PRELIMINARY REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION

TODD CREEK WASTE WATER
TREATMENT PLANT – PHASE II
KANSAS CITY, MISSOURI
TSI PROJECT NUMBER 20242002.00

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May 28, 2024

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Mr. Jeffrey Keller, P.E., Envision S.P.
BURNS & MCDONNELL
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Re: **Preliminary Report of Subsurface Exploration and Geotechnical Engineering Evaluation**
Todd Creek WWTP – Phase II
Kansas City, Missouri
TSi Project No. 20242002.00

Dear Mr. Keller:

TSi Geotechnical, Inc. (TSi) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the referenced project and is pleased to submit this preliminary report of our findings to Burns & McDonnell (B&McD). The purpose of our work was to determine subsurface conditions at specific exploration locations and to gather data on which to prepare preliminary geotechnical recommendations for the design and construction of the proposed new additions to the Todd Creek Waste Water Treatment Plant (WWTP) in Kansas City, Missouri. This report describes the exploration procedures used, exhibits the data obtained, and presents our evaluations and recommendations relative to the geotechnical engineering aspects of the project.

We appreciate the opportunity to assist you with this project. If you have any questions, or if we may be of further service to you, please call us.

Respectfully submitted,
TSI GEOTECHNICAL, INC.

Brooke Sidebottom, PE
Geotechnical Project Manager

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PRELIMINARY REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION TODD CREEK WWTP – PHASE II KANSAS CITY, MISSOURI

1.0 SCOPE OF SERVICES

This report summarizes the results of a preliminary geotechnical study performed for the proposed new additions to the Todd Creek WWTP in Kansas City, Missouri. The study was performed in general accordance with TSi's fee estimate to B&McD, dated January 10, 2024. Based on TSi's understanding of the project, the following items have been identified for inclusion in this study report:

- Subsurface conditions at the boring locations;
- Identification of the Bethany Falls Limestone Member;
- Laboratory test results;
- Influence of groundwater on the project;
- Soil strength parameters;
- Soil remediation recommendations;
- Depths to bedrock;
- Preliminary shallow and deep foundation recommendations, including LPILE parameters;
- Lateral Earth Pressures for below grade structures or walls;
- Pavement Subgrade Design Values;
- Seismic Site Classification;
- General construction considerations;
- Recommendations for fill and backfill material, placement and compaction; and,
- Recommendations for construction observation and testing.

2.0 SITE AND PROJECT DESCRIPTIONS

The following project understanding is based on discussions with B&McD and a site reconnaissance by an engineer from TSi. The proposed project includes the construction of various new structures and a new access road for the Todd Creek WWTP, as listed in Table 1 below. TSi performed a subsurface exploration in 2022 for the same project at a site approximately 0.25 miles north of this current project site. TSi understands that this new project site to the south is being considered as an alternative location for the project.

A Vicinity Map, Figure 1 in Appendix A, indicates the general project location. The Site and Boring Location Plan, Figure 2 in Appendix A, provides a more detailed plan of the project area.

The project site is currently located within an empty field previously used for farming. The general site terrain includes a quarry west of the project site, farming property which slopes from an approximately elevation of 890 feet to the west and 840 feet to the east, and Todd Creek to the east and south of the project site. The site generally drains to the east and south into Todd Creek and a tributary creek.

TABLE 1
TODD CREEK WWTP – PLANNED NEW STRUCTURES

Planned New Structure	Planned Approximate Grade, feet	Preliminary Structure Loads (psf*)	Borings within Preliminary Footprint Layout of Planned New Structures
Blower Building	856	3500	B-07
AGS Basins	856 or 851	4000	B-01, B-02, B-03, B-04
Solids Processing	861	3500	N/A
Administrative Building	861	3500	B-08
Effluent Structure	847	3000	B-06
UV Disinfection	851	3500	B-05
Headworks Building	856	4000	N/A
Main Access Road	Varies	N/A	B-09, B-10

*psf – pounds per square foot.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

TSi conducted a preliminary exploration program at the project site from January 31 to February 14, 2024. The exploration consisted of ten (10) soil borings, designated as Borings B-01 to B-10 which extended to depths ranging from approximately 5.1 feet to 250 feet below the existing ground surface. The approximate locations of the borings are indicated on the Site and Boring Location Plan, Figure 2 in Appendix A. The logs from this exploration are included in Appendix B. The boring locations were selected by B&McD and marked in the field by TSi using a handheld GPS device. The elevations listed on the boring logs were estimated using Google Earth Data and should be considered approximate.

The borings were drilled using a CME-550x all-terrain drill rig to advance hollow stem or flight auger drilling tools. Split-spoon samples were recovered from each boring while performing standard penetration tests (SPT). Split-spoon samples were recovered using a 2-inch outside-diameter, split-barrel sampler, driven by an automatic hammer, in accordance with ASTM D 1586. The split-spoon samples were placed in plastic bags for later testing in the laboratory. Three-inch diameter Shelby tube samples were also obtained in accordance with ASTM D 1587. The Shelby tube samples were preserved by sealing the entire sample in the tube. Borings were backfilled with bentonite grout.

Four borings (B-02, B-03, B-06, and B-08) were advanced about 20 to 25 feet below auger refusal depths into the underlying limestone and shale bedrock. Boring B-07 was advanced over 220 feet into bedrock to a total depth of 250 feet in an effort to identify the Bethany Falls Limestone Member. The bedrock was sampled using N series diamond-bit rock coring methods. The rock cores recovered were placed in boxes and taken to the laboratory for examination and testing. Percent recovery and Rock Quality Designation (RQD) values were calculated for each rock core sample and are noted on the boring logs. The RQD is the percentage of the total length of rock cored that consists of sound pieces that are a minimum of 4.0 inches in length. The RQD is a general indication of the integrity of the in-situ rock mass. Based on RQD, rock quality can be described as excellent (90 to 100), good (75 to 90), fair (50 to 75), poor (25 to 50), or very poor (0 to 25). TSi photographed the rock core samples and have included the photographs in Appendix D of this report.

The results of the field tests and measurements were recorded on field logs and appropriate data sheets by a geotechnical specialist. Those data sheets and logs contain information concerning the exploration methods, samples attempted and recovered, indications of the presence of various subsurface materials, and the observation of groundwater if encountered. The field logs and data sheets contain the field representative's interpretations of the conditions between samples, based on the performance of the exploration equipment and the cuttings brought to the surface. The final logs included in this report were based on the field logs, modified as appropriate based on the results of laboratory testing of soil samples.

