SW 120
Div of Waste Management
and Radiation Control

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August 9, 2016
Kleinfelder Project No: 20170041.001A

Salt Lake Valley Solid Waste Management
6030 West California Avenue
Salt Lake City, UT 84104

ATTENTION: Mr. John Ioannou
Mr. Thomas M. Burrup

SUBJECT: LANDFILL HEIGHT CHANGE FEASIBILITY STUDY
SALT LAKE COUNTY LANDFILL
6030 WEST CALIFORNIA AVE
SALT LAKE CITY, UTAH

Dear Messrs. Ioannou & Burrup:

We are pleased to submit our landfill height change feasibility study for the Salt Lake County Landfill located at 6030 West California Ave in Salt Lake City, Utah. This investigation was performed in accordance with our proposal to you dated April 1, 2016.

Based on our geotechnical investigation and analysis, we have provided conclusions regarding settlement and slope stability for the proposed increase in landfill height. We appreciate the opportunity to provide geotechnical services to you on this project. Please contact Mr. Trent Parkhill at 801.261.3336, if you have any questions regarding this report or if we can provide assistance with other aspects of the project.

Respectfully submitted,

KLEINFELDER

Matthew Moriarty, EIT
Staff Geotechnical Engineer

Trent Parkhill, PE
Sr. Principal Geotechnical Engineer

849 West Levoy Drive, Suite 200 Salt Lake City, UT 84123 p | 801.261.3336 f | 801.261.3306

LANDFILL HEIGHT CHANGE FEASIBILITY STUDY
SALT LAKE COUNY LANDFILL
6030 WEST CALIFORNIA AVE
SALT LAKE CITY, UTAH
KLEINFELDER PROJECT NO. 20170041.001A

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A Report prepared for:

Salt Lake Valley Solid Waste Management
6030 West California Ave
Salt Lake City, UT 84104

LANDFILL HEIGHT CHANGE FEASIBILITY STUDY
SALT LAKE COUNTY LANDFILL
6030 WEST CALIFORNIA AVE
SALT LAKE CITY, UTAH

Prepared by:

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SALT LAKE COUNTY LANDFILL
6030 WEST CALIFORNIA AVE
SALT LAKE CITY, UTAH

1 INTRODUCTION

1.1 GENERAL

This report presents the results of Kleinfelder's feasibility study for the increase in height of the Salt Lake County Landfill located at 6030 West California Avenue in Salt Lake City, Utah. The location of the project site is shown on the Site Vicinity Map (Figure A-1) in Appendix A. Our services for this study were performed in accordance with the scope of work outlined in our April 1, 2016 proposal.

This feasibility study includes our conclusions relating to the anticipated settlement and slope stability of the landfill with the proposed height increase. The conclusions and recommendations stated in this report are based on the subsurface conditions encountered in our exploratory borings at the time they were performed. They also are subject to the limitations and provisions stated in Section 5 of this report.

1.2 PROJECT DESCRIPTION

We understand that in planning for the future operations and eventual closure of the landfill site, the Utah Division of Waste Management and Radiation Control has requested that Salt Lake Valley Solid Waste Management Facility (SLVSWMF) study the geotechnical feasibility of the current plan to raise the height of the existing landfill cells above the elevation currently specified and approved in the existing solid waste permit. Our understanding is that current landfill cells are approximately 60 feet in height and the new plan proposes to raise the landfill an additional 60 feet.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our feasibility study was to explore and evaluate subsurface conditions at the landfill in order to estimate the effects of increasing the landfill height in terms of settlement, strain in the landfill liner system, and slope stability. The conclusions presented in this study are based on our analyses of the data from our field exploration and laboratory testing programs.

Kleinfelder's scope of services included:

- Research and review historic geotechnical information available through SLVSWMF, adjacent Utah Department of Transportation Properties, surrounding commercial developments, and the Salt Lake City engineering office.
- Develop preliminary analysis models and perform preliminary analysis for settlement and slope stability based on compiled historic data and observations.
- Use results from the preliminary analysis to modify proposed explorations to better obtain beneficial data.
- Conduct Cone Penetration Tests (CPT) at 5 locations to depths ranging from approximately 50 to 150 feet bgs.
- Perform geophysical surveys at 2 locations using Multichannel Analysis of Surface Waves (MASW) and Refraction Microtremor (ReMi).
- Advance up to 6 exploratory borings to depths ranging from approximately 31.5 to 96.5 feet below the ground surface (bgs). Take samples and perform field vane shear tests (VST) at selected depths while advancing the borings.
- Test selected samples obtained during the field exploration to evaluate relevant engineering properties of the soil.
- Use results of field and laboratory exploration and testing to develop soil profiles and analysis models to perform analysis for settlement and slope stability.

- Preparation of this feasibility study report, which includes a description of the surface and subsurface site conditions found during our investigation, summaries of our analyses our conclusions.

2 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

Five Cone Penetration Tests (CPT) were performed at the site on May 9, 2016. The CPT involve pushing a conical-shaped probe into a soil deposit and recording the resistance of the soil to penetration. Test equipment consists of a cone assembly, a series of hollow sounding rods, a hydraulic frame to push the cone and rods into the soil, an electronic data processing unit, and a truck to transport the test equipment and provide thrust resistance. The data obtained from the CPT can be used to derive several significant soil parameters such as estimates of soil type, strength, compressibility, and shear wave velocity.

In addition to the shear wave velocity measured from the CPT soundings, geophysical surveys were performed on May 13, 2016 using MASW and ReMi methods. These methods use a linear array of geophones to measure the velocity of surface waves generated by dropping a 500-pound weight on the ground. These velocities are analyzed to estimate shear wave velocities with depth.

Kleinfelder drilled 6 exploratory borings at the site between May 16 and 23, 2016. The exploratory borings were located within approximately five feet of the corresponding CPT soundings. The borings were advanced using a truck-mounted drill rig equipped with 6-inch outside diameter (O.D.) mud rotary equipment. Relatively undisturbed samples of fine-grained soils were collected during exploration using a standard Shelby tube sampler (3-inch O.D.). Disturbed subsurface soil samples were obtained using a standard split-spoon sampler (2-inch O.D.) driven into the soil with blows from a 140-pound automatic hammer falling through a 30-inch drop. The raw blows required to drive the samplers into the soil are recorded on each of the boring logs. These blow counts are an indication of the relative density or consistency of the on-site soils. In addition to collecting undisturbed and disturbed samples, in-situ strength testing was performed using the field vane shear test (VST). The raw VST results are recorded on each of the boring logs.

Samples obtained during the field exploration were transported to the laboratory for further examination and testing. Samples will be retained for a period of 90 days from the date of this feasibility study after which time samples will be discarded unless otherwise requested by SLVSWMF.

Approximate boring, CPT, and geophysical survey locations are shown on the Exploration Location Map (Figure A-2). Appendix B includes graphical boring logs, CPT soundings, and geophysical survey results. A key to the logs and a summary of the USCS (Unified Soil Classification System) soil descriptions are also contained in Appendix B. The lines defining boundaries between soil types on the logs are based upon Kleinfelder's field observations and are therefore approximate. Transition between soil types may be abrupt or may be gradual.

2.2 LABORATORY TESTING

Geotechnical laboratory tests were performed on selected soil samples to estimate their relative engineering properties. Testing for the following properties was performed in general accordance with recognized standards:

- Moisture Content / Dry Density (15 tests);
- Minus 200 Wash (25 tests);
- Sieve Analysis (2 tests);
- Atterberg Limits (24 tests);
- One-Dimensional Consolidation (15 test);

Gradation, percent passing the number 200 sieve, and Atterberg Limits analyses were performed to aid in classification of the soils encountered during the field investigation. The geotechnical laboratory tests results are included in Appendix C of this report. Selected geotechnical test results are also shown on the boring logs contained in Appendix B.

3 SITE CONDITIONS

3.1 SURFACE

The project site is located on the west side of Salt Lake City, at 6030 West California Avenue. The site is bounded on the north by Union Pacific Railroad tracks and on the south by California Avenue. It is bounded on the east and west primarily by undeveloped land. The southwest corner of the site is border by Waste Management's Mountain View Landfill. At the time of our investigation, the majority of the site was being used as an active landfill with offices located on the southeast end of the site and a small power plant fueled by collected landfill gases on the east end of the site.

3.2 GEOLOGIC SETTING

The site is located on the west side of the Salt Lake Valley. The Salt Lake Valley is within the Basin and Range Physiographic Province, which is characterized by approximately north-trending valleys and mountain ranges which have been formed by extensional tectonics and displacement along normal faults (Hunt, 1967). This valley is a deep, sediment-filled structural basin of Cenozoic age flanked by two uplifted blocks, the Wasatch Range on the east and the Oquirrh Mountains to the west. The Wasatch Range is the easternmost limit of the Basin and Range Physiographic Province.

The near-surface geology of the valley is dominated by sediments deposited by Lake Bonneville and the Jordan River during the late Pleistocene to Holocene Epochs. The native soils exposed at the surface in the vicinity of the site have been mapped as primarily of lacustrine and alluvial deposits consisting of clay and silt with minor sand and gravel (Solomon, Biek, and Smith, 2007). Native soils encountered at the site during our field investigation were generally consistent with the geologic mapping.

3.3 GEOLOGIC HAZARDS

3.3.1 Seismicity and Faulting

The proposed project site is located within the Intermountain Seismic Belt, a seismically active region that extends from Arizona to Montana (Smith and Arabasz, 1991). Solomon, Biek, and Smith (2007) have mapped traces of the Granger Fault approximately 1.3 miles east of the site. The USGS has mapped the Wasatch fault zone approximately 9.3 miles to the east of the site. Active faults in the region are potential sources for seismic loading hazards at the site. A fault is considered to be active if displacement has occurred within the past 10,000 years.

Based on our soils investigation and subsequent analysis the subsurface material at the site would correspond to a Site Class D. The design spectral response acceleration parameters, corresponding to a Site Class D, are S_{DS} = 0.861*g* and S_{D1} = 0.451g for short period and 1-second period, respectively. The peak ground acceleration for the site is 0.513. The PGA along with S_{DS} and S_{D1} values were used in our slope stability analysis for the seismic case. The intermediate values from ASCE 7 used to obtain the design parameters are contained below in Tables 1 and 2:

TABLE 1

DESIGN ACCELERATION FOR SHORT PERIODS

S_S	S_{MS}	S_{DS}
1.291	1.291	0.861

S_S = The mapped spectral accelerations for short periods (U.S. Geological Survey Seismic Design Maps, 2008)

S_{MS} = The maximum considered earthquake spectral response accelerations for short periods

S_{DS} = 5 percent damped design spectral response acceleration at short periods

TABLE 2

DESIGN ACCELERATION FOR 1-SEC PERIOD

S_1	S_{M1}	S_{D1}
0.431	0.676	0.451

S_1 = The mapped spectral accelerations for 1-second period (U.S. Geological Survey Seismic Design Maps, 2008)

S_{M1} = The maximum considered earthquake spectral response accelerations for 1 second period

S_{D1} = 5 percent damped design spectral response acceleration at 1 second period

3.3.2 Liquefaction and Lateral Spreading

Liquefaction is a phenomenon whereby loose, saturated, soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake, as excess pore water pressures are dissipated. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth-to-groundwater.

The site is mapped as having a high potential for liquefaction (Castleton, Elliott, & McDonald, 2011). However, based on information gathered during our subsurface investigation and subsequent analysis it appears that the landfill is underlain by soils which are not expected to liquefy.

3.4 GROUNDWATER

Groundwater was observed in the CPT soundings at depths ranging from 7 to 14.5 feet. Groundwater levels are dependent on seasonal precipitation, irrigation practices, land use and runoff conditions. As such, it is possible that the observed water level may fluctuate during dryer and wetter seasons of the year. A detailed study of site hydrogeologic conditions was beyond the scope of work of this investigation; as a result, we are unable to characterize potential groundwater fluctuations at the site.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 SETTLEMENT

Settlement analyses were performed using soil properties estimated from the site exploration and laboratory testing program. The total settlement resulting from adding approximately 120 feet of MSW near the perimeter of the landfill to a total of 215 feet of MSW at the center of the landfill is estimated to be approximately 6 feet. The total settlement resulting from adding approximately 120 feet of MSW to the landfill (i.e., no additional cap on top) is estimated to be approximately 3½ feet. Idealized cross sections for these two cases are shown in Figure 1 and Figure 2, respectively. These estimates are lower than was initially expected due to the relatively stiff soil properties found during laboratory testing. The soils were found to be consistently stiffer than in other areas near this part of the valley. This could be related to the historical use of the site as a tailings pond containing washed or milled ore (Solomon, Biek, & Smith 2007). However, we have not been able to verify this. With the low anticipated settlements we calculate strains in the liner under the landfill of less than 2%. According to literature, the liner material would not be expected to begin yielding at these levels of strain, and therefore, the strain is anticipated to be much less than the strain required to cause failure in the liner.

4.1.1 Methodologies Used in Settlement Analyses

Settlement analyses are performed using soil properties obtained during field and laboratory testing. Because of the very large size of the fill, properties were needed for soil layers below practical test boring depths. In order to develop these deeper soil properties, we used correlations from the literature between shear wave velocities in the soils and the settlement properties of the soil.

At the elevations where we were able to obtain samples of the soils, we primarily used the settlement properties from conventional consolidation tests (tests for settlement of clays.) However, in these shallower areas, we also used the correlations with shear wave velocity to aid in the interpretation of the soil properties.

In the deeper areas, where it was not practical to obtain soil samples, we used the correlations devolved with shear wave velocities to develop soil properties. The deeper shear wave velocities were obtained from the MASW and ReMi testing conducted on this site, and from a deeper shear wave velocity profile conducted by others, 4,800 ft. north of the landfill (Wilder & Stokoe).

In an effort to verify the settlement model, design drawings and survey data were obtained to look for older elevations. We hoped that we could find elevations of the same objects over time, allowing us to verify how the landfill has settled since its construction. This information would help us to further calibrate our settlement models. In particular, we looked for elevations at the bottoms of the leachate sumps. While we were able to find design plans with elevations noted, no as built drawings were found during our data search. Therefore we could not confirm that the sumps were placed exactly at the elevations noted in the design plans.

Survey data was obtained from a recent survey of the leachate sumps. The results of this survey are presented in Table 3. These data indicate that the leachate sumps are currently roughly 4 to 7 ft. below the as-designed sump elevations. Since it is very possible that the sumps were not placed at the design elevations, we cannot conclude that the settlement to date of the landfill is in the 4 to 7 ft. range. However, if the sumps were placed at the as-designed elevations, and these settlements are correct, then the calculated strains for the landfill liner at the future 120 ft. height, would still be on the order of 2% strain. Therefore, while there is uncertainty in these "measured" settlements, they do confirm the conclusion that the landfill liner will not reach rupture strains at the 120 ft. design height.

TABLE 3

ELEVATION OF LECHATE SUMPS

Leachate Sump	Design El. On EMCON Drawing #3 (11 Nov. 1991) (Leachate Collection and Removal System (LCRS) Plan (ft)	Top of Riser Elevation (ft)	Bottom of Leachate Riser Elevation (ft)
S-1	4217	4297.302	4212.90
S-2	4218.5	4332.02	4208.83
S-3	4216.5	4313.115	4211.55
S-4	4216.5	4325.623	4202.99
S-5	4218.5	4254.428	4214.54
S-6	4213	4300.192	4207.15
S-7	4213	4302.058	4206.24

The primary benchmark used for this work is the well-known benchmark at the southeast corner of the landfill, shown on the survey plan in Appendix B. Ensign Engineering checked the elevation of this benchmark against a higher accuracy benchmark, further from the landfill, and found that the benchmark in the southeast corner is 3.042 ft. higher than its official recorded elevation (El. 4233.119 vs. El. 4230.077). Knowing the error in this benchmark may be helpful in future surveys conducted at the landfill.

Now that good elevations have been determined for the bottom of the sumps, if confirmation of the estimated settlement and strain is desired, one could conduct future surveys of the bottom of sump elevations and compare the incremental movements with incremental calculated settlements.

4.2 SLOPE STABILITY

Slope stability failure can typically be described as a critical deep-seated deformation of a slope when the forces driving that deformation exceed the resisting forces from the underlying native soils. Driving forces include gravity and seismic loads, while resisting forces include soil shear strength and in some cases soil weight at the toe. In evaluating slope stability, it is convenient to convey the results of the analyses in terms of a factor of safety, which is defined as the ratio of the resisting forces to the driving forces.

4.2.1 Methodologies Used in Slope Stability Analyses

Slope stability analyses require assumptions, including development of soil strength parameters and geometry of subsurface conditions. These are developed based on results of field and laboratory investigations, review of existing published information, and previous experience in the site vicinity. Limit equilibrium slope stability analyses were performed using the computer program Slope/W by Geo-Slope International. Spencer's method of slices was used, which satisfies both moment and force equilibrium. The analyses employed entry-exit critical slip surface search routines using both circular and block failure surfaces.

Evaluation of slope stability involves developing a cross section of the existing topography and the proposed site grades; developing a generalized soil profile and soil strength parameters; and calculating the factor of safety under various stress conditions. Based on design drawings provided by SLVSWMF (Emcon, 1991), current conditions, and our understanding of future plans for the landfill we understand that constructed slopes could range from 3 Horizontal (H): 1 Vertical (V) to 4H: 1V. Slope stability analysis was performed using the idealized cross section geometry shown in Figures 1 through 3.

Soil strength was modeled using isotropic Mohr Coulomb failure criteria in the granular deposits. The upper clay layers were modeled with anisotropic undrained shear strength failure criteria that account for the increase in undrained shear strength with depth. Soil strength properties for the clays under the landfill were developed using in-situ Field Vane Shear Tests conducted adjacent to the landfill, CPT correlations, and an approach known as SHANSEP (Stress History and Normalized Soil Engineering Properties).

A summary of the soil engineering parameters used in the slope stability analyses is presented in Table 4.

TABLE 4

SUMMARY OF SOIL ENGINEERING PARAMETERS USED IN SLOPE STABILITY ANALYSIS

Material Type	Friction Angle (degrees)	Cohesion (psf)	Total Unit Weight (pcf)
Compacted Landfill Material *	32	300	60
HDPE Landfill Liner	22	-	60
Clay Landfill Liner	22	-	115
Upper Clay	-	1000 + 20 psf/ft.	122
Upper Sand	34	-	122
Middle Clay	-	2500	125

Notes: psf = pounds per square feet; pcf = pounds per cubic feet
* Compacted Landfill Material properties are from Wong, W. W. Y. (2009).

4.2.2 Slope Stability Analysis Results

Slope stability analyses were performed for a static case and a seismic case. Our initial analysis using material properties from previous nearby investigations indicated that the proposed increase in landfill height would result in unstable to marginally stable slopes for the static case. However, the strengths determined from the Field Vane Shear Tests, CPT correlations, and SHANSEP were about 4 times the strengths measured with lab testing during the 1990's. With the higher strengths determined by these more sophisticated testing methods, the landfill is expected to be stable for the following three cases:

- Case 1 – Landfill raised to 120 ft. height at 3H:1V with additional 70 ft. of fill at 5% slope placed on top (215' MSW at center of landfill). See Figure 1 for idealized cross section.
- Case 2 – Landfill raised to 120 ft. height (El. 4360') with 3H:1V slope (145' MSW at center of landfill). See Figure 2 for idealized cross section.
- Case 3 – Landfill raised to 120 ft. height at 3H:1V after Module 8 is excavated to liner depth. See Figure 3 for idealized cross section.

The idealized geometry for these cases are shown in Figures 1 through 3. The factors of safety for both static and seismic conditions are summarized in Table 5. The model output for static conditions for each case are shown in Figures D-1 through D-3 in Appendix D.

TABLE 5

RESULTS OF SLOPE STABILITY ANALYSIS

Design Case	Description	Static Factor of Safety	Pseudo-Static Factor of Safety
Case 1	Landfill raised to 120 ft. height at 3H: 1V with additional 70 ft. grade raise at 5% slope. (Figure 1)	1.66	0.65
Case 2	Landfill raised to 120 ft. height at 3H:1V slope (Figure 2)	1.74	0.78
Case 3	Landfill raised to 120 ft. height at 3H:1V slope after Module 8 is excavated to liner depth (Figure 3)	1.64	0.79

The slope stability results shown in Table 5 are greater than 1.5 for the static case and indicate the cases are considered stable for static conditions. The results for the seismic (pseudo-static) cases indicate that the slope may fail during a larger magnitude seismic event. However, based on our seismic displacement analyses, we anticipate that the total movement of the slope would be approximately 1 foot or less.

5 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided. This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than three years from the date of the report.

The scope of services was limited at the site. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

6 REFERENCES

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Figures

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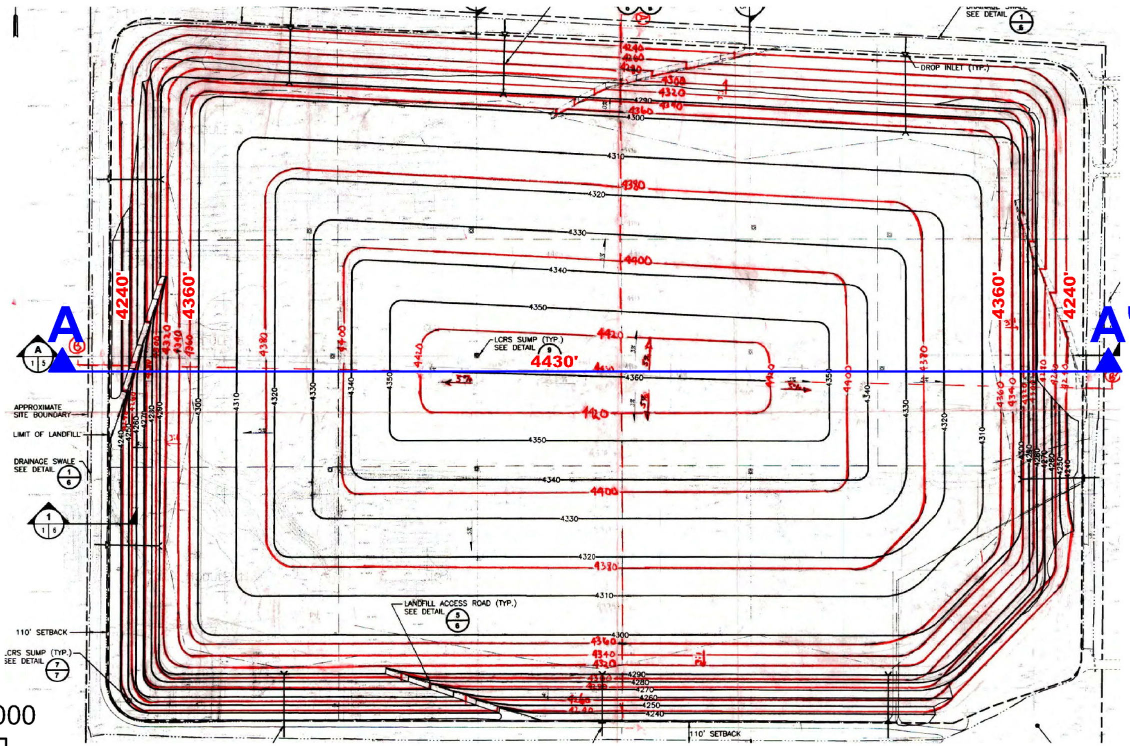
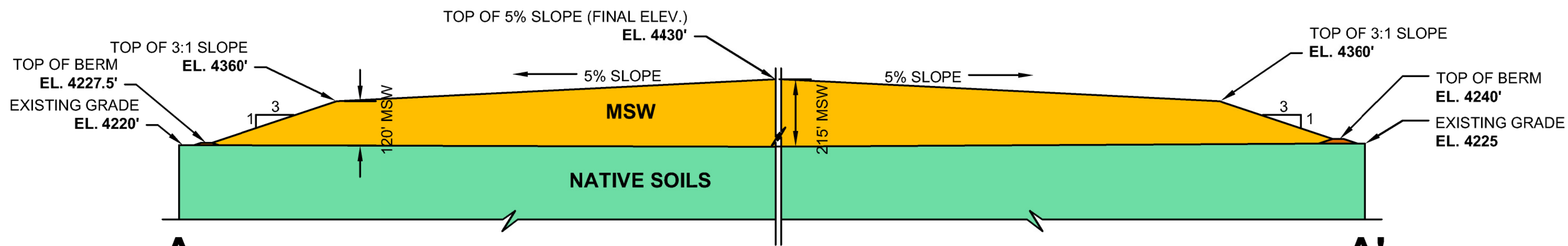
NOTE:
LANDFILL GRADING AND DRAINAGE PLAN (DRAWING NO. 1) FROM SLV LANDFILL HEIGHT INCREASE PERMIT DATED MAY 21, 2015



LANDFILL FUTURE GRADING PLAN



CASE 1 - IDEALIZED CROSS-SECTION FOR SETTLEMENT AND SLOPE STABILITY ANALYSES

0 500 1000

SCALE: 1" = 500' SCALE IN FEET

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CHECKED BY:	T. Parkhill
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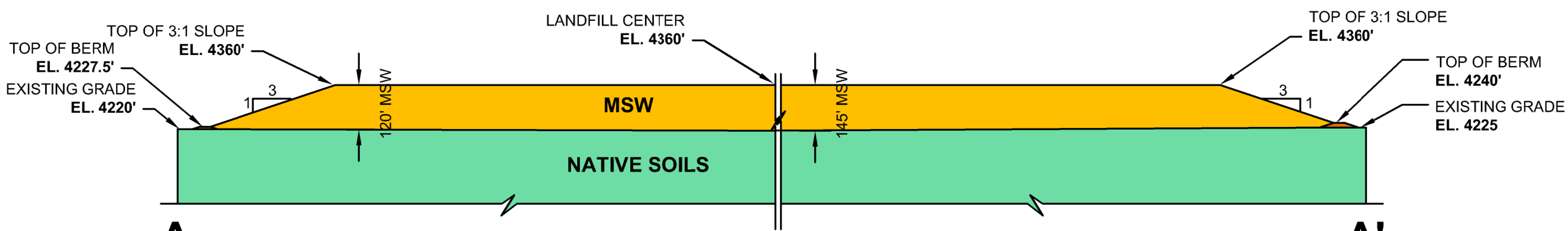
LANDFILL GRADING PLAN AND CROSS SECTIONS

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

1

NOTE:
LANDFILL GRADING AND DRAINAGE PLAN (DRAWING NO. 1) FROM SLV LANDFILL HEIGHT INCREASE PERMIT DATED MAY 21, 2015



CASE 2 - IDEALIZED CROSS-SECTION FOR SETTLEMENT AND SLOPE STABILITY ANALYSES

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SCALE: 1" = 500' SCALE IN FEET

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CROSS SECTIONS

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

2

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NOTE:
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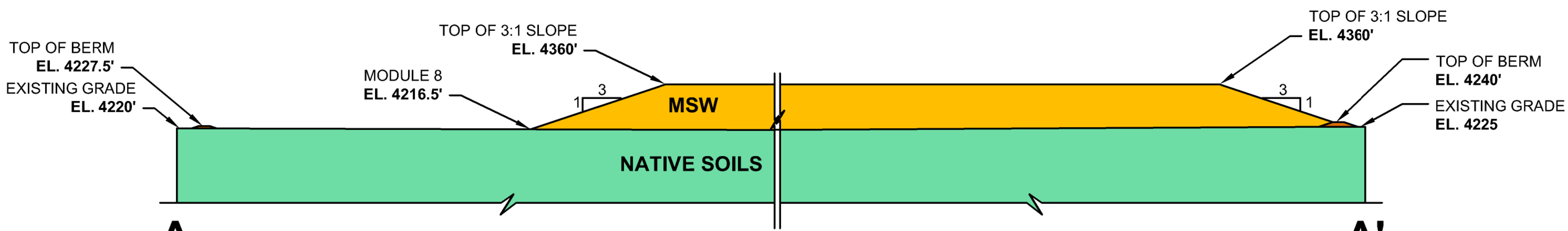

CASE 3 - IDEALIZED CROSS-SECTION FOR SLOPE STABILITY ANALYSES

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CROSS SECTIONS

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

3

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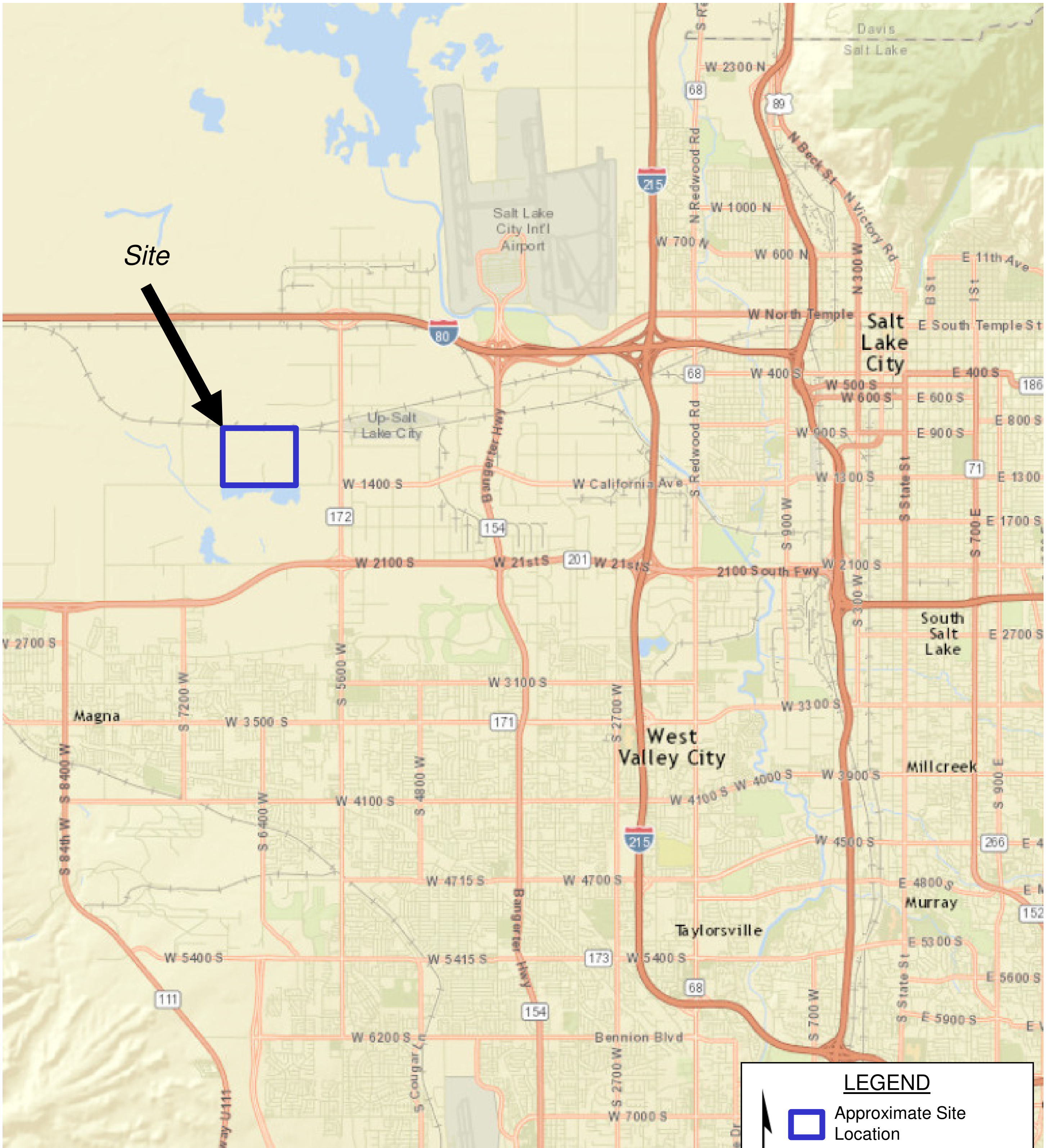
Appendix A

APPENDIX A

Site Vicinity Map and Exploration Location Map



LEGEND

Approximate Site Location

N

NOT TO SCALE

Image from ArcGIS Online Maps

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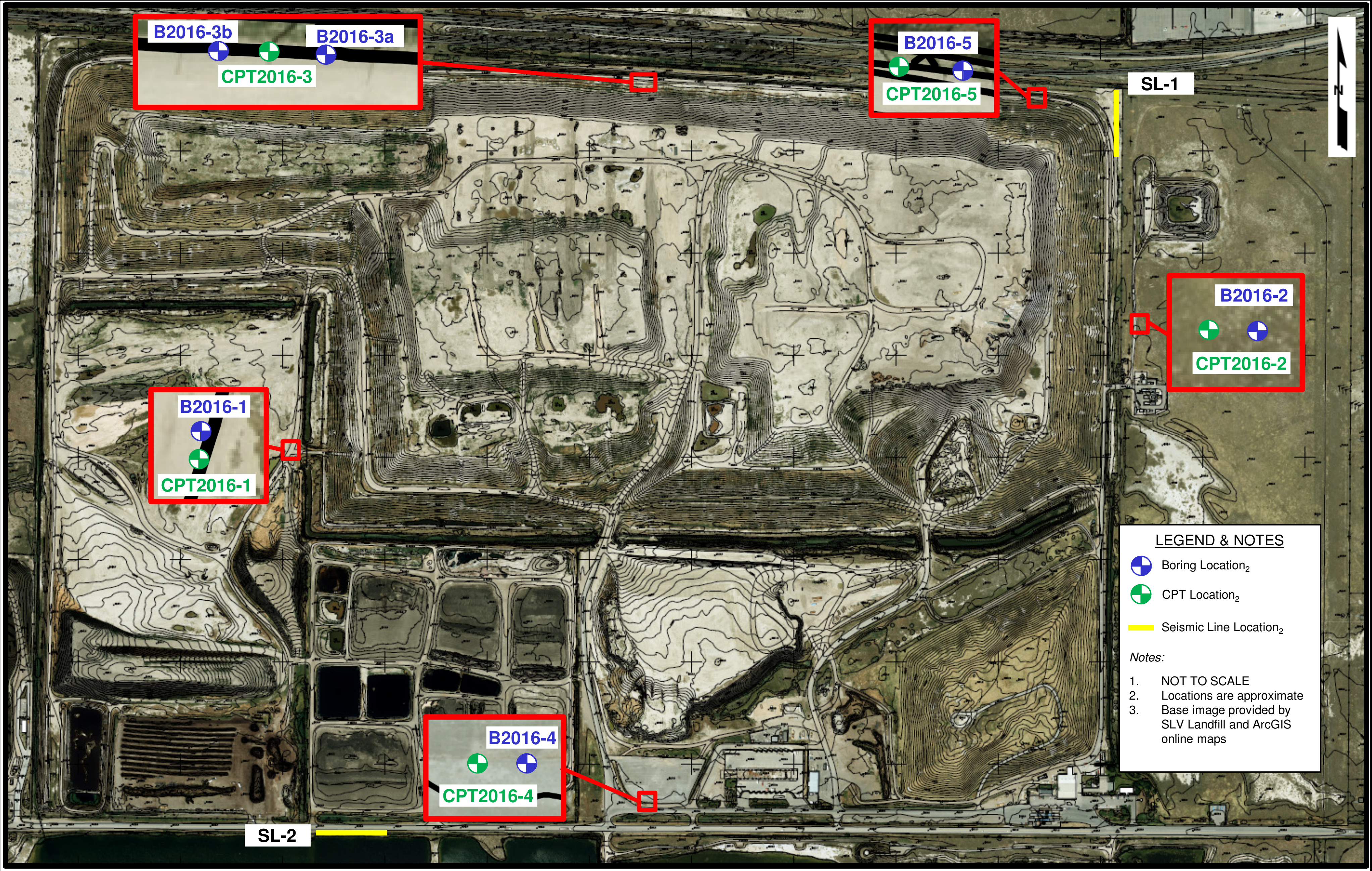
DRAWN	7/5/2016
DRAWN BY:	M. Moriarty
CHECKED BY:	T. Parkhill
FILE:	

SITE VICINITY MAP

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

FIGURE

A-1



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PROJECT NO.	20170041
DRAWN	7/5/2016
DRAWN BY:	M. Moriarty
CHECKED BY:	T. Parkhill
FILE:	

EXPLORATION LOCATION MAP

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, UT

FIGURE

A-2

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Appendix B

APPENDIX B

Logs of Exploratory Borings, CPT Results, Geophysical Results, Survey

SAMPLE/SAMPLER TYPE GRAPHICS

SHELBY TUBE SAMPLER

STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

VANE SHEAR

GROUND WATER GRAPHICS

WATER LEVEL (level where first observed)

WATER LEVEL (level after exploration completion)

WATER LEVEL (additional levels after exploration)

OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤3	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu <4 and/ or 1>Cc >3	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu ≥4 and 1≤ Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu <4 and/ or 1>Cc >3	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤3	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu <6 and/ or 1>Cc >3	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥6 and 1≤ Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu <6 and/ or 1>Cc >3	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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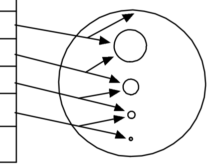
PROJECT NO.:	20170041	GRAPHICS KEY	APPENDIX
DRAWN BY:	MDM		
CHECKED BY:	TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	B-1
DATE:	7/1/2016		
REVISED:	-		

PLOTTED: 07/05/2016 03:38 PM BY: mmoriarty

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller

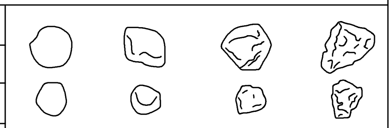


MUNSELL COLOR

NAME	ABBR
Red	R
Yellow Red	YR
Yellow	Y
Green Yellow	GY
Green	G
Blue Green	BG
Blue	B
Purple Blue	PB
Purple	P
Red Purple	RP
Black	N

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges



PARTICLES PRESENT

Amount	Percentage
trace	<5
few	5-10
little	15-25
some	30-45
and	50
mostly	50-100

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

NOTE: AFTER TERZAGHI AND PECK, 1948

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (q_u)(psf)	CRITERIA
Very Soft	< 1000	Thumb will penetrate soil more than 1 in. (25 mm.)
Soft	1000 - 2000	Thumb will penetrate soil about 1 in. (25 mm.)
Firm	2000 - 4000	Thumb will indent soil about 1/4-in. (6 mm.)
Hard	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail
Very Hard	> 8000	Thumbnail will not indent soil

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

CEMENTATION

DESCRIPTION	FIELD TEST
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

gINT FILE: PROJECTWISE: Salt Lake Valley Landfill.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2016.GLB [GEO-LEGEND 2 (SOIL DESCRIPTION KEY)]

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PROJECT NO.: 20170041	SOIL DESCRIPTION KEY	APPENDIX
DRAWN BY: MDM		B-2
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	
DATE: 7/1/2016		
REVISED: -		

Date Begin - End:	5/20/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-1**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Cloudy & Windy	**Exploration Diameter:**	6 in. O.D.		

