April 23, 2018
Kleinfelder Project No: 20184052.001A

Mr. Bradley Brown
Dominion Energy Utah
1140 West 200 South
Salt Lake City, Utah 84104

SUBJECT: GEOTECHNICAL ENGINEERING REPORT
ODORANT INJECTION FACILITY
APPROX. 3950 WEST 13400 SOUTH
RIVERTON, UTAH

Dear Mr. Brown:

We are pleased to submit our geotechnical engineering report for the proposed odorant injection facility and access road to be located at approximately 3950 West 13400 South in Riverton, Utah. This work was performed in accordance with our proposal to you dated March 7, 2018 (Kleinfelder file No. MPQSTRGS.001P).

Based on our field and laboratory testing, and engineering analyses, we have provided geotechnical recommendations for site preparation, grading, foundation design and pavement section design for the proposed facility.

We appreciate the opportunity to provide geotechnical services to you on this project. Please contact the undersigned at 801.261.3336 if you have any questions regarding this report or if we can provide assistance with other aspects of the project.

Respectfully submitted,

KLEINFELDER

Scott W. Davis, PE
Principal Geotechnical Engineer

John Diamond, PE
Geotechnical Group Manager

KLEINFELDER 849 West Levoy Drive, Suite 200, Taylorsville, UT 84123-2544 p | 801.261.3336 f | 801.261.3306

GEOTECHNICAL ENGINEERING REPORT
ODORANT INJECTION FACILITY
APPROX. 3950 WEST 13400 SOUTH
RIVERTON, UTAH
KLEINFELDER PROJECT NO: 20184052.001A

APRIL 23, 2018

A Report prepared for:

Mr. Bradley Brown
Dominion Energy Utah
1140 West 200 South
Salt Lake City, Utah 84104

GEOTECHNICAL ENGINEERING REPORT
ODORANT INJECTION FACILITY
APPROX. 3950 WEST 13400 SOUTH
RIVERTON, UTAH

Prepared by:

PROFESSIONAL ENGINEER
No. 174638-2202
SCOTT W. DAVIS
STATE OF UTAH

Scott W. Davis, PE
Principal Geotechnical Engineer

John Diamond, PE
Geotechnical Group Manager

KLEINFELDER
849 West Levoy Drive Suite 200
Salt Lake City, Utah 84123
Phone: 801.261.3336
Fax: 801.261.3306

April 23, 2018
Kleinfelder Project No.: 20184052.001A

TABLE OF CONTENTS

1 INTRODUCTION

1.1. GENERAL

This report presents the results of Kleinfelder's geotechnical evaluation for the design and construction of a planned odorant injection facility to be located at approximately 3950 West 13400 South in Riverton, Utah. The location of the project site is shown on Figure 1, Boring Location and Site Vicinity Map, in Appendix A. Our services for this study were performed in accordance with the scope of work outlined in our proposal dated March 7, 2018 (Kleinfelder File No. MPQSTRGS.001P).

This report includes our recommendations relating to the geotechnical aspects of project design and construction. The conclusions and recommendations stated in this report are based on the subsurface conditions encountered in our exploratory borings at the time they were performed. They also are subject to the limitations and provisions stated in Section 5 of this report. Please also refer to the document titled "Important Information About This Geotechnical Engineering Report" contained in Appendix E.

1.2. PROJECT DESCRIPTION

We understand Dominion Energy plans to construct an odorant injection facility to service the nearby Kern River Gas distribution system. The entire site will encompass approximately 0.2 acres and will be enclosed with a post and panel fence. The injection facility will consist of a 600 square-foot, single-story, slab-on-grade, steel-frame structure. Within the structure, two steel odorant tanks (1,000- and 1,450-gallon) will be supported on thickened slab footings. The tanks will be surrounded by a concrete containment wall, 1.25 feet tall with a capacity of approximately 3,000 gallons. Building structural loads were not provided, however, based on the size and type of structure planned, we anticipate wall loads will be on the order of 2 kips per lineal foot. We understand the steel storage tanks will have a combined full weight of 27,000 pounds.

The yard surrounding the structure will be surfaced with gravel consisting of coarse, angular gravel underlain by untreated base course (UTBC). A shallow storm water detention basin, approximately one foot deep, will be constructed in the northeast corner of the site, and is also planned to be lined with coarse gravel and UTBC.

In addition, a 20-foot wide driveway will extend from 13400 South Street northward through the site. The driveway will consist of Portland Cement concrete pavement within the sidewalk and approach area to 13400 South. The remainder of the driveway will consist of asphalt concrete pavement. We understand traffic loads will consist of an odorant transport truck with a maximum load of 27,140 pounds/axle, making two deliveries per year. In addition, a limited volume of lightweight trucks and passenger cars will access the facility daily. Given the existing grade surrounding the Kern River facility, we anticipate that design grade for the planned facility will be within 2 feet of existing site grade.

If the structural loads, traffic loads, or final site grade elevations are different from those described above, Kleinfelder should be notified immediately to re-evaluate the recommendations contained in this report.

1.3. PURPOSE AND SCOPE OF SERVICES

The purposes of our study were to evaluate subsurface conditions within the proposed building and pavement areas, and develop geotechnical recommendations based on the conditions encountered at the site. The conclusions and recommendations presented in this report are based on our analyses of the data from our field exploration and laboratory testing programs.

Kleinfelder's scope of services included:

- Performing subsurface exploration and soil sampling to characterize the subsurface soil profile throughout the site.
- Performing laboratory testing of selected soil samples to evaluate the engineering properties of the soils.
- Performing engineering analyses and developing geotechnical conclusions and recommendations for design and construction of the planned development.
- Preparation of this report, which includes a description of the proposed project, a description of the surface and subsurface site conditions found during our exploration and laboratory testing programs, and a summary of our conclusions and recommendations for site preparation and grading, foundation design, pavement design and related geotechnical issues.

2 FIELD EXPLORATION AND LABORATORY TESTING

2.1. FIELD EXPLORATION

The field exploration for this project was performed on March 21, 2018. Our field exploration consisted of observing the surface conditions at the site and drilling 3 borings to depths ranging from 9.5 to 19.5 feet below existing ground surface (bgs). Approximate locations of the borings are shown on Figure A-1, Boring Location Map.

The borings were drilled using a Simco 2800 truck-mounted drill rig using 8-inch O.D. hollow-stem augers. Subsurface soil samples were obtained during exploration using a standard split-spoon sampler (2-inch O.D). The split-spoon sampler was driven into the soil with blows from a 140-pound automatic hammer falling through a 30-inch drop. The number of blows required to drive the sampler 18 inches into the soil were recorded for each 6-inch increment of penetration on the boring logs. Bulk samples were also obtained from auger cuttings for additional testing. Upon completion of drilling, all borings were backfilled with the drill cuttings to match the surrounding ground surface.

The hollow stem auger drilling and sampling was performed by A Cache Corp and was supervised and logged by a Kleinfelder geologist. Samples obtained during the field exploration were transported to our laboratory for further evaluation and testing. Samples will be retained for a period of 90 days from the date of this geotechnical report after which time samples will be discarded unless otherwise requested.

The graphical boring logs, a key to the boring logs, and a summary of the Unified Soil Classification System (USCS) soil descriptions are presented in Appendix B. It should be noted that the lines defining boundaries between soil types on the boring logs are based upon our field observations and are only approximate. The actual transition between soil types may be abrupt or gradual.

