ECS Southwest, LLP

Geotechnical Engineering Report

National Cemetery Development

Cedar City Rural Initiative

2181 W. 1600 S.
Cedar City, Utah

ECS Project Number 17:5539

April 22nd, 2021

April 22, 2021

Mr. Mark Dyck
Gordon
148 S. Queen Street, Suite 201
Martinsburg, WV 25401

ECS Project No. 17:5539

Reference: Geotechnical Engineering Report
National Cemetery Development
Cedar City Rural Initiative
2181 W. 1600 S.
Cedar City, Utah

Dear Mr. Dyck:

ECS Southwest, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. ECS Southwest, LLP (ECS) conducted this subsurface exploration and geotechnical engineering evaluation in accordance with ECS Proposal No. 17-6783 dated December 15, 2020. This report presents our understanding of the geotechnical aspects of the project, the results of the field exploration and laboratory testing conducted, and our recommendations for design and construction.

It has been our pleasure to be of service during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the subsurface conditions considered for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

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TABLE OF CONTENTS

APPENDICES

Appendix A – Figures

- Site Location Diagram
- Exploration Location Diagram
- Site Geologic Map
- Surface Features Map
- Subsurface Profiles

Appendix B – Field Operations

- Boring Logs
- Test Pit Logs
- Reference Notes for Boring Logs
- CAT 321D Specifications

Appendix C – Geotechnical Laboratory Testing

- Laboratory Testing Summary

Appendix D – Analytical Laboratory Testing

- Sulfides
- Chlorides
- Sulfates
- pH
- Laboratory Resistivity
- Oxidation Reduction Potential

Appendix E – Photograph Log

- Rock Core & Progress Photographs

EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal geotechnical recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- In general, the subject development is considered geotechnically feasible, provided the recommendations of this report are implemented in the design and construction of the project. The predominant geotechnical and geological constraints affecting the site development are the potential to encounter very hard bedrock and large boulders in excavations, the potential to encounter caving soils in excavations, and the soil frost heave potential for shallow foundations.

- Earthwork, foundation and utility contractors should be prepared to encounter large boulders and very hard bedrock in some excavations, which will require rock excavation techniques and tooling for removal, and likely some limited blasting in confined excavations and where very hard basalt bedrock is present. Uneven excavations may result from areas containing these materials, which should be considered in estimation of construction material quantities.

- The proposed service shelter and pump house building can be supported by conventional strip and spread footings. The net allowable bearing capacity for footings at least 12 inches wide and deep and founded on properly compacted soil is 3,000 psf. Exterior footings should be embedded at least 30 inches beneath existing grade for frost protection considerations.

- Light duty pavements can consist of 2 inches asphaltic concrete on 8 inches base on a prepared subgrade, or 5 inches concrete on a prepared subgrade. Moderate duty pavements can consist of 2½ inches asphaltic concrete on 10 inches base on prepared subgrade, or 5½ inches concrete on a prepared subgrade. Heavy duty pavements can consist of 6½ inches concrete on a prepared subgrade.

1.0 INTRODUCTION

1.1 General

The purpose of this study was to provide geotechnical information for the design of foundations for the proposed structures, pavements and associated appurtenances and to provide commentary on excavation requirements anticipated for the proposed construction.

The recommendations developed for this report are based on project information provided by the Client. This report contains the results of our subsurface explorations and geotechnical laboratory testing programs, site characterization, engineering analyses, and recommendations for the design and construction of the proposed improvements.

1.2 Scope of Services

To obtain the necessary geotechnical information required for evaluation of subsurface soil conditions supporting the proposed structures, 30 soil borings were drilled and sampled to depths up to about 15 feet beneath the existing ground surface at the site. Additionally, 20 test pits were advanced to depths up to about 15 feet each beneath the existing ground surface at the site. The soil borings and test pits were performed at locations selected by ECS. A laboratory testing program was also implemented to characterize the physical and geotechnical engineering properties of the subsurface soils/rock.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following:

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface features and site conditions.
- A review of site geologic conditions.
- A review of subsurface soil/rock stratigraphy with pertinent available physical properties.
- Logs of our soil test borings and test pits.
- A preliminary review of corrosion test results.
- Recommendations for site preparation, grading and drainage.
- Recommendations for foundation design and construction.
- Recommendations for the structural design of pavements.

The scope of services for this project did not include an environmental assessment for determining the presence or absence of wetlands, or corrosive, hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

1.3 Authorization

Our services were provided in accordance with ECS Proposal No. 17-6783 dated December 15, 2020. This study was authorized via issuance of the Task Order for Gordon project No. 3336-0801 (Tasks Nos. 3336-0801-001A-002A, 3336-0801-001A-002B, and 3336-0801-001A-002C) dated March 4, 2021 pursuant to the Master Services Agreement between Gordon and ECS dated August 24, 2020.

2.0 PROJECT INFORMATION

2.1 Project Location

The project site is located at 2181 W. 1600 S., Cedar City, Utah. The location is depicted in the below Figure 2.1.1.

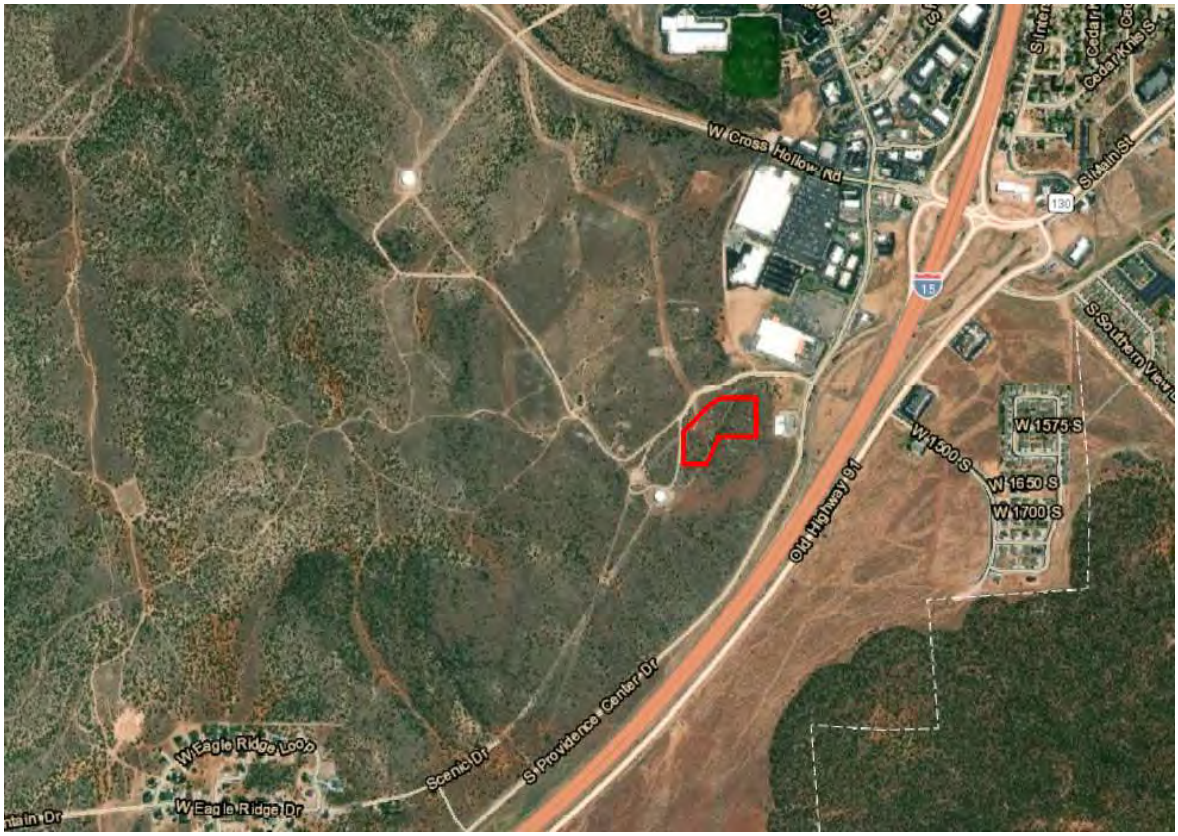


Figure 2.1.1 Site Location

2.2 Current Site Conditions

The site is currently undeveloped and contains sporadic trees, grassy underbrush, some unpaved drive paths, an existing corral, and some boulder outcrops. A surface feature map developed based on a visual review of the site in the field has been included in Appendix A for reference. The site's topographic high and low are approximately EL. 6,664 feet and EL. 5,589 feet and the site slopes downward from west to east.

2.3 Proposed Construction

It is understood that the proposed cemetery development will include pre-placed crypts, grave sites, a service shelter, a pump house, retaining walls, memorial wall, pavements and flatwork, a boundary fence, and associated appurtenances. It is understood that some moderate cuts are planned for the proposed grave-site and crypts, as well as for the proposed storm drain line. Structural loading information was not available at the time of this report and it is anticipated that the proposed structures will be supported by conventional strip and spread footings.

3.0 FIELD EXPLORATION

3.1 Field Exploration Program

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of geotechnical recommendations.

3.1.1 Test Borings

The subsurface conditions were explored by drilling a total of 30 soil borings at the site. Twenty-eight (28) borings were drilled to depths of about 15 feet each and 2 borings were drilled to depths of 10 feet each beneath the existing ground surface. Drilling was performed using a truck-mounted drill rig, utilizing ODEX casing system and rock coring drilling methodology.

The boring locations were determined by the client and identified in the field by ECS personnel using a handheld GPS unit. The approximate elevations listed on the boring logs were determined based on the provided survey. Some degree of error in these values should be understood, and these elevations should be considered approximate. The approximate boring locations are shown on the Exploration Location Diagram attached in Appendix A.

Field logs of the soils/rock encountered in the borings were maintained by the drill crew. After recovery, each geotechnical soil/rock sample was removed from the sampler and visually classified. Representative portions of each soil/rock sample were then bagged in plastic and placed in boxes and transported to our laboratory for further visual examination and laboratory testing. After completion of the exploratory operations, the boreholes were backfilled with the excess soil cuttings.

3.1.2 Test Pits

The subsurface conditions were explored by excavating 20 test pits. The test pits were excavated at the site to depths up to 15 feet, or to depths where the excavator experienced bucket refusal on large boulders or basalt bedrock. The test pit excavations were performed using a CAT 321 hydraulic excavator.

The test pit locations were determined and identified in the field by ECS personnel using a handheld GPS unit. The approximate elevations listed on the test pit logs were determined based on the provided survey. Some degree of error in these values should be understood, and these elevations

should be considered approximate. The approximate test pit locations are shown on the Exploration Location Plan attached in Appendix A.

The sizes of test pit excavations were variable depending on location and subsurface materials encountered. Test pit widths were generally about 2 feet to 4 feet wide depending on how even the excavation was due to cobbles and boulders present. Test pit lengths typically about 12 feet to 16 feet in total length, except for some approximately 20 feet to 25 feet in length excavations.

Field logs of the soils encountered in the test pits were maintained by an ECS representative. After recovery, each geotechnical sample was visually classified, and representative portions of each soil sample were then bagged in plastic and placed in bins and transported to our laboratory for further visual examination and laboratory testing. After completion of the exploratory operations, the test pits were backfilled with the excavated soils to the existing ground surface.

3.1.3 Penetration Tests and Sampling

Standard Penetration Tests (SPTs) were performed to obtain representative samples and penetration resistance measurements in general accordance with ASTM D 1586. Soil samples were obtained at various intervals with the 1.625-inch inside diameter, 2-inch outside diameter, Split Spoon sampler. The Split Spoon sampler was first seated 6 inches to penetrate any loose cuttings, and then was driven an additional 18 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler each 6 inch increment was recorded. The penetration resistance "N-value" is defined as the number of hammer blows required to drive the sampler the middle 12 inches and is indicated on the test boring logs. In very dense materials such as weathered rock material, the SPT test is usually stopped after 50 blows from the hammer and the measurement is recorded as 50 blows per distance penetrated (i.e. 50 over 3 inches).

3.1.4 Rock Coring

Rock coring with the aid of an air compressor was performed using an Nx core barrel with an inside diameter of 2.125 inches. The rock core was measured to determine the Recovery Ratio (REC) and the Rock Quality Designation (RQD) index values. The REC value is equal to the total length of core recovered divided by the total length of core advance. The RQD value is defined as the percentage of core advance that is recovered in segments that are 4 inches or longer and is a qualitative index of the quality or physical integrity of the rock. Rock coring was performed in general accordance with ASTM D 2113. Rock core samples were placed in cardboard core boxes for transport to our laboratory.

3.2 Regional Geology & Faulting

The *Interim geologic map of the Cedar City, 7.5-minute quadrangle* indicates that the site is underlain by Cross Hollow Hills lava flows (Qbc_1), which generally consists of dark-gray, crystal-poor trachybasalt. Individual flows are typically 10 to 30 feet thick. The approximate location of the site on the geologic map is provided in the Regional Geologic Map in Appendix A.

Based on a review of the Utah Geological Survey Quaternary Fault & Fold Map, the subject site is located in close proximity to the Hurricane Fault Zone (Cedar City section), and the Cross Hollow Hills faults. The site is located within an area with common seismic activity, typically of small to

moderate in size earthquakes. Based on the USGS 2018 Long-term National Seismic Hazard Map, the site appears to fall within a zone of moderate seismic hazard.

3.3 Subsurface Characterization

The following section provides generalized characterizations of the geology encountered during our subsurface exploration. For specific subsurface information, refer to the boring and test pit logs in Appendix B.

Information from the test borings and test pits indicates that the stratigraphy may generally consist of 2 distinguishable strata within the exploration depths of approximately 15 feet. A general description of each stratum is included in the table below.

STRATUM	RANGE OF DEPTH (FT)	STRATUM DESCRIPTION AND CLASSIFICATION	WC RANGE	PI RANGE	N RANGE	UCS RANGE	RQD RANGE	REC RANGE
			WC AVG.	PI AVG.	N AVG.	UCS AVG.	RQD AVG.	REC AVG.
I	0 – (2-15)	OVERBURDEN & RESIDUAL SOILS: (GC) Clayey Gravel, (GP & GP-GC) Gravel, (SC) Clayey Sand, (SP & SP-SC) Sand, (CL) Lean Clay, Sandy Lean Clay, some (CH) Sandy Fat Clay, boulders and cobbles noted throughout the site at various depths; dark brown to reddish brown and gray to light brown and tan; loose to very dense, firm to very hard	1-18	17-39	5-50/0”	251.5-716.5**	38-83**	72-83**
			8	25	63	467.5**	61**	77**
II*	2 – 14+	BEDROCK: Basalt; generally gray to black; very hard	--	--	50/3”-50/0”	161.6-1,890.9	0-100	0-100
			--	--	50/1”	743.3	59	71

***Encountered in borings B-01, B-03, B-07, B-12, B-15, B-17, B-22, & B-24 and test pit TP-05, and possibly test pits TP-10, TP-12, TP-17, and TP-20. The bedrock materials in our exploration appeared to be basalt, and we did not identify alternate types of rock outside of the igneous rock category.**
****UCS, RQD, and REC data for stratum I is representative of probable boulders encountered.**

Notes: **Depth**- Soil Stratum depth from existing ground surface at the time of our geotechnical exploration
WC- Water Content, %
PI- Plasticity Index
N- Standard Penetration Test (SPT) value, field blows per foot
UCS- Unconfined Compressive Strength, tsf
RQD- Rock Quality Designation, %
REC- Rock Sample Recovery, %

Please refer to the attached boring logs, test pit logs, and laboratory data summary tables for a more detailed description of the subsurface conditions encountered, as the stratification descriptions above are generalized for presentation purposes.

3.4 Groundwater Observations

The borings and test pits were advanced using relatively dry excavation techniques to their completion depths, enabling the potential detection of the presence of groundwater. Groundwater was not encountered during drilling in the borings and test pits completed at the site. Upon completion of field operations, the boreholes and test pits were backfilled with excess excavated soils generated during our field operations.

The groundwater observations were typically made during and upon completion of the excavations. A few of the initial borings were also checked several hours after completion, prior to backfilling. Based on the granularity of the subsurface and the quantity of explorations completed, if groundwater was present in the proposed development area at the time of our exploration, it would have likely been encountered in at least one of those explorations, which it was not. If a water table was hypothetically present, it could influence foundation design values if within the influence zone of the footing, but the degree of influence would depend on how shallow the hypothetical groundwater table was in relation to bottom of footing.

It should be noted that water levels in open boreholes and test pits may require several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at the site may be subject to seasonal conditions, recent rainfall, drought or temperature effects. Clays and massive bedrock are generally not conducive to the presence of groundwater; however, gravels, sands and silts, and open fractures and solution features; where present, can store and transmit “perched” groundwater flow or seepage. Therefore, groundwater conditions should be evaluated just prior to and during construction.

4.0 GEOTECHNICAL LABORATORY TESTING

Samples were transported to the ECS laboratory where they were examined and visually classified by an ECS geotechnical engineer using the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. To aid in classification of the soils and determination of their selected engineering characteristics, a testing program was conducted on selected samples in general accordance with the following standards:

LABORATORY TESTING	TEST STANDARD
Moisture Content	ASTM D 2216
Atterberg Limits	ASTM D 4318
Sieve Analysis	ASTM D 1140 and ASTM D 422
Uniaxial Compressive Strength	ASTM D7013

Results of the laboratory tests are included in the appendices on the boring and test pit logs and are presented on the laboratory test summary tables. Laboratory test results were used to classify the soils encountered as outlined by USCS in general accordance with ASTM D 2487. The USCS group symbols for each soil type are indicated in parentheses with the soil descriptions on the test logs.

Samples were returned to our laboratory in Austin, Texas. Samples not tested in the laboratory will be stored for a period of 60 days subsequent to submittal of this report and will be discarded after this period, unless we receive alternate instructions regarding their disposition.

5.0 DESIGN RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, the recommendations of this report should be reviewed and revised. It is recommended that ECS conduct a geotechnical review of the project plans (prior to issuance for construction) to check to see that ECS' geotechnical recommendations have been properly interpreted and implemented. This report considers that building finished floor elevations will be within close proximity to existing grade. If finished grades deviate from existing grade, the recommendations provided below should be evaluated by our office.

5.1 Conventional Strip and Spread Footing Foundations

The proposed service shelter and pump house building can be supported by conventional strip and spread footings. The net allowable bearing capacity for footings at least 12 inches wide and 30 inches deep and founded on undisturbed native soils or properly compacted fill is 3,000 psf.

For resistance to lateral loads, a coefficient of friction of 0.35 between the base of the foundation elements and underlying bearing soils is recommended. In addition, for footings cast directly against undisturbed soil excavation sidewalls, a passive resistance equal to an equivalent fluid weighing 250 pounds per cubic foot acting against the foundation may be used to resist lateral forces, respectively. The recommended lateral resistance values are ultimate values and a suitable factor of safety should be used in design.

Where utility trenches or other excavations are located adjacent to foundations, the bottom of the footing should be located below an imaginary 1:1 (horizontal to vertical) plane projected upward from the nearest bottom edge of the utility trench.

The uplift resistance of a shallow foundation formed in an open excavation will be limited to the weight of the foundation concrete and the soil above it. For design purposes, the ultimate uplift resistance should be based on effective unit weights of 105 and 150 pcf for soil and concrete, respectively. This value should be reduced by an appropriate factor of safety to arrive at the allowable uplift load. If there is a chance of submergence, the buoyant unit weights should be used.

Post-construction total and differential (over a 40-foot distance) settlements for foundations constructed as recommended herein are anticipated to be about one (1) inch and one-half (½) inch, respectively. Contraction, control, or expansion joints should be designed and placed in various portions of the structure. Properly planned placement of these joints will assist in controlling the degree and location of material cracking which normally occurs due to material shrinkage, thermal effects, soil movements, and other related structural conditions.

Footing excavations should have firm bottoms and be free from slough prior to concrete or reinforcing steel placement. The foundation excavations should be observed by ECS prior to placement of reinforcing steel or concrete to observe the exposed ground conditions.

5.2 Non-Structural Slab-on-Grade Floors

The design of any grade-supported floor slab should take into consideration the interaction between the slab and the supporting soils in resisting moments and shears induced by applied loads. Several design methods use the modulus of subgrade reaction, k, to account for soil properties in design. The modulus of subgrade reaction is a spring constant that depends on the soil type, the degree of compaction and the moisture content. The k-value presented in the following table can be used for the design of flat, grade-supported floor slabs for this project. The k-value assumes that soil materials have been properly placed and compacted beneath the slab and that site drainage is good. Adequate construction joints and reinforcement should be provided to reduce the potential for cracking of the floor slabs due to differential movement.

SUBGRADE TYPE	K-VALUE, PCI
Compacted Native Soils	125
6 Inches Compacted Aggregate Base Course (per Section 02721 of the UDOT 2017 Standard Specifications for Road and Bridge Construction) on Compacted Native Soils	175

Where moisture sensitive floor coverings or equipment will be installed, we recommend that at least a 10 mil vapor retarder be used beneath the slab. The vapor retarder should conform to ASTM E1745, Class C or better and shall have a maximum water vapor permeance of 0.044 when tested in accordance with ASTM E96. Consideration to specifying a thicker, more durable vapor retarder should also be made where anticipated construction traffic dictates. If a vapor retarder is considered to provide moisture protection, special attention should be given to the surface curing of the slabs to minimize uneven drying of the slabs and associated cracking and/or slab curling. Please refer to the latest edition of ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials and ASTM E 1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs for additional guidance on this issue.

5.3 Seismic Design Considerations

For the purposes of seismic design, a Site Class D (Very Stiff Soil) as defined in the 2018 International Building Code (IBC) / ASCE 7 is recommended for use at the project site. The site class is based on our review of geologic maps and literature and the subsurface conditions encountered in our soil borings. Using this site class and the location of the project site (lat. 37.6486°, long.

-113.0908°), probabilistic ground motion values were determined for this project and are shown in the following table:

PERIOD (SECONDS)	DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETERS	SITE COEFFICIENT, FA	SITE COEFFICIENT, FV
0.2	0.583 (S_{DS})	1.233	---
1.0	0.288 (S_{D1})	---	1.959

It should be noted that our borings and test pits at the project site extended to maximum depths of about 15 feet below the ground surface, whereas ASCE 7 site classifications are based on characterization of the upper 100 feet of the soil profile. The seismic parameters shown in the above table are based on the information provided in the IBC manual on Tables 1613.3.3(1) and 1613.3.3(2), the site classification, and mapped spectral response accelerations at the short and one (1) second time periods. The above parameters were developed using the SEAOC/OSHPD seismic design maps web tool, and the 2015 IBC design provisions.

5.4 Retaining Walls

The magnitude of the lateral earth pressures on retaining walls is dependent upon the in-situ material behind the wall; and if displaced, the type of material used to backfill the "active zone" behind the wall. The magnitude of the earth pressure is also dependent upon whether the active zone is allowed to drain water freely. The active zone can be considered as the area behind the structure within a boundary created by a 45 degree angle extending from the outside edge of the foundation heel upward to the ground surface.

The lateral earth pressures for drained, level soil backfill are expressed in terms of pounds per cubic foot (psf/ft.) "equivalent fluid" weight applied in a triangular distribution pattern as listed below. If the walls are free to deflect or rotate slightly at the top they may be designed using "active" lateral earth pressures. If the walls are laterally restrained at the top, "at-rest" lateral earth pressures should be used for the retaining wall design. Where multiple material types are used within the active zone, the higher values below should be used. The equivalent fluid weights shown in the table do not include any safety factors and do not account for any surcharges. Lateral loads from uniform surcharges on the wall backfill can be calculated by multiplying the vertical surcharge by the below earth pressure coefficients and should be considered as rectangular loads acting on the full wall height. An increase of 1 pcf and 1.5 pcf should be added to the active and at-rest earth pressures; respectively, for each degree of inclination of backfill.

SOIL DESCRIPTION	TOTAL UNIT WEIGHT (PCF)	ESTIMATED FRICTION ANGLE	ACTIVE EARTH PRESSURE COEFFICIENT	AT-REST EARTH PRESSURE COEFFICIENT	DRAINED ACTIVE EARTH PRESSURE (PSF/FT)	DRAINED AT-REST EARTH PRESSURE (PSF/FT)
Undisturbed or Compacted Native Soil	120	26	0.39	0.56	47	67

SOIL DESCRIPTION	TOTAL UNIT WEIGHT (PCF)	ESTIMATED FRICTION ANGLE	ACTIVE EARTH PRESSURE COEFFICIENT	AT-REST EARTH PRESSURE COEFFICIENT	DRAINED ACTIVE EARTH PRESSURE (PSF/FT)	DRAINED AT-REST EARTH PRESSURE (PSF/FT)
Select Fill	120	28	0.36	0.53	43	64
Undisturbed/Cemented Basalt Bedrock	145	36	0.26	0.41	38	60
ASTM C33 Size #56, #57 or #467 Stone	110	30	0.33	0.50	37	55
Compacted Manufactured Sand (< 8% Fines)	120	30	0.33	0.50	40	60
Compacted Aggregate Base	135	36	0.26	0.41	35	56

For sliding resistance, a coefficient of friction of 0.35 is recommended between the base of the foundation elements and the underlying soils. In addition, for footings cast directly against excavation sidewalls, a passive resistance equal to an equivalent fluid applying 250 pcf may be used to resist lateral forces for undisturbed soils. The passive resistance should be neglected in the upper 12 inches of soil unless the ground immediately in front of the footing is covered with concrete or other impervious pavement. The above values are ultimate values, and an appropriate safety factor should be used in design.

Retaining walls outside of prepared building areas can be supported by spread footing foundations at least 30 inches deep using an allowable bearing capacity of 3,000 psf at the bearing surface. Footing excavations should have firm bottoms and be free from slough prior to concrete or reinforcing steel placement. The geotechnical engineer should be allowed to observe foundation excavations prior to reinforcing steel or concrete placement to confirm anticipated ground conditions.

Retaining walls should be waterproofed as required by the project architect. Subdrain systems and/or drainboard composites are recommended to reduce hydrostatic pressures on retaining walls. A subdrain system can consist of 4 inch perforated pipe placed at the base of the retaining wall and surrounded by ASTM C33 Size #57 stone completely wrapped in Mirafi 140N or 160N filter fabric, or equivalent reviewed by the geotechnical engineer. The drainrock wrapped in fabric should be at least 12 inches wide and extend from the base of the wall to within two feet of the ground surface. The upper two feet of backfill should consist of compacted native soil or other impervious pavement. The retaining wall drainage system should be sloped to outlet pipes draining away from the foundations and pumped to the surface as grades require. The use of drainage openings through the base of the wall (weep holes, etc.) is not recommended where the seepage could be a nuisance or otherwise adversely impact the property adjacent to the base of the wall. The subdrain system should be checked periodically to confirm functionality; failure of the subdrain system will affect the design lateral earth pressures and the retaining wall stability. If subdrain systems are

determined to not be practical, full hydrostatic pressures should be incorporated into the wall design.

As an alternative to a stone and fabric backdrain, a prefabricated drainage composite (drainboard) such as MiraDRAIN 2000, or reviewed equivalent, can be used behind the retaining wall. The drainboard should extend from the base of the wall to within two feet of the ground surface and should be installed in accordance with manufacturer specifications. A subdrain collector pipe surrounded with at least 5 cubic feet per foot size #57 stone (wrapped in filter fabric) should be installed at the base of the drainboard; or alternatively, an engineered system can be selected with sufficient capacity for direct connectivity to a closed pipe system. The groundwater should be conducted to an appropriate discharge or sump pump facility.

Where free-draining, clean granular materials will be used to backfill the walls, and where structures, pavements or other improvements will be located closely behind the retaining walls, it is recommended that all clean granular materials be separated from the soils and fills with the use of the above stated filter fabrics. The use of the filter fabric can greatly reduce the intrusion of the soils into the void spaces of the clean granular materials. Intrusion of the soils into the void spaces causes a net ground loss and can cause settlement of the ground surface and overriding improvements. It is recommended that soils classified as CH (Fat Clay) not be used within the active zone of retaining wall backfill.

The retaining wall backfill should be compacted and tested in maximum 8 inch lifts to be at least 95 percent of the standard Proctor maximum dry density (ASTM D 698) at moisture contents between optimum and plus three (+3) percentage points of the optimum moisture content.

5.5 Pavement Design

ECS has prepared the following recommendations for the design and construction of both flexible and rigid pavement systems for use on the subject project. The "AASHTO Guide for Design of Pavement Structures" published by the American Association of State Highway and Transportation Officials was used to develop the pavement thickness recommendations in this report. This method of design considers pavement performance, traffic, roadbed soil, pavement materials, environment, drainage and reliability. Each of these items is incorporated into the design methodology.

We have based our analysis on the following Equivalent Single Axle Load (ESAL) information, which considers a load of 18 kip/per axle, and pavement-related subgrade design parameters, which are considered to be typical for the area. The AASHTO Guide for Design of Pavement Structures uses this as the basis of traffic design and provides a procedure to convert a mixed traffic stream of different axle loads into the standardized ESAL.

A CBR (California Bearing Ratio) value of 3.0 percent was selected for design purposes. The CBR value was estimated based on ECS's knowledge and experience with similar soils and projects in this area.

PAVEMENT DESIGN PARAMETERS	
RELIABILITY	70
INITIAL SERVICEABILITY INDEX, FLEXIBLE PAVEMENTS	4.2
INITIAL SERVICEABILITY INDEX, RIGID PAVEMENTS	4.5
TERMINAL SERVICEABILITY INDEX, ALL PAVEMENTS	2.0
STANDARD DEVIATION, FLEXIBLE PAVEMENTS	0.45
STANDARD DEVIATION, RIGID PAVEMENTS	0.35

Based on the design parameters listed above, we developed recommendations for "light duty," "moderate duty" and "heavy duty" pavement sections. "Light duty" pavements are intended for general parking areas with passenger vehicles only and have an approximate capacity of 20,000 ESAL. "Moderate duty" pavements are intended for areas subject to channelized traffic and fire lanes and have an approximate capacity of 80,000 ESAL. "Heavy duty" pavements are intended for areas subject to heavier vehicles with extensive turning, starting and stopping, such as pavement aprons associated with trash enclosures, and have an approximate capacity of 250,000 ESAL. If the owner or other members of the design team feel that the ESAL values used for design are not appropriate, ECS should be notified in writing, so any new information can be reviewed, and if necessary, the pavement recommendations revised accordingly.

The minimum recommended thickness for both hot mixed asphalt concrete (HMAC) and reinforced Portland cement concrete (PCC) pavement sections are presented in the following table for the described "light", "moderate" and "heavy" traffic conditions.

RECOMMENDED PAVEMENT SECTION OPTIONS						
COMPONENT	**LIGHT-DUTY 20,000 ESALS**		**MODERATE-DUTY 80,000 ESALS**		**HEAVY-DUTY 250,000 ESALS**	
	RIGID	**ASPHALT**	**RIGID**	**ASPHALT**	**RIGID**	**ASPHALT**
Portland Cement Reinforced Concrete (PCC)	5.0 in	--	5.5 in	--	6.0 in	--
Hot Mixed Asphalt Concrete (HMAC)	--	2.0 in	--	2.5 in	--	--
Aggregate Base (ABC)	--	8.0 in	--	10.0 in	--	--

The pavement sections described above are for general-purpose usage for the anticipated subgrade conditions and were designed using the AASHTO Pavement and Analysis System. An aggressive

maintenance program to keep joints and cracks sealed to prevent moisture infiltration will help extend the pavement life.