Latitude: 40.74540° N
Longitude: 112.04909° W
Surface Condition: Perimeter Road

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Silty GRAVEL with Sand (GM)											
		Gravelly Lean CLAY (CL)											
		bent shelby while pushing											
5													
		Lean CLAY (CL): medium plasticity, brownish gray, very moist, very stiff											
		Vane shear test performed with 2-inch vane. Peak = 600 in-lbs, Residual = 170 in-lbs.											
10													
		Vane shear test performed with 2-inch vane. Peak = 400 in-lbs, Residual = 120 in-lbs.											
		Fat CLAY (CH): gray, very moist, medium stiff			24"	CH	34.7	87.8		96	51	30	
15		**Lean CLAY (CL)**: gray, very moist, very stiff											
		Vane shear test performed with 2-inch vane. Peak = 600 in-lbs, Residual = 120 in-lbs.											
20													
		Vane shear test performed with 2-inch vane. Peak = 500 in-lbs, Residual = 310 in-lbs.											
		Lean CLAY with Sand (CL): gray, very moist, very stiff			24"	CL	24.3	99.0		84	29	8	
25													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
30													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											

The boring was terminated at approximately 31.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 20, 2016.

GROUNDWATER LEVEL INFORMATION:
Depth to groundwater was not observed due to mud rotary drilling techniques.
GENERAL NOTES:
See the companion CPT for detailed soil stratification

PROJECT NO.: 20170041	BORING LOG B2016-1	APPENDIX
DRAWN BY: MDM		B-3
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	
DATE: 7/1/2016		
REVISED: -		PAGE: 1 of 1

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Date Begin - End:	5/16/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-2**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

Latitude: 40.74707° N
Longitude: 112.03415° W
Surface Condition: Grass

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy Lean CLAY (CL): medium plasticity, tan, wet, very stiff											
		Vane shear test performed with 2.5-inch vane. Peak > 600 in-lbs, Residual not measured.											
5					NR								
		Lean CLAY (CL): medium to high plasticity, tan, wet, very stiff Vane shear test performed with 2.5-inch vane. Peak = 430 in-lbs, Residual = 190.											
10		becomes gray											
					24"	CL	35.7	86.7		99	49	30	
15													
		Vane shear test performed with 2-inch vane. Peak = 475 in-lbs, Residual = 175.											
20													
25													
30													
		Vane shear test performed with 2-inch vane. Peak = 500 in-lbs, Residual = 75.											

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PROJECT NO.: 20170041	BORING LOG B2016-2		APPENDIX
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		B-4
DATE: 7/1/2016			
REVISED: -			PAGE: 1 of 2

Date Begin - End:	5/16/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-2**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION

Latitude: 40.74707° N
Longitude: 112.03415° W
Surface Condition: Grass

LABORATORY RESULTS

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean CLAY (CL): medium to high plasticity, tan, wet, very stiff											
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											

The boring was terminated at approximately 36.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 16, 2016.

GROUNDWATER LEVEL INFORMATION:
Depth to groundwater was not observed due to mud rotary drilling techniques.
GENERAL NOTES:
See the companion CPT for detailed soil stratification

40
45
50
55
60
65

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PROJECT NO.: 20170041	BORING LOG B2016-2		APPENDIX
DRAWN BY: MDM			B-5
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		
DATE: 7/1/2016			
REVISED: -			PAGE: 2 of 2

Date Begin - End:	5/16/2016	**Drilling Company:**	Davis Drilling			**BORING LOG B2016-3a**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis			
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.	
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary			
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.			

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 40.75035° N
Longitude: 112.04299° W
Surface Condition: Perimeter Road

Depth (feet)	Lithologic Description	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	FILL :**Silty GRAVEL with Sand (GM)**: light brown, slightly moist, dense									
	Sandy Lean CLAY (CL): gray, very moist	18"	CL				67	42	20	
	Lean CLAY with ocassional Gravel and Cobbles (CL): gray, very moist		CL				93	39	19	
5	Shelby Tube bent on dense layer encountered at 4 feet									
	Lean CLAY (CL): medium plasticity, gray, very moist to wet, stiff to very stiff									
10	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.									
	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.									
		24"	CL	23.0	95.9		92	35	17	
15										
	Vane shear test performed with 2-inch vane. Peak = 530 in-lbs, Residual =100 in-lbs.									
	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.									
20		24"								
	Vane shear test performed with 2-inch vane. Peak = 550 in-lbs, Residual =140 in-lbs.									
25										
	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.									
30		24"	CL	35.6	87.2		96	47	28	
	SAND and Silt Mixtures (SP-SM): based on adjacent CPT performed by ConeTec 5/9/2016									

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PROJECT NO.:	20170041
DRAWN BY:	MDM
CHECKED BY:	TP
DATE:	7/1/2016
REVISED:	-

BORING LOG B2016-3a

Salt Lake Valley Landfill
6030 W California Ave
Salt Lake City, Utah

APPENDIX

B-6

KLEINFELDER - 849 West Levoy Drive, Suite 200 | Taylorsville, UT 84123 | PH: 801.261.3336 | FAX: 801.261.3306 | www.kleinfelder.com

Date Begin - End:	5/16/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-3a**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 40.75035° N Longitude: 112.04299° W Surface Condition: Perimeter Road — Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SAND and Silt Mixtures (SP-SM): based on adjacent CPT performed by ConeTec 5/9/2016											
40													
45													
50		**Lean CLAY with Sand (CL)**: medium plasticity, gray, wet, very stiff											
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
55					18"	CL	21.8	103.0		83	34	17	
60													
65													

The boring was terminated at approximately 56.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 16, 2016.

GROUNDWATER LEVEL INFORMATION:
Depth to groundwater was not observed due to mud rotary drilling techniques.

GENERAL NOTES:
See the companion CPT for detailed soil stratification

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PROJECT NO.: 20170041	BORING LOG B2016-3a		APPENDIX
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		B-7
DATE: 7/1/2016			
REVISED: -			PAGE: 2 of 2

Date Begin - End:	5/17/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-3b**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION: Latitude: 40.75035° N; Longitude: 112.04303° W; Surface Condition: Perimeter Road

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Silty GRAVEL with Sand (GM)											
		Lean CLAY with ocassional Gravel and Cobbles (CL): medium plasticity, gray, very moist											
5													
		Vane shear test performed with 2-inch vane. Peak = 490 in-lbs, Residual =100 in-lbs. Two vanes bent, likely when pushing 18 - inches											
		Lean CLAY (CL): medium to high plasticity, gray, wet, very stiff, trace coarse sand in upper few feet											
10													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
		Vane shear test performed with 2-inch vane. Peak = 500 in-lbs, Residual = 50 in-lbs.											
15													
		Vane shear test performed with 2-inch vane. Peak = 450 in-lbs, Residual = 60 in-lbs.											
		Vane shear test performed with 2-inch vane. Peak = 320 in-lbs, Residual = 50 in-lbs. Softer vane shear results consistent with softer drilling noted by drillers.											
20													
		Vane shear test performed with 2-inch vane. Peak = 470 in-lbs, Residual = 100 in-lbs.											
25					24"	CL	30.3	92.8		91	46	27	
30													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
		SAND and Silt Mixtures (SP-SM): based on adjacent CPT performed by ConeTec 5/9/2016											

Date Begin - End:	5/17/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-3b**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 40.75035° N
Longitude: 112.04303° W
Surface Condition: Perimeter Road

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SAND and Silt Mixtures (SP-SM): based on adjacent CPT performed by ConeTec 5/9/2016											
40													
45													
50		**Lean CLAY (CL)**: medium to high plasticity, gray, wet, very stiff											
		Vane shear test performed with 2-inch vane. Peak = 450 in-lbs, Residual = 190 in-lbs.											
55													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured. Likely tipped in sand.											
60													
65													

The boring was terminated at approximately 59 ft. below ground surface. The boring was backfilled with auger cuttings on May 17, 2016.

GROUNDWATER LEVEL INFORMATION:
Depth to groundwater was not observed due to mud rotary drilling techniques.
GENERAL NOTES:
See the companion CPT for detailed soil stratification

KLEINFELDER
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PROJECT NO.: 20170041	BORING LOG B2016-3b		APPENDIX
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		B-9
DATE: 7/1/2016			
REVISED: -			PAGE: 2 of 2

Date Begin - End:	5/23/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-4**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 40.74068° N
Longitude: 112.04268° W
Surface Condition: Asphalt

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		ASPHALT CONCRETE (5.5 inches)											
		RECYCLED ASPHALT CONCRETE: black, slightly moist, medium dense											
5				BC=14 8 7	12"								
		Lean CLAY (CL): medium plasticity, brown, moist, very stiff											
10		becomes gray, wet, stiff											
		Vane shear test performed with 2-inch vane. Peak = 330 in-lbs, Residual = 60 in-lbs.											
		Poorly graded SAND with Silt (SP-SM): fine-grained, gray, wet, medium dense											
15				BC=6 14 12	12"	SP-SM			88	11			
20		**Lean CLAY (CL)**: medium plasticity, gray, wet, very stiff											
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
25		increase in sand content											
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
30													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
		Well-graded SAND with Silt (SW-SM): gray, wet, very dense											

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PROJECT NO.: 20170041	BORING LOG B2016-4		APPENDIX
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		B-10
DATE: 7/1/2016			
REVISED: -			PAGE: 1 of 2

Date Begin - End:	5/23/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-4**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Partly Cloudy	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 40.74068° N
Longitude: 112.04268° W
Surface Condition: Asphalt

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Well-graded SAND with Silt (SW-SM): gray, wet, very dense											
40				BC=7 26 28	14"	SW-SM			97	8.1			
		Lean CLAY (CL): medium plasticity, gray, wet, stiff											
45													
		Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.			18"								
						CL				91	38	21	
		Lean CLAY with Sand (CL): medium plasticity, gray, wet, stiff, occasional silt zones				CL	25.1	97.9		81	31	13	
50		**Lean CLAY (CL)**: medium plasticity, gray, wet, stiff			12"	CL	32.7	87.9		100	41	21	
55													
60													
65													

The boring was terminated at approximately 52 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on May 23, 2016.

GROUNDWATER LEVEL INFORMATION:
Depth to groundwater was not observed due to mud rotary drilling techniques.

GENERAL NOTES:
See the companion CPT for detailed soil stratification

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20170041	BORING LOG B2016-4	APPENDIX
	DRAWN BY: MDM		
	CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	B-11
	DATE: 7/1/2016		
	REVISED: -		PAGE: 2 of 2

KLEINFELDER - 849 West Levoy Drive, Suite 200 | Taylorsville, UT 84123 | PH: 801.261.3336 | FAX: 801.261.3306 | www.kleinfelder.com

Date Begin - End:	5/18/2016 - 5/20/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-5**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 40.75010° N
Longitude: 112.03565° W
Surface Condition: Perimeter Road

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Silty GRAVEL with Sand (GM)**: light brown, slightly moist, dense											
2	**Lean CLAY with Sand (CL)**: medium to high plasticity, grayish brown, very moist, stiff											
2.5			BC=4 4 5		CL				80	43	25	
5												
8	becomes gray to black, wet, very stiff											
9	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
10	becomes gray with brown seams			12"	CL	29.8	88.5		83	42	23	
14	Vane shear test performed with 2-inch vane. Peak = 340 in-lbs, Residual = 50 in-lbs.											
15	**Lean CLAY (CL)**: gray, wet, very stiff											
16	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.											
17.5				24"	CL	25.8	98.5		90	34	17	
20												
24	Vane shear test performed with 2-inch vane. Peak = 560 in-lbs, Residual = 90 in-lbs.											
25												
26	**SAND and Silt Mixtures (SP-SM)**: based on adjacent CPT performed by ConeTec 5/9/2016											
30												

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PROJECT NO.: 20170041	BORING LOG B2016-5		APPENDIX
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah		B-12
DATE: 7/1/2016			
REVISED: -			PAGE: 1 of 3

Date Begin - End:	5/18/2016 - 5/20/2016	**Drilling Company:**	Davis Drilling		**BORING LOG B2016-5**
Logged By:	M. Moriarty	**Drill Crew:**	J. Davis & C. Davis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 40.75010° N
Longitude: 112.03565° W
Surface Condition: Perimeter Road

Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	Lean CLAY (CL): medium to high plasticity, gray, wet, very stiff		18"	CL	27.5	97.5		95	44	24	
	Poorly graded SAND with Silt (SP-SM): gray, wet										
40											
45	**Lean CLAY with Sand (CL)**: medium to high plasticity, gray, wet, very stiff										
	Vane shear test performed with 2-inch vane. Peak > 600 in-lbs, Residual not measured.										
50			18"	CL	23.9	98.1		76	37	19	
55	**Lean CLAY (CL)**: medium to high plasticity, gray, wet, very stiff	BC=1 3 4	18"	CL				92	38	21	
60	**Fat CLAY (CH)**: gray, wet, very stiff		18"	CH	40.7	75.4		98	71	49	
65	**Lean CLAY with Sand (CL)**: gray, wet, very stiff	BC=7 7 7	14"	CL				78	27	11	
	Sandy Lean CLAY (CL): gray, wet, very stiff 2-inch poorly graded sand zone in sample			CL				62	29	12	
	Lean CLAY (CL): gray, wet, very stiff		12"	CL	23.5	102.4		97	32	14	

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PROJECT NO.: 20170041	BORING LOG B2016-5	APPENDIX
DRAWN BY: MDM		
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	B-13
DATE: 7/1/2016		
REVISED: -		PAGE: 2 of 3

Date Begin - End: 5/18/2016 - 5/20/2016	**Drilling Company:** Davis Drilling		**BORING LOG B2016-5**
Logged By: M. Moriarty	**Drill Crew:** J. Davis & C. Davis		
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** CME-75	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Mud Rotary		
Weather: Sunny	**Exploration Diameter:** 6 in. O.D.		

Latitude: 40.75010° N
Longitude: 112.03565° W
Surface Condition: Perimeter Road

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	SAND and Silt Mixtures (SP-SM): based on adjacent CPT performed by ConeTec 5/9/2016											
75												Borehole caved between 70 and 80 feet. Re-drilled to 95 feet with thicker drilling mud mixture. Borehole caved again after taking sample at 95 feet. Boring was terminated due to caving soils in this zone.
80												
	Silty CLAY with Sand (CL-ML): gray, wet, very stiff		BC=4 9 15	18"	CL-ML				78	27	7	
	Sandy SILT (ML): gray, wet, medium dense				ML				52			
85												
90												
	Lean CLAY (CL): medium plasticity, gray, moist, stiff											
95			BC=1 5 7	12"	CL				87	32	14	
100												

The boring was terminated at approximately 96.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 20, 2016.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
See the companion CPT for detailed soil stratification

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PROJECT NO.: 20170041	BORING LOG B2016-5	APPENDIX	
DRAWN BY: MDM			
CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	B-14	
DATE: 7/1/2016			
REVISED: -		PAGE: 3 of 3	

Cone Penetration Test Summary and

Standard Cone Penetration Test Plots

Job No:	16-52046
Client:	Kleinfelder
Project:	SLC Landfill
Start Date:	09-May-2016
End Date:	09-May-2016

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft.)	Final Depth (ft.)	Latitude[2]	Longitude	Elevation[3] (ft.)	Refer to Notation Number
CPT 2016-01	16-52046_SP01	09-May-2016	458:T1500: F15:U500	7.0	50.03	40.745393	-112.049103	4231	
CPT 2016-02	16-52046_SP02	09-May-2016	458:T1500: F15:U500	7.8	50.03	40.747075	-112.034196	4243	
CPT 2016-03	16-52046_SP03	09-May-2016	458:T1500: F15:U500	14.6	60.04	40.750351	-112.043009	4251	
CPT 2016-04	16-52046_SP04	09-May-2016	458:T1500: F15:U500	8.3	50.03	40.740657	-112.042720	4235	
CPT 2016-05	16-52046_SP05	09-May-2016	458:T1500: F15:U500	13.1	150.10	40.750089	-112.035654	4253	

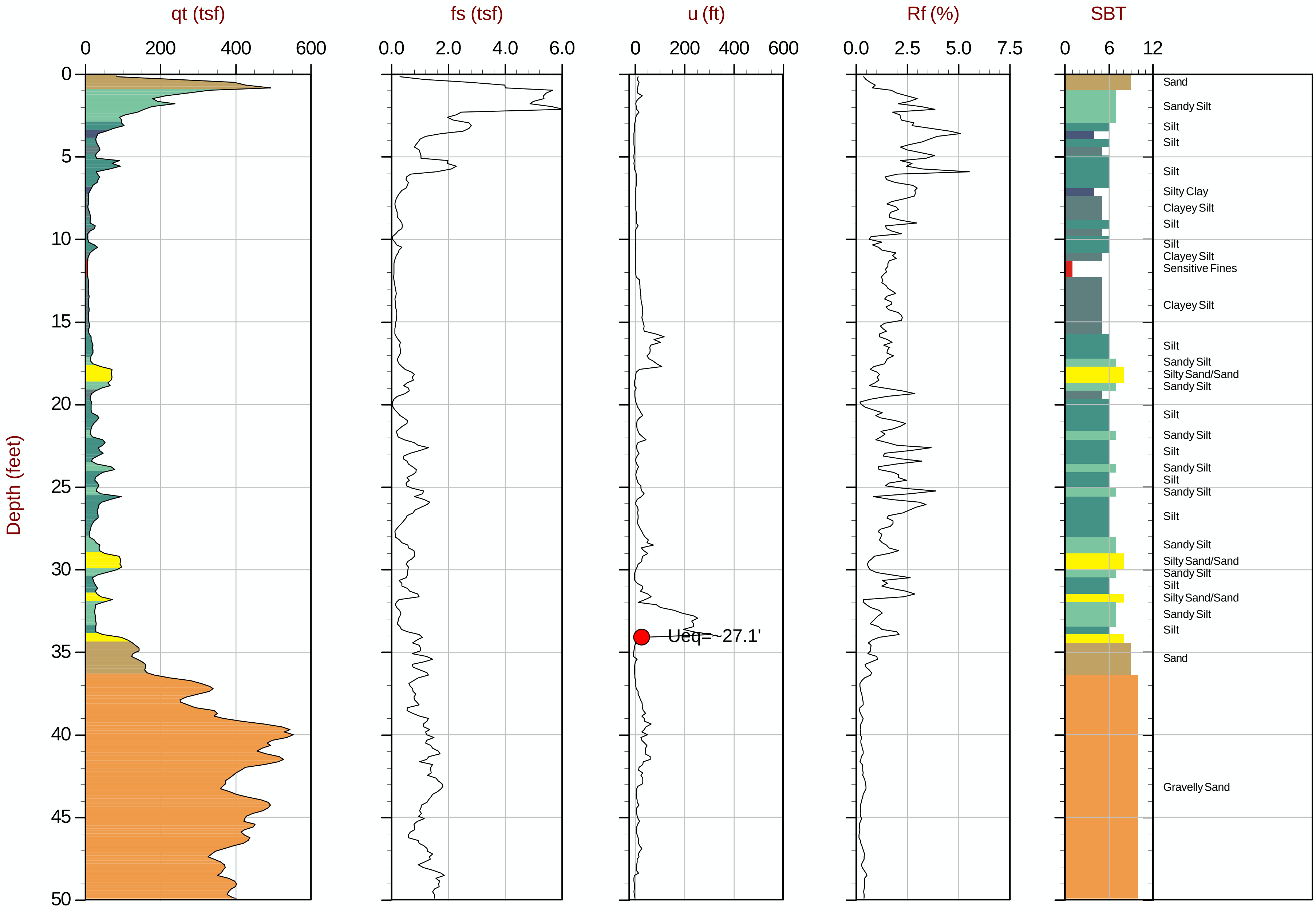
1. The assumed phreatic surface used in the CPT interpretations are based on the results of the shallowest pore pressure dissipation test performed within or nearest to the sounding.
2. The coordinates are based on the WGS84 Datum and have an accuracy of ±30 feet.
3. Elevations are referenced to the ground surface and are derived from the Google Earth Elevation for the recorded coordinates.

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 09:40
Site: SLC Landfill

Sounding: CPT 2016-01
Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP01.COR
Unit Wt: SBT Zones

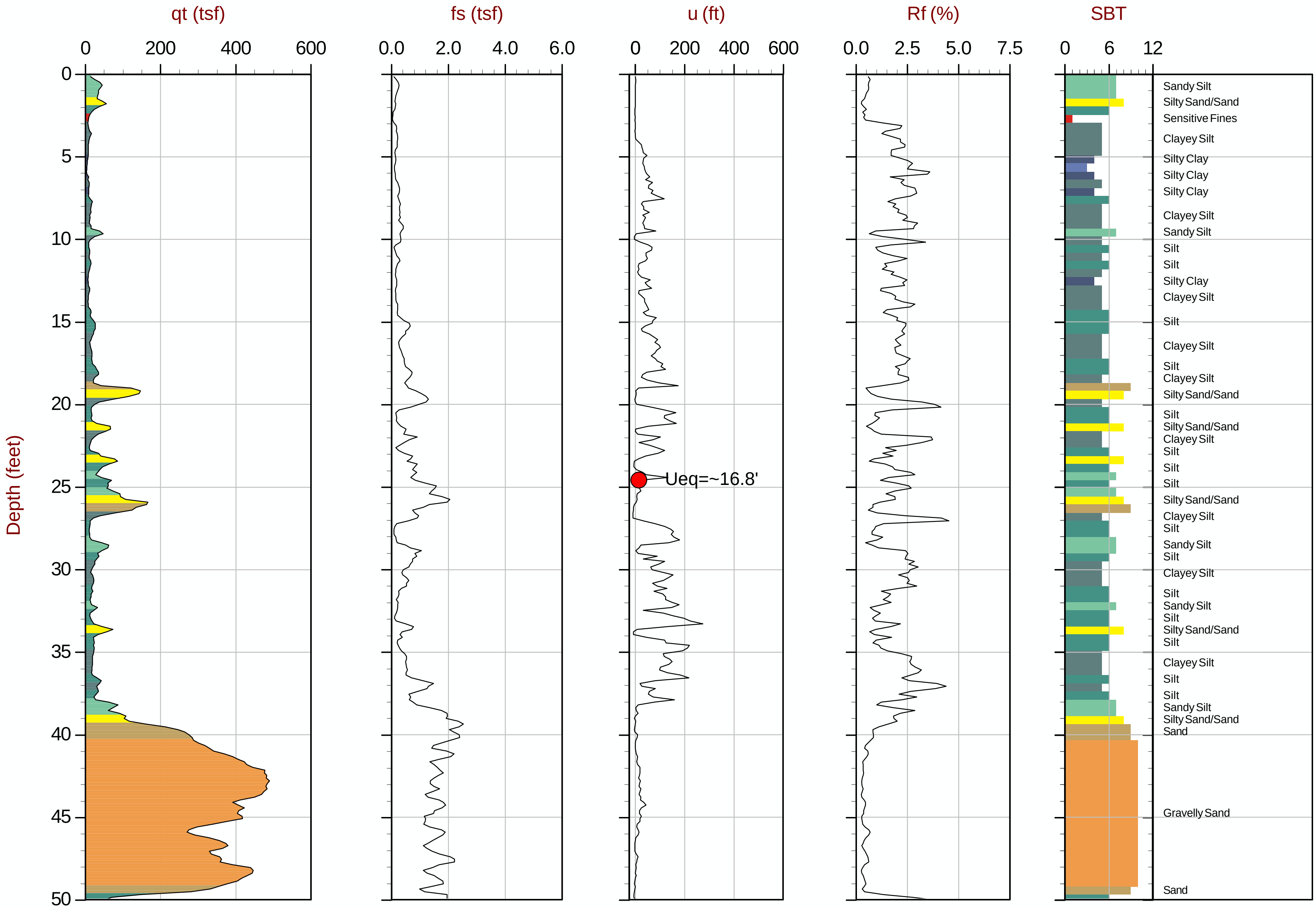
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.745393 Long: -112.049103
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 10:51
Site: SLC Landfill

Sounding: CPT 2016-02
Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP02.COR
Unit Wt: SBT Zones

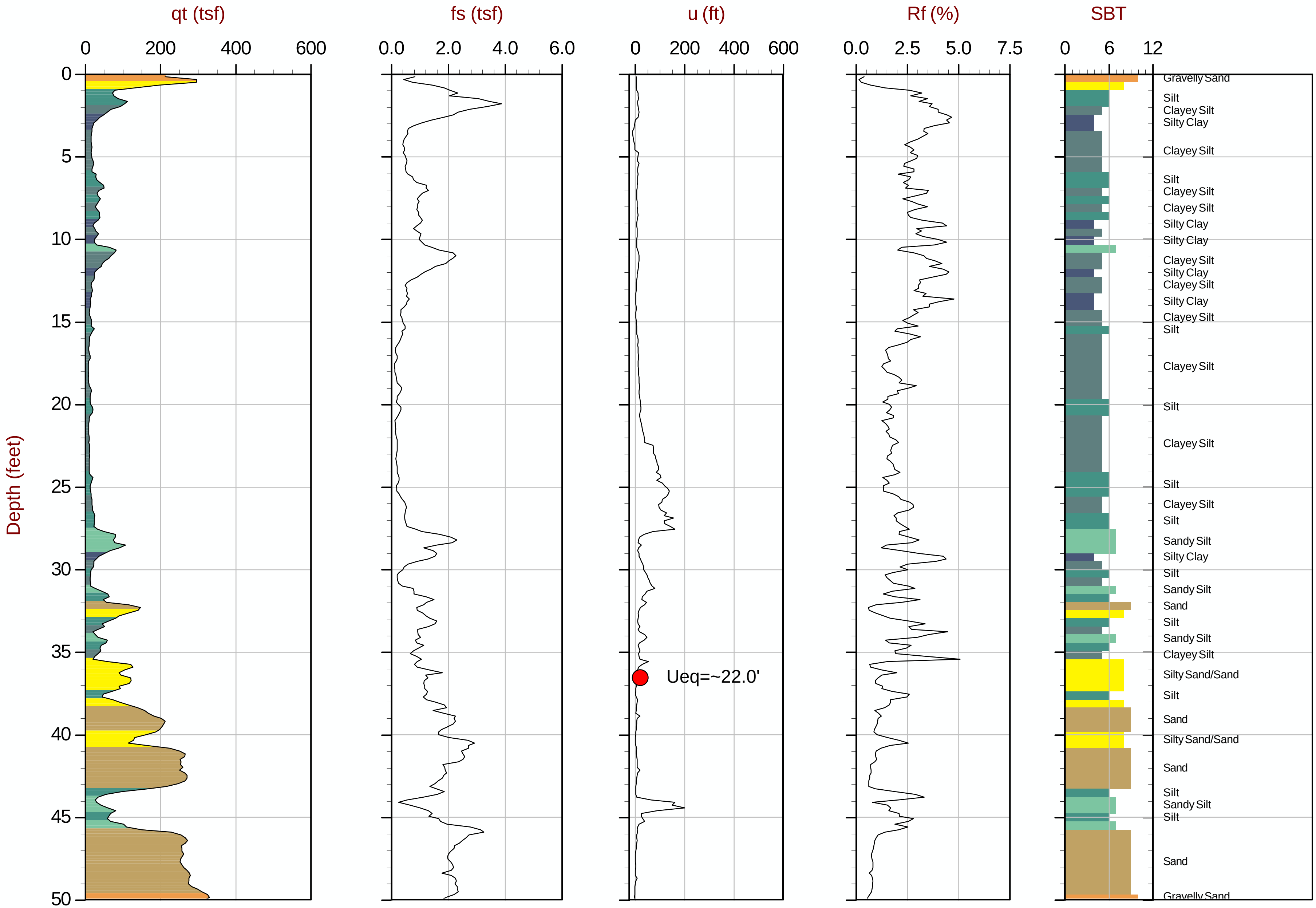
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.747075 Long: -112.034196
● Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 14:24
Site: SLC Landfill