3.2 LABORATORY TESTING

A laboratory testing program was conducted by TSi to determine selected engineering properties of the obtained soil samples. The following laboratory tests were performed on select samples recovered from the borings according to applicable ASTM standards:

- Visual descriptions by color and texture;
- Natural moisture content;
- Atterberg limits of selected cohesive samples;
- Unit weight of selected cohesive samples;
- Unconfined compression of selected cohesive samples;
- Grain size analysis of selected samples;
- Minus #200 sieve wash of selected samples;
- Corrosivity suite; and,
- Compressive strength of intact rock core samples.

The results of most of the laboratory tests are summarized on the boring logs in Appendix B. Results of the grain size analysis, corrosivity suite, and rock core compressive strength tests are included in Appendix C. The analysis and conclusions contained in this report are based on field and laboratory test results and on the interpretations of the subsurface conditions as reported on the logs. Only data pertinent to the objectives of this report have been included on the logs; therefore, these logs should not be used for other purposes.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the boring locations are shown on the boring logs in Appendix B. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at those locations on the dates shown; the reported conditions may be different at other locations or at other times.

4.1 GENERAL GEOLOGY

The surficial geologic deposit of the general project area is made up with soil named F-Glacial Drift consisting of nonstratified, generally heterogeneous mixture of clay, silt, sand, gravel, cobbles, and boulders deposited directly by glacial ice. The bedrock in the area is associated with Lansing Group of late Pennsylvanian-Upper Series- Missouri Stage. This bedrock formation is up to 60 feet thick which consists of primarily cyclic deposits of shale, limestone with minor sandstone layers. The underlying Kansas City Group bedrock generally consists of alternating layers of limestone and shale. Potential geologic hazards such as liquefiable soils, collapsible soils, faults, karst, and active mines were not encountered or discovered on or near the project site during subsurface exploration.

4.2 GENERALIZED SUBSURFACE PROFILE

The surficial materials at the boring locations generally consist of lean clays (CL, in accordance with the Unified Soil Classification System (USCS)) which contain various amounts of organics, sand, gravel, and shale fragments. Standard penetration tests (N-values) in the lean clays range from 6 blows per foot (bpf) to 50 blows for 5.5 inches of penetration. Moisture contents range from 14% to 29%. Atterberg tests performed within the lean clays result in liquid limits (LL) ranging from 33 to 47 and plasticity indexes (PI) of 16 to 25. Undrained shear strength and dry densities result at 0.35 to 1.35 tons per square foot (tsf) and 98 to 119 pounds per cubic foot (pcf), respectively. The native lean clays continue to apparent top of weathered bedrock in Borings B-03, B-04, and B-10 and to a planned termination depth of 20 feet below ground surface in Boring B-09.

In Borings B-01, B-02, B-05, B-06, B-07, and B-08, the surficial lean clays are generally underlain by sands and gravels (SC, SP, and GC, in accordance with the USCS) containing various amounts of clay. These sands and gravels continue to apparent top of weathered bedrock. N-values and moisture contents in the sands and gravels range from 8 bpf to 44 bpf and 6% to 22%, respectively.

Split spoon samples refused on the top of weathered bedrock in Borings B-02 through B-08, and Boring B-10. Standard penetration tests (N-values) and moisture contents within the upper weathered bedrock range from 50 blows for 4.5 inches of penetration to 50 blows for 0 inches of penetration and 1% to 14%, respectively.

Table 2 lists the depths and approximate elevations at which auger refusal was encountered across the site. Auger refusal was encountered on the top of weathered shale and/or limestone bedrock at depths ranging from 5.1 to 39.4 feet below the ground surface. Drilling operations were advanced below auger refusal in five of the ten borings to termination depths ranging from 35 feet to 250 feet below the ground surface. Recoveries in the limestone and shale bedrock range from 31% to 100% and rock quality designations (RQDs) range from 0% to 100%. The compressive strength of selected limestone and shale rock cores range from about 15,000 to 17,000 psi and 40 to 200 psi, respectively.

TABLE 2
AUGER REFUSAL DEPTH AND ELEVATION

Boring Location	Auger Refusal Depth (ft.)	Auger Refusal Elevation* (ft.)
B-01	NE	NE
B-02	20.5	830.5
B-03	12.0	828.0
B-04	15.6	829.4
B-05	24.0	829.0
B-06	16.0	831.0
B-07	29.2	828.8
B-08	39.4	830.6
B-09	NE	NE
B-10	5.1	878.9

*Elevations are approximate. NE – Not Encountered.

Boring B-07 was advanced to a depth of 250 feet in an effort to identify the Bethany Falls Limestone Member. Based on geologic information published in the *Stratigraphic Succession in Missouri* and the depictions of the bedrock formations, it appears that the Bethany Falls Limestone Member is present in a 19-foot stratum at an elevation of about 631 to 612 in Boring B-07.

4.3 GROUNDWATER

Groundwater was encountered in nine borings to approximate depths ranging from 5.9 to 28.5 feet below ground surface. The presence of groundwater at a particular location does not necessarily mean that groundwater will be present or absent at that location at other times. Seasonal variations and other unknown considerations could cause fluctuations in water levels and the presence of water in the soils.

5.0 Engineering Assessments and Recommendations

5.1 Preliminary Shallow Foundation & Ground Improvement Recommendations

Due to the relatively large anticipated loads given in Table 1 for the project, TSi generally does not recommend that shallow foundations be utilized bearing on native soils which have not been modified using ground improvement methods. If other, more lightly loaded, structures or retaining walls are planned to be constructed on site, then those proposed structures may be supported by shallow spread footing foundations bearing on native lean clays compacted in accordance with the recommendations provided in Section 6 of this report. Spread footings on the native lean clay soil may be designed for a net allowable bearing pressure (pressure in excess of adjacent overburden pressure) of up to 2,000 pounds per square foot (psf) for structural dead load plus maximum live load. This bearing pressure should be considered preliminary and should not be used for final design.

TSi understands that rammed aggregate pier (RAP), or geopier, ground improvement methods may be implemented for this project. These methods are typically designed and installed by a specialty contractor, who should be capable of verifying the improvement in bearing capacity and settlement characteristics, along with providing preliminary construction costs in the design phase. Because of the specialty nature of these technologies, the design/builder should accept responsibility for the performance of their methods and products. Note that there are certain limitations when utilizing RAP ground improvement methods, such as any planned utilities must be placed prior to the installation of the piers. Placing utilities after installation of the RAP ground improvements may result in a disruption of the ground improvement system, which will cause a decrease in bearing capacity.

Footings should be constructed at least 30 inches below the exterior finish grade to provide protection against the detrimental effects of seasonal moisture variations and frost penetration. Strip-type footings should be at least 1.5 feet wide and square footings at least 2.0 feet in dimension, regardless of the applied structural load, in order to provide a bearing area that will account for minor variations in the supporting soil.

