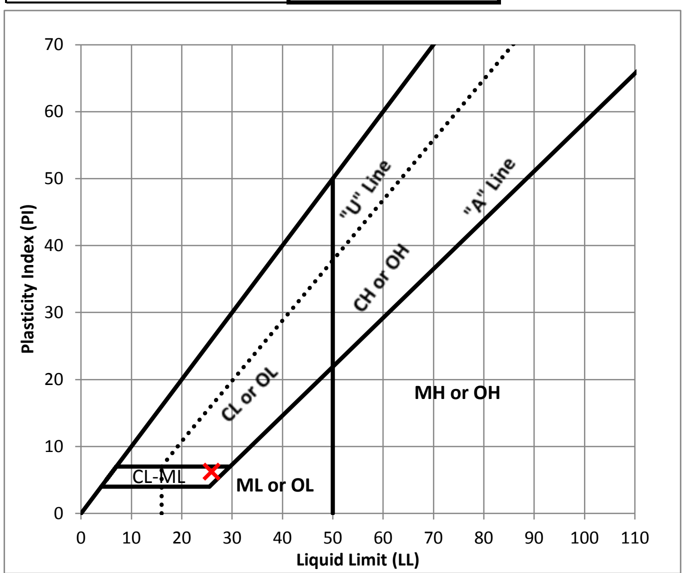
Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-09 **Depth:** 12.5 ft
Sample Description: Dark gray Clayey SILT (CL-ML)

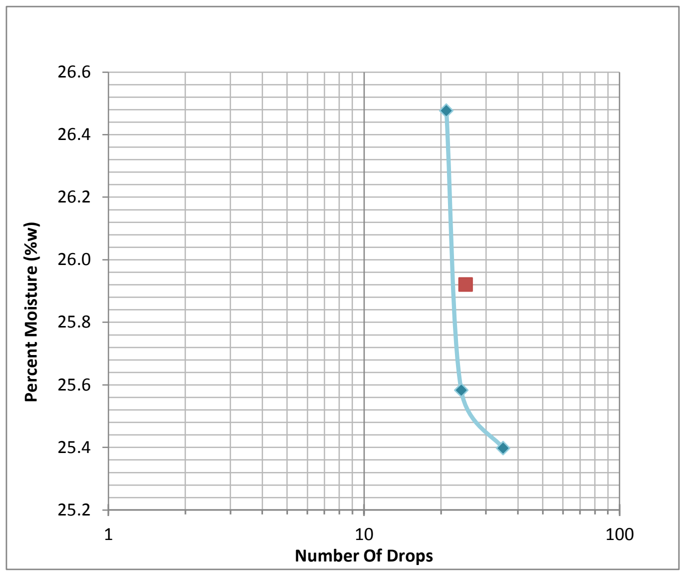
Liquid Limit	**LL**	SE-4	I	SE-14
	can	13.77	19.29	13.51
	can+wet	33.47	39.76	32.14
	can+dry	29.48	35.59	28.24
	dry soil	15.71	16.3	14.73
	Mw	3.99	4.17	3.9
	w%	25.4	25.6	26.5
	drops	35	24	21

Preparation Method: Dry
Method: A
Comments: H-10

Plastic Limit	**PL**	SE-1	SE-3
	can	13.92	13.79
	can+wet	23.9	24.3
	can+dry	22.25	22.58
	dry soil	8.33	8.79
	Mw	1.65	1.72
	w%	19.8	19.6
	Average	19.7	

Liquid Limit @ 25 **26** **blows**
PI = LL - PL **6**





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/21/2015
Date Tested: 4/27/2015
Date Entered: 5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-09 **Depth:** 40 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

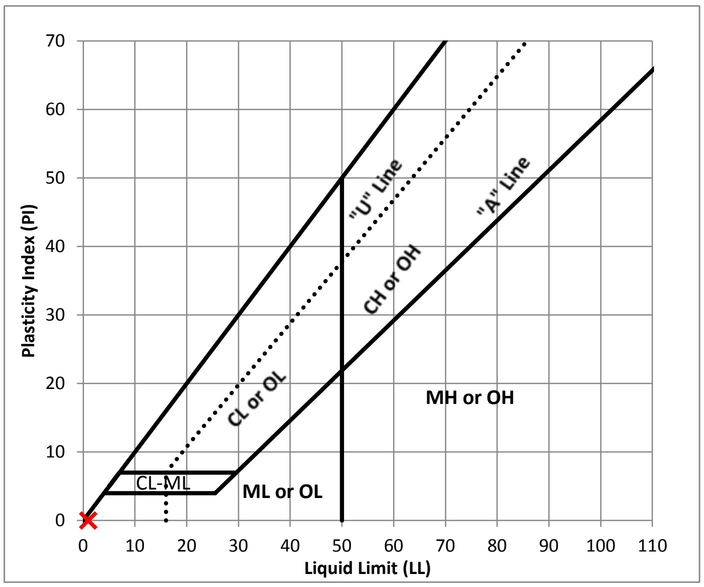
Sample Description: Gray Silty SAND (SM)

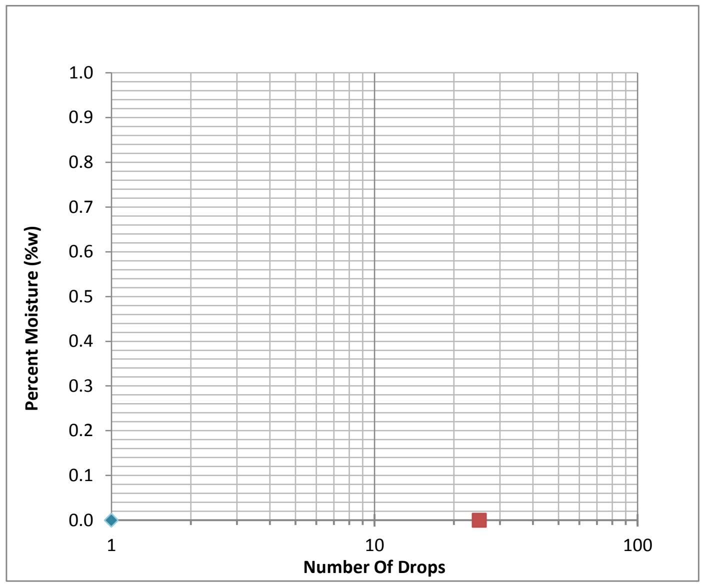
Liquid Limit	**LL**			
	can			
	can+wet			
	can+dry			
	dry soil			
	Mw			
	w%			
	drops	Non-Plastic		

Preparation Method: Dry
Method: A
Comments: Difficult to thread

Plastic Limit	**PL**		
	can		
	can+wet		
	can+dry		
	dry soil		
	Mw		
	w%		
	Average	Non-Plastic	

Liquid Limit @ 25 blows: **Non-Plastic**
PI = LL - PL: **Non-Plastic**





Performed By: RB
Entered By: LM
Reviewed By: MP

Date Sampled: 4/24/2015
Date Tested: 5/7/2015
Date Entered: 5/26/2016

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: BH-10 **Depth:** 40 ft
Sample Description: Yellow brown gray Silty CLAY with Sand (CL-ML)

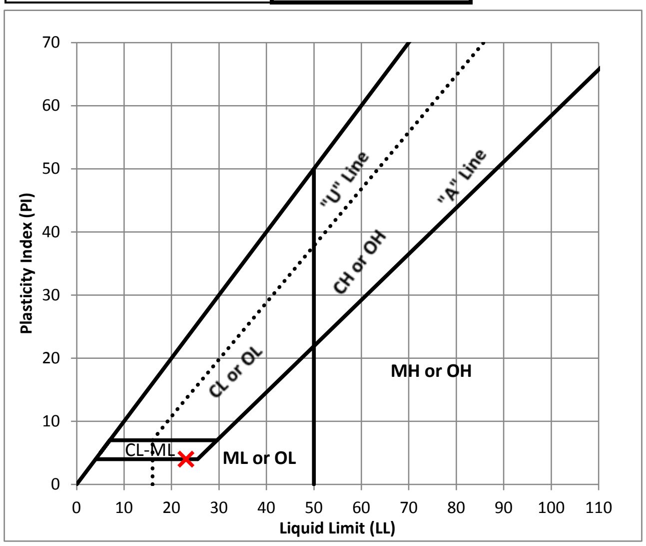
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

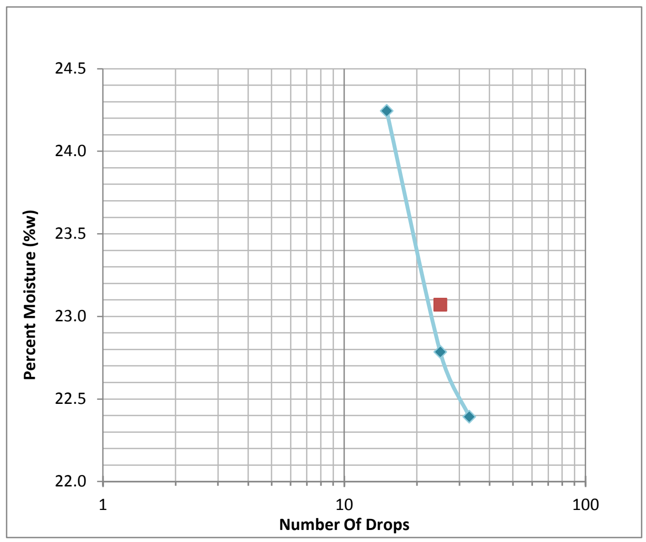
Liquid Limit	LL	SE-1	SE-12	SE-3
	can	13.91	13.6	13.8
	can+wet	33.86	33.27	32.71
	can+dry	30.21	29.62	29.02
	dry soil	16.3	16.02	15.22
	Mw	3.65	3.65	3.69
	w%	22.4	22.8	24.2
	drops	33	25	15

Preparation Method: Dry
Method: A
Comments: H-5

Plastic Limit	PL	SE-10	SE-6
	can	13.74	13.66
	can+wet	23.35	23.41
	can+dry	21.81	21.85
	dry soil	8.07	8.19
	Mw	1.54	1.56
	w%	19.1	19.0
	Average	19.1	

Liquid Limit @ 25	**23**	**blows**
PI = LL - PL	**4**	





Performed By:	RB	Date Sampled:	4/21/2015
Entered By:	LM	Date Tested:	4/27/2015
Reviewed By:	MP	Date Entered:	5/11/2015

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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: TP-05 **Depth:** 2.5 ft

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

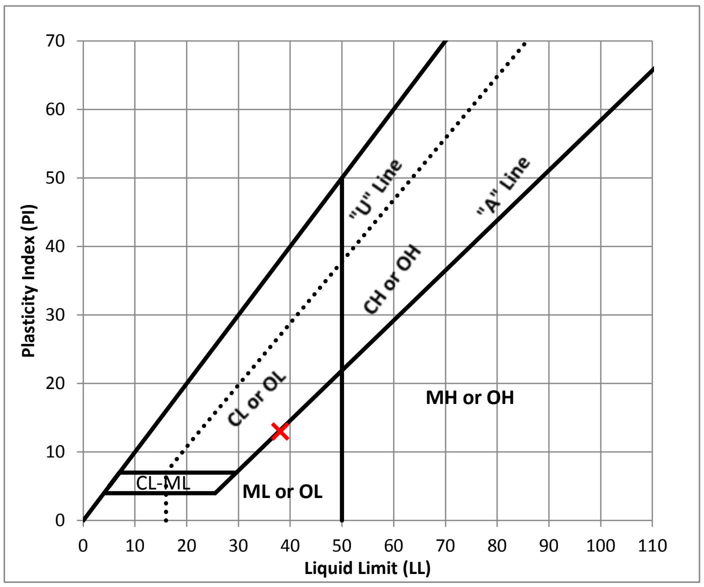
Sample Description: Brownish gray SILT (ML)

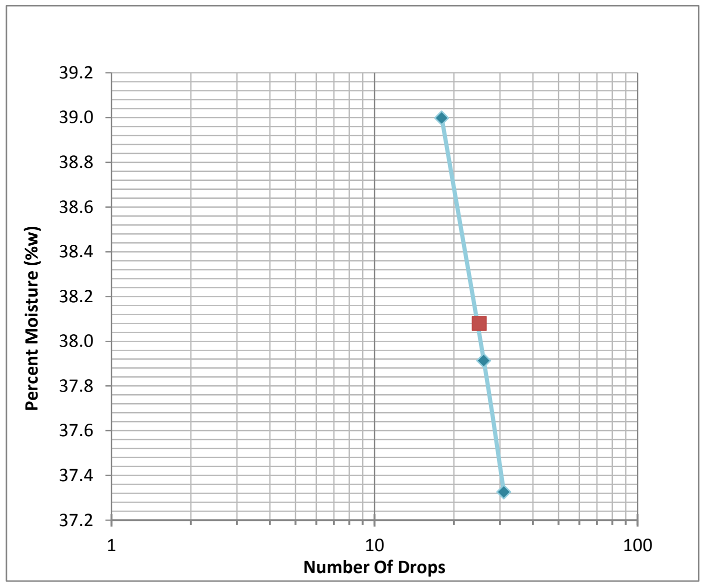
Liquid Limit	**LL**	SE-5	I-2	SE-8
	can	13.9	13.78	13.79
	can+wet	26.74	27.53	25.98
	can+dry	23.25	23.75	22.56
	dry soil	9.35	9.97	8.77
	Mw	3.49	3.78	3.42
	w%	37.3	37.9	39.0
	drops	31	26	18

Preparation Method: Wet
Method: A
Comments: C-2

Plastic Limit	**PL**	SE-18	I-6
	can	13.81	13.91
	can+wet	23.28	24.38
	can+dry	21.39	22.27
	dry soil	7.58	8.36
	Mw	1.89	2.11
	w%	24.9	25.2
	Average	25.1	

Liquid Limit @ 25	**38**	**blows**
PI = LL - PL	**13**	





Performed By:	RB	Date Tested:	6/25/2015
Entered By:	TC	Date Entered:	6/26/2015
Reviewed By:	TC	Date Reviewed:	6/26/2015

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50 East 100 South
Heber City, Utah 84032
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Project Name: I-80/7200 West Expanded Preliminary Geotechnical Invest.
Project Number: 15MGT004
Boring: TP-09 **Depth:** 3 ft
Sample Description: Silt with Sand (CL-ML)

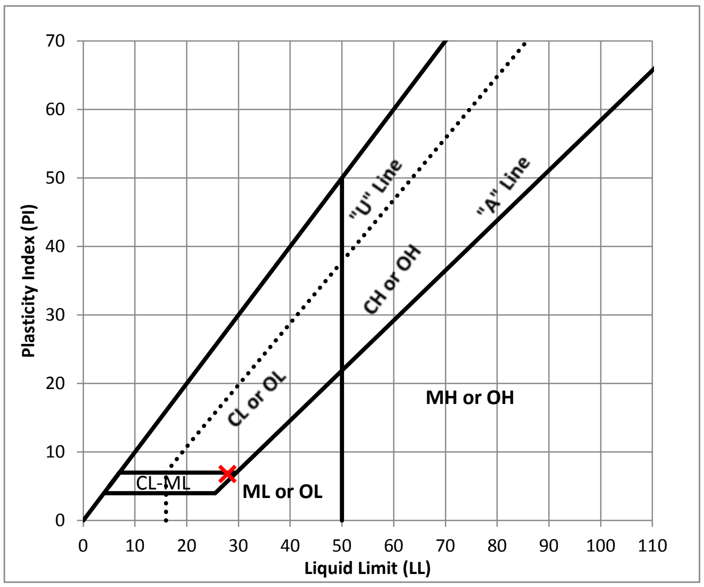
ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

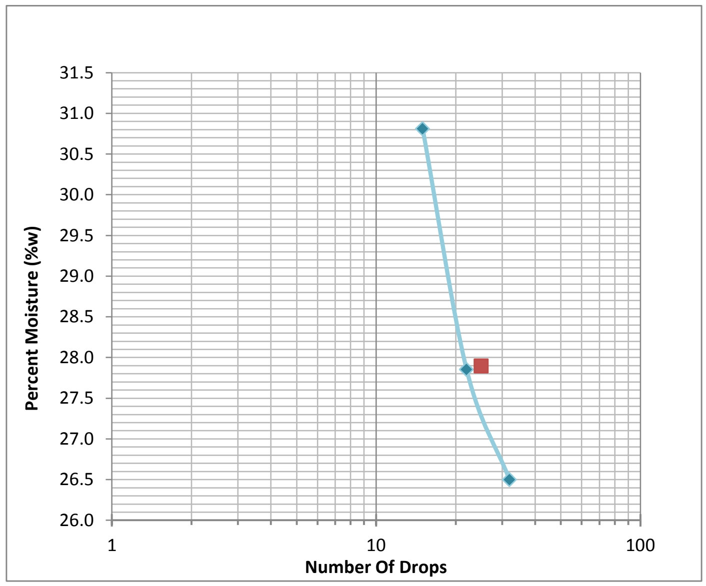
Liquid Limit	**LL**	B-1	II-2	A-4
	can	13.45	13.46	13.53
	can+wet	26.96	27.46	25.46
	can+dry	24.13	24.41	22.65
	dry soil	10.68	10.95	9.12
	Mw	2.83	3.05	2.81
	w%	26.5	27.9	30.8
	drops	32	22	15

Preparation Method: Wet
Method: A
Comments: D-2

Plastic Limit	**PL**	I-6	I-2
	can	13.93	13.78
	can+wet	25.58	24.57
	can+dry	23.57	22.67
	dry soil	9.64	8.89
	Mw	2.01	1.9
	w%	20.9	21.4
	Average	21.1	

Liquid Limit @ 25	**28**	**blows**
PI = LL - PL	**7**	





Performed By:	RB	Date Tested:	6/26/2015
Entered By:	TC	Date Entered:	6/29/2015
Reviewed By:	TC	Date Reviewed:	6/29/2015

Collapse/Swell Potential of Soils
(ASTM D4546 Method B)

IGES

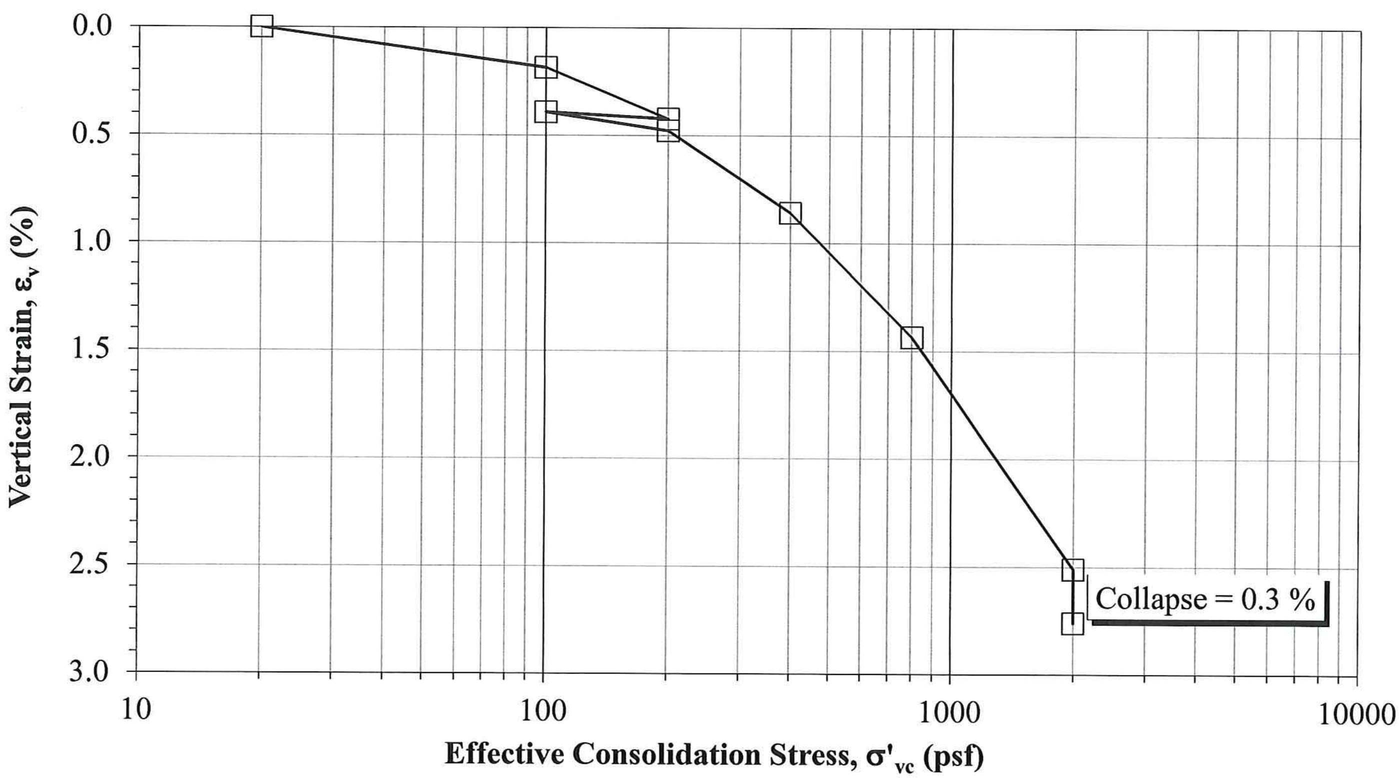
Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/13/2015
By: BRR

Boring No.: TP-01
Sample:
Depth: 2'
Sample Description: Brown silt
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

Consolidometer No.:	4	
Specific gravity, G_s	2.65	Assumed
Collapse (%)	0.3	
Collapse stress (psf)	2000	
Water type used for inundation	Tap	

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8946
Sample diameter, D (in.)	2.416	2.416
Mass rings + wet soil (g)	181.74	181.50
Mass rings/tare (g)	42.36	42.36
Moist unit wt., γ_m (pcf)	125.89	129.24
Wet soil + tare (g)	366.54	255.96
Dry soil + tare (g)	322.36	230.56
Tare (g)	127.50	117.46
Water content, w (%)	22.7	22.5
Dry unit wt., γ_d (pcf)	102.62	105.54
Saturation	98.17	100.00

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.1149	0.00	0.9200	0.612
20	0.1149	0.00	0.9200	0.612
100	0.1166	0.18	0.9183	0.609
200	0.1188	0.42	0.9161	0.605
100	0.1185	0.39	0.9164	0.606
200	0.1193	0.48	0.9156	0.604
400	0.1228	0.86	0.9121	0.598
800	0.1281	1.43	0.9068	0.589
2000	0.1380	2.51	0.8969	0.572
2000	0.1403	2.76	0.8946	0.567



Entered: BRR
Reviewed: NB

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Collapse/Swell Potential of Soils
(ASTM D4546 Method B)

IGES

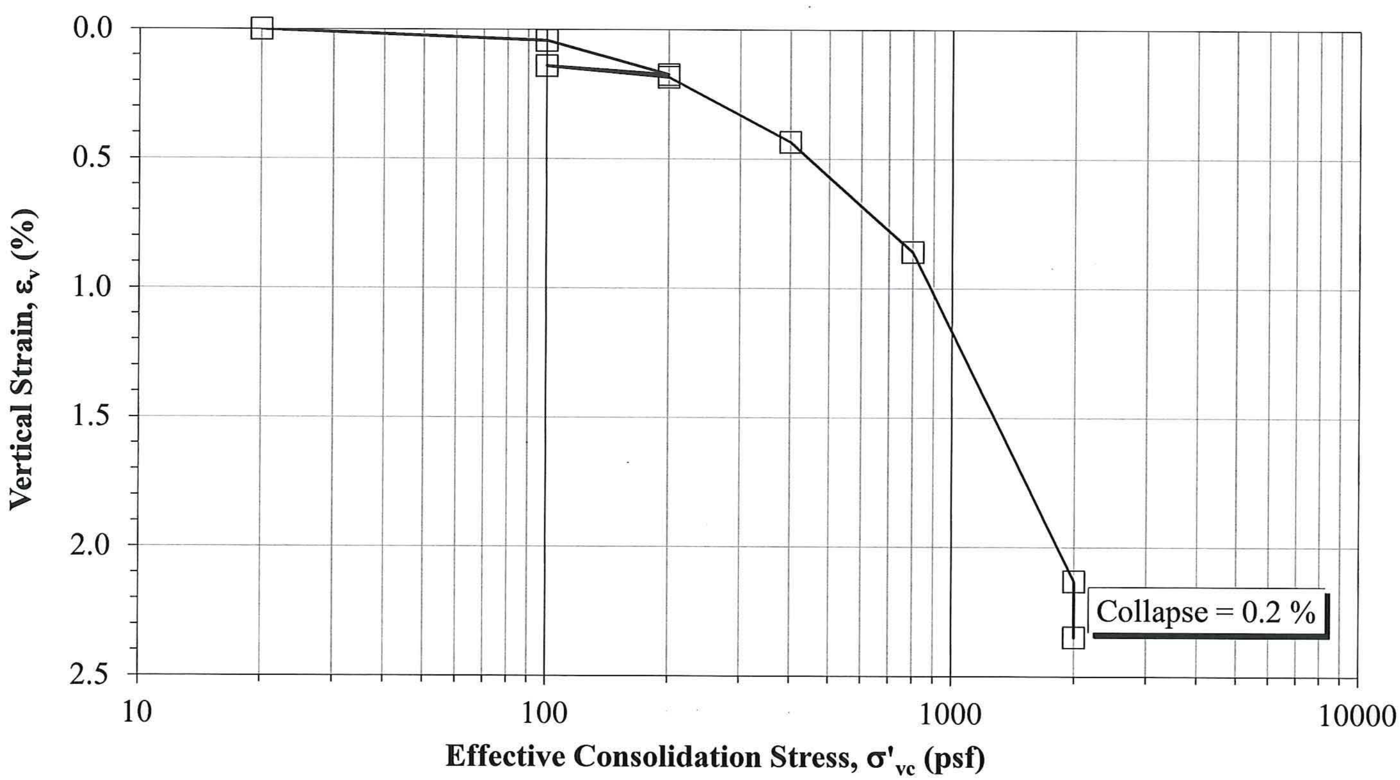
Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/13/2015
By: BRR

Boring No.: TP-04
Sample:
Depth: 2 1/4'
Sample Description: Brown clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

Consolidometer No.:	2	
Specific gravity, G_s	2.65	Assumed
Collapse (%)	0.2	
Collapse stress (psf)	2000	
Water type used for inundation		Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8984
Sample diameter, D (in.)	2.416	2.416
Mass rings + wet soil (g)	170.24	169.78
Mass rings/tare (g)	42.42	42.42
Moist unit wt., γ_m (pcf)	115.45	117.80
Wet soil + tare (g)	327.18	256.75
Dry soil + tare (g)	278.24	225.97
Tare (g)	124.43	127.76
Water content, w (%)	31.8	31.3
Dry unit wt., γ_d (pcf)	87.58	89.69
Saturation	94.86	98.35

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.2156	0.00	0.9200	0.889
20	0.2156	0.00	0.9200	0.889
100	0.2160	0.04	0.9196	0.888
200	0.2172	0.17	0.9184	0.886
100	0.2169	0.14	0.9187	0.886
200	0.2173	0.18	0.9183	0.885
400	0.2196	0.43	0.9160	0.881
800	0.2235	0.86	0.9121	0.873
2000	0.2352	2.13	0.9004	0.849
2000	0.2372	2.35	0.8984	0.844



Entered: BKK
Reviewed: NB

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Collapse/Swell Potential of Soils
(ASTM D4546 Method B)