Sounding: CPT 2016-03
Cone: 458:T1500F15U500



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP03.COR
Unit Wt: SBT Zones

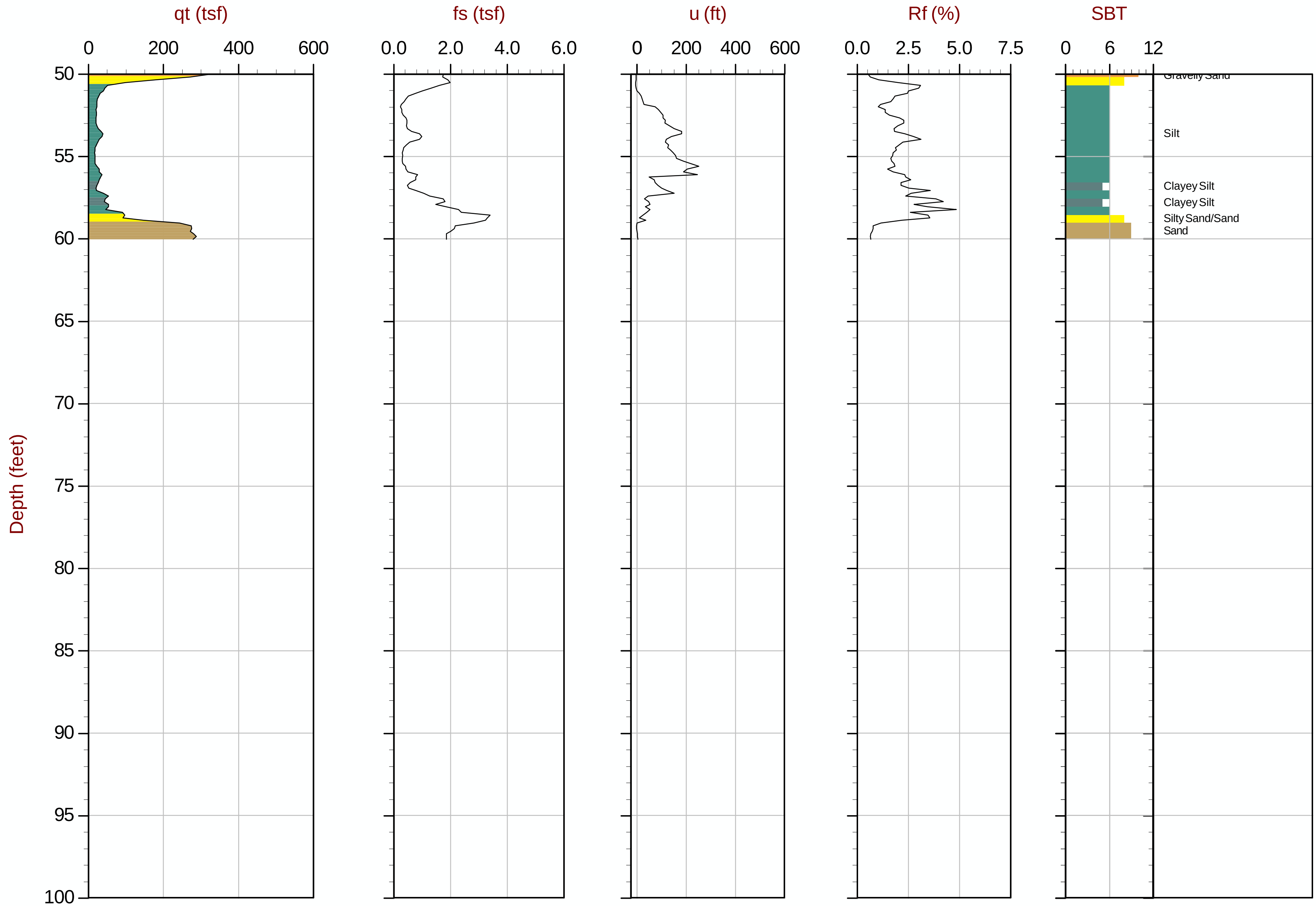
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750351 Long: -112.043009
● Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 14:24
Site: SLC Landfill

Sounding: CPT 2016-03
Cone: 458:T1500F15U500



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP03.COR
Unit Wt: SBT Zones

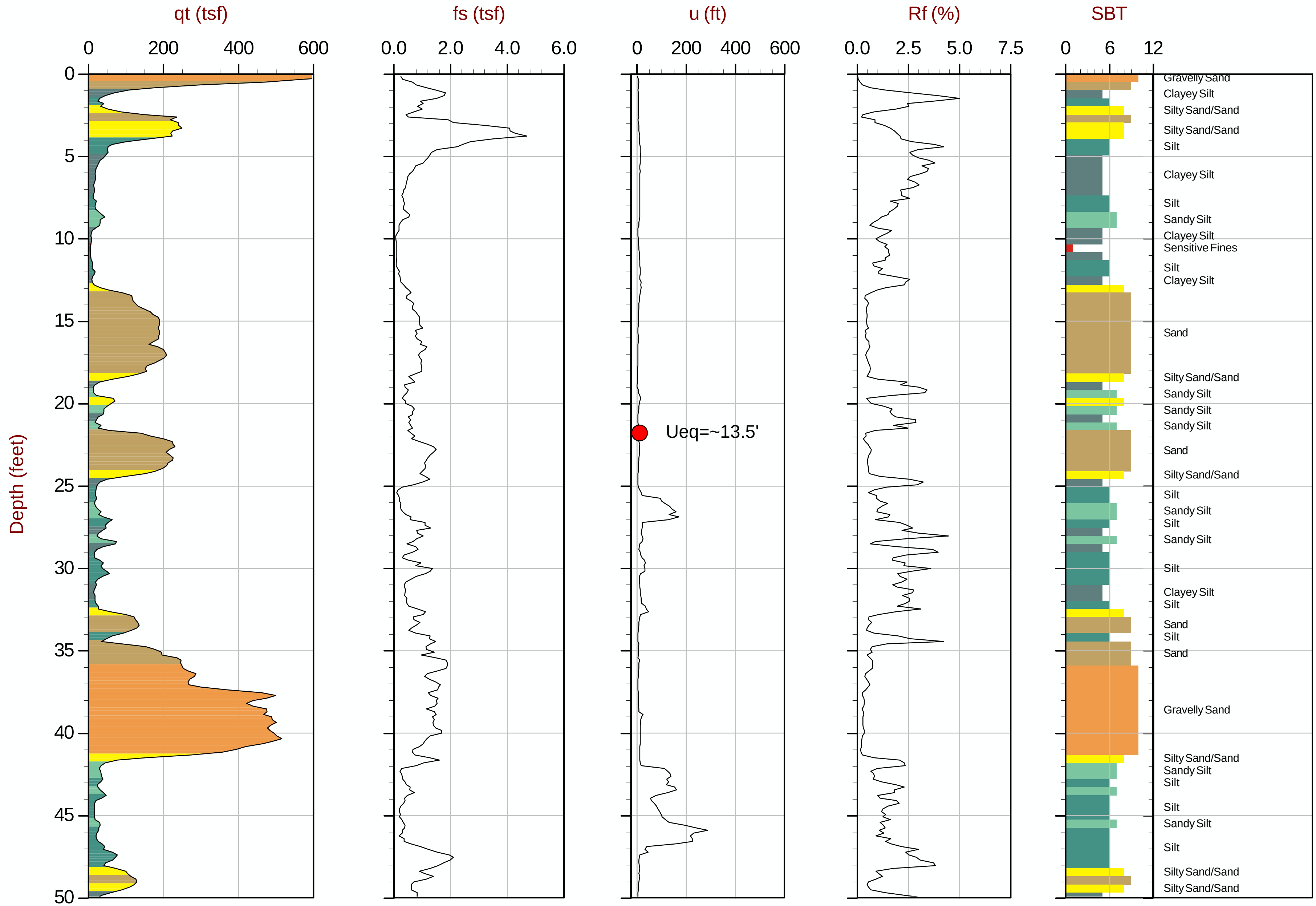
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750351 Long: -112.043009
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 08:19
Site: SLC Landfill

Sounding: CPT 2016-04
Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP04.COR
Unit Wt: SBT Zones

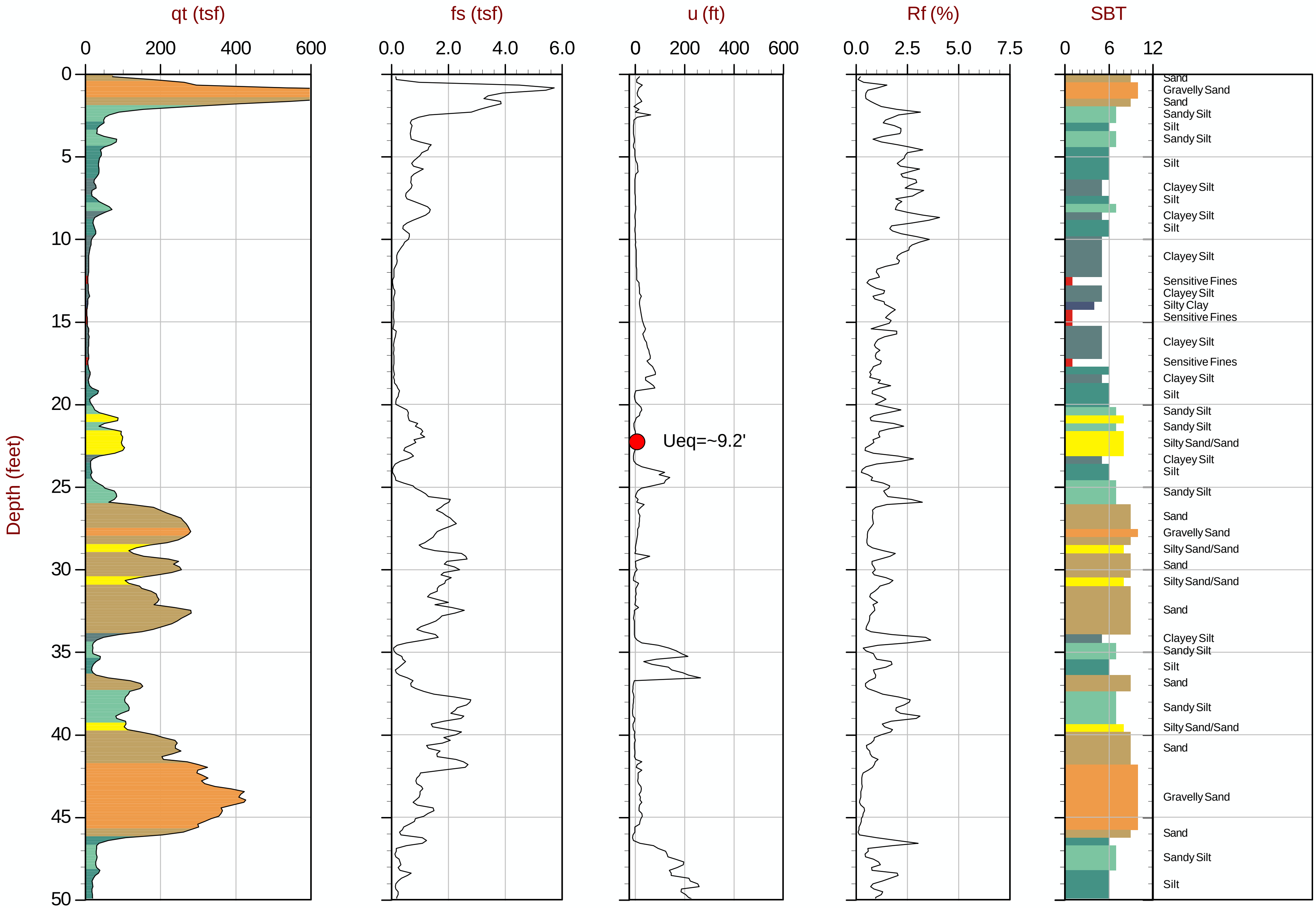
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.740657 Long: -112.042720
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

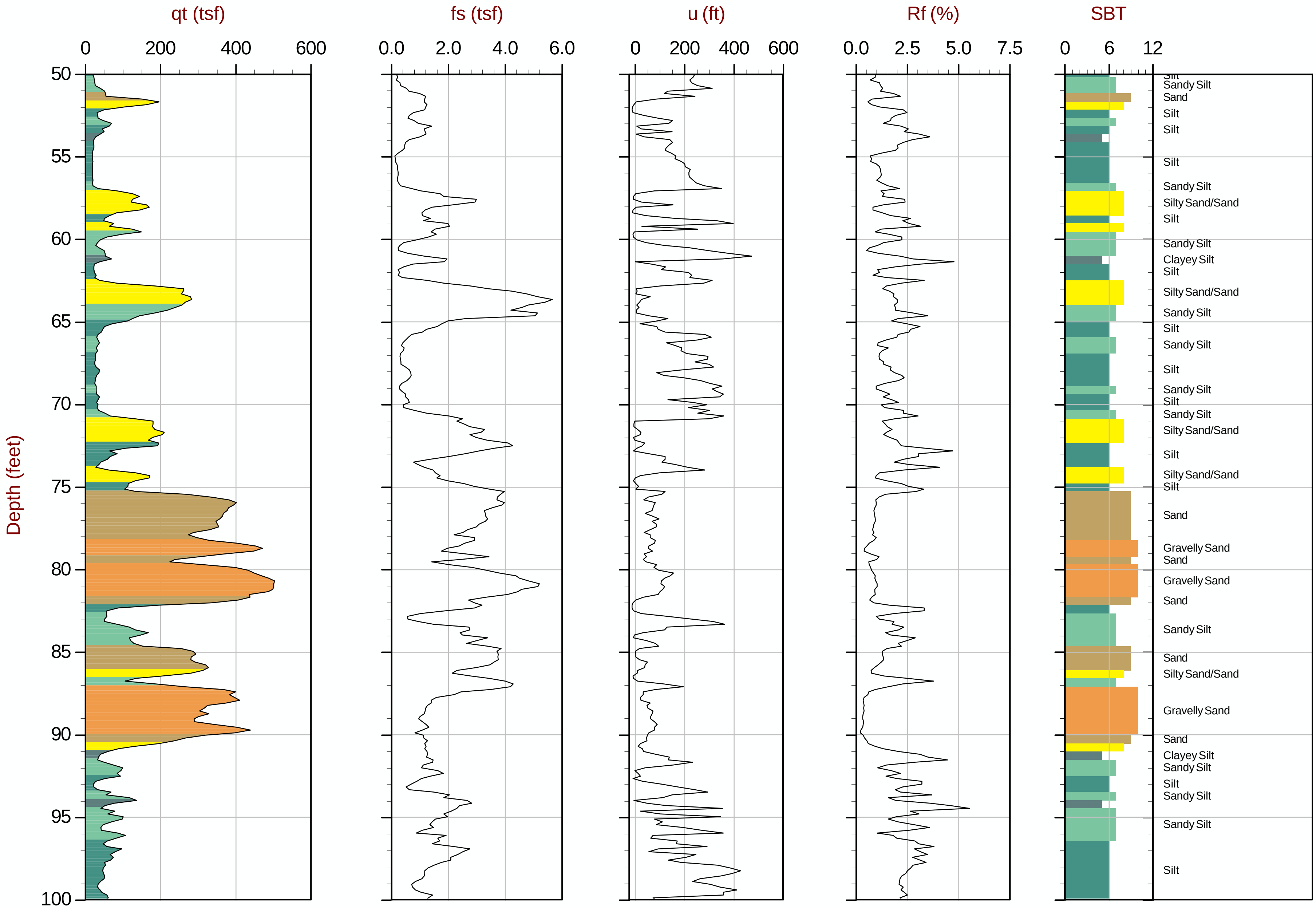
File: 16-52046_SP05.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP05.COR
Unit Wt: SBT Zones

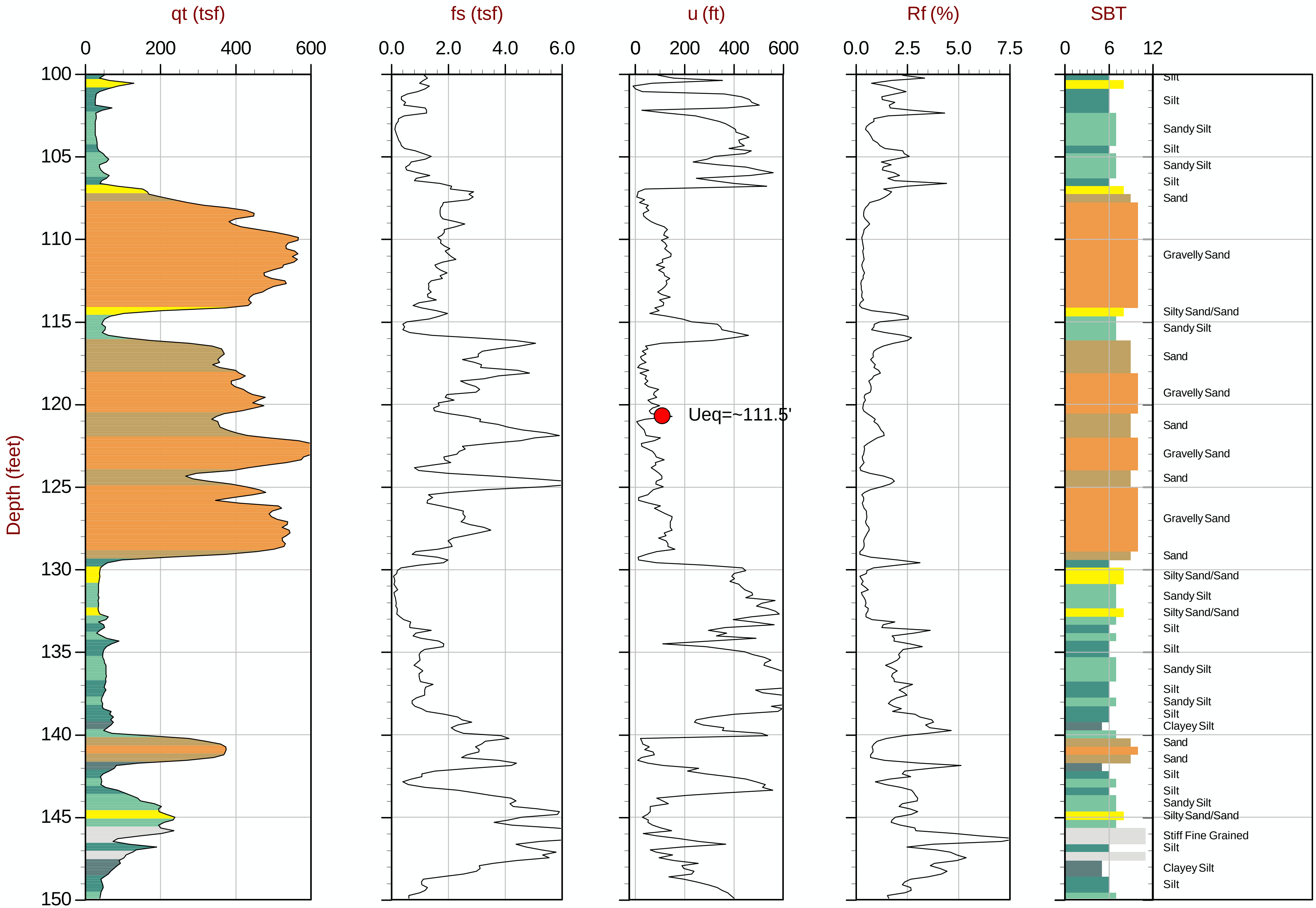
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP05.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

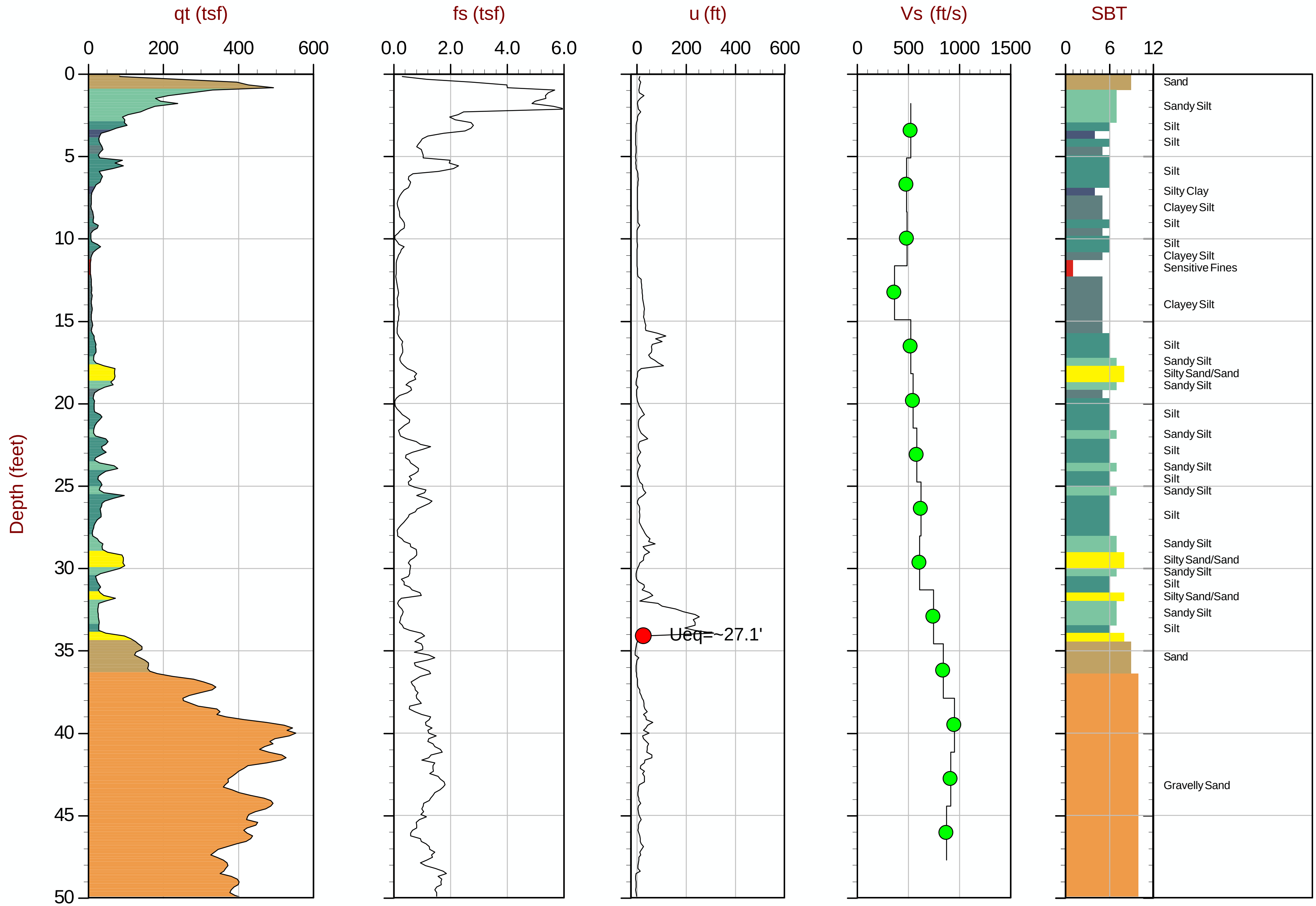
Seismic Cone Penetration Test Plots

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 09:40
Site: SLC Landfill

Sounding: CPT 2016-01
Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP01.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.745393 Long: -112.049103
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

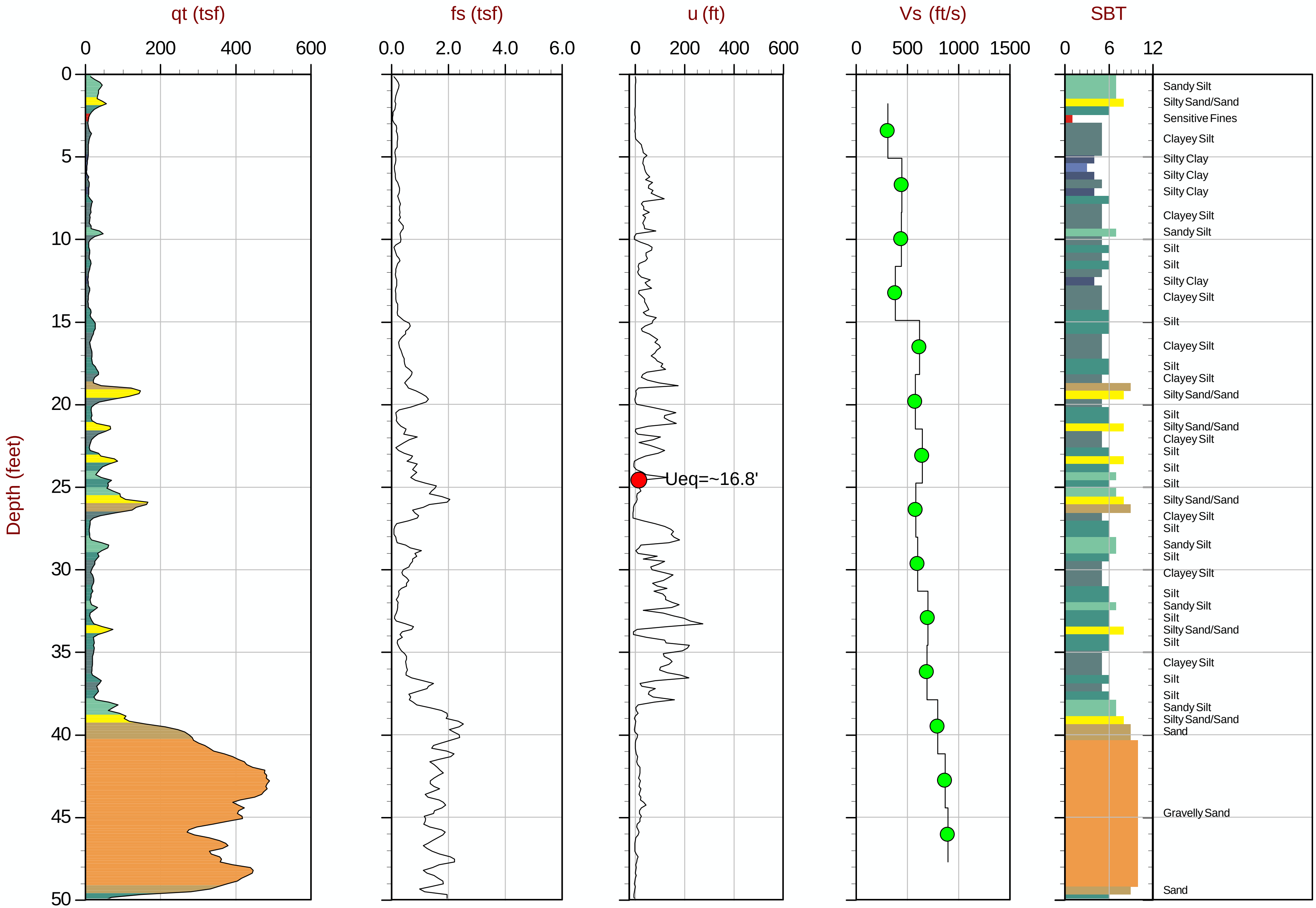
Job No: 16-52046

Date: 05:09:16 10:51

Site: SLC Landfill

Sounding: CPT 2016-02

Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft

Depth Inc: 0.050 m / 0.164 ft

Avg Int: 0.150 m

File: 16-52046_SP02.COR

Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986

Coords: Lat: 40.747075 Long: -112.034196

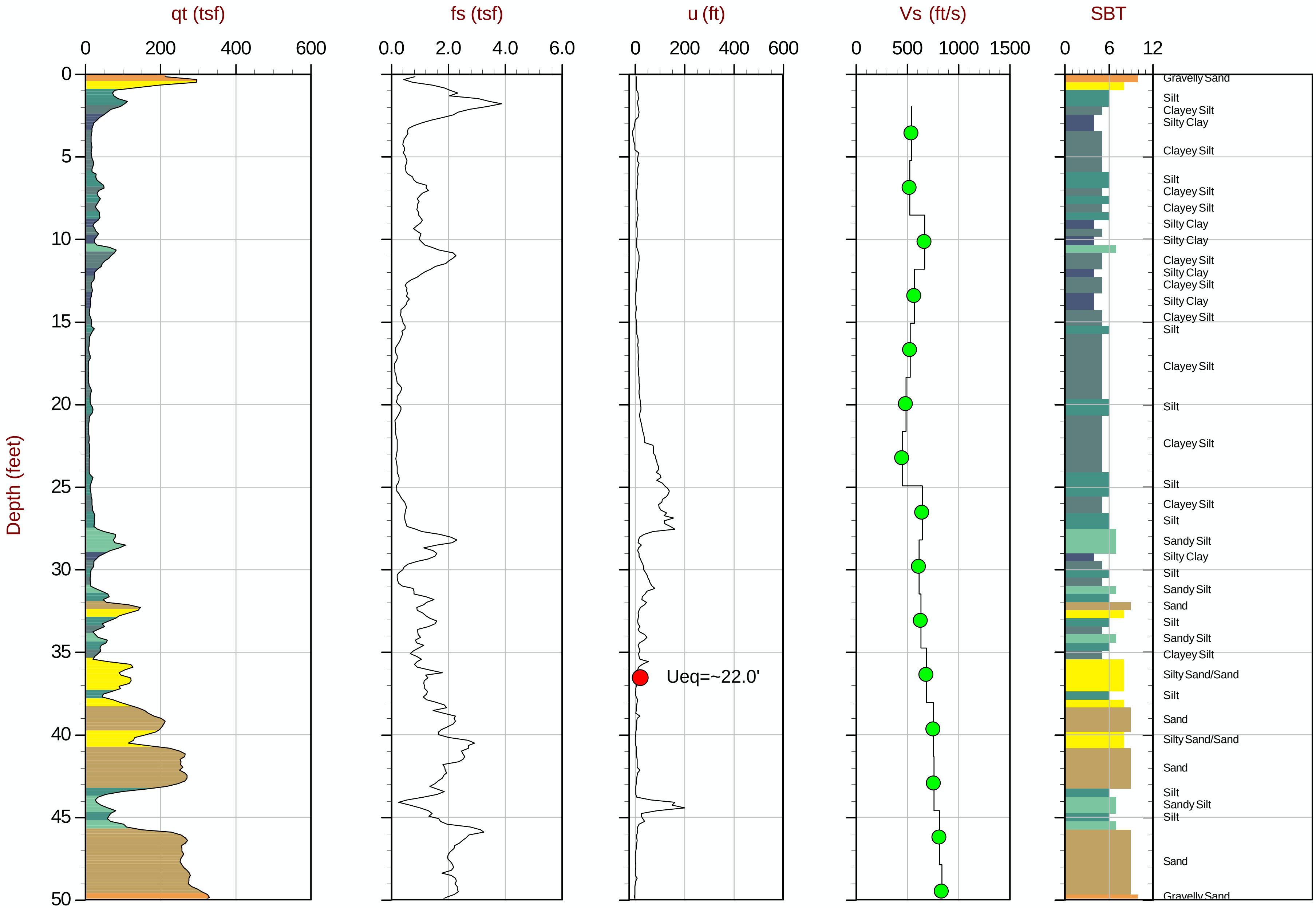
Equilibrium Pore Pressure from Dissipation

ConeTec

Kleinfelder

Job No: 16-52046
Date: 05:09:16 14:24
Site: SLC Landfill

Sounding: CPT 2016-03
Cone: 458:T1500F15U500



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP03.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750351 Long: -112.043009
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

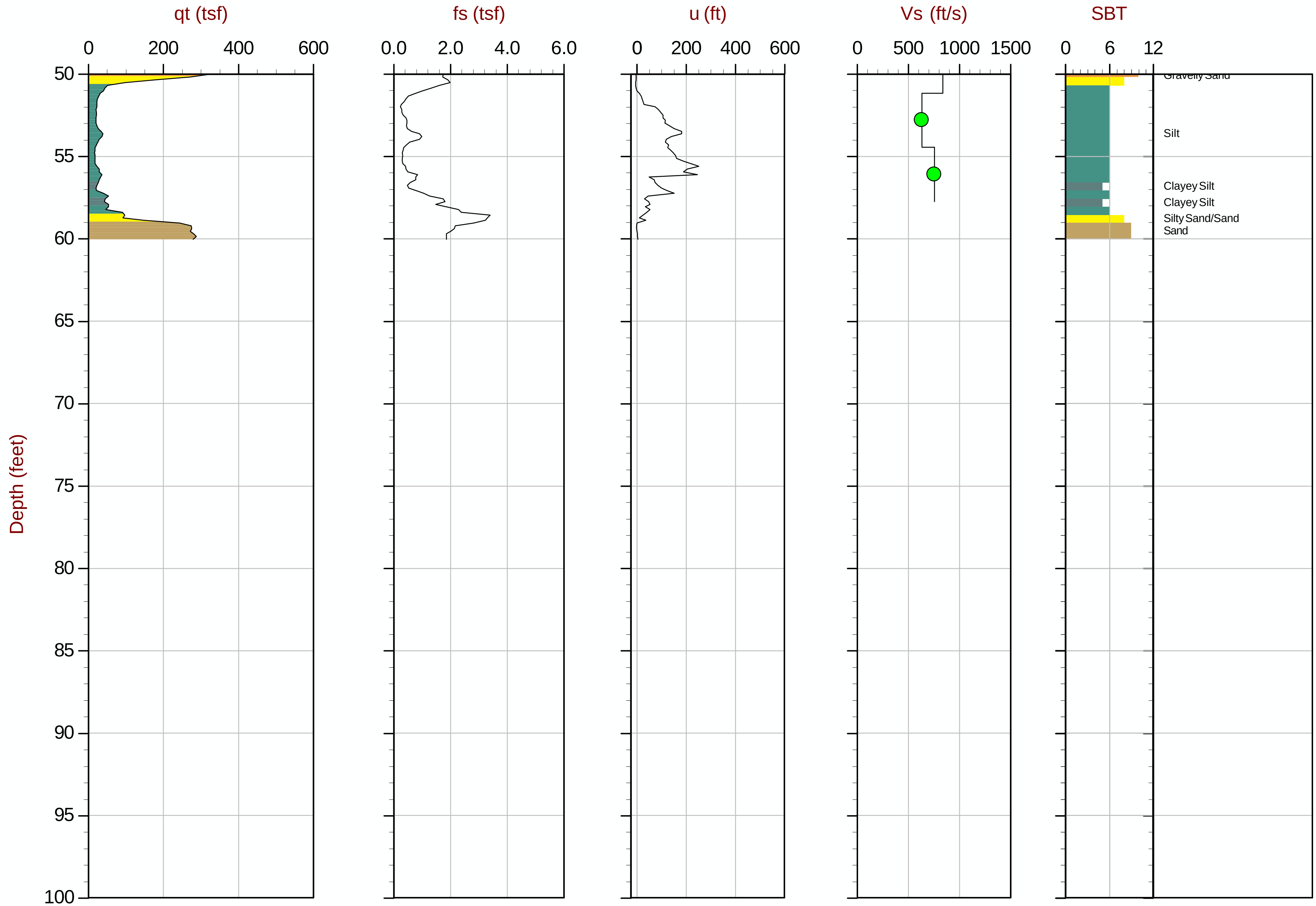
Job No: 16-52046

Date: 05:09:16 14:24

Site: SLC Landfill

Sounding: CPT 2016-03

Cone: 458:T1500F15U500



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP03.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750351 Long: -112.043009