We recommend that rigid pavement sections be used in all heavy truck traffic areas. The concrete pavement should extend throughout the areas that require extensive turning and maneuvering of the delivery vehicles, etc. Waste dumpster pads, loading areas and other heavily loaded pavement areas that are not designed to accommodate these conditions often experience localized pavement failures, particularly if flexible pavement sections are used.

5.5.1 Pavement Materials

Recommendations regarding material requirements for the various pavement sections are summarized below:

Portland Cement Concrete - Concrete used for paving should have a minimum compressive strength of 3,500 psi at 28-days. The air content at the point of placement should range from 3 to 6 percent. The concrete pavements should be reinforced and jointed per current ACI recommendations.

Hot Mix Asphalt Concrete (HMAC) Surface Course - The asphalt concrete surface course should be mixed, placed and compacted in conformance with the requirements of Sections 02741 and 02745 of UDOT 2017 Standard Specifications for Road and Bridge Construction.

Aggregate Base Course - Aggregate base should be placed in maximum 6 inch compacted lifts. The base materials should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557. Flexible base materials should be moisture conditioned to between minus two (-2) and plus three (+3) percentage points of the optimum moisture content. Aggregate base is recommended to consist of materials meeting the requirements of Section 02721 of the UDOT 2017 Standard Specifications for Road and Bridge Construction.

5.5.2 Rigid Pavement Considerations

Joints are typically placed in rigid pavements to control cracking, to facilitate construction, and to isolate a section of pavement from a structure or an adjacent pavement section. Joints used to control cracking are typically known as contraction or control joints as they are intended to control cracking that arises out of the shrinkage of concrete as it cures. Construction joints are used to provide clean breaks between pavement sections that result from the construction process. Isolation joints (or expansion joints) are used to separate the pavement from other structures or pavements and typically include the use of compressible materials in the joint as opposed to contraction or construction joints. Contraction joints should be spaced no greater than 15 feet between the nearest parallel joints with joint depths of at least one-quarter (¼) of the slab thickness. Contraction and construction joints should be no wider than one-eighth (⅛) of an inch whereas isolation joints may be up to one (1) inch wide.

Steel reinforcement of concrete is typically not necessary for concrete pavements with construction or isolation (expansion) joint spacing closer than 15 feet. When joints are spaced greater than 15 feet, steel reinforcement can be used to control the width of cracks that form between these joints,

such the fracture faces that form in the concrete are held together. Steel reinforcement is also used where subgrade conditions are not likely to provide uniform support to the concrete pavement. Generally, sites with expansive soils present are often unable to provide such support to rigid pavement sections. Therefore, reinforcing steel can be used to span between construction and isolation (expansion) joints and should consist of at-minimum No. 3 bars spaced 18 inches on-centers each way. The rebar should be Grade 60 steel.

As with steel reinforcement, load transfer devices such as dowels are typically not necessary for most parking lots. However, in situations where heavy loads are present or the subgrade may not provide uniform support to the pavement, dowels are commonly used to transfer loads across joints. Smooth dowels can be used for this purpose and should be utilized as recommended in the following table.

DOWEL DESIGN INFORMATION				
SLAB THICKNESS, IN.	**DOWEL DIAMETER, IN.**	**MIN. DOWEL EMBEDMENT EACH SIDE, IN.**	**MIN. DOWEL LENGTH, IN.**	**DOWEL SPACING ON-CENTERS, IN**
5.0	⅝	5	12	12
5.5	¾	6	14	12
6.0	⅞	7	16	12

The joint and reinforcing design of a rigid pavement system is largely a function of geometry for the pavement area. The proper length of concrete panels (defined as the distance between discontinuous pavement sections; e.g. between construction or isolation joints, or a combination of the two) and the location of contraction, construction, and isolation (expansion) joints are not included as a function of the above concrete pavement guidelines. Rather, these features should be determined based on the geometry and construction sequencing of the pavement. Actual joint spacing should be based on actual pavement areas and final panel lengths so that joints are evenly spaced. Joints should be designed to form approximately square panels where geometrically feasible.

The values provided herein are guidelines and the recommendations selected by the project civil engineer and any guidelines not provided or mentioned herein should not exceed the American Concrete Institute (ACI) 330R recommendations.

5.5.3 Pavement Drainage, Subdrainage, and Trenching

Longitudinal cracks and apparent distress due to expansive soils may appear in the pavement after construction and the introduction of landscape irrigation. These cracks and distress are not pavement failures with respect to traffic support, although they may be aesthetically undesirable. In addition, without regular maintenance, the cracks can allow additional moisture intrusion and rapid degradation of the pavement section. The pavement sections are primarily designed to support the traffic and will not resist the forces generated by swelling soils.

Positive drainage should be provided on and around pavement areas to avoid ponding of water. Irrigation of lawn and landscaped areas adjacent to the pavements should be moderate, with no

excessive wetting or drying of soils. If landscaped islands are provided, they should be designed to restrict excess water from migrating to the pavement subgrade by using self-contained beds, raised planter boxes, vertical moisture barriers, and/or edge drains. Curbs should extend through the base course and at least 4 inches into the underlying subgrade. Good perimeter surface drainage guiding surface water away from the pavement area is also recommended.

5.6 Soil Corrosivity

Corrosion of metals is an electrochemical process involving oxidation (anodic) and reduction (cathodic) reactions on metal surfaces. For metals in soil or water, corrosion is typically a result of contact with soluble salts found in the soil or water. This process requires moisture to form solutions of the soluble salts. Factors that influence the rate and amount of corrosion include the amount of moisture, the conductivity of the solution (soil and/or water), the hydrogen activity of the solution (pH), and the oxygen concentration (aeration). Other factors such as soil organic content, soil porosity, and texture indirectly effect corrosion of metals in soil by affecting the other factors listed above.

Characterizing the corrosivity of an environment is complicated due to the interaction of the variables described above. For example, a metal buried in an aerated or disturbed soil with a particular resistivity and soluble chloride concentration generally will not experience the same amount of corrosion as a similar metal placed in the same soil in a compacted, less aerated state.

Chloride ions from soil can lead to corrosion of steel reinforcement in concrete and steel structures by breaking down the normally present layer of oxides (passive layer) present on the steel surface. A chloride concentration of 500 parts per million (ppm) or greater is generally considered highly corrosive to steel.

Similar to chlorides, sulfate ions may also lead to accelerated corrosion of steel reinforcement. In addition to causing metals to corrode, high amounts of sulfates are deleterious to concrete. Sulfates react with lime in the concrete to form expansive products that cause the concrete to soften and crack. Consequently, the concrete weakens. Cracked concrete is more susceptible to attack by water and other aggressive ions that may accelerate the process.

The presence of high acidity, pH of 5.5 or less, in soil or water is also considered a corrosive condition. Soil or water with a pH of 5.5 or less can react with the lime in concrete to form soluble reaction products that can easily leach out of the concrete. The result is a more porous, weaker concrete. Acidic conditions often cause discoloration of the concrete surface. A yellowish or rusted color distributed over the concrete surface should be investigated.

ACI 318 provides the following evaluation criteria with respect to concrete mix designs for concrete in contact with the ground, as well as additional detail regarding acceptable cement types:

SULFATE EXPOSURE	WATER-SOLUBLE SULFATE IN SOIL, PERCENTAGE BY WEIGHT OR (MG/KG)	CEMENT TYPE	MAX. WATER CEMENTITIOUS RATIO BY WEIGHT	MIN. UNCONFINED COMPRESSIVE STRENGTH, PSI
Negligible	0.00-0.10 (0-1,000)	NA	NA	NA
Moderate	0.10-0.20 (1,000-2,000)	II, IP (MS), IS (MS)	0.50	4,000
Severe	0.20-2.00 (2,000-20,000)	V, IP (HS), IS (HS)	0.45	4,500
Very Severe	Over 2.00 (20,000)	V plus pozzolan	0.45	4,500

Please see the below tabulated water soluble sulfate content results corresponding to the samples obtain from the borings locations at the indicated depths.

BORING LOCATION	DEPTH	WATER SOLUBLE SULFATE CONTENT (MG/KG)	SULFATE EXPOSURE
B-3	4’-6’	41.7	Negligible
B-8	2’-4’	113	Negligible
B-13	13’-15’	6.45	Negligible
B-19	2’-4’	25.3	Negligible
B-21	0’-2’	13.4	Negligible
B-27	4’-6’	57.0	Negligible

Hence, in accordance with the above tables, the water-soluble sulfates are anticipated to have a negligible impact on buried concrete at the site.

Corrosion test results of soil samples obtained at the site can be evaluated based on ASTM A888 methods. Table X2.1, Soil-Test Evaluation, from the ASTM procedure is presented below. If the summed points are equal to 10, the soil should be considered corrosive to cast iron pipe.

Soil Characteristics	Points	Soil Characteristics	Points
Resistivity, ohm-cm, based on single probe or water-saturated soil box.		**Redox Potential, mV**	
< 700	10	> +100	0
700 – 1,000	8	+50 to +100	3.5
1,000 – 1,200	5	0 to 50	4
1,200 – 1,500	2	Negative	5
1,500 – 2,000	1		
> 2,000	0	**Sulfides**	
		Positive	3.5
pH		Trace	2
0 – 2	5	Negative	0
2 – 4	3		
4 – 6.5	0	**Moisture**	
6.5 – 7.5	0	Poor drainage, continuously wet	2
7.5 – 8.5	0	Fair drainage, generally moist	1
> 8.5	3	Good drainage, generally dry	0

Please see the below tabulated resistivity, pH, redox potential, sulfide, and chloride results corresponding to the samples obtain from the borings locations at the indicated depths.

BORING LOCATION	DEPTH	RESISTIVITY (OHM-CM)	pH	REDOX POTENTIAL (MV)	SULFIDES (MG/KG)	CHLORIDES (MG/KG)	ASSUMED DRAINAGE	TOTAL POINTS
B-3	4’-6’	4030	8.76	361	3.14	15.8	Fair	6
B-8	2’-4’	2470	8.61	279	4.10	43.1	Fair	6
B-13	13’-15’	6010	9.16	396	2.05	15.0	Fair	6
B-19	2’-4’	4610	8.53	413	<1.61	13.5	Fair	6
B-21	0’-2’	4220	8.16	421	4.38	5.83	Fair	3
B-27	4’-6’	4760	8.73	419	4.53	7.03	Fair	6

Hence, in accordance with the above table, soils at the site a generally considered to have a low to moderate potential for corrosion. Our sample receipt was delayed by the freeze our region experienced during the time of this subsurface exploration. The DHL lab report included in Appendix D notes that sulfide testing occurred outside of the EPA recommended holding time. The maximum points sulfides contribute to the corrosion analysis is 3.5, and under a worst-case scenario of assigning 3.5 points to each sample for positive sulfides, the total corrosion points for each sample analyzed would still be under 10 points (10 points or greater indicates a corrosive condition to cast iron pipes).

These results are preliminary, and provide information on the specific soils sampled and tested. Other soil at the site, and imported fill materials, may be more or less corrosive. Water-soluble sulfate concentrations can vary due to the addition of fertilizer, irrigation and other possible development activities. Providing a detailed assessment of the corrosion potential of the site soil is not within our scope of work. A qualified corrosion specialist should be contacted if a detailed evaluation is required.

5.7 Liquefaction Potential

Liquefaction is the phenomenon of soil behaving like a liquid due to rapid loading conditions that result in an increase in pore water pressure and a decrease in effective stress of the loaded soils. Ground conditions that are susceptible to liquefaction are saturated, coarse grained soils with a groundwater table near the surface. Cohesive soils are generally not susceptible to liquefaction. Based on our subsurface exploration and laboratory testing, the subsurface conditions encountered at the site did not appear to exhibit significant characteristics that pose a risk of liquefaction. Therefore, the liquefaction potential of the subject site is considered to be relatively low.

6.0 SITE PREPARATION, GRADING AND DRAINAGE

Preparation of the subgrade soils for areas to receive structures, fills or pavements should be conducted in accordance with the recommendations presented in the following sections.

6.1 General Site Preparation

Existing vegetation, organic laden soil, surficial debris, abandoned subsurface utilities, loose or soft soils, piled boulders and cobbles, and any other deleterious materials must be removed from the proposed construction areas and properly disposed. Excavations resulting from the removals should be cleaned down to firm soils and backfilled with general fill in accordance with this report.

After stripping and any required cuts have been completed, the subgrade soils should be scarified, moisture conditioned and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698 to a depth of at least 8 inches. The soils should be moisture conditioned to between optimum and plus four (+4) percentage points of the optimum moisture content just prior to compaction.

Proof-rolling should be performed where possible with a heavy (minimum 20 ton) rubber-tired vehicle such as a loaded dump truck. Soils that are observed to rut or deflect excessively under the moving load should be under-cut and replaced with compacted structural fill that meets the requirements of the section titled General Fill. All proof-rolling and under-cutting activities should be observed by ECS and should be performed preferably during periods of dry weather.

After stripping, removals, subgrade preparation, proof-rolling and evaluation has been completed, fill placement may begin where required. Excavated soil that meets the material requirements in the General Fill section below may be used as compacted fill. If suitable fill soils have to be imported to the site, they must meet the material and compaction requirements of the General Fill section of this report. Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of structural fill or other fill soils and aggregates.

The volume changes of on-site materials upon excavation and placement as general fill will vary depending on bedrock and soil type. Based on the estimated in-situ density and moisture contents

of materials encountered in our borings, the soils at the site would be expected to have a 0 to 10 percent bulking factor.

6.2 Building Pad Grading

After stripping (as discussed in the General Site Preparation section) and the required cuts have been completed, the subgrade soils should be scarified, moisture conditioned and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698 to a depth of at least 8 inches. The soils should be moisture conditioned to between optimum and plus four (+4) percentage points of the optimum moisture content just prior to compaction.

Proof-rolling should be performed where possible with a heavy (minimum 20 ton) rubber-tired vehicle such as a loaded dump truck. Soils that are observed to rut or deflect excessively under the moving load should be under-cut and replaced with compacted structural fill that meets the requirements of the section titled General Fill. All proof-rolling and under-cutting activities should be observed by ECS and should be performed during periods of dry weather.

After stripping, removals, subgrade preparation and evaluation has been completed, fill placement may begin. Fills in the building pad areas should consist of materials meeting the requirements of the Select Fill section below. Consideration should be given to creating an “all weather” working surface with the upper 6 inches of the select fill building pad. Such a working surface should consist of compacted aggregate base meeting the requirements of Section 02721 of the UDOT 2017 Standard Specifications for Road and Bridge Construction. The use of an “all weather” working surface can significantly improve the accessibility of the site to construction traffic during periods of wet weather.

The upper 18 inches of fill outside of the structures and adjoining concrete flatwork should consist of a properly compacted low permeability clay (CL) soil to reduce infiltration of moisture into the fill materials comprising the building pad. This clay layer may be replaced with asphalt or concrete pavement that extends to the edge of the structure foundation.

6.3 General Fill

General fill should consist of on-site or imported soils, provided they meet the requirements described below. All general fill materials should be free of organics, construction debris, deleterious materials, frozen soils, and should be free of rocks larger than 3 inches in greatest dimension. Proposed general fill should be evaluated and tested by ECS prior to placement in the field.

ECS recommends that general fill be placed in horizontal loose lifts of not more than 8 inches in thickness. Lift thickness should be decreased when using light compaction equipment. General fill should be compacted to at least 95% of the maximum dry density at moisture contents within the range of optimum to plus four (+4) percentage points of the optimum moisture content (ASTM D 698).

6.4 Select Fill

Select fill materials should be free of organics, construction debris, deleterious materials, frozen soils, and should be free of rocks larger than 3 inches in greatest dimension. Select fill should have

a Plasticity Index of 20 or less. Select fill should be evaluated and tested by ECS prior to placement in the field.

ECS recommends that select fill be placed in horizontal loose lifts of not more than 8 inches in thickness. Select fill should be compacted to at least 95% of the maximum dry density at moisture contents within the range of minus one (-1) to plus three (+3) percentage points of the optimum moisture content (ASTM D 698).

6.5 Drainage

Water should not be allowed to collect in the foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Final grading should be designed to promote positive drainage away from the structures and pavements. Soil areas within 10 feet of the buildings should slope at a minimum of 5 percent away from the structure. Adjacent pavements and concrete hardscape should slope at 1½ to 2 percent away from the structure. Roof leaders and downspouts should discharge onto paved surfaces sloping away from the structure or into a closed pipe system which outfalls to the street gutter pan or directly to the storm drain system.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Earthwork

Clayey soil is very sensitive to changes in moisture content. Subgrade support capacity will deteriorate when the moisture content increases. Effort should be made to keep fill, slab, pavement, and foundation subgrade areas properly drained and free of ponding water. Vehicle traffic on top of the subgrade should be avoided when the subgrade is visibly wet, and should be limited at other times. Site grading and fill placement should preferably be performed during drier seasons of the year.

Fill materials should not be placed on soils that have been recently subjected to precipitation or saturation. All wet soils should be removed or allowed to dry prior to continuation of fill placement operations. Borrow fill materials, if required, should not contain wet materials at the time of placement.

If any problems are encountered during the earthwork operations, or if site conditions deviate from those encountered during our subsurface exploration, ECS should be notified immediately to determine the effect on recommendations expressed in this report.

Certain construction practices can reduce the magnitude of problems associated with moisture content increases of subgrade soil for slabs and areas to receive compacted fill. The contractor should seal exposed subgrade areas at the end of the work day with a smooth drum roller to reduce the potential for infiltration of water into the subgrade. Site grading should be frequently evaluated to assure that surface runoff will drain away from slab and fill areas.

7.2 Shallow Foundations

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain exposed during periods of inclement weather. Therefore, foundation concrete should be placed as soon as possible after final excavation is achieved and after the subgrade has been evaluated by a representative of the geotechnical engineer. If the bearing soils are softened by surface water absorption or exposure to the environment, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the foundation excavation must remain open an extended period of time, or if rainfall is apparent while the bearing soils are exposed, we suggest that a 1 to 3-inch thick "mud mat" of "lean" concrete be placed over the exposed bearing soils before the placement of reinforcing steel.

7.3 Utility Trench Construction

Utility trenches in the building pads should be backfilled above the utility bedding and shading materials with select fill and general fill material outside the building pad areas. Utility trench backfill can act materially different than adjacent natural soils, even if properly placed and compacted. Differential movements may occur which can lead to crack development near the edges of utility trenches, riser structures, manholes, etc, with the more noticeable cracks appearing in deeper fill zones. This type of cracking is considered typical for this type of construction if special care is not taken to prevent it.

As an option to help mitigate the effects of differential soil movements, we recommend that fill placed at depths greater than 5 feet be compacted to no less than 98% of the maximum dry density between minus one (-1) and plus three (+3) percentage points of the optimum moisture content (ASTM D 698).

Utility trenches should be sealed with lean concrete, lean clayey soil, controlled low-strength material or flowable fill where the utility approaches and enters the building pad areas. This would reduce the potential for migration of water beneath the building through the bedding and shading materials in the utility trench.

7.4 Rock Excavation Considerations

Shallow bedrock and boulders were encountered in several areas at the site during our subsurface exploration and rock excavation techniques will be necessary for this project. For purposes of contract terms, we recommend that “rock” be defined as follows: “Rock shall be defined as those natural materials which cannot be excavated in an open excavation with a Caterpillar Model No. D-8, heavy duty tract type-tractor, weighted at not less than 285 hp (flywheel power) and equipped with a single-shank hydraulic ripper, capable of exerting not less than 45,000 lbs. breakout force, or equivalent machinery. For footings, utility trenches and pits, rock shall be defined as those materials that cannot be excavated with a Caterpillar Model No. 215D LC tract-type hydraulic excavator, equipped with a 42-inch wide short-tip radius rock bucket, rated at not less than 120 hp flywheel power with bucket-curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,000 lbs.” ECS completed several test pits at the site with reasonable efficiency, often extending to the planned completion depth of 15 feet, using a CAT 321D hydraulic excavator (see attached excavator equipment specifications in Appendix B). Some of the test pits experience refusal at depth on large boulders and/or basalt bedrock. The unconfined compressive strength

tests on the cored basalt bedrock and boulders encountered in limited areas of the site indicate the material was very hard, and would likely require blasting in excavations, where encountered. This condition is not anticipated to be ubiquitous throughout the site for each cut area and excavation planned, as evidenced by our ability to excavate the test pits in the majority our exploration locations to the planned completion depths of 15 feet beneath existing grade.

In confined excavations, such as utility trenches, excavation of dense residual soils typically requires the use of large track-mounted backhoes. Excavation of harder phases of weathered rock typically requires the use of large track-mounted backhoes, pneumatic spades, or light blasting. Refusal materials (apparent rock) normally require blasting in trench excavations or where very hard, cemented bedrock is present. Blasting in utility trenches should be done carefully to avoid damage to the surrounding materials. When the material to be excavated requires blasting, the contractor should comply with local and state requirements.

The subsurface materials that have SPT 'N' values equal to or greater than 50 that are not identified as Basalt generally appeared to be consistent with the material that was often rippable with a CAT 321D excavator, however these materials may not be rippable in some circumstances. A more thorough understanding of the rippability of this intermediate material that is very dense, but not identified as basalt rock, would require seismic refraction testing and comparison with Caterpillar rippability estimate charts for various materials.

8.0 FIELD OBSERVATIONS & TESTING

Personnel from ECS should perform the field observations and testing recommended in this report because of our familiarity with the project and site conditions. The performance of foundations and pavements is primarily controlled by the quality of the construction. To avoid misinterpretation of our recommendations, ECS should be retained to perform full time testing, observation, and documentation during construction of the foundations and pavements.

The performance of slabs and pavements placed on new fill material is controlled by the quality of the compaction and the materials selection for the fill material. ECS should be retained to perform testing and inspection during selection, placement, and compaction of the fill material.

8.1 Earthwork

Field observations and testing should be performed during the earthwork operations to document proper construction. Stripping should be observed by ECS to help identify unsuitable materials that should be removed prior to placement of fill, slab or pavement materials. Field observation and inspection should include final approval of subgrades prior to placement of compacted fill, slabs or pavements. Proof-rolling should be performed by a heavy rubber-tired vehicle such as a loaded dump truck on slab and pavement subgrades. Appropriate laboratory tests such as Proctor moisture-density tests and Atterberg Limits should be performed on samples of fill material and pavement base course material. Field moisture-density tests and visual observation of lift thickness and material types should be performed during compaction operations to document that the construction satisfies material and compaction requirements. The frequency of field density tests

should be at least 1 test per lift per 5,000 sf of building area, at least 1 test per lift per 10,000 sf of pavement area, and at least 1 test per lift per 150 linear feet of utility trench.

8.2 Shallow Foundations

Prior to concrete placement, the Geotechnical Engineer should observe the foundation excavations to determine if the foundations are being placed on suitable materials and to determine if all loose materials have been removed. Geotechnical probing or Dynamic Cone Penetrometer (DCP) tests can be performed to help evaluate the foundation bearing surfaces. In areas where the subgrade is soft or loose, the soil should be removed and foundations lowered to bear on firm compacted soils, or foundation subgrade elevations can be restored using properly compacted select fill or lean concrete (e.g. 2,000 psi). The selection of an alternative is controlled by the depth and condition of the subgrade. The Geotechnical Engineer should be consulted to determine the proper selection.

Footing dimensions and reinforcing steel should also be observed. Concrete material should be sampled and tested for compressive strength, and placement operations should be monitored to record concrete slump, temperature, air content, and age at time of placement. Concrete batch tickets should be provided by the supplier so that water-cement ratios and cement content can be checked and documented.

9.0 EXCAVATIONS

Earthwork, foundation and utility contractors should be prepared to encounter large boulders and very hard bedrock in excavations, which will require rock excavation techniques and tooling for removal, and likely some limited blasting in confined excavations and where very hard basalt bedrock is present. Uneven excavations may result from areas containing these materials, which should be considered in estimation of construction material quantities. Caving granular soils should also be anticipated in some excavations planned, and contractors should plan accordingly with appropriate provisions to create safe excavations.

Our comments on excavation are based on our experience in the project vicinity and observation of the recovered samples. Excavation depends on the contractor's equipment, capabilities, and experience. Therefore, it should be the contractor's responsibility to determine the most effective methods for excavation. The above comments are intended for informational purposes for the design team only and may be used to review the contractor's proposed excavation methods.

Excavations that will receive compacted fill should have vertical or benched sidewalls so that lifts of fill material will be placed and compacted on horizontal planes. Stockpiles of soil or materials, and heavy equipment should not be placed immediately above and adjacent to unbraced vertical excavation walls (trenches).

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, Part 1926, subpart P”. This document was issued for the safety of workmen entering trenches or excavations.

It is mandated by this federal regulation that all excavations such as utility trenches, basement excavation, or footing excavations be constructed in accordance with the new OSHA guidelines. These regulations are enforced.

The contractor is solely responsible for designing and constructing stable, temporary excavations and for shoring, sloping, or benching the sides of excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person as defined in 29 CFR Part 1926 should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth exceed those specified in applicable local, state, and federal safety regulations.

We are providing this information solely as a service to our client. ECS does not assume responsibility for construction site safety or the contractor's or other party's compliance with local, state, and federal regulations.

10.0 LIMITATIONS

This report has been prepared to aid in the evaluation of subsurface conditions at this site and to assist design professionals in the geotechnical related design of this project. It is intended for use with regard to the specific project as described in this report. Any substantial changes or differences in understood building loads, building and driveway layouts, understood finished floor elevations, or understood site grading should be brought to our attention so that we may determine any effect on the recommendations provided in this report. It is recommended that all construction operations dealing with earthwork and foundations be reviewed by ECS to provide information on which to base a decision as to whether the design requirements are fulfilled in the actual construction.

The opinions expressed in this report are those of ECS and represent interpretation of the subsurface conditions based on tests and the results of our analyses. ECS is not responsible for the interpretation or implementation by others of recommendations provided in this report. This report has been prepared in accordance with generally accepted principles of geotechnical engineering practice and no warranties are included, expressed, or implied, as to the professional services provided under the terms of our agreement.

The analysis and recommendations submitted in this report are based upon the data obtained from the test borings performed at the locations indicated in the exploration location plan, and from other information described in this report. This report does not reflect any variations that may occur around the test borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil conditions and depth to rock exist on most sites between test boring locations, and conditions such as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after allowing ECS to perform on-site observations during the construction period and note characteristics and variations, a re-evaluation of the recommendations in this report will be necessary.

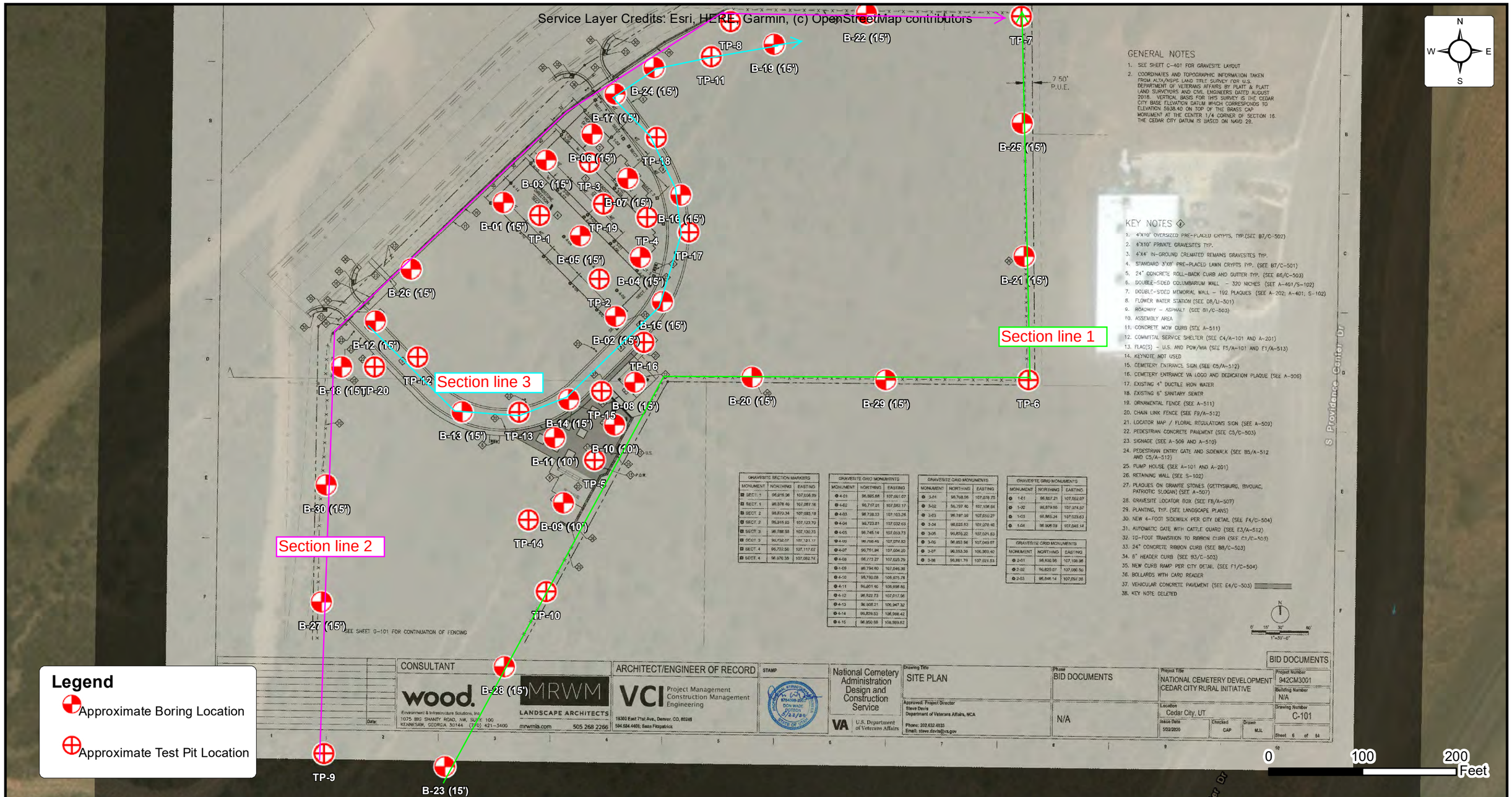
APPENDIX A – Figures

Site Location Diagram
Exploration Location Diagram
Site Geologic Diagram
Site Surface Features Map
Subsurface Profiles

Site Location Diagram
NATIONAL CEMETERY DEVELOPMENT

2181 W. 1600 S., CEDAR CITY, UTAH
GORDON

ENGINEER	MMS1
SCALE	AS NOTED
PROJECT NO.	17:5539
SHEET	1 OF 1
DATE	APRIL 2021



GENERAL NOTES

1. SEE SHEET C-401 FOR GRAVESITE LAYOUT
2. COORDINATES AND TOPOGRAPHIC INFORMATION TAKEN FROM ALTA/NSPS LAND TITLE SURVEY FOR U.S. DEPARTMENT OF VETERANS AFFAIRS BY PLATT & PLATT LAND SURVEYORS AND CIVIL ENGINEERS DATED AUGUST 2018. VERTICAL BASIS FOR THIS SURVEY IS THE CEDAR CITY BASE ELEVATION DATUM WHICH CORRESPONDS TO ELEVATION 5938.40 ON TOP OF THE BRASS CAP MONUMENT AT THE CENTER 1/4 CORNER OF SECTION 16. THE CEDAR CITY DATUM IS BASED ON NAVD 29.