IGES

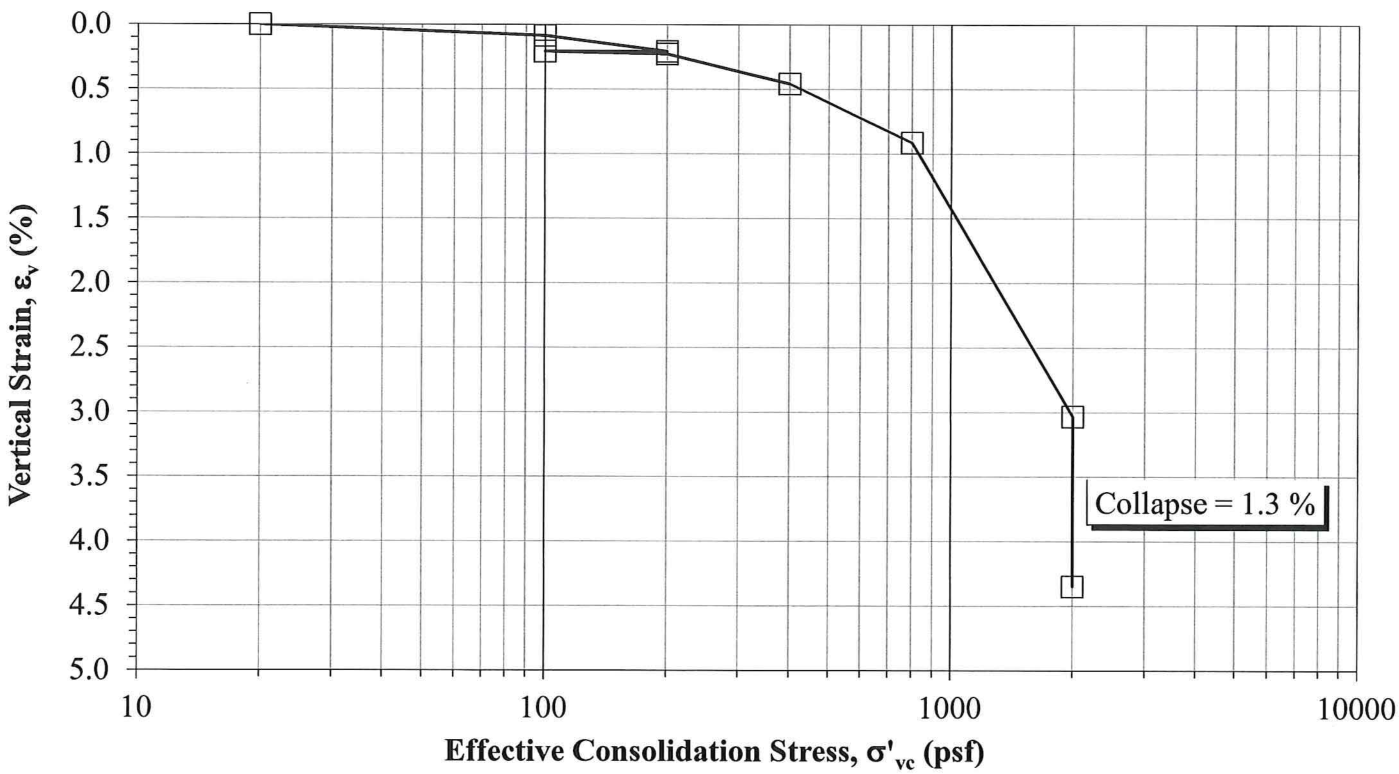
Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/13/2015
By: BRR

Boring No.: TP-08
Sample:
Depth: 2'
Sample Description: Brown silt
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

Consolidometer No.:	5	
Specific gravity, G_s	2.65	Assumed
Collapse (%)	1.3	
Collapse stress (psf)	2000	
Water type used for inundation	Tap	

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8800
Sample diameter, D (in.)	2.416	2.416
Mass rings + wet soil (g)	166.12	175.37
Mass rings/tare (g)	45.17	45.17
Moist unit wt., γ_m (pcf)	109.25	122.95
Wet soil + tare (g)	283.62	253.73
Dry soil + tare (g)	261.32	229.12
Tare (g)	118.43	128.46
Water content, w (%)	15.6	24.4
Dry unit wt., γ_d (pcf)	94.50	98.79
Saturation	55.10	96.05

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.1567	0.00	0.9200	0.751
20	0.1567	0.00	0.9200	0.751
100	0.1575	0.09	0.9192	0.749
200	0.1586	0.21	0.9181	0.747
100	0.1586	0.21	0.9181	0.747
200	0.1588	0.23	0.9179	0.747
400	0.1609	0.46	0.9158	0.743
800	0.1651	0.91	0.9116	0.735
2000	0.1846	3.03	0.8921	0.698
2000	0.1967	4.35	0.8800	0.675



Entered: BRR
Reviewed: NB

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Collapse/Swell Potential of Soils
(ASTM D4546 Method B)

IGES

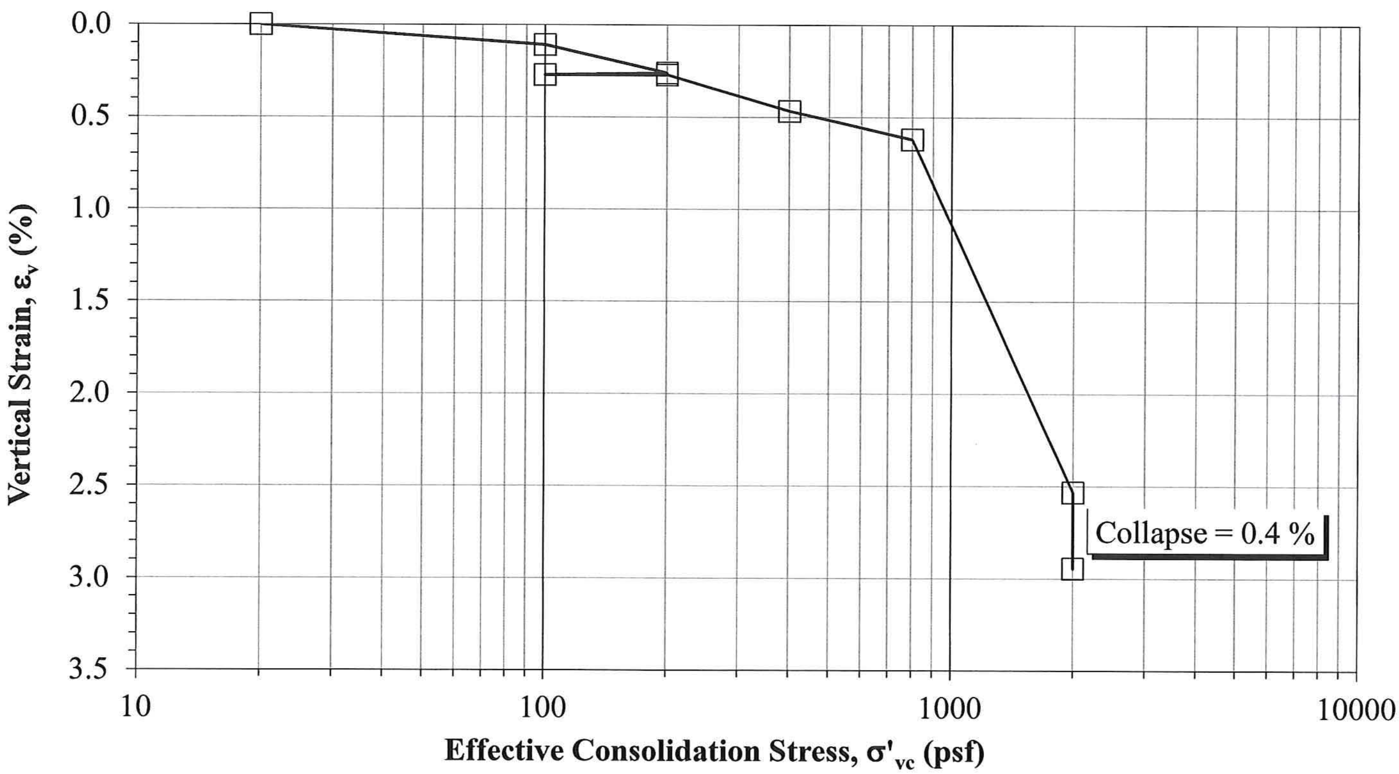
Project: **Epic Engineering**
No: **M00277-074 (15MGT004.01)**
Location: I-80 + 7200 West Expanded
Date: 5/13/2015
By: BRR

Boring No.: **TP-10**
Sample:
Depth: **2'**
Sample Description: Brown clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

Consolidometer No.:	3	
Specific gravity, G_s	2.65	Assumed
Collapse (%)	0.4	
Collapse stress (psf)	2000	
Water type used for inundation	Tap	

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8929
Sample diameter, D (in.)	2.416	2.416
Mass rings + wet soil (g)	170.61	175.16
Mass rings/tare (g)	44.76	44.76
Moist unit wt., γ_m (pcf)	113.67	121.36
Wet soil + tare (g)	302.53	249.92
Dry soil + tare (g)	264.56	220.11
Tare (g)	121.55	124.35
Water content, w (%)	26.6	31.1
Dry unit wt., γ_d (pcf)	89.82	92.55
Saturation	83.59	100.00

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.2149	0.00	0.9200	0.842
20	0.2149	0.00	0.9200	0.842
100	0.2159	0.11	0.9190	0.840
200	0.2173	0.26	0.9176	0.837
100	0.2174	0.27	0.9175	0.837
200	0.2174	0.27	0.9175	0.837
400	0.2192	0.47	0.9157	0.833
800	0.2206	0.62	0.9143	0.830
2000	0.2382	2.53	0.8967	0.795
2000	0.2420	2.95	0.8929	0.787



Entered: BRR
Reviewed: NB

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One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/19/2015
By: JDF

Boring No.: BH-03
Sample:
Depth: 10'
Sample Description: Brown clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

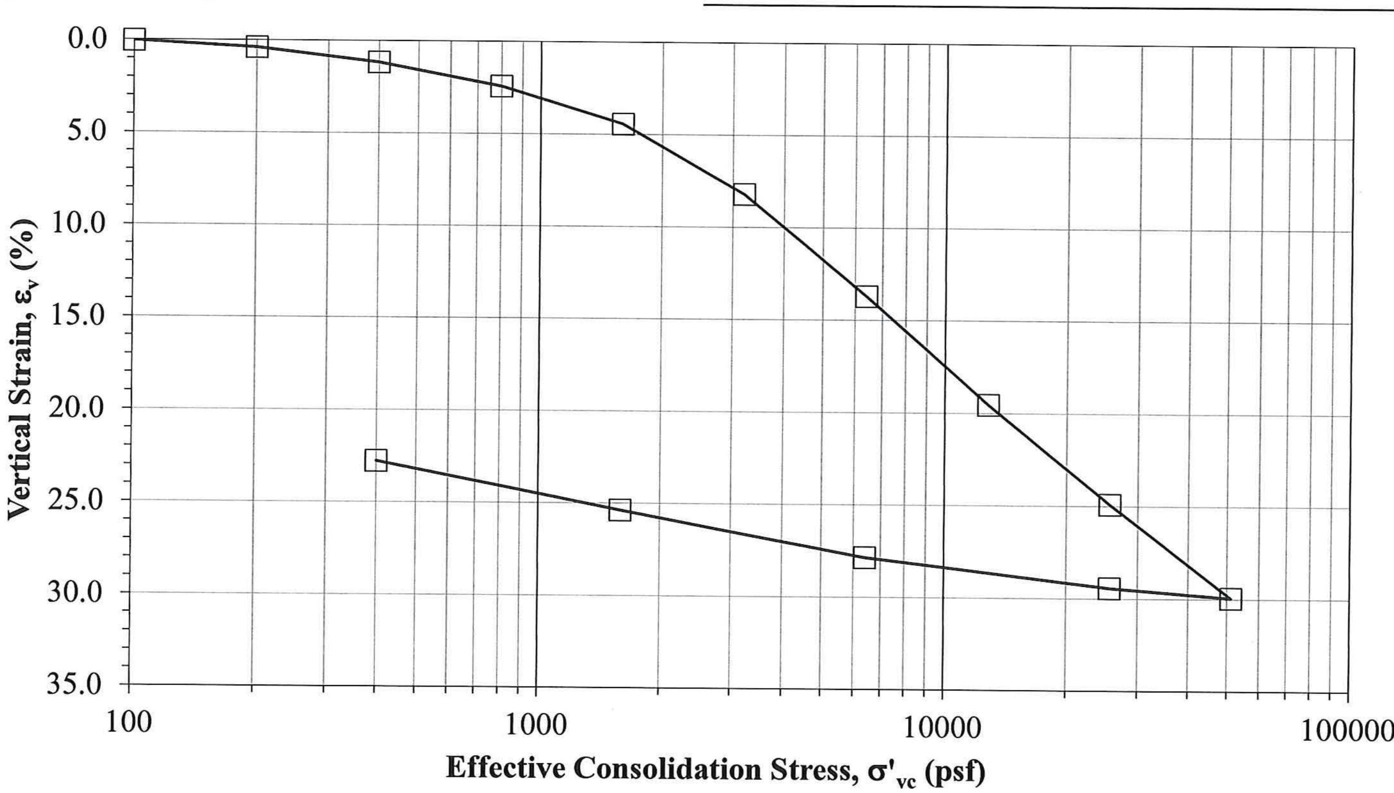
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7104
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	165.43	162.54
Wt. rings/tare (g)	45.55	45.55
Moist unit wt., γ_m (pcf)	108.3	136.8
Wet soil + tare (g)	424.91	
Dry soil + tare (g)	345.31	
Tare (g)	123.70	
Water content, w (%)	35.9	32.6
Dry unit wt., γ_d (pcf)	79.7	103.2
Saturation	0.87	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	1.1158
100	0.0004	0.04	0.9196	1.1149
200	0.0036	0.39	0.9164	1.1076
400	0.0108	1.17	0.9092	1.0910
800	0.0225	2.44	0.8975	1.0641
1600	0.0410	4.46	0.8790	1.0215
3200	0.0755	8.21	0.8445	0.9421
6400	0.1262	13.72	0.7938	0.8255
12800	0.1799	19.55	0.7401	0.7021
25600	0.2291	24.90	0.6909	0.5889
51200	0.2756	29.96	0.6444	0.4820
25600	0.2708	29.43	0.6492	0.4930
6400	0.2563	27.86	0.6637	0.5263
1600	0.2335	25.38	0.6865	0.5788
400	0.2096	22.78	0.7104	0.6337



Entered: JDF
Reviewed: NS

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One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/19/2015
By: JDF

Boring No.: BH-03
Sample:
Depth: 25'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

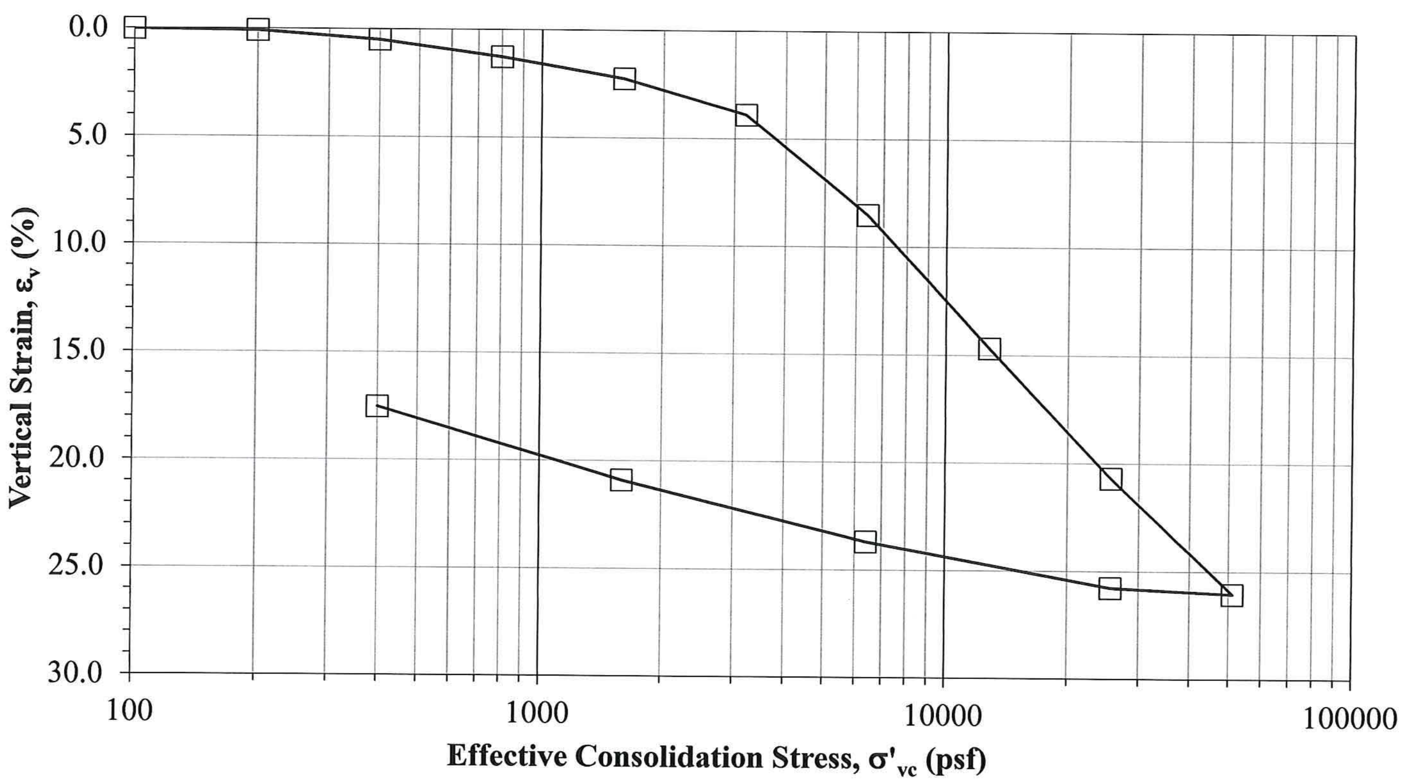
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7586
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	171.37	171.02
Wt. rings/tare (g)	45.10	45.10
Moist unit wt., γ_m (pcf)	114.1	137.9
Wet soil + tare (g)	249.72	
Dry soil + tare (g)	219.50	
Tare (g)	122.69	
Water content, w (%)	31.2	30.9
Dry unit wt., γ_d (pcf)	86.9	105.4
Saturation	0.90	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	0.9392
100	0.0003	0.03	0.9197	0.9386
200	0.0008	0.09	0.9192	0.9375
400	0.0046	0.50	0.9154	0.9295
800	0.0118	1.28	0.9083	0.9144
1600	0.0208	2.26	0.8992	0.8954
3200	0.0360	3.91	0.8840	0.8634
6400	0.0784	8.52	0.8416	0.7739
12800	0.1352	14.70	0.7848	0.6542
25600	0.1904	20.70	0.7296	0.5379
51200	0.2397	26.05	0.6803	0.4340
25600	0.2371	25.77	0.6829	0.4394
6400	0.2180	23.70	0.7020	0.4797
1600	0.1923	20.90	0.7277	0.5339
400	0.1614	17.54	0.7586	0.5990



Entered: JDF
Reviewed: ND

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/5/2015
By: JDF

Boring No.: BH-04
Sample:
Depth: 10'
Sample Description: Brown clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

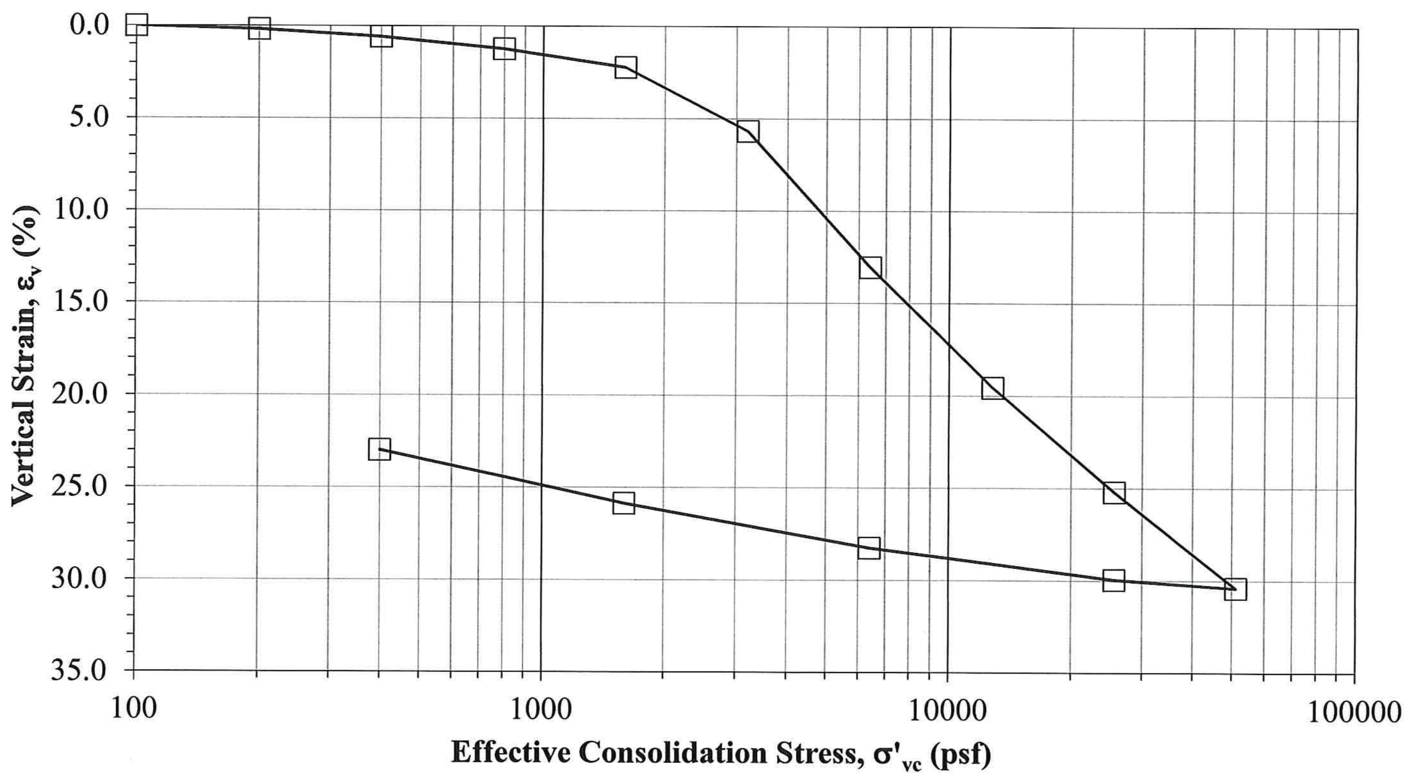
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7085
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	163.66	151.08
Wt. rings/tare (g)	42.36	42.36
Moist unit wt., γ_m (pcf)	109.6	127.5
Wet soil + tare (g)	437.12	
Dry soil + tare (g)	338.21	
Tare (g)	127.42	
Water content, w (%)	46.9	31.7
Dry unit wt., γ_d (pcf)	74.6	96.8
Saturation	1.00	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	1.2603
100	0.0001	0.01	0.9199	1.2602
200	0.0017	0.18	0.9183	1.2562
400	0.0054	0.59	0.9146	1.2471
800	0.0115	1.25	0.9085	1.2321
1600	0.0206	2.23	0.8994	1.2098
3200	0.0522	5.68	0.8678	1.1320
6400	0.1201	13.05	0.7999	0.9652
12800	0.1801	19.58	0.7399	0.8178
25600	0.2319	25.21	0.6881	0.6906
51200	0.2798	30.41	0.6402	0.5729
25600	0.2755	29.95	0.6445	0.5834
6400	0.2600	28.26	0.6600	0.6215
1600	0.2379	25.86	0.6821	0.6758
400	0.2115	22.99	0.7085	0.7407



Comments: Specimen swelled upon inundation and at the 100 psf loading.

Entered: JDF
Reviewed: NB

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One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/18/2015
By: JDF

Boring No.: BH-05
Sample:
Depth: 7.5'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

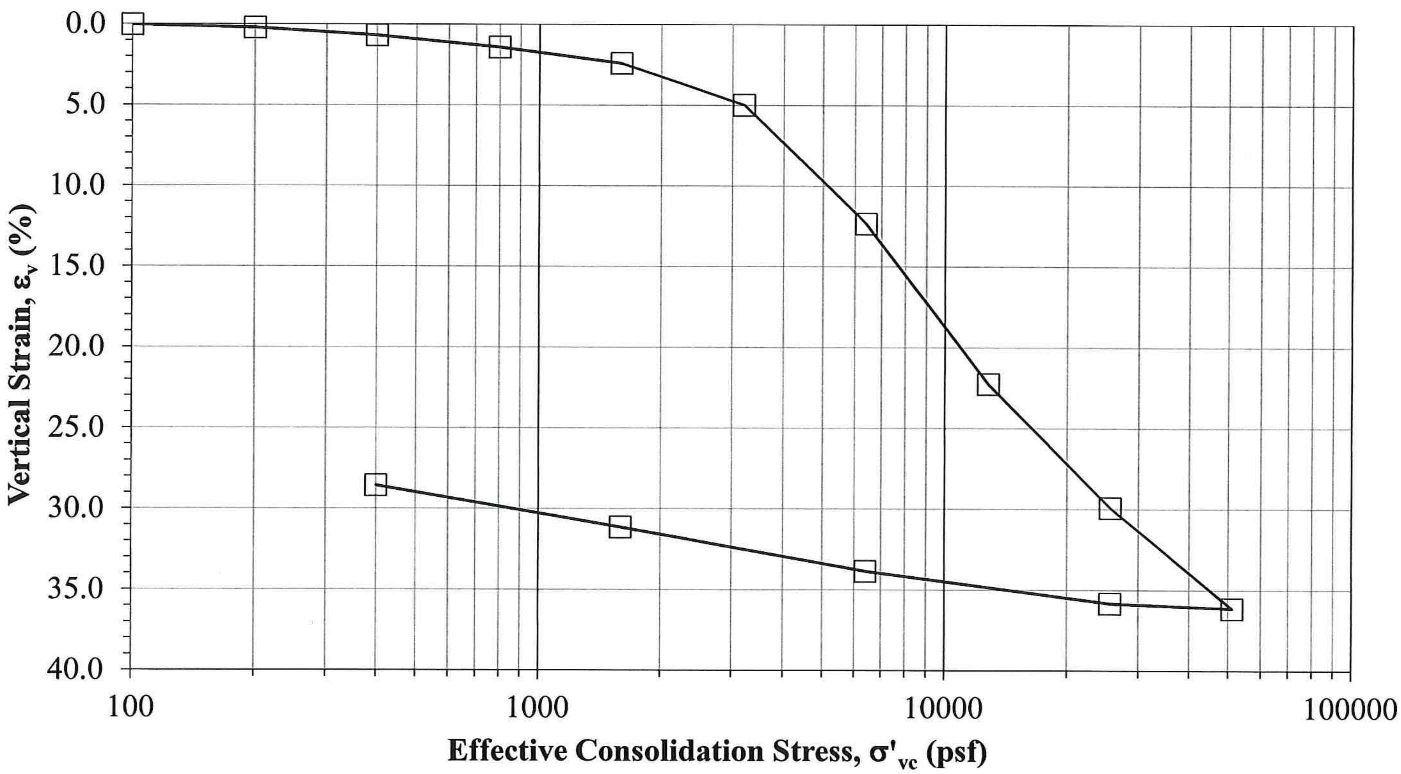
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.6572
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	157.19	141.51
Wt. rings/tare (g)	41.90	41.90
Moist unit wt., γ_m (pcf)	104.1	125.9
Wet soil + tare (g)	390.62	
Dry soil + tare (g)	295.15	
Tare (g)	124.07	
Water content, w (%)	55.8	34.6
Dry unit wt., γ_d (pcf)	66.8	93.6
Saturation	0.99	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	1.5219
100	0.0004	0.04	0.9196	1.5208
200	0.0020	0.22	0.9180	1.5163
400	0.0064	0.69	0.9136	1.5044
800	0.0130	1.41	0.9070	1.4862
1600	0.0221	2.41	0.8979	1.4612
3200	0.0460	4.99	0.8741	1.3959
6400	0.1136	12.35	0.8064	1.2105
12800	0.2048	22.26	0.7152	0.9605
25600	0.2752	29.91	0.6448	0.7675
51200	0.3326	36.15	0.5874	0.6102
25600	0.3297	35.84	0.5903	0.6181
6400	0.3114	33.85	0.6086	0.6683
1600	0.2866	31.15	0.6334	0.7363
400	0.2628	28.57	0.6572	0.8015



Entered: JDF
Reviewed: NB

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One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/20/2015
By: JDF

Boring No.: BH-05
Sample:
Depth: 15'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