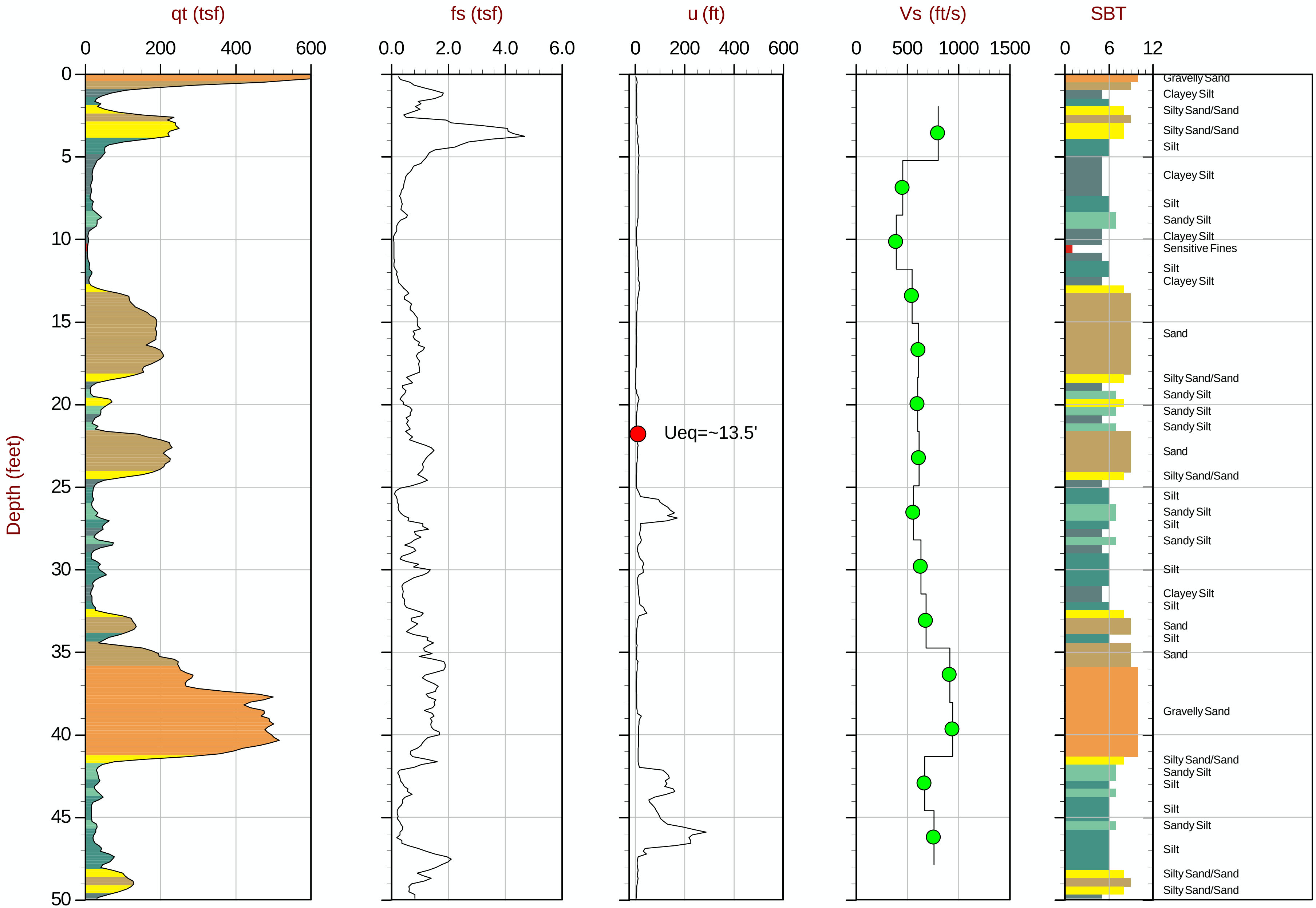
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 08:19
Site: SLC Landfill

Sounding: CPT 2016-04
Cone: 458:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP04.COR
Unit Wt: SBT Zones

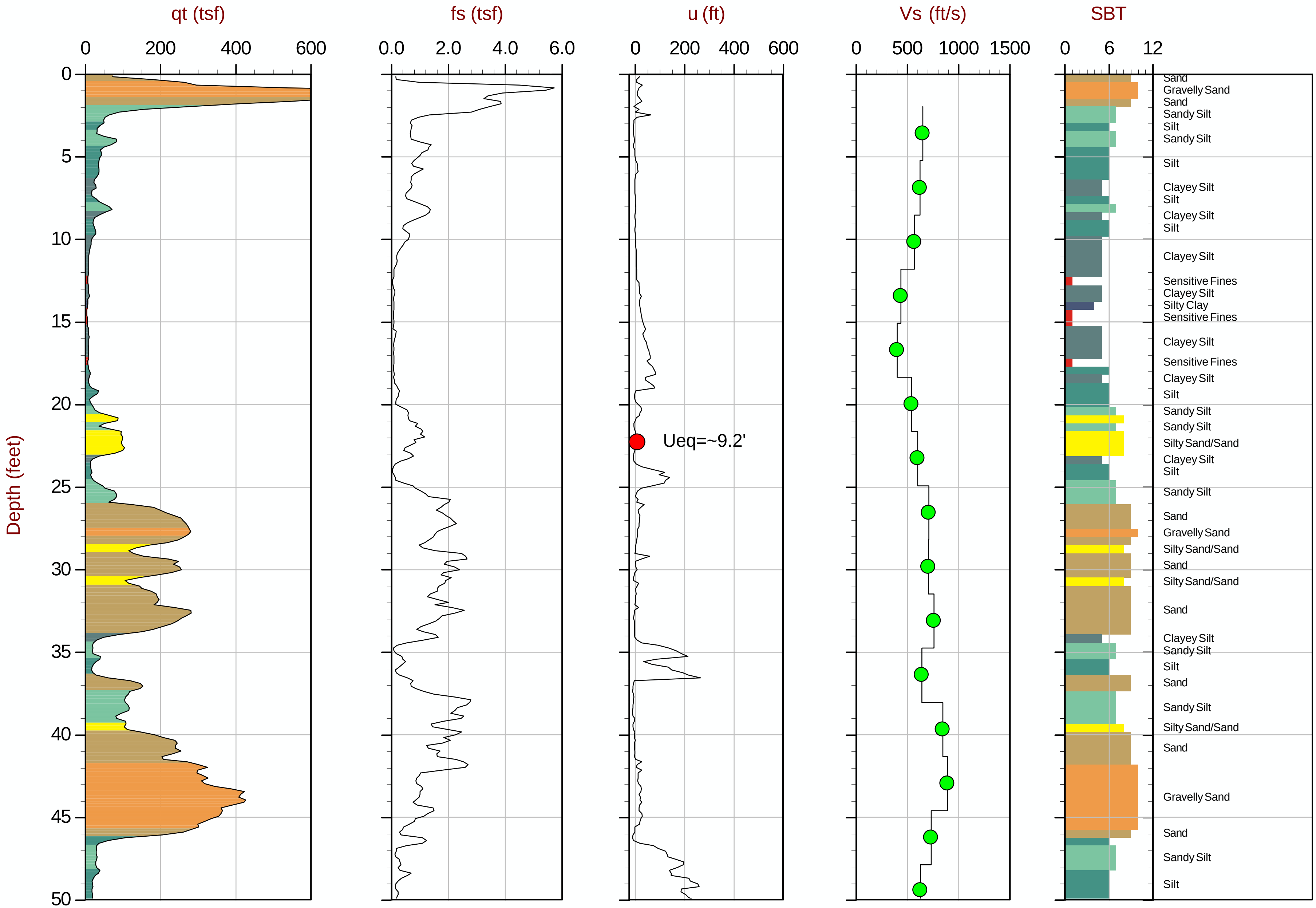
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.740657 Long: -112.042720
● Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP05.COR
Unit Wt: SBT Zones

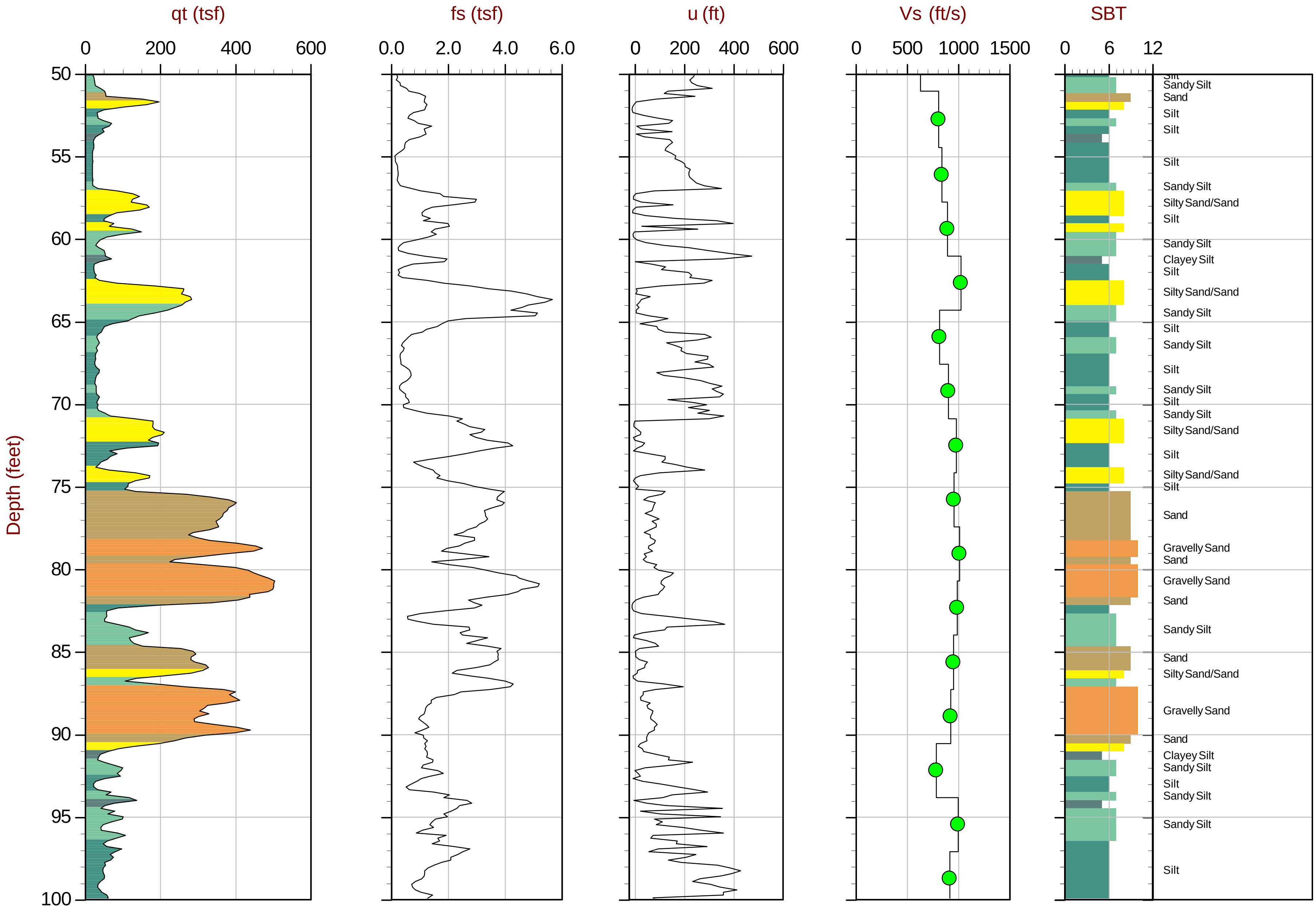
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP05.COR
Unit Wt: SBT Zones

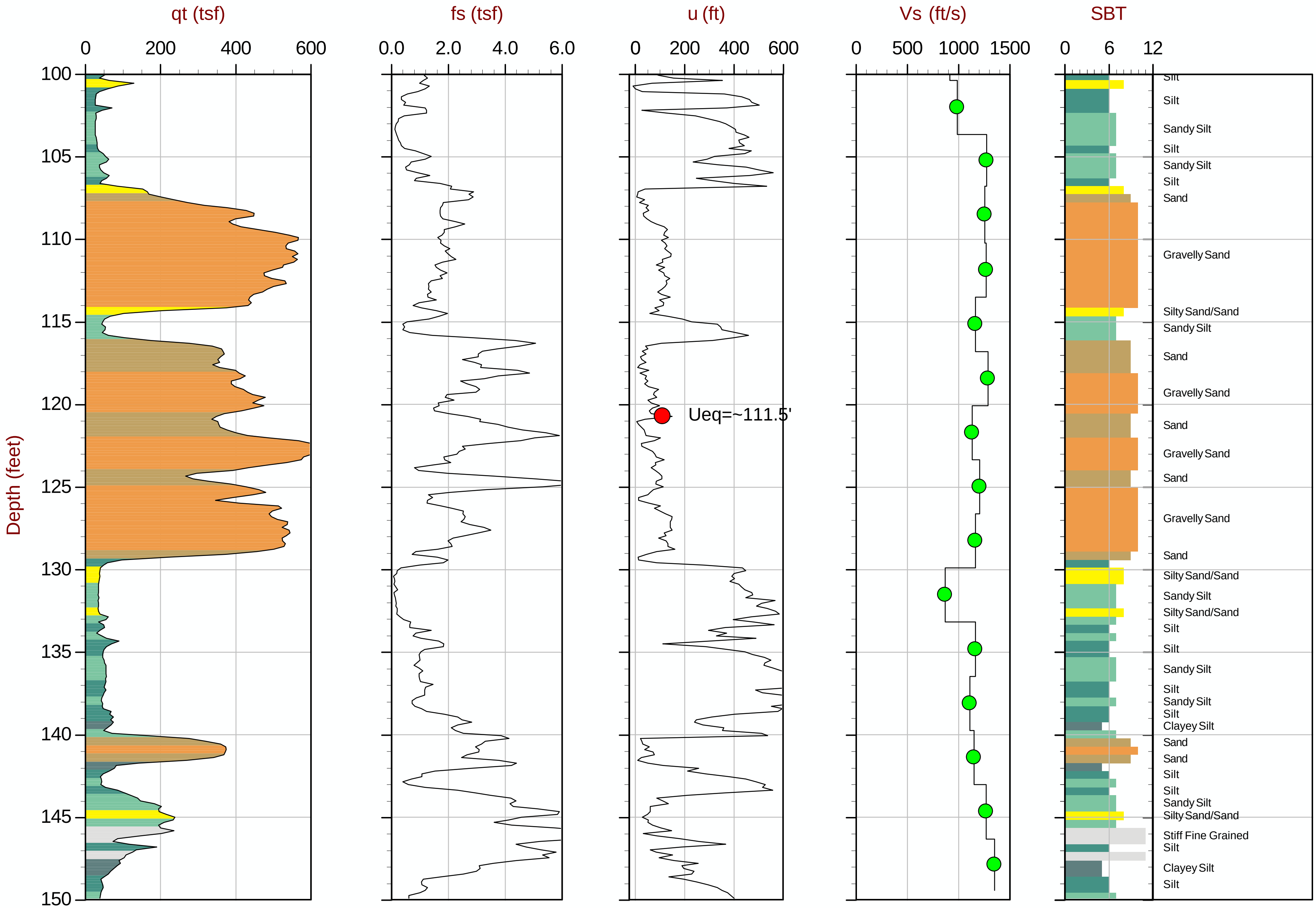
SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

ConeTec

Kleinfelder

Job No: 16-52046
Date: 05:09:16 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500



Max Depth: 45.750 m / 150.10 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 16-52046_SP05.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 40.750089 Long: -112.035654
Equilibrium Pore Pressure from Dissipation

Seismic Cone Penetration Test Tabular Results

CONETEC

Job No: 16-52046
Client: Kleinfelder
Project: SLC Landfill
Sounding ID: CPT 2016-01
Date: 09-May-2016

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.46	1.80	2.35			
5.74	5.09	5.30	2.96	5.63	525
9.02	8.37	8.50	3.20	6.58	486
12.30	11.65	11.74	3.24	6.62	490
15.58	14.93	15.00	3.26	8.93	365
18.86	18.21	18.27	3.27	6.23	524
22.15	21.49	21.54	3.27	5.96	549
25.43	24.77	24.82	3.27	5.62	582
28.71	28.05	28.09	3.28	5.26	623
31.99	31.33	31.37	3.28	5.36	611
35.27	34.61	34.65	3.28	4.39	746
38.55	37.89	37.92	3.28	3.89	843
41.83	41.17	41.20	3.28	3.45	950
45.11	44.46	44.48	3.28	3.57	918
48.39	47.74	47.76	3.28	3.75	873

Job No:	16-52046	
Client:	Kleinfelder	
Project:	SLC Landfill	
Sounding ID:	CPT 2016-02	
Date:	09-May-2016	

Seismic Source:	Beam
Source Offset (ft):	1.50
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.46	1.80	2.35			
5.74	5.09	5.30	2.96	9.50	311
9.02	8.37	8.50	3.20	7.13	449
12.30	11.65	11.74	3.24	7.28	445
15.58	14.93	15.00	3.26	8.47	385
18.86	18.21	18.27	3.27	5.25	622
22.15	21.49	21.54	3.27	5.63	581
25.43	24.77	24.82	3.27	5.05	648
28.71	28.05	28.09	3.28	5.59	586
31.99	31.33	31.37	3.28	5.46	601
35.27	34.61	34.65	3.28	4.67	702
38.55	37.89	37.92	3.28	4.73	694
41.83	41.17	41.20	3.28	4.11	797
45.11	44.46	44.48	3.28	3.76	871
48.39	47.74	47.76	3.28	3.65	899

Job No: 16-52046
Client: Kleinfelder
Project: SLC Landfill
Sounding ID: CPT 2016-03
Date: 09-May-2016

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.62	1.97	2.47			
5.91	5.25	5.46	2.98	5.51	541
9.19	8.53	8.66	3.20	6.11	524
12.47	11.81	11.91	3.24	4.85	669
15.75	15.09	15.17	3.26	5.72	570
19.03	18.37	18.43	3.27	6.17	529
22.31	21.65	21.71	3.27	6.70	488
25.59	24.93	24.98	3.27	7.24	452
28.87	28.22	28.26	3.28	5.07	647
32.15	31.50	31.53	3.28	5.31	617
35.43	34.78	34.81	3.28	5.16	635
38.71	38.06	38.09	3.28	4.75	690
41.99	41.34	41.37	3.28	4.33	757
45.28	44.62	44.64	3.28	4.30	763
48.56	47.90	47.92	3.28	4.02	816
51.84	51.18	51.20	3.28	3.91	838
55.12	54.46	54.48	3.28	5.17	634
58.40	57.74	57.76	3.28	4.33	757

CONETEC

Job No: 16-52046
Client: Kleinfelder
Project: SLC Landfill
Sounding ID: CPT 2016-04
Date: 09-May-2016

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.62	1.97	2.47			
5.91	5.25	5.46	2.98	3.72	803
9.19	8.53	8.66	3.20	6.99	458
12.47	11.81	11.91	3.24	8.21	395
15.75	15.09	15.17	3.26	5.94	549
19.03	18.37	18.43	3.27	5.36	610
22.31	21.65	21.71	3.27	5.42	604
25.59	24.93	24.98	3.27	5.33	614
28.87	28.22	28.26	3.28	5.83	561
32.15	31.50	31.53	3.28	5.16	635
35.43	34.78	34.81	3.28	4.79	684
38.71	38.06	38.09	3.28	3.58	916
41.99	41.34	41.37	3.28	3.47	945
45.28	44.62	44.64	3.28	4.90	670
48.56	47.90	47.92	3.28	4.30	762

Job No: 16-52046
Client: Kleinfelder
Project: SLC Landfill
Sounding ID: CPT 2016-05
Date: 09-May-2016

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.62	1.97	2.47			
5.91	5.25	5.46	2.98	4.59	650
9.19	8.53	8.66	3.20	5.14	623
12.47	11.81	11.91	3.24	5.69	571
15.75	15.09	15.17	3.26	7.45	438
19.03	18.37	18.43	3.27	8.12	402
22.31	21.65	21.71	3.27	6.03	542
25.59	24.93	24.98	3.27	5.42	604
28.87	28.22	28.26	3.28	4.61	711
32.15	31.50	31.53	3.28	4.64	706
35.43	34.78	34.81	3.28	4.29	763
38.71	38.06	38.09	3.28	5.11	641
41.99	41.34	41.37	3.28	3.86	849
45.28	44.62	44.64	3.28	3.67	894
48.56	47.90	47.92	3.28	4.46	735
51.67	51.02	51.04	3.12	4.95	630
55.12	54.46	54.48	3.44	4.28	805
58.40	57.74	57.76	3.28	3.91	840
61.68	61.02	61.04	3.28	3.68	891
64.96	64.30	64.32	3.28	3.20	1025
68.24	67.58	67.60	3.28	4.02	816
71.52	70.87	70.88	3.28	3.65	900
74.80	74.15	74.16	3.28	3.35	980
78.08	77.43	77.44	3.28	3.42	958
81.36	80.71	80.72	3.28	3.24	1012
84.65	83.99	84.00	3.28	3.31	990
87.93	87.27	87.28	3.28	3.44	953
91.21	90.55	90.56	3.28	3.54	927
94.49	93.83	93.84	3.28	4.18	784
97.77	97.11	97.12	3.28	3.28	999

Job No:	16-52046	
Client:	Kleinfelder	
Project:	SLC Landfill	
Sounding ID:	CPT 2016-05	
Date:	09-May-2016	

Seismic Source:	Beam
Source Offset (ft):	1.50
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
101.05	100.39	100.40	3.28	3.57	918
104.33	103.67	103.69	3.28	3.31	990
107.45	106.79	106.80	3.12	2.45	1274
110.89	110.24	110.25	3.44	2.74	1259
114.17	113.52	113.53	3.28	2.58	1270
117.45	116.80	116.81	3.28	2.82	1164
120.73	120.08	120.09	3.28	2.55	1288
124.02	123.36	123.37	3.28	2.89	1136
127.30	126.64	126.65	3.28	2.72	1207
130.58	129.92	129.93	3.28	2.82	1164
133.86	133.20	133.21	3.28	3.77	870
137.14	136.48	136.49	3.28	2.82	1164
140.42	139.76	139.77	3.28	2.96	1110
143.70	143.04	143.05	3.28	2.85	1150
146.98	146.33	146.33	3.28	2.58	1271
150.10	149.44	149.45	3.12	2.31	1350

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

ConeTec

Job No: 16-52046
Client: Kleinfelder
Project: SLC Landfill
Start Date: 09-May-2016
End Date: 09-May-2016

CPTu PORE PRESSURE DISSIPATION SUMMARY

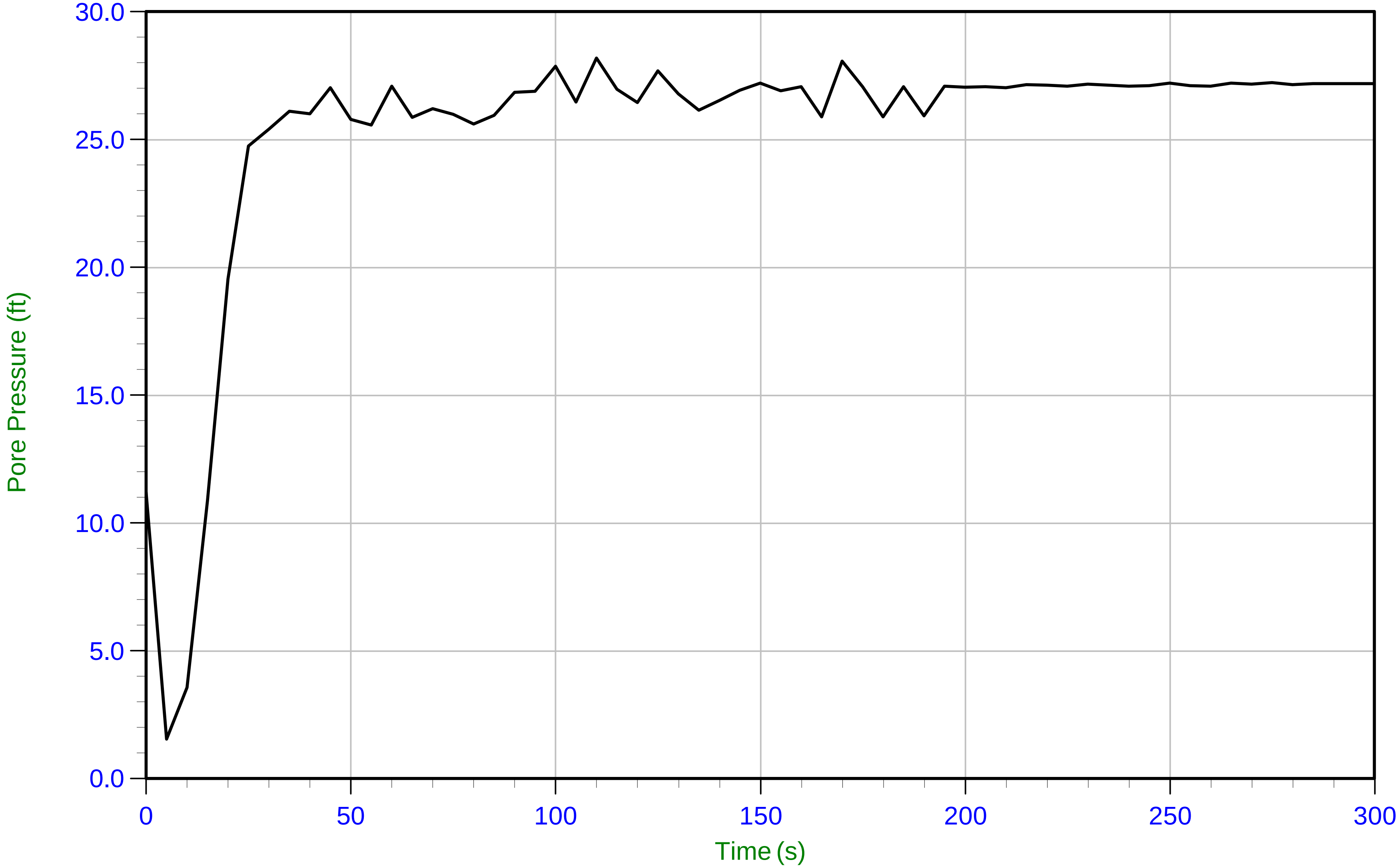
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft.)	Estimated Equilibrium Pore Pressure U_{eq} (ft.)	Calculated Phreatic Surface (ft.)	Refer to Notation Number
CPT 2016-01	16-52046_SP01	15	300	34.12	27.1	7.0	
CPT 2016-02	16-52046_SP02	15	600	24.61	16.8	7.8	
CPT 2016-03	16-52046_SP03	15	300	36.58	22.0	14.5	
CPT 2016-04	16-52046_SP04	15	800	21.82	13.5	8.3	
CPT 2016-05	16-52046_SP05	15	400	22.31	9.2	13.1	
		15	800	120.73	111.5	9.3	

1. Dissipation test stopped by client.

Kleinfelder

Job No: 16-52046
Date: 05/09/2016 09:40
Site: SLC Landfill

Sounding: CPT 2016-01
Cone: 458:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 16-52046_SP01.PPD
Depth: 10.400 m / 34.120 ft
Duration: 300.0 s

U Min: 1.5 ft
U Max: 28.2 ft

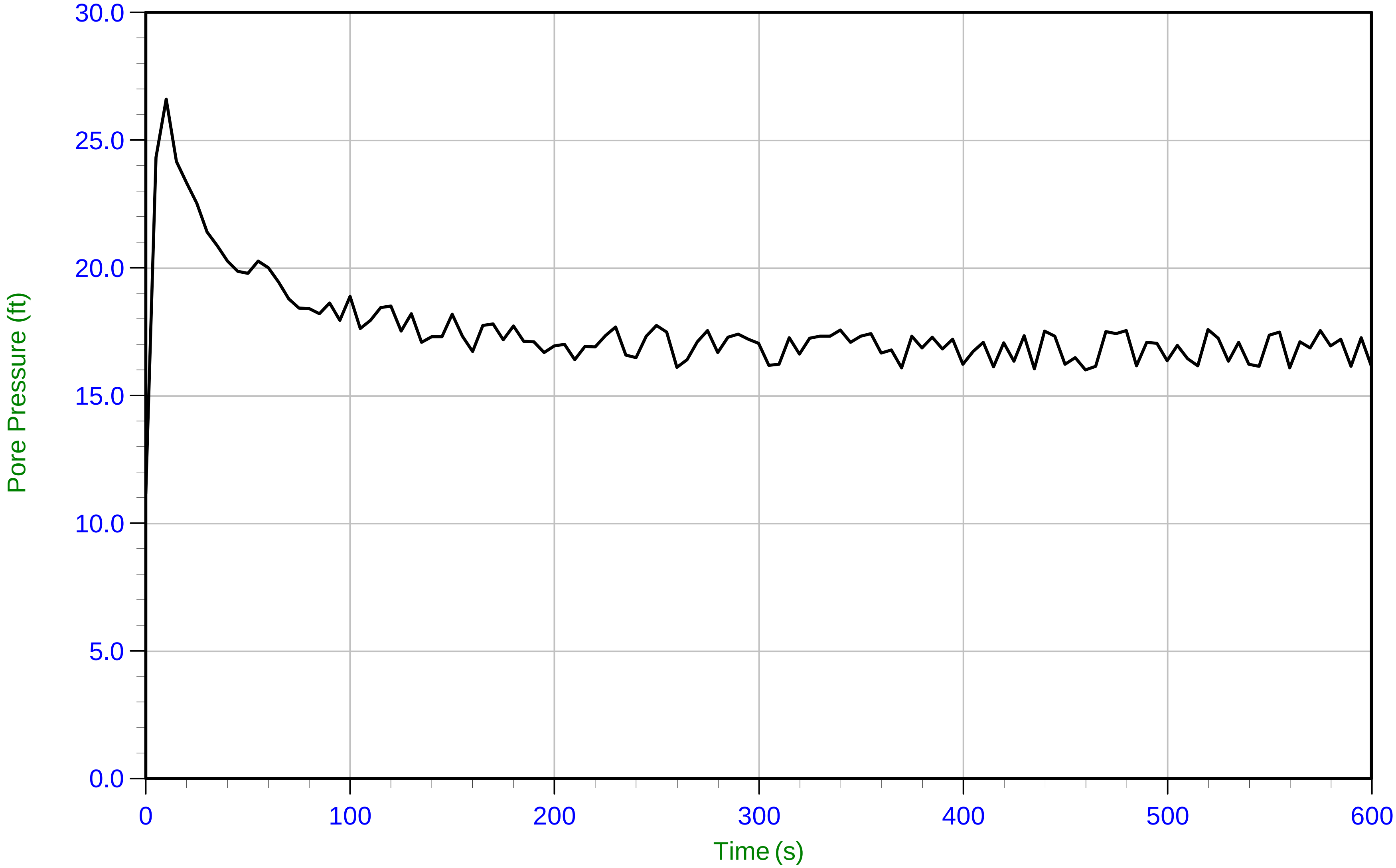
WT: 2.145 m / 7.037 ft
Ueq: 27.1 ft

ConeTec

Kleinfelder

Job No: 16-52046
Date: 05/09/2016 10:51
Site: SLC Landfill

Sounding: CPT 2016-02
Cone: 458:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 16-52046_SP02.PPD
Depth: 7.500 m / 24.606 ft
Duration: 600.0 s