5.2 Preliminary Deep Foundation Recommendations

Due to the relatively large anticipated loads given in Table 1 for the project, it is TSi's opinion that the proposed structures should be supported by deep foundations in the case that ground improvement methods are not implemented. This could include the use of drilled shafts or driven H-piles. The values provided below are intended for preliminary design only and should NOT be used for final design of structures. It is not known whether the borings are located within the final planned structure footprints and subsurface conditions are likely to vary across the site. It is TSi's recommendation that additional subsurface exploration be performed before the final design of any deep foundation elements.

Drilled Shafts

Drilled shafts could be used for support of the proposed structures. An estimated allowable side resistance value of 320 pounds per square foot for the native soils and an allowable ending bearing

capacity of 25 ksf for shale or limestone bedrock could be used for preliminary design of the structures. It is recommended that the upper 3 feet of the shaft be assumed to offer zero side resistance. Side resistance for uplift loading is equal to 2/3 of the side resistance used for design.

Groundwater may be encountered while each shaft is being constructed. Provisions should be made to dewater the base of the excavation prior to reinforcing steel installation. Each shaft should be cast the same day it is completed and approved. The base of each shaft should be cleaned of loose rock or soil material using a cleanout bucket. The shaft should continually be pumped as necessary to prevent the accumulation of water. No more than one inch of water accumulation on the shaft base should be allowed at the time of concrete placement.

Temporary casings will likely be needed during the construction of drilled shafts. The casings are used to stabilize the sides of the drilled shafts from sloughing during excavation procedures and placement of concrete and are typically seated in the bedrock for stability. Seated often requires a "twister bar" attachment to a Kelly bar which can be used to allow the drill rig to apply torque to the casing and advance it in the underlying soil or bedrock.

H-Piles

It is feasible to support the proposed structures on steel H-piles driven to practical refusal on bedrock. The H-piles would be driven through the overburden materials and seated on the competent limestone below. The capacity of piles driven to practical refusal on limestone bedrock will be controlled by the structural capacity of the pile. Driven H-piles terminating on shale may not achieve these capacities and may be governed by frictional capacities. Table 3 presents structural capacities of common pile sections as presented in the MoDOT EPG 751.36.3:

TABLE 3
STRUCTURAL STEEL H-PILE CAPACITIES

Section	End Area (in2)	GRADE 50	
		Structural Nominal Resistance (kips)	Structural Factored Compression Resistance (ϕ=0.5) (kips)
HP 12x53	15.5	775	380
HP 14x73	21.4	1070	535

5.3 PRELIMINARY DEEP FOUNDATION LATERAL LOADS

The lateral load capacity of deep foundations will vary based on the dimensions, depth to bedrock, and condition of the bedrock. Foundations subjected to lateral loads should be designed and analyzed for lateral deflection using the LPILE Version 6 computer program by Ensoft, Inc., or an

equivalent program. This program analyzes pile deflection as a function of the design loads, foundation properties and subsurface conditions.

Recommended parameters for use in the preliminary evaluation of lateral load capacity and deflection for deep foundations are presented in Table 4. The lateral design parameters below assume that no interaction of loading will occur between the drilled shaft foundations. This condition can be achieved if the foundations are spaced at least 3 diameters apart (center-to-center spacing) in a direction perpendicular to the applied loading and at least 6 diameters apart (center-to-center spacing) in a direction parallel to the applied loading. If the foundations are more closely spaced than this, then a reduction in the lateral design parameters would apply as presented in Table 5.

TABLE 4
LPILE PARAMETERS
(BASED ON BORINGS B-01 TO B-08)

Material	Approximate Elevation, ft	L-PILE Material Type	Effective Unit Weight [Note 1] γ', pcf	Effective Angle of Internal Friction, Φ, degrees	Undrained Cohesion psf	Soil Modulus Parameter [Note 1] k, pci	E_{50} Value [Note 2]
Native Lean Clay	Above 835	Stiff Clay w/o Free Water	125 (62.6)	N/A	1,500	500	0.007
Dense Sand	835 to 830	Sand (Reese)	115 (52.6)	36	N/A	157 (97)	N/A
Material	**Approximate Elevation, ft**	**L-PILE Material Type**	**Effective Unit Weight [Note 1] γ', pcf**	**K_{rm}**	**Uniaxial Compressive Strength (psi)**	**Rock Modulus (psi)**	**RQD**
Limestone	830 to 828	Strong Rock	160 (97.6)	0.0005	15,000	7.0×10^6	70
Shale	Below 828	Weak Rock	140 (77.6)	0.0005	100	7,000	25

[1]Use first value above water table and value in parentheses below water table.
[2]Version 6 of LPILE requires input of unconfined compressive strength (q_u) for strong rock models.

Group Effect – Laterally Loaded

Laterally loaded piers can have varying degrees of group interactions when center-to-center spacing are less than six diameters in the direction of loading. Allowable passive resistance provided by a row of piers in line with the direction of the load should be reduced by using a p-multiplier (P_m) method using lateral loading software of a single pile, such as LPILE. This method scales the p-y curves of a single shaft to determine the group shaft effect. The recommended p-multipliers are shown in Table 5 below:

TABLE 5
RECOMMENDED P-MULTIPLIER, P_M, VALUES FOR DESIGN BY ROW POSITION

	P-Multiplier, P_m			
Pile Spacing (c-c)	**3D**	**4D**	**5D**	**≥6D**
Lead Row	0.7	0.85	1.0	1.0
2nd Row	0.5	0.65	0.85	1.0
3rd and higher Rows	0.35	0.5	0.7	1.0

5.4 LATERAL EARTH PRESSURES

Lateral earth pressure parameters are provided for the design of the buried structures, such as the piping, below grade manhole/vaults, and retaining walls that may be included in the project. Earth pressures are a function of the excavation configuration and the backfill materials. Lateral earth pressure parameters are provided in Table 6 for the design of these subsurface structures. Hydrostatic forces should be added to the analyses below the design groundwater level unless the structure is designed with a permanent underdrain or pump system to prevent buildup of hydrostatic forces on the structure.

Below-grade structures that are restricted from movement at the top, such as footings or foundation walls and manholes, should be designed to resist at-rest pressures. Walls that are free to move and deflect at the top should be designed to resist active earth pressures. A horizontal deflection at the top of the wall of approximately 1% of the freestanding wall height is typically required to permit active pressure to develop. Earth pressures are a function of the excavation configuration and the backfill materials.