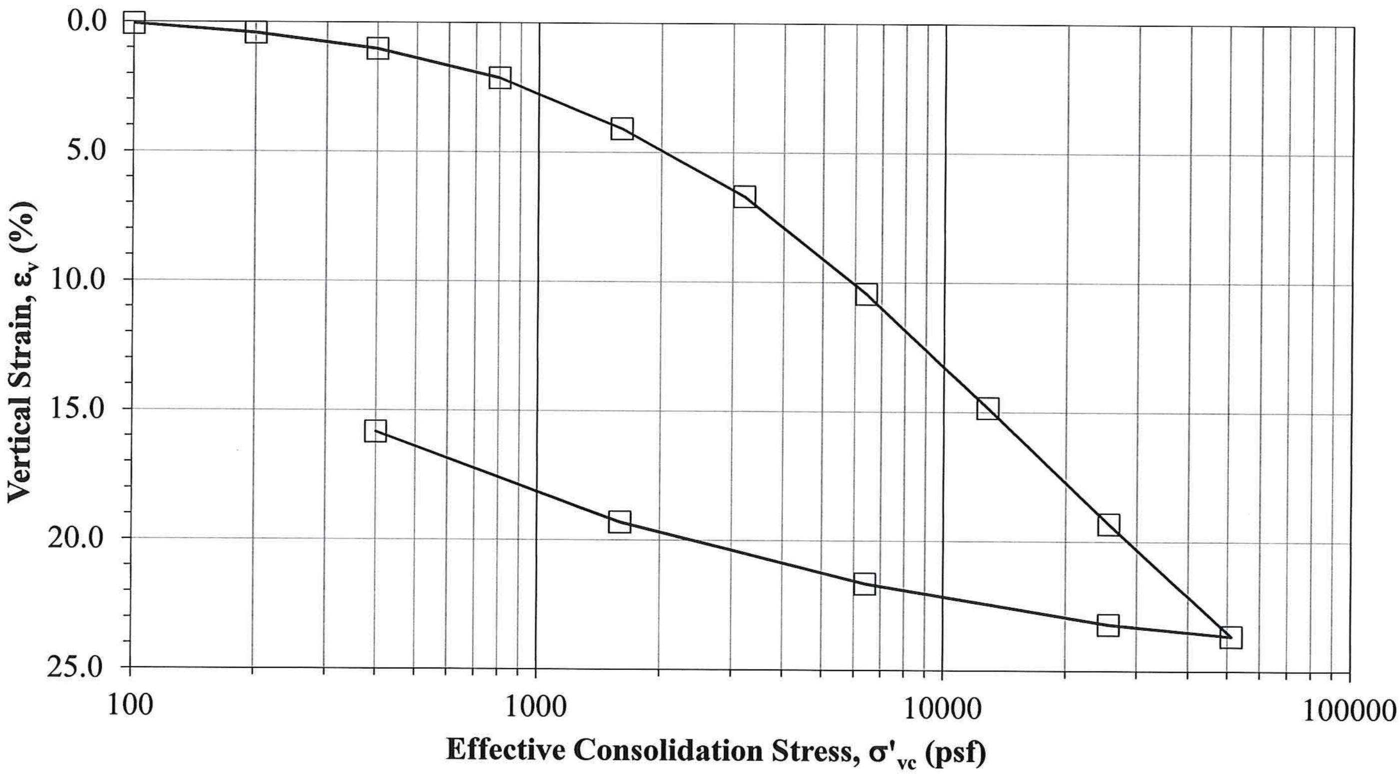
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7743
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	173.95	164.12
Wt. rings/tare (g)	44.75	44.75
Moist unit wt., γ_m (pcf)	116.7	128.1
Wet soil + tare (g)	310.78	
Dry soil + tare (g)	259.22	
Tare (g)	121.87	
Water content, w (%)	37.5	27.1
Dry unit wt., γ_d (pcf)	84.8	100.8
Saturation	1.00	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	0.9866
100	0.0006	0.07	0.9194	0.9852
200	0.0038	0.41	0.9162	0.9783
400	0.0094	1.03	0.9106	0.9662
800	0.0197	2.14	0.9003	0.9440
1600	0.0376	4.08	0.8824	0.9054
3200	0.0616	6.70	0.8584	0.8535
6400	0.0961	10.45	0.8239	0.7790
12800	0.1366	14.85	0.7834	0.6916
25600	0.1777	19.32	0.7423	0.6028
51200	0.2176	23.65	0.7024	0.5167
25600	0.2135	23.21	0.7065	0.5255
6400	0.1992	21.65	0.7208	0.5564
1600	0.1776	19.30	0.7424	0.6031
400	0.1457	15.84	0.7743	0.6719



Entered: JDF
Reviewed: NB

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

IGES

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/5/2015
By: JDF

Boring No.: BH-07
Sample:
Depth: 12.5'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

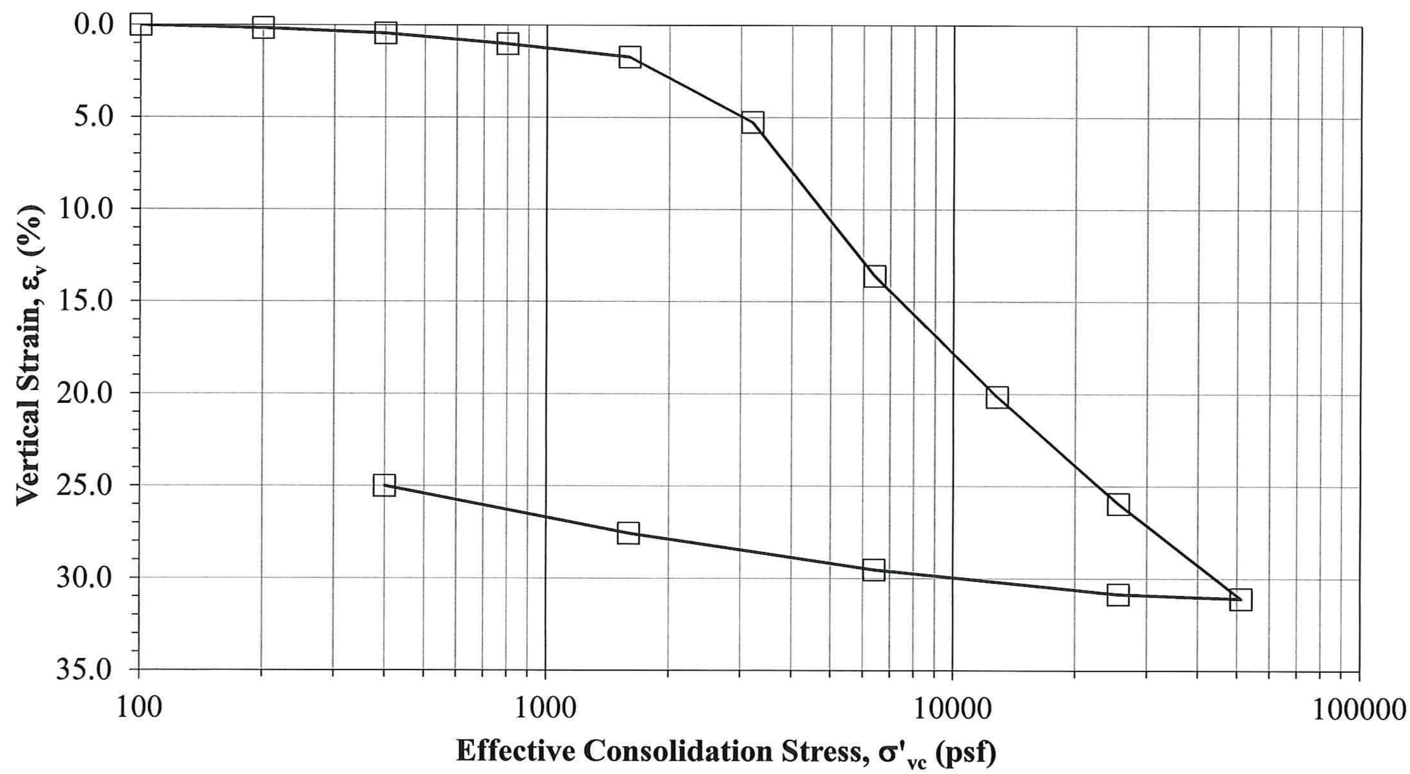
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.6900
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	165.94	150.53
Wt. rings/tare (g)	45.14	45.14
Moist unit wt., γ_m (pcf)	109.1	126.9
Wet soil + tare (g)	342.98	
Dry soil + tare (g)	269.59	
Tare (g)	122.35	
Water content, w (%)	49.8	30.7
Dry unit wt., γ_d (pcf)	72.8	97.1
Saturation	1.00	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9200	1.3148
100	0.0002	0.02	0.9198	1.3143
200	0.0015	0.17	0.9185	1.3109
400	0.0041	0.44	0.9159	1.3045
800	0.0094	1.02	0.9106	1.2911
1600	0.0158	1.72	0.9042	1.2749
3200	0.0484	5.26	0.8716	1.1929
6400	0.1251	13.60	0.7949	1.0000
12800	0.1854	20.15	0.7346	0.8483
25600	0.2387	25.95	0.6813	0.7142
51200	0.2861	31.10	0.6339	0.5949
25600	0.2839	30.86	0.6361	0.6005
6400	0.2718	29.54	0.6482	0.6309
1600	0.2535	27.55	0.6665	0.6770
400	0.2300	25.00	0.6900	0.7361



Comments: Specimen swelled upon inundation and at the 100 psf loading.

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Reviewed: [signature]

One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

(ASTM D4186)

IGES

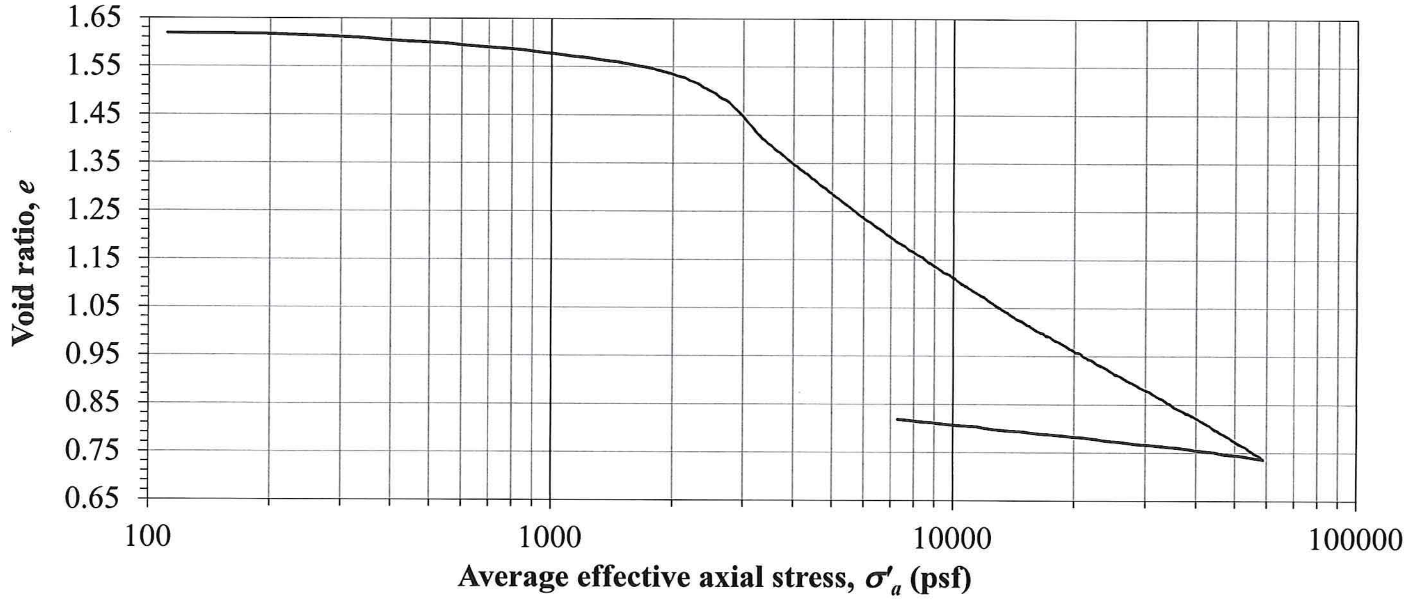
Project: **Epic Engineering**
No: **M00277-067 (15MGT004.01)**
Location: I-80 + 7200 West Expanded
Date: 5/12/2015
By: NB

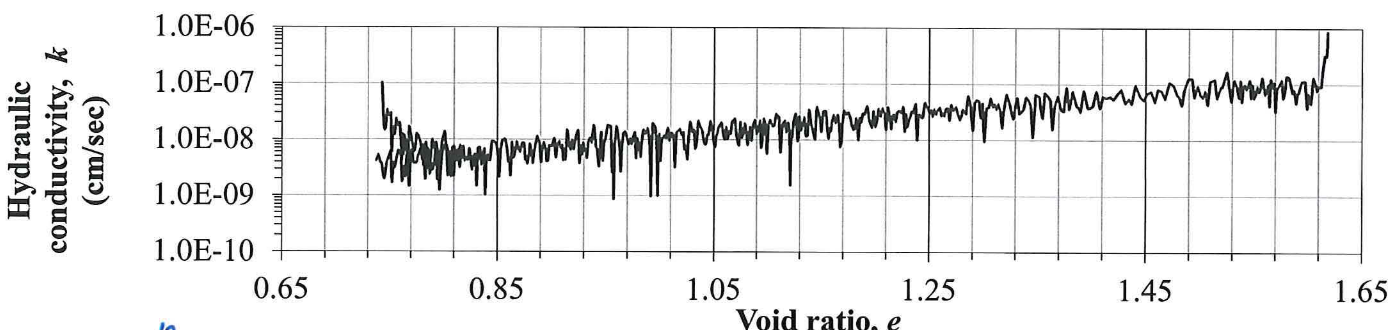
Boring No.: **BH-02**
Sample:
Depth: **15'**
Sample Description: Dark grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.949	0.6577
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	241.76	214.91
Wt. rings/tare (g)	111.74	111.74
Moist unit wt., γ_m (pcf)	106.33	121.74
Wet soil + tare (g)	315.15	231.33
Dry soil + tare (g)	239.37	208.52
Tare (g)	112.19	122.88
Water content, w (%)	59.58	26.63
Dry unit wt., γ_d (pcf)	66.63	96.14
Void ratio, e	1.622	0.817
Saturation ratio, S	1.028	0.912

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	0.1535
Height at end of saturation (in)	0.9475
Void ratio at end of saturation	1.6183
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.





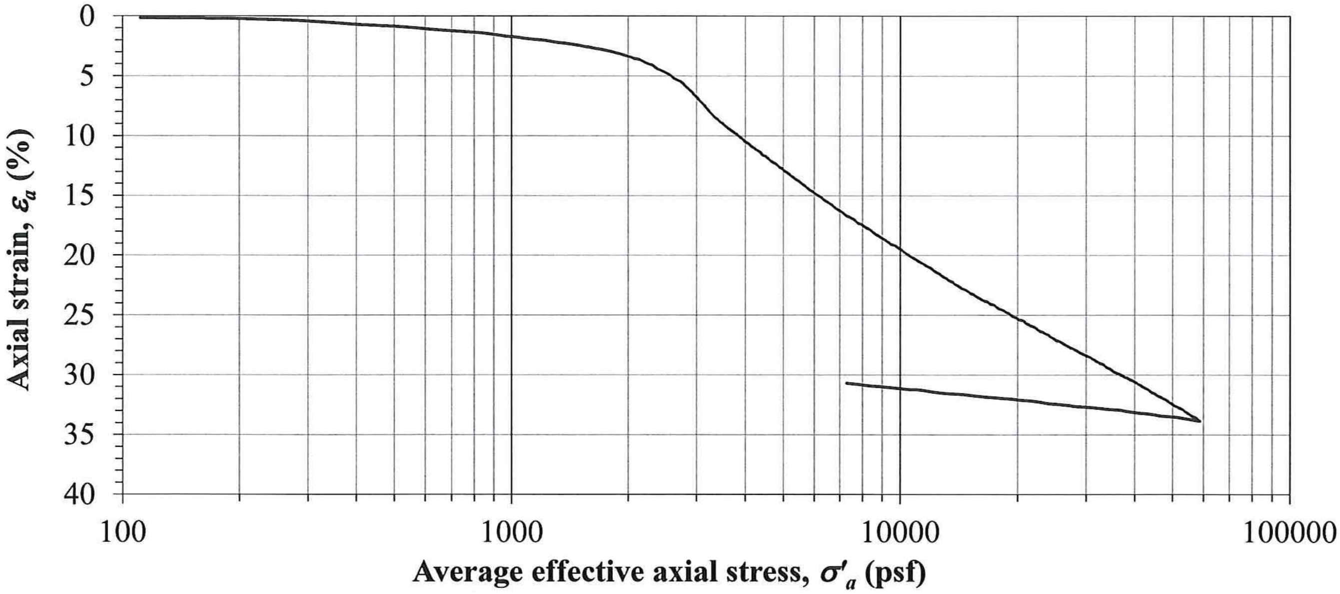
Entered: NB
Reviewed:

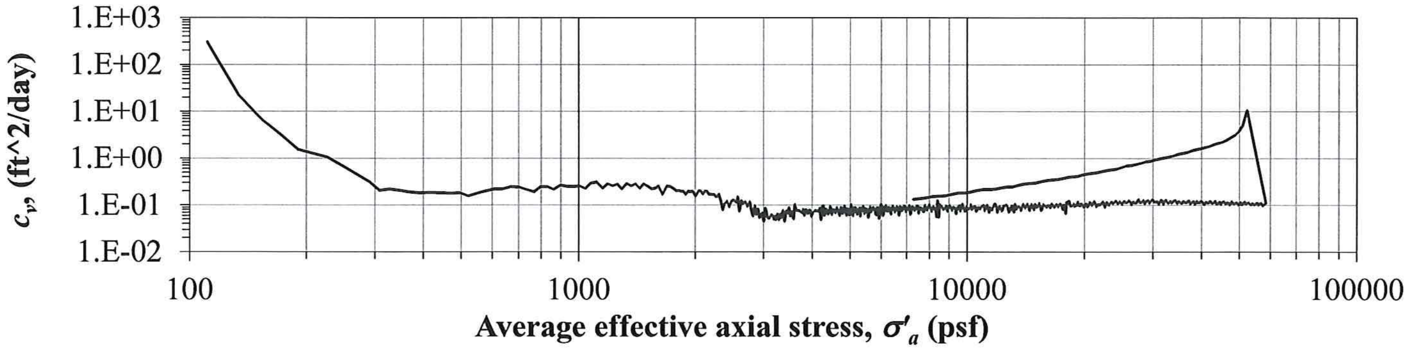
One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

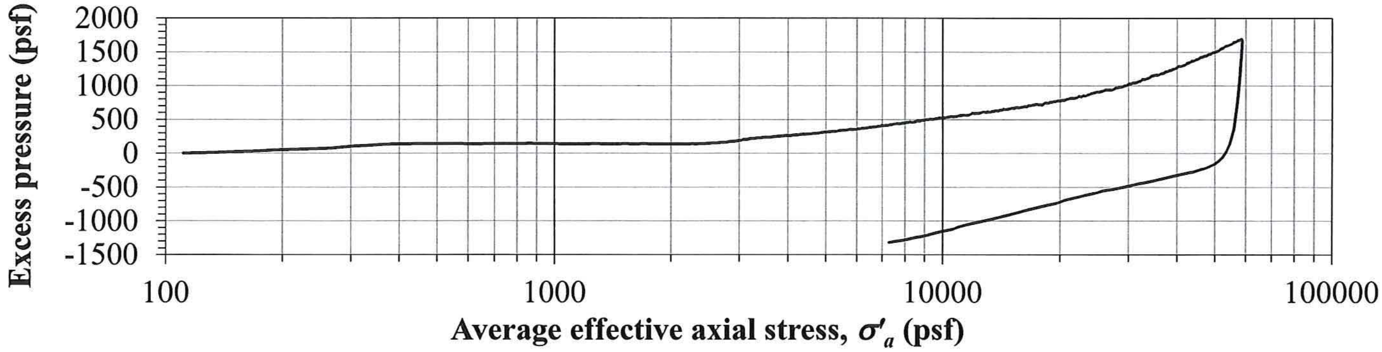
(*ASTM D4186*)

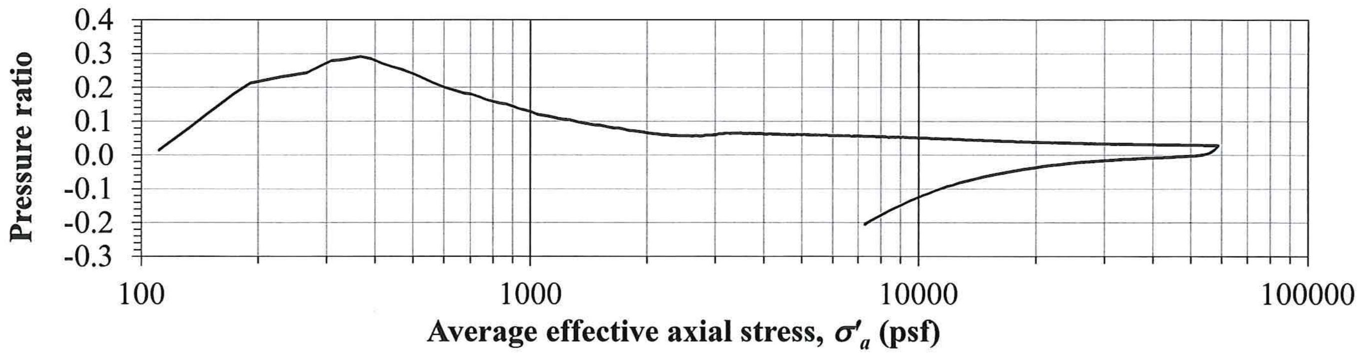
Project: Epic Engineering
No: M00277-067 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-02
Sample:
Depth: 15'









One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

IGES

(*ASTM D4186*)

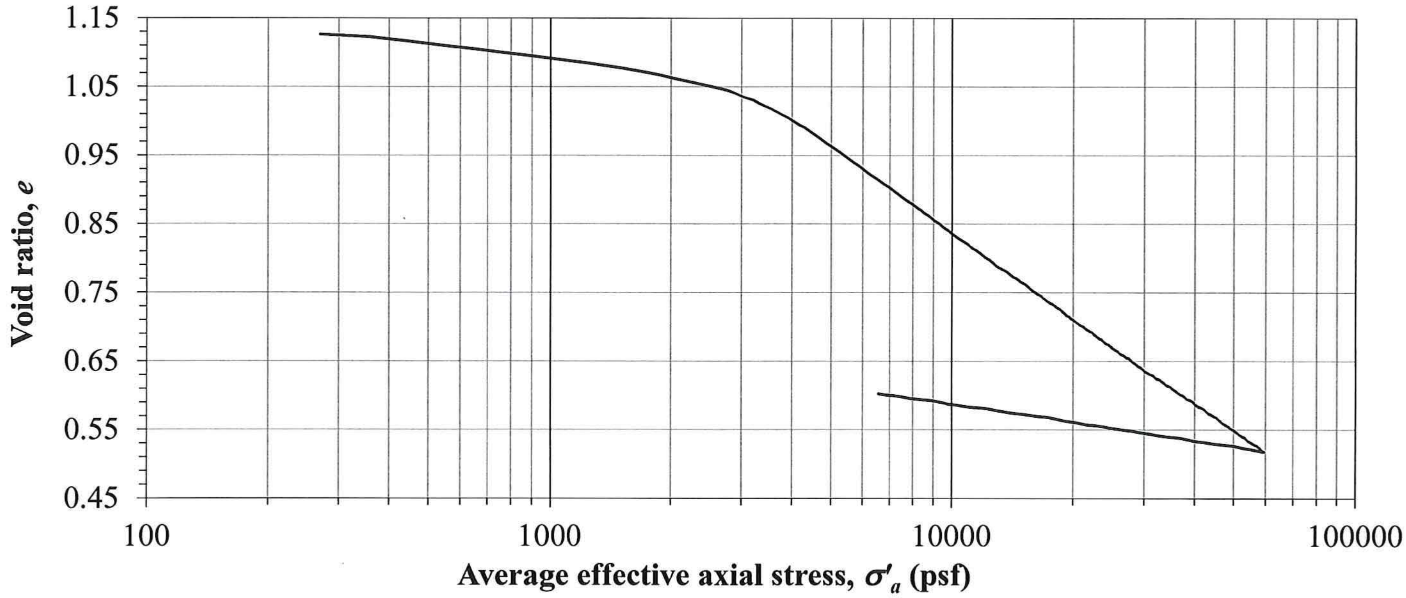
Project: Epic Engineering
No: M00277-068 (15MGT004.01)
Location: I-80 + 7300 West Expanded
Date: 5/12/2015
By: NB

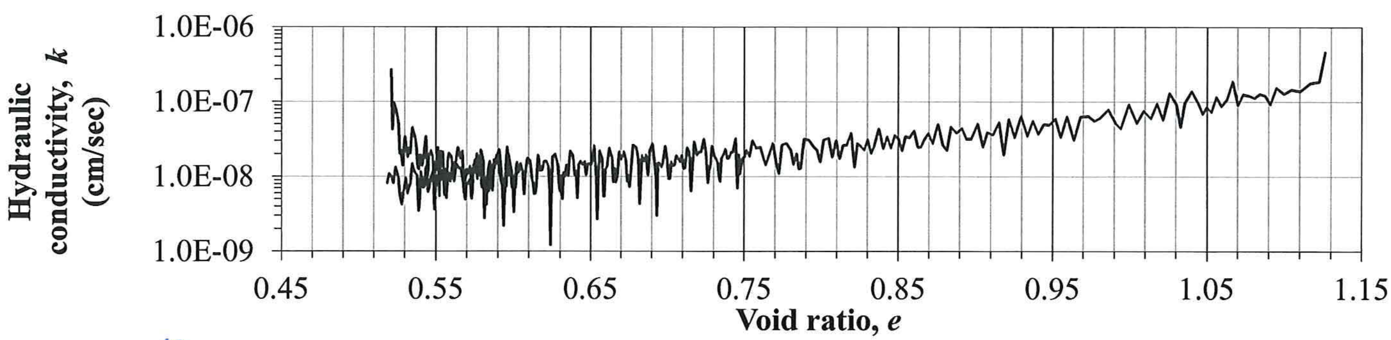
Boring No.: BH-06
Sample:
Depth: 20'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.6898
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	245.35	234.85
Wt. rings/tare (g)	111.72	111.72
Moist unit wt., γ_m (pcf)	112.72	138.53
Wet soil + tare (g)	303.01	241.05
Dry soil + tare (g)	254.83	215.96
Tare (g)	127.07	122.66
Water content, w (%)	37.71	26.89
Dry unit wt., γ_d (pcf)	81.86	109.17
Void ratio, e	1.134	0.600
Saturation ratio, S	0.931	1.000

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	0.3879
Height at end of saturation (in)	0.9164
Void ratio at end of saturation	1.1262
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.