U Min: 11.2 ft
U Max: 26.6 ft

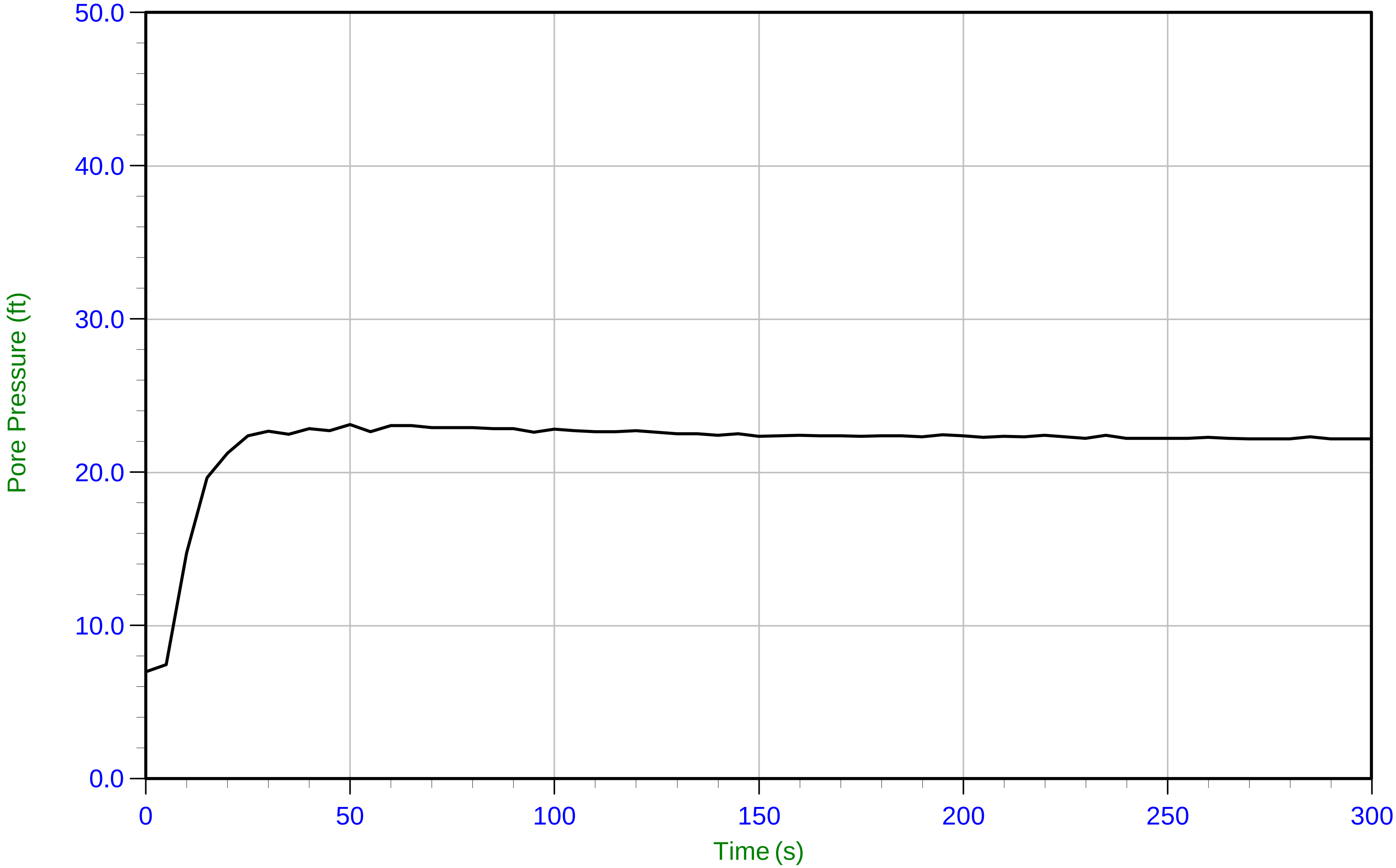
WT: 2.388 m / 7.835 ft
Ueq: 16.8 ft

CONETEC

Kleinfelder

Job No: 16-52046
Date: 05/09/2016 14:24
Site: SLC Landfill

Sounding: CPT 2016-03
Cone: 458:T1500F15U500
Cone Area: 15 sq cm



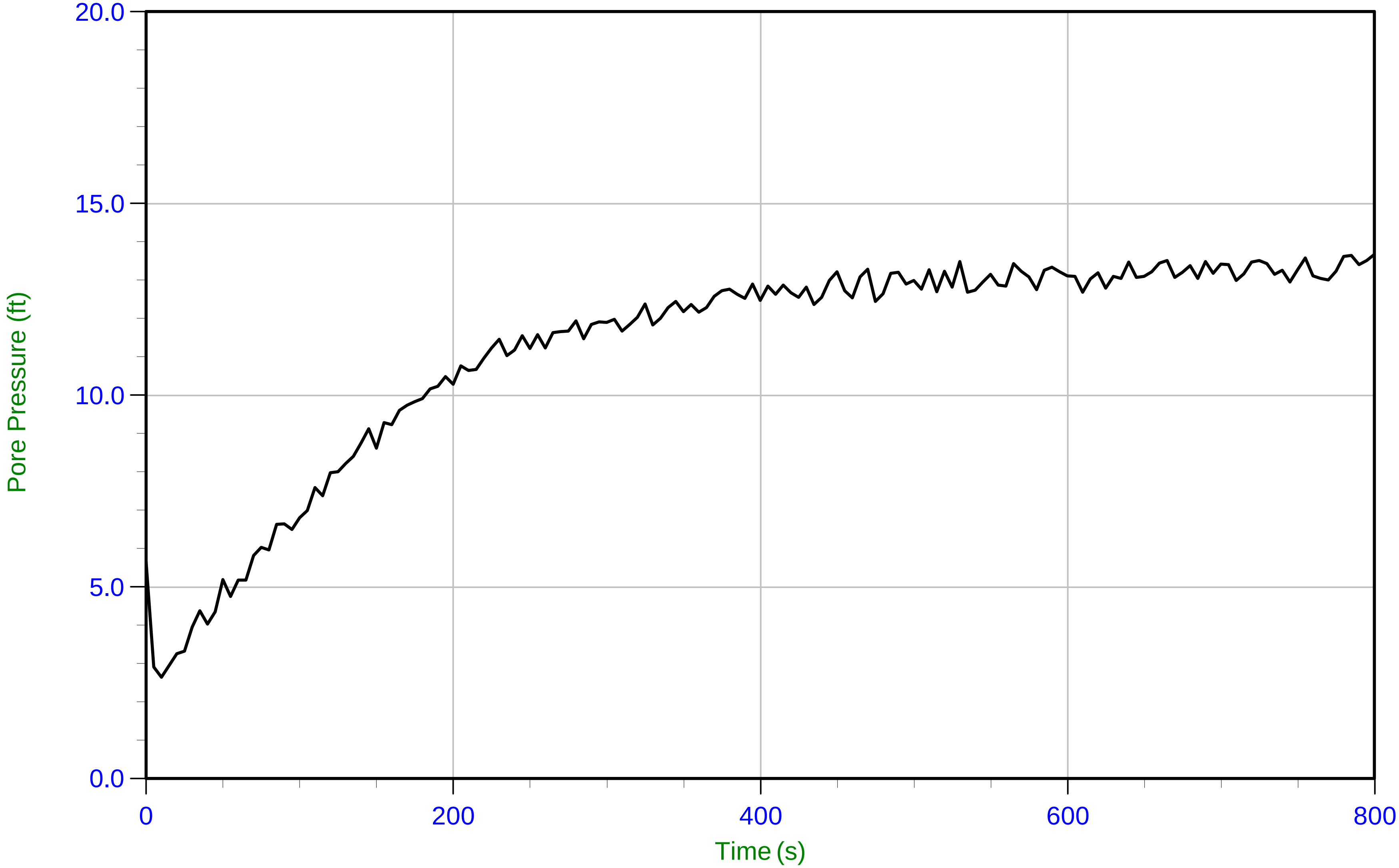
Trace Summary:

Filename: 16-52046_SP03.PPD
Depth: 11.150 m / 36.581 ft
Duration: 300.0 s

U Min: 7.0 ft
U Max: 23.1 ft

WT: 4.430 m / 14.533 ft
Ueq: 22.0 ft

Kleinfelder	Job No: 16-52046	Sounding: CPT 2016-04
	Date: 05/09/2016 08:19	Cone: 458:T1500F15U500
	Site: SLC Landfill	Cone Area: 15 sq cm



Trace Summary:

Filename: 16-52046_SP04.PPD
Depth: 6.650 m / 21.817 ft
Duration: 800.0 s

U Min: 2.6 ft
U Max: 13.7 ft

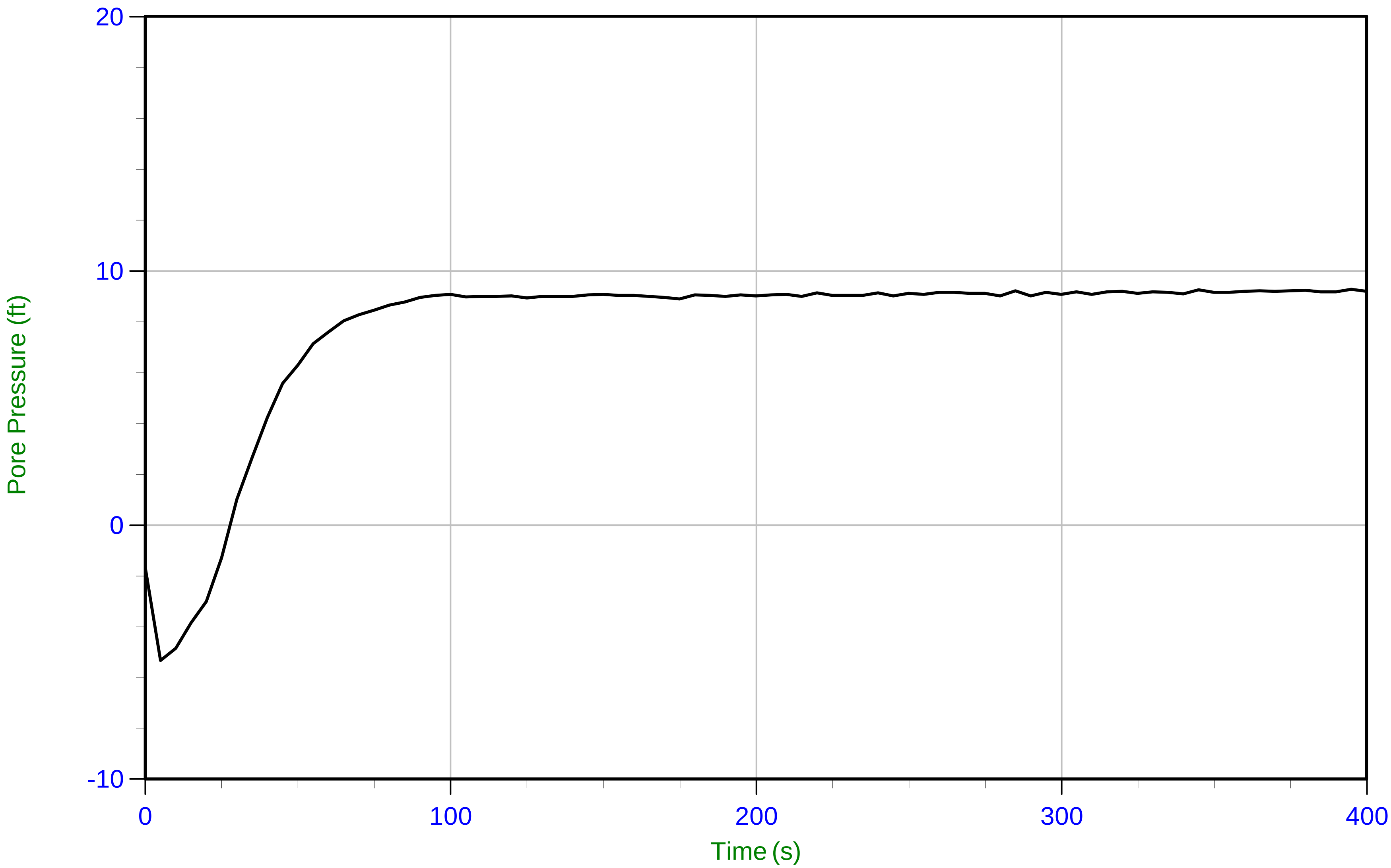
WT: 2.544 m / 8.345 ft
Ueq: 13.5 ft

ConeTec

Kleinfelder

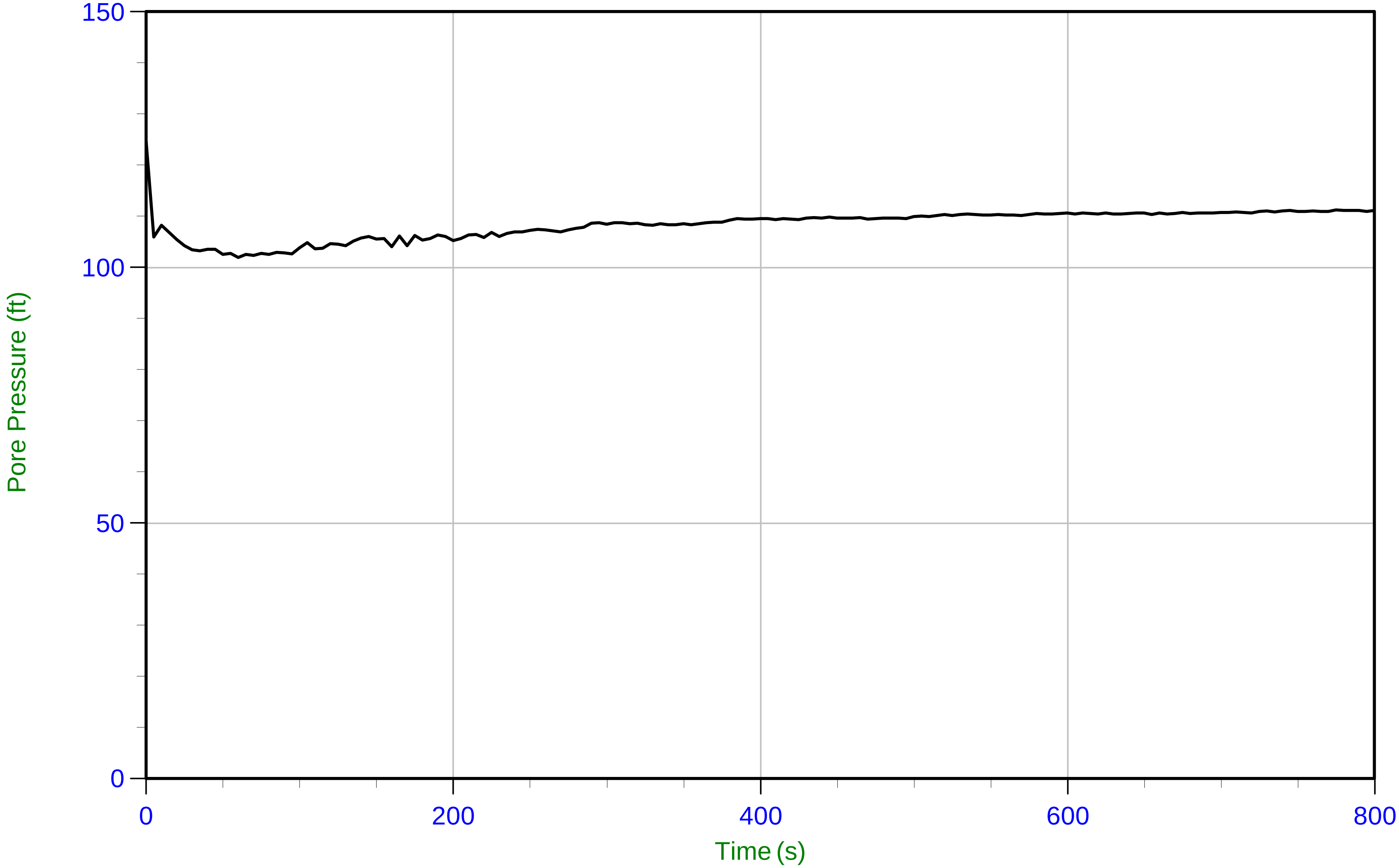
Job No: 16-52046
Date: 05/09/2016 11:55
Site: SLC Landfill

Sounding: CPT 2016-05
Cone: 458:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:	Filename: 16-52046_SP05.PPD	U Min: -5.3 ft	WT: 4.006 m / 13.143 ft
	Depth: 6.800 m / 22.309 ft	U Max: 9.3 ft	Ueq: 9.2 ft
	Duration: 400.0 s		

Kleinfelder	Job No: 16-52046	Sounding: CPT 2016-05
	Date: 05/09/2016 11:55	Cone: 458:T1500F15U500
	Site: SLC Landfill	Cone Area: 15 sq cm



Trace Summary:

Filename: 16-52046_SP05.PPD	U Min: 102.0 ft	WT: 2.827 m / 9.276 ft
Depth: 36.800 m / 120.733 ft	U Max: 124.7 ft	Ueq: 111.5 ft
Duration: 800.0 s		

SAGE EARTH SCIENCE
GEOPHYSICAL SURVEYS

May 13, 2016

RE: IN-SITU SHEAR WAVE VELOCITY TEST – SALT LAKE VALLEY SOLID WASTE FACILITY REV1

Based on the project objective and site conditions, Sage Earth Science conducted two shear wave velocity tests at the Northern Utah site. The objective of the tests is to determine the shear wave velocity in the top 200 feet or to the greatest depth possible of the subsurface

Seismic Velocity Survey

Seismic Surface Waves methods such as MASW (Multichannel Analysis of Surface Waves) and Refraction Microtremor use the dispersive characteristics of surface waves to determine the variation of the seismic shear wave velocity with depth. Velocity data are acquired by analyzing seismic surface waves generated by random sources or by a controlled impulsive source and received by a linear array of geophones.

A dispersion curve is calculated from the data that shows the phase velocity of the surface wave as a function of frequency or wavelength. A shear wave velocity profile (a 1-D sounding of velocity as a function of depth) is then modeled from the dispersion curve and the shear velocity of near surface is calculated.

Both MASW (active) and refraction microtremor data (passive) were acquired. Results to significantly greater depth were achieved using the microtremor passive approach. The results of the refraction microtremor data are presented here.


Figure 1. seismic source – 500 lb

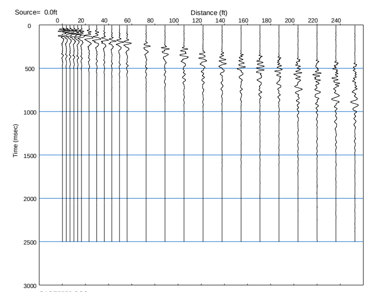


Figure 2. Field record (weight drop)

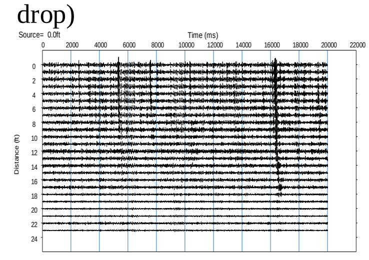


Figure 3. Field record (1 of 40 total 20 second recordings)

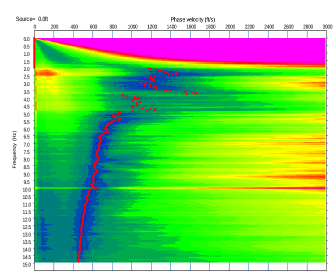


Figure 4 Phase vs. velocity plot

Table 1 Test recording parameters – test date 2016/05/13

Test location	Salt Lake Valley Solid Waste Facility
Recording instrument	Bison 9024
S/N	6-93913
geophone natural period	4.5 Hz.
geophone/station spacing	Variable (3.3-16.4 ft.)
number of channels	24
spread length	252 ft.
sample rate	2 millisecond
number of samples	10,000 per channel
record length	20 seconds
total recording time	8,000 seconds (40-20 sec. records)
low pass filter	120 Hz.
low cut filter	4 Hz.
seismic source	passive, refraction microtremor
source location	NA
Analysis software	SurfSeis™ Geometrics, Inc.

2184 Channing Way, Suite 110, Idaho Falls, ID 83404
telephone: (208)522-5049, Fax: (208)528-6200, email: sageearthscience@yahoo.com
http://www.sageearthscience.com

Figure 5. Test location – B 2016-5 (*scale and location approximate).*

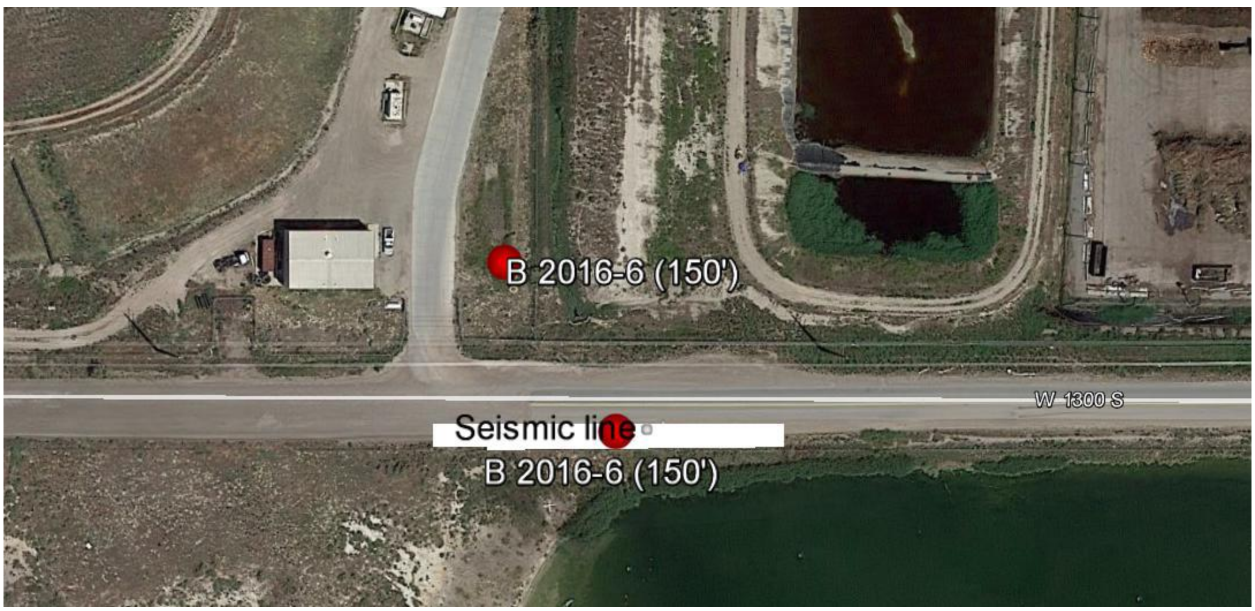
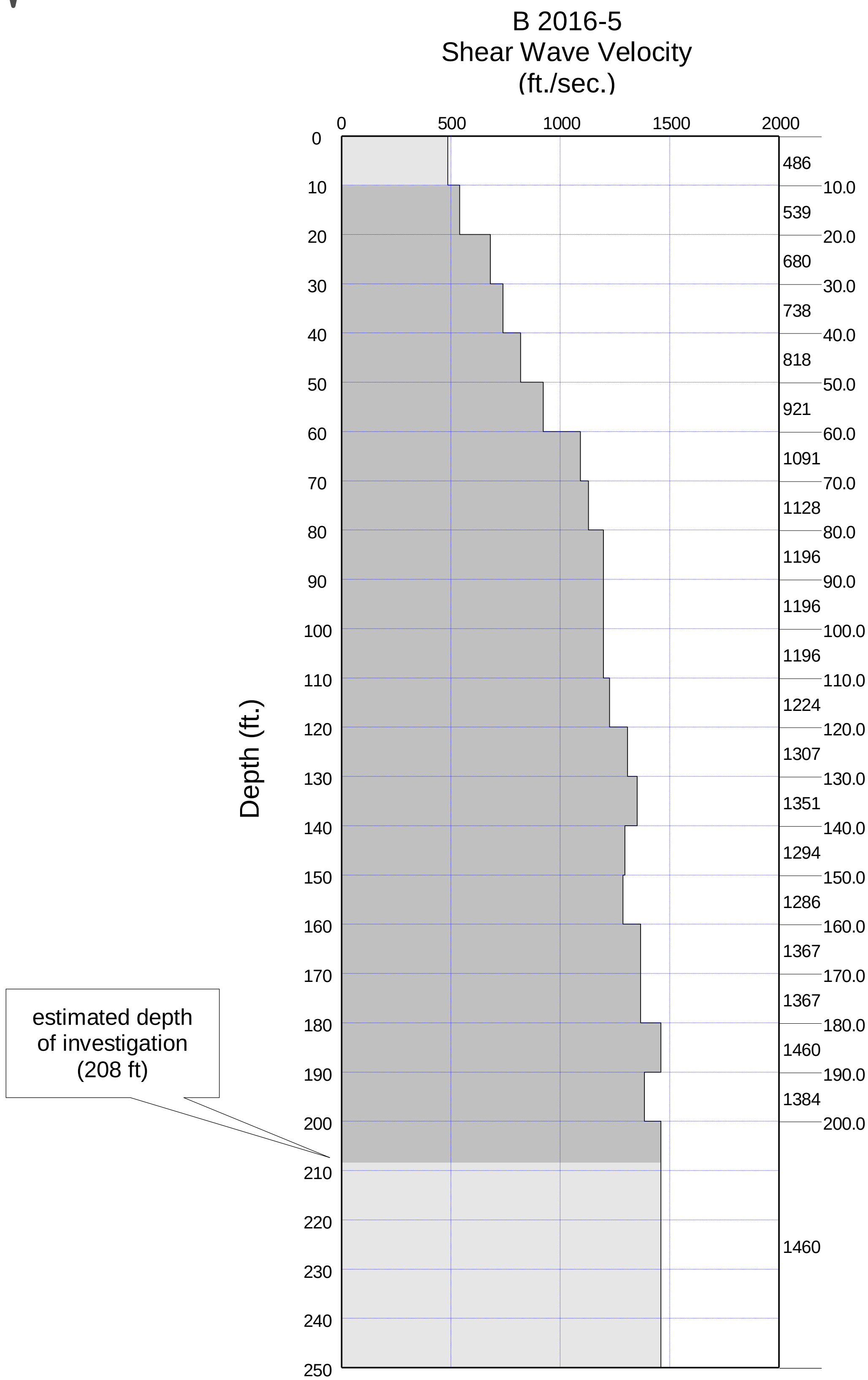


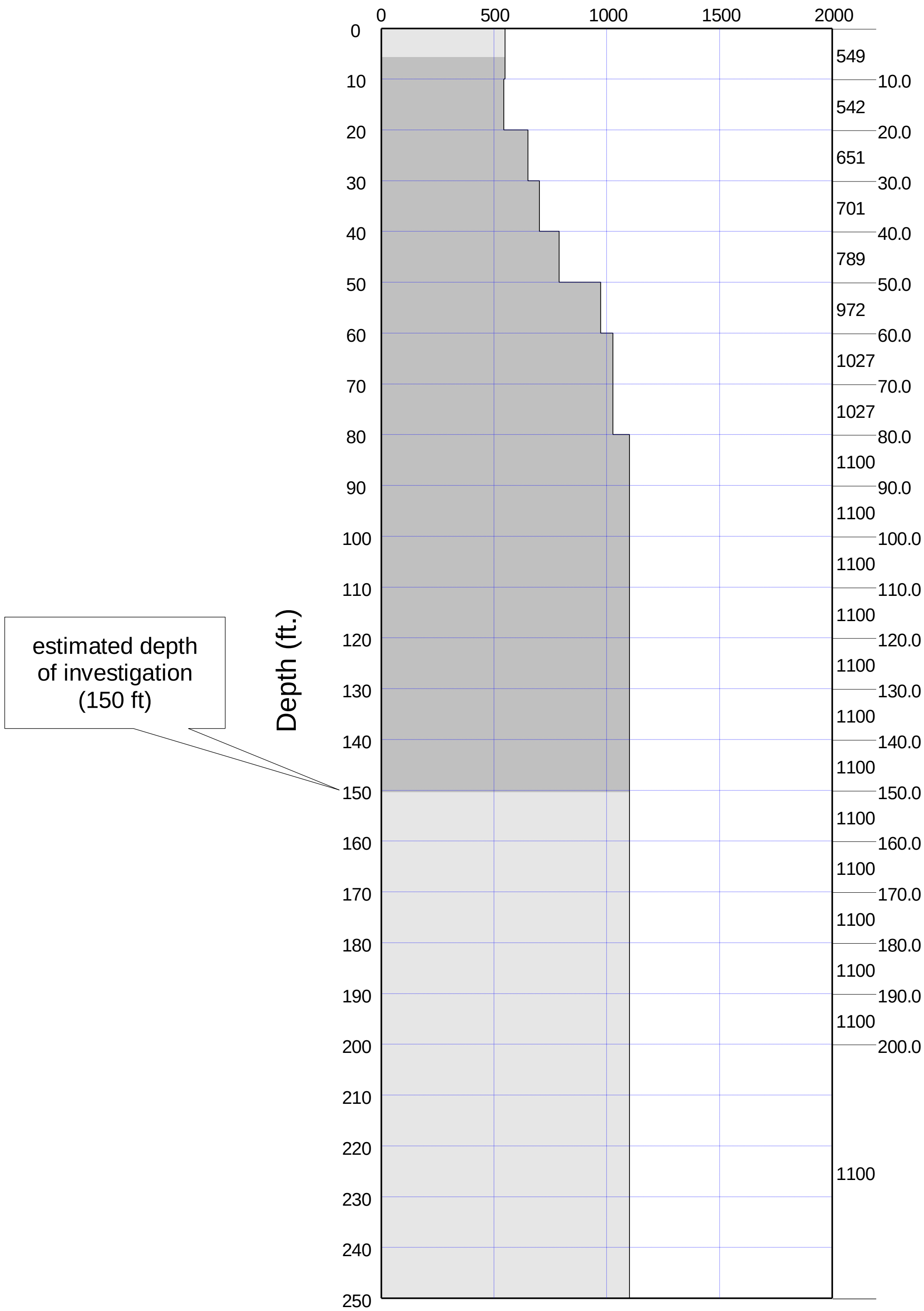
Figure 5. Test location – B 2016-6 (*scale and location approximate).*

Glen Carpenter / principal

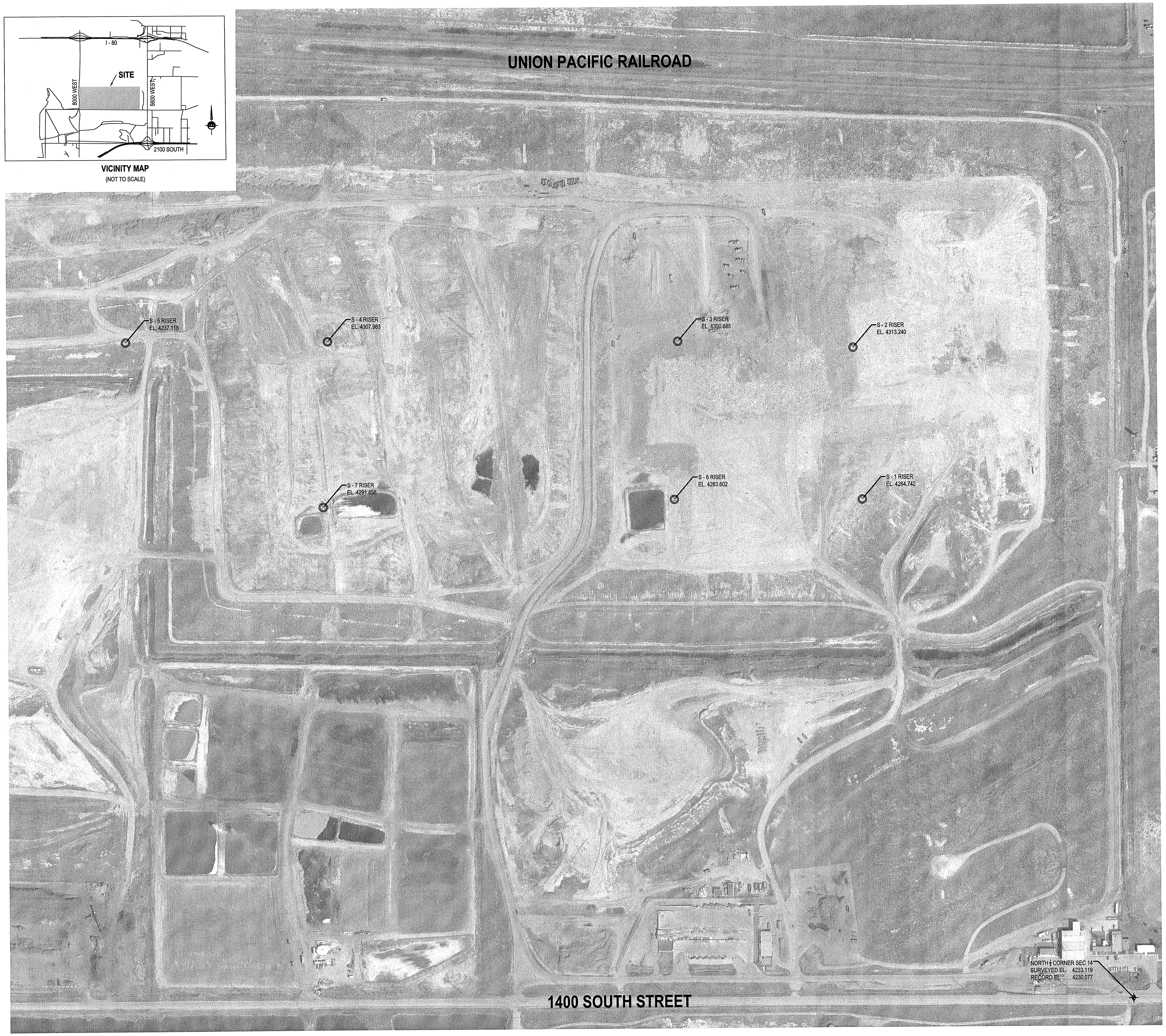


Shear Wave Velocity Model (inverted)
Average $V_{S(0-100)}$ = 799 fps
Refraction microtremor

B 2016-6
Shear Wave Velocity
(ft./sec.)



Shear Wave Velocity Model (inverted)
Average $V_{S(0-100)}$ = 788 fps
Refraction microtremor



SURVEYOR'S NARRATIVE

The purpose of this survey is to establish a vertical control network at various Leachate Risers located at the Salt Lake County Landfill at approximately 5600 West and 2100 South streets in Salt Lake City. A survey was performed to transfer nearby high quality NGS vertical values to the Landfill site to create a vertical control network for Kleinfelder's work at certain Leachate Risers and to compare the published NGS vertical datum against the vertical datum of an existing survey to verify if the current NGS vertical values are congruent with the existing survey. The benchmark for this survey is NGS Point - R 174, PID LP0219, a First Order Vertical adjusted value monument. This benchmark was verified against NGS Point - AA3687 - MUHAR a high accuracy Cooperative Base Network Control Station. Measured values of these monuments checked within 0.04' of each other and the published value of R 174 was held as the vertical basis for this survey. The Basis of Bearing for this survey is Geodetic North and a local coordinate of 10,000, 10,000 was assigned to AA3687 - MUHAR. The vertical datum was transferred to local benchmarks nearby each individual Leachate Riser with a combination of static GPS observations and the mean value of multiple control quality RTK GPS observations. Elevations were again transferred to a designated mark established by Kleinfelder on the side of each individual Leachate Riser with a reflectorless total station.Vertical values are accurate to within $\pm$0.20'.