TABLE 6
LATERAL EARTH PRESSURE PARAMETERS FOR SUBSURFACE STRUCTURES*

Parameter		**Backfilled with Crushed Limestone**	**Backfilled with Cohesive Soil**	**Backfill with Sand**
At-Rest Equivalent Fluid Pressure	Drained	55 pcf	72 pcf	58 pcf
	Undrained	91 pcf	99 pcf	89 pcf
Active Equivalent Fluid Pressure	Drained	35 pcf	51 pcf	38 pcf
	Undrained	81 pcf	88 pcf	80 pcf
Passive Equivalent Fluid Pressure	Drained	480 pcf	308 pcf	345 pcf
	Undrained	310 pcf	217 pcf	220 pcf
Soil Unit Weight		130 pcf	125 pcf	115 pcf
Angle of Internal Friction for Backfill		35°	25°	30°
Assumed Surcharge Condition		None	None	None
Slope Profile Behind Structure		Horizontal	Horizontal	Horizontal

* No factor of safety has been applied to the above values.

Significant wall movements would generally be necessary to develop the full values of passive pressures given; typically, the passive values stated are reduced by up to one-half for design.

To prevent the accumulation of water behind new subsurface walls and resulting hydrostatic pressure, a free-draining granular backfill material is recommended for the walls. The drainage backfill material should be encased in a nonwoven geotextile having a minimum weight of 8 ounces per square yard. A perforated pipe should be placed at the base of the wall to collect the water and carry it to daylight, to a storm sewer, or to a sump.

The effects of vertical surcharge loads or sloping ground behind the wall are not included for the stated fluid pressures. The effect of surface loading may be included as a uniform horizontal load against the wall equal to one-half the vertical load intensity.

5.5 Pavement Subgrade Recommendations for New Access Roadways

Based on the general character of the soils encountered in Borings B-09 and B-10 at the project site, and assuming a properly prepared subgrade, a California Bearing Ratio (CBR) value of 3.0 is considered appropriate for use in designing the flexible pavement sections for the site. Rigid pavement design can be based on a modulus of subgrade reaction (k) of 55 pci for the subgrade. Allowances should be included to improve unsuitable pavement areas encountered during construction. These values for rigid and flexible pavement design are based on the requirement that the pavement subgrade be prepared in accordance with the recommendations provided in this report. TSi recommends that a 6.0-inch base course of well-graded crushed limestone, such as MoDOT Type 5 or 7, be placed below all new pavements.

5.6 Seismic Site Classification

Based on the general soil characteristics as determined by field and laboratory tests and the depths to bedrock, the project area is designated as Site Class D, in accordance with the International Building Code (IBC) and ASCE 7.

The N-values from the borings suggest that the soil has adequate density and cohesion to resist liquefaction in consideration of the distance to known seismic sources. Thus, the site soil is not considered to be susceptible to liquefaction, or to substantial settlement or loss in strength when subject to the design earthquake loading.

5.7 Corrosion Potential

A soil sample at depth of 3.5 to 5.0 feet at Boring B-07 was selected for chemical and physical testing to determine the corrosion potential. Tests were completed for pH, electrical resistivity, sulfide content, sulfate content, oxidation/reduction potential, and chloride content on the sample. The results of these tests are presented in Table 7. The results of these laboratory tests were used to evaluate the corrosion potential of the soil using DIPRA's "10 Point" evaluation system, as outlined in Table 7. Our interpretation of the test results indicates that the selected soil sample is moderately corrosive to buried ferrous metal piping, cast iron pipes, or other objects made of these materials.

To evaluate the potential for sulfate attack on buried concrete, laboratory chemical tests were completed on the samples. The results of the tests indicate that water soluble sulfates were not detected in the sample. Interpretation of these test results, using Section 318 of the ACI Manual of Concrete Practice, indicates that the on-site materials may have negligible sulfate exposure characteristics.

TABLE 7
LABORATORY TEST RESULTS
DIPRA CORROSION POTENTIAL "10 POINT" SCORING SYSTEM

Parameter	Range	Points	Laboratory Results	Points Assigned for the Soil Sample
Resistivity (Ohms-cm)	< 1500 1500 – 1800 1800 – 2100 2100 – 2500 2500 - 3000 > 3000	10 8 5 2 1 0	16,900	0
pH	0.0 – 2.0 2.0 – 4.0 4.0 – 6.5 6.5 – 7.5 7.5 – 8.5 > 8.5	5 3 0 0ǂ 0 3	6.6	0
Redox (mV)	> 100 50 – 100 0 – 50 Negative	0 3.5 4 5	244.2	0
Sulfides	Positive Trace Non-Detect	3.5 2 0	Positive	3.5
Moisture	Poor drainage, continuously wet Fair drainage, generally moist Good drainage, generally dry	2 1 0	21.4%	1
ǂ 3 points assigned if sulfides are present and redox is < 0.				TOTAL =4.5

6.0 Site Preparation and Excavation Considerations

6.1 Subgrade Preparation

Construction areas should be stripped of vegetation, root mass, organic soil and any other deleterious materials prior to site excavation and grading. Care should be taken during stripping to prevent excessive disturbance of the underlying soil. After the removal of these materials, and where further excavation is not required for fill removal, the exposed subgrade should be proofrolled. Proofrolling is accomplished by passing over the subgrade with proper equipment such as a loaded tandem-axle dump truck or scraper and observing the subgrade for pockets of excessively soft, wet, disturbed, or otherwise unsuitable soils. Any unacceptable materials thus found should be excavated and either recompacted or replaced with new structural fill.

Prior to placing fill in any area, the subgrade should be scarified to a depth of about 6 inches, the moisture content adjusted to near its optimum moisture content, and the subgrade recompacted in accordance with recommendations made in subsequent sections of this report. The recommended proofrolling and/or scarification and recompaction may be waived if, in the opinion of TSi, this procedure would be detrimental or unnecessary. Following the satisfactory preparation of the subgrade, controlled fill material may be placed.

6.2 Excavations

It appears that the existing soils can likely be excavated using conventional earth moving equipment and methods. Trenching, excavating, and bracing should be performed in accordance with OSHA (Occupational Safety and Health Administration) regulations and other applicable regulatory agencies. In accordance with the OSHA excavation standards, the existing soils at the site are considered Type B, which requires a side slope for temporary excavations open less than 24 hours of not steeper than 1.0H:1.0V. However, worker safety and classification of the excavation soil is the responsibility of the contractor. Also according to OSHA requirements, any excavation extending to a depth of more than 20 feet must be designed by a registered professional engineer.