KEY NOTES

1. 4'X10' OVERSIZED PRE-PLACED CRYPTS, TYP.(SEE B7/C-502)
2. 4'X10' PRIVATE GRAVESITES TYP.
3. 4'X4' IN-GROUND CREMATED REMAINS GRAVESITES TYP.
4. STANDARD 3'X8' PRE-PLACED LAWN CRYPTS TYP. (SEE B7/C-501)
5. 24" CONCRETE ROLL-BACK CURB AND GUTTER TYP. (SEE B6/C-503)
6. DOUBLE-SIDED COLUMBARIUM WALL - 320 NICHES (SEE A-401/S-102)
7. DOUBLE-SIDED MEMORIAL WALL - 192 PLAQUES (SEE A-202; A-401; S-102)
8. FLOWER WATER STATION (SEE D8/L1-501)
9. ROADWAY - ASPHALT (SEE B1/C-503)
10. ASSEMBLY AREA
11. CONCRETE MOW CURB (SEE A-511)
12. COMMITTAL SERVICE SHELTER (SEE C4/A-101 AND A-201)
13. FLAG(S) - U.S. AND POW/MIA (SEE F5/A-101 AND F1/A-513)
14. KEYNOTE NOT USED
15. CEMETERY ENTRANCE SIGN (SEE C5/A-512)
16. CEMETERY ENTRANCE VA LOGO AND DEDICATION PLAQUE (SEE A-506)
17. EXISTING 4" DUCTILE IRON WATER
18. EXISTING 6" SANITARY SEWER
19. ORNAMENTAL FENCE (SEE A-511)
20. CHAIN LINK FENCE (SEE F9/A-512)
21. LOCATOR MAP / FLORAL REGULATIONS SIGN (SEE A-503)
22. PEDESTRIAN CONCRETE PAVEMENT (SEE C5/C-503)
23. SIGNAGE (SEE A-506 AND A-510)
24. PEDESTRIAN ENTRY GATE AND SIDEWALK (SEE B5/A-512 AND C5/A-512)
25. PUMP HOUSE (SEE A-101 AND A-201)
26. RETAINING WALL (SEE S-102)
27. PLAQUES ON GRANITE STONES (GETTYSBURG, BIVOUAC, PATRIOTIC SLOGAN) (SEE A-507)
28. GRAVESITE LOCATOR BOX (SEE F8/A-507)
29. PLANTING, TYP. (SEE LANDSCAPE PLANS)
30. NEW 4-FOOT SIDEWALK PER CITY DETAIL (SEE F4/C-504)
31. AUTOMATIC GATE WITH CATTLE GUARD (SEE E3/A-512).
32. 10-FOOT TRANSITION TO RIBBON CURB (SEE C1/C-503)
33. 24" CONCRETE RIBBON CURB (SEE B8/C-503)
34. 6" HEADER CURB (SEE B3/C-503)
35. NEW CURB RAMP PER CITY DETAIL (SEE F1/C-504)
36. BOLLARDS WITH CARD READER
37. VEHICULAR CONCRETE PAVEMENT (SEE E4/C-503)
38. KEY NOTE DELETED

GRAVESITE SECTION MARKERS

MONUMENT	NORTHING	EASTING
SECT. 1	96,819.36	107,656.09
SECT. 1	96,876.46	107,087.76
SECT. 2	96,870.34	107,093.18
SECT. 2	96,815.63	107,123.70
SECT. 3	96,786.58	107,130.73
SECT. 3	96,732.07	107,121.17
SECT. 4	96,722.56	107,117.67
SECT. 4	96,976.35	107,082.74

GRAVESITE GRID MONUMENTS

MONUMENT	NORTHING	EASTING
4-01	96,585.68	107,061.07
4-02	96,717.01	107,082.17
4-03	96,738.33	107,103.26
4-04	96,723.81	107,032.63
4-05	96,745.14	107,053.73
4-06	96,766.46	107,074.83
4-07	96,751.94	107,004.20
4-08	96,773.27	107,025.29
4-09	96,794.60	107,046.39
4-10	96,780.08	106,975.76
4-11	96,801.40	106,996.86
4-12	96,822.73	107,017.96
4-13	96,808.21	106,947.32
4-14	96,829.53	106,968.42
4-15	96,850.86	106,989.52

GRAVESITE GRID MONUMENTS

MONUMENT	NORTHING	EASTING
3-01	96,768.06	107,076.70
3-02	96,797.40	107,106.64
3-03	96,797.09	107,050.27
3-04	96,825.53	107,078.40
3-05	96,826.22	107,021.83
3-06	96,853.56	107,049.97
3-07	96,853.26	106,993.40
3-08	96,881.79	107,021.53

GRAVESITE GRID MONUMENTS

MONUMENT	NORTHING	EASTING
1-01	96,557.21	107,552.07
1-02	96,879.95	107,374.57
1-03	96,865.24	107,023.63
1-04	96,908.09	107,045.14

GRAVESITE GRID MONUMENTS

MONUMENT	NORTHING	EASTING
2-01	96,600.96	107,106.96
2-02	96,620.07	107,086.50
2-03	96,646.14	107,097.35

Legend

- Approximate Boring Location
- Approximate Test Pit Location

CONSULTANT: wood. Environment & Infrastructure Solutions, Inc. 1075 BIG SHANTY ROAD, NW, SUITE 100 KENNESAW, GEORGIA 30144 (770) 421-3400

MRWM LANDSCAPE ARCHITECTS mrwmla.com 505 268 2266

ARCHITECT/ENGINEER OF RECORD: VCI Project Management Construction Management Engineering. 18300 East 71st Ave., Denver, CO, 80249. 504.524.4408; Sara Fitzpatrick

STAMP: 9764109-2202 DON WADE PUTNAM 5/22/20 STATE OF UTAH

National Cemetery Administration Design and Construction Service

VA U.S. Department of Veterans Affairs

Drawing Title: SITE PLAN

Approved: Project Director: Steve Davis, Department of Veterans Affairs, NCA. Phone: 202.632.4833. Email: steve.davis@va.gov

Phase: BID DOCUMENTS

N/A

Project Title: NATIONAL CEMETERY DEVELOPMENT CEDAR CITY RURAL INITIATIVE

Location: Cedar City, UT

Issue Date: 5/22/2020 | Checked: CAP | Drawn: MJL

BID DOCUMENTS

Project Number: 942CM3001

Building Number: N/A

Drawing Number: C-101

Sheet 6 of 54

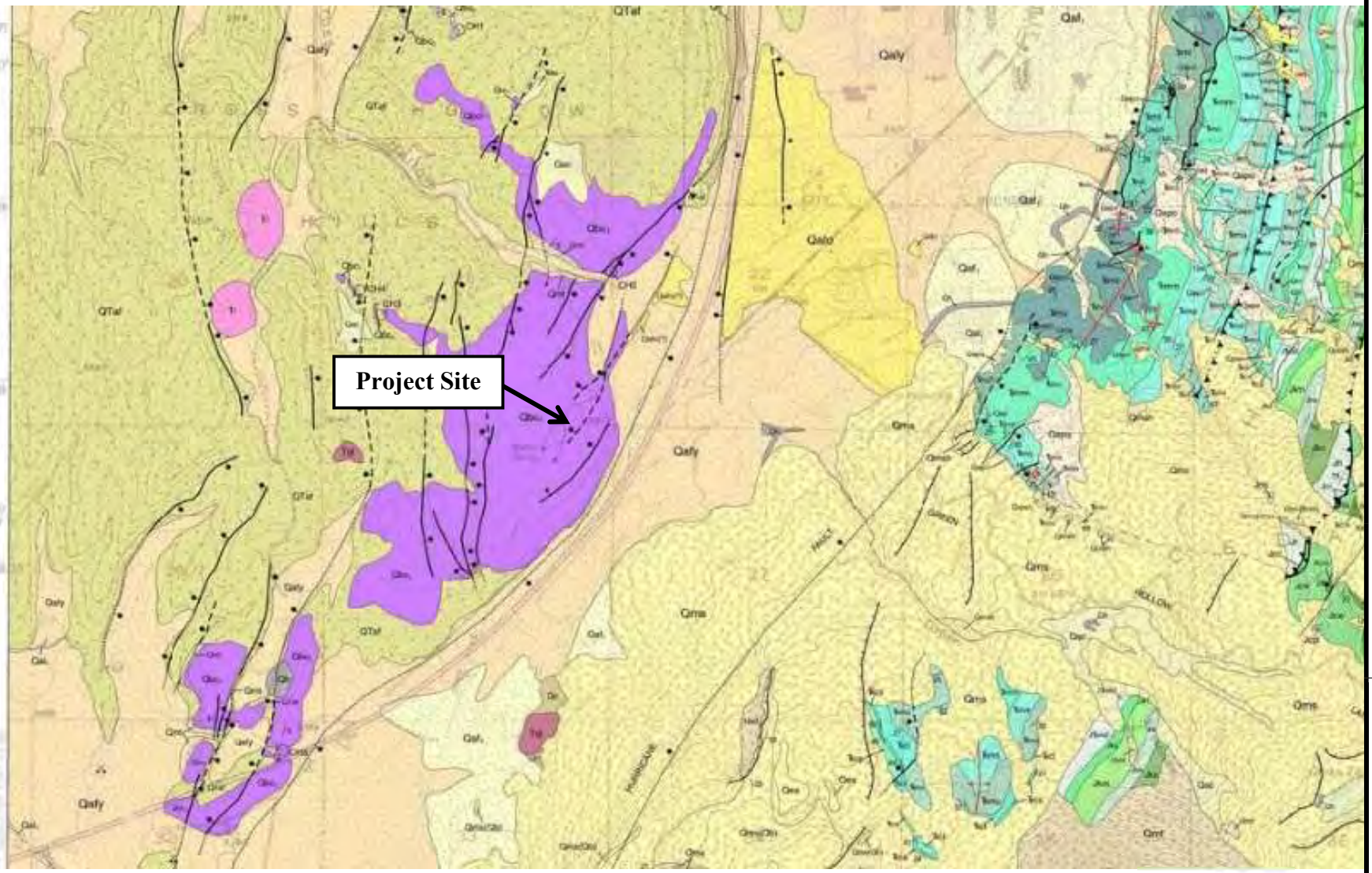
Exploration Location Diagram

GORDON

NATIONAL CEMETERY DEVELOPMENT

2181 W. 1600 S., CEDAR CITY, UTAH

ENGINEER	MMS1
SCALE	AS NOTED
PROJECT NO.	17:5539
SHEET	1 OF 1
DATE	APRIL 2021



Qbc_1 – Cross Hollow Hills Lava Flow (Hawaiite)

Interim geologic map of the Cedar City 7.5-minute quadrangle, Iron County, Utah: Utah Geological Survey, 2014

ECS-SOUTHWEST, LLP
14050 Summit Drive, Suite 101
Austin, Texas 78728

SCALE: NTS | PROJECT No.: 17-5539

DATE: APRIL 2021 | FIGURE: **3**

PM:CFR

FIG 3: Site Geologic Diagram

National Cemetery Development
2181 W. 1600 S.
Cedar City, Utah

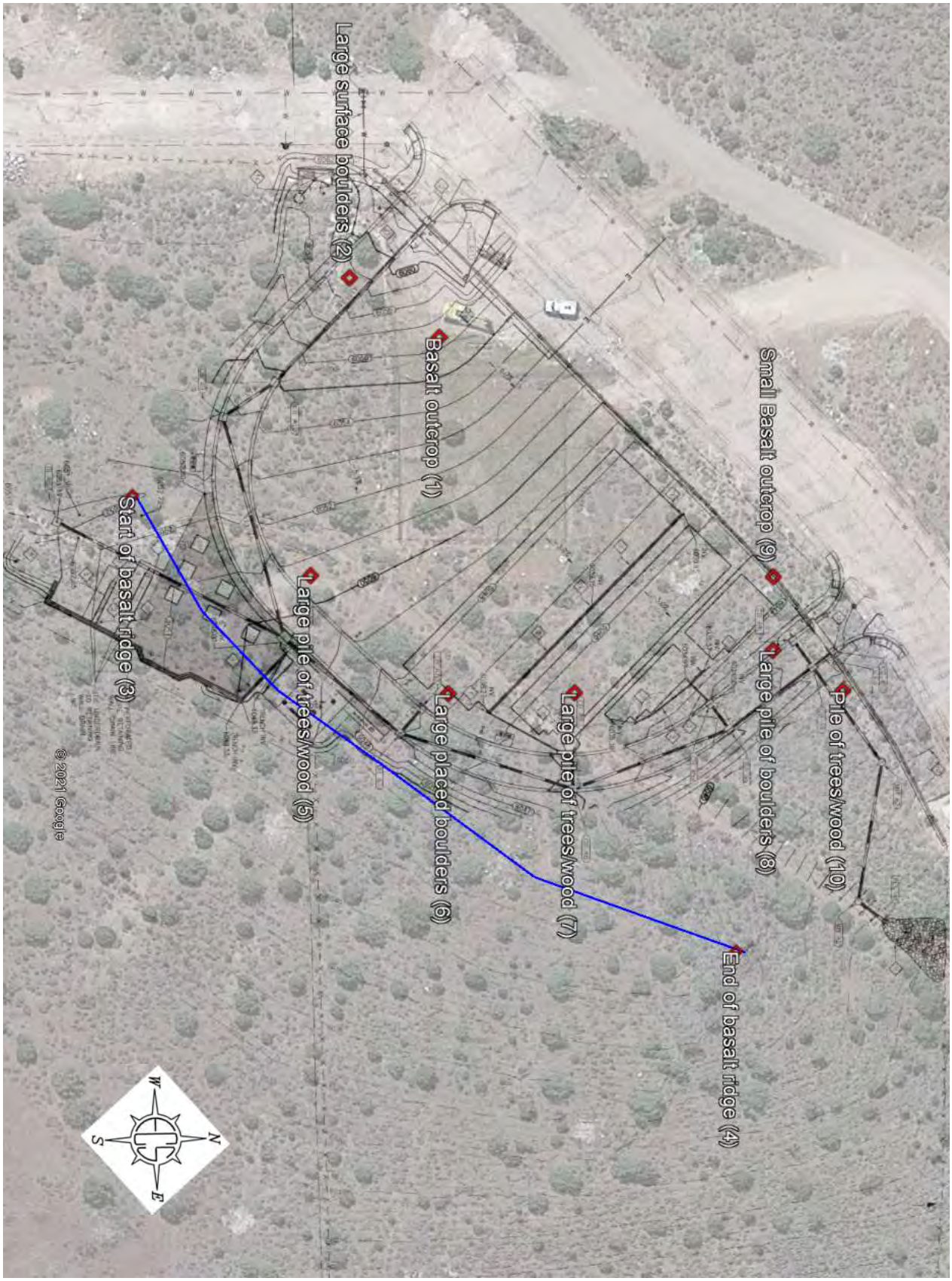
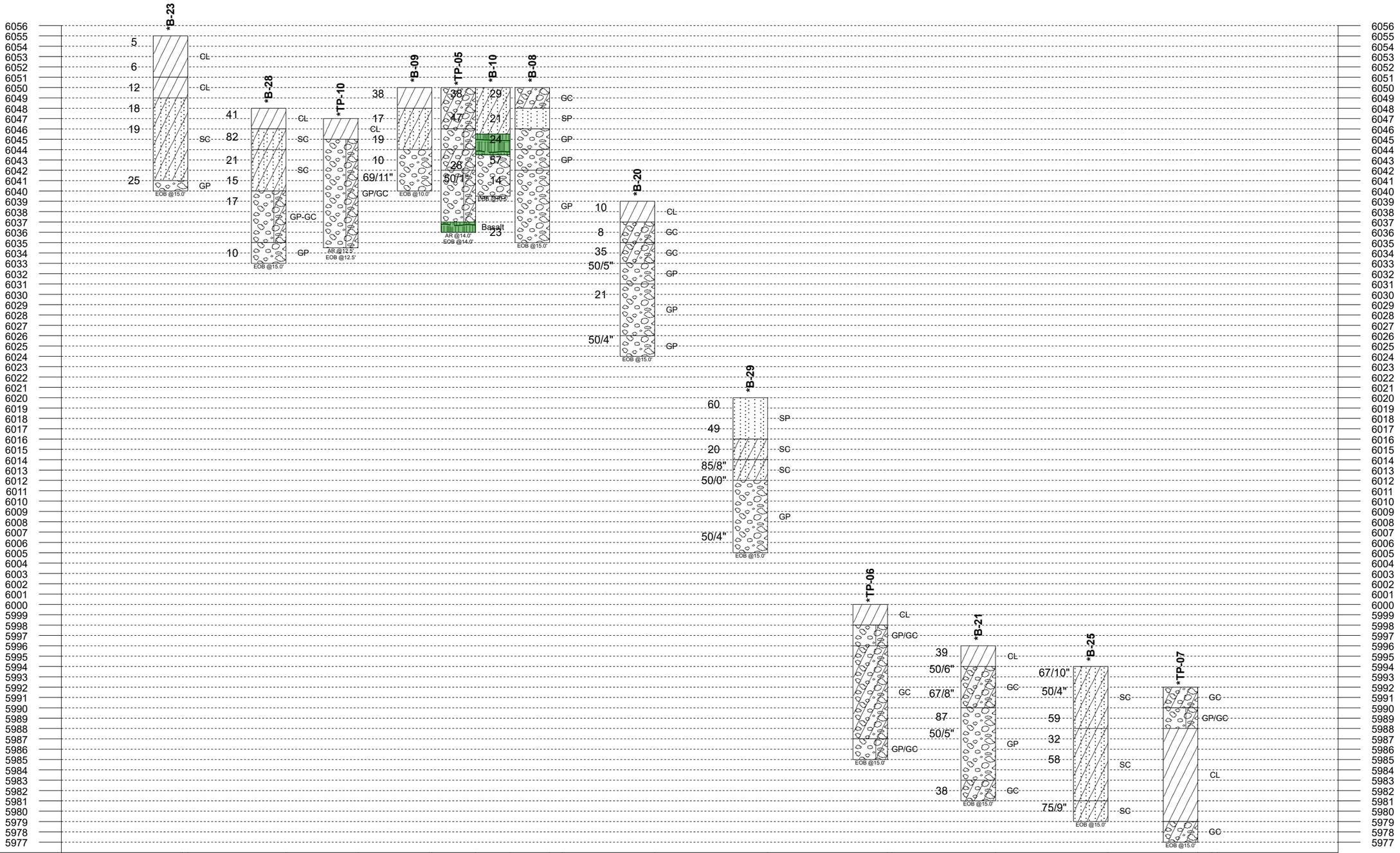


FIG 4: Site Surface Feature Map

National Cemetery Development
2181 W. 1600 S.
Cedar City, Utah

ECS-SOUTHWEST, LLP
14050 Summit Drive, Suite 101
Austin, Texas 78728

	SCALE: NTS	PROJECT No.: 17-5539
PM:CFR	DATE: APRIL 2021	FIGURE: **4**



Legend Key

- Lean CLAY
- CLAYEY SAND
- CLAYEY GRAVEL
- Poorly Graded SAND
- Poorly Graded GRAVEL
- Poorly Graded Gravel w…
- Basalt
- Poorly Graded Gravel w…

5976.00

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△
[FINES CONTENT %]

BOTTOM OF CASING
LOSS OF CIRCULATION

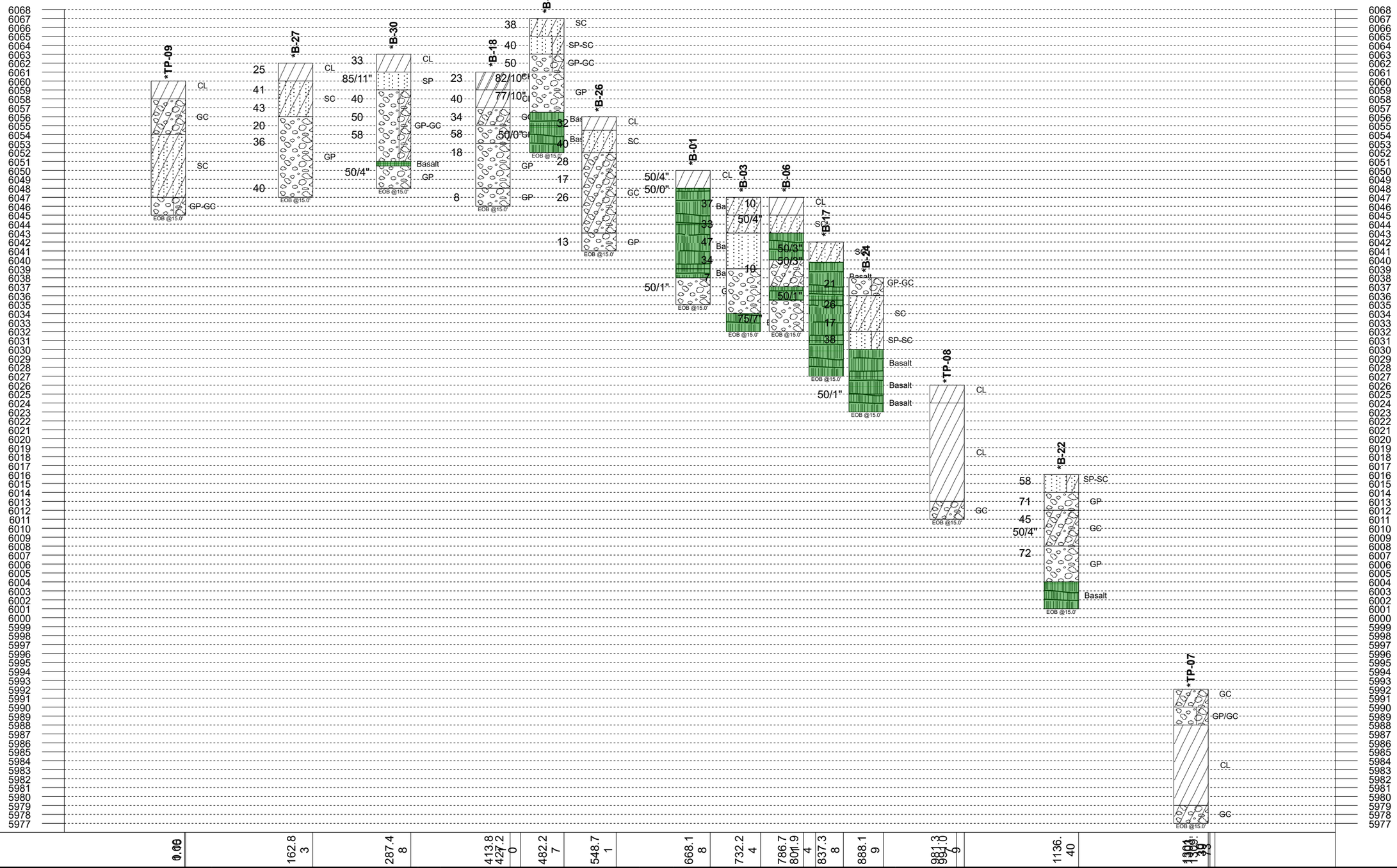
WL (First Encountered)
WL (Completion)
WL (Seasonal High Water)
WL (Stabilized)

Fill
Possible Fill
Probable Fill
Rock

GENERALIZED SUBSURFACE SOIL PROFILE Section line 1

National Cemetery Development
Gordon
2181 W. 1600 S., Cedar City, Utah 84720

Project No: 17:5539 Date: 04/22/2021



Legend Key

- CLAYEY SAND
- Poorly Graded SAND w…
- Lean CLAY
- Poorly Graded Gravel w…
- Poorly Graded GRAVEL
- Poorly Graded SAND
- Fat CLAY
- CLAYEY GRAVEL
- Basalt
- Poorly Graded Gravel w…

5976.00

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△
[FINES CONTENT %]

BOTTOM OF CASING
LOSS OF CIRCULATION

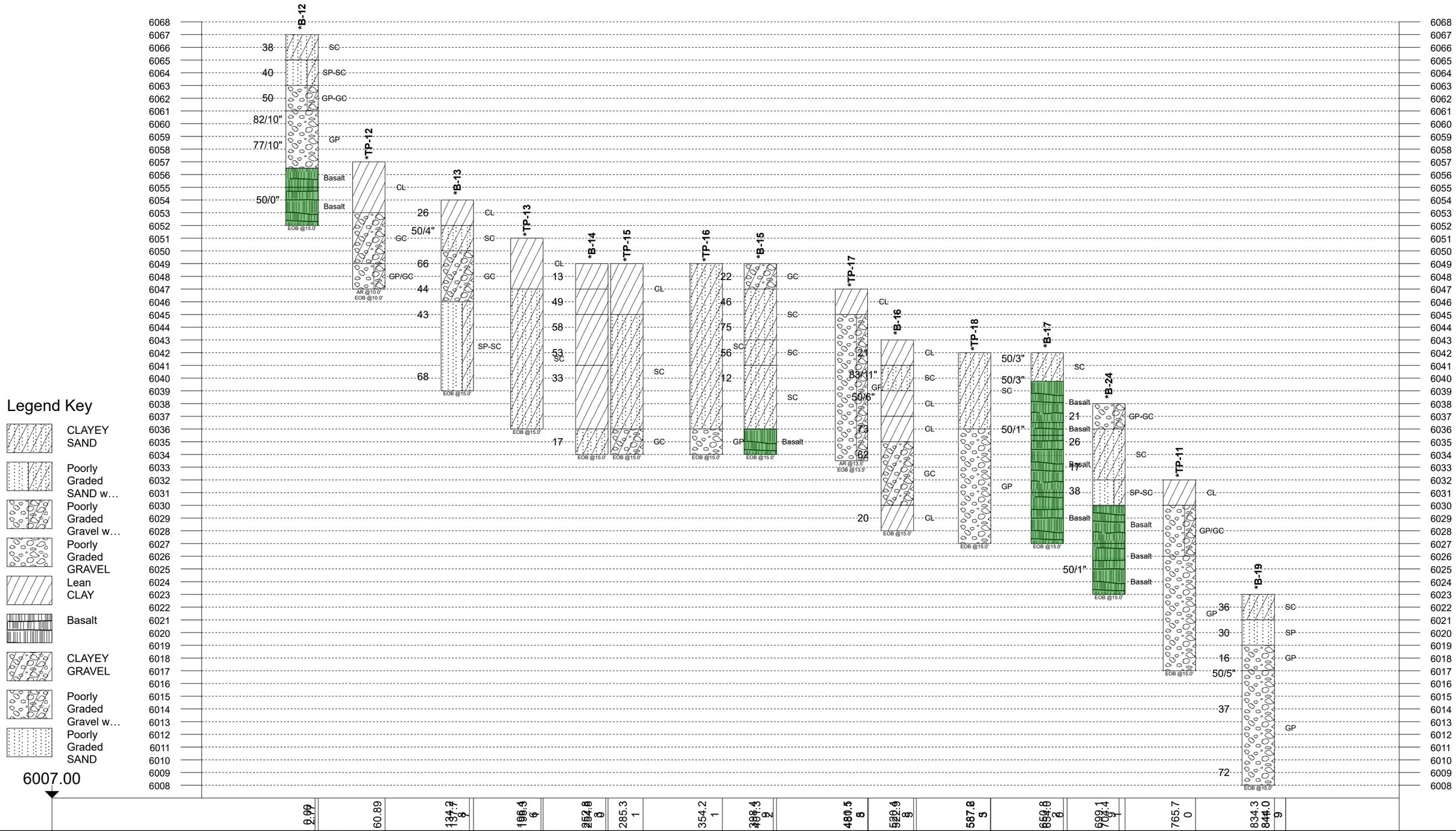
WL (First Encountered)
WL (Completion)
WL (Seasonal High Water)
WL (Stabilized)

Fill
Possible Fill
Probable Fill
Rock

GENERALIZED SUBSURFACE SOIL PROFILE Section line 2

National Cemetery Development
Gordon
2181 W. 1600 S., Cedar City, Utah 84720

Project No: 17:5539 Date: 04/22/2021



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△
[FINES CONTENT %]

BOTTOM OF CASING
LOSS OF CIRCULATION

WL (First Encountered)
WL (Completion)
WL (Seasonal High Water)
WL (Stabilized)

Fill
Possible Fill
Probable Fill
Rock

ECS

GENERALIZED SUBSURFACE SOIL PROFILE Section line 3

National Cemetery Development
Gordon
2181 W. 1600 S., Cedar City, Utah 84720

Project No: 17:5539 Date: 04/22/2021

APPENDIX B – Field Operations

Boring Logs B-1 to B-30
Test Pit Logs TP-1 to TP-20
Reference Notes for Boring Logs
CAT 321D Specifications

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-01**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6050.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	4	4	(CL) LEAN CLAY WITH SAND, dark brown, dry, very hard			50/4" (50/4")
	S-2	SS	0	0				50/0" (50/0")
5	S-3	RC	42	39	BASALT, [REC=93%,RQD=74%], Very Hard, Gray		6045	
10	S-4	RC	60	51	BASALT, [REC=85%,RQD=85%], Very Hard, Gray		6040	
	S-5	RC	12	8	BASALT, [REC=63%,RQD=63%], Very Hard, Gray			
15	S-6	SS	1	1	(GP) GRAVEL, dark gray, very dense		6035	50/1" (50/1")
					END OF DRILLING AT 15.0 FT			
20							6030	
25							6025	
30							6020	

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

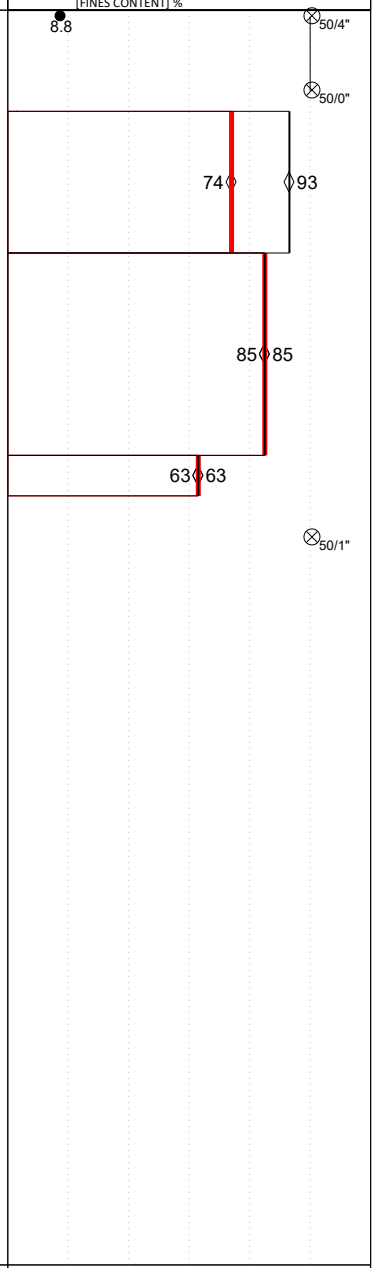
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 13 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 13 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-02**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6049.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, dry, very stiff			4-10-10-10 (20)
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, light brown, dry, hard			11-15-19-25 (34)
5	S-3	SS	24	24	(CL) SANDY LEAN CLAY WITH GRAVEL, light brown, dry, hard		6044	23-22-24-29 (46)
	S-4	SS	24	24				22-15-23-24 (38)
10	S-5	SS	23	23	(SP) SAND WITH GRAVEL, light brown, dry, very dense		6039	15-33-33-50/5" (66)
	S-6	SS	24	24	(GP) GRAVEL WITH SAND, light brown, medium dense			8-14-8-10 (22)
15					**END OF DRILLING AT 15.0 FT**		6034	
20							6029	
25							6024	
30							6019	