SURVEYOR'S CERTIFICATE

I, William L. Clark, do hereby certify that I am a Professional Land Surveyor and that I hold License No. 5251265 as prescribed by the laws of the State of Utah and represent that I have made a survey transferring vertical benchmarks to locations at the Salt Lake County Landfill and the results of said survey are correct depicted hereon.

6-1-2016
Date

William L. Clark
William L. Clark
License no. 5251265

NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	10000.000	10000.000	4245.749	MUHAR
2	13652.813	9380.261	4235.820	R 174
3	14926.043	6673.747	4233.119	N 1/4 14
400	16948.358	3403.625	4291.458	MARK on S-7
401	16970.279	5589.542	4284.742	MARK on S-1
402	17591.168	5556.899	4313.240	MARK on S-2
403	17620.284	4846.320	4300.685	MARK on S-3
404	16973.980	4827.763	4283.602	MARK on S-6
405	17626.268	3425.416	4307.983	MARK on S-4
406	17627.203	2606.595	4237.118	MARK on S-5

NORTH

HORIZONTAL GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
HORZ: 1 inch = 200 ft.

ENSIGN

SALT LAKE CITY
45 W. 10000 S., Suite 500
Sandy, UT 84070
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FOR:
KLEINFELDER
849 LEVOY DR. #200
SALT LAKE CITY, UTAH 84123

CONTACT:
TRENT PARKHILL
PHONE: 801-261-3336
FAX:

KLEINFELDER - SLC LANDFILL
LEACHATE RISER BENCHMARK SURVEY
6030 WEST CALIFORNIA AVE.
SALT LAKE CITY, UTAH

PROFESSIONAL LAND SURVEYOR
WILLIAM L CLARK
No. 5251265
6-1-2016
STATE OF UTAH

LEACHATE RISER BENCHMARK SURVEY

PROJECT NUMBER 6972
PRINT DATE 6/1/2016
DRAWN BY B.HANEL
CHECKED BY B. CLARK
PROJECT MANAGER B. CLARK

KLEINFELDER

Bright People. Right Solutions.

Appendix C

APPENDIX C

Laboratory Test Results

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B2016-1	12.5	FAT CLAY (CH)	34.7	87.8			96	51	21	30	
B2016-1	23.3	LEAN CLAY WITH SAND (CL)	24.3	99.0			84	29	21	8	
B2016-2	12.5	LEAN CLAY (CL)	35.7	86.7			99	49	19	30	
B2016-3a	2.5	SANDY LEAN CLAY (CL)					67	42	22	20	
B2016-3a	3.3	LEAN CLAY (CL)					93	39	20	19	
B2016-3a	12.5	LEAN CLAY (CL)	23.0	95.9			92	35	18	17	
B2016-3a	30.0	LEAN CLAY (CL)	35.6	87.2			96	47	19	28	
B2016-3a	55.0	LEAN CLAY WITH SAND (CL)	21.8	103.0			83	34	17	17	
B2016-3b	25.0	LEAN CLAY (CL)	30.3	92.8			91	46	19	27	
B2016-4	15.0	POORLY GRADED SAND WITH SILT (SP-SM)				88	11				
B2016-4	40.0	WELL-GRADED SAND WITH SILT (SW-SM)				97	8.1				
B2016-4	47.5	LEAN CLAY (CL)					91	38	17	21	
B2016-4	47.9	LEAN CLAY WITH SAND (CL)	25.1	97.9			81	31	18	13	
B2016-4	50.0	LEAN CLAY (CL)	32.7	87.9			100	41	20	21	
B2016-5	2.5	LEAN CLAY WITH SAND (CL)					80	43	18	25	
B2016-5	10.0	LEAN CLAY WITH SAND (CL)	29.8	88.5			83	42	19	23	
B2016-5	17.5	LEAN CLAY (CL)	25.8	98.5			90	34	17	17	
B2016-5	35.0	LEAN CLAY (CL)	27.5	97.5			95	44	20	24	
B2016-5	51.2	LEAN CLAY WITH SAND (CL)	23.9	98.1			76	37	18	19	
B2016-5	55.0	LEAN CLAY (CL)					92	38	17	21	
B2016-5	60.0	FAT CLAY (CH)	40.7	75.4			98	71	22	49	
B2016-5	65.0	LEAN CLAY WITH SAND (CL)					78	27	16	11	
B2016-5	65.5	SANDY LEAN CLAY (CL)					62	29	17	12	
B2016-5	67.5	LEAN CLAY (CL)	23.5	102.4			97	32	18	14	
B2016-5	83.0	SILTY CLAY WITH SAND (CL-ML)					78	27	20	7	
B2016-5	83.5	SANDY SILT (ML)					52				
B2016-5	95.0	LEAN CLAY (CL)					87	32	18	14	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

KLEINFELDER
Bright People. Right Solutions.

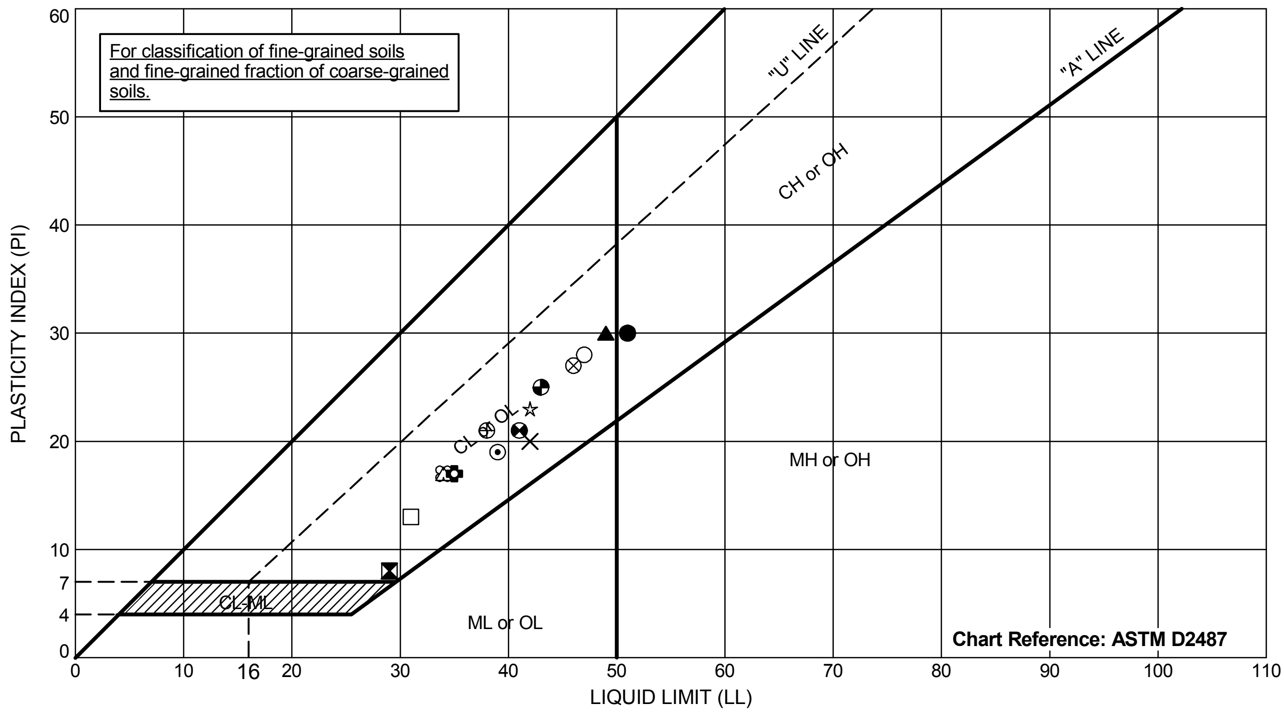
PROJECT NO.: 20170041
DRAWN BY: MDM
CHECKED BY: TP
DATE: 7/1/2016
REVISED: -

LABORATORY TEST RESULT SUMMARY

Salt Lake Valley Landfill
6030 W California Ave
Salt Lake City, Utah

APPENDIX

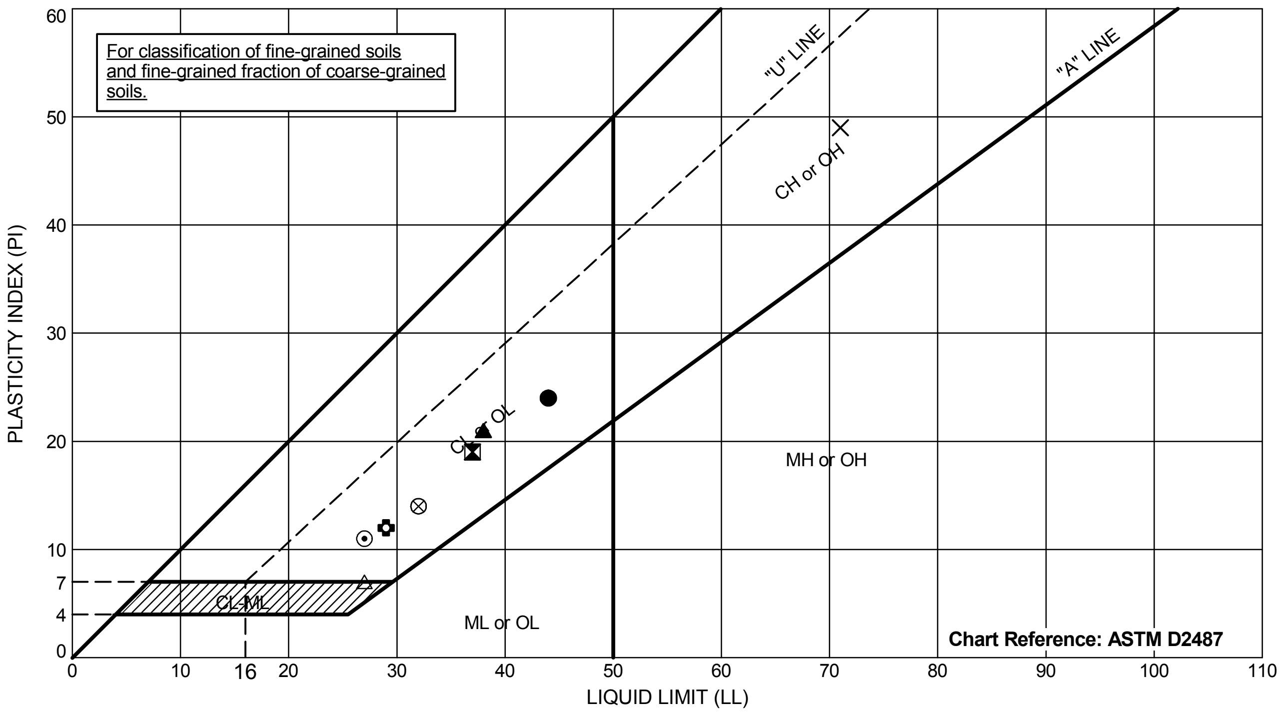
C-1



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B2016-1	12.5	FAT CLAY (CH)	96	51	21	30
⧗	B2016-1	23.3	LEAN CLAY with SAND (CL)	84	29	21	8
▲	B2016-2	12.5	LEAN CLAY (CL)	99	49	19	30
×	B2016-3a	2.5	SANDY LEAN CLAY (CL)	67	42	22	20
⊙	B2016-3a	3.3	LEAN CLAY (CL)	93	39	20	19
✿	B2016-3a	12.5	LEAN CLAY (CL)	92	35	18	17
○	B2016-3a	30	LEAN CLAY (CL)	96	47	19	28
△	B2016-3a	55	LEAN CLAY with SAND (CL)	83	34	17	17
⊗	B2016-3b	25	LEAN CLAY (CL)	91	46	19	27
⊕	B2016-4	47.5	LEAN CLAY (CL)	91	38	17	21
□	B2016-4	47.9	LEAN CLAY with SAND (CL)	81	31	18	13
◉	B2016-4	50	LEAN CLAY (CL)	100	41	20	21
◑	B2016-5	2.5	LEAN CLAY with SAND (CL)	80	43	18	25
☆	B2016-5	10	LEAN CLAY with SAND (CL)	83	42	19	23
✾	B2016-5	17.5	LEAN CLAY (CL)	90	34	17	17

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20170041	ATTERBERG LIMITS	APPENDIX
	DRAWN BY: MDM		
	CHECKED BY: TP	Salt Lake Valley Landfill 6030 W California Ave Salt Lake City, Utah	C-2
	DATE: 7/1/2016		
	REVISED: -		



Symbol	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B2016-5	35	LEAN CLAY (CL)	95	44	20	24
⊠	B2016-5	51.2	LEAN CLAY with SAND (CL)	76	37	18	19
▲	B2016-5	55	LEAN CLAY (CL)	92	38	17	21
×	B2016-5	60	FAT CLAY (CH)	98	71	22	49
⊙	B2016-5	65	LEAN CLAY with SAND (CL)	78	27	16	11
✿	B2016-5	65.5	SANDY LEAN CLAY (CL)	62	29	17	12
○	B2016-5	67.5	LEAN CLAY (CL)	97	32	18	14
△	B2016-5	83	SILTY CLAY with SAND (CL-ML)	78	27	20	7
⊗	B2016-5	95	LEAN CLAY (CL)	87	32	18	14

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
Bright People. Right Solutions.

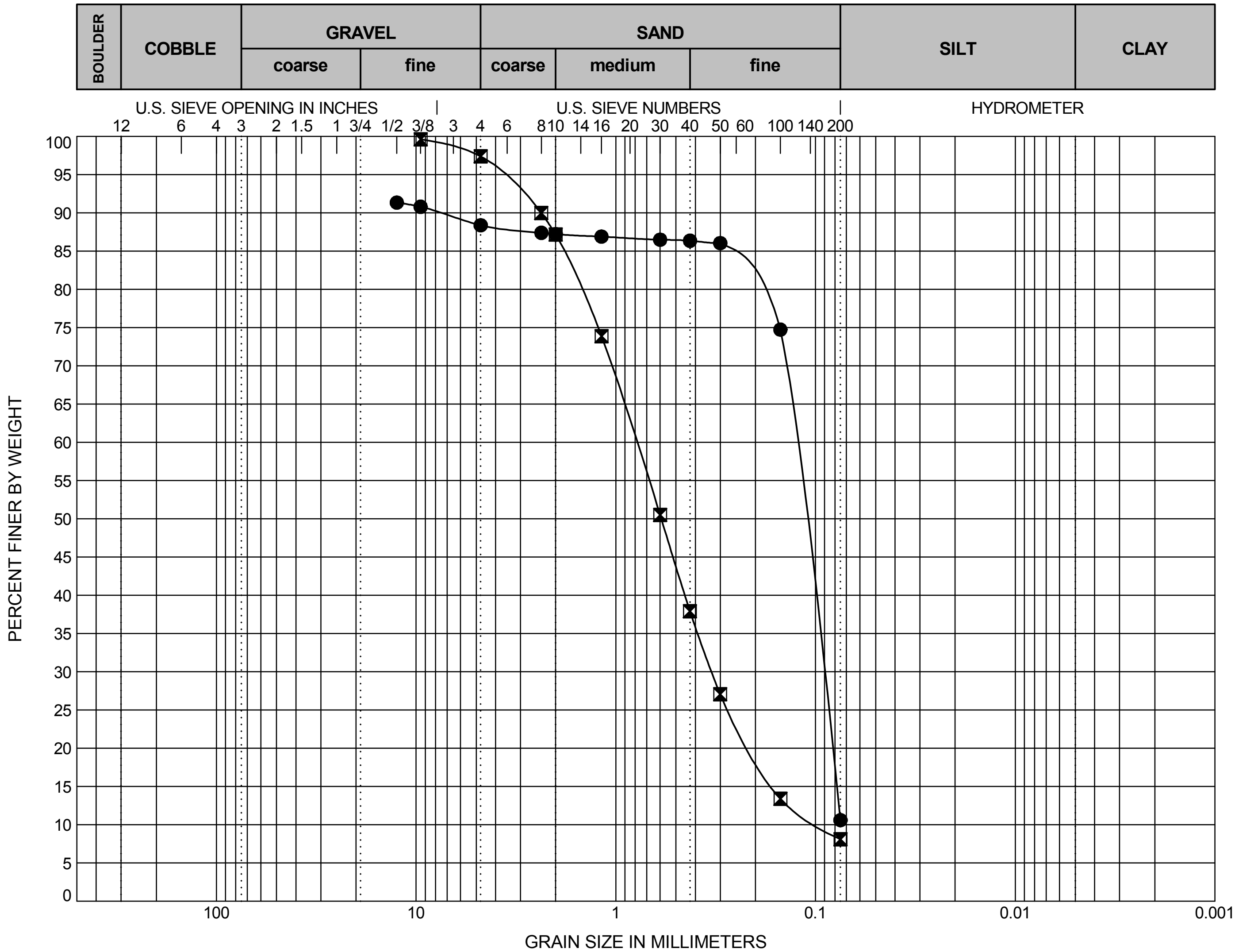
PROJECT NO.: 20170041
DRAWN BY: MDM
CHECKED BY: TP
DATE: 7/1/2016
REVISED: -

ATTERBERG LIMITS

Salt Lake Valley Landfill
6030 W California Ave
Salt Lake City, Utah

APPENDIX

C-3



Exploration ID		Depth (ft.)	Sample Description	LL	PL	PI
●	B2016-4	15	POORLY GRADED SAND WITH SILT (SP-SM)	NM	NM	NM
⧗	B2016-4	40	WELL-GRADED SAND WITH SILT (SW-SM)	NM	NM	NM

Exploration ID		Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	B2016-4	15	12.5	0.128	0.093	NM	0.90	1.72		88	11	NM	NM
⧗	B2016-4	40	9.5	0.79	0.33	0.096	1.43	8.20		97	8.1	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.
NP = Nonplastic
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60} D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20170041	DRAWN BY: MDM	CHECKED BY: TP	DATE: 7/1/2016
REVISED: -			

SIEVE ANALYSIS

Salt Lake Valley Landfill
6030 W California Ave
Salt Lake City, Utah

APPENDIX

C-4

One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

Project: Kleinfelder
No: M00194-044 (20170041)
Location: SLC Landfill
Date: 5/31/2016
By: JDF

Boring No.: B-2016-1
Sample:
Depth: 12.5'
Sample Description: Grey fat clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

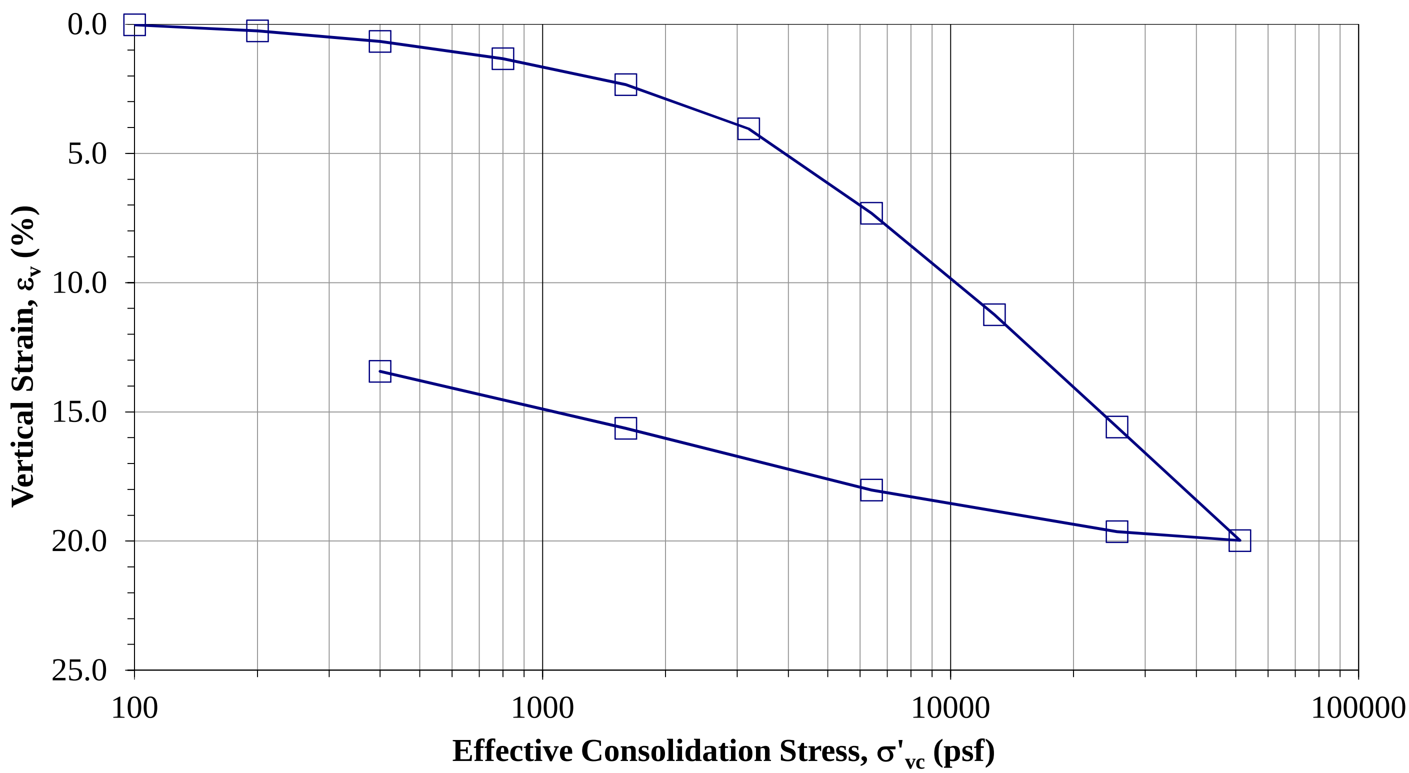
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7964
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	177.22	168.94
Wt. rings/tare (g)	46.34	46.34
Moist unit wt., γ_m (pcf)	118.2	127.92
Wet soil + tare (g)	452.40	250.17
Dry soil + tare (g)	375.13	224.72
Tare (g)	152.32	127.44
Water content, w (%)	34.7	26.2
Dry unit wt., γ_d (pcf)	87.8	101.4
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	0.9203
100	0.0002	0.03	0.9198	0.9198
200	0.0023	0.25	0.9177	0.9154
400	0.0061	0.66	0.9139	0.9076
800	0.0123	1.34	0.9077	0.8946
1600	0.0215	2.34	0.8985	0.8754
3200	0.0373	4.05	0.8827	0.8425
6400	0.0673	7.31	0.8527	0.7799
12800	0.1034	11.24	0.8166	0.7045
25600	0.1434	15.59	0.7766	0.6210
51200	0.1838	19.98	0.7362	0.5366
25600	0.1807	19.64	0.7393	0.5431
6400	0.1659	18.03	0.7541	0.5740
1600	0.1439	15.64	0.7761	0.6199
400	0.1236	13.43	0.7964	0.6623



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

IGES

Project: Kleinfelder
No: M00194-044 (20170041)
Location: SLC Landfill
Date: 5/31/2016
By: NB

Boring No.: B-2016-1
Sample: 2
Depth: 23.5'
Sample Description: Grey lean clay with sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

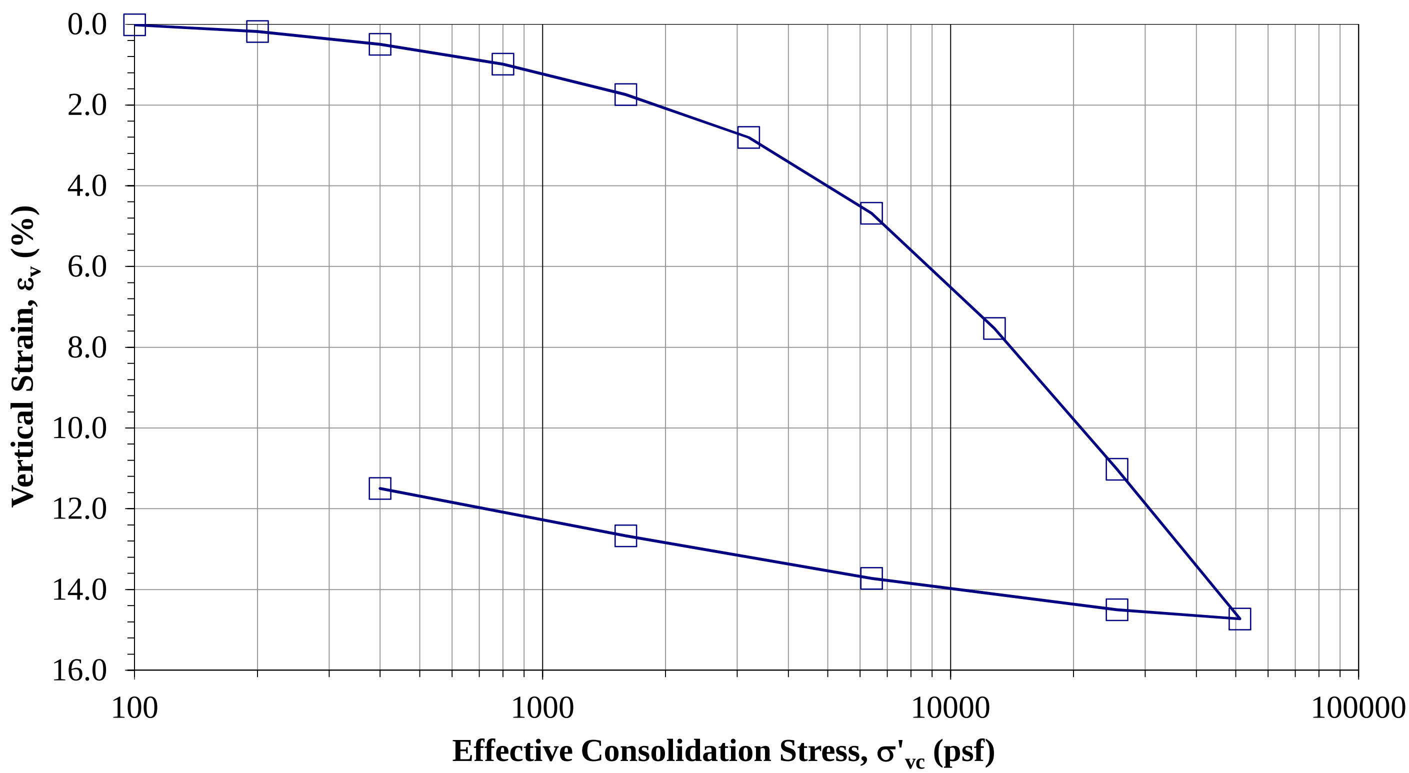
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8142
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	178.58	175.02
Wt. rings/tare (g)	42.27	42.27
Moist unit wt., γ_m (pcf)	123.1	135.49
Wet soil + tare (g)	247.28	247.21
Dry soil + tare (g)	222.56	224.34
Tare (g)	120.86	115.76
Water content, w (%)	24.3	21.1
Dry unit wt., γ_d (pcf)	99.0	111.9
Saturation	0.94	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	0.7018
100	0.0002	0.02	0.9198	0.7015
200	0.0017	0.18	0.9183	0.6987
400	0.0046	0.50	0.9154	0.6933
800	0.0091	0.99	0.9109	0.6849
1600	0.0160	1.74	0.9040	0.6721
3200	0.0258	2.80	0.8942	0.6541
6400	0.0431	4.69	0.8769	0.6220
12800	0.0694	7.54	0.8507	0.5735
25600	0.1014	11.02	0.8186	0.5142
51200	0.1355	14.73	0.7845	0.4511
25600	0.1334	14.50	0.7866	0.4550
6400	0.1263	13.73	0.7937	0.4682
1600	0.1166	12.67	0.8034	0.4861
400	0.1058	11.50	0.8142	0.5061



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-2
Sample:
Depth: 12.5'
Sample Description: Grey lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

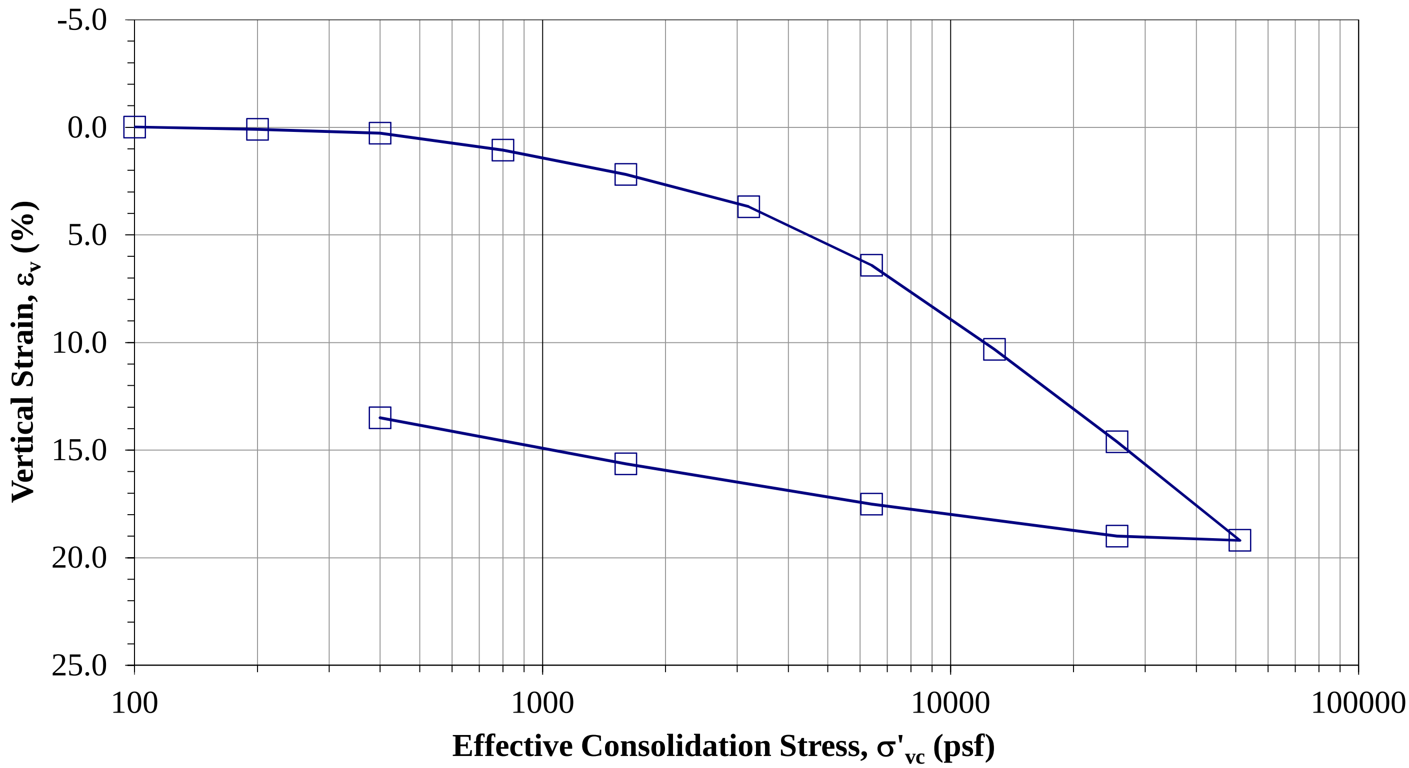
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7958
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	172.05	163.41
Wt. rings/tare (g)	41.74	41.74
Moist unit wt., γ_m (pcf)	117.7	127.05
Wet soil + tare (g)	322.78	249.36
Dry soil + tare (g)	271.63	223.50
Tare (g)	128.46	126.75
Water content, w (%)	35.7	26.7
Dry unit wt., γ_d (pcf)	86.7	100.3
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	0.9437
100	-0.0001	-0.01	0.9201	0.9439
200	0.0009	0.09	0.9191	0.9419
400	0.0025	0.28	0.9175	0.9383
800	0.0097	1.06	0.9103	0.9231
1600	0.0201	2.19	0.8999	0.9012
3200	0.0339	3.68	0.8861	0.8721
6400	0.0590	6.41	0.8610	0.8191
12800	0.0950	10.32	0.8251	0.7431
25600	0.1345	14.62	0.7855	0.6595
51200	0.1766	19.20	0.7434	0.5706
25600	0.1748	19.00	0.7452	0.5744
6400	0.1611	17.51	0.7589	0.6033
1600	0.1439	15.64	0.7761	0.6397
400	0.1242	13.50	0.7958	0.6813



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

Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-3a
Sample:
Depth: 12.5'
Sample Description: Brown lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