6.3 Subgrade Protection

Construction areas should be properly drained in order to reduce or prevent surface runoff from collecting on the exposed subgrade in excavations. Any ponded water on the exposed subgrade or trench bottom should be removed immediately. Temporary storm-water swales and collection areas may be required to control surface water flow into low areas of the site or into trench excavations.

6.4 Fill and Backfill Materials

Structural fill should consist of approved soils or crushed limestone material, free of organic matter and debris. Fill material placed within 24 inches of floor slab subgrade or pavement section should

consist of select Low Volume Change (LVC) fill material. LVC fill should consist of approved, well-graded granular materials or low plasticity cohesive soil. Low plasticity cohesive materials used as LVC fill should consist of inorganic clay with a liquid limit less than 45 and a plasticity index of less than 25. Most of the native lean clays encountered on the site may be reused as fill. Granular fill should have a maximum particle size of 1.5 inches. Fill materials from off-site sources should be approved prior to their use. Soil with decayable material such as wood, metal, or vegetation is not acceptable.

Some of the soil on the site will require the addition of moisture prior to compaction. This should be performed in a controlled manner using a tank truck with a spray bar, and the moistened soil should be thoroughly blended with a disk or pulverizer to produce a uniform moisture content. Repeated passages of the equipment may be required to achieve a uniform moisture content. If this facility is constructed during the winter season, fill materials should be carefully observed to see that no ice or frozen soils are placed as fill or remain in the base materials upon which fill is placed.

Some of the on-site soil may require moisture reduction prior to compaction. During warm weather, moisture reduction can generally be accomplished by disking, or otherwise aerating the soil. When air-drying is not possible, a moisture-reducing chemical additive, such as lime or Class C fly ash, could be used as a drying agent.

6.5 Fill and Backfill Placement

Cohesive fill should be compacted to a dry density of at least 95% of the standard Proctor maximum dry density (ASTM D 698) of the soil. Granular material, such as crushed limestone, placed for structure or pavement support, should be compacted to at least 100% of the standard Proctor maximum dry density. The moisture content of lean clay or granular fill at the time of compaction should generally be from $^{+}$/- 3% of the optimum moisture content of the material as determined by the standard Proctor compaction test. Open-graded granular material used for drainage backfill should be compacted to at least 70% of the relative density of the material (ASTM D 4253 and D 4254). Fill should be placed in loose lifts not in excess of 8 inches thick, and compacted to the aforementioned criterion. However, it may be necessary to place fill in thinner lifts to achieve the recommended compaction when using small hand-operated equipment.

7.0 CONSTRUCTION OBSERVATION AND TESTING

It is recommended that TSi be retained during construction to perform testing and observation services for the following items:

- Observation and documentation of the exposed soil after stripping topsoil, during scarification, compaction, and proofrolling;
- Quality assurance testing for concrete and structural steel materials;
- Testing of asphalt and/or concrete materials used for paving; and,
- Placement and compaction of fill materials.

These Quality Assurance services should help verify the design assumptions and maintain construction procedures in accordance with the project plans, specifications, and good engineering practice.

8.0 REPORT LIMITATIONS

This preliminary geotechnical report has been prepared for the exclusive use of **BURNS & MCDONNELL** for the specific application to the subject project. The information and recommendations contained in this report have been made in accordance with generally accepted geotechnical and foundation engineering practices; no other warranties are implied or expressed.

The assessments and recommendations submitted in this report are based in part upon the data obtained from the borings. The nature and extent of variations between the borings may not be evident at this time. If variations appear evident at a later date, it may be necessary to re-evaluate the recommendations of this report.

We emphasize that this report was prepared for design purposes only and may not be sufficient to prepare an accurate construction bid. Contractors reviewing this report should acknowledge that the information and recommendations contained herein are for design purposes.

If conditions at the site have changed due to natural causes or other operations, this report should be reviewed by TSi to determine the applicability of the analyses and recommendations considering the changed conditions. The report should also be reviewed by TSi if changes occur in the structure location, size, and type, in the planned loads, elevations, grading and site development plans or the project concepts.

TSi requests the opportunity to review the final plans and specifications for the project prior to construction to verify that the recommendations in this report are properly interpreted and incorporated in the design and construction documents. If TSi is not accorded the opportunity to make this recommended review, we can assume no responsibility for the misinterpretation of our recommendations.

APPENDIX A

Vicinity Map
Site and Boring Location Plan

Note: This plan was prepared from an image obtained from Google Earth on January 18, 2024.

N
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Figure 1, Vicinity Map	Project No. 20242002.00
Todd Creek WWTP – Phase II Kansas City, Missouri	
Not to Scale	Approved by: TBS

TSI geotechnical, inc.

Note: This plan was prepared from an image obtained from Google Earth on January 19, 2024.

N
W E
S

Figure 2, Site and Boring Location Plan	Project No. 20242002.00
Todd Creek WWTP – Phase II Kansas City, Missouri	
Not to Scale / Approved by: TBS	

TSi geotechnical, inc.

APPENDIX B

Boring Logs
General Notes
Unified Soil Classification System

LOG OF BORING NO. B-01

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **863***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown and gray, lean CLAY (CL), trace sand	94		4 5 7	2.50			27			
		SS-2		- brown from 3.5 to 15.0 ft.	100		3 5 5	1.50			27	43	21	22
5		SS-3			100		3 4 5	2.00			23			
		ST-4			92			2.50	0.71	105	23			
10		SS-5		- with sand, trace gravel below 11.0 ft. (80% passing No. 200 sieve)	100		2 8 11	1.75			20			
		SS-6			100		4 6 12	1.50			19			
15		SS-7		- brown and gray, sandy below 18.5 ft.	100		8 15 18	1.75			23			
20		SS-8		Brown, clayey fine SAND (SC) (30% passing No. 200 sieve)	100		20 16 14				16			
25														

Completion Depth: 30.0
Date Boring Started: 1/31/24
Date Boring Completed: 1/31/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT.
Groundwater encountered at 28.5 ft. after 24 hours.
*Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Continued Next Page

LOG OF BORING NO. B-01

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **863***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, clayey fine SAND (SC)										
				▼ - trace gravel below 28.5 ft.										
		SS-9			83		2 6 6				21			
30				Boring terminated at 30.0 ft.										
35														
40														
45														
50														

Completion Depth: 30.0
Date Boring Started: 1/31/24
Date Boring Completed: 1/31/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT.
Groundwater encountered at 28.5 ft. after 24 hours.
*Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-02