2.2. LABORATORY TESTING

2.2.1. Geotechnical Laboratory Testing

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

- Moisture Content;
- Minus 200 Wash;
- Sieve Analysis;
- Atterberg Limits;
- Chemical Testing;
- Moisture-Density Relationship; and
- California Bearing Ratio.

Results of all geotechnical laboratory tests are included in Appendix C of this report. Selected geotechnical test results are also shown on the boring logs contained in Appendix B.

2.2.2. Analytical Laboratory Testing

The following analytical laboratory testing was performed on soil samples by an independent analytical laboratory:

- pH;
- Oxidation-reduction potential, (eH);
- Resistivity;
- Water soluble sulfate;
- Sulfide; and
- Chloride.

The analytical laboratory test results are presented in Appendix D and are summarized below:

TABLE 1

ANALYTICAL LABORATORY TEST RESULTS

Sample Location and Depth (Feet)	pH	eH (mV)	Resistivity (ohms-cm)	Water Soluble Sulfate (mg/kg dry)	Chloride (mg/kg-dry)	Sulfide (mg/kg dry)
B-1 @ 1.0	7.83	436	991	164	166	<0.0353*

**reporting limit*

2.3. INFILTRATION TEST RESULTS

A soil moisture infiltration test was performed near boring B-2 at the south end of the planned storm water detention pond. The test was performed at a depth of 3 feet below existing ground surface. Results of the test are presented below in Table 2.

TABLE 2

INFILTRATION TEST RESULTS

Material Description	Depth (ft)*	Average Infiltration Rate (minutes/inch)
Lean Clay with Sand	3.0	83.3

*Depth below existing ground surface.

The infiltration test result presented above should not be used directly as a long-term design infiltration rate for the design of infiltration systems. Natural soil conditions are variable and infiltration rates usually decline as the soil moisture content increases and as a result of long-term clogging of the void matrix within the soil due to the suspended solids being carried by the storm water. In this case, the soils are fine-grained and were very moist at the time of testing. Both of these factors contributed to the relatively slow infiltration rate recorded. An appropriate safety factor should be applied during design to account for further reduction in infiltration over time. The result presented in the table above should be considered as preliminary, and should be supplemented with additional larger scale, 24-hour pit tests once the specific storm water detention basin design is further developed, as appropriate.

To facilitate infiltration, consideration may also be given to drilling a series of dry wells into the underlying granular soils below the planned detention pond. It is likely that infiltration will occur more rapidly within these granular soils. Kleinfelder would be happy to discuss this option in further detail and perform the necessary additional testing, upon request.

3 SITE CONDITIONS

3.1. SURFACE

The site is currently partially developed with an existing Kern River Gas enclosure and underground piping, along with additional underground utilities roughly paralleling 13400 South Street. The remainder of the site consists of cultivated farm land. The site was relatively flat with drainage to the southwest. The site is bounded by agricultural land to the north, east, and west, and by 13400 South Street to the south.

3.2. SUBSURFACE CONDITIONS

The subsurface conditions at the site generally consisted of soft to very stiff lean clay overlying very dense, well-graded sand and silty sand with gravel. The clay soils extended to depths of 10 feet and 7.5 feet in borings B-1 and B-2, respectively, and extended to the full depth explored (10 feet) in boring B-3. The clay soils were moist to very moist, with low to medium plasticity, and relative low strength with respect to foundation and pavement support. A slight pinhole structure was observed in the upper soils in boring B-1 indicative of possible collapse potential. However, laboratory testing of these soils indicated a low potential (less than 1%) for collapse.

The granular soils underlying the upper clay soils contained variable amounts of gravel with a fines content (material passing the #200 mesh sieve) of 17 to 21 percent. The boring logs presented in Appendix B as well as the laboratory test results presented in Appendix C should be referred to for more detailed information regarding the subsurface soil conditions at this site.

3.3. GROUNDWATER

Ground water was not encountered within the depths explored (19.5 feet) at the time of our field investigation on March 21, 2018. Ground water levels are dependent on seasonal precipitation and ground water fluctuations, irrigation practices, land use, and runoff conditions. It is possible that ground water levels may rise in the spring, however, we do not anticipate that ground water levels would rise to the extent to impact the planned construction.

3.4. GEOLOGIC SETTING

The site is located at an elevation of approximately 4,630 feet within the southwest portion of the Salt Lake Valley. This valley is a deep, sediment-filled structural basin that has formed since the beginning of the Cenozoic age, approximately 65 million years ago. The valley is within the Basin and Range Physiographic Province, which is characterized by approximately north-trending valley and mountain ranges formed by extensional tectonics and displacement along normal faults (Hunt, 1967). The basin is flanked by two fault-bounded uplifted blocks, the Wasatch Range on the east, and the Oquirrh Mountains to the west. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Wasatch Front is dominated by sediments deposited within the last 30,000 years by Lake Bonneville (Currey and Oviatt, 1985; Personius and Scott, 1992). As the lake receded, streams began to incise through large deltas formed at the mouths of major Wasatch Range canyons. The eroded material was deposited in shallow lakes and marshes in the basin and in a series of recessional deltas and alluvial fans and terraces. Toward the center of the valley, deep-water deposits of clay, silt, and fine-grained sand predominate (Personius and Scott, 1992). In many places, these deep-water deposits are covered by thin post-Lake Bonneville alluvial and/or eolian covers.

The surface sediments at the project site are mapped as Pleistocene lacustrine deposits consisting predominantly of clay and silt with constituents of sand and gravel. These sediments were deposited during transgression and regression of Lake Bonneville between approximately 21,000 and 12,500 years ago (Personius and Scott, 1992). The soils encountered in our borings at the site are generally consistent with the surficial mapping.

3.5. GEOLOGIC HAZARDS

3.5.1. Seismicity and Faulting

Active faults in the region are potential sources for seismic shaking hazards on the proposed pipeline. Active earthquake faults are typically considered as faults that have moved during the past 10,000 years (Christenson and others, 2003). Solomon and others (2010) and Solomon and Machette (2009) have mapped traces of the Wasatch Fault zone approximately 7.3 miles east of the site.

Based on our soils investigation for this site coupled with our experience at the adjacent site to the north, the subsurface soils at the site correspond with a Site Class D. The design spectral response acceleration parameters for the project site with site classification of Site Class D are S_{DS} = 0.814*g* and S_{D1} = 0.425g for short period and 1-second period, respectively. The intermediate values from IBC (2015) used to obtain the design parameters are shown in Tables 3 and 4:

TABLE 3

DESIGN ACCELERATION FOR SHORT PERIODS (USGS, 2012)

S_S	S_{MS}	S_{DS}
1.196 g	1.222 g	0.814 g

S_S = The mapped maximum considered earthquake (MCE_R), 5 percent damped, spectral response acceleration parameter at short periods (0.2s)

S_{MS} = The MCE_R, 5 percent damped, spectral response acceleration parameter at short periods (0.2s) adjusted for site class effects

S_{DS} = The design, 5 percent damped, spectral response acceleration parameter at short periods (0.2s)

TABLE 4

DESIGN ACCELERATION FOR 1-SEC PERIOD (USGS, 2012)

S_1	S_{M1}	S_{D1}
0.397 g	0.638 g	0.425 g

S_1 = The mapped maximum considered earthquake (MCE_R), 5 percent damped, spectral response acceleration parameter at 1-second period

S_{M1} = The MCE_R, 5 percent damped, spectral response acceleration parameter at 1-second period adjusted for site class effects

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

3.5.2 Liquefaction and Lateral Spreading

Liquefaction is a phenomenon whereby loose, saturated, soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake, as excess pore water pressures are dissipated. Horizontally continuous liquefied layers may also have a potential to spread laterally where sufficient slope or free-face conditions exist. As the surrounding soils liquefy, buoyant forces acting on buried structures may cause them to displace upwards. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth-to-groundwater.