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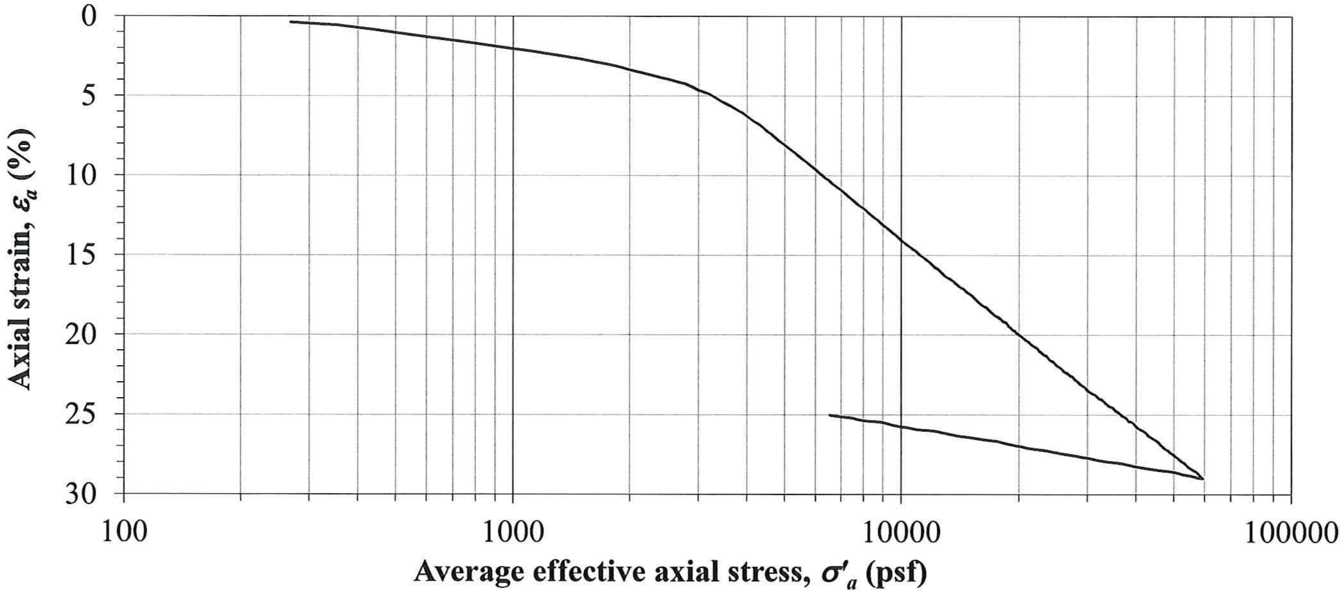
One-Dimensional Consolidation Properties of Saturated Cohesive Soils
Using Controlled-Strain Loading

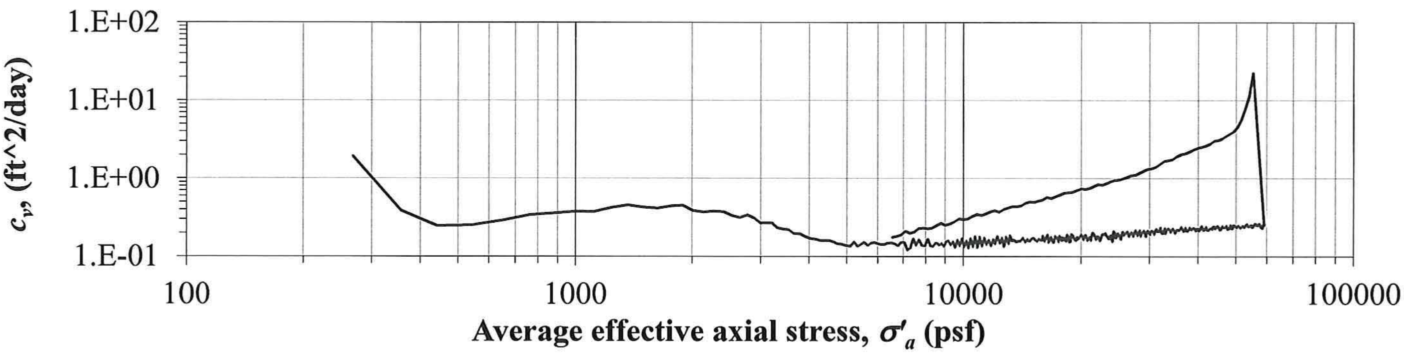
(*ASTM D4186*)

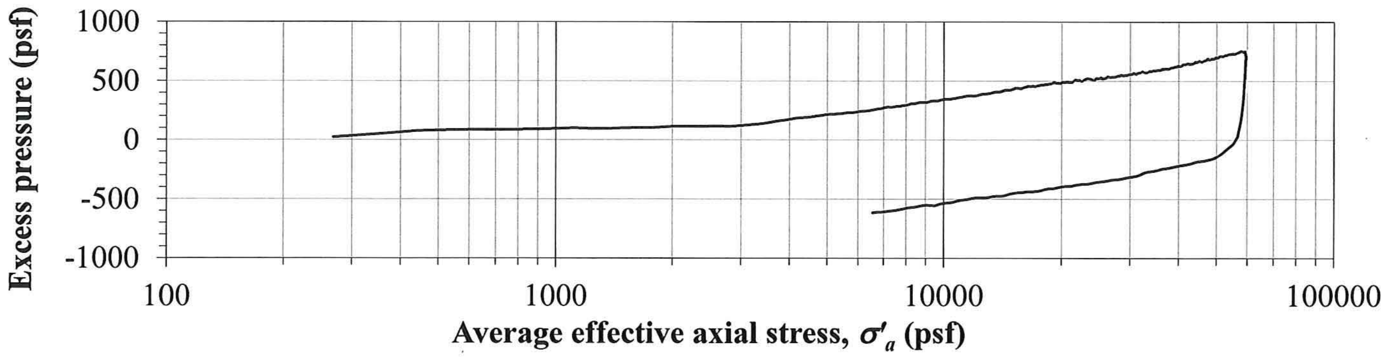
IGES

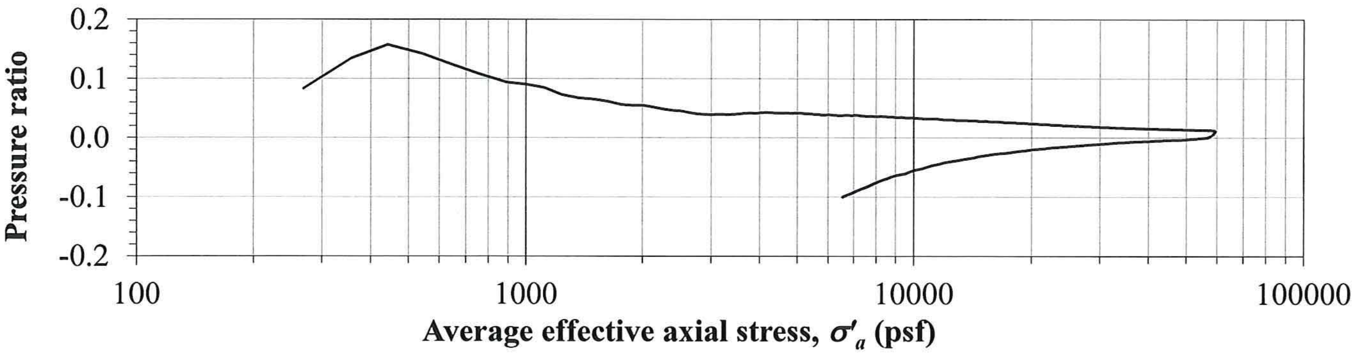
Project: Epic Engineering
No: M00277-068 (15MGT004.01)
Location: I-80 + 7300 West Expanded

Boring No.: BH-06
Sample:
Depth: 20'









One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

(*ASTM D4186*)

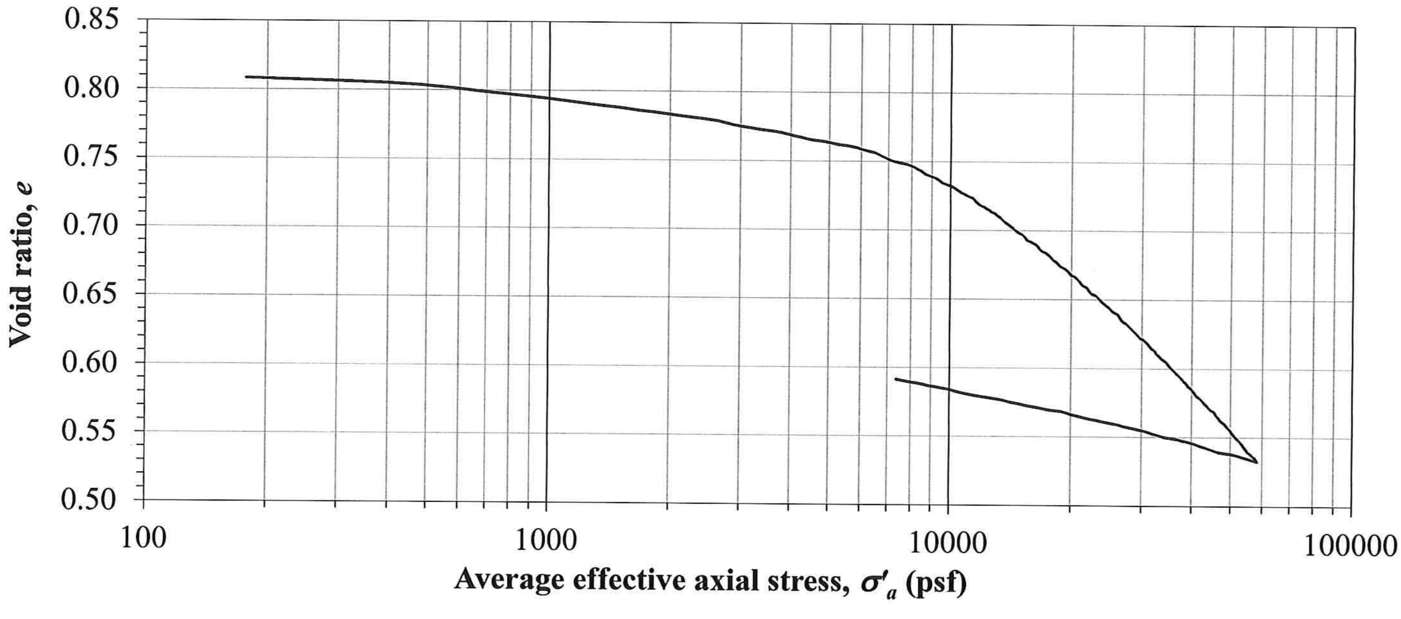
Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded
Date: 5/19/2015
By: NB

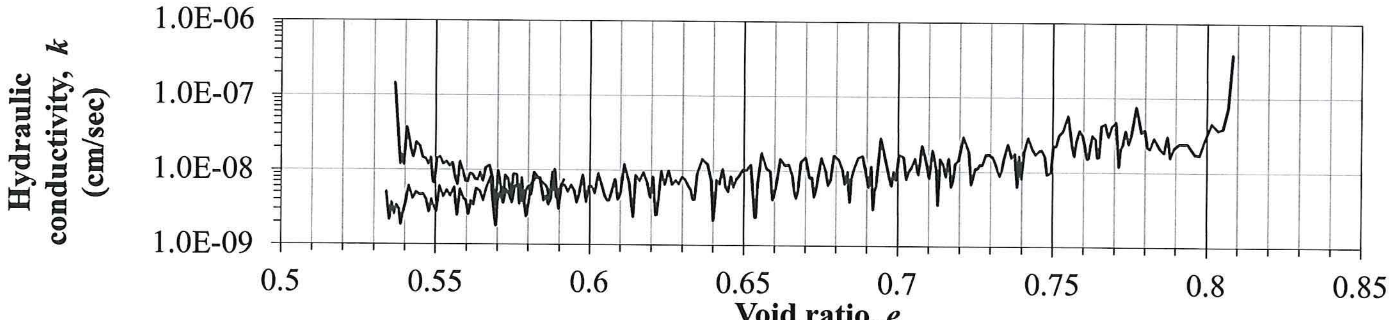
Boring No.: BH-07
Sample:
Depth: 50'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8083
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	255.72	250.66
Wt. rings/tare (g)	110.51	110.51
Moist unit wt., γ_m (pcf)	122.49	134.55
Wet soil + tare (g)	462.53	261.50
Dry soil + tare (g)	391.40	235.97
Tare (g)	127.56	122.66
Water content, w (%)	26.96	22.53
Dry unit wt., γ_d (pcf)	96.48	109.81
Void ratio, e	0.811	0.591
Saturation ratio, S	0.931	1.000

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	0.1451
Height at end of saturation (in)	0.9187
Void ratio at end of saturation	0.8083
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.





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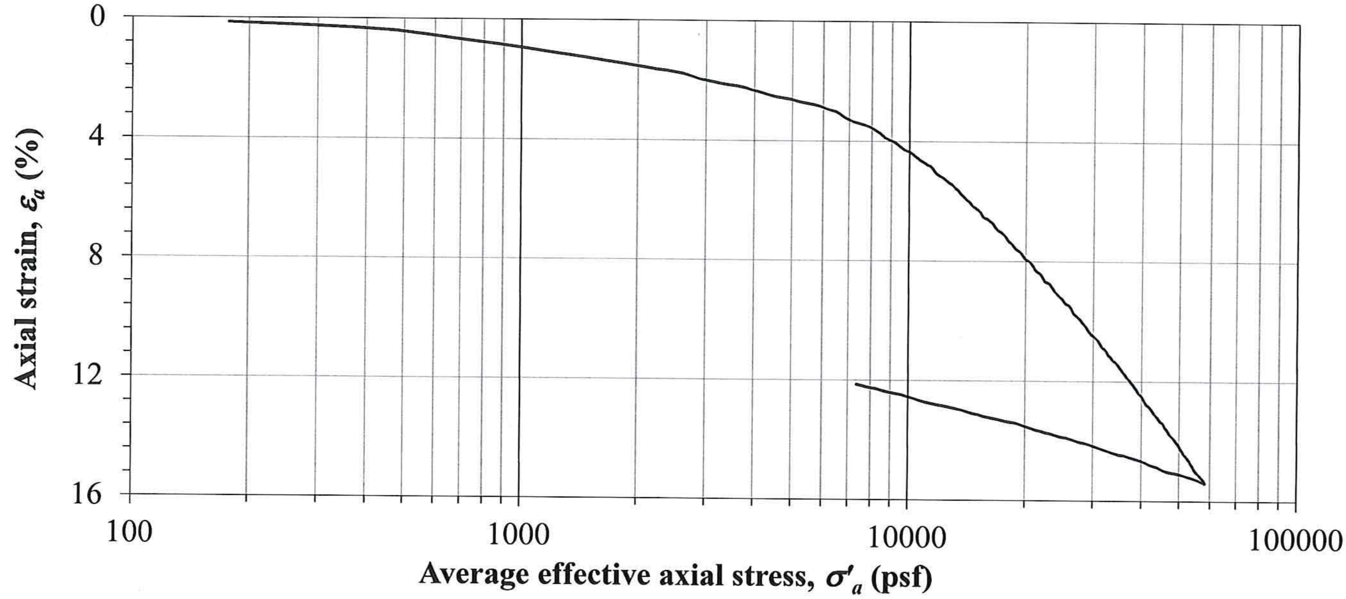
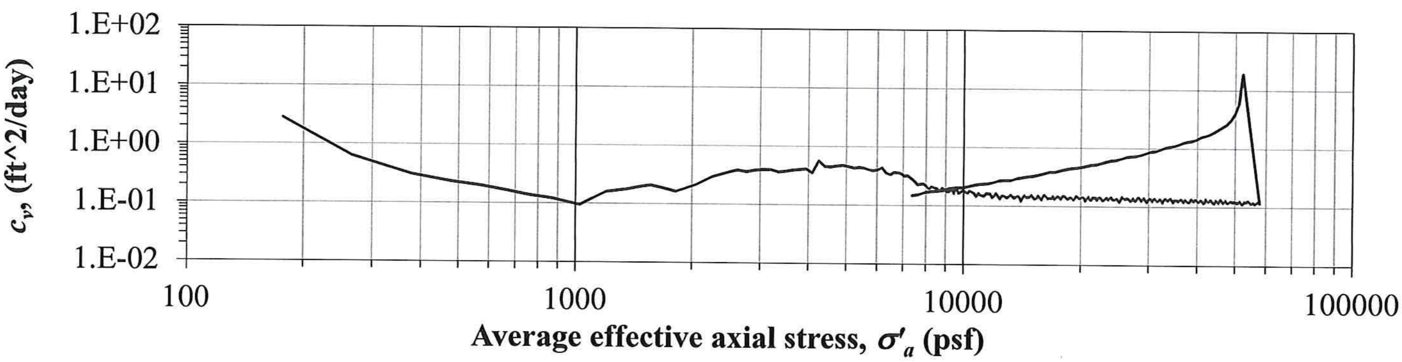
One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

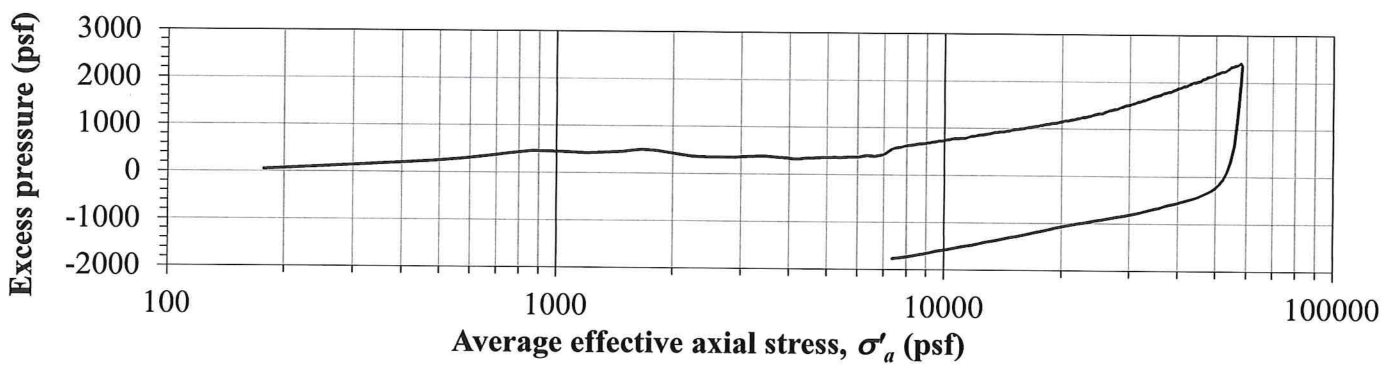
(*ASTM D4186*)

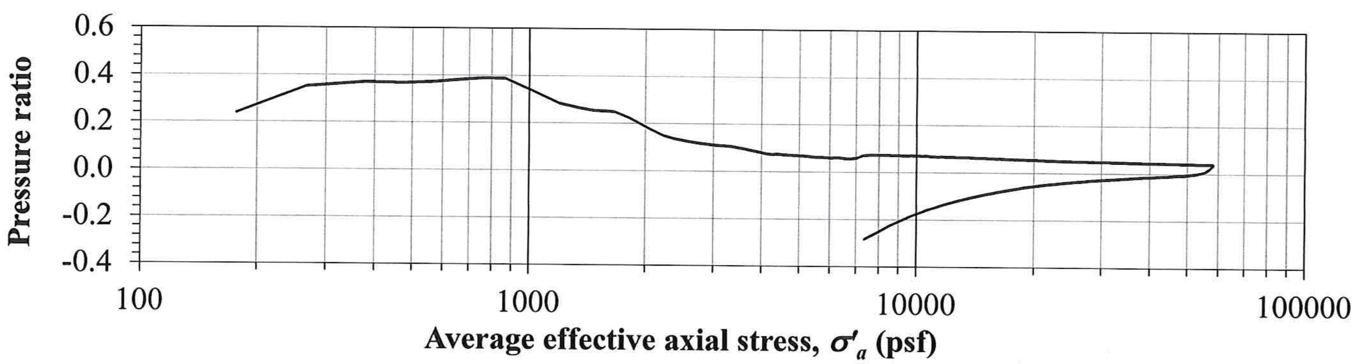
Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded

Boring No.: BH-07
Sample:
Depth: 50'









One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

IGES

(*ASTM D4186*)

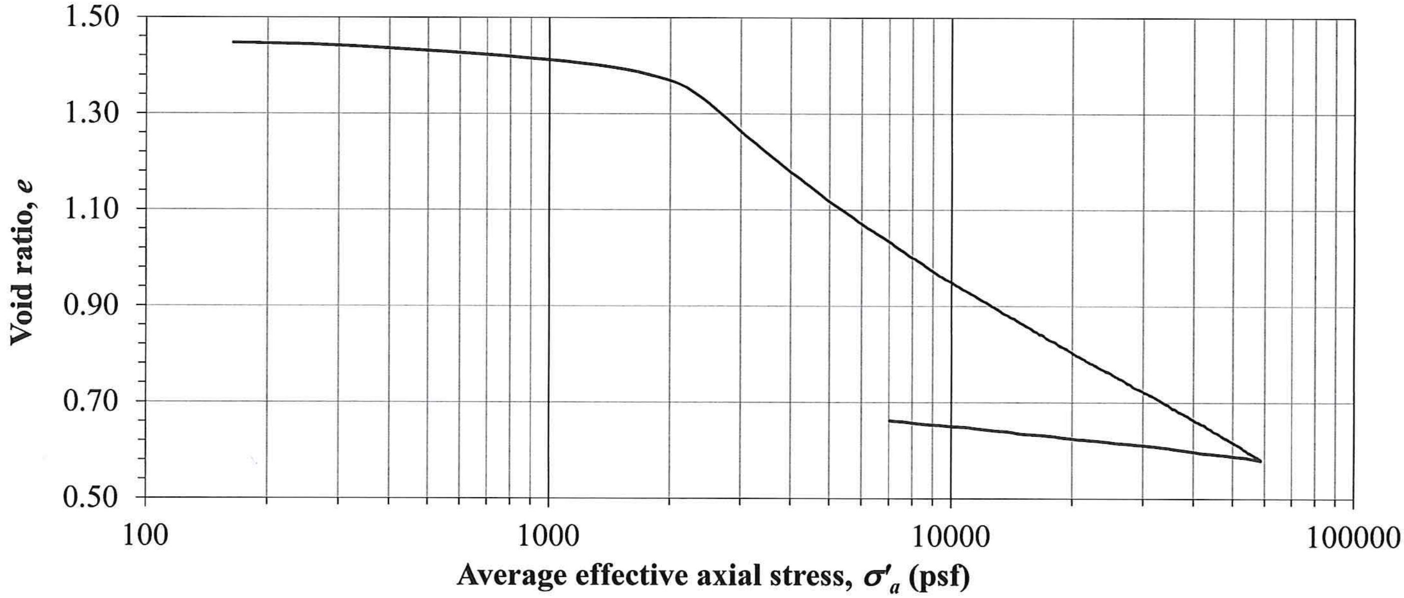
Project: Epic Engineering
No: M00277-068 (15MGT004.01)
Location: I-80 + 7300 West Expanded
Date: 5/15/2015
By: NB

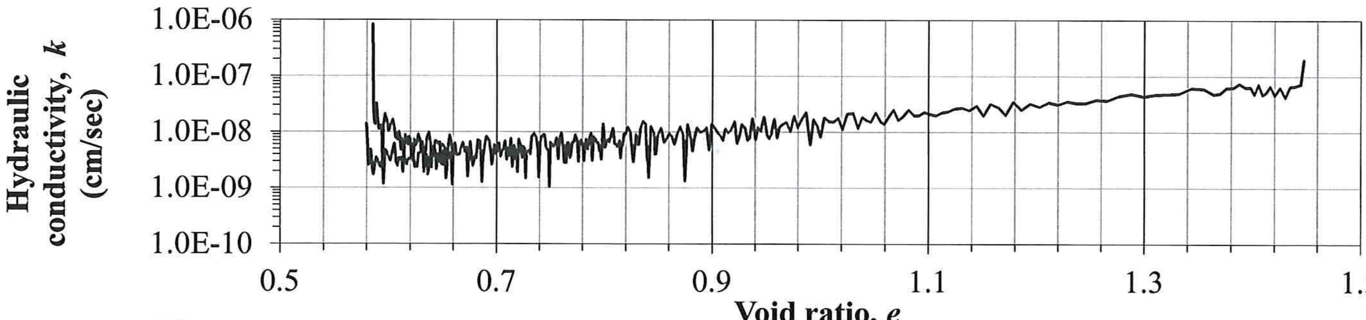
Boring No.: BH-08
Sample:
Depth: 12.5'
Sample Description: Dark grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.6230
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	239.41	220.07
Wt. rings/tare (g)	111.72	111.72
Moist unit wt., γ_m (pcf)	107.71	134.98
Wet soil + tare (g)	285.30	247.53
Dry soil + tare (g)	231.96	224.05
Tare (g)	127.70	140.98
Water content, w (%)	51.16	28.27
Dry unit wt., γ_d (pcf)	71.26	105.23
Void ratio, e	1.452	0.660
Saturation ratio, S	0.987	1.000

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	0.1873
Height at end of saturation (in)	0.9183
Void ratio at end of saturation	1.4474
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and $\sigma_p{}'$ to be determined by Geotechnical Engineer.





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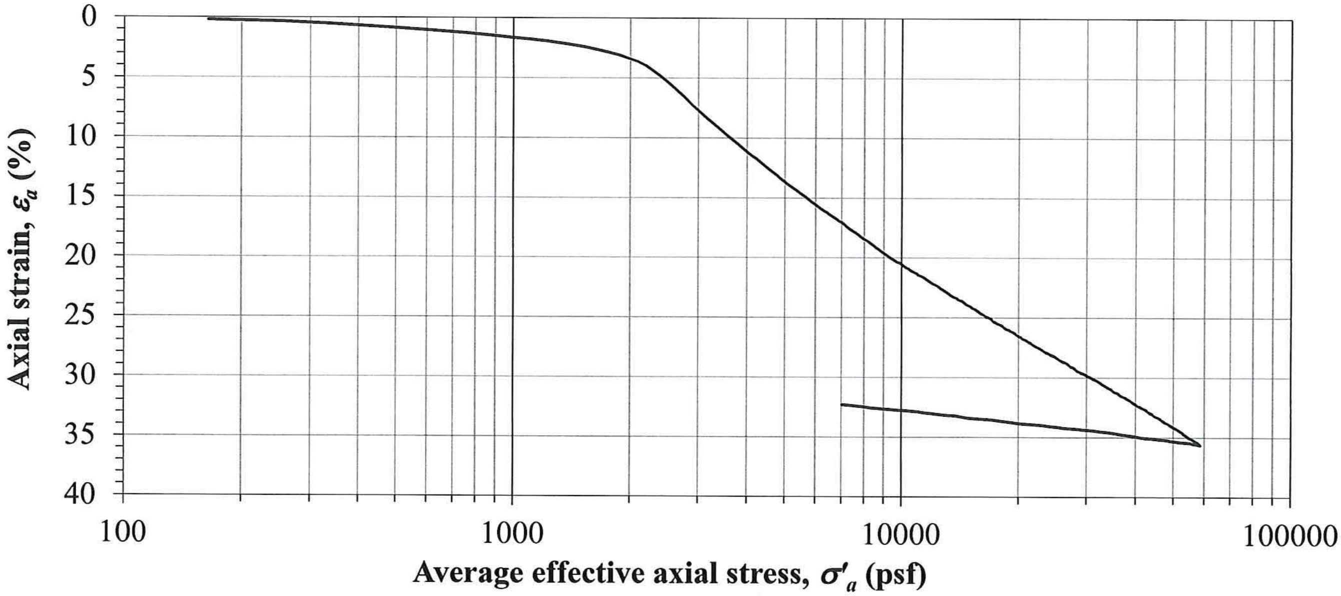
One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

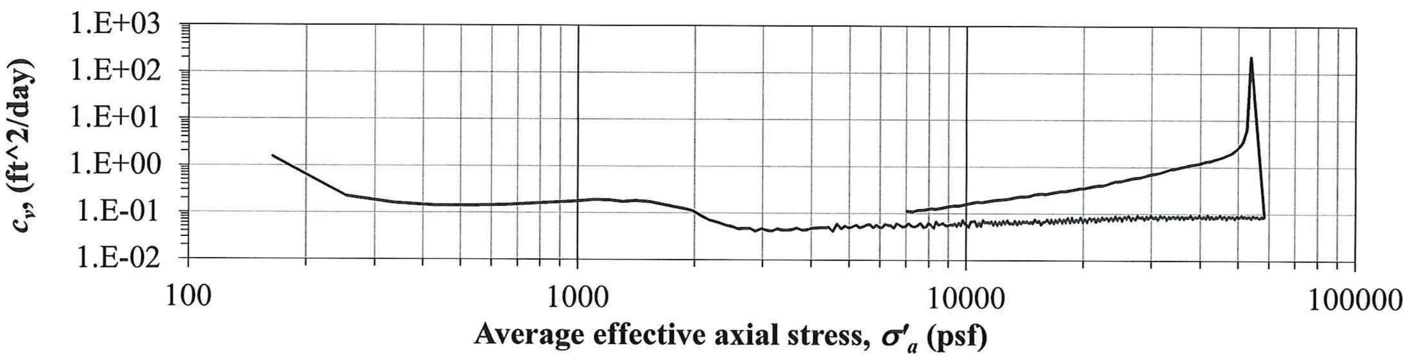
(*ASTM D4186*)

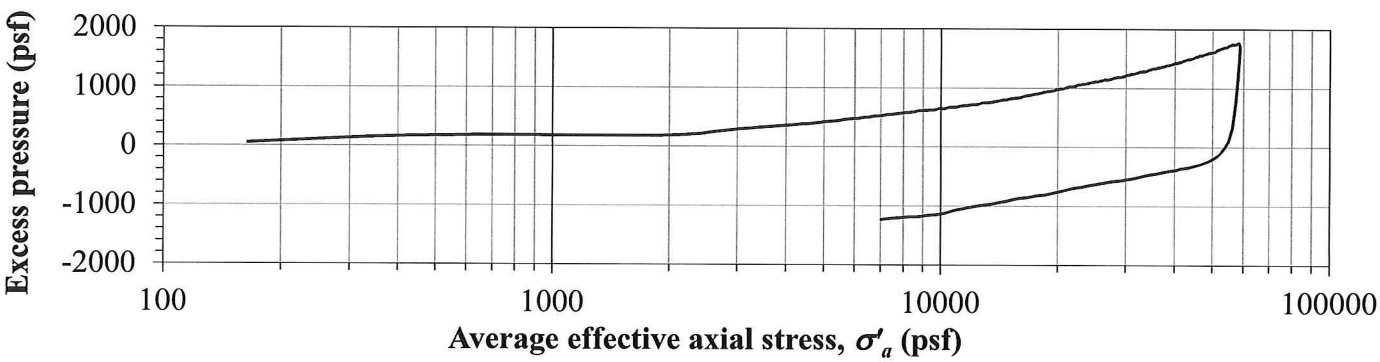
IGES

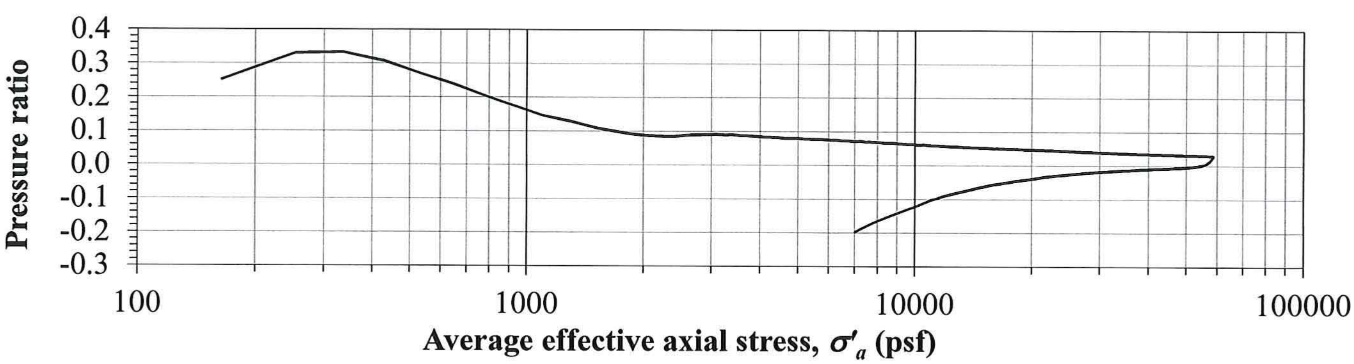
Project: Epic Engineering
No: M00277-068 (15MGT004.01)
Location: I-80 + 7300 West Expanded

Boring No.: BH-08
Sample:
Depth: 12.5'









One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

IGES

(*ASTM D4186*)