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **851***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown, lean CLAY (CL), trace sand - trace fine roots from 1.0 to 3.0 ft.	83		3 5 6	2.50			26			
		ST-2		- brown and gray, with sand from 3.0 to 5.0 ft.	100			2.25	0.77	98	26			
5		SS-3		(99% passing No. 200 sieve)	100		3 6 6	0.50			29			
		SS-4			100		4 5 6	0.75			26			
10		SS-5			100		6 4 5	1.25			24			
		ST-6		- trace gravel from 13.0 to 15.0 ft.	83			3.25	0.92	105	22	40	15	25
15				▼										
		SS-7		Brown, clayey GRAVEL (GC), with sand (16% passing No. 200 sieve)	56		8 7 6				13			
20		SS-8					50/0.0"							
		RUN1		LIMESTONE, gray, hard, slightly weathered, finely crystalline, parted	70	26								
				SHALE, dark gray, soft, highly weathered, trace limestone fragments Core loss from 23.7 to 25.0 ft.										
25														

Completion Depth:	45.0
Date Boring Started:	2/8/24
Date Boring Completed:	2/8/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 15.5 ft. after 24 hours. Auger refusal at 20.5 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Continued Next Page

LOG OF BORING NO. B-02

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **851***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				(possible shale washout)										
				SHALE, dark gray, soft, highly weathered, aphanitic - black, fissile from 25.5 to 26.0 ft.										
		RUN2		- gray from 27.3 to 30.0 ft.	100	55								
30				- calcareous from 28.4 to 40.0 ft. - moderately weathered from 28.4 to 30.0 ft. - moderately hard below 30.0 ft. - slightly weathered from 30.0 to 32.4 ft.										
		RUN3		- moderately weathered from 32.4 to 40.0 ft. - fissile from 33.7 to 35.0 ft.	100	53								
35														
		RUN4		- fissile from 37.5 to 40.0 ft.	100	63								
40				- slightly weathered below 40.0 ft.										
		RUN5			100	72								
45				Boring terminated at 45.0 ft.										
50														

Completion Depth:	45.0
Date Boring Started:	2/8/24
Date Boring Completed:	2/8/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 15.5 ft. after 24 hours. Auger refusal at 20.5 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-03

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **840***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, lean CLAY (CL), trace sand										
		SS-1			61		4 3 4	1.75			25			
				- brown and gray from 3.0 to 10.0 ft.										
		ST-2			63			2.50	0.67	100	23	33	17	16
5				▼										
		SS-3			100		5 3 5	2.00			23			
				(94% passing No. 200 sieve)										
		ST-4			79			2.00	1.16	106	22			
10														
		SS-5		- brown, with gravel below 11.0 ft.	75		3 50/2.0"	0.50			76			
				LIMESTONE, gray, hard, weathered, finely crystalline, parted										
		RUN1		SHALE, dark gray, soft, highly weathered, aphanitic	31	0								
				Core loss from 13.0 to 15.0 ft. (possible shale washout)										
15				Calcareous SHALE, dark gray, moderately hard, weathered, aphanitic										
		RUN2			100	90								
				- fissile from 18.0 to 21.1 ft.										
20														
		RUN3			100	58								
25				- fissile below 25.0 ft.										

Completion Depth:	35.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/12/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT.
Groundwater encountered at 5.9 ft. after 24 hours.
Sampler refusal at 11.7 ft. Auger refusal at 12.0 ft.
*Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

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LOG OF BORING NO. B-03

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **840***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Calcareous SHALE, dark gray, moderately hard, weathered, aphanitic, fissile										
		RUN4			100	78								
30				- 1.0" limestone seam at 28.3 ft.										
		RUN5			100	48								
35				Boring terminated at 35.0 ft.										
40														
45														
50														

Completion Depth: 35.0
Date Boring Started: 2/12/24
Date Boring Completed: 2/12/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT.
Groundwater encountered at 5.9 ft. after 24 hours.
Sampler refusal at 11.7 ft. Auger refusal at 12.0 ft.
*Elevation estimated using Google Earth data

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

LOG OF BORING NO. B-04

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **845***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown and gray, lean CLAY (CL), trace sand	100		5 9 9	2.00			27	45	23	22
		SS-2		(98% passing No. 200 sieve)	100		8 15 24	1.50			28			
5		SS-3			100		7 14 21	1.50			29			
		SS-4		- with sand below 8.5 ft. (83% passing No. 200 sieve)	100		7 13 13	1.00			21			
10		SS-5			100		7 11 12	0.75			20			
		ST-6		- trace gravel below 13.0 ft.	29			1.50		102	24			
15		SS-7					50/0.0"							
				Boring terminated at 15.6 ft.										
20														
25														

Completion Depth: 15.6
Date Boring Started: 1/31/24
Date Boring Completed: 1/31/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 12.0 ft. during drilling, at 11.0 ft. prior to backfill, and at 8.2 ft. after 24 hours. Auger refusal at 15.6 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-05

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **853***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown and gray, lean CLAY (CL), trace sand - trace fine roots from 1.0 to 2.5 ft.	78		5 7 8	2.50			27	46	23	23
		SS-2		- with sand from 3.5 to 5.0 ft.	100		4 4 5	1.50			28			
5		SS-3		(91% passing No. 200 sieve)	100		9 20 28	2.00			24			
		ST-4			96			3.00	0.35	119	14			
10		SS-5		- brown below 11.0 ft. - trace gravel from 11.0 to 12.5 ft.	100		3 5 6	1.50			18			
		SS-6		- with gravel from 13.5 to 14.0 ft.	80		50/5.5"				16			
15														
		SS-7		Brown, clayey SAND (SC), with gravel - gravelly below 18.5 ft. (12% passing No. 200 sieve)	50		10 5 7				17			
20		SS-8			100		50/2.0"				14			
				Boring terminated at 23.7 ft.										
25														

Completion Depth:	23.7
Date Boring Started:	1/31/24
Date Boring Completed:	1/31/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 23.5 ft. during drilling, at 21.5 ft. prior to backfill, and at 20.2 ft. after 24 hours. Sampler Refusal at 14.0 ft. Auger Refusal at 24.0 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-06

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **847***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, lean CLAY (CL), trace sand										
		SS-1		- trace fine roots from 1.0 to 2.5 ft.	83		6 6 8	3.25			27	47	23	24
		ST-2		- brown and gray below 3.0 ft.	100			3.25	1.35	101	25			
5		SS-3			100		5 6 14	2.00			23			
				(93% passing No. 200 sieve)										
				- with sand from 8.0 to 12.0 ft.										
		ST-4			100			3.50	1.24	110	21			
10				▼										
		SS-5		- sandy below 12.0 ft.	100		8 10 18	3.50			20			
				Brown and gray, clayey SAND (SC)										
		SS-6		(46% passing No. 200 sieve)	100		4 4 4	0.75			21			
15		SS-7		LIMESTONE, gray, hard, highly weathered	46		50/4.5"				1			
		RUN1		LIMESTONE, gray, hard, slightly weathered, very finely crystalline, parted	100	77								
20		RUN2		SHALE, dark gray, very soft, highly weathered, with limestone fragments - soft below 20.0 ft.	100	70								
25														

Completion Depth:	40.0
Date Boring Started:	2/7/24
Date Boring Completed:	2/7/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 10.5 ft. after 24 hours. Auger refusal at 16.0 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries. In situations, the transition may be gradual.