Based on review of mapping developed by the Utah Geologic Survey, the site is located within an area designated as having a "very low" potential for liquefaction. Based on the soils conditions encountered in our explorations, previous experience in the site vicinity, and the depth to groundwater, it is our opinion that the risk of liquefaction at this site is low and does not warrant further consideration.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1. GENERAL CONCLUSIONS

Based on the results of our field exploration and laboratory testing, it is our opinion that the site is suitable for the construction of the planned facility provided that the recommendations contained in this report are followed. These opinions, conclusions, and recommendations are based on our field exploration, engineering analysis, the properties of the materials encountered in our borings, the results of the laboratory testing program, and our understanding of the proposed development of the site.

It should be noted that the upper clay soils were observed to have variable consistency, ranging from soft to stiff. In addition, the moisture content of the soil was generally very moist. These factors can affect the performance of footings established directly on these soils. The following sections of this report address this issue and present specific recommendations for general site preparation and grading, structural fill material requirements and compaction, foundation and pavement design.

4.2. EARTHWORK

4.2.1. General Site Preparation and Grading

Prior to beginning site grading operations, the planned building and pavement areas, including driveways and sidewalk areas and all areas to receive gravel surfacing, should be stripped of all vegetation, debris and fill soils to expose competent native soils. Stripping operations will expose native, fine-grained soil which are currently in a moist to very moist condition and are susceptible to softening when exposed to added moisture and exposure to construction traffic. For these reasons, consideration should be given to performing site grading operations during the drier seasons of the year. Earthwork contractors should be informed of these conditions so that proper equipment and methods are used to avoid creation of unstable soil conditions.

After general site stripping and excavation has been completed, exposed soils should be proof-rolled with a fully loaded tandem-axle dump truck or fully loaded water truck and observed by the geotechnical engineer or his representative to identify soft or unstable areas. Soft soils encountered during proof-rolling should be over-excavated and replaced with structural fill. The overexcavation depth should extend to competent soil as assessed by the geotechnical engineer. Overexcavated areas should be backfilled with structural fill in accordance with Section 4.2.5.

Following proof-rolling, the exposed subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned to near optimum moisture content (+/- 2 percent of optimum) and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557 (Modified Proctor).

4.2.2. Wet Weather Construction

If exposed to excess moisture and repeated construction traffic, the native, near surface soils may become unstable, especially during wet weather. Unstable, disturbed soils must be overexcavated to a stable depth and replaced with structural fill. The use of track-mounted equipment with low ground pressure tracks and/or the use of dump and spread techniques to place material should be considered under such conditions.

4.2.3. Temporary Excavation Stability

Stability of construction excavations is the contractor’s responsibility. If stability of an excavation becomes questionable, the excavation should be evaluated promptly by Kleinfelder. The soils classification and strength properties presented in this report may be used for the planning of excavations and trench slopes in accordance with OSHA requirements or for the design of excavation slopes, shoring, and/or the use of trench boxes. Construction personnel should be aware that soil conditions may change rapidly if soil moisture conditions change or if soils that have been disturbed by previous excavations are encountered. Measures should be taken to protect construction personnel from raveling of trench sidewalls. If sloughing or free water is encountered, it may be necessary to reduce trench slopes beyond OSHA requirements or provide shoring. All excavations should comply with current OSHA safety requirements. Backfill of excavations should be structural fill placed in compliance with Section 4.2.5. If unstable conditions, or conditions other than those described in the geotechnical explorations are encountered during construction, excavation slopes should immediately be evaluated by the contractor’s Competent Person.

4.2.4. Excavatability

We anticipate that excavation of the on-site materials can be performed using conventional earth-moving equipment; however, the contractor should perform his own evaluation of the site conditions, the potential difficulties involved, and the type of equipment needed.

4.2.5. Structural Fill and Compaction

Structural fill placed within the planned building and pavement areas should be granular material as detailed in Table 5, or untreated base course.

TABLE 5

CRITERIA FOR STRUCTURAL FILL

Gradation Requirements	
Standard Sieve Size	Percent Passing
3 inch	100
No. 4	50 max
No. 200	20 max*
Plasticity Requirements of Fines (Atterberg Limits)	
Plasticity Index	6 or less

*Fill with more than 20 percent fines may be acceptable as approved by Kleinfelder

Base course material should be comprised of Untreated Base Course Aggregate Class “C” per Section 02721 of the Utah Department of Transportation Standard Specifications for Untreated Base Course.

Imported fill materials should be approved by the testing agency prior to importing. Also, prior to placing structural fill, the excavation should be observed by the testing agency to note that unsuitable material has been removed and the exposed soil is in a firm and unyielding condition. Structural fill should be placed in maximum 8-inch-thick loose lifts and compacted to at least 95 percent of the maximum dry density (Modified Proctor). The moisture content should be within 2 percent of optimum at the time of compaction. All utility trenches should be backfilled with structural fill.

4.3. FOUNDATIONS

In order to limit total and differential settlement of the footings due to the potential variation in soil consistency, we recommend the structure be supported by conventional continuous and/or spread footings established on a minimum of 12 inches of properly compacted structural fill. The native soil exposed in footing excavations should be compacted to a firm, unyielding surface prior to structural fill placement. Footing excavations should extend laterally beyond the edges of all footings a minimum of 12 inches or the depth of the excavation below the footing.

Exterior footings, or footings in unheated areas, should be established a minimum of 30 inches below the lowest adjacent final grade for frost protection and confinement. Embedment may be reduced to 18 inches for interior footings protected from frost.

Footings supported on a minimum of 12 inches of compacted structural fill with a minimum footing width of 18 inches may be proportioned for a maximum net allowable soil bearing pressure of 2,500 pounds per square foot (psf). A one-third increase may be applied for transient wind or seismic loads. Total, static settlement of footings should be on the order of 1 inch or less with maximum differential settlements of ½-inch or less. Prior to constructing the foundations, the footing excavations should be observed by the geotechnical engineer to evaluate whether suitable bearing soils have been exposed and whether the excavation bottoms are free of loose or disturbed soils.

Horizontal loads acting on foundations formed in open excavations will be resisted by friction acting at the base of foundations and by passive earth pressures. If design makes use of passive earth pressures, it is important that any backfill below or around footings is placed and compacted properly. Therefore, we recommend the geotechnical engineer, or his representative is present during any footing backfill placement.

The friction acting along the base of footings founded on properly compacted, granular structural fill may be computed by using a coefficient of friction of 0.45 with the normal dead load. An ultimate lateral passive earth pressure may be computed by using an equivalent lateral fluid weighing 300 pounds per cubic feet (pcf) for the side of footings placed against natural soils, or properly placed and compacted imported granular backfill. An appropriate factor of safety should be applied to the passive earth pressure value listed above. The values given above may be increased by one-third for transient wind or seismic loads.