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

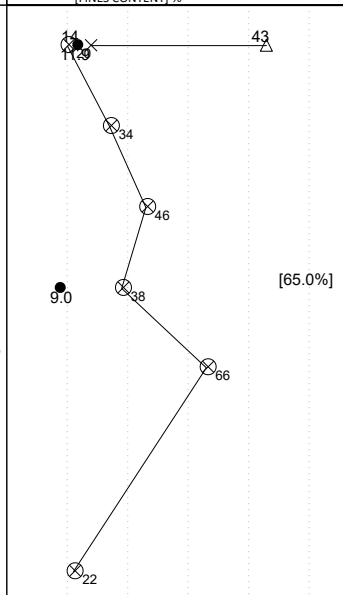
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 13 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 13 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-03**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6047.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(SC) CLAYEY SAND, light grayish brown, dry, dense			6-11-26-22 (37)
	S-2	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light grayish brown, dry, dense			16-19-14-13 (33)
5	S-3	SS	24	24	(SP) SAND WITH GRAVEL, light grayish brown, dry, dense		6042	26-24-23-17 (47)
	S-4	SS	24	24				10-11-23-34 (34)
	S-5	SS	24	24	(GP) GRAVEL WITH SAND, grayish brown, loose			4-3-4-6 (7)
10							6037	
	S-6	RC	24	20	BASALT, [REC=83%,RQD=83%], Very Hard, Dark Gray to Black			
15					**END OF DRILLING AT 15.0 FT**		6032	
20							6027	
25							6022	
30							6017	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

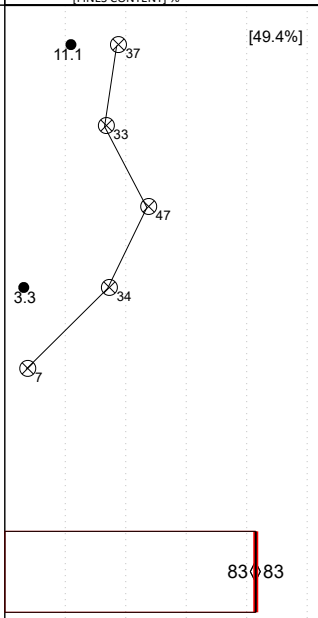
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 11 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 11 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-04**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6046.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, dry, very stiff			4-8-12-15 (20)
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, light brown, dry, hard			16-21-27-43 (48)
	S-3	SS	3	3	(CL) SANDY LEAN CLAY, brown, dry, very hard		6041	50/3" (50/3")
5	S-4	SS	12	12	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, very dense			28-50/6" (50/6")
	S-5	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light grayish brown, dry, dense		6036	11-24-20-22 (44)
10	S-6	SS	24	24	(GP) GRAVEL WITH SAND, grayish brown, medium dense		6031	11-13-10-12 (23)
15					**END OF DRILLING AT 15.0 FT**			
20							6026	
25							6021	
30							6016	

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

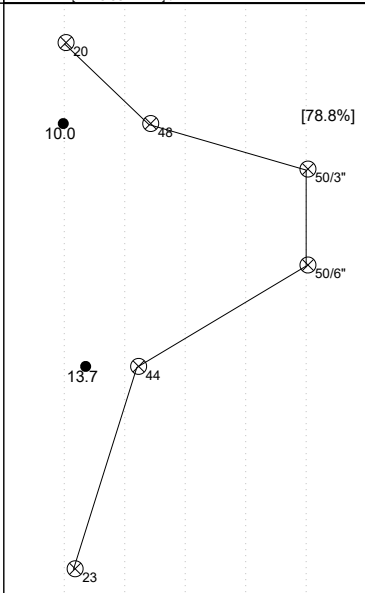
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 13 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 13 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-05**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6048.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) SANDY LEAN CLAY, dark brown, moist, hard			4-17-22-28 (39)
	S-2	SS	16	16	(CL) SANDY LEAN CLAY, light brown, dry, very hard			23-38-50/4" (88/10")
5	S-3	SS	24	24	(CH) SANDY FAT CLAY, light reddish brown, dry, very hard		6043	17-21-32-19 (53)
	S-4	SS	24	24	(CH) SANDY FAT CLAY WITH GRAVEL, light reddish brown, dry, hard			20-20-15-17 (35)
	S-5	SS	24	24	(CL) SANDY LEAN CLAY, reddish brown, dry, firm			8-5-3-3 (8)
10							6038	
	S-6	SS	24	24	(GP) GRAVEL, dark gray, medium dense			5-11-12-15 (23)
15					**END OF DRILLING AT 15.0 FT**		6033	
20							6028	
25							6023	
30							6018	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

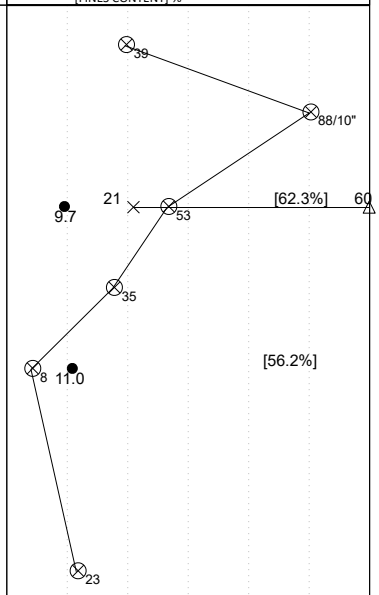
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 13 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 13 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-06**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6047.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) SANDY LEAN CLAY WITH GRAVEL, brown, moist, stiff			3-3-7-12 (10)
	S-2	SS	10	10	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, very dense			20-50/4" (50/4")
5	S-3	RC	36	26	BASALT (POSSIBLE BOULDER), [REC=72%,RQD=38%], Very Hard, Black to Brownish Red		6042	
	S-4	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, light brown, dry, very dense			2-3-7-20 (10)
10	S-5	RC	18	15	BASALT (POSSIBLE BOULDER), [REC=83%,RQD=83%], Very Hard, Dark Gray to Black		6037	
	S-6	SS	13	13	(GP) GRAVEL WITH SAND, dark gray, very dense			10-25-50/1" (75/7")
15					**END OF DRILLING AT 15.0 FT**		6032	
20							6027	
25							6022	
30							6017	

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

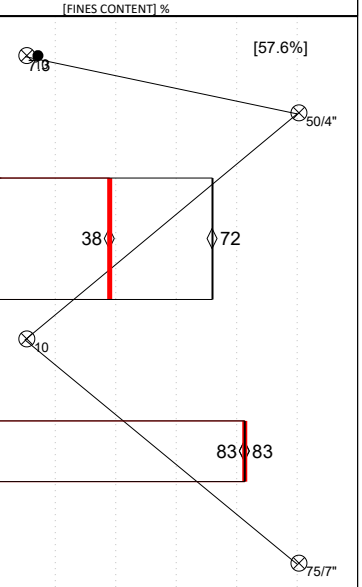
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 10 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 10 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-07**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6045.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense to dense		6045	3-12-47-47 (59)
	S-2	SS	24	24				34-20-21-16 (41)
5	S-3	SS	24	24	(SP) SAND WITH GRAVEL, gray, dry, very dense to dense		6040	9-14-45-20 (59)
	S-4	SS	10	10				36-50/4" (50/4")
	S-5	SS	24	24				15-8-22-23 (30)
10							6035	
	S-6	RC	30	30	BASALT, [REC=100%,RQD=100%], Very Hard, Dark Gray to Black			
15					**END OF DRILLING AT 15.0 FT**		6030	
20							6025	
25							6020	
30							6015	

Plastic Limit Water Content Liquid Limit
X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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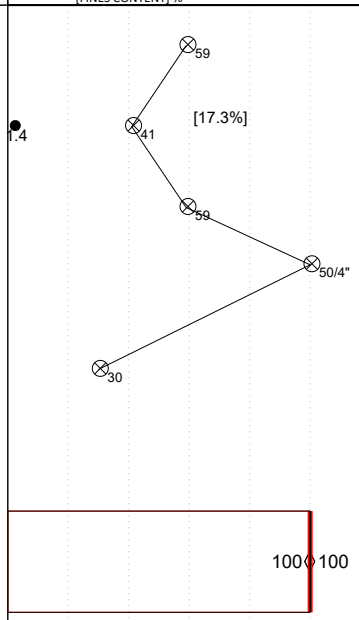


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 10 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 10 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-08**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6050.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, dark to light brown, dry, medium dense		6050	12-17-12-10 (29)
	S-2	SS	24	24	(SP) SAND WITH GRAVEL, brown, dry, medium dense			16-6-15-12 (21)
5	S-3	SS	24	24	(GP) GRAVEL WITH SAND, dark brown, dry, medium dense		6045	8-9-15-9 (24)
	S-4	SS	24	24	(GP) GRAVEL, gray, very dense			20-24-33-13 (57)
	S-5	SS	24	24	(GP) GRAVEL WITH SAND, grayish brown, medium dense			10-6-8-9 (14)
10							6040	
	S-6	SS	24	24				9-10-13-10 (23)
15					**END OF DRILLING AT 15.0 FT**		6035	
20							6030	
25							6025	
30							6020	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

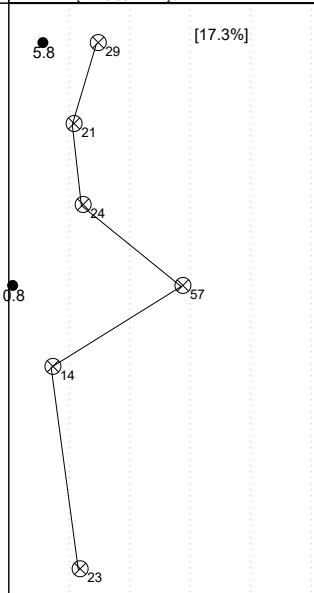
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 16 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 16 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-09**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6050.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) SANDY LEAN CLAY WITH GRAVEL, brown, dry, hard		6050	3-16-22-15 (38)
	S-2	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, grayish brown, dry, medium dense			16-8-9-8 (17)
5	S-3	SS	24	24			6045	8-12-7-6 (19)
	S-4	SS	24	24	(GP) GRAVEL WITH SAND, light brown to brown, dry, loose to very dense			6-3-7-11 (10)
	S-5	SS	17	17				15-19-50/5" (69/11")
10					**END OF DRILLING AT 10.0 FT**		6040	
15							6035	
20							6030	
25							6025	
30							6020	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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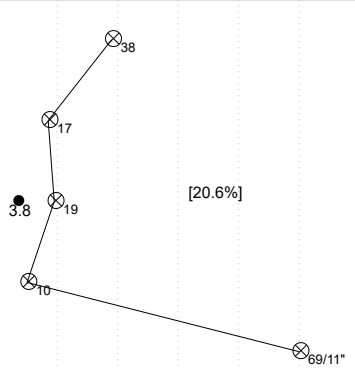

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 15 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 15 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-10**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6050.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, dense		6050	6-13-25-25 (38)
	S-2	SS	22	22				24-23-24-50/4" (47)
5	S-3	RC	24	18	BASALT (POSSIBLE BOULDER), [REC=75%,RQD=63%], Very Hard, Dark Reddish Gray		6045	
	S-4	SS	24	24	(GP) GRAVEL WITH SAND, dark reddish brown, dry, medium dense to very dense			8-10-18-39 (28)
	S-5	SS	7	7				30-50/1" (50/1")
10					**END OF DRILLING AT 10.5 FT**		6040	
15							6035	
20							6030	
25							6025	
30							6020	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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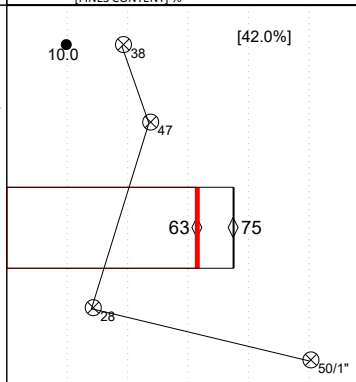

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 16 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 16 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY:	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-11**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6051.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, moist, stiff			3-3-7-11 (10)
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, light brown, dry, hard			11-17-18-18 (35)
5	S-3	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown, dry, very dense		6046	19-29-37-26 (66)
	S-4	SS	16	16	(CL) SANDY LEAN CLAY WITH GRAVEL, brown, dry, very hard			35-45-50/4" (95/10")
	S-5	SS	21	21	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, dense			21-11-24-50/3" (35)
10							6041	
	S-6	SS	1	1	(GP) GRAVEL WITH SAND, dark gray, very dense			50/1" (50/1")
15					**END OF DRILLING AT 15.0 FT**		6036	
20							6031	
25							6026	
30							6021	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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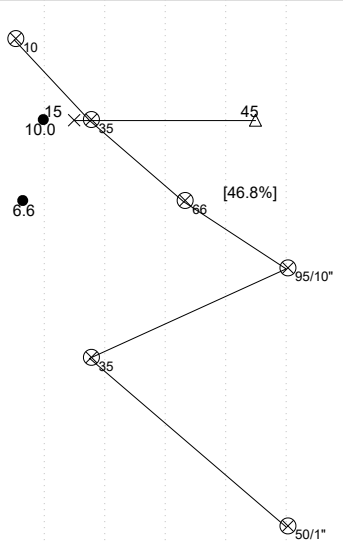

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 14 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 14 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-12**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6067.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, dense			5-13-25-34 (38)
	S-2	SS	24	24	(SP-SC) SAND WITH CLAY AND GRAVEL, reddish brown, dry, dense			24-18-22-19 (40)
5	S-3	SS	23	23	(GP-GC) GRAVEL WITH CLAY AND SAND, grayish brown, dry, dense		6062	24-19-31-50/5" (50)
	S-4	SS	16	16	(GP) GRAVEL WITH SAND, dark brownish gray to brown, dry, very dense			40-32-50/4" (82/10")
	S-5	SS	16	16				19-27-50/4" (77/10")
10	S-6	RC	18	3	BASALT, [REC=17%,RQD=0%], Highly Weathered, Very Hard, Dark Gray to Black		6057	
	~~S-7~~	~~SS~~	~~0~~	~~0~~	BASALT, Very Hard, Dark Gray			50/0" (50/0")
15					**END OF DRILLING AT 15.0 FT**		6052	
20							6047	
25							6042	
30							6037	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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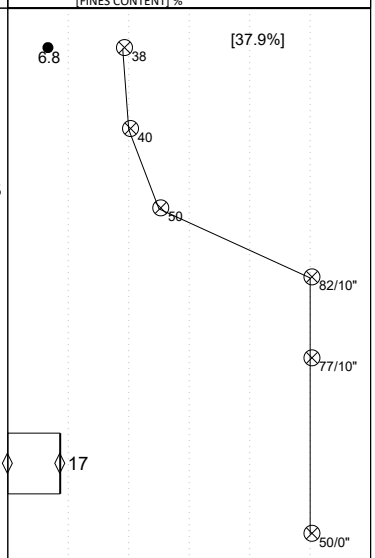

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)		BORING STARTED: **Feb 09 2021**	CAVE IN DEPTH:
▼ WL (Completion)	**NONE**	BORING COMPLETED: **Feb 09 2021**	HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)		EQUIPMENT: **Truck CME-75** / LOGGED BY: **RB8**	DRILLING METHOD: **ODEX, HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-13**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6054.0**	BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, brown, moist, very stiff			4-9-17-33 (26)
	S-2	SS	10	10	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, very dense			38-50/4" (50/4")
5	S-3	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, light brown, dry, very dense to dense		6049	28-26-40-40 (66)
	S-4	SS	24	24				10-25-19-18 (44)
	S-5	SS	24	24	(SP-SC) SAND WITH CLAY AND GRAVEL, reddish brown, dry, dense to very dense			12-24-19-18 (43)
10							6044	
	S-6	SS	21	21				16-23-45-50/3" (68)
15					**END OF DRILLING AT 15.0 FT**		6039	
20							6034	
25							6029	
30							6024	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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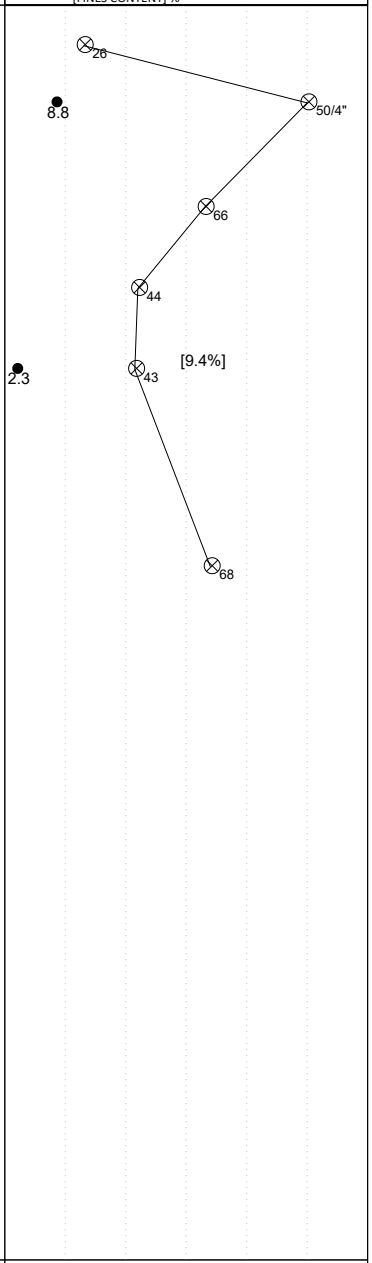


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 14 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 14 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-14**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6049.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) SANDY LEAN CLAY, brown, dry, stiff			3-6-7-14 (13)
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, brown, dry, hard			22-23-26-30 (49)
5	S-3	SS	24	24	(CL) SANDY LEAN CLAY WITH GRAVEL, brown, dry, very hard		6044	33-33-25-27 (58)
	S-4	SS	24	24				26-26-27-28 (53)
	S-5	SS	24	24	(CL) LEAN CLAY WITH SAND, brown, dry, hard			10-13-20-17 (33)
10							6039	
15	S-6	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, medium dense		6034	9-7-10-10 (17)
					END OF DRILLING AT 15.0 FT			
20							6029	
25							6024	
30							6019	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

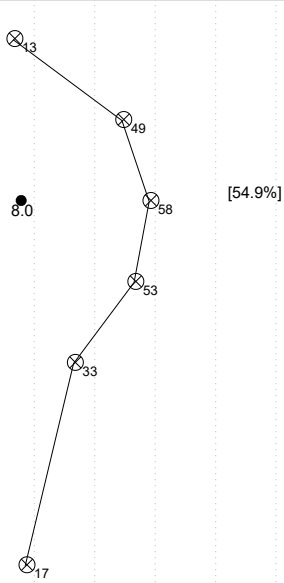
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 14 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 14 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-15**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6049.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown, dry, medium dense			4-12-10-17 (22)
	S-2	SS	24	24	(SC) CLAYEY SAND, brown, dry, dense to very dense			28-20-26-34 (46)
5	S-3	SS	24	24			6044	30-38-37-38 (75)
	S-4	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense			42-32-24-20 (56)
	S-5	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, medium dense			5-5-7-10 (12)
10							6039	
	S-6	RC	24	1	BASALT, [REC=4%,RQD=0%], Highly Weathered, Very Hard, Black and Reddish Brown to Light Brown			
15					**END OF DRILLING AT 15.0 FT**		6034	
20							6029	
25							6024	
30							6019	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

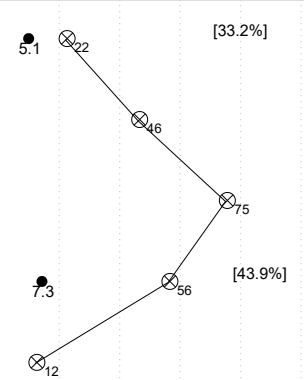
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 09 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 09 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-16**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6043.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, dry, very stiff			5-10-11-15 (21)
	S-2	SS	17	17	(SC) CLAYEY SAND, light brown, dry, very dense			23-33-50/5" (83/11")
5	S-3	SS	12	12	(CL) LEAN CLAY WITH GRAVEL, dark brown, dry, very hard		6038	43-50/6" (50/6")
	S-4	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, dry, very hard			19-41-32-42 (73)
10	S-5	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown, dry, very dense		6033	14-23-39-45 (62)
15	S-6	SS	24	24	(CL) SANDY CLAY WITH GRAVEL, brown, dry, very stiff		6028	7-10-10-10 (20)
					END OF DRILLING AT 15.0 FT			
20							6023	
25							6018	
30							6013	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

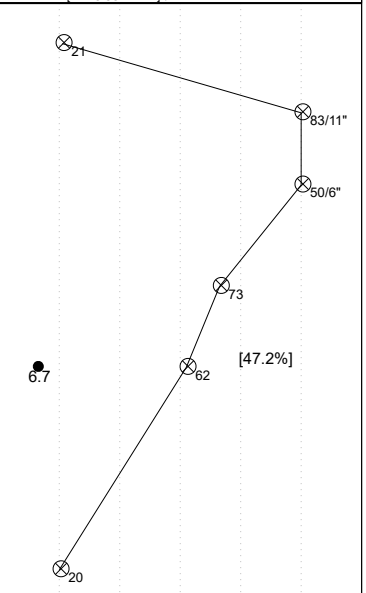
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 09 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 09 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-17**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
National Cemetery Development	**Enviro-Drill, Inc.**		
SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6042.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	9	9	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense			15-50/3" (50/3")
	S-2	SS	3	3	BASALT, [REC=97%,RQD=92%], Very Hard, Dark Gray and Reddish Gray			50/3" (50/3")
5	S-3	RC	39	38			6037	
	S-4	SS	1	1	BASALT, Very Hard, Dark Gray			50/1" (50/1")
		RC	54	54	BASALT, [REC=100%,RQD=93%], Very Hard, Gray to Dark Gray			
10							6032	
	S-6	RC	48	44	BASALT, [REC=91%,RQD=91%], Very Hard, Gray to Dark Gray			
15					**END OF DRILLING AT 15.0 FT**		6027	
20							6022	
25							6017	
30							6012	

Plastic Limit Water Content Liquid Limit
X———●———△
⊗ STANDARD PENETRATION BLOWS/FT
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
○ CALIBRATED PENETROMETER TON/SF
[FINES CONTENT] %

5.6
50/3"
50/3"
92
97
50/1"
93
100
91
91

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 12 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 12 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-18**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6061.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CH) FAT CLAY WITH SAND, dark brown, moist, very stiff			4-9-14-19 (23)
	S-2	SS	24	24	(CL) LEAN CLAY WITH SAND, light brown, dry, hard			16-20-20-23 (40)
5	S-3	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown to gray, dry, dense		6056	18-18-16-19 (34)
	S-4	SS	21	21	(GP) GRAVEL WITH SAND, dark brownish gray, dry, very dense			19-17-41-50/3" (58)
	S-5	SS	24	24	(GP) GRAVEL WITH SAND, dark gray and brown, dry, medium dense			28-10-8-7 (18)
10							6051	
	S-6	SS	24	24	(GP) GRAVEL, dark gray, dry, loose			4-5-3-4 (8)
15					**END OF DRILLING AT 15.0 FT**		6046	
20							6041	
25							6036	
30							6031	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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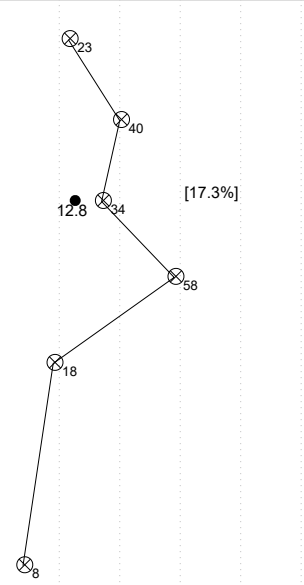

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 14 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 14 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-19**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6023.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, dense			5-15-21-21 (36)
	S-2	SS	24	24	(SP) SAND WITH GRAVEL, dark brown to dark gray, dry, medium dense			11-14-16-12 (30)
5	S-3	SS	24	24	(GP) GRAVEL WITH SAND, dark grayish brown, dry, medium dense		6018	10-7-9-12 (16)
	S-4	SS	5	5	(GP) GRAVEL WITH SAND, dark brown to gray, dry, very dense to dense			50/5" (50/5")
	S-5	SS	24	24				9-14-23-23 (37)
10							6013	
	S-6	SS	24	24				11-38-34-13 (72)
15					**END OF DRILLING AT 15.0 FT**		6008	
20							6003	
25							5998	
30							5993	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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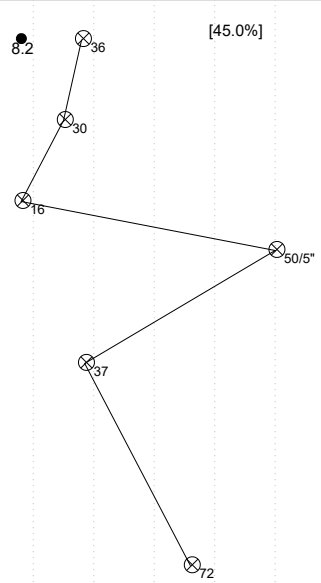


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 12 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 12 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-20**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6039.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, moist, stiff			4-5-5-2 (10)
	S-2	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, dark brown, dry, loose			3-5-3-7 (8)
5	S-3	SS	21	21	(GC) CLAYEY GRAVEL WITH SAND, dark brown, dry, dense		6034	17-20-15-50/3" (35)
	S-4	SS	5	5	(GP) GRAVEL, dark gray, very dense			50/5" (50/5")
10	S-5	SS	24	24	(GP) GRAVEL, dark gray, medium dense		6029	8-11-10-11 (21)
	S-6	SS	10	10	(GP) GRAVEL WITH SAND, brownish gray, very dense			39-50/4" (50/4")
15					**END OF DRILLING AT 15.0 FT**		6024	
20							6019	
25							6014	
30							6009	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

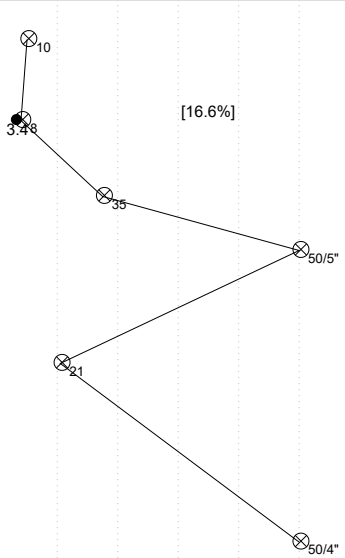
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 16 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 16 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-21**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **5996.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, light brown, dry, hard			5-18-21-34 (39)
	S-2	SS	6	6	(GC) CLAYEY GRAVEL WITH SAND, light brown, dry, dense to very dense			50/6" (50/6")
5	S-3	SS	14	14			5991	14-17-50/2" (67/8")
	S-4	SS	21	21	(GP) GRAVEL WITH SAND, brown to grayish brown, very dense			27-40-47-50/3" (87)
	S-5	SS	11	11				41-50/5" (50/5")
10							5986	
	S-6	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown, dry, dense			14-20-18-17 (38)
15					**END OF DRILLING AT 15.0 FT**		5981	
20							5976	
25							5971	
30							5966	

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

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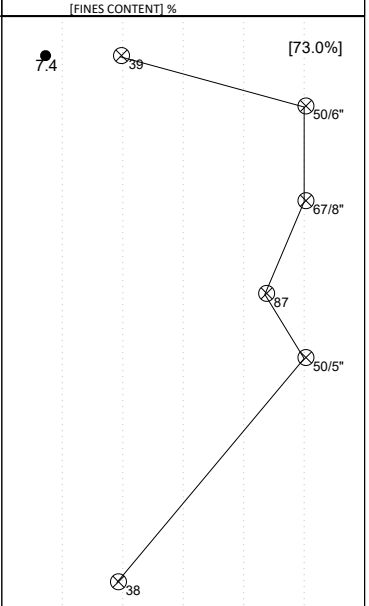

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 16 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 16 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-22**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6016.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(SP-SC) SAND WITH CLAY AND GRAVEL, brown to light brown, dry, very dense		6016	7-26-32-35 (58)
	S-2	SS	24	24	(GP) GRAVEL WITH SAND, dark brown to reddish brown, very dense			32-31-40-18 (71)
5	S-3	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, reddish brown, dense to very dense		6011	30-20-25-23 (45)
	S-4	SS	4	4				50/4" (50/4")
	S-5	SS	18	18	(GP) GRAVEL WITH SAND, reddish brown, very dense			29-22-50 (72)
10							6006	
	S-6	RC	36	32	BASALT, [REC=89%,RQD=89%], Very Hard, Dark Gray			
15					**END OF DRILLING AT 15.0 FT**		6001	
20							5996	
25							5991	
30							5986	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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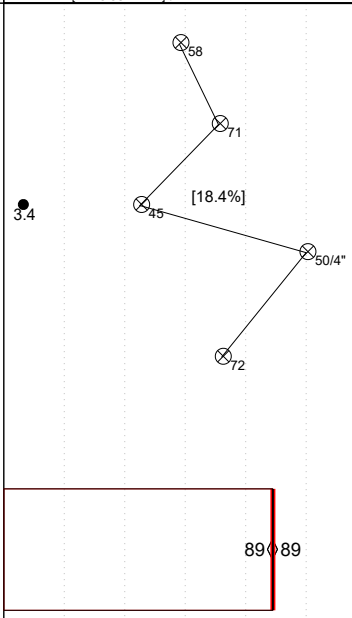


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 17 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 17 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-23**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6055.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, dark brown, firm			2-2-3-3 (5)
	S-2	SS	24	24				3-3-3-4 (6)
5	S-3	SS	24	24	(CL) LEAN CLAY WITH GRAVEL, dark brown, dry, stiff		6050	4-4-8-9 (12)
	S-4	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, dark brown, dry, medium dense			11-10-8-14 (18)
	S-5	SS	24	24				10-9-10-11 (19)
10							6045	
	S-6	SS	24	24				31-14-11-10 (25)
15					(GP) GRAVEL WITH SAND, reddish gray, medium dense		6040	
					END OF DRILLING AT 15.0 FT			
20							6035	
25							6030	
30							6025	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