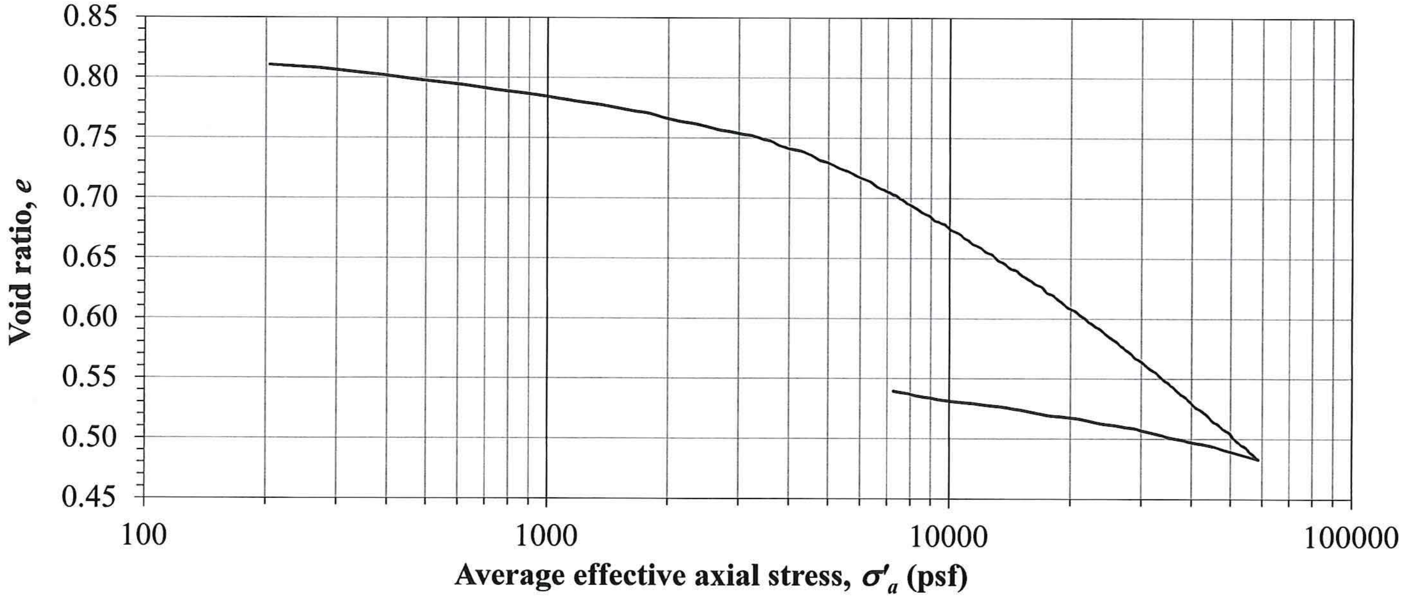
Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded
Date: 5/19/2015
By: NB

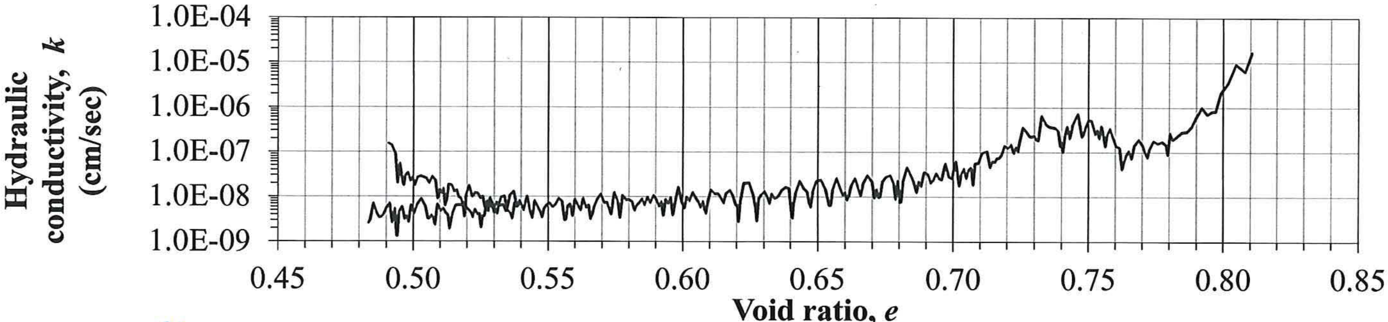
Boring No.: BH-09
Sample:
Depth: 45'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7820
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	256.36	250.26
Wt. rings/tare (g)	111.67	111.67
Moist unit wt., γ_m (pcf)	122.05	137.55
Wet soil + tare (g)	298.00	259.77
Dry soil + tare (g)	262.25	235.79
Tare (g)	127.48	122.64
Water content, w (%)	26.53	21.19
Dry unit wt., γ_d (pcf)	96.46	113.49
Void ratio, e	0.811	0.539
Saturation ratio, S	0.916	1.000

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	-0.0290
Height at end of saturation (in)	0.9203
Void ratio at end of saturation	0.8118
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.





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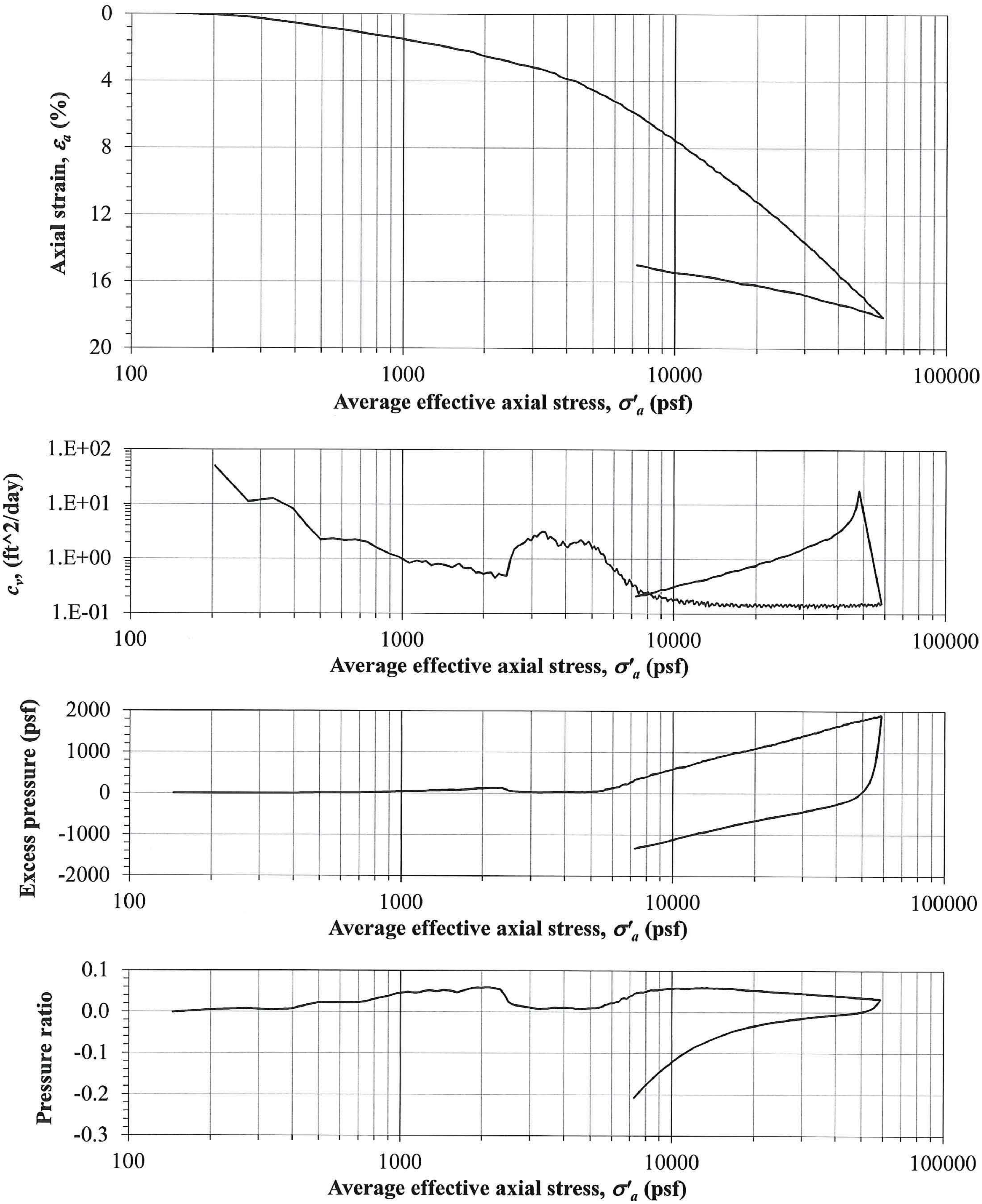
One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

IGES

(*ASTM D4186*)

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded

Boring No.: BH-09
Sample:
Depth: 45'



One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

(*ASTM D4186*)

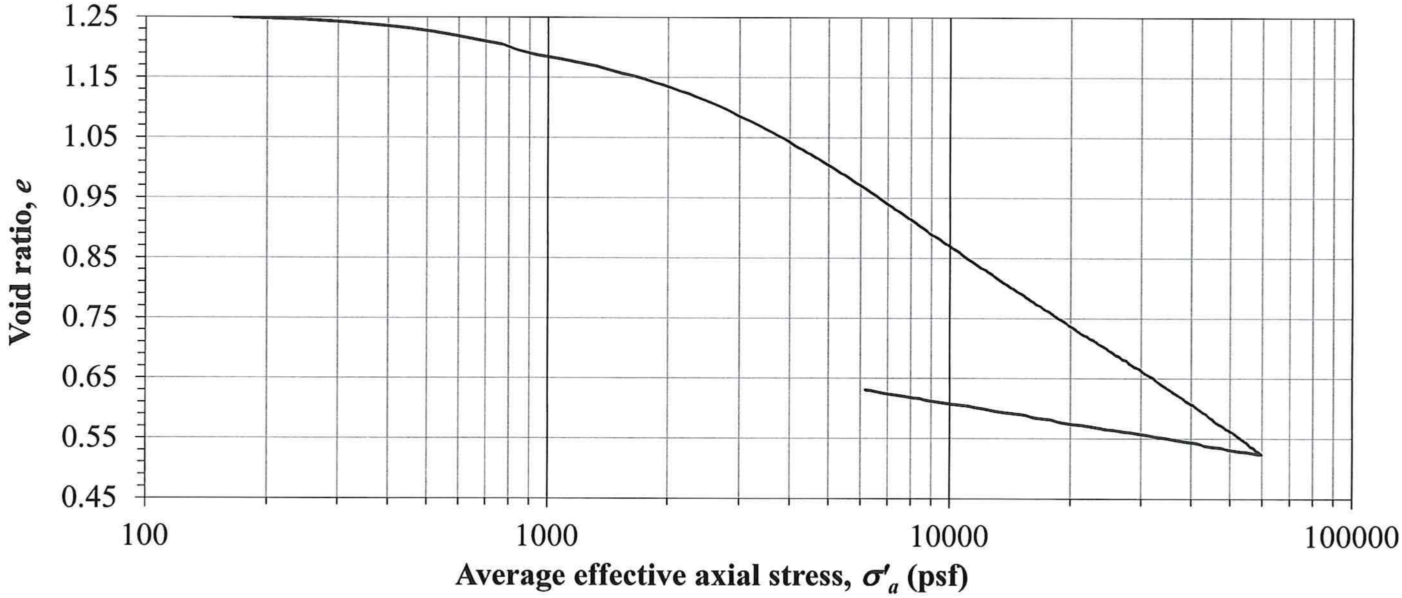
Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded
Date: 5/26/2015
By: NB

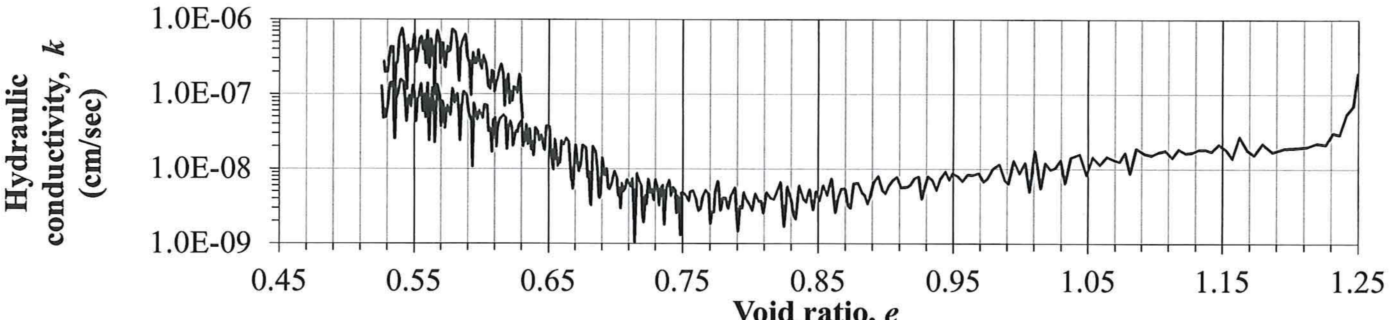
Boring No.: BH-10
Sample:
Depth: 20'
Sample Description: Dark grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

Specific gravity, G_s	2.80	Assumed
	Initial (o)	Final (f)
Sample height, H (in.)	0.910	0.6598
Sample diameter, D (in.)	2.500	2.500
Wt. rings + wet soil (g)	241.03	225.92
Wt. rings/tare (g)	110.57	110.57
Moist unit wt., γ_m (pcf)	111.26	135.67
Wet soil + tare (g)	270.64	254.30
Dry soil + tare (g)	227.72	230.44
Tare (g)	128.40	140.84
Water content, w (%)	43.21	26.63
Dry unit wt., γ_d (pcf)	77.69	107.14
Void ratio, e	1.249	0.631
Saturation ratio, S	0.969	1.000

Seating pressure (psf)	100
Backpressure (psf)	7200
Strain at end of saturation (%)	-0.0240
Height at end of saturation (in)	0.9102
Void ratio at end of saturation	1.2495
Average loading strain rate (%/hr)	0.85
Average unloading strain rate (%/hr)	-0.85

*Note: C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.





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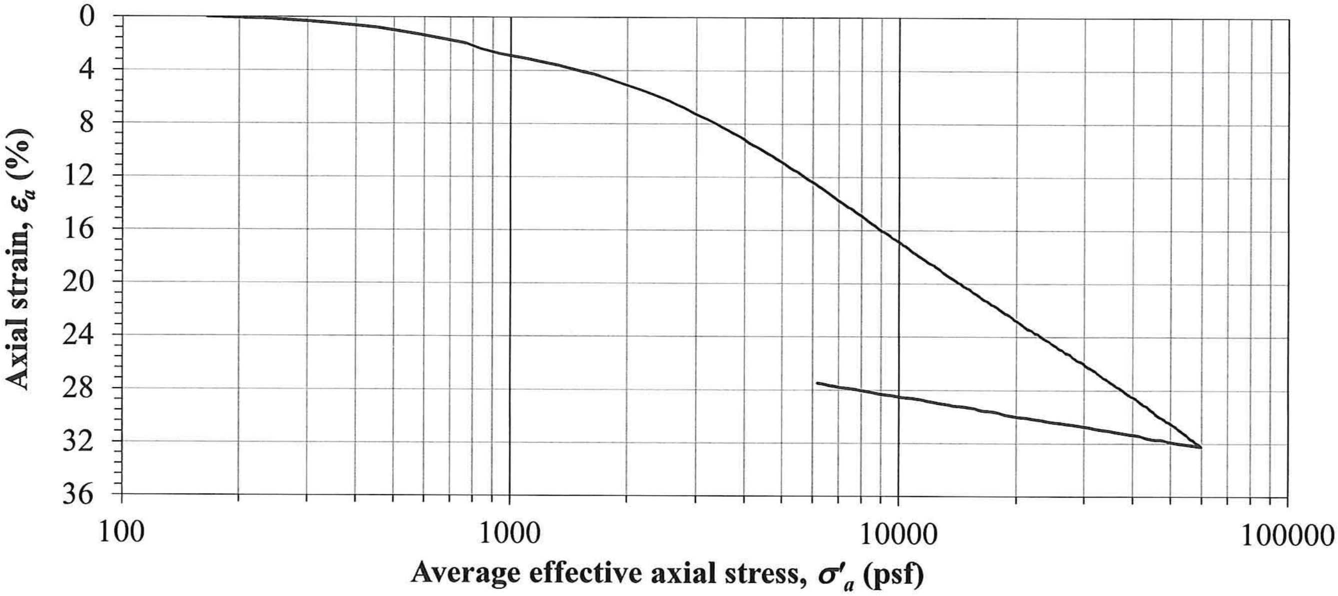
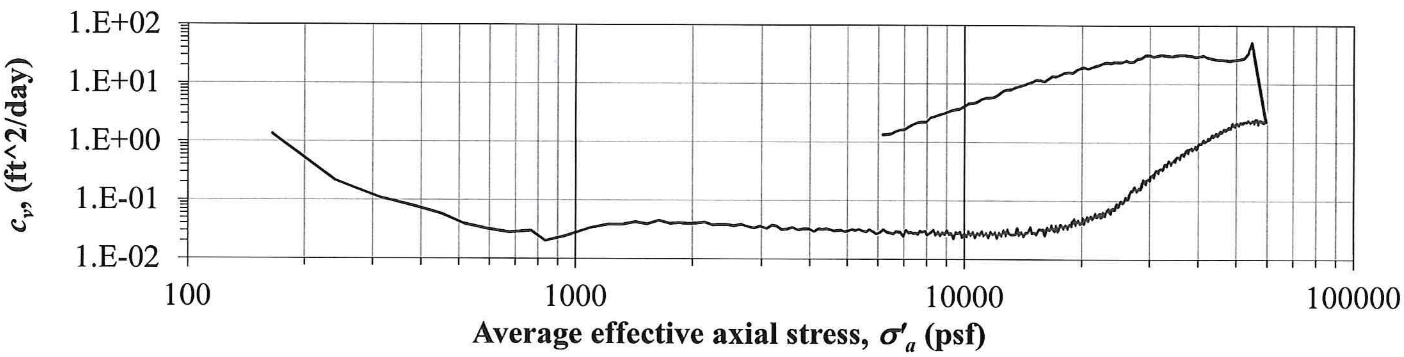
One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

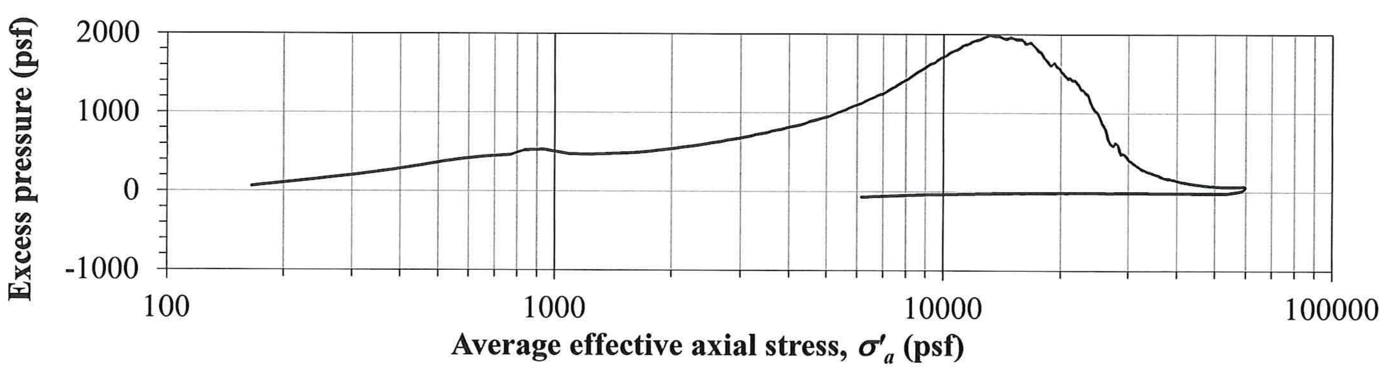
(*ASTM D4186*)

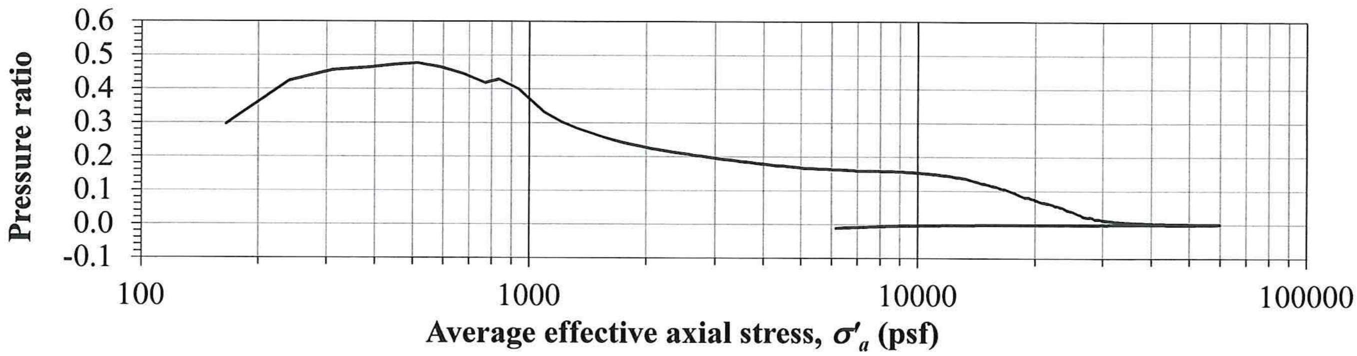
Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7300 West Expanded

Boring No.: BH-10
Sample:
Depth: 20'









Consolidated Undrained Triaxial Compression Test for Cohesive Soils

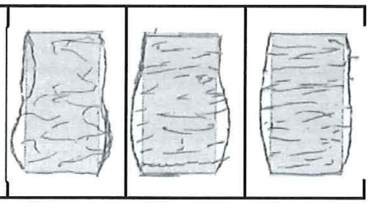
(*ASTM D4767*)

Project: Epic Engineering
No: M00277-067 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 6/2/2015
By: NB/JDF

Boring No.: BH-01
Sample:
Depth: 12.5'
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

	Test Number:	S1	S2	S3
Initial	Height, H (in)	6.001	6.116	6.012
	Diameter, D (in)	2.836	2.809	2.806
	Water content, w (%)	53.4	29.1	35.5
	Dry unit weight, γ_d (pcf)	67.7	97.3	85.2
	Saturation (%)	93.4	100.0	93.0
	Void ratio, e	1.63	0.83	1.09
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	55.1	28.7	34.4
	Dry unit weight, γ_d (pcf)	69.2	97.9	87.4
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	1.57	0.82	1.04
	Area, A_{eoc} (in^2)	6.24	6.10	5.92
	Area method	A	A	A
	B	0.945	0.945	0.945
	t_{50} (min)	109.87	8.62	66.40
	Back pressure (psf)	4751	4418	6045
	Strain rate (%/min)	0.00602	0.00602	0.00602
	Time to failure (min)	1428.6	3322.3	2757.5
	Strain at failure, ε_f (%)	8.60	20.00	16.60
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes

Assumed specific gravity 2.85



[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	160
	ϕ (deg)	24.8
Effective stress	c' (psf)	120
	ϕ' (deg)	31.3

Comments:

Test number S2 contained sand sized particles throughout the test specimen which may account for the higher strength in test number S2.

Tested by: NB

Reviewed: [signature]

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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

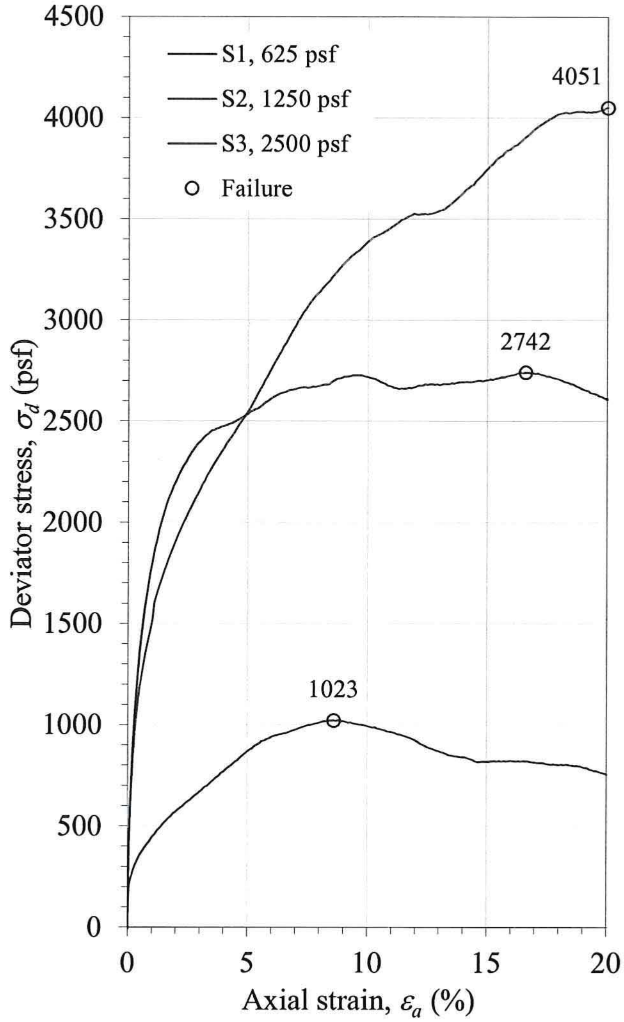
(*ASTM D4767*)

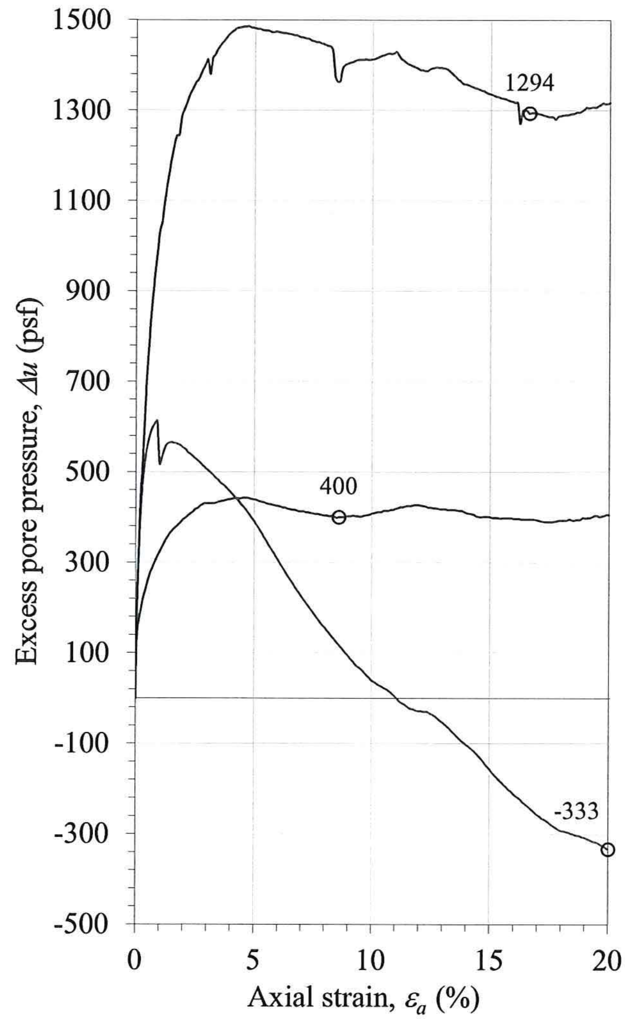
IGES

Project: Epic Engineering
No: M00277-067 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-01
Sample:
Depth: 12.5'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	625	1250	2500
	σ_1-σ_3 (psf)	1023	4051	2742
	σ_1 (psf)	1648	5301	5242
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	511	2026	1371
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	1137	3276	3871
Effective stress	Δu (psf)	400	-333	1294
	σ'_3 (psf)	225	1583	1207
	σ'_1-σ'_3 (psf)	1023	4051	2742
	σ'_1 (psf)	1248	5635	3948
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	511	2026	1371
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	736	3609	2578
	σ'_1/σ'_3	5.54	3.56	3.27
	$A = \Delta u/(\sigma_1 - \sigma_3)$	0.391	-0.082	0.472