Lateral active earth pressure may be computed by using an equivalent lateral fluid weighing 36 pounds per cubic feet (pcf) for the side of foundation walls backfilled with properly placed and compacted granular backfill.

4.4. CONCRETE SLABS-ON-GRADE

Direct support for the concrete floor slabs may be provided by a minimum 6-inch blanket of clean gravel (less than 10 percent passing No. 4 sieve and less than 2 percent passing No. 200 sieve) or untreated base course material. Prior to placement of the gravel or base course material, the native soil should be prepared as recommended in Section 4.2.1 of this report. As a basis for designing concrete slab thickness, competent native soils may be considered to possess a subgrade modulus (Kv_1) of 200 pounds per cubic inch (pci).

All concrete slabs should be designed to minimize cracking as a result of shrinkage. Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking, or curling in the slabs. We recommend that all concrete placement and curing operations be performed in accordance with the current version of the American Concrete Institute Manual of Concrete Practice (ACI, 2017).

4.5. PAVEMENT DESIGN AND CONSTRUCTION

We understand that the pavement extending through the facility will consist of asphalt concrete (AC). The approach and sidewalk area connecting to 13400 South Street will consist of Portland Cement concrete (PCC). Design of the asphalt pavement section was performed in accordance with the 1993 American Association State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures and was based on the traffic loading parameters described in Section 1.2 of this report, a design life of 20 years, and the subgrade soil parameters obtained from our laboratory testing. A CBR value of 7 was obtained from a bulk sample of the fine-grained, surficial soil and was used in our analysis of the asphalt pavement section. Tables 6 and 7 present Kleinfelder's recommended minimum AC pavement and PCC pavement structural sections, respectively.

TABLE 6

RECOMMENDED AC PAVEMENT SECTION

Material	Recommended Minimum Pavement Thickness (in)
Asphalt Concrete	3.0
Untreated Base Course	6.0

TABLE 7

RECOMMENDED PCC PAVEMENT SECTION

Material	Recommended Minimum Pavement Thickness (in)
Portland Cement Concrete	5.0
Untreated Base Course	6.0

Asphalt pavement materials quality and construction requirements should conform to the Utah Department of Transportation Specifications for Hot Mix Asphalt, Section 02741. Prime coats are not desired and tack coats are to be called out for vertical surfaces or when base and top coats are not installed consecutively. PCC pavement materials quality and construction requirements should conform to the Utah Department of Transportation Specifications for Portland Cement Concrete Pavement, Section 02752.

New pavement sections (AC and PCC) may be placed on competent native material which has been properly prepared in accordance to Section 4.2.1, or on properly compacted structural fill as described in Section 4.2.5. The final pavement subgrade should be graded to provide positive drainage and prevent ponding and/or moisture infiltration.

Once the subgrade has been proof-rolled, compacted, and approved, the untreated base course should be placed. The untreated base course should be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with the Modified Proctor (ASTM D1557). Moisture content at the time of compaction should be within 2 percent of the optimum moisture content.

If updated traffic information or actual traffic conditions are different than those assumed, Kleinfelder should be notified so that our recommendations can be reviewed and modified as appropriate.

4.5.1. Yard Surfacing

We understand Dominion Energy desires to place gravel surfacing within all areas of the facility not occupied with structures or pavement, including roadway shoulders and within the detention pond area. We understand the gravel-surfaced areas may experience occasional light truck/passenger car traffic, but no heavy truck traffic. Based on this understanding, we recommend a minimum gravel section thickness as described below in Table 8:

TABLE 8

RECOMMENDED GRAVEL SURFACING SECTION

Material	Recommended Minimum Pavement Thickness (in)
Coarse, Angular Gravel (3/4 to 1.5-in. diameter)	3.0
Untreated Base Course	6.0

It is important that the surface gravel possess a high degree of angularity to reduce the tendency to "push" under wheel loads. Untreated base course material should conform to UDOT requirements and be compacted as specified in Section 4.2.5 of this report. Prior to placing base course materials, the exposed subgrade should have been prepared and compacted as described in Section 4.2 of this report.

4.6. MOISTURE PROTECTION AND SURFACE DRAINAGE

Precautions should be taken during and after construction to eliminate, or at least reduce the potential for saturation of soils beneath foundations, pavements and walkways. Over-wetting of the native soils prior to or during construction may result in softening and pumping, causing equipment mobility problems and difficulty in achieving compaction. Positive drainage should be designed into all finished pavement surfaces. Landscape watering adjacent to structures and pavements should be limited to avoid moisture infiltration into the subgrade. All utility trenches beneath pavements should be backfilled with compacted structural fill.

4.7. SOIL CORROSION AND REACTIVITY

Kleinfelder has completed preliminary laboratory testing to provide data regarding corrosivity of onsite soils. Our services do not include corrosion engineering and, therefore, a detailed analysis of corrosion test results is not included in this report. A qualified corrosion engineer should be retained to review the test results, perform additional testing as required, and design protective systems that may be required. Kleinfelder may be able to provide those services.

Laboratory resistivity, water-soluble sulfate, and pH tests was performed on a representative sample of the near-surface soil. Results of these tests are listed in Appendix D and summarized in Table 1. If fill materials will be imported to the project site, similar corrosion potential laboratory testing should be completed on the imported material.

Metal and concrete elements in contact with soil are subject to degradation due to corrosion or chemical attack. Therefore, buried metal and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

A resistivity value of 991 ohm-cm was obtained from tests performed on the native, near surface soils. Based on the "10-point" method developed by the American Water Works Association (AWWA) in standard AWWA C105/A21.5, we recommend that **the site be considered corrosive for buried ferrous metal piping, cast iron pipes, or other objects made of these materials**. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures.

The degradation of concrete or cement grout can be caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds within the concrete, causing cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete or cement grout. The American Concrete Institute (ACI) in their publication *Guide to Durable Concrete* (ACI 201.2R-08) provides guidelines for this assessment. Based on the results of the tests, performed at the site, **the risk of attack to concrete from water-soluble sulfates appears to be "low" according to American Concrete Institute standards (ACI 318)**; therefore, Type I Portland cement may be used for concrete placed on native soils.

5 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than three years from the date of the report.

The work performed was based on project information provided by Client. Any changes in the project information listed herein that will have an impact on recommendations in this report must be approved by Kleinfelder's engineer.

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

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. If soil, rock or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated building loads, and the design depths or locations of the foundations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

As the geotechnical engineering firm that performed the geotechnical evaluation for this project, we recommend that Kleinfelder be retained to verify the design assumptions and confirm the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction. This may avoid misinterpretation of the information by other parties and will allow us to review and modify our recommendations if variations in subsurface conditions are encountered. It is our recommendation Kleinfelder be retained to provide the following continuing services for the project:

- Review the project plans and specifications, including any revisions or modifications;
- Observe and evaluate the site earthwork operations to confirm subgrade soils are suitable for construction of foundations, slabs-on-grade, pavements and placement of engineered fill; and
- Confirm that engineered fill for the site improvements is placed and compacted per the project specifications.

If a third party is retained to provide the above activities, they are responsible to notify Kleinfelder of any changed site conditions that affect the recommendations presented herein. Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report. If notification is not provided, the testing company will assume responsibility associated with the changed site conditions.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction. Furthermore, the contractor should be prepared to handle contamination conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers.

6 REFERENCES

AASHTO (1993). “Guide for Design of Pavement Structures”, American Association of State Highway and Transportation Officials, Washington, D.C.