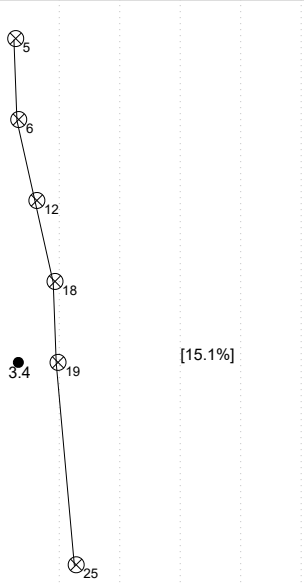
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 15 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 15 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-24**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6038.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(GP-GC) GRAVEL WITH CLAY AND SAND, dark brown, dry, medium dense			6-11-10-17 (21)
	S-2	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light brown to brown, dry, medium dense			13-12-14-12 (26)
5	S-3	SS	24	24			6033	11-7-10-8 (17)
	S-4	SS	21	21	(SP-SC) SAND WITH CLAY AND GRAVEL, brown, dry, dense			9-10-28-50/3" (38)
	S-5	RC	36	28	BASALT, [REC=78%,RQD=61%], Very Hard, Dark Gray to Reddish Gray			
10							6028	
	S-6	RC	24	22	BASALT, [REC=90%,RQD=58%], Very Hard, Gray			
	~~S-7~~	~~SS~~	~~1~~	~~1~~				50/1" (50/1")
					BASALT, Very Hard, Gray, fragments			
15					**END OF DRILLING AT 15.0 FT**		6023	
20							6018	
25							6013	
30							6008	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ **STANDARD PENETRATION BLOWS/FT**

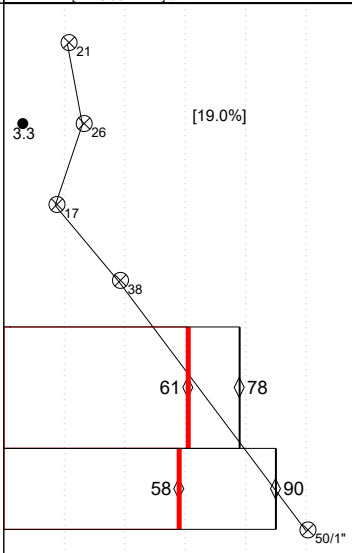
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ **CALIBRATED PENETROMETER TON/SF**

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 12 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 12 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-25**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **5994.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	16	16	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, very dense			2-17-50/4" (67/10")
	S-2	SS	10	10				5-50/4" (50/4")
5	S-3	SS	24	24			5989	35-39-20-21 (59)
	S-4	SS	24	24	(SC) CLAYEY SAND, light brown, dry, dense to very dense			15-16-16-27 (32)
	S-5	SS	24	24				27-33-25-26 (58)
10							5984	
	S-6	SS	15	15	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense			16-25-50/3" (75/9")
15					**END OF DRILLING AT 15.0 FT**		5979	
20							5974	
25							5969	
30							5964	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 17 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 17 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-26**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6056.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, brown, dry, hard			8-14-18-20 (32)
	S-2	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, dense			29-25-15-15 (40)
5	S-3	SS	24	24	(GC) CLAYEY GRAVEL WITH SAND, brown to grayish brown, medium dense		6051	18-17-11-18 (28)
	S-4	SS	24	24				14-8-9-10 (17)
	S-5	SS	24	24				7-12-14-27 (26)
10							6046	
	S-6	SS	24	24	(GP) GRAVEL WITH SAND, reddish gray, medium dense			5-6-7-3 (13)
15					**END OF DRILLING AT 15.0 FT**		6041	
20							6036	
25							6031	
30							6026	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

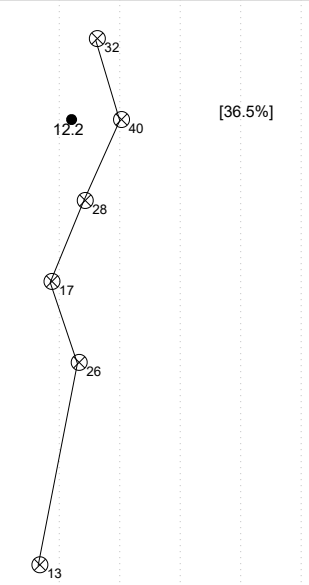
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 14 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 14 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY:	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-27**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6062.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	24	(CL) SANDY LEAN CLAY WITH GRAVEL, dark to light brown, dry, very stiff			4-11-14-19 (25)
	S-2	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown to grayish brown, dry, dense			14-14-27-29 (41)
5	S-3	SS	24	24			6057	18-25-18-18 (43)
	S-4	SS	24	24	(GP) GRAVEL WITH SAND, reddish brown, medium dense to dense			12-11-9-14 (20)
	S-5	SS	19	19				11-13-23-50/1" (36)
10							6052	
	S-6	SS	24	24				14-20-20-31 (40)
15					**END OF DRILLING AT 15.0 FT**		6047	
20							6042	
25							6037	
30							6032	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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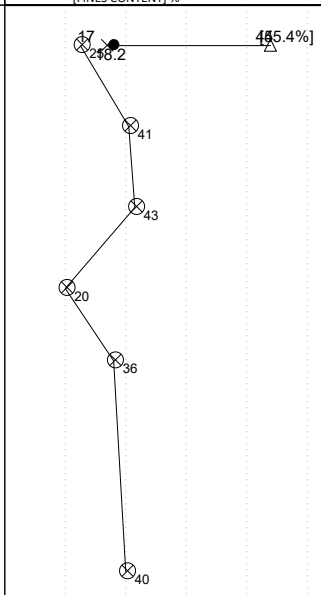

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 15 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 15 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-28**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6048.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, brown to light brown, dry, hard			5-18-23-48 (41)
	S-2	SS	18	18	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense			27-32-50 (82)
5	S-3	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, medium dense		6043	9-11-10-10 (21)
	S-4	SS	24	24				5-8-7-10 (15)
10	S-5	SS	24	24	(GP-GC) GRAVEL WITH CLAY AND SAND, brown, medium dense		6038	7-9-8-10 (17)
	S-6	SS	24	24	(GP) GRAVEL, reddish gray, loose			5-6-4-8 (10)
15					**END OF DRILLING AT 15.0 FT**		6033	
20							6028	
25							6023	
30							6018	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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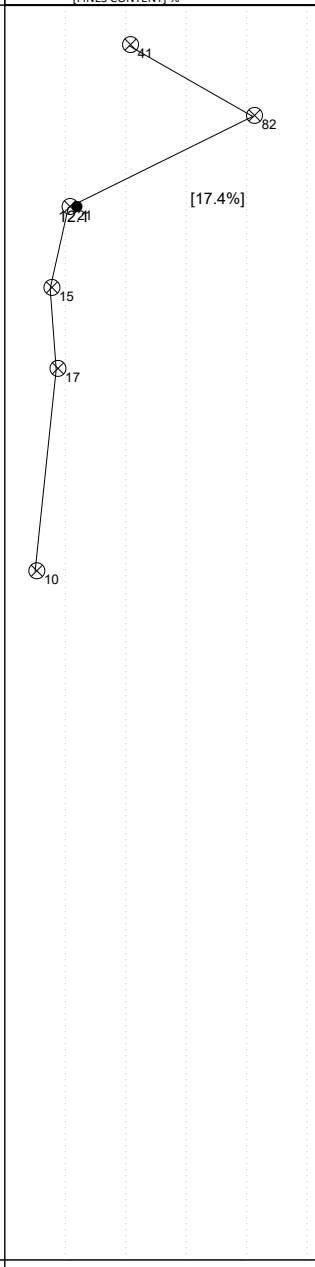

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 15 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 15 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-29**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6020.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, light brown, dry, very dense to dense			17-34-26-35 (60)
	S-2	SS	24	24				33-26-23-17 (49)
5	S-3	SS	24	24	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, medium dense		6015	14-10-10-11 (20)
	S-4	SS	14	14	(SC) CLAYEY SAND WITH GRAVEL, brown, dry, very dense			15-35-50/2" (85/8")
	S-5	SS	0	0				50/0" (50/0")
10					(GP) GRAVEL WITH SAND, dark gray, very dense		6010	
	S-6	SS	10	10				27-50/4" (50/4")
15					**END OF DRILLING AT 15.0 FT**		6005	
20							6000	
25							5995	
30							5990	

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

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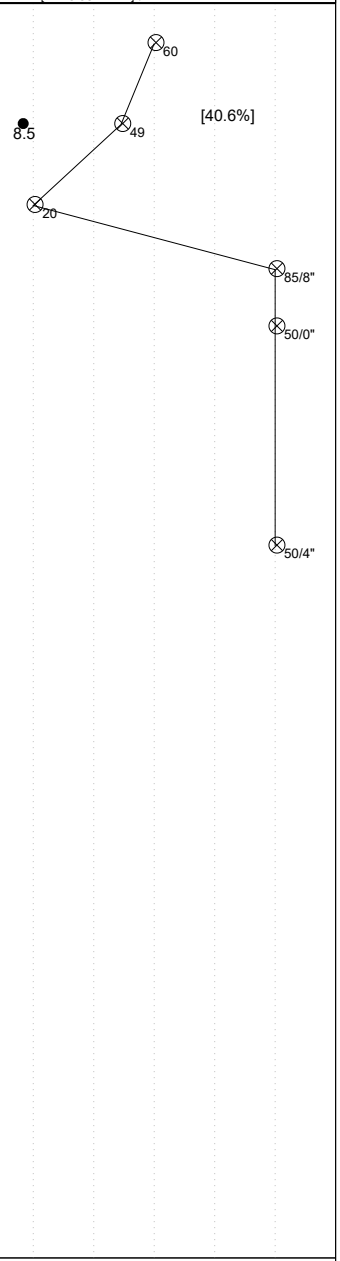


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 16 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 16 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Gordon	**17:5539**	**B-30**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
National Cemetery Development	**Enviro-Drill, Inc.**

SITE LOCATION: **2181 W. 1600 S., Cedar City, Utah 84720**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **6063.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	(CL) LEAN CLAY WITH SAND, brown, dry, hard			7-10-23-47 (33)
	S-2	SS	17	17	(SP) SAND WITH GRAVEL, grayish brown, very dense			32-35-50/5" (85/11")
5	S-3	SS	24	24	(GP-GC) GRAVEL WITH CLAY AND SAND, reddish brown, dense to very dense		6058	17-20-20-26 (40)
	S-4	SS	24	24				29-25-25-28 (50)
	S-5	SS	24	24				20-32-26-20 (58)
10	S-6	RC	6	0	POSSIBLE BASALT, [REC=0%,RQD=0%], No Recovery		6053	0
	S-7	SS	4	4	(GP) GRAVEL, reddish gray, dry, very dense			50/4" (50/4")
15					**END OF DRILLING AT 15.0 FT**		6048	
20							6043	
25							6038	
30							6033	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

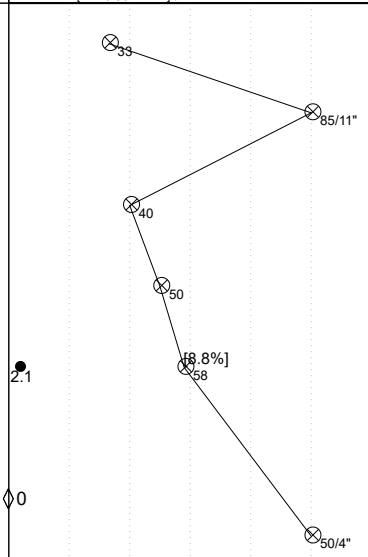
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 15 2021**		CAVE IN DEPTH:
▼ WL (Completion) **NONE**	BORING COMPLETED: **Feb 15 2021**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME-75**	LOGGED BY: **RB8**	DRILLING METHOD: **ODEX**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-01**	**6049.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) GRAVELLY LEAN CLAY WITH SAND, brown	M			S-1	10.1
			(CL) SANDY LEAN CLAY, contains trace gravel, reddish brown	M			S-2	
5		6044		D			S-3	13.3
				M			S-4	
				D			S-5	
10		6039						
			(CL) GRAVELLY LEAN CLAY WITH SAND, reddish brown	VD			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Catepiller**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-02**	**6048.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(GP-GC) GRAVEL WITH CLAY AND SAND, light brown	M			S-1	
			(GC) CLAYEY GRAVEL, light brown	M			S-2	11.9
5		6043	(SC) CLAYEY SAND WITH GRAVEL, brown	D			S-3	
			(GC) CLAYEY GRAVEL WITH SAND, brown	D			S-4	9.3
			(GP-GC) GRAVEL WITH CLAY AND SAND, contains basalt rock fragments, dark reddish brown, medium sized boulders encountered at ~8 feet	D			S-5	
10		6038		D			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-03**	**6047.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) LEAN CLAY WITH SAND, brown, contains organic materials	E			S-1	8.8
			(SC) CLAYEY SAND, brown	M			S-2	4.0
5		6042	(GC) CLAYEY GRAVEL WITH SAND, light brown, light brown to tan small boulders encountered ~6 feet	M			S-3	
				D			S-4	
10		6037	(GP-GC) GRAVEL WITH CLAY AND SAND, contains basalt rock fragments, dark reddish brown, medium to large boulders encountered ~13 feet	D			S-5	
				D			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-04**	**6045.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) GRAVELLY LEAN CLAY, contains trace organics, brown	E			S-1	9.5
			(GP-GC) GRAVEL WITH SAND AND CLAY, tan to dark gray, small to medium sized boulders encountered ~13 feet,	M			S-2	
5		6040		D			S-3	4.3
				D			S-4	
				D			S-5	
10		6035		VD			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-05**	**6050.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(GC) CLAYEY GRAVEL, contains trace organics, brown,	M			S-1	5.6
				M			S-2	7.6
5		6045	(GP-GC) GRAVEL WITH CLAY AND SAND, brown	D			S-3	
			(GC) CLAYEY GRAVEL WITH SAND, brown	VD			S-4	
			(GP-GC) GRAVEL WITH CLAY AND SAND, contains basalt rock fragments, dark reddish brown, large boulders encountered at 10 feet	VD			S-5	
10		6040						
			BASALT, Dark Reddish Brown	VD			S-6	
			Refusal encountered at 14.0 feet. **END OF TEST PIT AT 14.0 FT**					
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-06**	**6000.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) LEAN CLAY WITH GRAVEL, brown	E			S-1	8.1
			(GP-GC) GRAVEL WITH SAND AND CLAY, reddish brown	D			S-2	
5		5995	(GC) CLAYEY GRAVEL WITH SAND, reddish brown, large boulders/rock layers encountered at 4 feet, had to excavate around them to avoid refusal	D			S-3	
				VD			S-4	5.5
				VD			S-5	
10		5990						
			(GP-GC) GRAVEL WITH SAND AND CLAY, contains basalt rock fragments, dark reddish brown,	VD			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	⧩ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-07**	**5992.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(GC) CLAYEY GRAVEL, brown	E			S-1	
			(GP-GC) GRAVEL WITH SAND AND CLAY, tan	M			S-2	
5		5987	(CL) GRAVELLY LEAN CLAY WITH SAND, light brown to reddish brown,	M			S-3	9.2
				D			S-4	
				D			S-5	
10		5982						
			(GC) CLAYEY GRAVEL, reddish brown	D			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-08**	**6026.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) GRAVELLY LEAN CLAY WITH SAND, contains trace organics, brown	E			S-1	10.9
			(CL) SANDY LEAN CLAY WITH GRAVEL, light brown	M			S-2	
5		6021		D			S-3	
				D			S-4	
				D			S-5	
10		6016						
			(GC) CLAYEY GRAVEL WITH SAND, brown, small to medium sized boulders ~13 feet	D			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-09**	**6060.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) SANDY CLAY WITH GRAVEL, brown, contains organic materials	E			S-1	11.3
			(GC) CLAYEY GRAVEL WITH SAND, brown	M			S-2	
5		6055		M			S-3	
			(SC) CLAYEY SAND WITH GRAVEL, reddish brown	D			S-4	
				D			S-5	
10		6050						
			(GP-GC) GRAVEL WITH SAND AND CLAY, contains basalt rock fragments, dark reddish brown,	D			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-10**	**6047.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) GRAVELLY CLAY, brown, contains organic material	E			S-1	12.4
			(GP-GC) GRAVEL WITH SAND AND CLAY, grayish brown, very large boulders encountered at ~6 to12.5 feet	M			S-2	
5		6042		M			S-3	
				D			S-4	
				D			S-5	
10		6037		VD			S-6	
			Refusal encountered at 12.5 feet. **END OF TEST PIT AT 12.5 FT**					
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-11**	**6032.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) GRAVELLY CLAY WITH SAND, contains trace organics, brown,	E			S-1	10.1
			(GP-GC) GRAVEL WITH SAND AND CLAY, grayish brown,	D			S-2	
5		6027		VD			S-3	
			(GP) GRAVEL WITH SAND, contains rock fragments, gray, medium sized boulders encountered ~8 feet	M			S-4	
				D			S-5	
10		6022						
				VD			S-6	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 09 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-12**	**6057.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) CLAY WITH GRAVEL, brown, contains organic material	E			S-1	12.4
5		6052	(GC) CLAYEY GRAVEL WITH SAND, reddish brown, very large boulders encountered at 4 feet	D			S-2	11.7
			(GP-GC) GRAVEL WITH SAND AND CLAY, gray	VD			S-3	
10		6047	Refusal encountered at 10.0 feet. **END OF TEST PIT AT 10.0 FT**					
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-13**	**6051.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) LEAN CLAY, brown	E			S-1	
5		6046	(SC) CLAYEY SAND, contains trace gravel, reddish brown					
				D			S-2	9.2
10		6041						
				D			S-3	14.1
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-14**	**6052.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) SANDY LEAN CLAY, brown	M			S-1	7.5
5		6047	(CL) SANDY LEAN CLAY WITH GRAVEL, reddish brown, very large boulders from ~8 to 15 feet	M			S-2	
10		6042		M			S-3	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-15**	**6049.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) SANDY LEAN CLAY, brown	M			S-1	8.9
5		6044	(SC) CLAYEY SAND WITH GRAVEL, reddish brown	D			S-2	
10		6039	(GC) CLAYEY GRAVEL WITH SAND, reddish brown	VD			S-3	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-16**	**6049.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
0			(SC) CLAYEY SAND WITH GRAVEL, reddish brown	E			S-1	7.7
5		6044					S-2	
10		6039		M				
			(GP) GRAVEL WITH SAND, contains basalt rock fragments, dark reddish brown	D			S-3	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-17**	**6047.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(CL) SANDY CLAY, brown	E			S-1	10.2
			(GP-GC) GRAVEL WITH SAND AND CLAY, gray, large boulders ~10 feet					
5		6042		D			S-2	
10		6037		VD			S-3	
			Refusal encountered at 13.5 feet.					
			END OF TEST PIT AT 13.5 FT					
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-18**	**6042.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
0			(SC) CLAYEY SAND, light brown	M			S-1	8.9
5		6037	(GP) GRAVEL WITH SAND, contains basalt rock fragments, dark reddish brown,	D			S-2	
10		6032		D			S-3	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	⧩ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-19**	**6047.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
			(GC) CLAYEY GRAVEL, brown	E			S-1	11.6
5		6042	(SC) CLAYEY SAND, light brown	M			S-2	7.8
10		6037	(GP) GRAVEL WITH SAND, contains basalt rock fragments, dark reddish brown	D			S-3	
15			**END OF TEST PIT @ 15'**					

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

CLIENT:	PROJECT NO.:	SHEET:
Gordon	**17:5539**	**1 of 1**
PROJECT NAME:	TEST PIT NO.:	SURFACE ELEVATION:
National Cemetery Development	**TP-20**	**6060.0**
SITE LOCATION:		STATION:
2181 W. 1600 S., Cedar City, Utah 84720		
NORTHING:	EASTING:	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	QP (TSF)	SAMPLE NUMBER	MOISTURE CONTENT (%)
5		6055	(GC) CLAYEY GRAVEL WITH SAND, light brown	M			S-1	
10		6050	(CL) GRAVELLY CLAY, brown, large to medium boulders encountered ~8 feet	D			S-2	5.5
			(SC) CLAYEY SAND WITH GRAVEL, contains rock fragments, brown	VD			S-3	
			Refusal encountered at 14.0 feet. **END OF TEST PIT AT 14.0 FT**					
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	CONTRACTOR:	OPERATOR:	MAKE/MODEL:
▼ WL (Completion)		**Austin Geo-Logic**	**Precision Contractors**	**Caterpillar**

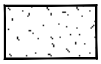
ECS REP.:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
Joffre Crouere	**Feb 10 2021**	**English**	

TEST PIT LOG

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]


ASPHALT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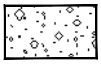
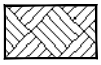
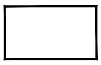
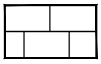

GRAVEL

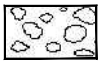

TOPSOIL

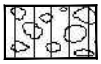

VOID


BRICK

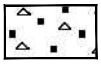

AGGREGATE BASE COURSE

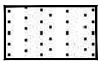

GW **WELL-GRADED GRAVEL**
gravel-sand mixtures, little or no fines

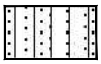

GP **POORLY-GRADED GRAVEL**
gravel-sand mixtures, little or no fines


GM **SILTY GRAVEL**
gravel-sand-silt mixtures


GC **CLAYEY GRAVEL**
gravel-sand-clay mixtures

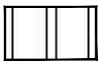

SW **WELL-GRADED SAND**
gravelly sand, little or no fines

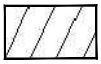

SP **POORLY-GRADED SAND**
gravelly sand, little or no fines


SM **SILTY SAND**
sand-silt mixtures

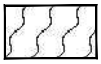

SC **CLAYEY SAND**
sand-clay mixtures

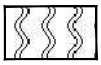

ML **SILT**
non-plastic to medium plasticity

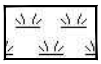

MH **ELASTIC SILT**
high plasticity


CL **LEAN CLAY**
low to medium plasticity


CH **FAT CLAY**
high plasticity


OL **ORGANIC SILT or CLAY**
non-plastic to low plasticity


OH **ORGANIC SILT or CLAY**
high plasticity


PT **PEAT**
highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

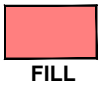

WL (First Encountered)


WL (Completion)


WL (Seasonal High Water)


WL (Stabilized)

FILL AND ROCK


FILL


POSSIBLE FILL


PROBABLE FILL


ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

321D LCR
Hydraulic Excavator

Cat® C6.4 Engine with ACERT™ Technology	
Net Power (ISO 9249) at 1800 rpm	103 kW/140 hp
Operating Weight	24 180 to 25 680 kg
Maximum Travel Speed	5.7 km/h
Maximum Reach at Ground Level	10 110 mm
Maximum Digging Depth	6680 mm
Tail Swing Radius	1680 mm

321D LCR Hydraulic Excavator

Offers a compact radius and improved performance, versatility and styling.

Compact Radius

The 321D LCR is a “Compact Radius” machine developed so that it can work in the narrow job-site. The cylindrical upper frame and cylindrical operator station, allow the 321D LCR to rotate in the narrower job-sites. **pg. 4**

C6.4 Engine with ACERT™ Technology

✔ ACERT™ Technology works at the point of combustion to optimize engine performance and provide low exhaust emissions to meet EU Stage IIIA emission regulations, with exceptional performance capabilities and proven reliability. **pg. 5**

Operator Comfort

✔ A ROPS cab provides maximum space, wider visibility and easy access to switches. The monitor is a full-color graphical display that allows the operator to understand the machine information easily. Overall, the new ROPS cab provides a comfortable environment for the operator. **pg. 8**

Hydraulics

The hydraulic system has been designed to provide reliability and outstanding controllability. An optional Tool Control System provides enhanced flexibility. **pg. 6**

Versatility

Caterpillar offers a wide variety of factory-installed attachments that enhance performance and job site management. **pg. 12**

The Caterpillar 321D LCR excavator provides all the elements to give you the lowest cost to own and operate. At the end of the day, it all comes down to how much work you got done and how much did it cost you. Caterpillar and the 321D LCR offer you the tools to help lower your owning and operating costs.

✔ *New Feature*

Booms, Stick and Linkage

✔ One Reach boom and one VA boom related to one long stick (R2.9B1) are available to suit a variety of application conditions. **pg. 10**

Structures

Caterpillar® design and manufacturing techniques assure outstanding durability and service life from these important components. **pg. 7**

Work Tools

Caterpillar buckets, multi-processors, sorting and demolition grapples, hammers and quick couplers provide a total solution package to the end-user. **pg. 11**

Service and Maintenance

✔ Fast, easy service has been designed in with extended service intervals, advanced filtration, convenient filter access and user-friendly electronic diagnostics for increased productivity and reduced maintenance costs. **pg. 13**

Complete Customer Support

Your Cat® dealer offers a wide range of services that can be set up under a customer support agreement when you purchase your equipment. The dealer will help you choose a plan that can cover everything from machine configuration to eventual replacement. **pg. 13**

Compact Radius

The 321D LCR delivers exceptional performance and comfort.

Compact Radius. The 321D LCR features a compact radius design, which makes it ideal for working in space restricted areas such as: close to buildings, road construction – limiting lane closures or logging roads. The tail swing is just 1680 mm as compared to the 2750 mm on the 320D. When rotated 90 degrees and working over the side, a minimal amount of counterweight extends beyond the track width.

Operator Confidence. Due to the 321D LCR's compact working envelope, operators can work confidently knowing that the counterweight will not swing into any object behind them.

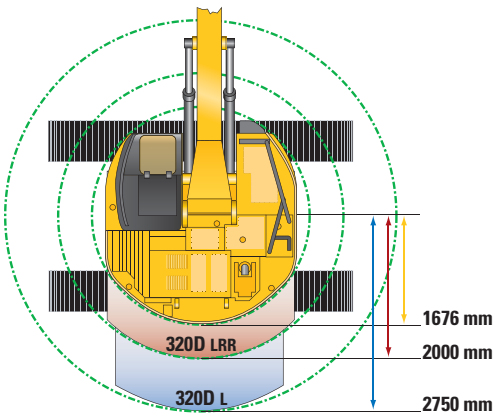
Comfort. The ROPS cab on the 321D LCR is a comfortable place to work, with low sound levels, good visibility and convenient access to switches and controls.

Working Envelope. To further minimize the working envelope, the boom is repositioning more towards the center of the machine as compared to a standard excavator. This reduced the front swing radius when the boom is pulled all the way up and the stick brought in completely. This design also increases the lift capacity of the 321D LCR over the front as it has a better mechanical advantage when compared to a standard excavator.

321D LCR versus 320D LRR and 320D L

Compare minimum front swing radius and tail swing radius:

	321D LCR	320D LRR	320D L
Tail swing radius (mm)	1676	2000	2750
Minimum front swing radius (mm)	2340	3660	3660
Overhang (mm)			
with 600 mm shoes	186	510	1235
with 790 mm shoes	86	410	1110



Engine

The Cat® C6.4 gives the 321D LCR exceptional power and fuel efficiency unmatched in the industry for consistently high performance in all applications.

Cat C6.4. The Cat C6.4 with ACERT Technology introduces a series of evolutionary, incremental improvements that provide breakthrough engine technology. The building blocks of ACERT Technology are fuel delivery, air management and electronic control. ACERT Technology optimizes engine performance while meeting EU Stage IIIA emission regulations. With its proven technology, robust components and precision manufacturing, you can count on this engine to power up at start time and keep working productively all shift long.

Performance. The 321D LCR, equipped with the C6.4 engine with ACERT Technology, provides 7% more power as compared to the 3066 TA in the 321C LCR. The additional power delivers a speed and efficiency advantage in high production applications.

Automatic Engine Speed Control. The two-stage, one-touch control maximizes fuel efficiency and reduces sound levels.

ADEM™ A4 Engine Controller. The ADEM A4 electronic control module manages fuel delivery to get the best performance per liter of fuel used. The engine management system provides flexible fuel mapping, allowing the engine to respond quickly to varying application needs. It tracks engine and machine conditions while keeping the engine operating at peak efficiency.

Electronic Control Module. The Electronic Control Module (ECM) works as the “brain” of the engine’s control system, responding quickly to operating variables to maximize engine efficiency. Fully integrated with sensors in the engine’s fuel, air, coolant, and exhaust systems, the ECM stores and relays information on conditions such as rpm, fuel consumption, and diagnostic information.

Fuel Delivery. The Cat C6.4 features electronic controls that govern the fuel injection system. Multiple injection fuel delivery involves a high degree of precision. Precisely shaping the combustion cycle lowers combustion chamber temperatures, generating fewer emissions and optimizing fuel combustion. This translates into more work output for your fuel cost.

Cooling System. The cooling fan is directly driven from the engine. An electrically controlled viscous clutch fan is available as an attachment to reduce fan noise. The optimum fan speed is calculated based on the target engine speed, coolant temperature, hydraulic oil temperature and actual fan speed. When fan speed is reduced, there’s more power available for other functions – and less fuel is burned.

Hydraulics

Cat® hydraulics deliver power and precise control to keep material moving.

Component Layout. To optimize efficiency of hydraulic performance, the hydraulic components are located close together, which reduces friction loss and pressure drops in the lines.

System Pressure. System pressure has been increased to 350 bar, which attributes to improved performance:

- Increased stick and bucket forces (up 7% higher than the 321C LCR) to better handle those tight digging conditions
- More drawbar pull (206 kN) to provide more ability to climb slopes, easier spot turns and improved travel in poor underfoot conditions
- More lift capacity, generally over the front where you are generally hydraulically limited

Heavy Lift. The 321D LCR features the addition of a heavy lift, which increases system pressure to 360 bar, giving even more lift capacity over the front. Heavy Lift is activated be depressing the soft switch on the right hand console. As the pressure increases, the engine speed is reduced, which allows better control while lifting objects.

Pilot System. The pilot pump is independent from the main pumps and controls the front linkage, swing and travel operations.

Hydraulic Cross Sensing System. The hydraulic cross sensing system utilizes each of two hydraulic pumps to 100 percent of engine power, under all operating conditions. This improves productivity with faster implement speeds and quicker, stronger pivot turns.

Boom and Stick Regeneration Circuit. Boom and stick regeneration circuit saves energy during boom-down and stick-in operation which increases efficiency, reduces cycle times and pressure loss for higher productivity, lower operating costs and increased fuel efficiency.

Auxiliary Hydraulic Valve. The auxiliary valve is standard on the 321D LCR. Control Circuits are available as attachments, allowing for operation of high and medium pressure tools such as shears, grapples, hammers, pulverizers, multi-processors and vibratory plate compactors.

Hydraulic Cylinder Snubbers. Snubbers are located at the rod-end of the boom cylinders and both ends of the stick cylinder to cushion shocks while reducing sound levels and extending component life.

Structures

321D LCR is designed to handle the most rugged operating conditions, while providing long life and value.

Robust Undercarriage. A solid foundation built tough to absorb the stresses of everyday work.

- Rollers and idlers are sealed and lubricated to extend service life.
- Track links are assembled and sealed with grease to decrease internal bushing wear and increase life by as much as 25%, when compared to dry seal undercarriages.
- Spring recoil system stroke has been increased to better relieve excess track tension, which can occur when material builds up between the track and sprocket.

Rugged Structures. Structural components and the undercarriage are the backbone of the machine's durability. Caterpillar places a lot of emphasis on the machine's durability during the designing and manufacturing of its excavators.

- Up to 95% of the structural welds are welded by robots, which achieve up to three times the penetration of a manual weld and improving overall durability of the machine.
- The 321D LCR's main frame utilizes high-tensile strength steel and a one-piece swing table, which improves strength and reliability.
- The carbody has a X-shaped, box section design to resist bending and twisting forces.
- Track roller frames are press-formed in a pentagonal shape for additional strength.

Dozer blade. The 321D LCR features an optional undercarriage mounted dozer blade. This blade is adjustable from the ROPS cab. It provides increased front stability as well as dozing and leveling capacities.

Engine Hood. The 321D LCR features a one-piece, flat engine hood. The engine hood opens backwards and is located in a place that does not obstruct access to inspection points in the engine compartment.