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LOG OF BORING NO. B-06

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **847***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				SHALE, dark gray, soft, highly weathered, with limestone fragments										
		RUN3		Shaley LIMESTONE, gray, hard, moderately weathered	97	38								
30				SHALE, dark gray, soft, highly weathered, aphanitic - embedded limestone fragments from 28.2 to 28.6 ft. - fissile below 30.0 ft.										
		RUN4			98	15								
35														
		RUN5			100	25								
40				Boring terminated at 40.0 ft.										
45														
50														

Completion Depth: 40.0
Date Boring Started: 2/7/24
Date Boring Completed: 2/7/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 10.5 ft. after 24 hours. Auger refusal at 16.0 ft. *Elevation estimated using Google Earth data

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown, lean CLAY (CL), trace sand - trace fine roots from 1.0 to 2.5 ft.	67		7 5 7	2.25			27			
		SS-2		- brown and gray from 3.5 to 15.0 ft.	94		8 9 12	1.75			26	44	21	23
5		SS-3			100		7 14 22	1.50			27			
		SS-4		(94% passing No. 200 sieve)	100		7 11 13	2.00			22			
10		ST-5			96			2.75	1.06	105	21			
		SS-6		- trace gravel below 13.5 ft.	100		9 5 5	1.50			22			
15														
		ST-7		Brown, clayey SAND (SC) - trace gravel from 18.0 to 20.0 ft. (49% passing No. 200 sieve)	75			3.50	0.30	111	19			
20														
		SS-8		- with gravel below 23.5 ft.	44		18 18 26				6			
25														

Completion Depth: 250.0
Date Boring Started: 2/12/24
Date Boring Completed: 2/14/24
Engineer/Geologist: AB/JM
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Continued Next Page

LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, clayey SAND (SC), with gravel										
				(31% passing No. 200 sieve)										
		SS-9		- 2.0" shale seam at 29.0 ft.	100		30 50/3.0"				20			
30		RUN1		LIMESTONE, gray, hard, slightly weathered, finely crystalline	97	92								
		RUN2		SHALE, gray, moderately hard, moderately weathered, aphanitic, parted - calcareous from 30.8 to 31.0 ft. - soft from 31.0 to 40.0 ft. - calcareous from 32.5 to 32.8 ft.	100	23								
35				- highly weathered from 35.7 to 37.6 ft.										
		RUN3			100	48								
40				- fissile below 40.0 ft.										
		RUN4		- 0.6" limestone seam at 42.0 ft.	100	44								
45														
		RUN5			97	0								
50														

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Continued Next Page

LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		RUN6		SHALE, gray, moderately hard, moderately weathered, aphanitic, fissile	100	35								
55				- micaceous from 55.0 to 60.0 ft.										
		RUN7			100	77								
60				- highly weathered, fissile below 60.0 ft.										
		RUN8			100	0								
65														
		RUN9			100	0								
70				- micaceous below 70.0 ft.										
		RUN10		Core loss from 71.8 to 75.0 ft. (possible obstruction of drill bit causing shale washout)	35	0								
75														

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Continued Next Page

LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		RUN11		SHALE, gray, moderately hard, highly weathered, aphanitic, fissile, micaceous - 0.6" limestone seam at 76.7 ft. - trace gravel below 78.5 ft.	72	45								
80				Core loss from 78.6 to 81.0 ft. (possible washout due to highly weathered shale)										
		RUN12		SHALE, gray, moderately hard, highly weathered, aphanitic, parted - 1.8" limestone seam at 82.8 ft. - calcareous below 83.7 ft.	77	35								
85		RUN13		LIMESTONE, gray, hard, slightly weathered, finely crystalline - algal below 85.0 ft. - 0.5" vug at 86.8 ft. - 0.5" vug at 90.3 ft.	100	100								
90				SHALE, gray, soft, highly weathered, aphanitic, parted										
		RUN14		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded - algal from 91.8 to 95.6 ft. - 2.4" shale seam at 95.6 ft.	99	91								
95		RUN15		- fossiliferous below 97.9 ft.	97	75								
				Calcareous SHALE, dark gray, moderately hard										
100														

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Calcareous SHALE, dark gray										
		RUN16		Shaley LIMESTONE, dark gray, hard, slightly weathered, finely crystalline, thin bedded, fossiliferous	100	97								
				SHALE, dark gray, moderately hard, moderately weathered, aphanitic, parted										
105														
		RUN17		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded, fossiliferous	100	80								
				Shaley LIMESTONE, dark gray, moderately hard, moderately weathered										
110														
		RUN18		SHALE, dark gray, moderately hard, slightly weathered, aphanitic, parted	83	21								
				- micaceous below 112.0 ft.										
		RUN19			100	61								
115				- fissile below 115.0 ft.										
		RUN20			94	40								
				LIMESTONE, light gray, hard, slightly weathered, finely crystalline, thin bedded										
120														
		RUN21			100	95								
				SHALE, dark gray, soft, highly weathered, aphanitic, parted										
125				LIMESTONE, gray, hard										

Completion Depth: 250.0
Date Boring Started: 2/12/24
Date Boring Completed: 2/14/24
Engineer/Geologist: AB/JM
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		RUN22		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded	95	48								
130		RUN23		SHALE, gray, soft, highly weathered, aphanitic, parted, fissile, trace limestone fragments	95	0								
				- maroon from 133.5 to 133.9 ft.										
135		RUN24			100	0								
140				- calcareous below 141.4 ft.										
		RUN25		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded	100	55								
145		RUN26		Calcareous SHALE, dark gray, moderately hard, highly weathered, aphanitic, parted, trace limestone fragments - 1.0" limestone seam at 148.8 ft.	100	85								
150														