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

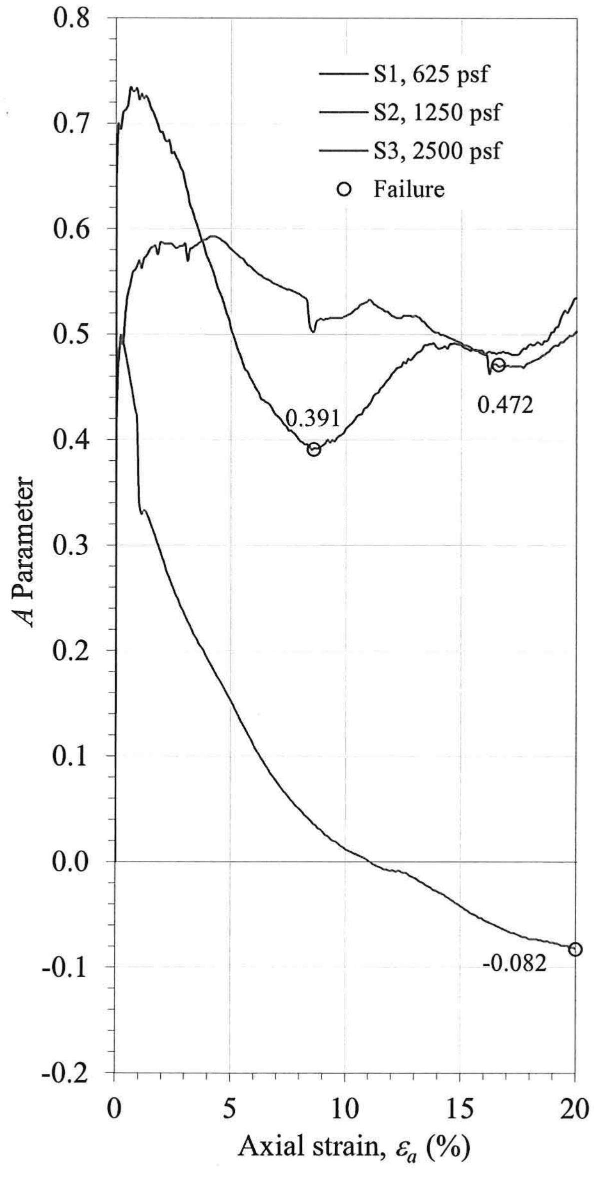
(*ASTM D4767*)

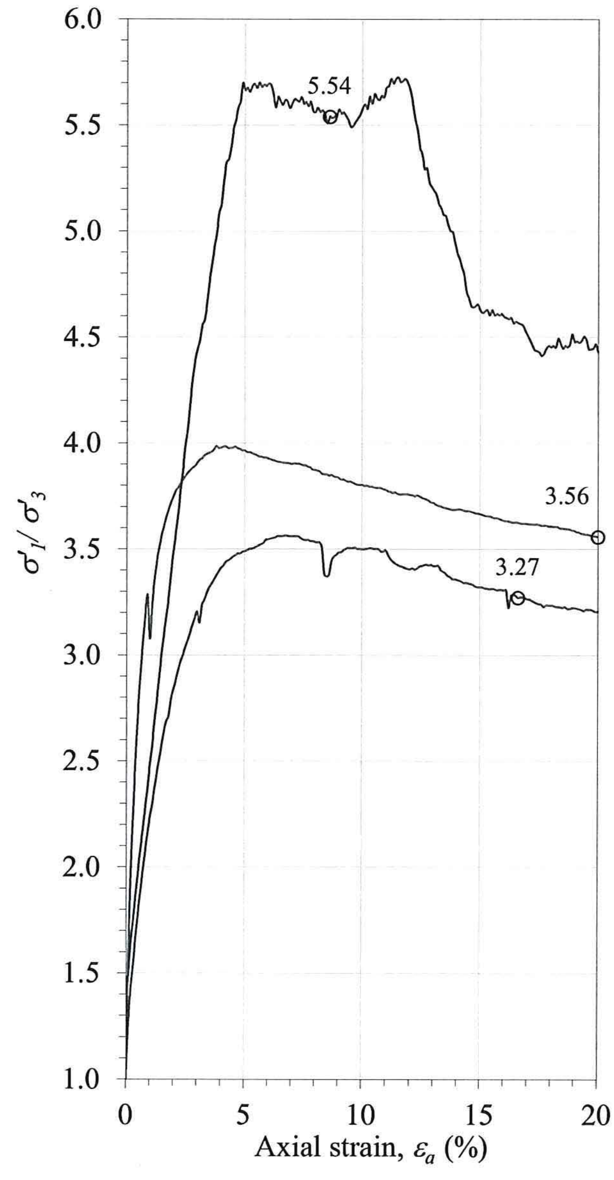
IGES

Project: Epic Engineering
No: M00277-067 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-01
Sample:
Depth: 12.5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	160
	ϕ (deg)	24.8
Effective stress	c' (psf)	120
	ϕ' (deg)	31.3





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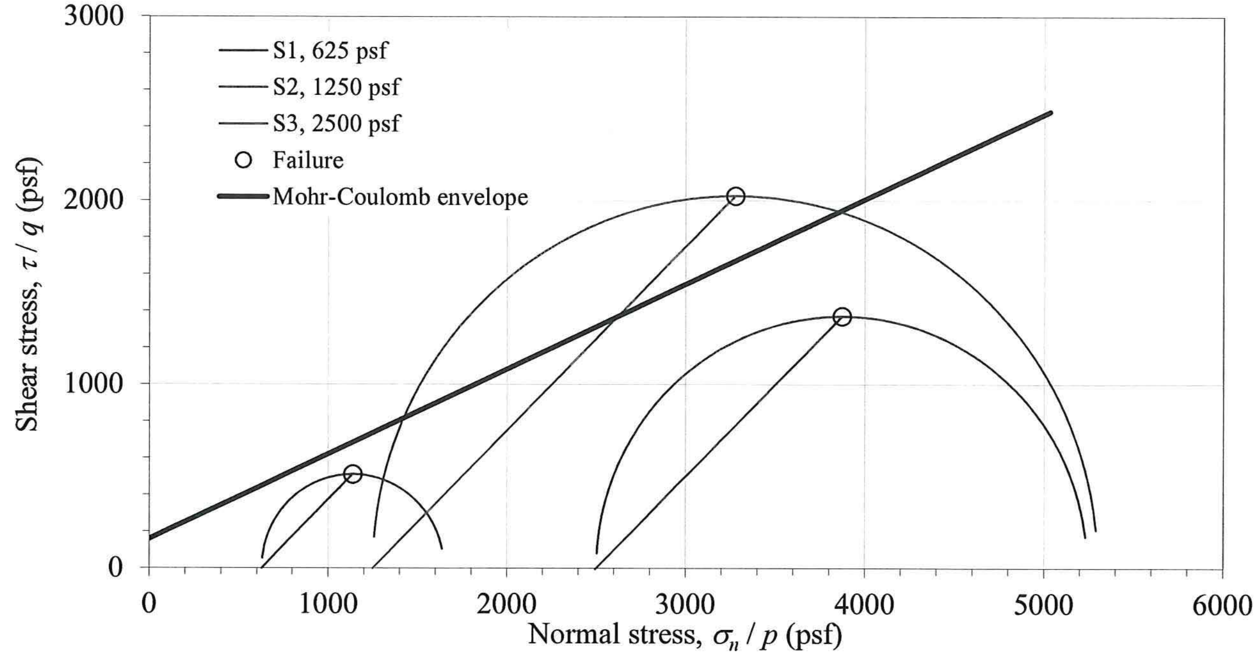
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

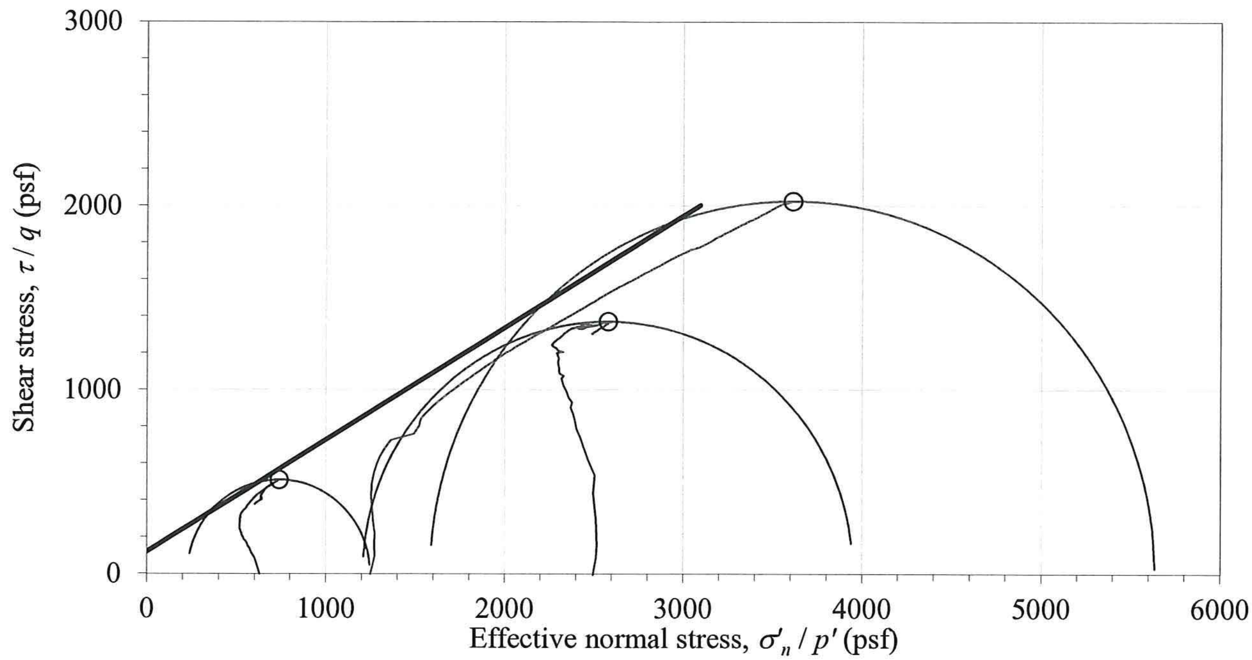
(*ASTM D4767*)

Project: Epic Engineering
No: M00277-067 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-01
Sample:
Depth: 12.5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	160
	ϕ (deg)	24.8
Effective stress	c' (psf)	120
	ϕ' (deg)	31.3





Z:\PROJECTS\M00277_Epic\067_Prison\[GTXCU3v2_BH01_12.5ft.xlsm]Summary

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

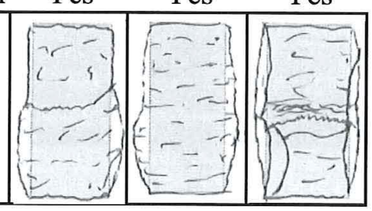
(*ASTM D4767*)

Project: **Epic Engineering**
No: **M00277-069 (15MGT004.01)**
Location: I-80 + 7200 West Expanded
Date: 6/12/2015
By: JDF/NB

Boring No.: **BH-09**
Sample:
Depth: **25'**
Sample Description: Grey clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

	Test Number:	S1	S2	S3
Initial	Height, H (in)	6.351	6.294	6.372
	Diameter, D (in)	2.850	2.821	2.795
	Water content, w (%)	26.9	26.7	27.9
	Dry unit weight, γ_d (pcf)	96.8	97.1	98.1
	Saturation (%)	93.7	93.5	100.0
	Void ratio, e	0.81	0.80	0.78
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	27.1	28.5	25.5
	Dry unit weight, γ_d (pcf)	99.3	97.3	102.0
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.76	0.80	0.71
	Area, A_{eoc} (in^2)	6.32	6.19	5.78
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	15.91	17.33	27.69
	Back pressure (psf)	4751	4752	4752
	Strain rate (%/min)	0.0144	0.0144	0.0144
	Time to failure (min)	1312.5	1166.7	1340.3
	Strain at failure, ε_f (%)	18.90	16.80	19.30
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes

Assumed specific gravity 2.80



[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	465
	ϕ (deg)	25.3
Effective stress	c' (psf)	0
	ϕ' (deg)	34.6

Comments:

Test number S1 contained sand sized particles throughout the test specimen which may account for the higher strength in test number S1.

Tested by: [signature]
Reviewed: [signature]

Z:\PROJECTS\M00277_Epic\069_Prison\[GTXCU3v2_BH09_25ft.xlsm]Summary

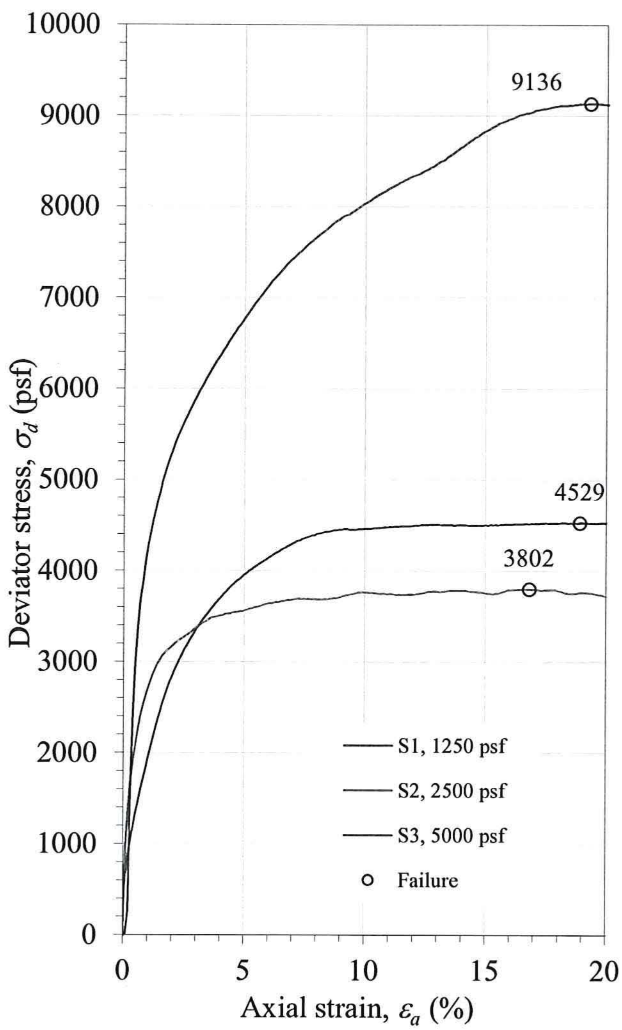
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

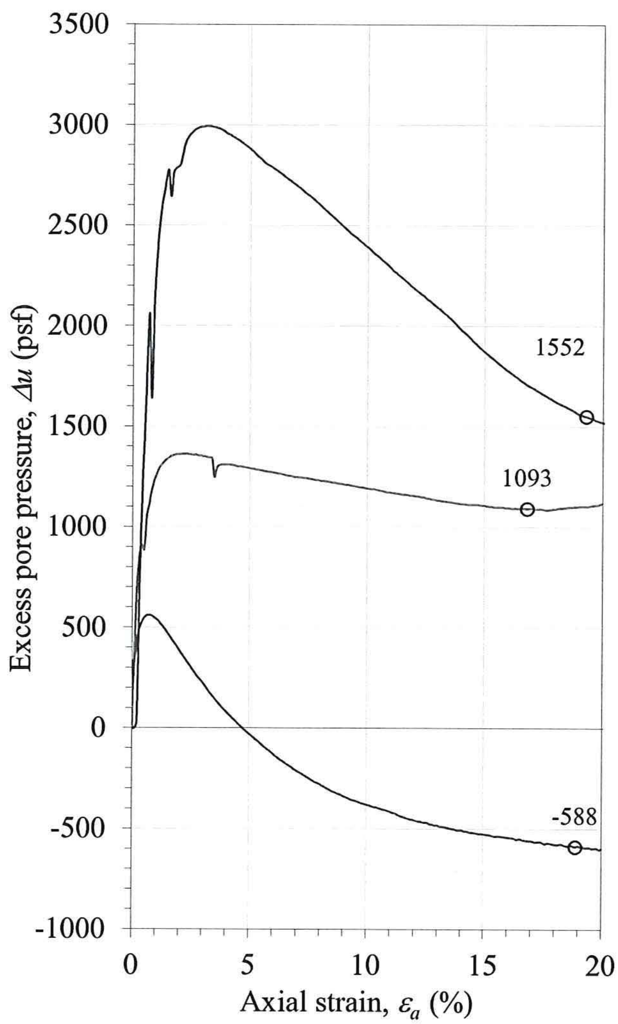
(*ASTM D4767*)

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-09
Sample:
Depth: 25'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	1250	2500	5000
	$\sigma_1 - \sigma_3$ (psf)	4529	3802	9136
	σ_1 (psf)	5779	6302	14136
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	2264	1901	4568
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	3514	4401	9568
Effective stress	Δu (psf)	-588	1093	1552
	σ'_3 (psf)	1838	1408	3448
	$\sigma'_1 - \sigma'_3$ (psf)	4529	3802	9136
	σ'_1 (psf)	6367	5209	12584
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	2264	1901	4568
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	4103	3308	8016
	σ'_1/σ'_3	3.46	3.70	3.65
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.130	0.287	0.170





Z:\PROJECTS\M00277_Epic\069_Prison\[GTXCU3v2_BH09_25ft.xlsm]Summary

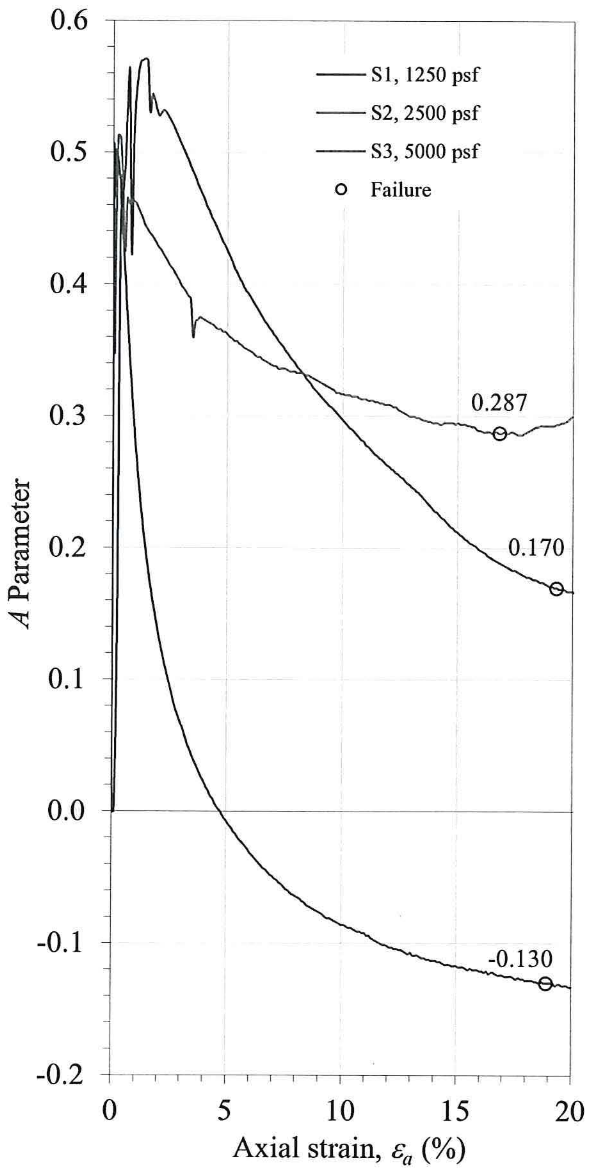
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

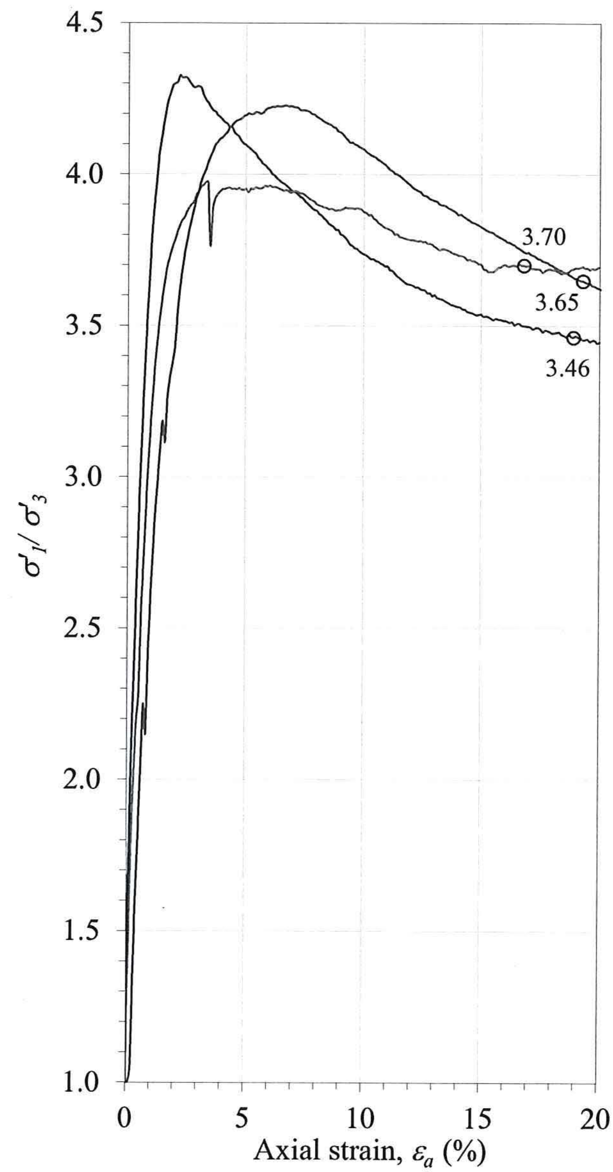
(*ASTM D4767*)

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-09
Sample:
Depth: 25'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	465
	ϕ (deg)	25.3
Effective stress	c' (psf)	0
	ϕ' (deg)	34.6





Z:\PROJECTS\M00277_Epic\069_Prison\[GTXCU3v2_BH09_25ft.xlsm]Summary

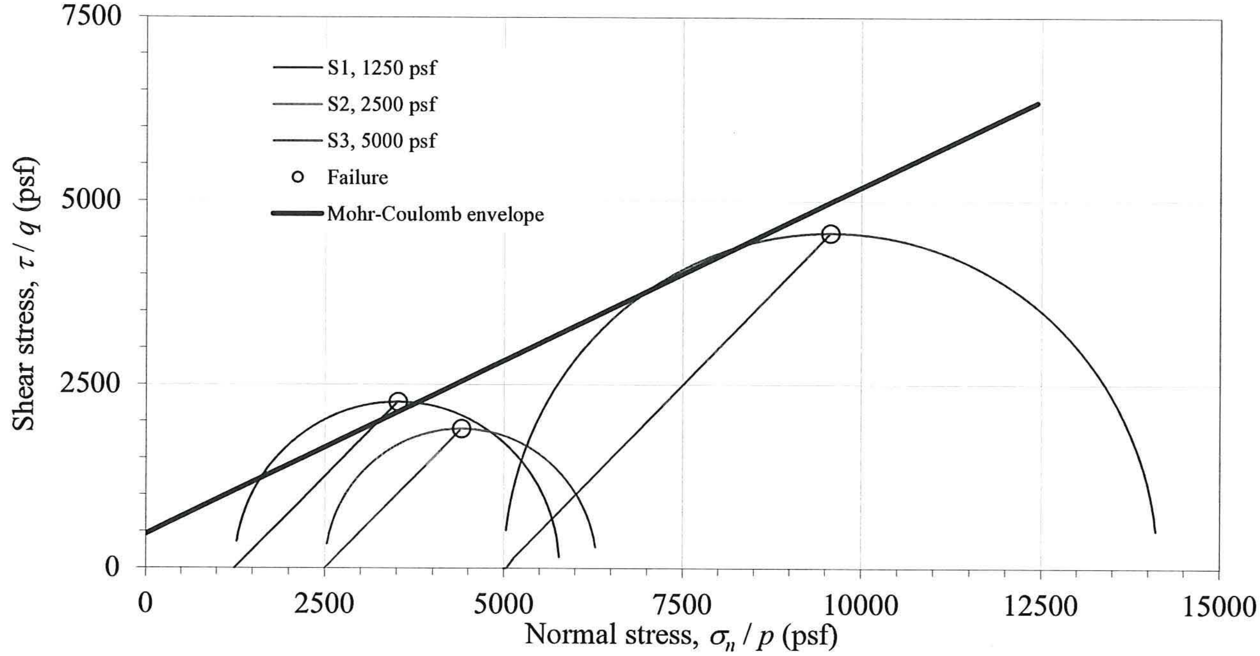
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

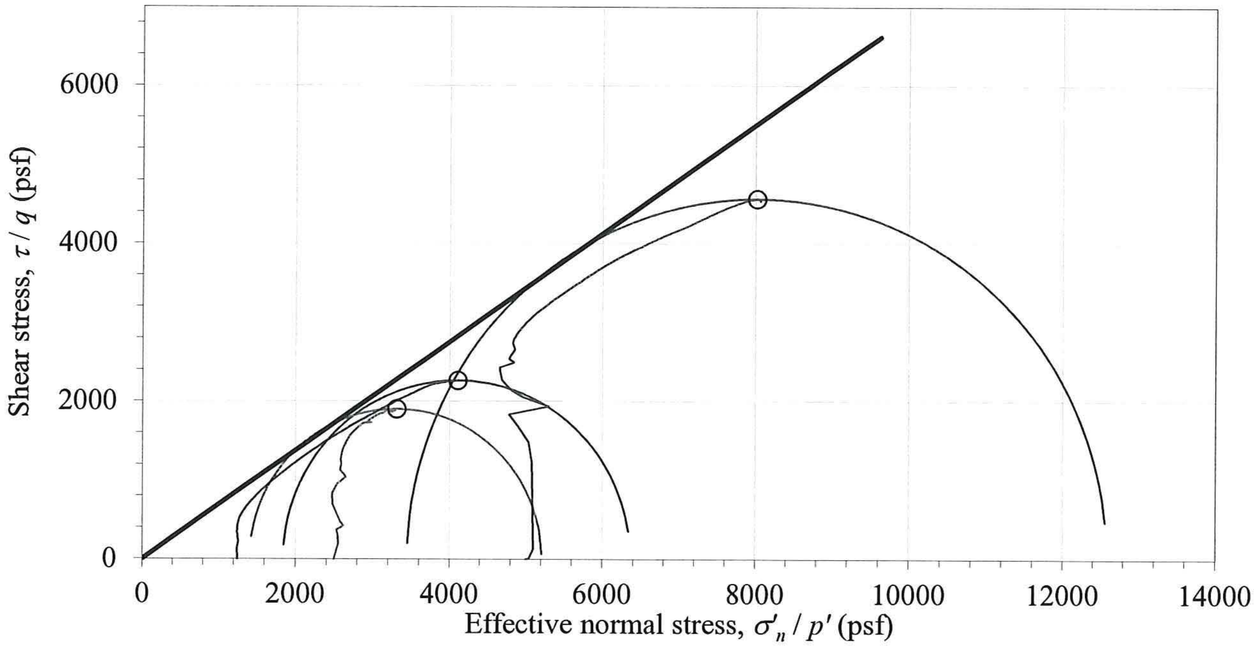
(*ASTM D4767*)

Project: Epic Engineering
No: M00277-069 (15MGT004.01)
Location: I-80 + 7200 West Expanded

Boring No.: BH-09
Sample:
Depth: 25'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	465
	ϕ (deg)	25.3
Effective stress	c' (psf)	0
	ϕ' (deg)	34.6





Z:\PROJECTS\M00277_Epic\069_Prison\[GTXCU3v2_BH09_25ft.xlsm]Summary

Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

(ASTM D2974)

IGES

Project: Epic Engineering
No: M00277-074 (15MGT004.01)
Location: I-80 + 7200 West Expanded
Date: 5/13/2015
By: BRR

Sample Info.	Boring No.	TP-07							
	Sample:								
	Depth:	10'							
	Test Method:	C							
	Furnace temp. (°C)	440							
Moisture	Wet soil + tare (g)	389.33							
	Dry soil + tare (g)	290.26							
	Tare (g)	127.66							
Ash / Organic Info.	Mass of crucible and oven-dried sample (g)	542.72							
	Mass of crucible and ash (g)	534.61							
	Mass of crucible (g)	380.06							
Moisture Content, w (%) [a]		**60.9**							
Ash Content (%)		**95.0**							
Organic Matter (%)		**5.0**							

[a] Moisture contents are by proportion of oven-dried mass (geotechnical convention).

Entered by: BRR
Reviewed: NS

American West
ANALYTICAL LABORATORIES

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e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Mike Platt
Epic Engineering
3341 South 4000 West
West Valley City, UT 84120
TEL: (801) 955-5605

RE: I-80 & 7200 West Expanded / 15 MGT 004.01

Dear Mike Platt: Lab Set ID: 1505335

American West Analytical Laboratories received sample(s) on 5/19/2015 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Accreditation Program (NELAP) in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, Wyoming, and Missouri.

All analyses were performed in accordance to the NELAP protocols unless noted otherwise. Accreditation scope documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

The sample receipt temperature exceeded the recommended USEPA limits.