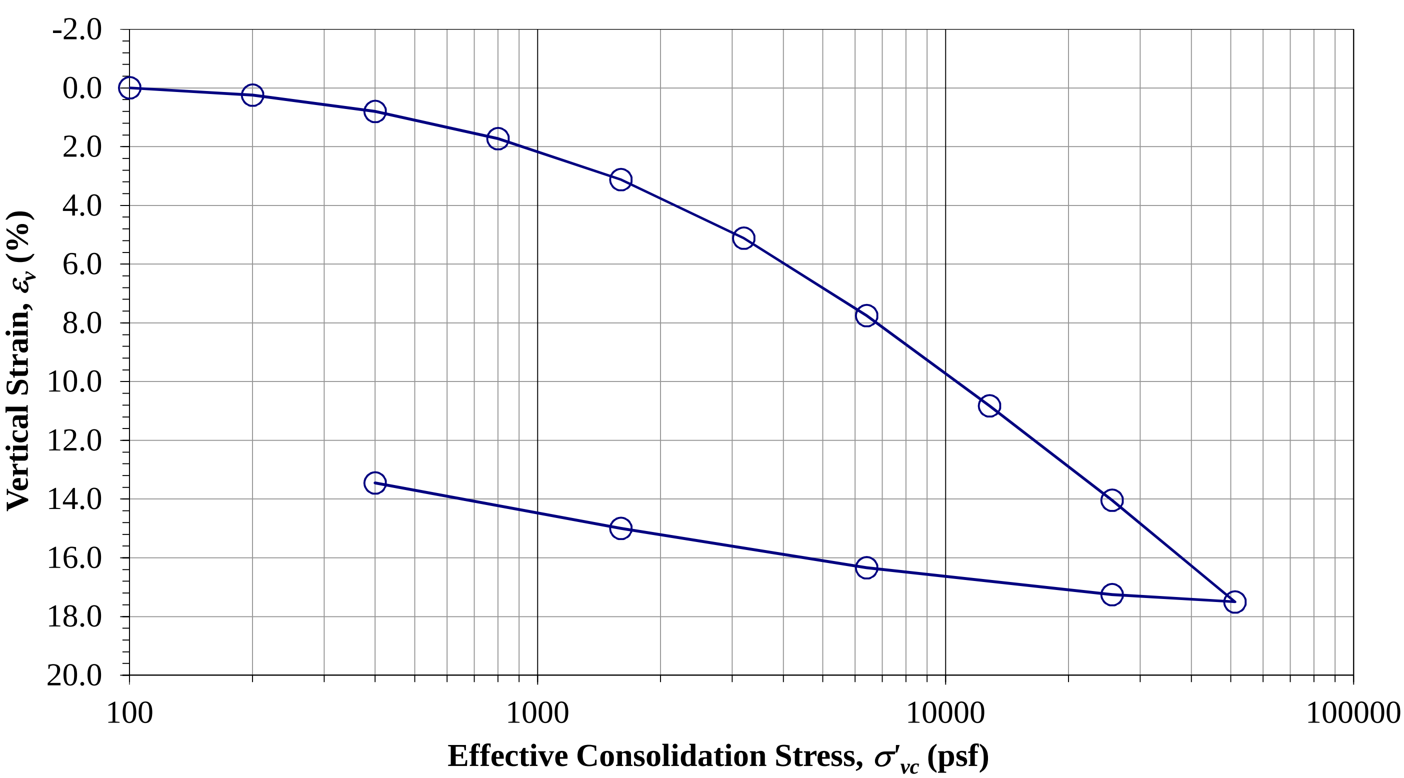
Test method:	B	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7963
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	175.71	172.92
Wt. rings/tare (g)	45.06	45.06
Total unit wt., γ (pcf)	118.0	133.43
Wet soil + tare (g)	343.97	278.02
Dry soil + tare (g)	301.56	256.58
Tare (g)	117.44	151.53
Water content, ω (%)	23.0	20.4
Dry unit wt., γ_d (pcf)	95.9	110.8
Saturation, S	0.82	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	0.7573
100	-0.0001	-0.01	0.9201	0.7574
200	0.0022	0.24	0.9178	0.7531
400	0.0074	0.80	0.9126	0.7432
800	0.0159	1.73	0.9041	0.7270
1600	0.0287	3.12	0.8913	0.7026
3200	0.0470	5.11	0.8730	0.6675
6400	0.0713	7.75	0.8487	0.6211
12800	0.0996	10.82	0.8204	0.5671
25600	0.1292	14.04	0.7908	0.5105
51200	0.1610	17.50	0.7590	0.4498
25600	0.1587	17.25	0.7613	0.4542
6400	0.1503	16.34	0.7697	0.4702
1600	0.1380	15.00	0.7820	0.4937
400	0.1237	13.45	0.7963	0.5210



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

Entered: ________
Reviewed: ________

Z:\PROJECTS\M00194_Kleinfelder_SLC\043_SLC_Landfill\[CONSOL_GC+TRv1_B2016_3a_12.5ft.xlsm]CON

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-3a
Sample:
Depth: 30'
Sample Description: Grey lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

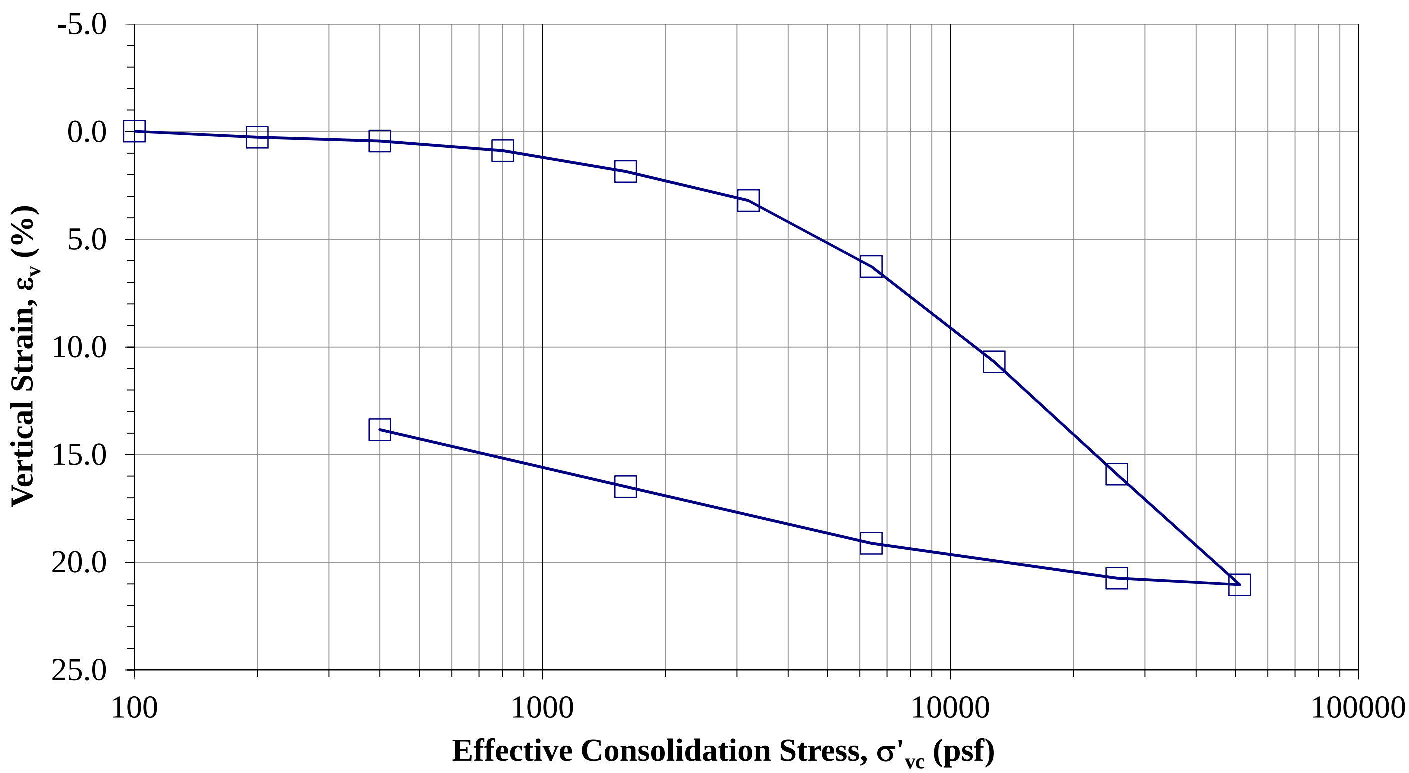
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7927
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	173.98	166.68
Wt. rings/tare (g)	43.01	43.01
Moist unit wt., γ_m (pcf)	118.3	129.64
Wet soil + tare (g)	504.64	248.89
Dry soil + tare (g)	405.48	222.32
Tare (g)	127.02	127.59
Water content, w (%)	35.6	28.0
Dry unit wt., γ_d (pcf)	87.2	101.2
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	0.9322
100	-0.0002	-0.02	0.9202	0.9326
200	0.0024	0.26	0.9176	0.9272
400	0.0041	0.44	0.9159	0.9237
800	0.0081	0.88	0.9119	0.9153
1600	0.0170	1.84	0.9030	0.8966
3200	0.0294	3.20	0.8906	0.8704
6400	0.0576	6.26	0.8624	0.8113
12800	0.0983	10.68	0.8217	0.7258
25600	0.1463	15.90	0.7737	0.6250
51200	0.1936	21.04	0.7264	0.5256
25600	0.1908	20.74	0.7292	0.5315
6400	0.1758	19.11	0.7442	0.5630
1600	0.1517	16.49	0.7683	0.6136
400	0.1273	13.84	0.7927	0.6649



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

Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

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Project: Kleinfelder

No: M00194-043 (20170041)

Location: SLC Landfill

Date: 5/24/2016

By: JDF

Boring No.: B-2016-3a

Sample:

Depth: 55'

Sample Description: Grey lean clay with sand

Engineering Classification: Not requested

Sample type: Undisturbed-trimmed from Shelby tube

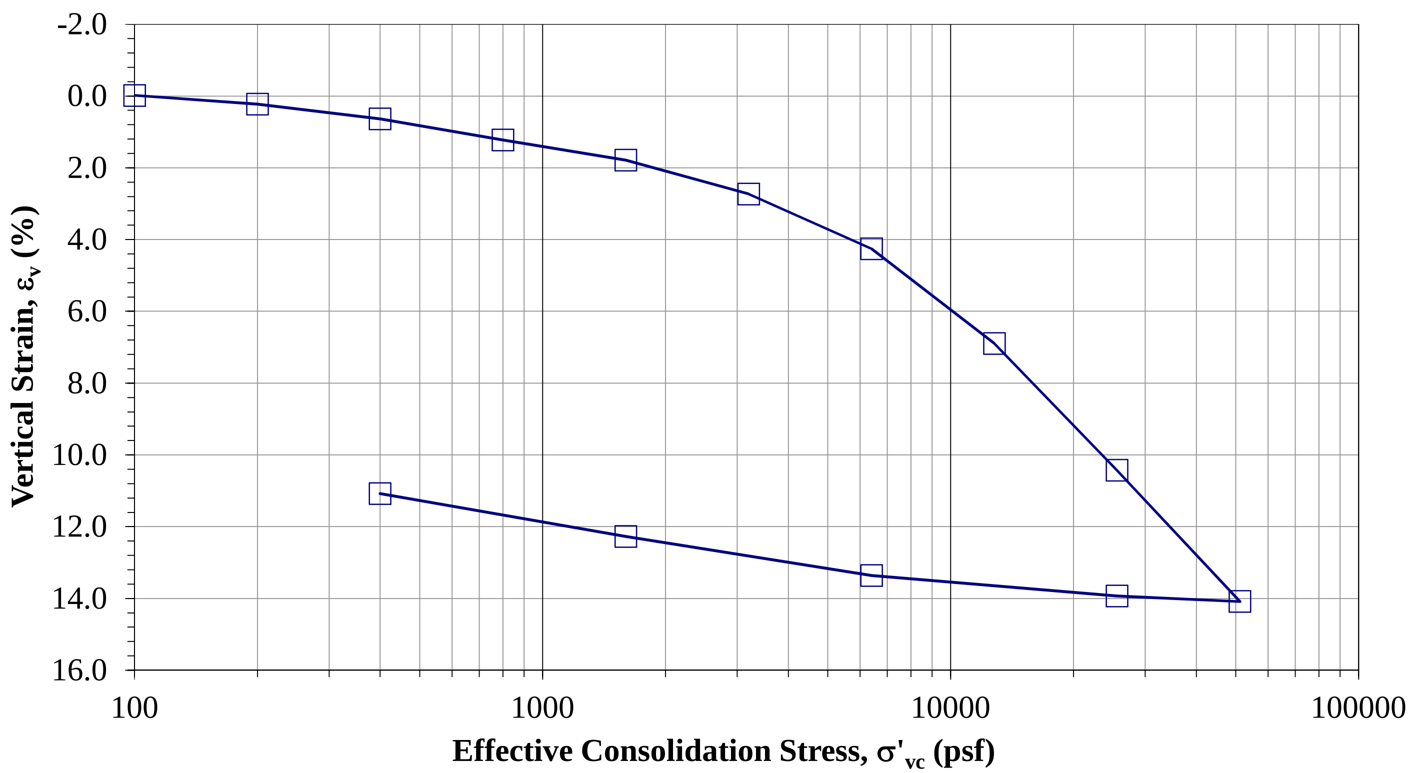
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8181
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	181.15	178.20
Wt. rings/tare (g)	42.24	42.24
Moist unit wt., γ_m (pcf)	125.5	138.10
Wet soil + tare (g)	574.22	245.74
Dry soil + tare (g)	494.42	224.23
Tare (g)	128.14	112.19
Water content, w (%)	21.8	19.2
Dry unit wt., γ_d (pcf)	103.0	115.9
Saturation	0.92	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	0.6361
100	-0.0001	-0.02	0.9201	0.6363
200	0.0021	0.23	0.9179	0.6324
400	0.0058	0.64	0.9142	0.6257
800	0.0113	1.22	0.9087	0.6160
1600	0.0164	1.78	0.9036	0.6069
3200	0.0251	2.73	0.8949	0.5914
6400	0.0392	4.26	0.8808	0.5664
12800	0.0635	6.90	0.8565	0.5232
25600	0.0960	10.43	0.8241	0.4654
51200	0.1296	14.09	0.7904	0.4056
25600	0.1282	13.93	0.7918	0.4081
6400	0.1229	13.36	0.7971	0.4175
1600	0.1129	12.27	0.8071	0.4353
400	0.1019	11.08	0.8181	0.4549



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

Entered: ________

Reviewed: ________

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One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-3b
Sample:
Depth: 25'
Sample Description: Grey lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

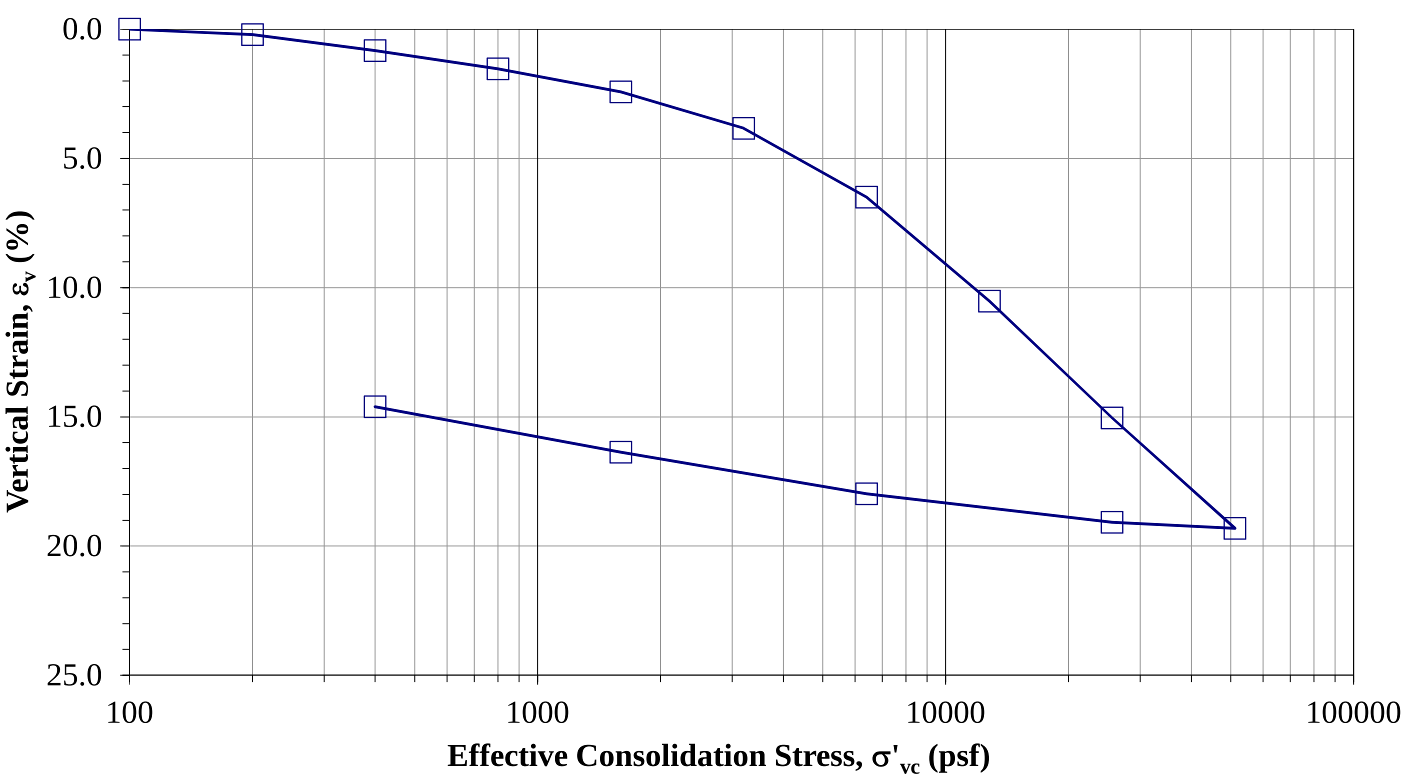
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7856
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	175.97	168.34
Wt. rings/tare (g)	42.15	42.15
Moist unit wt., γ_m (pcf)	120.9	133.48
Wet soil + tare (g)	576.30	243.65
Dry soil + tare (g)	474.98	220.26
Tare (g)	140.46	117.93
Water content, w (%)	30.3	22.9
Dry unit wt., γ_d (pcf)	92.8	108.6
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	0.8169
100	0.0000	0.00	0.9200	0.8169
200	0.0019	0.21	0.9181	0.8130
400	0.0077	0.83	0.9123	0.8017
800	0.0142	1.54	0.9059	0.7889
1600	0.0223	2.43	0.8977	0.7728
3200	0.0353	3.83	0.8847	0.7472
6400	0.0598	6.50	0.8602	0.6988
12800	0.0968	10.52	0.8232	0.6257
25600	0.1384	15.04	0.7816	0.5435
51200	0.1777	19.32	0.7423	0.4659
25600	0.1755	19.08	0.7445	0.4703
6400	0.1654	17.98	0.7546	0.4902
1600	0.1506	16.37	0.7694	0.5194
400	0.1344	14.61	0.7856	0.5514



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

Entered: ________

Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

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Project: **Kleinfelder**
No: **M00194-044 (20170041)**
Location: SLC Landfill
Date: 5/31/2016
By: JDF

Boring No.: **B-2016-4**
Sample:
Depth: **47.9'**
Sample Description: Brown lean clay with sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

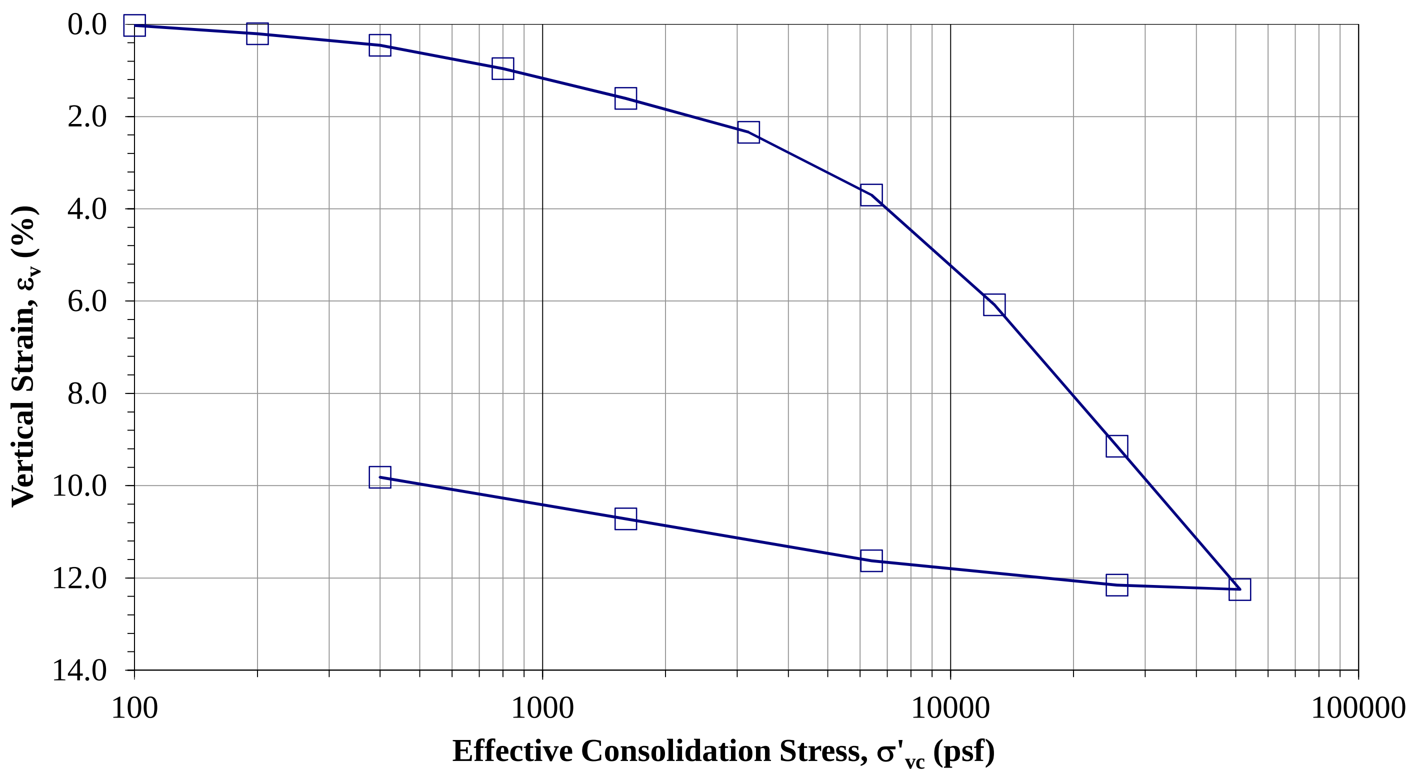
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8297
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	180.79	176.73
Wt. rings/tare (g)	45.24	45.24
Moist unit wt., γ_m (pcf)	122.4	131.70
Wet soil + tare (g)	328.77	259.45
Dry soil + tare (g)	287.28	236.39
Tare (g)	122.00	128.39
Water content, w (%)	25.1	21.4
Dry unit wt., γ_d (pcf)	97.9	108.5
Saturation	0.94	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	0.7223
100	0.0002	0.03	0.9198	0.7218
200	0.0019	0.21	0.9181	0.7187
400	0.0042	0.46	0.9158	0.7144
800	0.0089	0.97	0.9111	0.7057
1600	0.0148	1.61	0.9052	0.6946
3200	0.0216	2.35	0.8984	0.6819
6400	0.0341	3.70	0.8859	0.6585
12800	0.0559	6.08	0.8641	0.6176
25600	0.0841	9.14	0.8359	0.5648
51200	0.1127	12.25	0.8073	0.5113
25600	0.1118	12.15	0.8082	0.5130
6400	0.1070	11.63	0.8130	0.5220
1600	0.0987	10.72	0.8214	0.5376
400	0.0904	9.82	0.8297	0.5531



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

IGES

Project: Kleinfelder
No: M00194-044 (20170041)
Location: SLC Landfill
Date: 5/31/2016
By: JDF

Boring No.: B-2016-4
Sample:
Depth: 50.0'
Sample Description: Brown lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

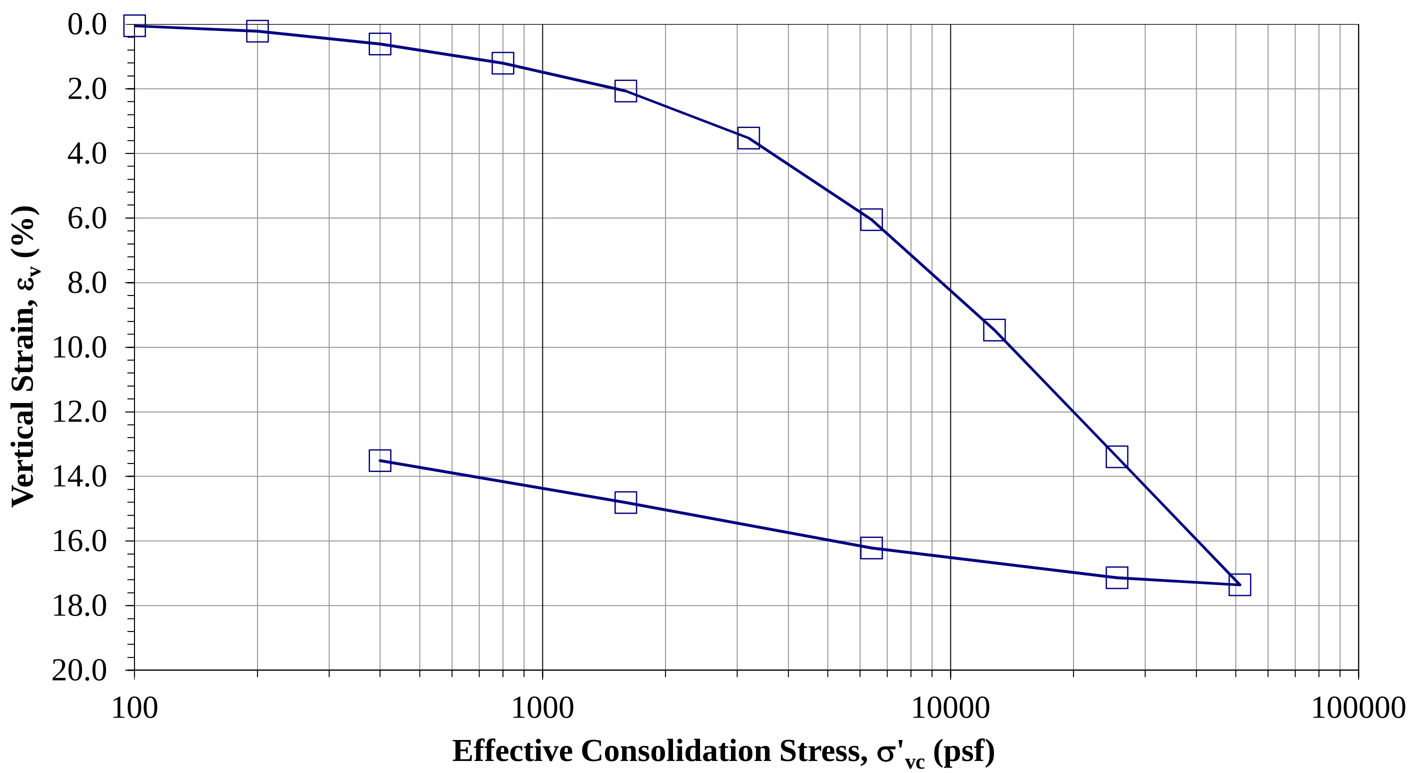
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation: Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7957
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	172.37	164.84
Wt. rings/tare (g)	43.28	43.28
Moist unit wt., γ_m (pcf)	116.6	126.94
Wet soil + tare (g)	445.07	247.93
Dry soil + tare (g)	363.10	223.33
Tare (g)	112.19	124.64
Water content, w (%)	32.7	24.9
Dry unit wt., γ_d (pcf)	87.9	101.6
Saturation	0.96	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	0.9178
100	0.0005	0.05	0.9195	0.9169
200	0.0020	0.22	0.9180	0.9136
400	0.0057	0.62	0.9143	0.9060
800	0.0111	1.20	0.9089	0.8948
1600	0.0190	2.07	0.9010	0.8782
3200	0.0324	3.52	0.8876	0.8503
6400	0.0557	6.05	0.8643	0.8018
12800	0.0871	9.47	0.8329	0.7362
25600	0.1232	13.39	0.7968	0.6610
51200	0.1597	17.36	0.7603	0.5849
25600	0.1577	17.14	0.7623	0.5891
6400	0.1492	16.22	0.7708	0.6068
1600	0.1362	14.80	0.7838	0.6339
400	0.1243	13.51	0.7957	0.6587



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-5
Sample:
Depth: 10'
Sample Description: Brown lean clay with sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

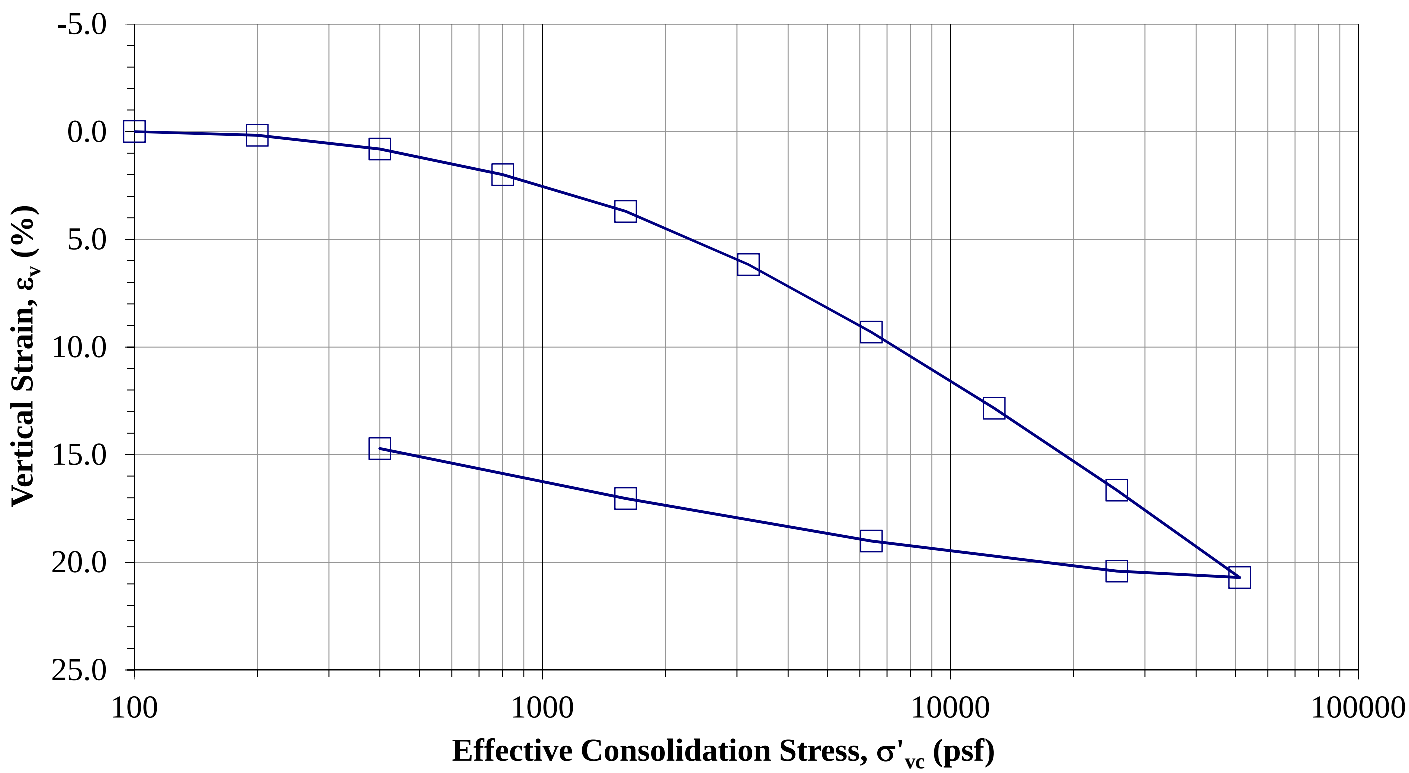
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7846
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	171.72	168.47
Wt. rings/tare (g)	44.52	44.52
Moist unit wt., γ_m (pcf)	114.9	131.28
Wet soil + tare (g)	328.17	249.46
Dry soil + tare (g)	282.09	224.13
Tare (g)	127.57	128.56
Water content, w (%)	29.8	26.5
Dry unit wt., γ_d (pcf)	88.5	103.8
Saturation	0.89	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	0.9046
100	-0.0001	-0.01	0.9201	0.9047
200	0.0016	0.17	0.9184	0.9013
400	0.0074	0.80	0.9126	0.8893
800	0.0183	1.99	0.9017	0.8666
1600	0.0341	3.70	0.8859	0.8341
3200	0.0567	6.17	0.8633	0.7871
6400	0.0856	9.31	0.8344	0.7273
12800	0.1182	12.85	0.8018	0.6599
25600	0.1531	16.64	0.7669	0.5876
51200	0.1905	20.71	0.7295	0.5102
25600	0.1878	20.41	0.7322	0.5158
6400	0.1749	19.01	0.7451	0.5425
1600	0.1567	17.03	0.7633	0.5802
400	0.1354	14.72	0.7846	0.6243



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

Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-5
Sample:
Depth: 17.5'
Sample Description: Grey lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