ACI 318 (2011). “Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary”, American Concrete Institute, Farmington Hills, MI.

Anderson, L.R., Keaton, J.R., and Bischoff, J.E. (1994). “Liquefaction Potential Map for A Part of Salt Lake County, Utah”, Utah Geological Survey Contract Report 94-4, Utah Geological Survey, scale 1:48,000, 48 p.

Currey, D.R., and Oviatt, C.G. (1985). “Average rates, and probable causes of Lake Bonneville expansion, still-stands, and contractions during the last deep-lake cycle, 32,000 to 10,000 years ago”, in Kay, P.A., and Diaz, H.F., (eds.), “Problems of and prospects for predicting Great Salt Lake levels”, Proceedings of a NOAA Conference, March 26-28, 1985: Salt Lake City, Utah.

Personius, Stephen F., and Scott, William E., 1992, Surficial geologic map of the Salt Lake City segment and parts of adjacent segments of the Wasatch fault zone, Davis, Salt Lake, and Utah Counties, Utah: U.S. Geological Survey Map 1-2106, scale 1:50,000

Hunt, C.B. (1967). “Physiography of the United States: San Francisco”, W.H. Freeman, 480 p.

IBC (2015). “International Building Code”, International Code Council.

Smith, R. B., and Arabasz, W. J. (1991). Seismicity of the Intermountain Seismic Belt, in Slemmons, D. B., Engdahl, E. R., Zoback, M. D., and Blackwell, D. D., editors, Neotectonics of North America, Geological Society of America, Decade Map Volume 1, pp. 185-228.

USGS (2012), “Quaternary fault and fold database for the United States”, U.S. Geological Survey, http//earthquakes.usgs.gov/regional/qfaults. Accessed 9/16/2015.

KLEINFELDER
Bright People. Right Solutions.

Appendix A

APPENDIX A

BORING LOCATION AND VICINITY MAP

PLOTTED: 4/20/2018 12:48:39 PM BY: TCisney

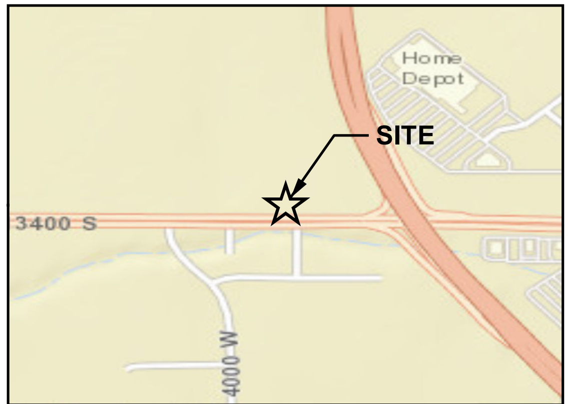
N

LEGEND

Approximate Boring Location

Approximate Site Boundary

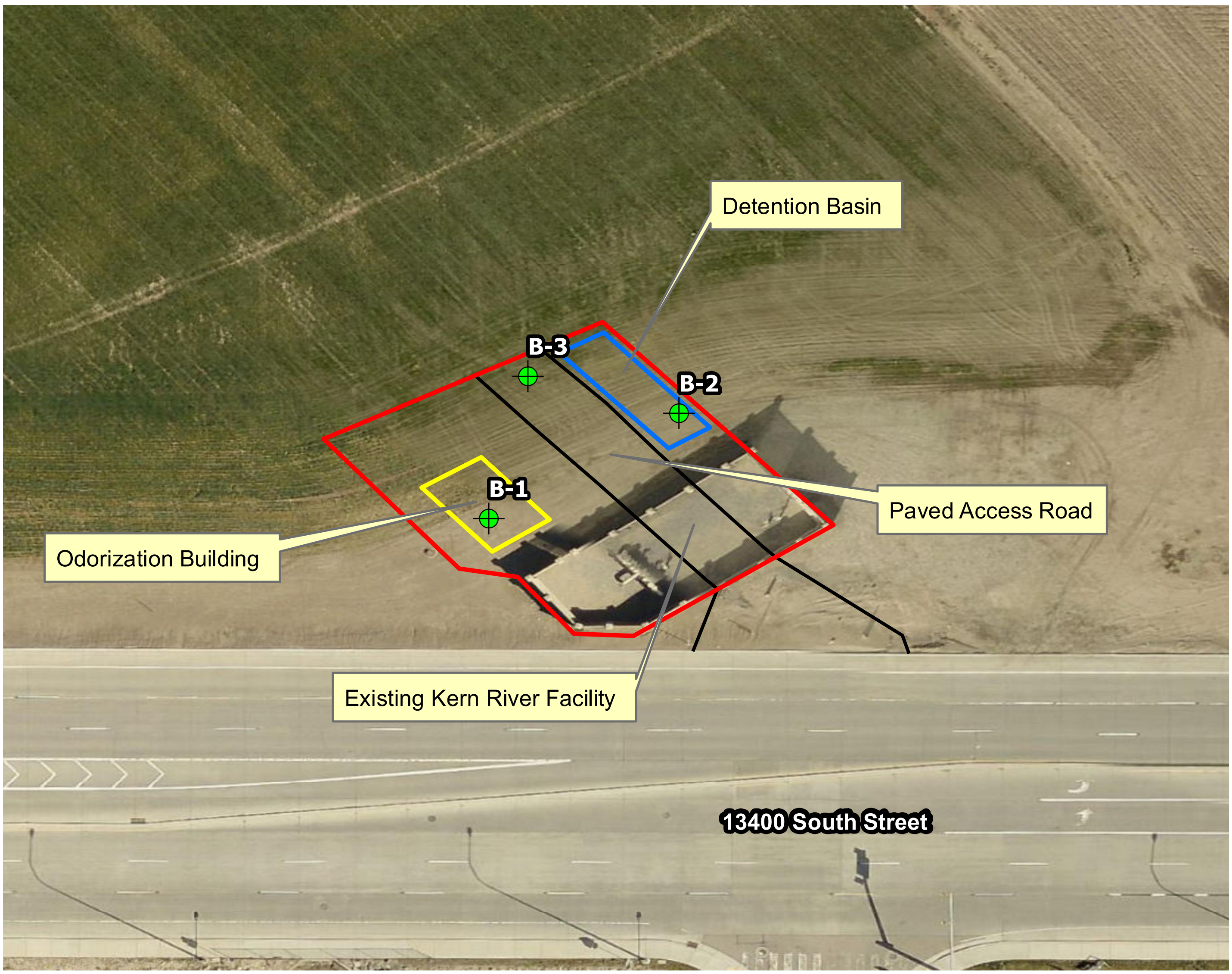
NOTE:
BASE MAPPING AND VICINITY MAP CREATED FROM LAYERS COMPILED BY ESRI PRODUCTS AND 2017 MICROSOFT CORPORATION. COORDINATE SYSTEM: GCS WGS 1984



N

VICINITY MAP

NOT TO SCALE



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

0 60 120

1 " = 60 SCALE IN FEET

GIS FILE: C:\Users\tcisney\OneDrive - Kleinfelder\Desktop\20184052-Dominion\SitePlan.mxd

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.	20184052
DRAWN BY:	T.Cisney
CHECKED BY:	S.Davis
DATE:	04-20-2018
REVISED:	-

EXPLORATION LOCATION PLAN AND VICINITY MAP

Dominion Energy Odorant Injection Facility
3950 West 13400 South
Riverton, Utah

FIGURE

A-1

Bright People. Right Solutions.