Counterweight. The counterweight is split into two pieces for improved serviceability. The top piece weighs approximately 2270 kg, and the bottom weighs 3830 kg. The counterweight is a rounded cast structure that minimizes the amount of overhang.

Operator Comfort

Caterpillar offers the most intuitive and easy to operate excavators while providing great all around visibility and exceptional operator comfort.

Operator Station. The layout of the interior has been redesigned to maximize operator comfort and reduce operator fatigue.

- Frequently used switches have been relocated for easier access.
- Consoles and armrests have been redesigned for better comfort and adjustability.
- More seat options – choose from the standard mechanical suspension seat, or the optional air suspension seat with heater. Both provide excellent comfort.
- ROPS cab air filter accessible at ground level.

Standard Cab Equipment. To enhance operator comfort and productivity, the cab includes a lighter, drink holder, coat hook, service meter, literature holder, magazine rack and storage compartment.

Joystick Control. Joystick controls have low lever effort and are designed to match the operator's natural wrist and arm position.

Hydraulic Activation Control Lever. For added safety, this lever must be in the operate position to activate the machine control functions.

Climate Control. Climate control adjusts temperature and flow, and determines which air outlet is best in each situation with a touch of a button.

Cab Exterior (ROPS). The ROPS cab is made of pressed-steel plates. The pillars, beams and crossbeam, are formed box-shape, which improves the resistance of fatigue and vibration. A ROPS cab (Roll Over Protective Structure) is standard on CE-compliant units, and provides 10% more glass area than the previous non-ROPS cab.

Hand Control Pattern Changer (Optional). Switches the joystick pattern between ISO and SAE patterns. For easy access, the pattern changer is located in the cab, underneath the floor mat. In order to change positions, simply remove the bolt, slide the lever into the appropriate location, then secure the bolt.

Sliding Door. The cab door slides alongside the cab and takes less space to open and close than a hinged door. This unique design allows the operator to easily get in and out of the cab when working next to objects or walls.

Skylight. An enlarged skylight with sunshade provides excellent visibility and ventilation.

Time delay lights. The 321D LCR has optional cab working lights with time delay functionality. These lights have auto shut-off capability, programmable up to 90 seconds and supports safe egress out the machine and easy departure from job site.

Monitor. The monitor is a full color Liquid Crystal Display that gives you vital operating and performance information, alerts in text, all in a simple, easy to navigate format.

Default Display. Three analog gauges, fuel level, hydraulic oil temperature and coolant temperature, are displayed in this area.

Main Menu. Four menu options to choose from:

- Settings – Adjust monitor settings, select work tool or choose video mode (when equipped with a camera).
- Maintenance – Displays service intervals and hours accumulated since last serviced.
- Performance – Displays machine performance attributes such as Engine Speed, Coolant and Hydraulic Oil Temperature.
- Service – Allows access to machine parameters for service intervals, diagnostic information and information related to the machines software.

Event Display. Machine information is displayed in this area with the icon and language.

Multi-information Display. This area is reserved for displaying various information which is convenient for the operator. The "CAT" logo is displayed when no information is available to be displayed.

Booms, Stick and Bucket Linkage

Built for performance and long service life, Caterpillar® booms and sticks are large, welded, box-section structures with thick, multi-plate fabrications in high stress areas.

Bucket Linkage. The power link improves durability, increases machine-lifting capability in key lifting positions and with the integrated lift-eye it is easier to use than compared to the previous power link. The lift eye also gives you the optimum lift performance. It allows you to lower the load point, which maximizes the use of the boom cylinders.

Front Linkage Attachments. Select the right combination of front linkage with your Cat dealer to ensure high productivity from the very start of your job. Two types of booms and one stick are available. All booms and sticks undergo a stress relieving process for greater durability.

Reach Boom. The reach boom is designed to balance reach, digging force bucket capacity, offering a wide range of applications as digging, loading, trenching and working with hydraulic tools.

Variable Adjustable Boom. It offers superb flexibility and versatility in the working envelope. Boom position can be adjusted from 90° when fully retracted to 165° when fully extended. With full extension, the working range gives both maximum dig depth, reach and working height. Equally, when the VA boom is retracted, it can work closer to its tracks, increase lifting capacity and work in confined areas.

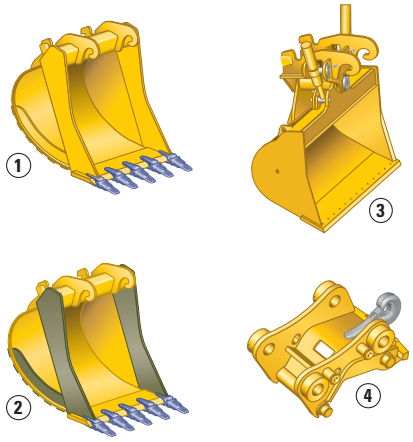
Stick Construction. Sticks are made of high-tensile strength steel using a large box section design with interior baffle plates and an additional bottom guard to protect against damage.

R2.9B1 Stick

- The 2920 mm stick with reach boom gives the largest working envelope with medium-sized buckets.
- The 2920 mm stick with VA boom provides the necessary strength in digging, lifting and hammering applications.

Work Tools

A wide variety of Work Tools help optimize machine performance. Purpose designed and built to Caterpillar's high durability standards.



1 Excavation (X)

2 Extreme Excavation (EX)

3 Ditch Cleaning

4 Quick Coupler

Work Tools. Caterpillar work tools are designed to function as an integral part of your excavator and to provide the best possible performance in your particular application. All work tools are performance-matched to Cat machines.

Quick Couplers. Quick couplers enable the operator to simply release one work tool and connect to another, making your hydraulic excavator highly versatile. Productivity also increases, as a carrier no longer needs to be idle between jobs. Caterpillar offers hydraulic and spindle quick coupler versions.

Buckets. Caterpillar offers a wide range of specialized buckets, each designed and tested to function as an integral part of your excavator. Buckets feature the new Caterpillar K Series™ Ground Engaging Tools.

Hammers. Cat hammer series deliver very high blow rates, increasing the productivity of your tool carriers in demolition and construction applications. Wide oil flow acceptance ranges make the Caterpillar hammers suitable for a wide range of carriers and provide a system solution from one safe source.

Orange Peel Grapples. The orange peel grapple is constructed of high-strength, wear-resistant steel, with a low and compact design that makes it ideal for dump clearance. There are several choices of tine and shell versions.

Multi-Grapples. The multi-grapple with unlimited left and right rotation is the ideal tool for stripping, sorting, handling and loading. The powerful closing force of the grab shells combined with fast opening/closing time ensures rapid cycle time which translates to more tons per hour.

Multi-Processors. Thanks to its single basic housing design, the multi-processor series of hydraulic demolition equipment makes it possible to use a range of jaw sets that can handle any demolition job. The multi-processor is the most versatile demolition tool on the market.

Vibratory Plate Compactors. Cat compactors are performance-matched to Cat machines, and integrate perfectly with the Cat hammer line – brackets and hydraulic kits are fully interchangeable between hammers and compactors.

Shears. Cat shears provide superior and effective scrap processing, and are highly productive in demolition environments. Shears are compatible with a matching Cat excavator, and bolt-on brackets are available for either stick or boom-mounted options.

Versatility

A wide variety of optional factory-installed attachments are available to enhance performance and improve job site management.

Auxiliary Hydraulic Options.
Allows you to configure your 321D LCR to meet your work tools needs, while increasing its versatility.

- Single Function Circuit – suited for tools that require one-way flow with both pumps, such as hammers, vibratory plate compactors.
- Double Function Circuit – suited for tools that require two-way flow, utilizing one pump, such as thumbs or non-rotation grapples or shears.
- Tool Control System
  - Accommodates single or double function tools
  - Stores pressure and flow information for up to 10 tools
  - Electronically adjustability of pressures and flows via monitor
  - Cat tools selectable from monitor's menu that have preset optimal flows and pressures
  - Shortcut button on right hand console, making tool selection easier.
  - Medium pressure circuit accommodates e.g. rotation or tilting function

Machine Security. An optional Machine Security System is available from the factory on the 321D LCR. This system controls when the machine can be operated and utilizes specific keys to prevent unauthorized machine use, a significant theft deterrent.

Product Link. Both the PL121 and PL321 are available as factory installed attachments.

PL121 gives you Asset Watch, which includes the following features:

- Engine hours
- Machine location
- Time based fences (when the machines can operate)
- Geo-based fences (boundaries that the machine can operate)

PL321 gives you all of the features listed for PL121, plus the ability to include Health and Maintenance Watch:

- Health Watch
  - Codes from on-board EDM's/Sensors
  - Estimated Fuel Consumption
  - Fuel Watch
- Maintenance Watch
  - Preventative Maintenance Planning
  - Preventative Maintenance Checklists
  - Overdue PM Notification
  - PM History Recording

More Attachments. The 321D LCR offers the most options available to equip your machine to best match your application and work environment requirements. From track shoe size to guarding packages to operator comfort options, the 321D LCR offers more options.

Service and Maintenance

Simplified service and maintenance save you time and money.

Extended Service Intervals. 321D LCR service and maintenance intervals have been extended to reduce machine service time and increase machine availability.

Air Filter Compartment. The air filter features a double-element construction for superior cleaning efficiency. When the air cleaner plugs, a warning is displayed on the monitor screen inside the cab.

Ground Level Service. The design and layout of the 321D was made with the service technician in mind. Many service locations are easily accessible at ground level allowing critical maintenance to get done quickly and efficiently.

Pump Compartment. A service door on the right side of the upper structure allows ground-level access to the pump and pilot filter.

Capsule Filter. The hydraulic return filter, a capsule filter, is situated outside the hydraulic tank. This filter prevents contaminants from entering the system when hydraulic oil is changed and keeps the operation clean.

Diagnostics and Monitoring. The 321D is equipped with S•O•S℠ sampling ports and hydraulic test ports for the hydraulic system, engine oil, and for coolant. A test connection for the Electronic Technician (ET) service tool is located behind the cab.

Anti-Skid Plate. Anti-skid plate covers top of storage box and upper structure to prevent slipping during maintenance.

Fan Guard. Engine radiator fan is completely enclosed by fine wire mesh, reducing the risk of an accident.

Greasing Points. A concentrated remote greasing block on the boom delivers grease to hard-to-reach locations on the front.

Radiator Compartment. The left rear service door allows easy access to the engine radiator, oil cooler and air-to-air aftercooler. Reserve tank and drain cock are attached to the radiator for simplified maintenance.

Complete Customer Support

Cat dealer services help you operate longer with lower costs.

Machine Selection. Make detailed comparisons of the machines you are considering before you buy. What are the job requirements, machine attachments and operating hours? What production is needed? Your Cat dealer can provide recommendations.

Purchase. Consider the financing options available as well as day-to-day operating costs. This is also the time to look at dealer services that can be included in the cost of the machine to yield lower equipment owning and operating costs over the long run.

Customer Support Agreements. Cat dealers offer a variety of product support agreements, and work with customers to develop a plan the best meets specific needs. These plans can cover the entire machine, including attachments, to help protect the customer's investment.

Operation. Improving operating techniques can boost your profits. Your cat dealer has videotapes, literature and other ideas to help you increase productivity, and Caterpillar offers certified operator training classes to help maximize the return on your investment.

Product Support. You will find nearly all parts at our dealer parts counter. Cat dealers utilize a worldwide computer network to find in-stock parts to minimize machine downtime. You can save money with Cat remanufactured components.

Maintenance Services. Repair option programs guarantee the cost of repairs up front. Diagnostic programs such as Scheduled Oil Sampling, Coolant Sampling and Technical Analysis help you avoid unscheduled repairs.

Replacement. Repair, rebuild or replace? Your Cat dealer can help you evaluate the cost involved so you can make the right choice.

Engine

Cat C6.4 Engine with ACERT Technology	
Net Power at 1,800 rpm	
ISO 9249	103 kW/140 hp
80/1269/EEC	103 kW/140 hp
Bore	102 mm
Stroke	130 mm
Displacement	6.4 L

- All engine horsepower (hp) are metric including front page.
- The C6.4 engine meets EU Stage IIIA emission requirements.
- Net power advertised is the power available at the flywheel when the engine is equipped with fan, air cleaner, muffler, and alternator.
- Full engine net power up to 2300 m altitude (engine derating required above 2300 m).

Drive

Maximum Travel Speed	5.7 km/h
Maximum Drawbar Pull	206 kN

Swing Mechanism

Swing Speed	11.5 rpm
Swing Torque	62 kNm

Sound

The dynamic exterior sound power level meets EU Directive 2005/88/EC.

Cab/ROPS/FOGS

- Caterpillar cab with integrated Roll Over Protective Structure (ROPS) meets ISO 12117-2:2008 criteria.
- Cab with Falling Object Guard Structure (FOGS) meets ISO 10262.

Hydraulic System

Main System	
Maximum flow	2 x 205 L/min
Maximum pressure	
Normal	350 bar
Heavy	360 bar
Travel	350 bar
Swing	250 bar
Pilot System	
Maximum flow	32 L/min
Maximum pressure	39 bar
Boom Cylinders	
Bore	120 mm
Stroke	1260 mm
Stick Cylinder	
Bore	140 mm
Stroke	1518 mm
B1 Family Bucket Cylinder	
Bore	120 mm
Stroke	1104 mm

Machine and Major Component Weights

Actual weights and ground pressures will depend on final machine configuration.

		Reach boom	VA boom
Stick type		**R2.9B1**	**R2.9B1**
Stick length	mm	2920	2920
Bucket weight	kg	784	700
Bucket capacity	m^3	1.1	0.9
Bucket width/type	mm	1200/X	1000/X
Operating weight*			
600 mm shoes	kg	24 150	25 010
790 mm shoes	kg	24 820	25 670
Ground pressure			
600 mm shoes	bar	0.53	0.55
790 mm shoes	bar	0.41	0.42
Stick weight (with bucket cylinder)	kg	690	690
Boom weight (with stick cylinder)	kg	1380	2210
Upperstructure (without counterweight)	kg	6720	
Undercarriage			
600 mm shoes	kg	7190	
790 mm shoes	kg	7860	
Counterweight	kg	6100	

* With counterweight, quick coupler, bucket, operator and full fuel.

Service Refill Capacities

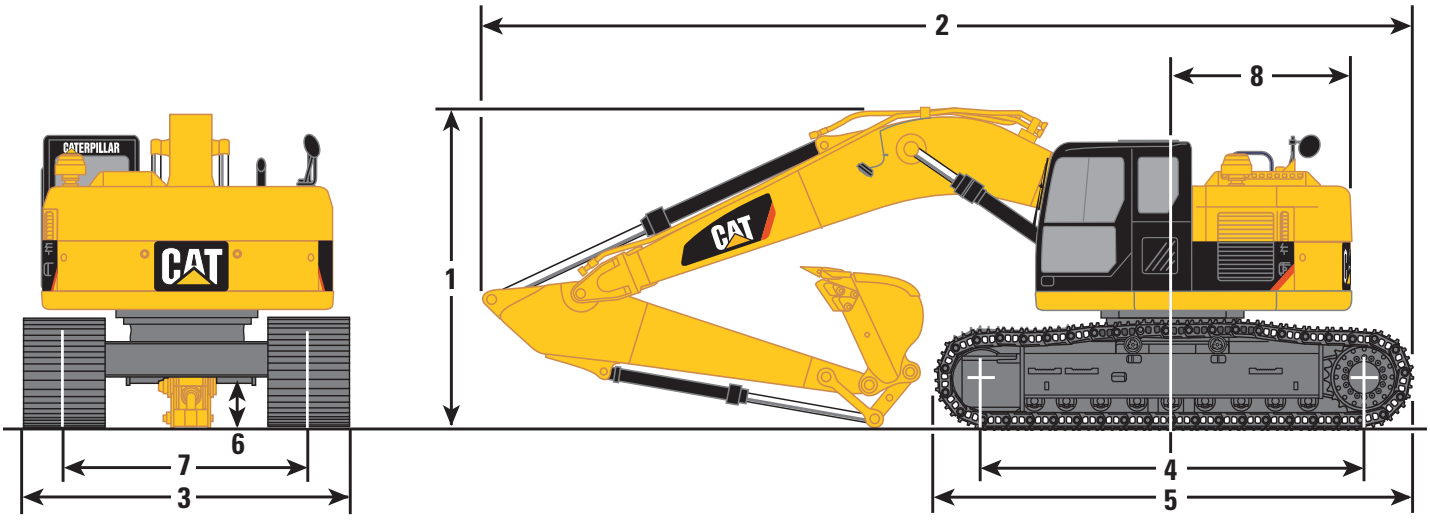
	Liters
Fuel Tank	410
Cooling System	25
Diesel Engine	30
Swing Drive (each)	8
Final Drive (each)	8
Hydraulic system (including tank)	260
Hydraulic tank	120

Track Shoes

Triple grouser	600, 700, 790 mm

Dimensions

All dimensions are approximate.



		mm
1	Shipping height (with bucket)	
	Reach Boom	
	2920 mm stick	3170
	VA Boom	
	2920 mm stick	3170

		mm
2	Shipping length	
	Reach Boom	
	2920 mm stick	8900
	VA Boom	
	2920 mm stick	9200

		mm
3	Transport width	
	600 mm shoes	2980
	790 mm shoes	3180
4	Length to centers of rollers	3650
5	Track length	4455
6	Ground clearance	450
7	Track gauge	2380
8	Tail swing radius	1676
	Cab height	2980

Bucket Specifications

Contact your Cat dealer for special bucket requirements. All buckets are available to fit the Cat quick coupler.

Bucket type	Linkage	Width	Capacity (ISO)	Reach boom 5680 mm			
				Pin-on		Quick coupler	
				Weight*		Weight*	
		mm	m^3	kg	R2.9B1 (2920 mm)	kg	R2.9B1 (2920 mm)
Excavation (X)	B1	544	0.44	601		544	
	B1	585	0.59	593		585	
	B1	662	0.86	698		662	
	B1	475	1.08	784		475	
	B1	765	1.13	801		765	
	B1	783	1.19	819		783	
	B1	818	1.3	854		818	
	B1	853	1.41	889		853	
Extreme Excavation (EX)	B1	615	0.59	620		615	
	B1	791	1.13	827		791	
	B1	828	1.18	864		828	
	B1	865	1.3	901		865	
Maximum load in kg (payload plus bucket)					3134		2651

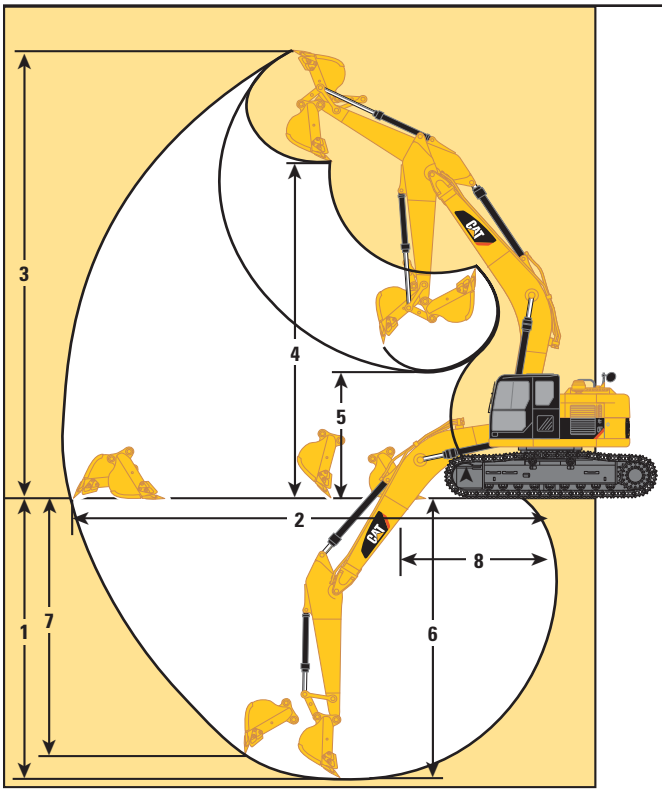
* Including tips

Max. Material density 1200 kg/m^3

Max. Material density 1500 kg/m^3

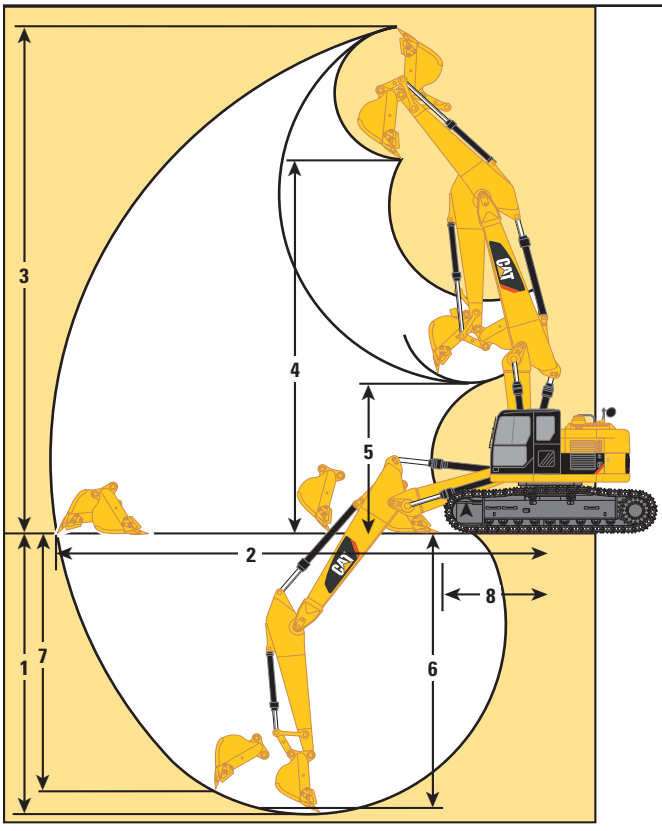
Material density 1800 kg/m^3 and more

Working Range – Reach Boom (5680 mm)



Stick Type	R2.9B1
Stick Length	2920 mm
1 Maximum Digging Depth	6680 mm
2 Maximum Reach at Ground Level	9750 mm
3 Maximum Cutting Height	10 990 mm
4 Maximum Loading Height	7920 mm
5 Minimum Loading Height	3000 mm
6 Maximum Digging Depth 2.5 m Level Bottom	6500 mm
7 Maximum Vertical Wall Digging Depth	6170 mm
8 Minimum Front Swing Radius	2340 mm
Bucket Tip Radius	1554 mm
Bucket Forces (ISO 6015)	141 kN
Stick Forces (ISO 6015)	106 kN

Working Ranges – Variable Adjustable Boom (5940 mm)



Stick Type	R2.9B1
Stick Length	2920 mm
1 Maximum Digging Depth	6490 mm
2 Maximum Reach at Ground Level	10 110 mm
3 Maximum Cutting Height	11 630 mm
4 Maximum Loading Height	8580 mm
5 Minimum Loading Height	3440 mm
6 Maximum Digging Depth 2.5 m Level Bottom	6400 mm
7 Maximum Vertical Wall Digging Depth	5770 mm
8 Minimum Front Swing Radius	2340 mm
Bucket Tip Radius	1554 mm
Bucket Forces (ISO 6015)	141 kN
Stick Forces (ISO 6015)	106 kN

Lift Capacities – Reach Boom (5680 mm)

All weights are in kg, without bucket, with quick coupler, heavy lift on.

Stick
2920 mm
Shoes
600 mm

	1.5 m		3.0 m		4.5 m		6.0 m		7.5 m		9.0 m				
															m
9.0 m													*3350	*3350	4.99
7.5 m							*3900	*3900					*3100	*3100	6.64
6.0 m							*5350	5100	*3500	3500			*2950	*2950	7.66
4.5 m					*6700	*6700	*5950	4900	*5250	3400			*2950	2850	8.29
3.0 m			*8850	*8850	*8700	7150	*6900	4650	5400	3300			*3050	2600	8.62
1.5 m			*6850	*6850	*9450	6600	7400	4350	5250	3150			*3300	2550	8.67
Ground Line			*6800	*6800	*8050	6300	7200	4200	5150	3050			*3750	2550	8.46
–1.5 m	*7850	*7850	*6800	*6800	*7800	6150	7100	4100	5100	3000			*4550	2750	7.96
–3.0 m	*7000	*7000	*6900	*6900	*8200	6200	7100	4100					5550	3250	7.11
–4.5 m	*6800	*6800	*7400	*7400	*8950	6350							*6650	4500	5.76

Stick
2920 mm
Shoes
700 mm

	1.5 m		3.0 m		4.5 m		6.0 m		7.5 m		9.0 m				
															m
9.0 m													*3350	*3350	4.99
7.5 m							*3900	*3900					*3100	*3100	6.64
6.0 m							*5350	5150	*3500	*3500			*2950	*2950	7.66
4.5 m					*6700	*6700	*5950	5000	*5250	3450			*2950	2900	8.29
3.0 m			*8850	*8850	*8700	7300	*6900	4700	5500	3350			*3050	2650	8.62
1.5 m			*6850	*6850	*9450	6750	7550	4450	5350	3200			*3300	2600	8.67
Ground Line			*6800	*6800	*8050	6400	7300	4250	5250	3100			*3750	2600	8.46
–1.5 m	*7850	*7850	*6800	*6800	*7800	6300	7200	4150	5200	3050			*4550	2800	7.96
–3.0 m	*7000	*7000	*6900	*6900	*8200	6300	7200	4150					5650	3300	7.11
–4.5 m	*6800	*6800	*7400	*7400	*8950	6500							*6650	4550	5.76

Stick
2920 mm
Shoes
790 mm

	1.5 m		3.0 m		4.5 m		6.0 m		7.5 m		9.0 m				
															m
9.0 m													*3350	*3350	4.99
7.5 m							*3900	*3900					*3100	*3100	6.64
6.0 m							*5350	5200	*3500	*3500			*2950	*2950	7.66
4.5 m					*6700	*6700	*5950	5050	*5250	3500			*2950	*2950	8.29
3.0 m			*8850	*8850	*8700	7350	*6900	4750	5550	3400			*3050	2700	8.62
1.5 m			*6850	*6850	*9450	6800	7600	4500	5400	3250			*3300	2600	8.67
Ground Line			*6800	*6800	*8050	6500	7400	4300	5300	3150			*3750	2650	8.46
–1.5 m	*7850	*7850	*6800	*6800	*7800	6350	7300	4200	5250	3100			*4550	2850	7.96
–3.0 m	*7000	*7000	*6900	*6900	*8200	6400	7300	4200					5700	3350	7.11
–4.5 m	*6800	*6800	*7400	*7400	*8950	6550							*6650	4600	5.76

Load Point Height Load Radius Over Front Load Radius Over Side Load at Maximum Reach

* Limited by hydraulic rather than tipping load.
The above loads are in compliance with hydraulic excavator lift capacity ratings standard ISO 10567, they do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity. Weight of all lifting accessories must be deducted from the above lifting capacities.

Lift Capacities – VA Boom (5940 mm)

All weights are in kg, without bucket, with quick coupler.

Stick
2920 mm
Shoes
600 mm

	1.5 m		3.0 m		4.5 m		6.0 m		7.5 m		9.0 m				
															m
9.0 m					*3350	*3350							*3250	*3250	5.62
7.5 m							*3250	*3250					*2950	*2950	7.13
6.0 m					*5600	*5600	*4700	*4700	*2850	*2850			*2800	*2800	8.09
4.5 m			*8450	*8450	*6500	*6500	*4600	*4600	*2950	*2950			*2800	2500	8.69
3.0 m	*6700	*6700	*7600	*7600	*6300	*6300	*4000	*4000	*3250	3100			*2850	2300	9.00
1.5 m	*6050	*6050	*5150	*5150	*5250	*5250	*4050	*4050	*3800	2950	*3100	2200	*3050	2200	9.05
Ground Line	*5050	*5050	*6600	*6600	*6900	5900	*4800	3900	*4350	2850			*3400	2200	8.84
–1.5 m	*6650	*6650	*6600	*6600	*7300	5750	*6000	3800	4900	2750			*4000	2400	8.37
–3.0 m	*6600	*6600	*6650	*6650	*6900	5850	*5300	3800	*3550	2800			*3450	2800	7.57
–4.5 m	*6700	*6700	*7200	*7200	*5700	*5700							*4200	4150	5.84

Stick
2920 mm
Shoes
790 mm

	1.5 m		3.0 m		4.5 m		6.0 m		7.5 m		9.0 m				
															m
9.0 m					*3350	*3350							*3250	*3250	5.62
7.5 m							*3250	*3250					*2950	*2950	7.13
6.0 m					*5600	*5600	*4700	*4700	*2850	*2850			*2800	*2800	8.09
4.5 m			*8450	*8450	*6500	*6500	*4600	*4600	*2950	*2950			*2800	2600	8.69
3.0 m	*6700	*6700	*7600	*7600	*6300	*6300	*4000	*4000	*3250	3200			*2850	2350	9.00
1.5 m	*6050	*6050	*5150	*5150	*5250	*5250	*4050	*4050	*3800	3050	*3100	2300	*3050	2250	9.05
Ground Line	*5050	*5050	*6600	*6600	*6900	6100	*4800	4050	*4350	2900			*3400	2300	8.84
–1.5 m	*6650	*6650	*6600	*6600	*7300	5950	*6000	3900	*5000	2850			*4000	2450	8.37
–3.0 m	*6600	*6600	*6650	*6650	*6900	6000	*5300	3950	*3550	2900			*3450	2900	7.57
–4.5 m	*6700	*6700	*7200	*7200	*5700	*5700							*4200	*4200	5.84

Load Point Height Load Radius Over Front Load Radius Over Side Load at Maximum Reach

* Limited by hydraulic rather than tipping load.
The above loads are in compliance with hydraulic excavator lift capacity ratings standard ISO 10567, they do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity. Weight of all lifting accessories must be deducted from the above lifting capacities.

Standard Equipment

Standard equipment may vary. Consult your Cat dealer for specifics.

Electrical
Alternator, 50 A
Base machine light (frame)
Electric start, 24 volt
Horn
Pre-start monitoring system – checks for low fluids (engine oil, coolant, hydraulic oil) prior to starting machine

Operator Environment
Air conditioner, heater, defroster with automatic climate control
Ashtray with 24 volt lighter
Beverage/cup holder
Bolt-on Falling object Guarding System (FOGS) capability
Cab Glass
- Openable and retractable two-piece front windshield
- Skylight, pop-up

Cab, ROPS
Coat hook
Floor mat
Instrument panel and gauges
Joysticks, console mounted, pilot operated
Light, interior
Literature compartment
Monitor, full graphic color display
Neutral lever (lock out) for all controls
Positive filtered ventilation
Pressurized cab
Seat, suspension, with high back and head rest
Seat belt, retractable – 75 mm
Storage compartment suitable for lunch box cooler
Sun shade (for skylight)
Travel control pedals with removable hand levers
Tempered glass windows
Windshield wiper and washer (upper and lower)

Engine/Power Train
C6.4 with ACERT™ Technology
- Air intake heater
- Air-to-air aftercooler (ATAAC)
- HEUI™ injectors
- 2300 m altitude capability without derate

Automatic engine speed control with one touch low idle
Cooling
- Protection of 43° C to –18° C at 50% concentration

Straight line travel
Two-speed auto-shift travel
Water separator in fuel line

Undercarriage
Grease lubricated track
Hydraulic track adjusters
Idler and center section track guards
Long undercarriage

Other Standard Equipment
Automatic swing parking brake
Auxiliary hydraulic valve
Capability of stackable valves (max of 3) for main valve
Capability of auxiliary circuit
Counterweight with lifting eyes
Door locks, cap locks and Caterpillar® one key security system
Fine swing control
Fully pressurized hydraulic system
Heavy lift
Mirrors (frame-right, cab left)
S•O•S quick sampling valves for engine and hydraulic oil
Wave fin radiator
Wiring provision for Product Link

Optional Equipment

Optional equipment may vary. Consult your Cat dealer for specifics.