Thank You,

Jose G. Rocha

Digitally signed by Jose G. Rocha
DN: cn=Jose G. Rocha, o=American West Analytical Laboratories, ou, email=jose@awal-labs.com, c=US
Date: 2015.05.20 15:35:11 -06'00'

Approved by:
Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client: Epic Engineering **Contact:** Mike Platt
Project: I-80 & 7200 West Expanded / 15 MGT 004.01
Lab Sample ID: 1505335-001
Client Sample ID: BH-01 @ 5'
Collection Date: 4/22/2015
Received Date: 5/19/2015 1512h

American West Analytical Laboratories
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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		5/19/2015 2223h	SW9251	73.0	**875**	[1]
pH @ 25° C	pH Units		5/19/2015 1936h	SW9045D	1.00	**9.23**	H
Resistivity	ohm-cm		5/20/2015 612h	SM2510B	10.0	**695**	&
Sulfate	mg/kg-dry		5/20/2015 835h	SM4500-SO4-E	73.0	**384**	&

& - Analysis is performed on a 1:1 DI water extract for soils.
[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client: Epic Engineering **Contact:** Mike Platt
Project: I-80 & 7200 West Expanded / 15 MGT 004.01
Lab Sample ID: 1505335-002
Client Sample ID: BH-04 @ 25'
Collection Date: 4/22/2015
Received Date: 5/19/2015 1512h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		5/19/2015 2227h	SW9251	66.3	**890**	
pH @ 25° C	pH Units		5/19/2015 1936h	SW9045D	1.00	**9.26**	H
Resistivity	ohm-cm		5/20/2015 612h	SM2510B	10.0	**211**	&
Sulfate	mg/kg-dry		5/20/2015 835h	SM4500-SO4-E	66.3	**471**	&

& - Analysis is performed on a 1:1 DI water extract for soils.
H - Sample was received outside of the holding time.

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client: Epic Engineering **Contact:** Mike Platt
Project: I-80 & 7200 West Expanded / 15 MGT 004.01
Lab Sample ID: 1505335-003
Client Sample ID: BH-07 @ 7.5'
Collection Date: 4/22/2015
Received Date: 5/19/2015 1512h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		5/19/2015 2228h	SW9251	73.0	**1,640**	
pH @ 25° C	pH Units		5/19/2015 1936h	SW9045D	1.00	**9.42**	H
Resistivity	ohm-cm		5/20/2015 612h	SM2510B	10.0	**135**	&
Sulfate	mg/kg-dry		5/20/2015 835h	SM4500-SO4-E	73.0	**574**	&

& - Analysis is performed on a 1:1 DI water extract for soils.
H - Sample was received outside of the holding time.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Epic Engineering **Contact:** Mike Platt
Project: I-80 & 7200 West Expanded / 15 MGT 004.01
Lab Sample ID: 1505335-004
Client Sample ID: BH-08 @ 20'
Collection Date: 4/22/2015
Received Date: 5/19/2015 1512h

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		5/19/2015 2214h	SW9251	69.0	**649**	
pH @ 25° C	pH Units		5/19/2015 1936h	SW9045D	1.00	**9.80**	H
Resistivity	ohm-cm		5/20/2015 612h	SM2510B	10.0	**362**	&
Sulfate	mg/kg-dry		5/20/2015 835h	SM4500-SO4-E	138	**318**	&

& - Analysis is performed on a 1:1 DI water extract for soils.
H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

Client: Epic Engineering **Contact:** Mike Platt
Project: I-80 & 7200 West Expanded / 15 MGT 004.01
Lab Sample ID: 1505335-005
Client Sample ID: BH-10 @ 7.5
Collection Date: 4/22/2015
Received Date: 5/19/2015 1512h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		5/19/2015 2230h	SW9251	75.8	**370**	
pH @ 25° C	pH Units		5/19/2015 1936h	SW9045D	1.00	**8.90**	H
Resistivity	ohm-cm		5/20/2015 612h	SM2510B	10.0	**465**	&
Sulfate	mg/kg-dry		5/20/2015 835h	SM4500-SO4-E	75.8	**217**	&

& - Analysis is performed on a 1:1 DI water extract for soils.
H - Sample was received outside of the holding time.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories **5 Day Rush** D

WORK ORDER Summary

Work Order: **1505335**

Client: Epic Engineering | Due Date: 5/27/2015

Client ID: EPI100 | **Contact:** Mike Platt

Project: **I-80 & 7200 West Expanded / 15 MGT 004.01** | **QC Level:** I | WO Type: Standard

Comments: 5 Day Rush. Footnote report, pH received outside of hold. Watch hold time on other analytical - close to hold time. Email 2 people.;

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1505335-001A	BH-01 @ 5'	4/22/2015	5/19/2015 1512h	CL-S-9251	Soil		df - wc	1
				PH-9045D			df - wc	
				PMOIST			df - wc	
				RESIST-S-2510B			df - wc	
				SO4-S-4500SO4			df - wc	
				SOIL-PR			df - wc	
1505335-002A	BH-04 @ 25'	4/22/2015	5/19/2015 1512h	CL-S-9251	Soil		df - wc	1
				PH-9045D			df - wc	
				PMOIST			df - wc	
				RESIST-S-2510B			df - wc	
				SO4-S-4500SO4			df - wc	
				SOIL-PR			df - wc	
1505335-003A	BH-07 @ 7.5'	4/22/2015	5/19/2015 1512h	CL-S-9251	Soil		df - wc	1
				PH-9045D			df - wc	
				PMOIST			df - wc	
				RESIST-S-2510B			df - wc	
				SO4-S-4500SO4			df - wc	
				SOIL-PR			df - wc	
1505335-004A	BH-08 @ 20'	4/22/2015	5/19/2015 1512h	CL-S-9251	Soil		df - wc	1
				PH-9045D			df - wc	
				PMOIST			df - wc	
				RESIST-S-2510B			df - wc	
				SO4-S-4500SO4			df - wc	
				SOIL-PR			df - wc	
1505335-005A	BH-10 @ 7.5	4/22/2015	5/19/2015 1512h	CL-S-9251	Soil		df - wc	1
				PH-9045D			df - wc	
				PMOIST			df - wc	
				RESIST-S-2510B			df - wc	
				SO4-S-4500SO4			df - wc	
				SOIL-PR			df - wc	

Printed: 5/19/2015 FOR LABORATORY USE ONLY [fill out on page 1]: %M ☑ RT ☑ CN ☑ TAT ☑ QC ☑ HOK____ HOK____ HOK____ COC Emailed____

WORK ORDER Summary

Work Order: **1505335**

Client: Epic Engineering

Due Date: 5/27/2015

AWAL Use Only. Close Hold Times

Test Code	# Samps	Min. days left
CL-S-9251	5	.29
PMOIST	5	-20.71
RESIST-S-2510B	5	.29
SO4-S-4500SO4	5	.29
SOIL-PR	5	.29

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www.awal-labs.com

Chain of Custody

All analysis will be conducted using NELAP accredited methods and all data will be reported using AWAL's standard analyte lists and reporting limits (PQL) unless specifically requested otherwise on this Chain of Custody and/or attached documentation.

1505335
AWAL Lab Sample Set #
Page ___ of ___

QC Level: 1 2 2+ 3 3+

Turn Around Time: 1 2 3 4 (5) Stnd

Unless other arrangements have been made, signed reports will be emailed by 5:00 PM on the day they are due.

Due Date:

Client: Epic Engineering
Address: 3341 South 4000 West
West Valley City, UT
Contact: Mike Platt or Joshua White
Phone #: 801-955-5605 Cell #:
Email: mplatt@epiceng.net or jwhite@epiceng.net
Project Name: I-80 + 7200 West Expanded
Project #: 15 MGT004.01
PO #:
Sampler Name:

☐ Report down to the MDL
☐ Include EDD:
☐ Lab Filter for:
☐ Field Filtered For:

For Compliance With:
☐ NELAP
☐ RCRA
☐ CWA
☐ SDWA
☐ ELAP / A2LA
☐ NLLAP
☐ Non-Compliance
☐ Other:

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Ph	Resistivity	Sulfates	Chlorides							Known Hazards & Sample Comments
1	BH-01 @ 5'	4/22/15				X	X	X	X							
2	BH-04 @ 25'	↓				X	X	X	X							
3	BH-07 @ 7.5' *	↓				X	X	X	X							sample reads BH-07 @ 8'
4	BH-08 @ 20'	↓				X	X	X	X							
5	BH-10 @ 7.5	↓				X	X	X	X							
6																
7																
8																
9																
10																
11																
12																

Laboratory Use Only

Samples Were:
1. Shipped or (Hand Delivered)
2. (Ambient) or Chilled
3. Temperature 16.7 °C
4. Received Broken/Leaking (Improperly Sealed) Y (N)
5. Properly Preserved (Y) N Checked at bench
6. Received Within Holding Times Y (N)

COC Tape Was:
1. Present on Outer Package Y N (NA)
2. Unbroken on Outer Package Y N (NA)
3. Present on Sample Y N (NA)
4. Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? (Y) ~~N~~ DB 5/18/15
#3 Sample Depth

Relinquished by: Signature	Date	Received by: Signature	Date
[signature] / Print Name: Stockton Demos	Date: 5/14/15 Time: 2:35	[signature] / Print Name: Denise Bruun	Date: 5/19/15 Time: 14:35
Print Name:	Date: Time:	Print Name:	Date: Time:
Print Name:	Date: Time:	Print Name:	Date: Time:
Print Name:	Date: Time:	Print Name:	Date: Time:

Special Instructions:

APPENDIX D
ESTIMATED LIQUEFACTION, LATERAL SPREADING POTENTIALS AND PRELIMINARY PILE DESIGN

epic ENGINEERING

Epic Engineering
3341 South 4000 West
West Valley City, UT 84120
http://www.epiceng.net

LIQUEFACTION ANALYSIS REPORT

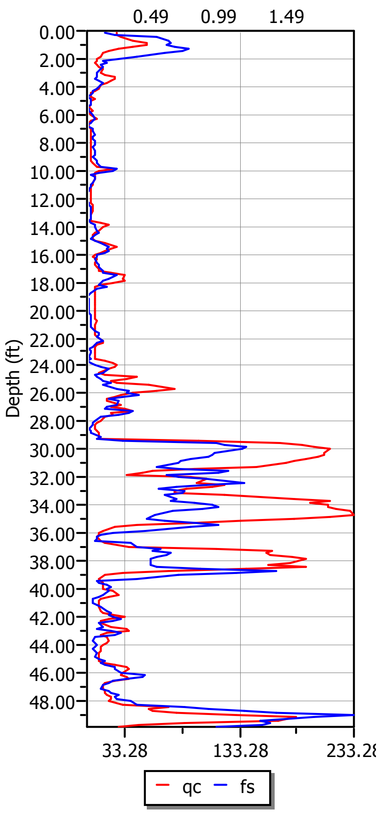
Project title : I-80/7200 West Expanded Preliminary Geotechnical Investigation

Project subtitle : Liquefaction Analysis CPT-01

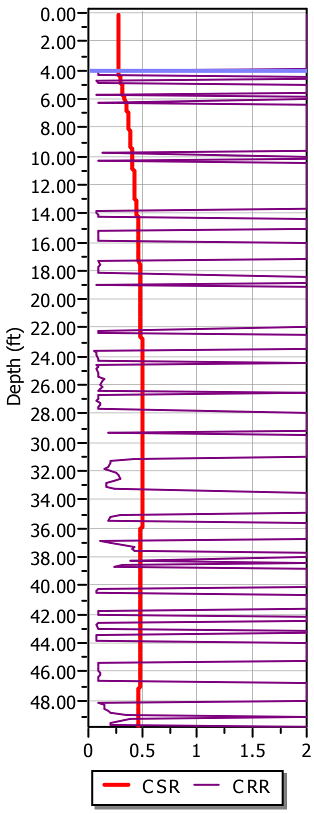
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	4.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	7.00
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.50 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

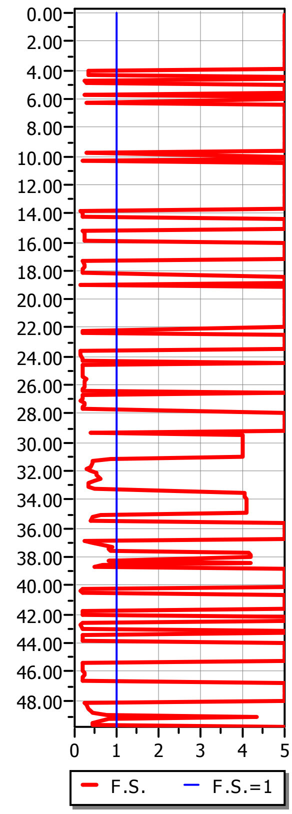
CPT data graph



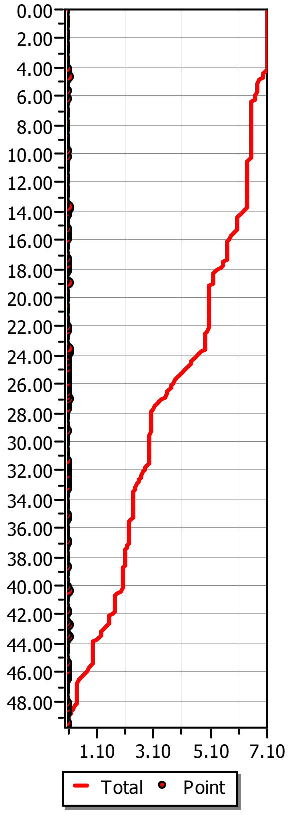
Shear stress ratio



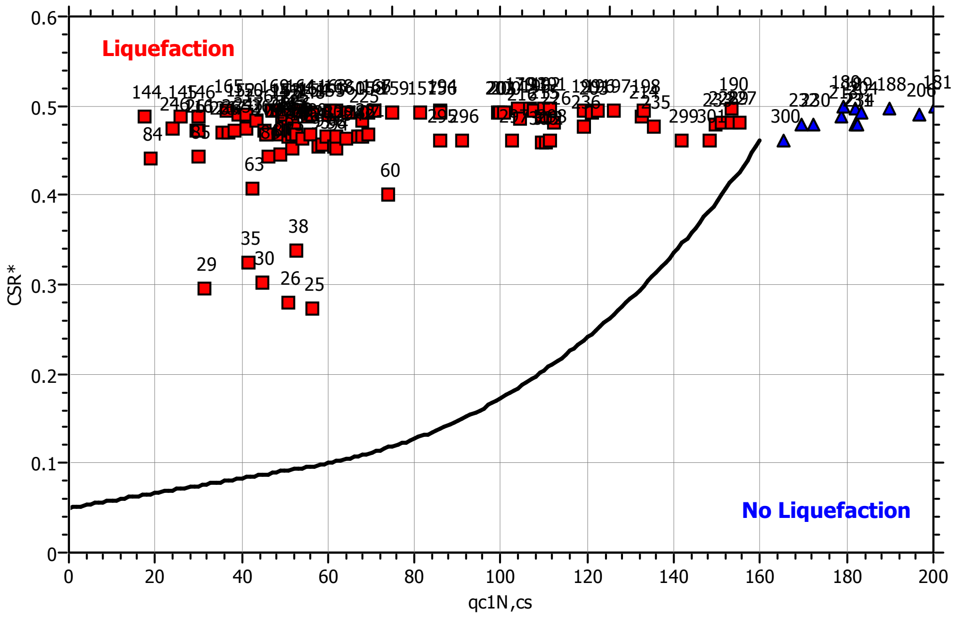
Factor of safety



Settlements (in)



M_w=7$^{1/2}$, sigma'=1 atm base curve



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LIQUEFACTION ANALYSIS REPORT

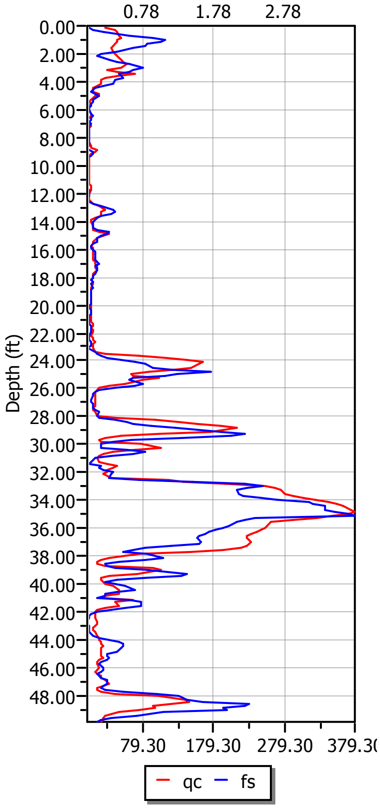
Project title : I-80/7200 West Expanded Preliminary Geotechnical Investigation

Project subtitle : Liquefaction Analysis CPT-02

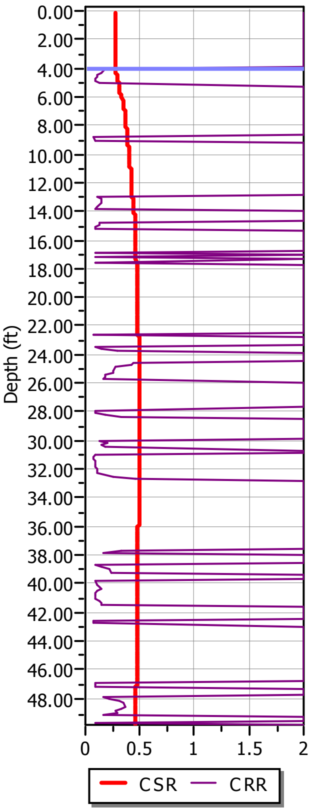
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	4.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	7.00
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.50 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

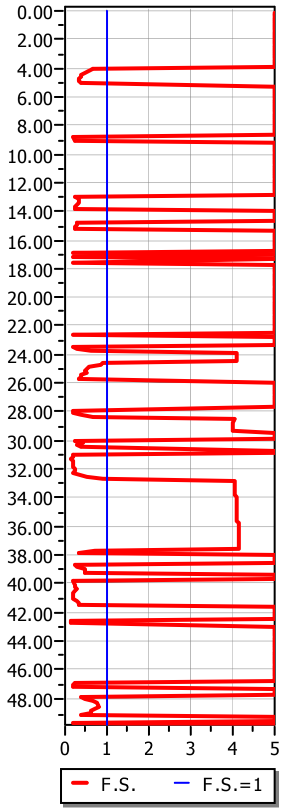
CPT data graph



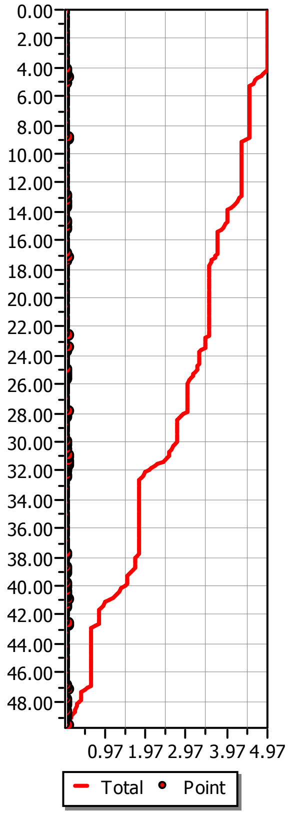
Shear stress ratio



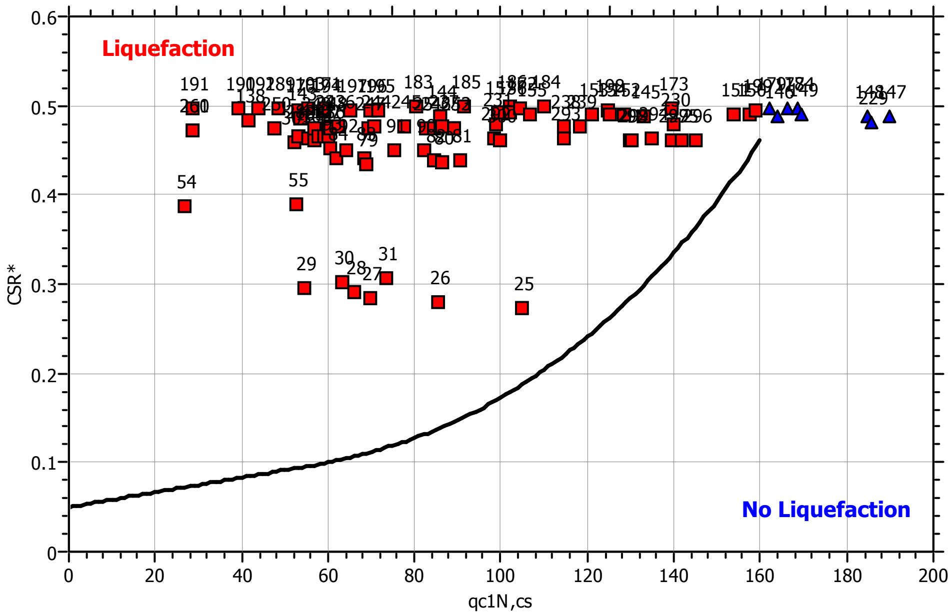
Factor of safety



Settlements (in)



$M_w=7^{1/2}$, sigma'=1 atm base curve



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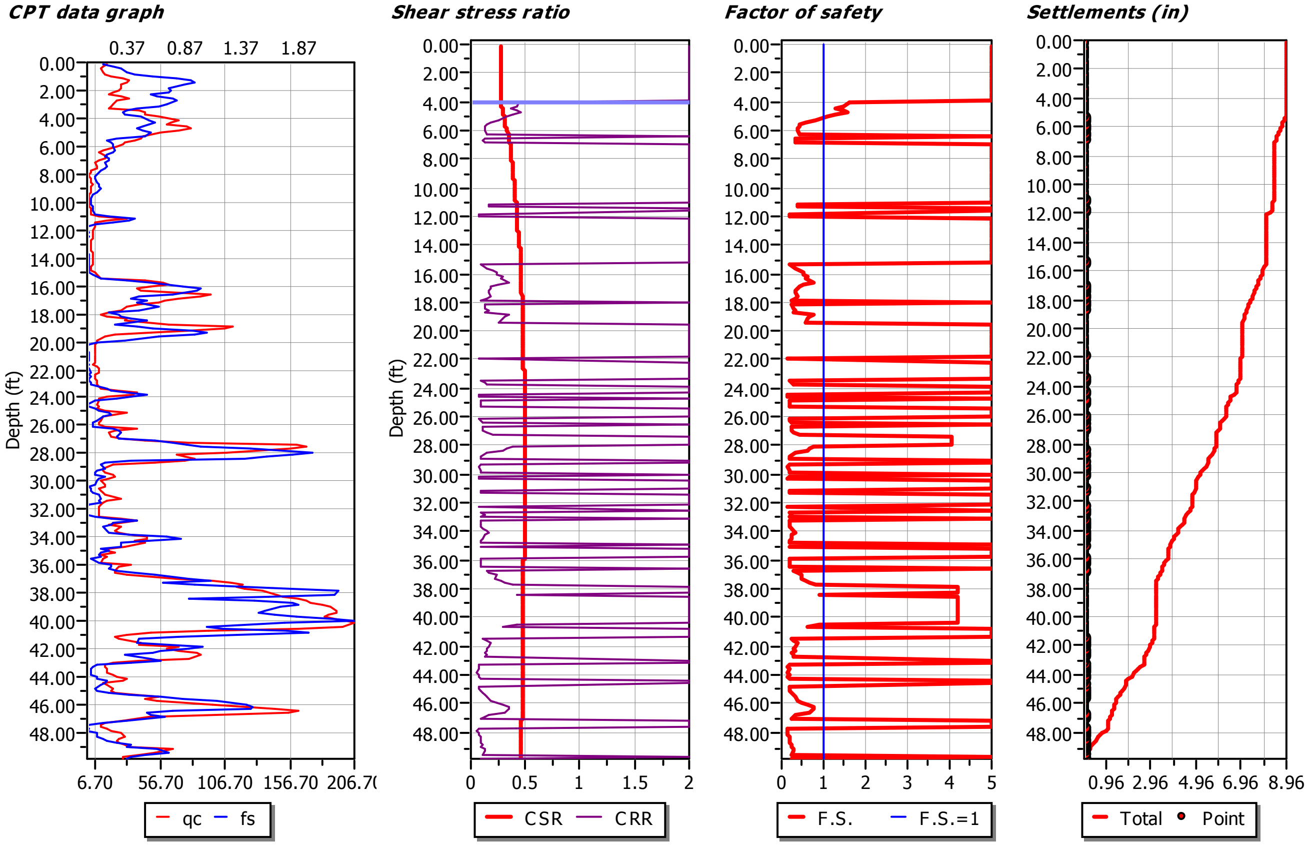
LIQUEFACTION ANALYSIS REPORT

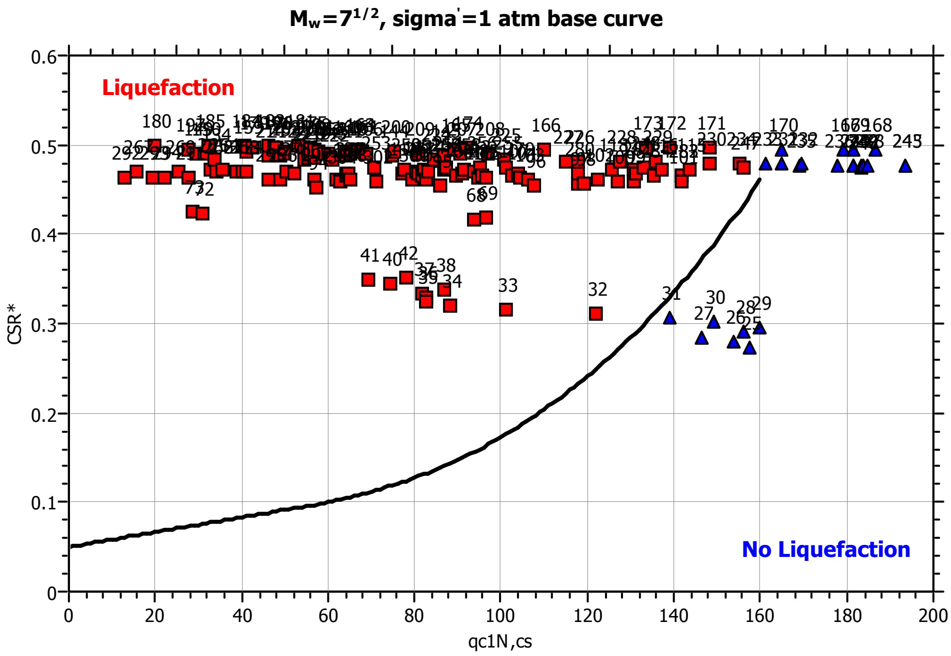
Project title : I-80/7200 West Expanded Preliminary Geotechnical Investigation

Project subtitle : Liquefaction Analysis CPT-03

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	4.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	7.00
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.50 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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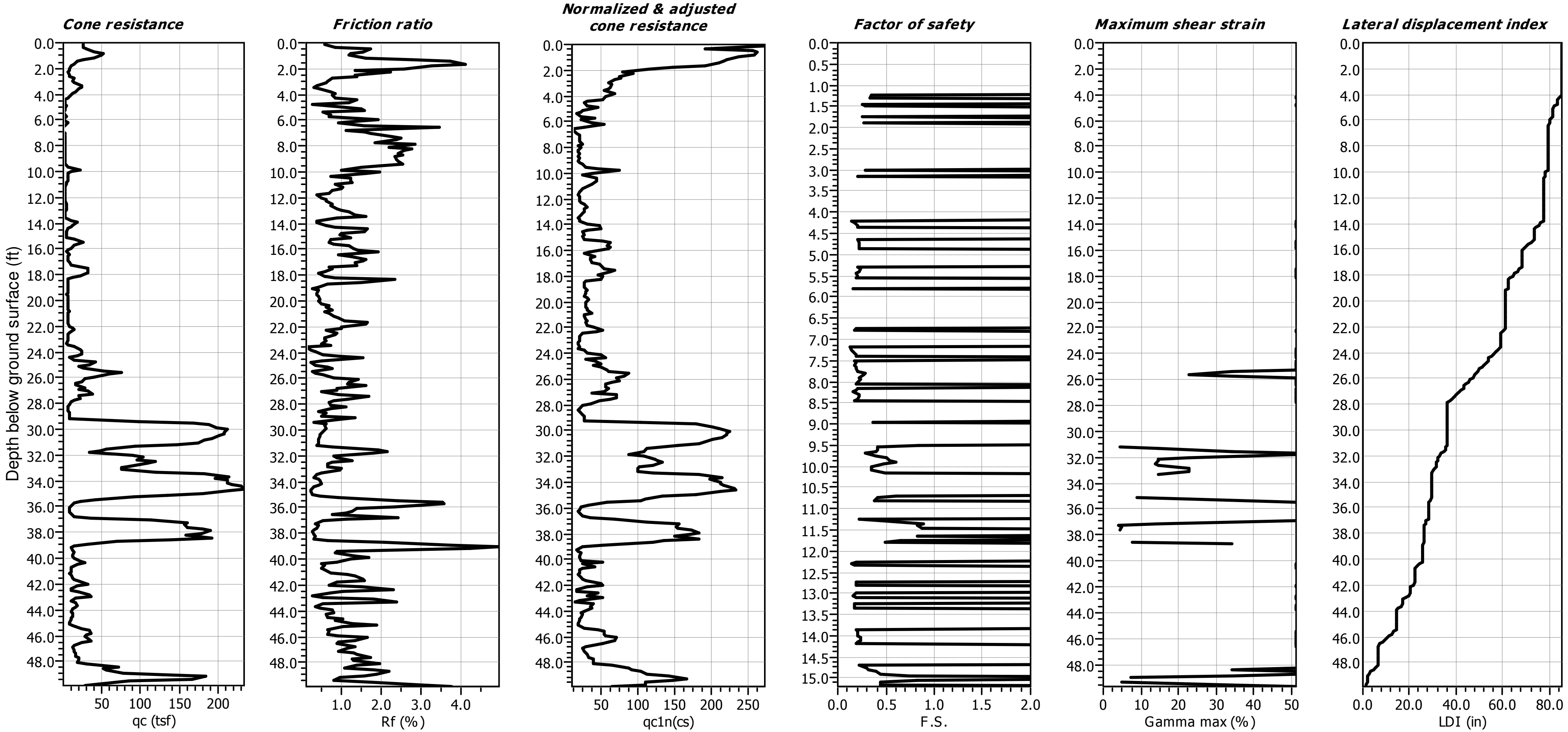
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1] for CPT-01