Appendix B

APPENDIX B

LOGS OF EXPLORATORY BORINGS

SAMPLER AND DRILLING METHOD GRAPHICS

- BULK / GRAB / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)
- SHELBY TUBE SAMPLER
- HOLLOW STEM AUGER
- SOLID STEM AUGER
- WASH BORING

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

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

ABBREVIATIONS
WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

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

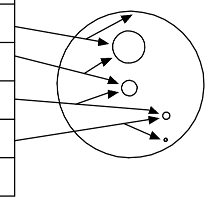
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS,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

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20184052	GRAPHICS KEY	APPENDIX
	DRAWN BY: TC		
	CHECKED BY: SD	Dominion Energy Ordorant Injection Facility 3950 West 13400 South Riverton, Utah	B-1
	DATE: 3/30/2018		
	REVISED: -		

PLOTTED: 04/20/2018 12:59 PM BY: TCisney
OFFICE FILTER: SALT LAKE CITY
PROJECT NUMBER: 20184052.001A
gINT FILE: Klf_gint_master_2017
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [LEGEND 2 (SOIL DESC KEY)]

GRAIN SIZE

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



SECONDARY CONSTITUENT

Term of Use	AMOUNT: Secondary Constituent is Fine Grained	AMOUNT: Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

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

CEMENTATION

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

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

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

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

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

FROM TERZAGHI AND PECK, 1948

PLASTICITY

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

STRUCTURE

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

ANGULARITY

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

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20184052
DRAWN BY:	TC
CHECKED BY:	SD
DATE:	3/30/2018
REVISED:	-

SOIL DESCRIPTION KEY

Dominion Energy Ordorant Injection Facility
3950 West 13400 South
Riverton, Utah

APPENDIX
B-2

Date Begin - End:	3/21/2018	**Drilling Company:**	Acache Drilling		**BORING LOG B-1**
Logged By:	D.Pike	**Drill Crew:**	Jay		
Hor.-Vert. Datum:	NAD83 - NAVD88	**Drilling Equipment:**	Simco 2800	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast	**Exploration Diameter:**	7.5 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 40.50812° N
Longitude: -111.98533° E
Surface Condition: Bare Earth

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Push Tube(PT)= psi Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0		**Lean CLAY (CL)**: low plasticity, dark brown, moist, very stiff, trace sand											
				BC=6 7 9 PP=2.75-4.5	15"	CL	18.2				32	14	Collaspe <1%
					21"								
5		becomes grey											
		Silty CLAY (CL-ML): low plasticity, brown, moist, stiff		BC=4 5 7 PP=1.75-2	16"	CL-ML	21.8				27	7	
10		**Well-Graded SAND (SW)**: sub-rounded, brown, moist, very dense, trace fine gravel											rig grinding
15				BC=22 30 37	15"	SW	6.7		64	17			
				BC=12 21 50/5"	8"								
20													
25													
30													

The boring was terminated at approximately 19.5 ft. below ground surface. The boring was backfilled with auger cuttings on March 21, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20184052	BORING LOG B-1	APPENDIX
	DRAWN BY: TC		
	CHECKED BY: SD	Dominion Energy Ordorant Injection Facility 3950 West 13400 South Riverton, Utah	B-3
	DATE: 3/30/2018		
	REVISED: -		PAGE: 1 of 1

Date Begin - End:	3/21/2018	**Drilling Company:**	Acache Drilling		**BORING LOG B-2**
Logged By:	D.Pike	**Drill Crew:**	Jay		
Hor.-Vert. Datum:	NAD83 - NAVD88	**Drilling Equipment:**	Simco 2800	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear	**Exploration Diameter:**	7.5 in. O.D.		

Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 40.50823° N, Longitude: -111.98514° E, Surface Condition: Bare Earth — Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Push Tube(PT)= psi Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean CLAY with Sand (CL): low plasticity, dark brown, moist, soft											
				BC=1 2 2 PP=1.0	18"	CL	25.5			83			
5		light gray, stiff, trace sand		BC=2 3 9 PP=1.25	10"	CL	23.7				32	12	
		Silty SAND with Gravel (SM): sub-rounded, brown, moist, dense		BC=25 28 20	12"	SM	8.7						rig grinding
10													
15													
20													
25													
30													

The boring was terminated at approximately 9.5 ft. below ground surface. The boring was backfilled with auger cuttings on March 21, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20184052	BORING LOG B-2		APPENDIX
DRAWN BY: TC			
CHECKED BY: SD	Dominion Energy Ordorant Injection Facility 3950 West 13400 South Riverton, Utah		B-4
DATE: 3/30/2018			
REVISED: -			PAGE: 1 of 1

PLOTTED: 04/20/2018 12:51 PM BY: TCisney
OFFICE FILTER: SALT LAKE CITY
PROJECT NUMBER: 20184052.001A
gINT FILE: Klf_gint_master_2017
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [_KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End:	3/21/2018	**Drilling Company:**	Acache Drilling		**BORING LOG B-3**
Logged By:	D.Pike	**Drill Crew:**	Jay		
Hor.-Vert. Datum:	NAD83 - NAVD88	**Drilling Equipment:**	Simco 2800	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear	**Exploration Diameter:**	7.5 in. O.D.		

FIELD EXPLORATION						LABORATORY RESULTS								
Depth (feet)	Graphical Log	Latitude: 40.50827° N Longitude: -111.98533° E Surface Condition: Bare Earth Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. / Push Tube(PT)= psi / Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean CLAY with Sand (CL): medium plasticity, brown, moist, very stiff, trace gravel			12"	CL	17.0			77	36	17	CBR=7 MDD=110.3 pcf opt. wc=16.5% ST refusal
				BC=5 4 16	6"								
5		gray, stiff		BC=3 4 5 PP=1.5-2	12"	CL	17.1						rig grinding
10													

15

20

25

30

The boring was terminated at approximately 10 ft. below ground surface. The boring was backfilled with auger cuttings on March 21, 2018.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20184052	BORING LOG B-3	APPENDIX
DRAWN BY: TC		
CHECKED BY: SD	Dominion Energy Ordorant Injection Facility 3950 West 13400 South Riverton, Utah	B-5
DATE: 3/30/2018		
REVISED: -		PAGE: 1 of 1

KLEINFELDER

Bright People. Right Solutions.