Front Linkage
Booms
- Reach 5680 mm
- VA 5940 mm

Stick
- Reach 2920 mm

Bucket Linkage
- B1 Family

Boom Lowering Control Device
Stick Lowering Control Device

Electrical
Light, Boom – Right side
Lights, Cab mounted (2)
Machine Security System (MSS)
Power supply (12 V/5 A)
Product Link
Travel Alarm

Guarding
Falling Object Guarding System (FOGS)
Front windshield guard
Full length, wire mesh
Heavy-duty bottom guards
Track guiding guards
- Sprocket end, idler end guard
- Two-piece full length (center guard removed)

Operator Environment
AM/FM Radio with antenna and 2 speakers
Rear window, secondary exit
Seat, high back with air suspension and heater

Engine/Power Train
Starting, Cold weather package
- Two additional maintenance free batteries
- High capacity starter motor
- Heavy-duty cable

Water level indicator (fuel)

Undercarriage
Track shoes triple grouser
- 600, 700, 790 mm

Heavy-duty rollers

Auxiliary Hydraulics
Hammer Circuit
- For single function (1 way/2 pump) hydraulic tools

Lines for booms and sticks
Thumb Circuit
- For double function (2 way/1 pump) hydraulic tools

Tool Control System
- Capability of adding medium pressure
- For single or double function (1 or 2 way, 1 or 2 pump) hydraulic tools
- Joysticks with additional switches
- Medium pressure circuit (added to Tool Control only) for tools requiring medium pressure
- Program up to 10 tools in memory

321D LCR Hydraulic Excavator

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at www.cat.com

Materials and specifications are subject to change without notice. Featured machines in photos may include additional equipment. See your Caterpillar dealer for available options. Note also that the machines featured may not be equipped with an appropriate operator protective structure as required for compliance to the Machinery Directive (2006/42/EC). All machines will be supplied by Caterpillar with a compliant cab structure, details available from your dealer.

HEHH4007-01 (08-2010) hr
(EU – ROPS)

APPENDIX C – Laboratory Testing

Laboratory Testing
Unconfined Compressive Strengths

Laboratory Testing Summary

Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Organic Content
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-01	S-1	0.0	0.3	0.3	8.8									
B-02	S-1	0.0	2.0	2.0	11.9		43	14	29					
B-02	S-4	6.0	8.0	2.0	9.0					65.0				
B-03	S-1	0.0	2.0	2.0	11.1					49.4				
B-03	S-4	6.0	8.0	2.0	3.3									
B-04	S-2	2.0	4.0	2.0	10.0					78.8				
B-04	S-5	8.0	10.0	2.0	13.7									
B-05	S-3	4.0	6.0	2.0	9.7		60	21	39	62.3				
B-05	S-5	8.0	10.0	2.0	11.0					56.2				
B-06	S-1	0.0	2.0	2.0	7.3					57.6				
B-07	S-2	2.0	4.0	2.0	1.4					17.3				
B-08	S-1	0.0	2.0	2.0	5.8					17.3				
B-08	S-4	6.0	8.0	2.0	0.8									
B-09	S-3	4.0	6.0	2.0	3.8					20.6				
B-10	S-1	0.0	2.0	2.0	10.0					42.0				
B-11	S-2	2.0	4.0	2.0	10.0		45	15	30					
B-11	S-3	4.0	6.0	2.0	6.6					46.8				
B-12	S-1	0.0	2.0	2.0	6.8					37.9				

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ration, OC: Organic Content (ASTM D 2974)

Project No. 17-5539
Project Name: National Cemetery Development
PM: Connor Roman
PE: Michael Sorgenfrei
Printed On: March 9, 2021

ECS Southwest, LLP - Austin
14050 Summit Drive Suite 101,
Austin, TX 78728
Phone: 512-837-8005
Fax: 512-388-8914

Laboratory Testing Summary

Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Organic Content
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-13	S-2	2.0	2.8	0.8	8.8									
B-13	S-5	8.0	10.0	2.0	2.3					9.4				
B-14	S-3	4.0	6.0	2.0	8.0					54.9				
B-15	S-1	0.0	2.0	2.0	5.1					33.2				
B-15	S-4	6.0	8.0	2.0	7.3					43.9				
B-16	S-5	8.0	10.0	2.0	6.7					47.2				
B-17	S-1	0.0	0.8	0.8	5.6									
B-18	S-3	4.0	6.0	2.0	12.8					17.3				
B-19	S-1	0.0	2.0	2.0	8.2					45.0				
B-20	S-2	2.0	4.0	2.0	3.4					16.6				
B-21	S-1	0.0	2.0	2.0	7.4					73.0				
B-22	S-3	4.0	6.0	2.0	3.4					18.4				
B-23	S-5	8.0	10.0	2.0	3.4					15.1				
B-24	S-2	2.0	4.0	2.0	3.3					19.0				
B-25	S-4	6.0	8.0	2.0	7.2					48.6				
B-26	S-2	2.0	4.0	2.0	12.2					36.5				
B-27	S-1	0.0	2.0	2.0	18.2		44	17	27	55.4				
B-28	S-3	4.0	6.0	2.0	12.1					17.4				

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ration, OC: Organic Content (ASTM D 2974)

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Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Organic Content
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-29	S-2	2.0	4.0	2.0	8.5					40.6				
B-30	S-5	8.0	10.0	2.0	2.1					8.8				
TP-01	S-1	1.0			10.1		36	15	21					
TP-01	S-3	5.0			13.3					66.1				
TP-02	S-2	3.0			11.9		49	28	21					
TP-02	S-4	7.0			9.3					27.7				
TP-03	S-1	1.0			8.8		34	17	17					
TP-03	S-2	3.0			4.0					22.2				
TP-04	S-1	1.0			9.5		42	19	23					
TP-04	S-3	5.0			4.3					10.4				
TP-05	S-1	1.0			5.6									
TP-05	S-2	3.0			7.6									
TP-06	S-1	1.0			8.1									
TP-06	S-4	7.0			5.5					35.7				
TP-07	S-3	5.0			9.2					54.5				
TP-08	S-1	1.0			10.9									
TP-09	S-1	1.0			11.3									
TP-10	S-1	1.0			12.4									

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ration, OC: Organic Content (ASTM D 2974)

Project No. 17-5539
Project Name: National Cemetery Development
PM: Connor Roman
PE: Michael Sorgenfrei
Printed On: March 9, 2021

ECS Southwest, LLP - Austin
14050 Summit Drive Suite 101,
Austin, TX 78728
Phone: 512-837-8005
Fax: 512-388-8914

Laboratory Testing Summary

Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Organic Content
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
TP-11	S-1	1.0			10.1									
TP-12	S-1	1.0			12.4									
TP-12	S-2	5.0			11.7					25.7				
TP-13	S-2	9.0			9.2					43.5				
TP-13	S-3	14.0			14.1									
TP-14	S-1	3.0			7.5					63.3				
TP-15	S-1	3.0			8.9									
TP-16	S-1	3.0			7.7									
TP-17	S-1	1.0			10.2					69.8				
TP-18	S-1	3.0			8.9									
TP-19	S-1	1.0			11.6		38	21	17					
TP-19	S-2	7.0			7.8					22.0				
TP-20	S-2	9.0			5.5									

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ration, OC: Organic Content (ASTM D 2974)

Project No. 17-5539
Project Name: National Cemetery Development
PM: Connor Roman
PE: Michael Sorgenfrei
Printed On: March 9, 2021

ECS Southwest, LLP - Austin
14050 Summit Drive Suite 101,
Austin, TX 78728
Phone: 512-837-8005
Fax: 512-388-8914

Project: National Cemetary
Project No.: 17-5539
Date: April 2021

Boring & Sample (Feet)	Sample Diameter (inches)	Sample Height (inches)	Axial Load (lbs)	Area (sq. in)	Compressive Stress (tsf)	Compressive Stress (psi)	L/D Ratio
B-01 (3.5')	2.025	4.215	44800	3.22	1002.05	13,917	2.08
B-01 (7.5')	2.043	4.202	86048	3.28	1890.89	26,262	2.06
B-01 (10')	2.041	4.196	37728	3.27	830.69	11,537	2.06
B-03 (13')	2.026	4.188	11968	3.22	267.43	3,714	2.07
B-06 (5')	2.037	4.210	11712	3.26	258.89	3,596	2.07
B-06 (11')	2.041	4.203	11424	3.27	251.53	3,494	2.06
B-07 (14.5')	1.997	4.215	13152	3.13	302.48	4,201	2.11
B-10 (4.5')	2.028	4.223	32128	3.23	716.49	9,951	2.08
B-10 (6.5')	1.981	4.195	27520	3.08	643.19	8,933	2.12
B-17 (5.5')	2.041	4.166	28032	3.27	617.21	8,572	2.04
B-17 (9')	2.026	4.185	28572	3.22	638.45	8,867	2.07
B-17 (14.5')	2.046	4.165	60864	3.29	1333.56	18,522	2.04
B-22 (12')	2.002	4.228	7936	3.15	181.61	2,522	2.11
B-24 (9')	2.043	4.126	17664	3.28	388.16	5,391	2.02

APPENDIX D – Analytical Laboratory Testing

Sulfides
Chlorides
Sulfates
pH
Laboratory Resistivity
Oxidation Reduction Potential

March 08, 2021

Connor Roman
ECS-Texas, LLP
14050 Summit Dr, Suite #101
Austin, Texas 78728
TEL: (512) 837-8005
FAX

Order No.: 2102146

RE: National Cemetery

Dear Connor Roman:

DHL Analytical, Inc. received 6 sample(s) on 2/25/2021 for the analyses presented in the following report.

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative and all estimated uncertainties of results are within method specifications.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

John DuPont
General Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-21-26

Table of Contents

DHL ANALYTICAL
2300 Double Creek Dr. ■ Round Rock, TX 78664
Phone (512) 388-8222 ■ FAX (512) 388-8229
Web: www.dhlanalytical.com
E-Mail: login@dhlanalytical.com

№

CHAIN-OF-CUSTODY

CLIENT: ECS Southwest LLP
ADDRESS: 14050 Summit Drive, Ste 101, Austin, TX
PHONE: 512-749-2321 FAX/E-MAIL: croman@ecslimited.com
DATA REPORTED TO: Connor
ADDITIONAL REPORT COPIES TO:

DATE: 2/25/21 PAGE 1 OF 1
PO #: 17-5539 DHL WORK ORDER #: 2102146
PROJECT LOCATION OR NAME: National Cemetery
CLENT PROJECT #: 17-5539 COLLECTOR:

Authorize 5% surcharge for TRRP Report? ❑ Yes ❑ No

S=SOIL W=WATER A=AIR L=LIQUID SE=SEDIMENT P=PAINT SL=SLUDGE O=OTHER SO=SOLID

Field Sample I.D.	DHL Lab #	Date	Time	Matrix	Container Type	# of Containers	PRESERVATION: HCl	HNO_3	H_2SO_4 ❑ NaOH ❑	ICE	UNPRESERVED	ANALYSES: BTEX ❑ MTBE ❑ [METHOD 8021]	TPH 1005 ❑ TPH 1006 ❑ HOLD 1006 ❑	GRO [METHOD 8015] ❑ DRO [METHOD 8105] ❑	VOC 8260 ❑ VOC 624 ❑ VOC 8260/5035 ❑	SVOC 8270 ❑ PAH 8270 ❑ HOLD PAH ❑ SVOC 625 ❑	8270 PEST ❑ 625 PEST/PCB ❑ 608 PCB ❑ 8082 PCB ❑ 8270 PCB ❑	8270 O-P PEST ❑ 8082 PEST ❑ T PHOS, AMMONIA ❑	8321 HERB ❑ T PHOS, AMMONIA ❑	METALS 6020 ❑ METALS 200.8 ❑ DISS. METALS ❑	RCRA ❑ TX11 ❑	PH ☑ HEX CHROM ❑ ALKALINITY ❑ COD ❑	CHLORIDE ☑ ANIONS Sulfate ❑	TCLP-SVOC ❑ VOC ❑ PEST ❑ HERB ❑	TCLP-METALS ❑ RCRA 8 ❑ TX-11 ❑ Pb ❑	RCI ❑ FLASHPOINT ❑ DGAS ❑	TDS ❑ TSS ❑ % MOISTURE ❑ CYANIDE ❑	Soil Resistivity	Sulfides	FIELD NOTES
B-3 (4'-6')	01	2-11-21		S																		✓	✓				✓	✓		
B-8 (2'-4')	02	2-16-21		S																		✓	✓				✓	✓		
B-13 (13'-15')	03	2-14-21		S																		✓	✓				✓	✓		
B-19 (2'-4')	04	2-12-21		S																		✓	✓				✓	✓		
B-21 (0'-2')	05	2-16-21		S																		✓	✓				✓	✓		
B-27 (4'-6')	06	2-15-21		S																		✓	✓				✓	✓		

RELINQUISHED BY: (Signature) DATE/TIME 2/25/21 1:55 RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

❑ DHL DISPOSAL @ $5.00 each ❑ Return

TURN AROUND TIME
RUSH ❑ CALL FIRST
1 DAY ❑ CALL FIRST
2 DAY ❑
NORMAL ☑
OTHER ❑ _____

LABORATORY USE ONLY:
RECEIVING TEMP: 15.1°C THERM #: 28
CUSTODY SEALS: ❑ BROKEN ❑ INTACT ☒ NOT USED
CARRIER: ❑ LONE STAR ❑ FEDEX ❑ UPS ❑ OTHER
❑ COURIER DELIVERY
☒ HAND DELIVERED

DHL Analytical, Inc.

Sample Receipt Checklist

Client Name **ECS-Texas, LLP**

Date Received: **2/25/2021**

Work Order Number **2102146**

Received by: **EL**

Checklist completed by: _____ 2/25/2021
Signature | Date

Reviewed by _____ 2/25/2021
Initials | Date

Carrier name: Hand Delivered

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	**15.1** °C
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH<2 acceptable upon receipt?	Yes ☐	No ☐	NA ☑ LOT #
	Adjusted? _____		Checked by _____
Water - ph>9 (S) or ph>10 (CN) acceptable upon receipt?	Yes ☐	No ☐	NA ☑ LOT #
	Adjusted? _____		Checked by _____

Any No response must be detailed in the comments section below.

Client contacted: _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding: _____

Comments: _____

Corrective Action: _____

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT: ECS-Texas, LLP
Project: National Cemetery
Lab Order: 2102146

CASE NARRATIVE

Samples were analyzed using the methods outlined in the following references:

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition and ASA 3:14.

For Sulfide analysis all samples were received and analyzed outside of EPA recommended HoldTime of 7 days. All results are flagged with a "C" to designate this.

All method blanks, sample duplicates, laboratory spikes, and/or matrix spikes met quality assurance objectives except where noted in the following. For Anions analysis by method SW9056A the sample and sample duplicate had the RPD above control limits for Chloride. This was due to matrix effect. This is flagged accordingly in the enclosed QC summary report. The "R" flag denotes the RPD was outside control limits. The LCS was within control limits for this analyte. No further corrective actions were taken.

The Sulfide analysis was sub-contracted to Ana-Lab.

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-3 (4'-6')
Project:	National Cemetery	**Lab ID:**	2102146-01
Project No:	17-5539	**Collection Date:**	02/11/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	3.14	1.61	2.08	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	15.8	2.07	5.18		mg/Kg-dry	1	03/03/21 03:32 AM
Sulfate	41.7	3.11	10.4		mg/Kg-dry	1	03/03/21 03:32 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	8.76	0	0		pH Units@23°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	4.00	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	4030	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:45 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-8 (2'-4')
Project:	National Cemetery	**Lab ID:**	2102146-02
Project No:	17-5539	**Collection Date:**	02/16/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	4.10	1.58	2.04	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	43.1	1.90	4.76		mg/Kg-dry	1	03/03/21 03:48 AM
Sulfate	113	2.85	9.52		mg/Kg-dry	1	03/03/21 03:48 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	8.61	0	0		pH Units@22.6°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	2.15	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	2470	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:30 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-13 (13'-15')
Project:	National Cemetery	**Lab ID:**	2102146-03
Project No:	17-5539	**Collection Date:**	02/14/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	2.05	1.59	2.05	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	15.0	1.99	4.97		mg/Kg-dry	1	03/03/21 05:24 AM
Sulfate	6.45	2.98	9.95	J	mg/Kg-dry	1	03/03/21 05:24 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	9.16	0	0		pH Units@22.9°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	2.22	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	6010	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:30 PM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-19 (2'-4')
Project:	National Cemetery	**Lab ID:**	2102146-04
Project No:	17-5539	**Collection Date:**	02/12/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	<1.61	1.61	2.07	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	13.5	1.90	4.75		mg/Kg-dry	1	03/03/21 05:40 AM
Sulfate	25.3	2.85	9.50		mg/Kg-dry	1	03/03/21 05:40 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	8.53	0	0		pH Units@23°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	3.47	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	4610	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:30 PM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-21 (0'-2')
Project:	National Cemetery	**Lab ID:**	2102146-05
Project No:	17-5539	**Collection Date:**	02/16/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	4.38	1.69	2.19	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	5.83	2.15	5.37		mg/Kg-dry	1	03/03/21 05:56 AM
Sulfate	13.4	3.22	10.7		mg/Kg-dry	1	03/03/21 05:56 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	8.16	0	0		pH Units@22.9°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	8.50	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	4220	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:30 PM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *08-Mar-21*

CLIENT:	ECS-Texas, LLP	**Client Sample ID:**	B-27 (4'-6')
Project:	National Cemetery	**Lab ID:**	2102146-06
Project No:	17-5539	**Collection Date:**	02/15/21
Lab Order:	2102146	**Matrix:**	SOIL

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SULFIDE IN SOLID MATRIX		**SW9031**					Analyst: **SUB**
Sulfide	4.53	1.75	2.26	C	mg/Kg-dry	1	03/03/21 09:40 AM
ANIONS BY IC METHOD - SOIL		**SW9056A**					Analyst: **BM**
Chloride	7.03	2.20	5.50		mg/Kg-dry	1	03/03/21 06:12 AM
Sulfate	57.0	3.30	11.0		mg/Kg-dry	1	03/03/21 06:12 AM
PH OF SOLID OR LIQ. (CORROSIVITY)		**SW9045D**					Analyst: **JS**
pH	8.73	0	0		pH Units@22.9°C	1	03/01/21 04:30 PM
PERCENT MOISTURE		**D2216**					Analyst: **BTJ**
Percent Moisture	11.4	0	0		WT%	1	03/01/21 08:00 AM
RESISTIVITY OF SOIL		**ASA 3:14**					Analyst: **JS**
Resistivity	4760	0.0100	0.0100	N	Ohm-cm	1	03/01/21 04:30 PM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT: ECS-Texas, LLP
Work Order: 2102146
Project: National Cemetery

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_210302C

The QC data in batch 99645 applies to the following samples: 2102146-01A, 2102146-02A, 2102146-03A, 2102146-04A, 2102146-05A, 2102146-06A

Sample ID: **MB-99645** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg**
SampType: **MBLK** Run ID: **IC2_210302C** Analysis Date: **3/2/2021 11:48:37 PM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	<2.00	5.00								
Sulfate	<3.00	10.0								

Sample ID: **LCS-99645** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg**
SampType: **LCS** Run ID: **IC2_210302C** Analysis Date: **3/3/2021 12:04:37 AM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	52.8	5.00	50.00	0	106	80	120			
Sulfate	146	10.0	150.0	0	97.6	80	120			

Sample ID: **LCSD-99645** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg**
SampType: **LCSD** Run ID: **IC2_210302C** Analysis Date: **3/3/2021 12:20:37 AM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	52.7	5.00	50.00	0	105	80	120	0.206	15	
Sulfate	146	10.0	150.0	0	97.6	80	120	0.010	15	

Sample ID: **2102145-01A-DUP** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg-dry**
SampType: **DUP** Run ID: **IC2_210302C** Analysis Date: **3/3/2021 12:52:37 AM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	26.4	55.3	0	0				200	10	R
Sulfate	<33.2	111	0	0				0	10	

Sample ID: **2102145-01AMS** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg-dry**
SampType: **MS** Run ID: **IC2_210302C** Analysis Date: **3/3/2021 1:08:37 AM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	125	56.9	113.8	0	110	80	120			
Sulfate	129	114	113.8	0	113	80	120			

Sample ID: **2102145-01AMSD** Batch ID: **99645** TestNo: **SW9056A** Units: **mg/Kg-dry**
SampType: **MSD** Run ID: **IC2_210302C** Analysis Date: **3/3/2021 1:24:37 AM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	116	55.5	111.0	0	104	80	120	7.45	15	
Sulfate	120	111	111.0	0	108	80	120	6.60	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: ECS-Texas, LLP
Work Order: 2102146
Project: National Cemetery

ANALYTICAL QC SUMMARY REPORT

RunID: PH2_210301A

The QC data in batch 99641 applies to the following samples: 2102146-01A, 2102146-02A, 2102146-03A, 2102146-04A, 2102146-05A, 2102146-06A

Sample ID: **2102145-01A-DUP** Batch ID: **99641** TestNo: **SW9045D** Units: **pH Units@23.4°C**
SampType: **DUP** Run ID: **PH2_210301A** Analysis Date: **3/1/2021 4:30:00 PM** Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
pH	7.90	0	0	7.650				3.22	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: ECS-Texas, LLP
Work Order: 2102146
Project: National Cemetery

ANALYTICAL QC SUMMARY REPORT

RunID: PMOIST_210226A

The QC data in batch 99616 applies to the following samples: 2102146-01A, 2102146-02A, 2102146-03A, 2102146-04A, 2102146-05A, 2102146-06A

Sample ID: **2102139-01D-DUP** Batch ID: **99616** TestNo: **D2216** Units: **WT%**
SampType: **DUP** Run ID: **PMOIST_210226A** Analysis Date: **3/1/2021 8:00:00 AM** Prep Date: **2/26/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Percent Moisture	16.9	0	0	16.93				0	30	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: ECS-Texas, LLP
Work Order: 2102146
Project: National Cemetery

ANALYTICAL QC SUMMARY REPORT

RunID: WC_210301C

The QC data in batch 99643 applies to the following samples: 2102146-02A, 2102146-03A, 2102146-04A, 2102146-05A, 2102146-06A

Sample ID: **MB-99643**	Batch ID: **99643**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **MBLK**	Run ID: **WC_210301C**	Analysis Date: **3/1/2021 4:30:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	1670000	0.0100								N

Sample ID: **LCS-99643**	Batch ID: **99643**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **LCS**	Run ID: **WC_210301C**	Analysis Date: **3/1/2021 4:30:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	720	0.0100	707.7	0	102	91	107			N

Sample ID: **2102145-02A-DUP**	Batch ID: **99643**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **DUP**	Run ID: **WC_210301C**	Analysis Date: **3/1/2021 4:30:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	4070	0.0100	0	4950				19.6	25	N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: ECS-Texas, LLP
Work Order: 2102146
Project: National Cemetery

ANALYTICAL QC SUMMARY REPORT

RunID: WC_210301D

The QC data in batch 99642 applies to the following samples: 2102146-01A

Sample ID: **MB-99642**	Batch ID: **99642**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **MBLK**	Run ID: **WC_210301D**	Analysis Date: **3/1/2021 4:45:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	1390000	0.0100								N

Sample ID: **LCS-99642**	Batch ID: **99642**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **LCS**	Run ID: **WC_210301D**	Analysis Date: **3/1/2021 4:45:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	722	0.0100	707.7	0	102	91	107			N

Sample ID: **2102145-01A-DUP**	Batch ID: **99642**	TestNo: **ASA 3:14**	Units: **Ohm-cm**
SampType: **DUP**	Run ID: **WC_210301D**	Analysis Date: **3/1/2021 4:45:00 PM**	Prep Date: **3/1/2021**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Resistivity	4460	0.0100	0	3759				17.1	25	N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

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Project
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DHL1-C

DHL Analytical
John Dupont
2300 Double Creek Dr
Round Rock, TX 78664

Printed 03/08/2021 9:52

TABLE OF CONTENTS

This report consists of this Table of Contents and the following pages:

Email: projectmanger@ana-lab.com

NELAP-accredited #T104704201-20-17

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Laboratory Data Package Cover Page

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SOLID

This data package consists of:

☑ This signature page, the laboratory review checklist, and the following reportable data:

☑ R1 Field chain-of-custody documentation;

☑ R2 Sample identification cross-reference;

☑ R3 Test reports (analytical data sheets) for each environmental sample that includes:
- a) Items consistent with NELAC 5.13 or ISO/IEC 17025 Section 5.10
- b) dilution factors,
- c) preparation methods,
- d) cleanup methods, and
- e) if required for the project, tentatively identified compounds (TICs).

☑ R4 Surrogate recovery data including: (R4 - R8: See QC Report)
- a) Calculated recovery (%R), and
- b) The laboratory's surrogate QC limits.

☑ R5 Test reports/summary forms for blank samples;

☑ R6 Test reports/summary forms for laboratory control samples (LCSs) including:
- a) LCS spiking amounts,
- b) Calculated %R for each analyte, and
- c) The laboratory's LCS QC limits.

☑ R7 Test reports for project matrix spike/matrix spike duplicates (MS/MSDs) including:
- a) Samples associated with the MS/MSD clearly identified,
- b) MS/MSD spiking amounts,
- c) Concentration of each MS/MSD analyte measured in the parent and spiked samples,
- d) Calculated %Rs and relative percent differences (RPDs), and
- e) The laboratory's MS/MSD QC limits

☑ R8 Laboratory analytical duplicate (if applicable) recovery and precision:
- a) the amount of analyte measured in the duplicate,
- b) the calculated RPD, and
- c) the laboratory's QC limits for analytical duplicates.

☑ R9 List of method quantitation limits (MQLs) for each analyte for each method and matrix; See Results Summary

☑ R10 Other problems or anomalies.

☑ The Exception Report for every "No" or "Not Reviewed (NR)" item in laboratory review checklist.

Release Statement: I am responsible for the release of this laboratory data package. This data package has been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By me signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data.

Name	Signature	Official Title	Date
Trey Peery, MA (WP3)		Project Manager	3/8/2021

Email: projectmanger@ana-lab.com

Central TX Region: 8101 Cameron Rd - Ste 305 Austin TX 78754

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Sample Cross Reference

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Sample	Sample ID	Taken	Time	Received
1965209	*2102146-01B*	02/11/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

Sample	Sample ID	Taken	Time	Received
1965210	*2102146-02B*	02/16/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

Sample	Sample ID	Taken	Time	Received
1965211	*2102146-03B*	02/14/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

Sample	Sample ID	Taken	Time	Received
1965212	*2102146-04B*	02/12/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

Sample	Sample ID	Taken	Time	Received
1965213	*2102146-05B*	02/16/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

Sample	Sample ID	Taken	Time	Received

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1
2

Sample Cross Reference

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1965214	*2102146-06B*	02/15/2021		02/26/2021

Bottle 01 Client supplied glass

Method	Bottle	PrepSet	Preparation	QcGroup	Analytical
EPA 9031	01	940888	03/03/2021	940888	03/03/2021

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Sample Preparation

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Default

Prep Set # 940888 03/03/2021

Analytical Set # 940888 EPA 9031 03/03/2021

Sample	Sample ID	Bottle
1965209	2102146-01B	01
1965210	2102146-02B	01
1965211	2102146-03B	01
1965212	2102146-04B	01
1965213	2102146-05B	01
1965214	2102146-06B	01

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Holding Time Compliance

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Name	Method	Taken:	Received	Analyzed	Hold	Elapsed	
	1965209	2/11/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	20.00	*
	1965210	2/16/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	15.00	*
	1965211	2/14/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	17.00	*
	1965212	2/12/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	19.00	*
	1965213	2/16/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	15.00	*
	1965214	2/15/21 0:00	02/26/2021				
Sulfide Extractable	EPA 9031			3/3/21 9:40	7.00	16.00	*

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Results

Sample Results

1965209 2102146-01B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/11/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**3.01**	**mg/kg**	2.00	HO		01

1965210 2102146-02B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/16/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**4.01**	**mg/kg**	2.00	HO		01

1965211 2102146-03B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/14/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**2.00**	**mg/kg**	2.00	HO		01

1965212 2102146-04B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/12/2021

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Printed: 03/08/2021

1965212 2102146-04B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/12/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**<2.00**	**mg/kg**	2.00	HO		01

1965213 2102146-05B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/16/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**4.01**	**mg/kg**	2.00	HO		01

1965214 2102146-06B — Received: 02/26/2021

Solid & Chemical Materials — Collected by: Client — DHL Analytical — PO: 18352
Taken: 02/15/2021

EPA 9031 — Prepared: 940888 03/03/2021 09:40:00 — Analyzed 940888 03/03/2021 09:40:00 NHL

	Parameter	Results	Units	RL	Flags	CAS	Bottle
NELAC	**Sulfide Extractable**	**4.01**	**mg/kg**	2.00	HO		01

Sample Preparation

1965209 2102146-01B — Received: 02/26/2021

18352

02/11/2021

Prepared: 03/01/2021 12:25:54 — Calculated 03/01/2021 12:25:54 CAL

NELAP-accredited #T104704201-20-17

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Project
955408

Printed: 03/08/2021

1965209 2102146-01B

Received: 02/26/2021

18352

02/11/2021

		Prepared:	*03/01/2021*	*12:25:54*	*Calculated*	*03/01/2021*	*12:25:54*	*CAL*
z	**Environmental Fee (per Project)**	**Verified**						
	Cooler Return	*Prepared:*	*03/01/2021*	*15:00:00*	*Analyzed*	*03/01/2021*	*15:00:00*	*MG3*
z	**Return Cooler/No bottles Require**	**Returned**						

Qualifiers:

O - Lab closed due to inclement weather. H - Sample started outside recommended holding time

We report results on an As Received or wet basis unless marked Dry Weight. Unless otherwise noted, testing was performed at Ana-labs corporate laboratory that holds the following Federal and State certificates: EPA Lab Number TX00063, US Department of Agriculture Soil Import Permit P330-17-00117, Texas Commission on Environmental Quality Commercial Drinking Water Lab Approval (Lab ID: TX219), Texas Commission on Environmental Quality NELAP T104704201-20-17, Louisiana Department of Environmental Quality Laboratory Certification (NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water (NELAP) Certificate No LA026, Oklahoma Department of Environmental Quality TNI Laboratory Accreditation Program Certificate No. 2018-126, Arkansas Department of Environmental Quality Certification #18-068-0. The Accredited column designates accreditation by N -- NELAC, or z -- not covered under NELAC scope of accreditation.
These analytical results relate to the sample tested. This report may NOT be reproduced EXCEPT in FULL without written approval of Ana-Lab Corp. Unless otherwise specified, these test results meet the requirements of NELAC.
RL is the Reporting Limit (sample specific quantitation limit) and is at or above the Method Detection Limit (MDL). CAS is Chemical Abstract Service number. RL is our Reporting Limit, or Minimum Quantitation Level. The RL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL), and any dilutions and/or concentrations performed during sample preparation (EQL). Our analytical result must be above this RL before we report a value in the 'Results' column of our report (without a 'J' flag). Otherwise, we report ND (Not Detected above RL), because the result is "<" (less than) the number in the RL column. MAL is Minimum Analytical Level and is typically from regulatory agencies. Unless we report a result in the result column, or interferences prevent it, we work to have our RL at or below the MAL.