Geometric parameters: Gently sloping ground without free face
Total lateral displacement estimation: 59.67 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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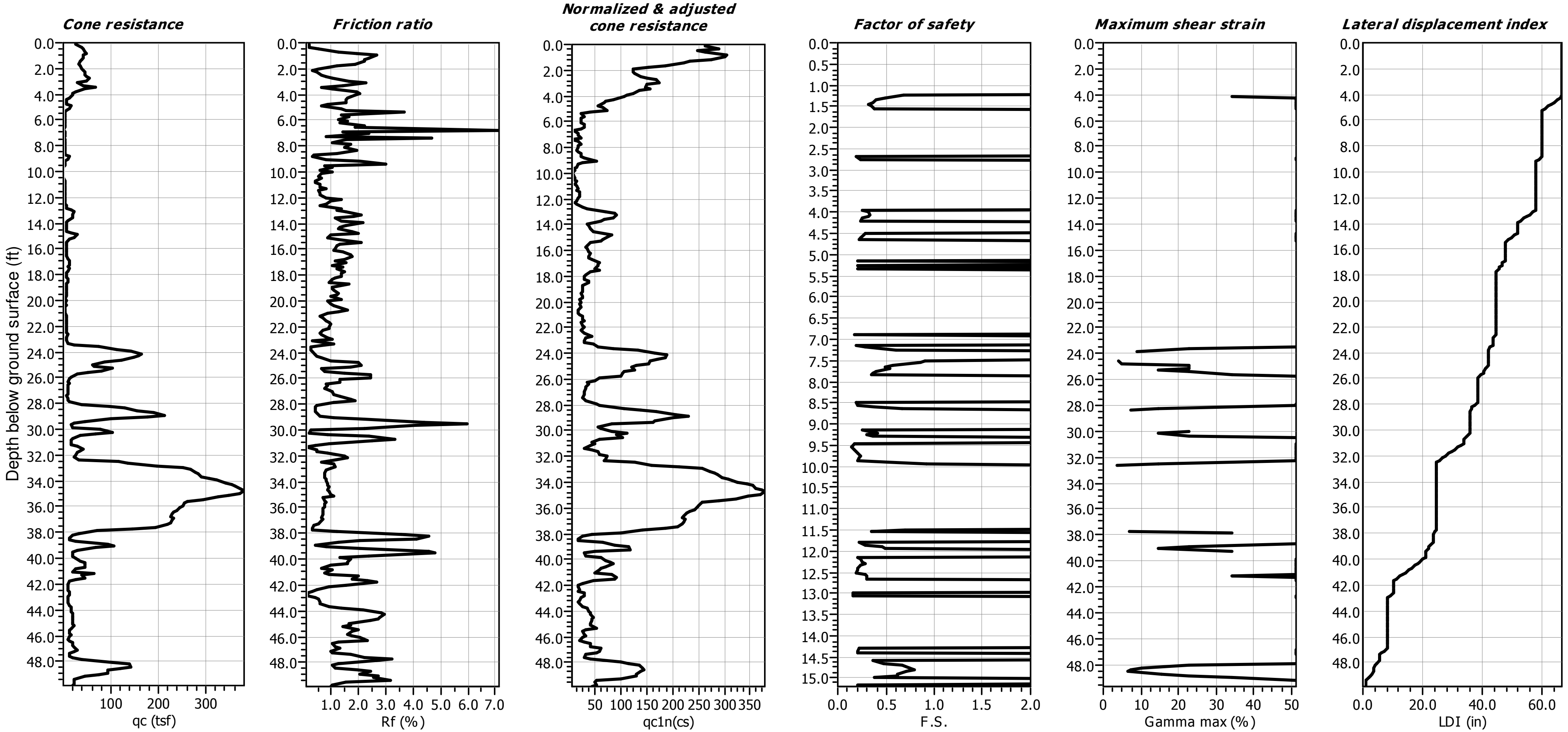
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1] for SCPT-02

Geometric parameters: Gently sloping ground without free face
Total lateral displacement estimation: 46.48 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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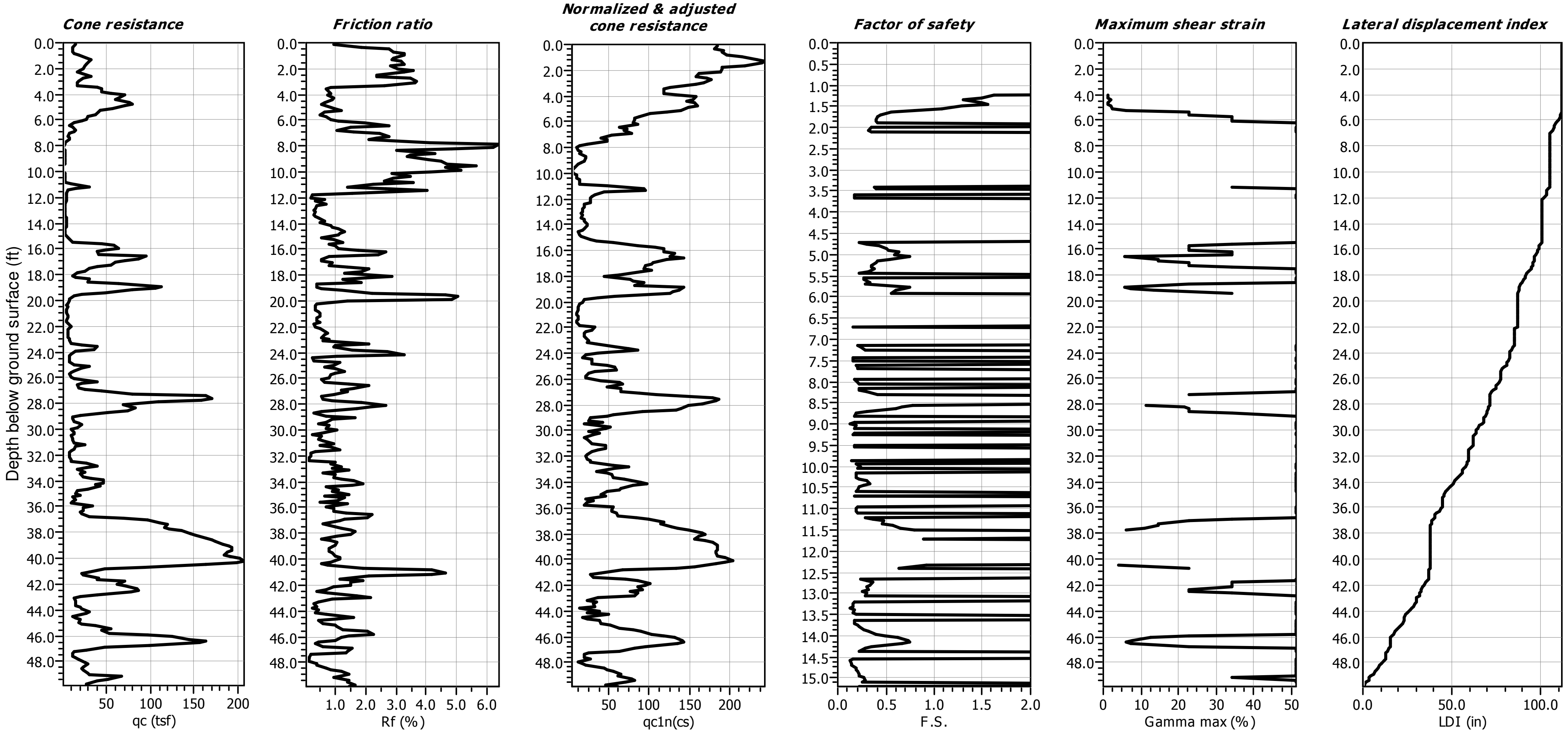
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1] for CPT-03

Geometric parameters: Gently sloping ground without free face
Total lateral displacement estimation: 78.37 in



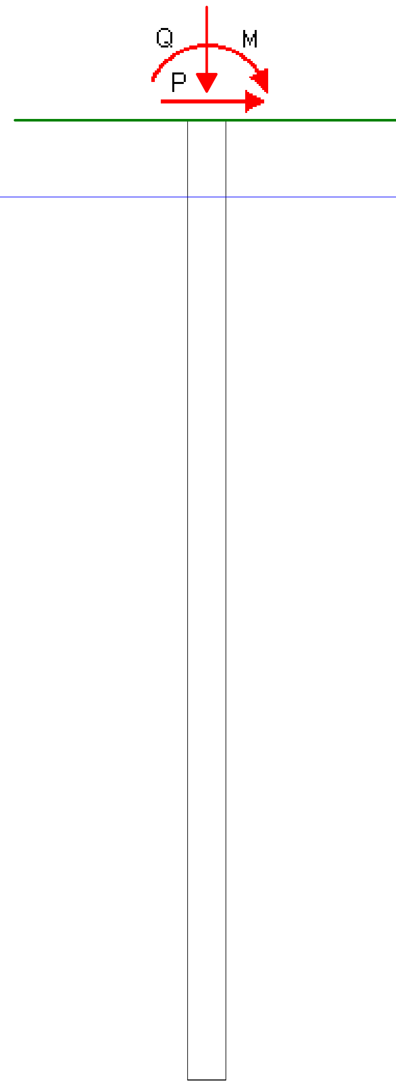
q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

FOUNDATION PROFILE & SOIL CONDITIONS

Displacement pile: Closed End pipe. Soil is displaced during driving. Higher friction expected. Total area is used in bearing calculation.



FOUNDATION PROPERTIES

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	12	18.1	37.7	299.2	29000	0.061
		Steel (smooth)				
50.0						

SOIL PROPERTIES

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	99.7	26.9	0.00	1.9		2
			Sand/Gravel			
4.0	37.1	26.8	0.00	3.2		2
			Sand/Gravel			
5.0	33.2	0.0	0.08	8.3	4.81	1
			Soft Clay			
31.0	63.3	0.0	0.94	201.0	1.04	8
			Soft Clay			
35.0	70.7	0.0	2.80	943.7	0.53	22
			Stiff Clay			
45.0	74.5	42.1	0.00	197.2		60
			Sand/Gravel			
50.0	55.7	0.0	0.59	83.3	1.38	5
			Soft Clay			
56.0	56.9	35.1	0.00	51.2		15
			Sand/Gravel			

Depth from Ground-ft: 0, 10, 20, 30, 40, 50, 60

Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

Epic Engineering
AllPile Software Version 7

Preliminary Closed End Pipe Pile
I-80 7200 West Based on BH-01

Figure 1

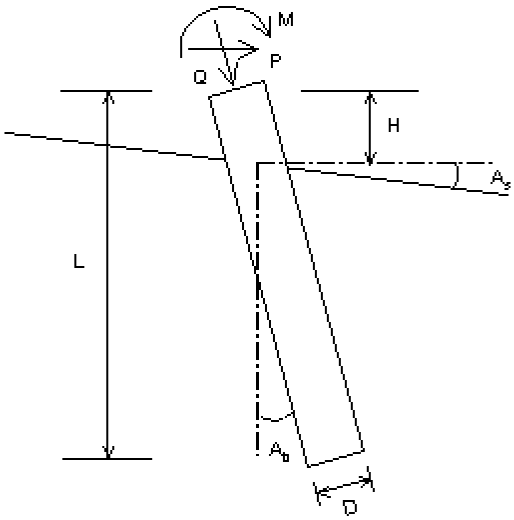
VERTICAL ANALYSIS

Figure 1

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 20.0 -kp

Profile:
Pile Length, L= 50.0 -ft
Top Height, H= 0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0



Driving Steel Pile (Closed end)

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	99.5	26.8	0.00	1.7	7.03	2
4	37.8	27.1	0.00	4.0	8.28	2
5	34.0	0.0	0.09	9.7	4.38	1
31	63.3	0.0	0.94	201.0	1.04	8
35	70.6	0.0	2.71	905.6	0.55	22
45	74.5	42.1	0.00	197.2	95.94	60
50	56.8	0.0	0.63	95.5	1.33	5
56	56.8	35.1	0.00	50.8	45.73	15
62	63.8	0.0	0.98	214.1	1.01	8
74	58.4	0.0	0.69	116.0	1.25	6

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12	18.1	37.7	299.2	29000	0.061
50.0						

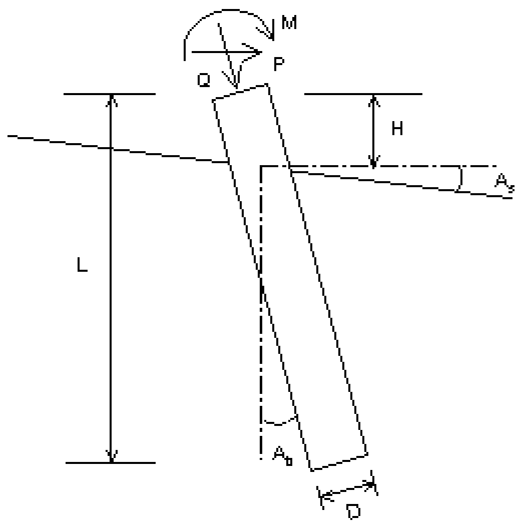
Vertical Capacity:
Weight above Ground= 0.00 Total Weight= 3.05-kp *Soil Weight is not included
Side Resistance (Down)= 55.699-kp Side Resistance (Up)= 48.073-kp
Tip Resistance (Down)= 13.209-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 68.908-kp Total Ultimate Capacity (Up)= 51.123-kp
Total Allowable Capacity (Down) Qallow= 22.969-kp Total Allowable Capacity (Up) Qallow= 17.041-kp
OK! Qallow > Q

Settlement Calculation:
At Q= 20.00-kp Settlement= 0.01443-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

VERTICAL ANALYSIS

Figure 1



Driving Steel Pile (Closed end)

Loads:

Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 20.0 -kp

Profile:

Pile Length, L= 50.0 -ft
Top Height, H= 0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	99.7	26.9	0.00	1.9	7.45	2
4	37.1	26.8	0.00	3.2	7.03	2
5	33.2	0.0	0.08	8.3	4.81	1
31	63.3	0.0	0.94	201.0	1.04	8
35	70.7	0.0	2.80	943.7	0.53	22
45	74.5	42.1	0.00	197.2	95.94	60
50	55.7	0.0	0.59	83.3	1.38	5
56	56.9	35.1	0.00	51.2	45.92	15
62	66.9	0.0	1.26	317.7	0.87	10
75	66.4	0.0	1.20	294.7	0.89	10

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	12	113.1	37.7	1017.9	500	0.055
50.0	8	50.3	25.1	201.1	500	0.024

Vertical Capacity:

Weight above Ground= 0.00 Total Weight= 0.50-kp *Soil Weight is not included
Side Resistance (Down)= 50.964-kp Side Resistance (Up)= 41.642-kp
Tip Resistance (Down)= 2.832-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down) Qult= 53.797-kp Total Ultimate Capacity (Up)= 42.138-kp
Total Allowable Capacity (Down) Qallow= 17.932-kp Total Allowable Capacity (Up) Qallow= 14.046-kp
N/G! Qallow < Q

Settlement Calculation:

At Q= 20.00-kp Settlement= 0.10886-in
At Xallow= 1.00-in Q= 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

APPENDIX E
REFERENCES

REFERENCES

ASCE (American Society of Civil Engineers). 2010. *Minimum Design Loads for Buildings and Other Structures. ASCE Stan*dard. ASCE 7-10.

Black, B.D, and DuRoss, C.B., and Hylland, M.D., and Hecker, S., compilers, 2004, Fault number 2386b, West Valley fault zone, Granger section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults, accessed 06/29/2015

Black, Bill D., *Earthquake Fault Map of a Portion of Salt Lake County, Utah,* Utah Geological Survey, June 24, 2015

Bowles, Joseph. E. *Foundation Analysis and Design 5th ed.* New York, McGraw-Hill, 1996

Christenson, Gary E. and Shaw, *Lucas M. Surface Fault Rupture Study Areas, Wasatch Front and Nearby Areas, Utah*, Utah Geological Survey, 2008

Christenson, Gary E. and Shaw, Lucas M., *Geographic Information System Database Showing Geologic-Hazard Special-Study Areas, Wasatch Front, Utah*, Utah Geological Survey, 2008

Christenson, Gary E. and Shaw, Lucas M., Landslide *Special Study Areas, Wasatch Front and Nearby Areas, Utah*, Utah Geological Survey, 2008, scale1:200,000.

Christenson, Gary E. and Shaw, Lucas M., Liquefaction *Special Study Areas, Wasatch Front and Nearby Areas, Utah*, Utah Geological Survey, 2008, scale1:250,000.

Christenson, Gary E. and Shaw, Lucas M., Surface Fault Rupture *Special Study Areas, Wasatch Front and Nearby Areas, Utah,* Utah Geological Survey, 2008

Currey, Donald R., Atwood, Genevieve, and Mabey, Don R. *Major Levels of Great Salt lake and lake Bonneville,* Utah Geological Survey, May 1984

Das, Braja. Principals of Foundation Engineering, Cengage Learning, Stamford CT, 2011

Hylland, M.D., DuRoss, C.B., McDonald, G.N., Olig, S.S., Oviatt, C.G., Mahan, S.A., Crone, A.J., and Personius, S.F., 2014, Late Quaternary paleoseismology of the West Valley fault zone—insights from the Baileys Lake trench site, in DuRoss, C.B., and Hylland, M.D., Evaluating surface faulting chronologies of graben-bounding faults in Salt Lake Valley, Utah—new paleoseismic data from the Salt Lake City segment of the Wasatch fault zone and the West Valley fault zone—Paleoseismology of Utah, Volume 24: Utah Geological Survey Special Study 149, p. 41–76, 8 appendices, 1 plate, CD.

McKean, A.P., and Hylland, M.D., 2013, Interim geologic map of the Baileys Lake quadrangle, Salt Lake County, Utah: Utah Geological Survey Open-File Report 624, scale 1:24,000

OHSA, *Safety and Health Regulations for Construction, P-Excavations, Sloping and Benching*; Occupational Safety & Health Administration, www.ohsa.gov.

Paula L. Gori (Edited By), Walter W. Hays, *Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah*, 2000, Professional Paper 1500-K-R, U.S. Department of the Interior and U.S. Geological Survey, http://pubs.usgs.gov/pp/1500k-r/report.pdf

Utah Geological Survey, *Utah Geologic Map Index*, geology.utah.gov, January 2015, http://geology.utah.gov/apps/intgeomap/

Utah Geological Survey, *Geologic-Hazard Resources for Consultants & Design Professionals*, geology.utah.gov, January 2015, http://geology.utah.gov/about-us/geologic-programs/geologic-hazards-program/for-consultants-and-design-professionals/

Utah Geological Survey, Utah Geologic Map Index*, Interim Geologic map of Bailey's Lake 7.5' Quadrangle, Salt Lake County, Utah 2004*

USGS, 2014, *Utah, 2014 Seismic Hazard Map*, Earthquake Hazards Program, May 2015, http://earthquake.usgs.gov/earthquakes/states/utah/hazards.php

USGS, *Radon-Hazard Potential*, Utah Geological Survey, http://geology.utah.gov/harzards/radon

USGS, 2014, Utah, *2014 Seismic Hazard Map, Earthquake Hazards Program*, May 2015, http://earthquake.usgs.gov/earthquakes/states/utah/hazards.php

USGS, 2012, *U.S. Seismic Design Maps*: United States Geologic Survey, May 15, 2015 http://geohazards.usgs.gov/designmaps/us/ March 26, 2015.

Wong, I., Silva, W., Wright, D., Olig, S., Ashland, F., Gregor, N., Christenson, G., Pechmann, J., Thomas, P., Dober, M., and Gerth, R., 2002, *Ground-shaking map for a magnitude 7.0 earthquake on the Wasatch fault, Salt Lake City, Utah, metropolitan area*: Utah Geological Survey Public Information Series 76, 1 p., 1 figure, approximate scale 1:43,500

Design Maps Summary Report

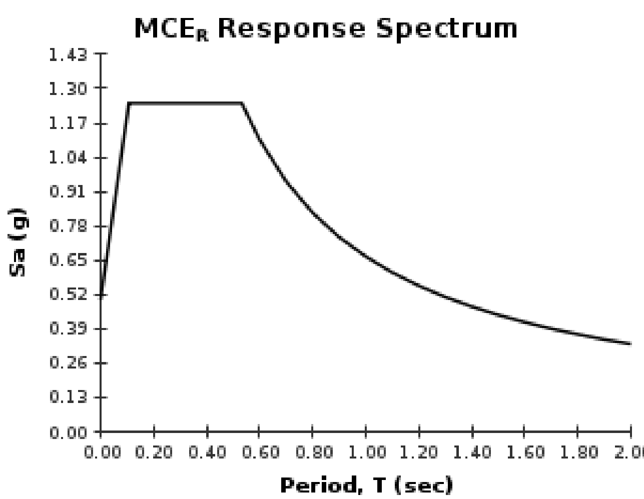
User–Specified Input

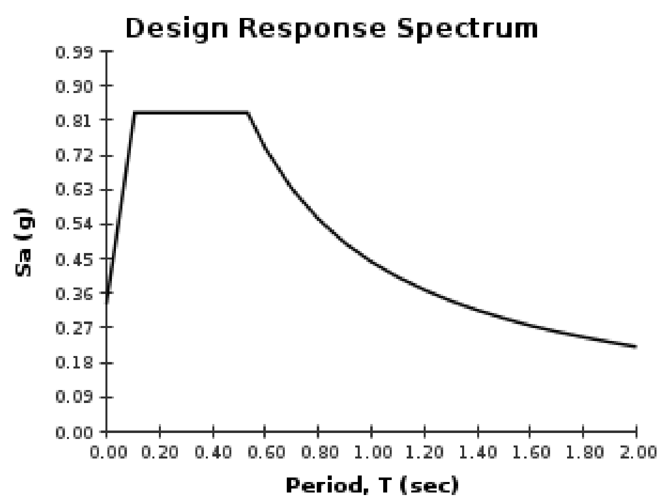
Report Title	I-80/7200 West Expanded Fri June 5, 2015 15:15:37 UTC
Building Code Reference Document	2012 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	40.80355°N, 112.09637°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	1.239 g	S_{MS} =	1.244 g	S_{DS} =	0.830 g
S_1 =	0.420 g	S_{M1} =	0.664 g	S_{D1} =	0.442 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





Design Maps Detailed Report

2012 International Building Code (40.80355°N, 112.09637°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 1613.3.1 — Mapped acceleration parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2012 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.3.3.

From Figure 1613.3.1(1) [1] S_S = 1.239 g

From Figure 1613.3.1(2) [2] S_1 = 0.420 g

Section 1613.3.2 — Site class definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Section 1613.

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.3.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.239 g, F_a = 1.004

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.420 g, F_v = 1.580

Equation (16-37): $S_{MS} = F_aS_S = 1.004 \times 1.239 = 1.244$ g

Equation (16-38): $S_{M1} = F_vS_1 = 1.580 \times 0.420 = 0.664$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39): $S_{DS} = ⅔ S_{MS} = ⅔ \times 1.244 = 0.830$ g

Equation (16-40): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.664 = 0.442$ g

Section 1613.3.5 — Determination of seismic design category

TABLE 1613.3.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 second) RESPONSE ACCELERATION

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.830 g, Seismic Design Category = D

TABLE 1613.3.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.442 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.3.5(1) or 1613.3.5(2)" = D

Note: See Section 1613.3.5.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.3.1(1)*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(1).pdf
2. *Figure 1613.3.1(2)*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(2).pdf

accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

LIMITATION OF YOUR PRELIMINARY GEOTECHNICAL REPORT

GEOTECHNICAL REPORTS ARE PROJECT AND CLIENT SPECIFIC

This preliminary report has been prepared for the exclusive use of State of Utah Prison Relocation Commission for the purpose of providing preliminary geotechnical design recommendations for the I-80/7200 West Expanded site only and is not intended for application to other sites or buildings. The data gathered and the preliminary conclusions and recommendations presented are based upon the consideration of many factors including, but not limited to, the type of development proposed, the configuration of surrounding structures, the materials encountered, and our understanding of the level of risk acceptable to the Client. Therefore, the preliminary conclusions and recommendations contained in this report shall not be considered valid for use by others because it is preliminary in use for comparative purposes only and not final in recommendations.

In the event that any changes in the nature or design of the project are planned, the preliminary conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing from Epic Engineering. It is recommended that Epic Engineering be provided the opportunity for a general review of the final design and specifications to evaluate whether the earthwork and foundation recommendations have been properly interpreted and implemented in the design and specifications once a site is selected.

This preliminary geotechnical report has been prepared for Sate of Utah Prison Relocation Commission for the use in selection of proposed site based on the preliminary design and construction at the I-80/7200 West Expanded site located in Salt Lake City, Utah. This report is preliminary, site specific and should not be relied upon for use in other investigations and is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance and expressed written consent of Sate of Utah Prison Relocation Commission and Epic Engineering; therefore, any use or reliance upon this geotechnical evaluation by a party other than the Client shall be solely at the risk of such third party and without legal recourse against Epic Engineering, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statue, or otherwise. The Client has the responsibility to see that all parties to the project including the designer, contractor, subcontractor, and building official, etc., are aware of the geotechnical report in its complete form. Epic Engineering cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL CONDITIONS CAN CHANGE

Borehole and test pit location conditions may not be indicative of subsurface conditions outside the study area. The boreholes and test pits chosen are very localized approximations of subsurface conditions and thus have limited value in depicting subsurface conditions for contractor bidding. If it is necessary to define subsurface conditions in sufficient detail to allow accurate bidding we recommend an additional study be conducted which is designed for that purpose. An experienced professional from Epic Engineering should observe fill placement and conduct testing as required to confirm the use of proper structural fill materials and placement procedures.

Geotechnical conditions may be affected as a result of natural processes or human activity. Preliminary geotechnical reports are based on conditions that existed at the time of the subsurface exploration. Construction operations, such as cuts, fills, or drains in the vicinity of the site and natural events such as floods, earthquakes, or groundwater fluctuations may affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report.

Variations from the conditions portrayed at the borehole and test pit locations may occur and can only be confirmed during earthwork and foundation construction. The fill condition indicated in this report represents what was encountered during the Phase I preliminary site investigation. Subsequent changes to the site may result in fill or topsoil amounts varying from what is represented in this report. If fill, topsoil, or subsurface conditions are found to be different than those presented in this report, Epic Engineering should be notified immediately to determine if changes in the recommendations are required. If Epic Engineering is not contacted about variations in the soil conditions, Epic Engineering cannot be responsible for the impact of those conditions on the performance of the project.

GEOTECHNICAL ENGINEERING IS NOT AN EXACT SCIENCE

It should be remembered that preliminary geotechnical engineering conclusions and recommendations are generated through analytical methods which are not an exact science. The concept of risk as it applies to structure construction is the single most significant aspect of any geotechnical evaluation. The primary reason for this is that the methods used by geotechnical engineers to develop recommendations for construction is not an exact science. The methods used are typically empirical and therefore, engineering judgment and experience must also be applied. The solutions presented in any geotechnical evaluation therefore cannot be considered risk free, and are therefore not a guarantee that the interaction between the soils and the proposed structure will act as desired or intended. Actual conditions in areas not sampled or observed may differ from those predicted in your preliminary report. Retaining your consultant to advise you during the design process, review plans and specifications, and then to observe subsurface construction operations can minimize the risks associated with the uncertainties associated with such interpretations. Because of the constantly changing state of the practice in geotechnical engineering, and the potential of site changes after our site exploration, this report should not be relied upon after a period of three years, without Epic Engineering being given the opportunity to review and, if necessary, revise our findings.

OWNERSHIP OF RISK AND STANDARD OF CARE

The engineering recommendations presented in the preceding sections represent Epic Engineering's professional findings regarding the proposed structures on this project based on the information generated and referenced during this evaluation and Epic Engineering's experience in working with these conditions. The builder and owner must understand this concept of risk, as it is they who must decide the acceptable level of risk for the type of structure(s) to be constructed on the site. The geotechnical engineer's duty is to provide professional services in accordance with the stated scope and consistent with the standard of practice at the present time and in the subject geographic area. It is not to provide insurance against geo-hazards or unanticipated soil conditions.

RETENTION OF SOIL SAMPLES

Epic Engineering will typically retain soil samples for 3 months after issuing the preliminary phase I geotechnical report. If you would like to hold the samples for a longer period of time, you should make specific arrangements to have the samples held longer or arrange to take charge of the samples yourself.