Appendix C

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	1.0	LEAN CLAY (CL)	18.2					32	18	14	Collaspe <1%
B-1	8.0	SILTY CLAY (CL-ML)	21.8					27	20	7	
B-1	15.0	WELL-GRADED SAND (SW)	6.7		97	64	17				
B-2	2.5	LEAN CLAY WITH SAND (CL)	25.5				83				
B-2	5.0	LEAN CLAY WITH SAND (CL)	23.7					32	20	12	
B-2	8.0	SILTY SAND WITH GRAVEL (SM)	8.7								
B-3	1.0	LEAN CLAY WITH SAND (CL)	17.0				77	36	19	17	CBR=7
											MDD=110.3 pcf
											opt. wc=16.5%
B-3	5.0	LEAN CLAY WITH SAND (CL)	17.1								

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

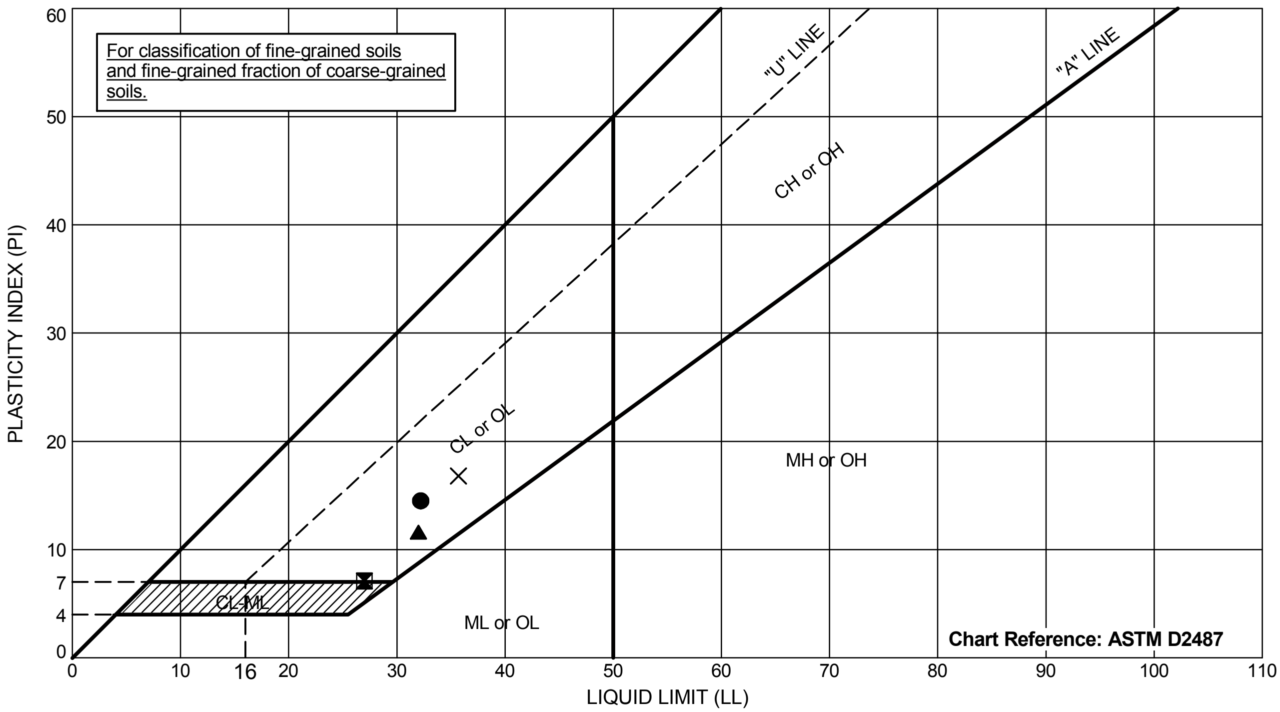
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20184052
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

LABORATORY TEST
RESULT SUMMARY

Dominion Energy Ordorant Injection Facility
3950 West 13400 South
Riverton, Utah

TABLE
C-1



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-1	1	LEAN CLAY (CL)	NM	32	18	14
⧗	B-1	8	SILTY CLAY (CL-ML)	NM	27	20	7
▲	B-2	5	LEAN CLAY WITH SAND (CL)	NM	32	20	12
×	B-3	1	LEAN CLAY with SAND (CL)	77	36	19	17

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

KLEINFELDER
Bright People. Right Solutions.

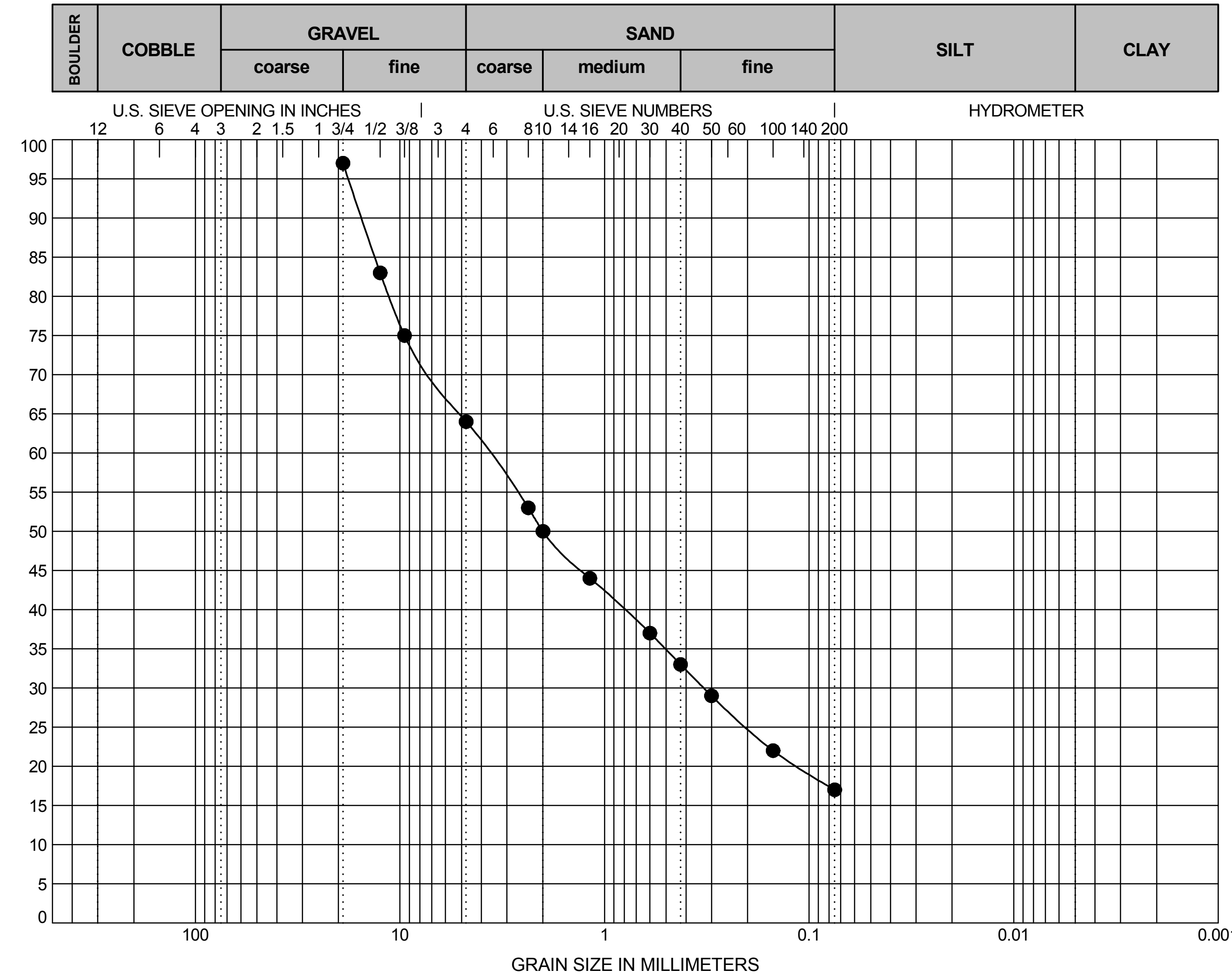
PROJECT NO.:	20184052
DRAWN BY:	TC
CHECKED BY:	SD
DATE:	3/30/2018
REVISED:	-

ATTERBERG LIMITS

Dominion Energy Ordorant Injection Facility
3950 West 13400 South
Riverton, Utah

TABLE

C-2



Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
● B-1	15	WELL-GRADED SAND (SW)	NM	NM	NM

Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
● B-1	15	19	3.683	0.327	NM	NM	NM	97	64	17	NM	NM

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

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

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20184052
DRAWN BY:	TC
CHECKED BY:	SD
DATE:	3/30/2018
REVISED:	-

SIEVE ANALYSIS

Dominion Energy Ordorant Injection Facility
3950 West 13400 South
Riverton, Utah

TABLE
C-3

PLOTTED: 04/20/2018 12:53 PM BY: TCisney
OFFICE FILTER: SALT LAKE CITY
PROJECT NUMBER: 20184052.001A
gINT FILE: Klf_gint_master_2017
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [_KLF_SIEVE ANALYSIS]

KLEINFELDER

Bright People. Right Solutions.