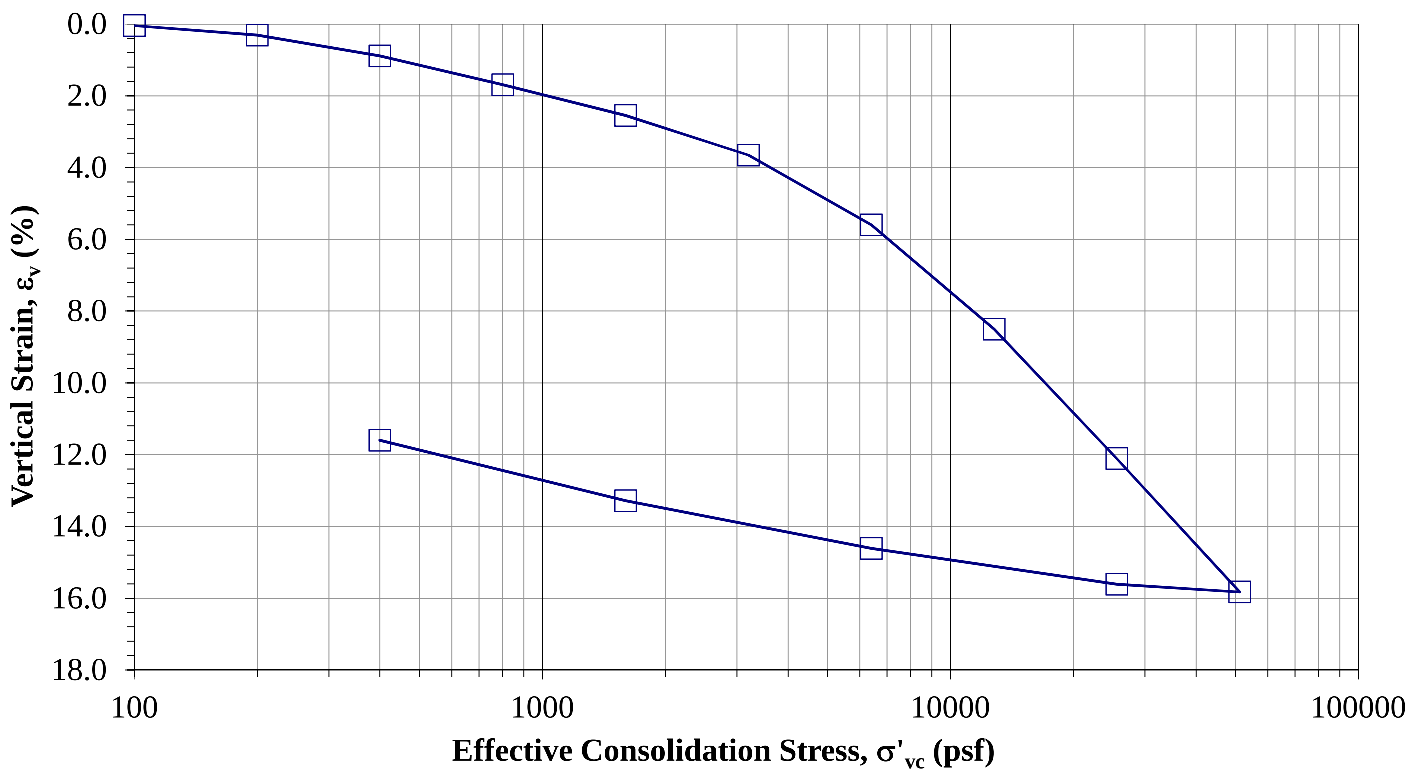
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8133
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	182.07	178.19
Wt. rings/tare (g)	44.86	44.86
Moist unit wt., γ_m (pcf)	123.9	136.22
Wet soil + tare (g)	407.34	253.40
Dry soil + tare (g)	350.03	229.51
Tare (g)	127.69	121.98
Water content, w (%)	25.8	22.2
Dry unit wt., γ_d (pcf)	98.5	111.5
Saturation	0.98	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	0.7106
100	0.0004	0.05	0.9196	0.7098
200	0.0028	0.31	0.9172	0.7053
400	0.0082	0.89	0.9118	0.6953
800	0.0156	1.70	0.9044	0.6816
1600	0.0234	2.54	0.8966	0.6671
3200	0.0336	3.65	0.8864	0.6481
6400	0.0515	5.60	0.8685	0.6148
12800	0.0782	8.50	0.8418	0.5652
25600	0.1114	12.11	0.8086	0.5035
51200	0.1456	15.83	0.7744	0.4399
25600	0.1436	15.61	0.7764	0.4436
6400	0.1344	14.61	0.7856	0.4607
1600	0.1222	13.28	0.7978	0.4834
400	0.1067	11.60	0.8133	0.5122



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

IGES

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-5
Sample:
Depth: 35'
Sample Description: Grey lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

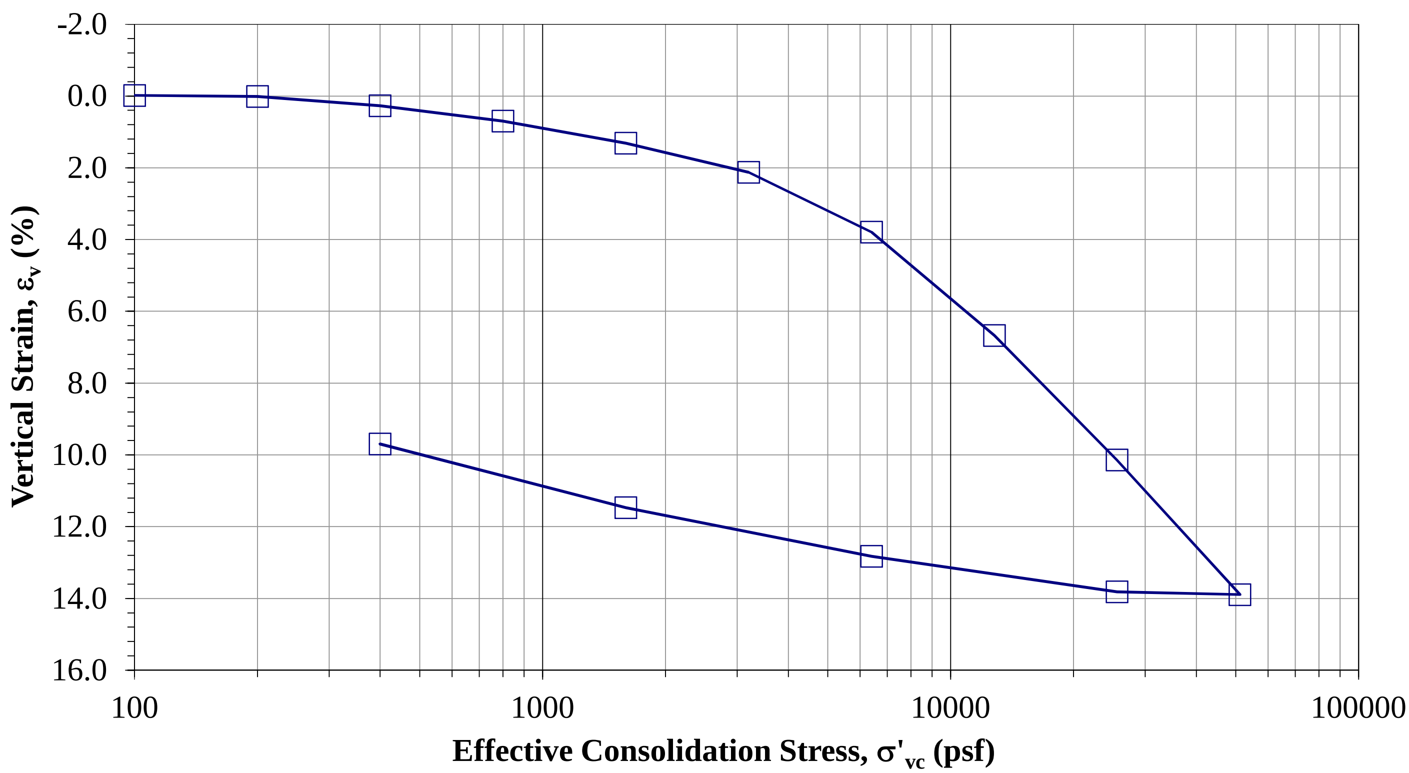
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8308
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	182.41	176.74
Wt. rings/tare (g)	44.78	44.78
Moist unit wt., γ_m (pcf)	124.3	131.98
Wet soil + tare (g)	411.78	260.00
Dry soil + tare (g)	349.10	235.91
Tare (g)	120.85	127.44
Water content, w (%)	27.5	22.2
Dry unit wt., γ_d (pcf)	97.5	108.0
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	0.7282
100	-0.0002	-0.02	0.9202	0.7285
200	0.0001	0.01	0.9199	0.7281
400	0.0025	0.27	0.9175	0.7235
800	0.0064	0.70	0.9136	0.7161
1600	0.0121	1.31	0.9079	0.7056
3200	0.0196	2.13	0.9004	0.6915
6400	0.0349	3.79	0.8851	0.6627
12800	0.0614	6.67	0.8586	0.6129
25600	0.0933	10.14	0.8267	0.5530
51200	0.1278	13.89	0.7922	0.4882
25600	0.1271	13.82	0.7929	0.4895
6400	0.1180	12.83	0.8020	0.5066
1600	0.1055	11.47	0.8145	0.5300
400	0.0892	9.69	0.8308	0.5607



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

Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils
(ASTM D2435)

IGES

Project: Kleinfelder
No: M00194-044 (20170041)
Location: SLC Landfill
Date: 5/31/2016
By: JDF

Boring No.: B-2016-5
Sample:
Depth: 51.2'
Sample Description: Brown lean clay with sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

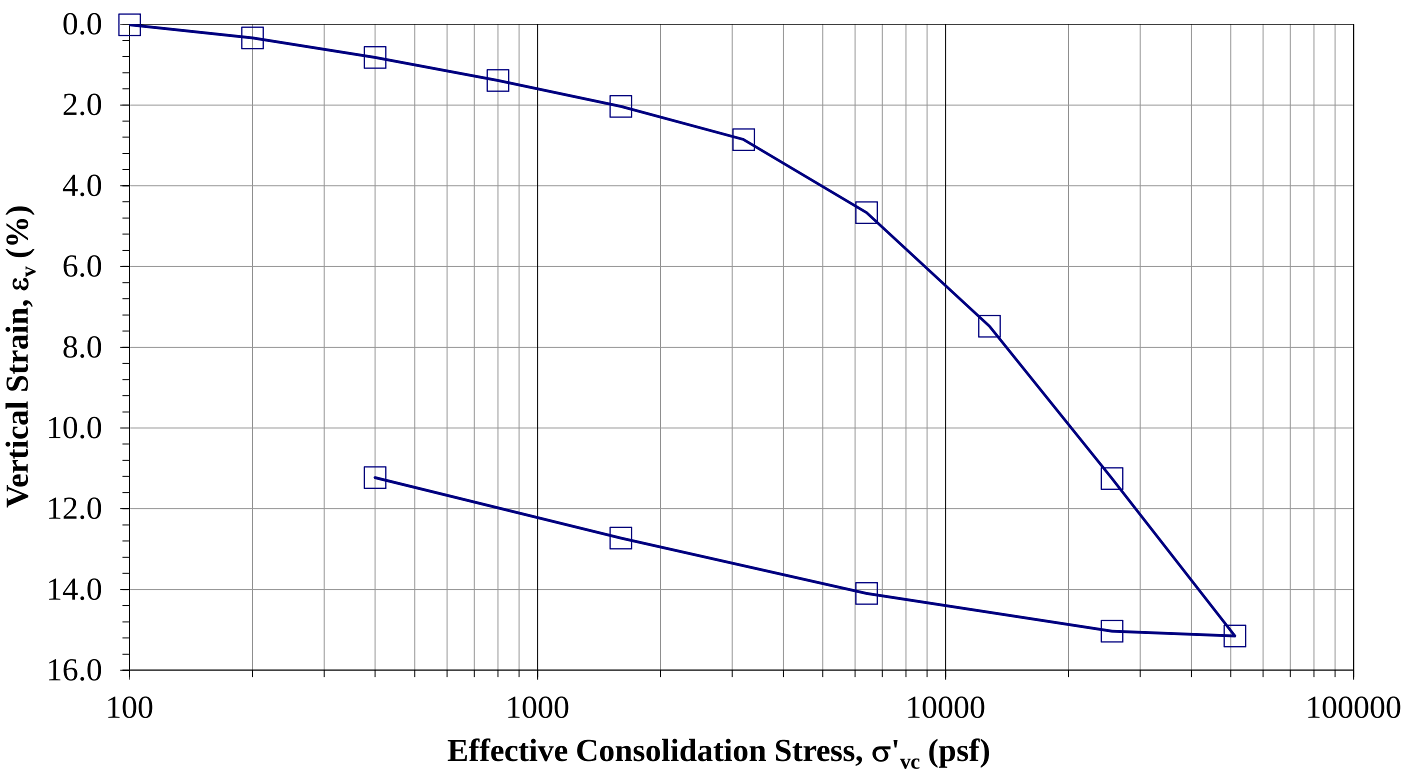
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8167
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	180.04	178.31
Wt. rings/tare (g)	45.44	45.44
Moist unit wt., γ_m (pcf)	121.6	135.20
Wet soil + tare (g)	343.94	283.34
Dry soil + tare (g)	300.24	259.74
Tare (g)	117.48	154.02
Water content, w (%)	23.9	22.3
Dry unit wt., γ_d (pcf)	98.1	110.5
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	0.7179
100	0.0001	0.02	0.9199	0.7176
200	0.0031	0.34	0.9169	0.7121
400	0.0076	0.82	0.9124	0.7038
800	0.0129	1.40	0.9072	0.6939
1600	0.0187	2.03	0.9013	0.6830
3200	0.0263	2.86	0.8937	0.6687
6400	0.0430	4.67	0.8770	0.6377
12800	0.0689	7.48	0.8512	0.5894
25600	0.1035	11.25	0.8165	0.5246
51200	0.1394	15.15	0.7806	0.4576
25600	0.1383	15.03	0.7817	0.4597
6400	0.1297	14.10	0.7903	0.4757
1600	0.1171	12.73	0.8029	0.4993
400	0.1033	11.23	0.8167	0.5250



Entered: ________
Reviewed: ________

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One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: **Kleinfelder**
No: **M00194-043 (20170041)**
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: **B-2016-5**
Sample:
Depth: **60'**
Sample Description: Light brown fat clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

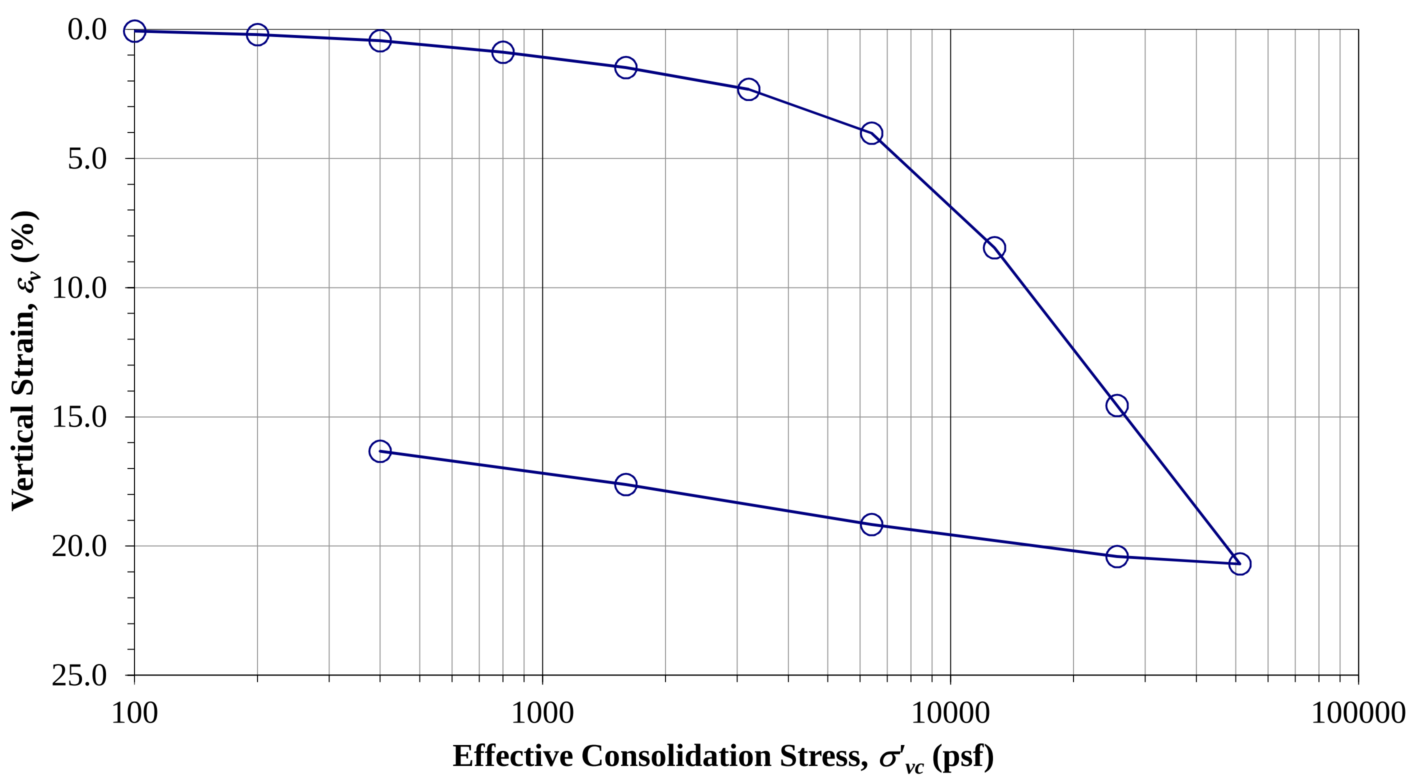
Test method:	B	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.7697
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	159.99	152.64
Wt. rings/tare (g)	42.49	42.49
Total unit wt., γ (pcf)	106.1	118.92
Wet soil + tare (g)	472.26	239.67
Dry soil + tare (g)	372.75	212.84
Tare (g)	128.30	128.74
Water content, ω (%)	40.7	31.9
Dry unit wt., γ_d (pcf)	75.4	90.2
Saturation, S	0.89	0.99

*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	1.2347
100	0.0007	0.07	0.9193	1.2331
200	0.0019	0.21	0.9181	1.2301
400	0.0040	0.44	0.9160	1.2249
800	0.0082	0.89	0.9118	1.2148
1600	0.0137	1.49	0.9063	1.2015
3200	0.0214	2.32	0.8986	1.1828
6400	0.0370	4.02	0.8830	1.1448
12800	0.0778	8.45	0.8422	1.0458
25600	0.1340	14.57	0.7860	0.9092
51200	0.1904	20.70	0.7296	0.7722
25600	0.1877	20.40	0.7323	0.7788
6400	0.1763	19.16	0.7437	0.8065
1600	0.1621	17.62	0.7579	0.8409
400	0.1503	16.34	0.7697	0.8696



Entered: ________
Reviewed: ________

One-Dimensional Consolidation Properties of Soils

(ASTM D2435)

Project: Kleinfelder
No: M00194-043 (20170041)
Location: SLC Landfill
Date: 5/24/2016
By: JDF

Boring No.: B-2016-5
Sample:
Depth: 67.5'
Sample Description: Brown lean clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from Shelby tube

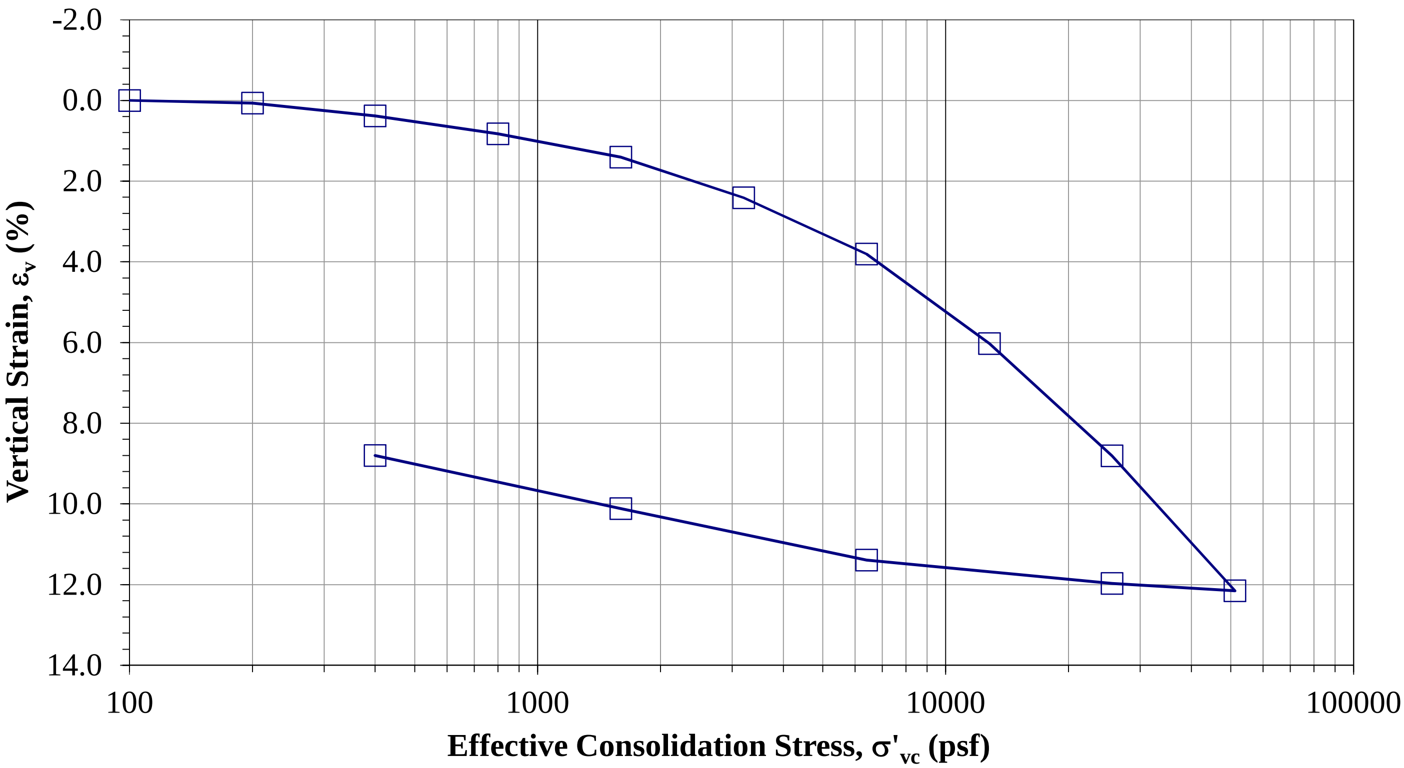
Test method:	A	
Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Water type used for inundation Tap

	Initial (o)	Final (f)
Sample height, H (in.)	0.920	0.8390
Sample diameter, D (in.)	2.416	2.416
Wt. rings + wet soil (g)	183.27	178.99
Wt. rings/tare (g)	43.21	43.21
Moist unit wt., γ_m (pcf)	126.5	134.48
Wet soil + tare (g)	420.48	288.43
Dry soil + tare (g)	364.76	266.01
Tare (g)	127.66	152.34
Water content, w (%)	23.5	19.7
Dry unit wt., γ_d (pcf)	102.4	112.3
Saturation	0.98	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	0.6455
100	0.0000	0.00	0.9200	0.6455
200	0.0006	0.07	0.9194	0.6444
400	0.0035	0.38	0.9165	0.6392
800	0.0076	0.83	0.9124	0.6318
1600	0.0129	1.41	0.9071	0.6223
3200	0.0222	2.41	0.8978	0.6058
6400	0.0350	3.81	0.8850	0.5828
12800	0.0554	6.02	0.8646	0.5464
25600	0.0811	8.81	0.8390	0.5005
51200	0.1118	12.15	0.8082	0.4455
25600	0.1101	11.97	0.8099	0.4486
6400	0.1048	11.39	0.8152	0.4580
1600	0.0931	10.12	0.8269	0.4790
400	0.0810	8.80	0.8390	0.5006



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

Entered: ________
Reviewed: ________

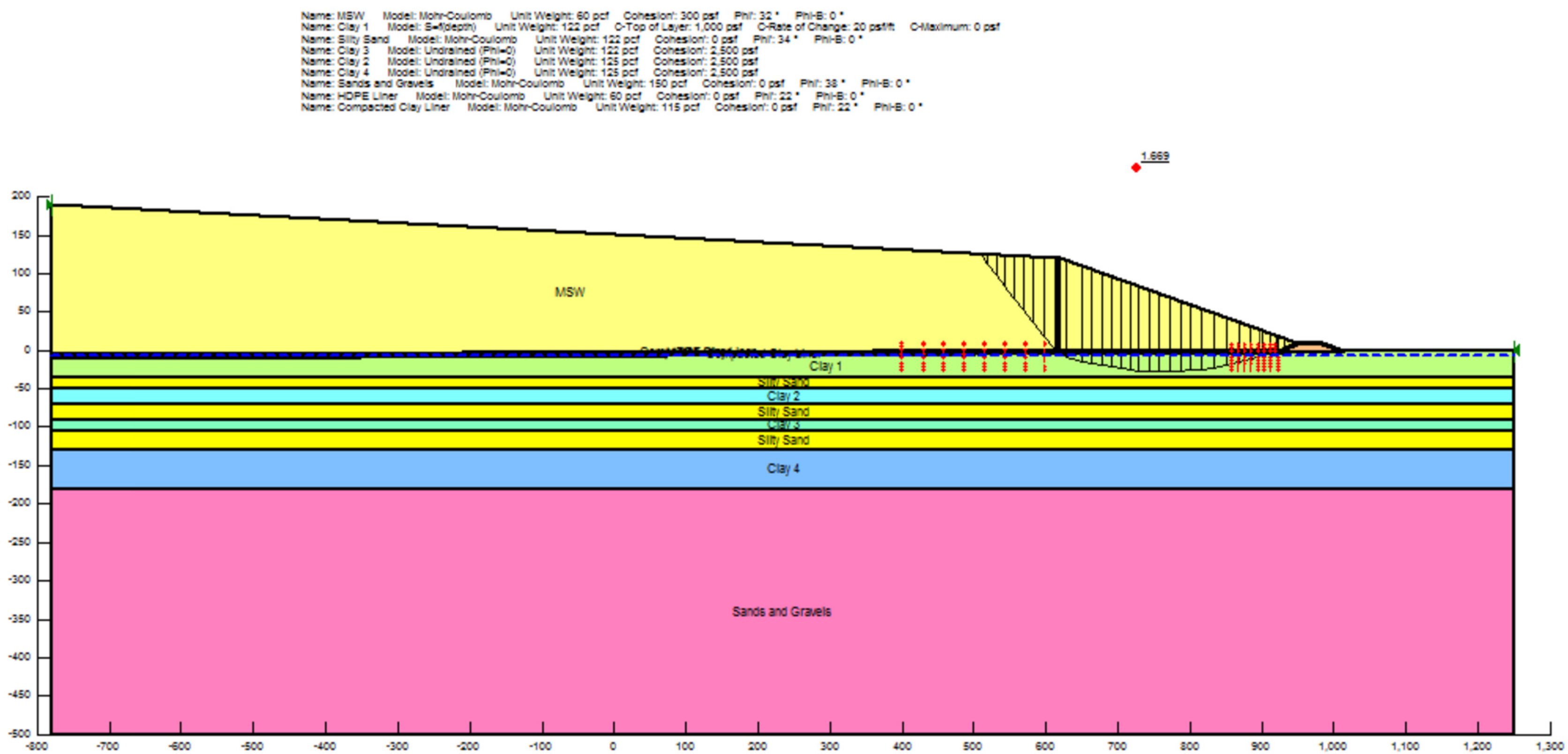
KLEINFELDER
Bright People. Right Solutions.

Appendix D

APPENDIX D

Slope Stability Results

NOTE: Slope stability results shown looking North to South
(Section A-A' in Figure 1 - 3 shown looking South to North)



CASE 1 - STATIC SLOPE STABILITY RESULTS

0 250 500

SCALE: 1" = 250' SCALE IN FEET

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.	20170041
DRAWN BY:	B. Foster
CHECKED BY:	T. Parkhill
DATE:	8/8/2016
REVISED:	-

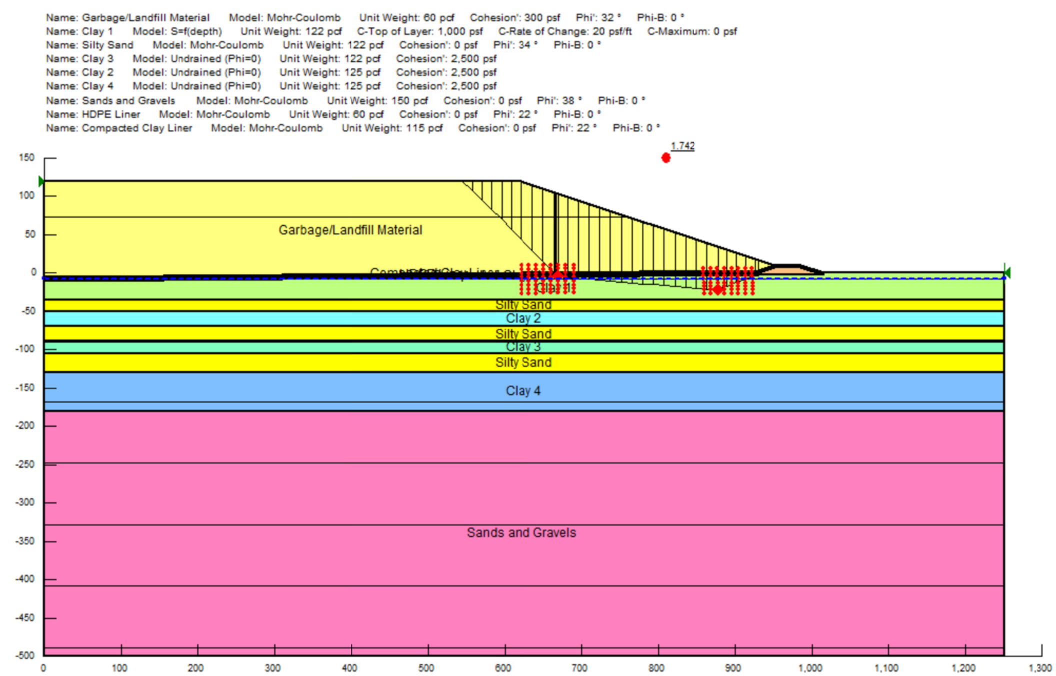
SLOPE STABILITY RESULTS

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

FIGURE

D-1

NOTE: Slope stability results shown looking North to South
(Section A-A' in Figure 1 - 3 shown looking South to North)



CASE 2 - STATIC SLOPE STABILITY RESULTS

0 250 500

SCALE: 1" = 250' SCALE IN FEET

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.	20170041
DRAWN BY:	B. Foster
CHECKED BY:	T. Parkhill
DATE:	8/8/2016
REVISED:	-

SLOPE STABILITY RESULTS

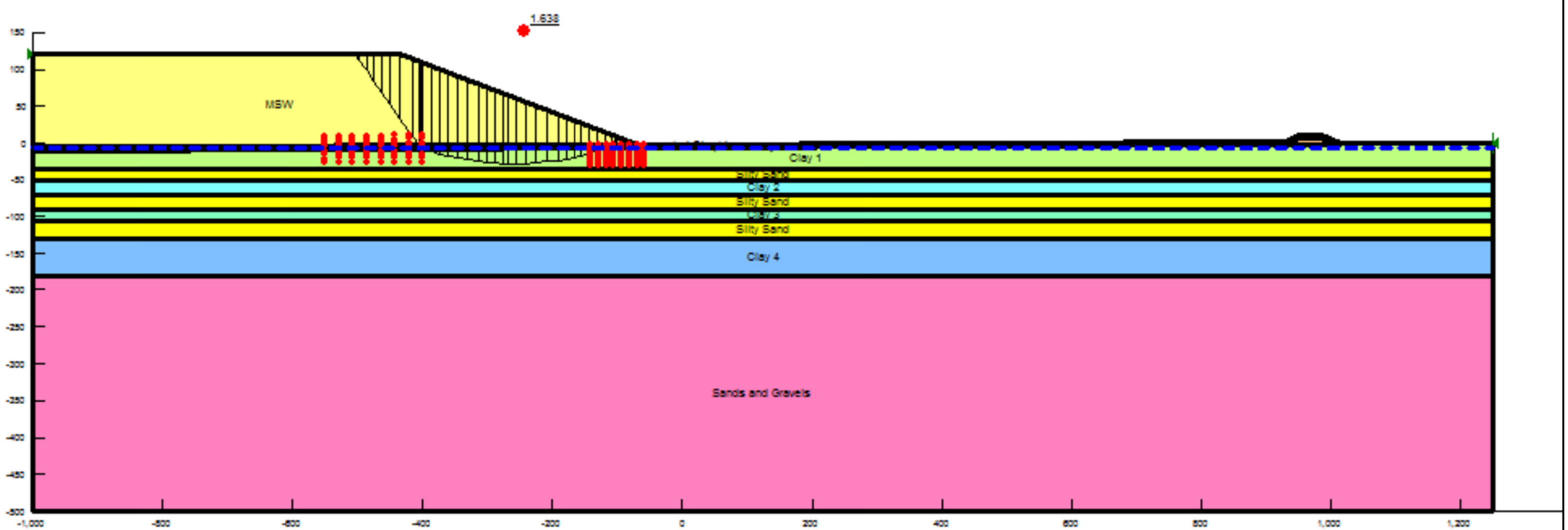
Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

FIGURE

D-2

NOTE: Slope stability results shown looking North to South
(Section A-A' in Figure 1 - 3 shown looking South to North)

Name: MSW Model: Mohr-Coulomb Unit Weight: 60 pcf Cohesion': 300 psf Phi': 32 ° Phi-B: 0 °
Name: Clay 1 Model: S=f(depth) Unit Weight: 122 pcf C-Top of Layer: 1,000 psf C-Rate of Change: 20 psf/ft C-Maximum: 0 psf
Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 122 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 °
Name: Clay 3 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 2,500 psf
Name: Clay 2 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,500 psf
Name: Clay 4 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,500 psf
Name: Sands and Gravels Model: Mohr-Coulomb Unit Weight: 150 pcf Cohesion': 0 psf Phi': 38 ° Phi-B: 0 °
Name: HDPE Liner Model: Mohr-Coulomb Unit Weight: 60 pcf Cohesion': 0 psf Phi': 22 ° Phi-B: 0 °
Name: Compacted Clay Liner Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 22 ° Phi-B: 0 °



CASE 3 - STATIC SLOPE STABILITY RESULTS

0 250 500

SCALE: 1" = 250' SCALE IN FEET

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.	20170041
DRAWN BY:	B. Foster
CHECKED BY:	T. Parkhill
DATE:	8/8/2016
REVISED:	-

SLOPE STABILITY RESULTS

Salt Lake County Landfill
6030 W California Ave
Salt Lake City, Utah

FIGURE

D-3

KLEINFELDER
Bright People. Right Solutions.

Appendix E

APPENDIX E

Important Information about your Geotechnical Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org