Trey Peery, MA, Project Manager

NELAP-accredited #T104704201-20-17

2600 Dudley Rd. Kilgore, Texas 75662
R: 3306 State Highway 135 N, Kilgore, TX 75662
Office: 903-984-0551 * Fax: 903-984-5914

ANA LAB
Testing the Limits of Science and Service

RESULTS

Project
955408

DHL1

Printed 03/08/2021

DHL Analytical
John Dupont
2300 Double Creek Dr
Round Rock, TX 78664

SOLID

CAS	Parameter	Results	MDL	SDL	MQL	MQLAdj	Flag	Units	Target	Bottle	Dilute
Solid & Chemical Materials	**Wet Bench**									**EPA 9031**	
1965209	**2102146-01B**										
		Collection: 02/11/2021				Client			*Received:*	02/26/2021	
	Prepared: ***940888***			*Analyzed:*	***940888***		3/3/21	09:40:00			
	Sulfide Extractable	**3.01**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00
1965210	**2102146-02B**										
		Collection: 02/16/2021				Client			*Received:*	02/26/2021	
	Prepared: ***940888***			*Analyzed:*	***940888***		3/3/21	09:40:00			
	Sulfide Extractable	**4.01**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00
1965211	**2102146-03B**										
		Collection: 02/14/2021				Client			*Received:*	02/26/2021	
	Prepared: ***940888***			*Analyzed:*	***940888***		3/3/21	09:40:00			
	Sulfide Extractable	**2.00**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00
1965212	**2102146-04B**										

Email: projectmanger@ana-lab.com

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John Dupont
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Round Rock, TX 78664

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CAS	Parameter	Results	MDL	SDL	MQL	MQLAdj	Flag	Units	Target	Bottle	Dilute
Solid & Chemical Materials	**Wet Bench**									**EPA 9031**	
		Collection:	02/12/2021			Client			*Received:*	02/26/2021	
	Prepared: ***940888***										
				Analyzed:	***940888***	3/3/21	09:40:00				
	Sulfide Extractable	**ND**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00
1965213	**2102146-05B**										
		Collection:	02/16/2021			Client			*Received:*	02/26/2021	
	Prepared: ***940888***										
				Analyzed:	***940888***	3/3/21	09:40:00				
	Sulfide Extractable	**4.01**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00
1965214	**2102146-06B**										
		Collection:	02/15/2021			Client			*Received:*	02/26/2021	
	Prepared: ***940888***										
				Analyzed:	***940888***	3/3/21	09:40:00				
	Sulfide Extractable	**4.01**	1.55	1.55	2.00	2.00	HO	**mg/kg**		01	1.00

MDL is Method Detection Limit (40 CFR 136 Appendix B)

SDL is Sample Detection Limit and is the adjusted MDL (sample specific dilutions, dry weight)

Email: projectmanger@ana-lab.com

NELAP-accredited #T104704201-20-17

2600 Dudley Rd. Kilgore, Texas 75662
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ANA LAB
Testing the Limits of Science and Service

RESULTS

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John Dupont
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Round Rock, TX 78664

MQL is the Method Quantitation Limit and corresponds to a low standard

MQLADJ is the Adjusted Method Quantitation Limit (dilutions, dry weight)

Qualifiers:

O - Lab closed due to inclement weather. *H - Sample started outside recommended holding time*

We report results on an As Received or wet basis unless marked Dry Weight. Unless otherwise noted, testing was performed at Ana-labs corporate laboratory that holds the following Federal and State certificates: EPA Lab Number TX00063, US Department of Agriculture Soil Import Permit P330-17-00117, Texas Commission on Environmental Quality Commercial Drinking Water Lab Approval (Lab ID: TX219), Texas Commission on Environmental Quality NELAP T104704201-20-17, Louisiana Department of Environmental Quality Laboratory Certification (NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water (NELAP) Certificate No LA026, Oklahoma Department of Environmental Quality TNI Laboratory Accreditation Program Certificate No. 2018-126, Arkansas Department of Environmental Quality Certification #18-068-0. The Accredited column designates accreditation by N -- NELAC, or z -- not covered under NELAC scope of accreditation.
These analytical results relate to the sample tested. This report may NOT be reproduced EXCEPT in FULL without written approval of Ana-Lab Corp. Unless otherwise specified, these test results meet the requirements of NELAC.

Trey Peery, MA, Project Manager

Email: projectmanger@ana-lab.com

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R: 3306 State Highway 135 N, Kilgore, TX 75662
Office: 903-984-0551 * Fax: 903-984-5914

ANALAB
Testing the Limits of Science and Service

QC Groups

Project
955408

DHL Analytical
John Dupont
2300 Double Creek Dr
Round Rock, TX 78664

Test	QCgroup	Analyzed
SUEX	940,888	03/03/2021

Quality Control

ANALAB
Testing the Limits of Science and Service

DHL1-C

DHL Analytical
John Dupont
2300 Double Creek Dr
Round Rock, TX 78664

Project
955408

Printed 03/08/2021

Analytical Set 940888 EPA 9031

Blank

Parameter	PrepSet	Reading	MDL	MQL	Units	File
Sulfide Extractable	940888	ND	1.55	2.00	mg/kg	122076655

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Sulfide Extractable	940888	3.31	3.01	4.00	70.0 - 130	82.8	75.2	mg/kg	9.49	30.0

* Out RPD is Relative Percent Difference: abs(r1-r2) / mean(r1,r2) * 100%

Recover% is Recovery Percent: result / known * 100%

Blank - Method Blank

NELAP-accredited #T104704201-20-17

DHL Analytical, Inc.
2300 Double Creek Drive
Round Rock, TX 78664
TEL: *(512) 388-8222* FAX: *(512) 388-8229*

CHAIN-OF-CUSTODY RECORD

Work Order: 2102146

Subcontractor:

Ana-Lab
2600 Dudley Rd
Kilgore, TX 75662

TEL: (903) 984-0551
FAX:
Acct #:

25-Feb-21

Sample ID	Matrix	DHL#	Date Collected	Bottle Type	Requested Tests: Sulfide_S SW9031					
B-3 (4'-6')	Soil	01B	02/11/21	2-OZGJAR	1	1965209				
B-8 (2'-4')	Soil	02B	02/16/21	2-OZGJAR	1	210				
B-13 (13'-15')	Soil	03B	02/14/21	2-OZGJAR	1	211				
B-19 (2'-4')	Soil	04B	02/12/21	2-OZGJAR	1	212				
B-21 (0'-2')	Soil	05B	02/16/21	2-OZGJAR	1	213				
B-27 (4'-6')	Soil	06B	02/15/21	2-OZGJAR	1	214				

General Comments:

Please analyze these samples with a Standard Turnaround Time.
Quality Control Package Needed: Standard - SEND PDF & Excel EDD Please
EMAIL report to both cac@dhlanalytical.com & dupont@dhlanalytical.com
Call John DuPont if you have questions.
Please do not Perform Percent moisture

		Date/Time		Date/Time
Relinquished by:	[illegible]	2/25/21 1700	Received by: LSO	2/25/21 1700
Relinquished by:	LSO	2/25/21 0850	Received by: [illegible]	

See Attached for Tracking # and Temp


LSO
It's all in the delivery.
Airbill No. ZY03U1MV
LSO
1-800-800-8984
www.lso.com
SHIP TO:
SAMPLE RECEIVI
ANA-LAB CORP
2600 DUDLEY RD
KILGORE, TX 756
9039845914
From:
LOGIN
ANALYTICAL
EK DR
79684
Date
Temp:
Time
Tech
Therm#: 6205 Corr Fact: 0.2 C
C
WGGG
LSO GROUND
END OF BUSINESS DAY DELIVERY
PRINT DATE: 2/25/2021
QUICKCODE: ANA-LAB
REF 1: SUB-OUT 1D00V.0009 REF 2:
SIGNATURE RELEASE
REF 3:
WEIGHT: 16.00LBS

Appendix A:		Laboratory Review Checklist: Reportable Data						
Laboratory Name: ANA-LAB			LRC Date: 03/08/2021					
Project Name: Default			Laboratory Job (Project) Number: 955408					
Reviewer Name: Trey Peery, MA (WP3)			PrepSet: 940888 QCgroup: 940888					
#	A	Description	Yes	No	NA	NR	ER#	
R01	OI	**Chain-of-Custody (C-O-C)**						
		Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?				X	1	
		Were all departures from standard conditions described in the exception report?	X					
R02	OI	**Sample and Quality Control (QC) Identification**						
		Are all field sample ID numbers cross referenced to the laboratory ID numbers?	X					
		Are all laboratory ID numbers cross-referenced to the corresponding QC data?	X					
R03	OI	**Test Reports**						
		Were all samples prepared and analyzed within holding times?		X			2	
		Other than those results < MQL, were all other raw values bracketed by calibration standards?	X					
		Were calculations checked by a peer or supervisor?	X					
		Were all analyte identifications checked by a peer or supervisor?	X					
		Were sample quantitation limits reported for all analytes not detected?	X					
		Were all results for soil and sediment samples reported on a dry weight basis?	X					
		Were % moisture (or solids) reported for all soil and sediment samples?	X					
		If required for the project, tentatively identified compounds reported?			X			
R04	O	**Surrogate Recovery Data**						
		Were surrogates added prior to extraction?			X			
		Were surrogate percent recoveries in all samples within the laboratory QC limits?			X			
R05	OI	**Test Reports/Summary Forms for Blank Samples**						
		Were appropriate type(s) of blanks analyzed?	X					
		Were blanks analyzed at the appropriate frequency?	X					
		Were blank concentrations < MQL?	X					
		Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures?	X					
R06	OI	**Laboratory Control Samples (LCS)**						
		Were all chemicals of concern included in the LCS?			X			
		Was each LCS taken though the entire analytical procedure, including prep and cleanup steps?			X			
		Were LCSs analyzed at the required frequency?			X			
		Were LCS (and LCS duplicate, if applicable) %Rs within the laboratory QC limits?	X					
		Does the detectability data document the laboratory's capability to detect the chemicals of concern at the MDL used to calculate the SQLs?	X					
		Was the LCS duplicate relative percent difference within QC limits?	X					
R07		**Matrix Spike (MS) and Matrix Spike Duplicate (MSD) data**						
		Were the project/method specified analytes included in the MS and MSD?			X			
		Were MS/MSD analyzed at the appropriate frequency?			X			
		Were MS (and MSD, if applicable) %Rs within the laboratory QC limits?			X			
		Were MS/MSD RPDs within laboratory QC limits?			X			
R08	OI	**Analytical Duplicate Data**						
		Were appropriate analytical duplicates analyzed for each matrix?			X			
		Were analytical duplicates analyzed at the appropriate frequency?			X			
		Were RPDs or relative standard deviations within the laboratory QC limits?			X			
R09	OI	**Method Quantitation Limits (MQLs)**						
		Are the MQLs for each method analyte included in the laboratory data package?	X					
		Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?	X					
		Are unadjusted MQLs included in the laboratory data package?	X					
R10	OI	**Other Problems/Anomalies**						
		Are all known problems/anomalies/special condition noted in this LRC and ER?	X					
		Were all necessary corrective actions preformed for the reported data?	X					
		Was applicable and available technology used to lower the SQL and minimize the matrix interference effects on the sample results?	X					

Appendix A:		Laboratory Review Checklist: Reportable Data						
Laboratory Name: ANA-LAB			LRC Date: 03/08/2021					
Project Name: Default			Laboratory Job (Project) Number: 955408					
Reviewer Name: Trey Peery, MA (WP3)			PrepSet: 940888 QCgroup: 940888					
#	A	Description	Yes	No	NA	NR	ER#	
S01	OI	**Initial Calibration (ICAL)**						
		Were response factors and/or relative response factors for each analyte within QC limits?	X					
		Were percent RSDs or correlation coefficient criteria met?	X					
		Was the number of standards recommended in the method used for all analytes?	X					
		Were all points generated between the lowest and highest standard used to calculate the curve?	X					
		Are ICAL data available for all instruments used?	X					
		Has the initial calibration curve been verified using an appropriate second source standard?	X					
S02	OI	**Initial and Continuing Calibration Verification (ICCV and CCV) and Continuing Calibration**						
		Was the CCV analyzed at the method-required frequency?	X					
		Were percent differences for each analyte within the method-required QC limits?			X			
		Was the ICAL curve verified for each analyte?	X					
		Was the absolute value of the analyte concentration in the inorganic CCB < MQL?			X			
S03	O	**Mass Spectral Tuning**						
		Was the appropriate compound for the method used for tuning?			X			
		Were ion abundance data within the method-required QC limits?			X			
S04	O	**Internal Standards (IS)**						
		Were IS area counts and retention times within the method-required QC limits?			X			
S05	OI	**Raw Data (NELAC section 1 appendix A glossary, and section 5.12 or ISO/IEC 17025 section . . .)**						
		Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?	X					
		Were data associated with manual integrations flagged on the raw data?	X					
S06	O	**Dual Column Confirmation**						
		Did dual column confirmation results meet the method-required QC?			X			
S07	O	**Tentatively Identified Compounds (TICs)**						
		If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?			X			
S08	I	**Interference Check Sample (ICS) Results**						
		Were precent recoveries within method QC limits?			X			
S09	I	**Serial Dilutions, Post Digestion Spikes, and Method of Standard Additions**						
		Were percent differences, recoveries, and the linearity within the QC limits specified in the method?			X			
S10	OI	**Method Detection Limit (MDL) Studies**						
		Was a MDL study performed for each reported analyte?	X					
		Is the MDL either adjusted or suppported by the analysis of detectability check samples?	X					
S11	OI	**Proficiency Test Reports**						
		Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?	X					
S12	OI	**Standards Documentation**						
		Are all standards used in the analyses NIST-traceable or obtained from other apropriate sources?	X					
S13	IO	**Compound/Analyte Identification Procedures**						
		Are the procedures for compound/analyte identification documented?	X					
S14	OI	**Demonstration of Analyst Compentency (DOC)**						
		Was DOC conducted consistent with NELAC Chapter 5C or ISO/IEC Section 4?	X					
		Is documentation of the analyst's competency up-to-date and on file?	X					
S15	OI	**Verification/Validation Documentation Methods (NELAC Chapter 5 or ISO/IEC Section 5)**						
		Are all the methods used to generate the data documented, verified and validated, where applicable?	X					
S16	OI	**Laboratory Standard Operating Procedures (SOPs)**						
		Are laboratory SOPs current and on file for each method performed?	X					

1. Items identified by the letter "R" must be included on the laboratory data package submitted in the TRRP-required report(s). Items identified by the letter "S" should be retained and made available upon request for the appropriate retention
2. O = organic analyses; I = ionorganic analyses (and general chemistry, when applicable);
3. N/A = Not applicable;
4. NR = Not reviewed
5. ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked).

Appendix A: (cont'd):	Laboratory Review Checklist: Exception Reports		
Laboratory Name:	ANA-LAB	LRC Date:	03/08/2021
Project Name:	Default	Laboratory Job (Project) Number:	955408
Reviewer Name:	Trey Peery, MA (WP3)	PrepSet: 940888	QCgroup: 940888

ER#	Description
1	Bottles were reviewed at login. Please see the chain of custody record for sample receipt details.
2	The following samples were analyzed outside EPA recommended holding times: 1965209, 1965210, 1965211, 1965212, 1965213, 1965214

1 ER# = Exception Report identification number (an Exception Report should be completed for an item if "NR" or "No" is checked on the LRC)

Client: ECS Southwest, LLP
Project: 17-5539 - National Cemetery

TRI Log #: 62059

Jeffrey A. Kuhn, Ph.D., P.E., 3/2/2021
Quality Review/Date

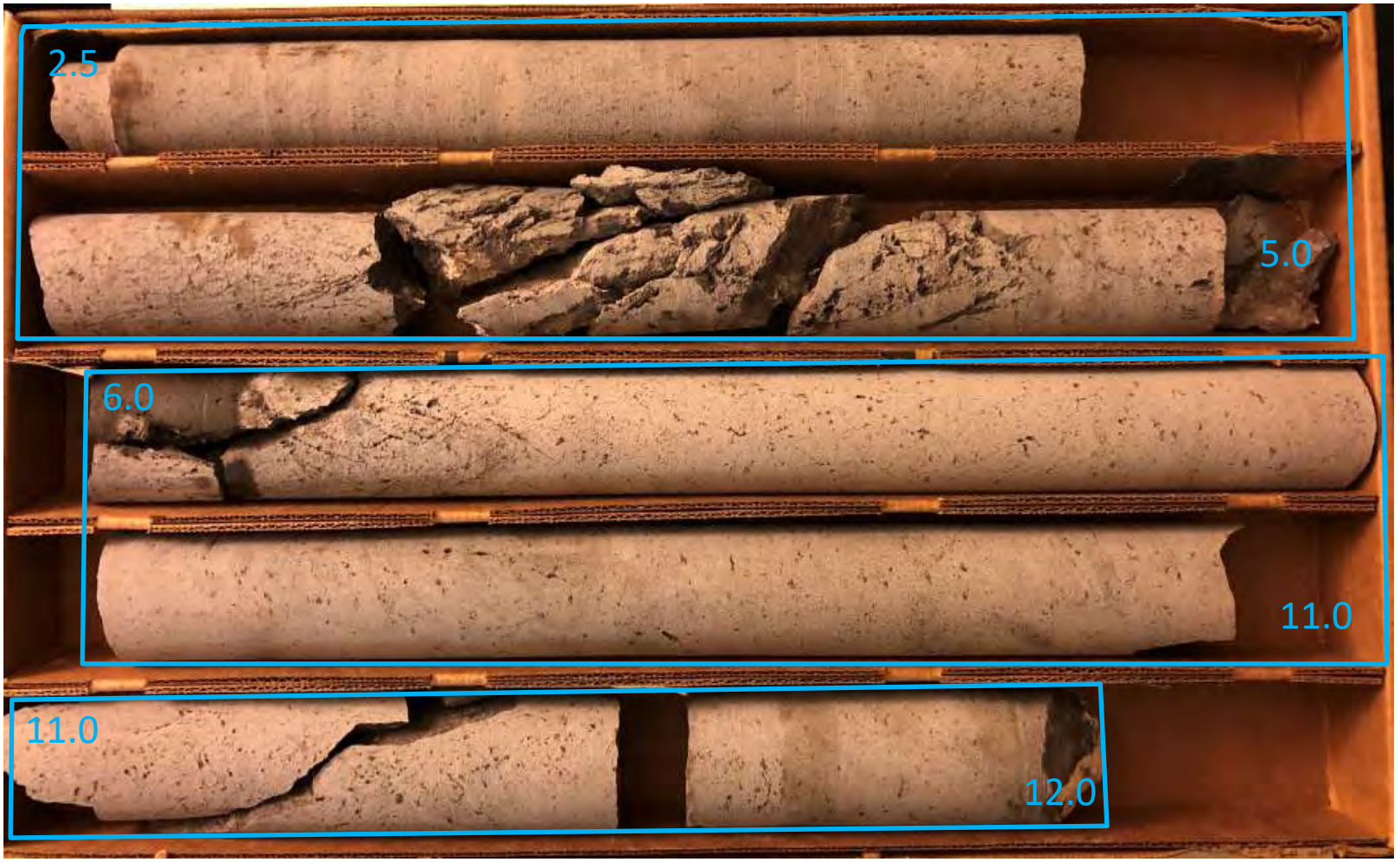
Analytical

COC Line #	Sample Identification	Oxidation Reduction Potential (mV) ASTM G200			
		Reading 1	Reading 2	Reading 3	Average
1	B-3 (4.0-6.0)	353	360	369	361
2	B-8 (2.0-4.0)	39	396	401	279
3	B-13 (13.0-15.0)	395	394	399	396
4	B-19 (2.0-4.0)	399	418	422	413
5	B-21 (0.0-2.0)	419	422	423	421
6	B-27 (4.0-6.0)	415	420	422	419

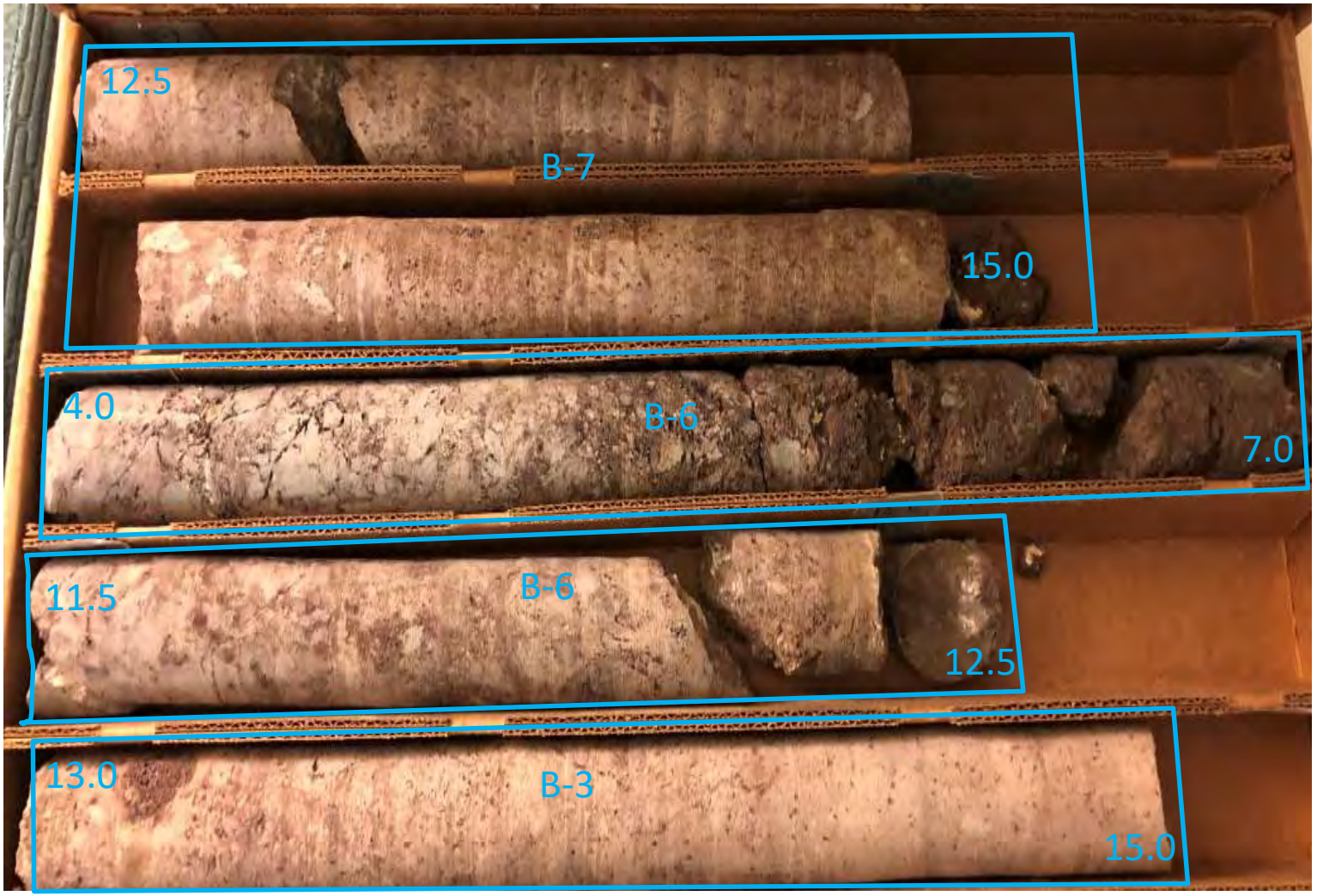
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

APPENDIX E – Photograph Log

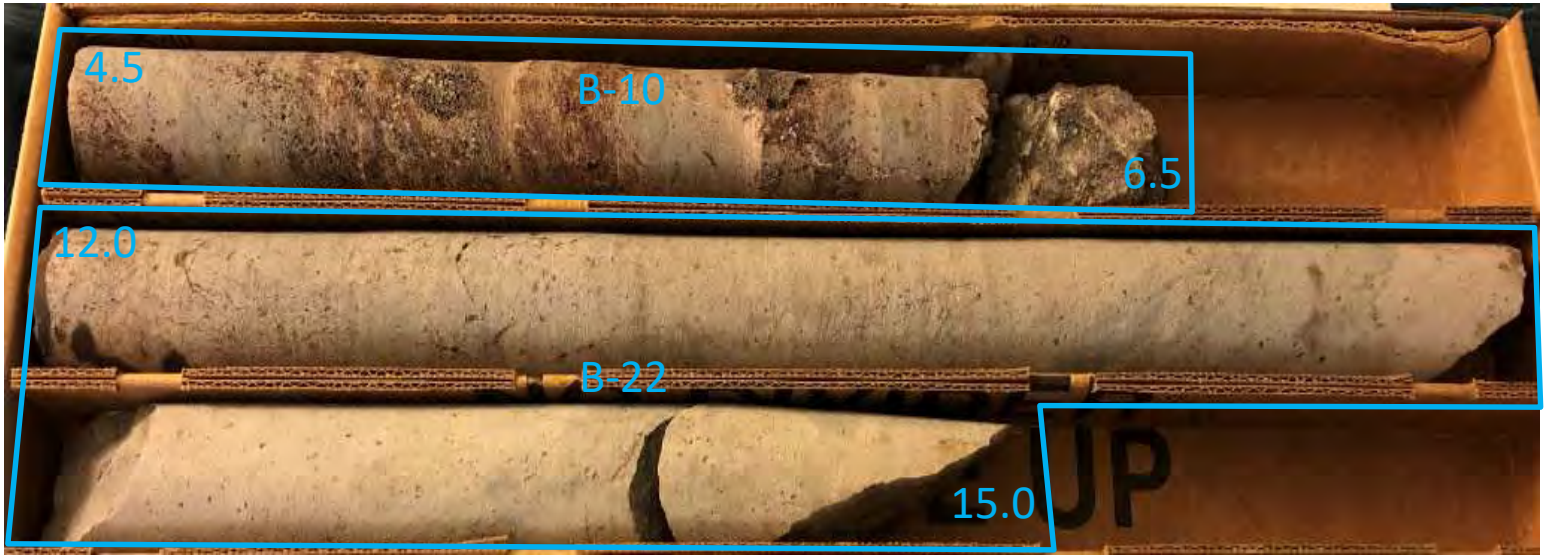
Rock Core & Progress Photographs



B-1 (2.5’-5’)(6’-11’)(11’-12’) Rock Cores

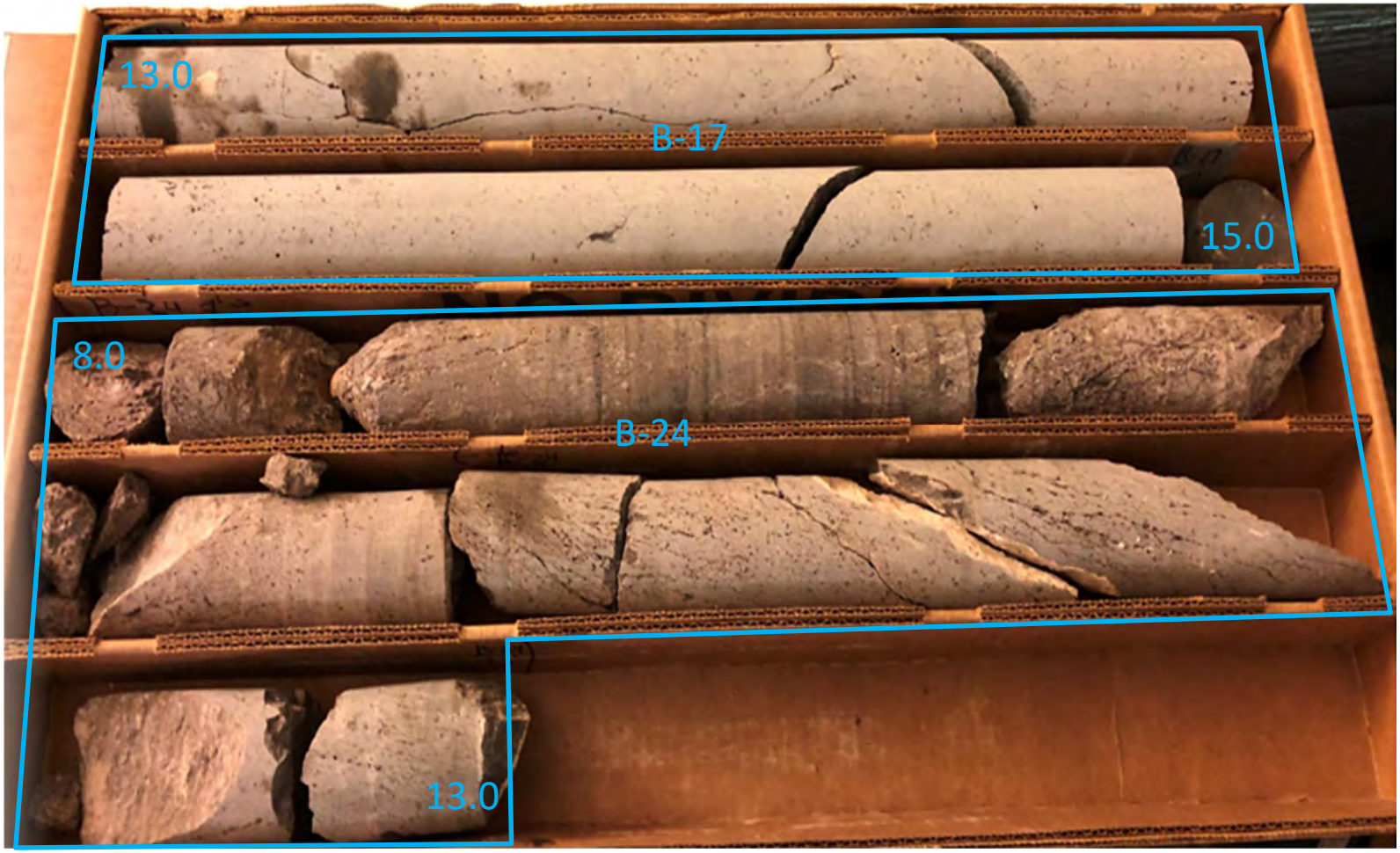


B-7 (12.5’-15’); B-6 (4’-7’)(10’-11.5’); B-3(13’-15’) Rock Cores



B-10 (4.5’-6.5’); B-22 (12’-15’) Rock Cores

B-17 (2’-5.5’)(6.5’-11’) Rock Cores



B-17 (13’-15’); B-24 (8’-13’) Rock Cores

Test Pit Excavator Equipment

TP-3 Excavated Materials

TP-4 (0’-4’)

TP-5 (0’-15’)

TP-5 Excavated Boulder

TP-7 (0’-15’)

TP-13 (0-15)

TP-14 (0-15)

TP-18 (0-15)

Boring B-3

Boring B-6

Boring B-20 (SPT sampling)

Boring B-24