Appendix D

APPENDIX D

ANALYTICAL LABORATORY TEST RESULTS

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Scott Davis
Kleinfelder-SLC
849 West Levoy Drive, Suite 200
Taylorsville, UT 84123
TEL: (801) 261-3336

RE: Dominion Energy Odorant Facility / 20184052

Dear Scott Davis: Lab Set ID: 1803538

American West Analytical Laboratories received sample(s) on 3/26/2018 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Accreditation Program (NELAP) in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, Wyoming, and Missouri.

All analyses were performed in accordance to the NELAP protocols unless noted otherwise. Accreditation scope documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

The sample receipt temperature exceeded the recommended USEPA limits for some analyses.

Thank You,

Approved by: Kyle F. Gross Digitally signed by Kyle F. Gross Date: 2018.04.04 13:53:16 -06'00'

Laboratory Director or designee

American West
ANALYTICAL LABORATORIES

INORGANIC ANALYTICAL REPORT

Client: Kleinfelder-SLC **Contact:** Scott Davis
Project: Dominion Energy Odorant Facility / 20184052
Lab Sample ID: 1803538-001
Client Sample ID: B-1 @ 1'
Collection Date: 3/21/2018 1500h
Received Date: 3/26/2018 1750h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Chloride	mg/kg-dry		4/3/2018 1708h	SW9056A	5.89	**166**	&
eH	mV		3/26/2018 1849h	SM2580B	0	**436**	H
pH @ 25° C	pH Units		3/26/2018 1830h	SW9045D	1.00	**7.83**	H
Resistivity	ohm-cm		3/27/2018 544h	SM2510B	10.0	**991**	
Sulfate	mg/kg-dry		3/27/2018 640h	SM4500-SO4-E	58.9	**164**	&
Sulfide	mg/kg-dry		3/27/2018 721h	SM4500-S2-D	0.0353	< 0.0353	&[1]

& - Analysis is performed on a 1:1 DI water extract for soils.
[1] - Matrix spike recovery indicates matrix interference. The method is in control as indicated by the LCS.
H - Sample was received outside of the holding time.

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

Rpt Emailed: D

WORK ORDER Summary

Work Order: **1803538** Page 1 of 1

Due Date: 4/4/2018

Client: Kleinfelder-SLC

Client ID: KLE100 **Contact:** Scott Davis

Project: **Dominion Energy Odorant Facility / 20184052** **QC Level:** I **WO Type:** Standard

Comments: PA Rush. Footnote report: sample received out of hold for pH and eH;

VNS

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1803538-001A	**B-1 @ 1'**	3/21/2018 1500h	3/26/2018 1750h	**CL-S-9251**	Soil	☐	DF-SHARE	1
				EH-S-2580B		☐	DF-SHARE	
				PH-9045D		☐	DF-SHARE	
				PMOIST		☐	DF-SHARE	
				RESIST-S-2510B		☐	DF-SHARE	
				S2-S-4500S2D		☐	DF-SHARE	
				SO4-S-4500SO4		☐	DF-SHARE	
				SOIL-PR		☐	DF-SHARE	

AWAL Use Only - One or more samples expired upon receipt.

Test Code
EH-S-2580B
PH-9045D

AWAL Use Only - Close Hold Times

Test Code	# Samps	Min. days left
PMOIST	1	1.88
S2-S-4500S2D	1	1.88

LABORATORY CHECK: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ LUO ☐ HOK____ HOK____ HOK____ COC Emailed______

American West
Analytical Laboratories
3440 S. 700 W. Salt Lake City, UT 84119
Phone # (801) 263-8686 Toll Free # (888) 263-8686
Fax # (801) 263-8687 Email awal@awal-labs.com
www.awal-labs.com

CHAIN OF CUSTODY

All analysis will be conducted using NELAP accredited methods and all data will be reported using AWAL's standard analyte lists and reporting limits (PQL) unless specifically requested otherwise on this Chain of Custody and/or attached documentation.

1803538
AWAL Lab Sample Set #
Page ____ of ____

QC Level: 1 2 2+ 3 3+

Turn Around Time: 1 2 3 4 5 Stnd

Unless other arrangements have been made, signed reports will be emailed by 5:00 pm on the day they are due.

Due Date:

Client: Kleinfelder, Inc.
Address: 849 West Levoy Dr. #200
City, State, Zip: Salt Lake City, Utah 84123
Contact: Scott Davis
Phone #: 801.261.3336 Cell #: 801.628.2216
E-mail: scdavis@kleinfelder.com
Project Name: Dominion Energy Odorant Facility
Project #: 20184052
PO #:
Sampler Name: Dylan

☐ Report down to the MDL
☐ Include EDD:
☐ Lab Filter for:
☐ Field Filtered For:

For Compliance With:
☐ NELAP
☐ RCRA
☐ CWA
☐ SDWA
☐ ELAP / A2LA
☐ NLLAP
☐ Non-Compliance
☐ Other:

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	PH	Resistivity	Chloride	Soluble Sulfate	Sulfide	Redox					Known Hazards & Sample Comments
1	B-1 @ 1'	3/21/18	1500	1		/	/	/	/	/	/					
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

Laboratory Use Only

COC Tape Was:
1 Present on Outer Package Y N NA
2 Unbroken on Outer Package Y N NA
3 Present on Sample Y N
4 Unbroken on Sample Y N NA

Samples Were:
1 Shipped or hand delivered
2 Ambient or Chilled
3 Temperature 20.4 °C
4 Received Intact Y N
5 Properly Preserved Y N Checked at bench
6 Received Within Holding Times Y N out of hold for pH+eH

Sample Labels and COC Record Match? Y N

Relinquished by	Date / Time	Received by	Date / Time
Signature: Scott W. Davis; Print Name: Scott W. Davis	Date: 3/26/18; Time: 1630	Signature: ; Print Name:	Date: ; Time:
Signature: Scott W. Davis; Print Name:	Date: 3/26/18; Time: 1750	Signature: Valiu; Print Name: Valerie Norman-Swarr	Date: 3/26/18; Time: 1750
Signature: ; Print Name:	Date: ; Time:	Signature: ; Print Name:	Date: ; Time:

Special Instructions:

KLEINFELDER

Bright People. Right Solutions.

Appendix E

APPENDIX E

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

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

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

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

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

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer about Change

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

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

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

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

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

This Report May Not Be Reliable

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

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

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

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

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org   www.geoprofessional.org