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Calcareous SHALE, dark gray - 1.0" limestone seam at 150.2 ft.										
				LIMESTONE, gray, hard, slightly weathered, finely crystalline										
		RUN27		SHALE, dark gray, moderately hard, slightly weathered, aphanitic, parted - micaceous from 151.3 to 155.4 ft.	100	85								
155				- 1.0" sandy clay seam - soft, highly weathered, fissile below 155.4 ft.										
		RUN28			100	0								
160				- gray below 159.3 ft.										
		RUN29		Core loss from 161.2 to 162.6 ft. (possible shale washout)	58	0								
		RUN30		SHALE, gray, soft, highly weathered, aphanitic, parted - fissile from 162.6 to 168.9 ft. - highly weathered from 163.3 to 168.9 ft. - moderately hard from 163.3 to 169.3 ft.	100	100								
165		RUN31			100	8								
170		RUN32		- dark gray below 168.9 ft. - moderately weathered, calcareous from 168.9 to 172.5 ft. - hard, very finely crystalline from 169.3 to 172.5 ft. - fossiliferous from 170.0 to 172.5 ft. - soft, highly weathered, fissile from 172.5 to 172.7 ft.	100	60								
175		RUN33		LIMESTONE, gray, hard, slightly weathered, fossiliferous	100	100								

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

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In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		RUN34		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded, fossiliferous - 6.0" calcareous shale seam at 177.0 ft. - 3.6" calcareous shale seam at 178.5 ft.	100	95								
180		RUN35		Calcareous SHALE, dark gray, moderately hard, slightly weathered, aphanitic, fossiliferous, parted - 5.0" fossiliferous limestone seam at 181.0 ft. - gray from 182.2 to 182.4 ft.	100	93								
185		RUN36		LIMESTONE, dark gray, hard, slightly weathered, thin bedded, finely crystalline, fossiliferous, interbedded shale - 2.0" calcareous shale seam at 189.8 ft.	100	100								
190				SHALE, dark gray, moderately hard, slightly weathered, aphanitic										
		RUN37		LIMESTONE, gray, hard, slightly weathered, finely crystalline SHALE, dark gray, moderately hard, slightly weathered, fissile	100	83								
195		RUN38		LIMESTONE, gray, hard, slightly weathered, finely crystalline, thin bedded - 4.8" calcareous shale seam at 195.7 ft. - tan, hard, moderately weathered from 197.2 to 197.6 ft. - gray and dark gray from 197.6 to 200.3 ft. - very hard from 197.6 to 209.3 ft.	98	83								
200														

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		RUN39		LIMESTONE, gray and dark gray, very hard, slightly weathered, finely crystalline, thin bedded - vuggy from 200.8 to 200.9 ft. - 1.0" vug with crystals at 202.0 ft. - dark gray, shaley, fossiliferous from 202.6 to 203.8 ft.	100	100								
205		RUN40		- 1.0" chert band at 207.9 ft.	100	100								
210		RUN41		- fossiliferous below 210.0 ft.	98	97								
215		RUN42		- shaley from 217.7 to 218.3 ft.	97	98								
220				- coarsely crystalline below 219.3 ft. - shaley below 221.0 ft.										
		RUN43		SHALE, dark gray, moderately hard, slightly weathered, aphanitic, parted	95	40								
225				- 1.0" limestone seam at 223.7 ft. - highly weathered below 223.8 ft.										

Completion Depth:	250.0
Date Boring Started:	2/12/24
Date Boring Completed:	2/14/24
Engineer/Geologist:	AB/JM
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

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In situations, the transition may be gradual.

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LOG OF BORING NO. B-07

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **858***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				SHALE, gray, moderately hard, moderately weathered, aphanitic, parted - calcareous below 225.4 ft.										
		RUN44		LIMESTONE, gray, hard, highly weathered, finely crystalline, thin bedded - fractures from 226.6 to 229.4 ft.	100	83								
230				- slightly weathered from 230.0 to 240.0 ft.										
		RUN45		- fractures from 231.7 to 232.4 ft. - 3.0" cavity at 231.9 ft.	100	83								
235				- mottled gray from 234.4 to 235.0 ft. - chert nodule at 235.2 ft.										
		RUN46		- fractures from 237.2 to 237.4 ft.	100	83								
240				- trace pyrite from 239.6 to 240.0 ft. - moderately weathered below 240.0 ft. - fractures from 240.5 to 241.2 ft.										
		RUN47		- stylolite from 243.1 to 243.2 ft. - dark gray, vuggy from 243.2 to 243.8 ft.	98	80								
245														
		RUN48		SHALE, dark gray, moderately hard, slightly weathered - calcareous from 245.8 to 246.1 ft. - moderately weathered, fissile below 246.1 ft.	100	70								
				LIMESTONE, gray, hard, slightly weathered Boring terminated at 250.0 ft.										
250														

Completion Depth: 250.0
Date Boring Started: 2/12/24
Date Boring Completed: 2/14/24
Engineer/Geologist: AB/JM
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 27.0 ft. during drilling. Auger refusal at 29.2 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-08

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **870***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, lean CLAY (CL), trace sand										
		SS-1		- trace fine roots from 1.0 to 2.5 ft.	72		5 7 8	2.50			26			
		SS-2		- brown and gray from 3.5 to 20.0 ft.	89		4 7 7	1.50			28			
5		SS-3		(98% passing No. 200 sieve)	100		4 3 3	0.75			30			
		ST-4			79			0.75	0.55	100	23			
10		SS-5			100		4 3 4	0.50			25	33	15	18
		SS-6		- trace gravel from 13.5 to 15.0 ft. - with sand from 13.5 to 20.0 ft.	100		3 3 3	1.50			24			
15														
		ST-7			96			2.00	0.56	102	25			
20														
		SS-8		- sandy below 23.5 ft. (64% passing No. 200 sieve)	100		3 4 6	1.25			19			
25														

Completion Depth: 60.0
Date Boring Started: 2/8/24
Date Boring Completed: 2/8/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 26.8 ft. after 24 hours. Sampler refusal at 39.4 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries. In situations, the transition may be gradual.

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LOG OF BORING NO. B-08

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **870***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				Brown, sandy lean CLAY (CL)										
				Brown, fine grained SAND (SP), trace gravel										
30		SS-9			67		4 7 8				15			
				Brown, clayey fine to medium SAND (SC)										
35		SS-10		(28% passing No. 200 sieve)	83		3 5 6				22			
				SHALE, gray, soft, highly weathered, aphanitic										
		SS-11			100		36 50/4.0"				11			
40		RUN1		- dark gray below 39.4 ft. - fissile below 40.0 ft.	100	0								
		RUN2		LIMESTONE, gray, hard, weathered, very finely crystalline, parted - 1.0" shale seam at 41.8 ft. - 3.0" calcareous shale seam at 42.3 ft.	100	47								
45				SHALE, gray, soft, highly weathered, aphanitic - embedded limestone fragments from 46.0 to 50.0 ft.										
		RUN3			100	15								
50				- dark gray below 50.0 ft.										

Completion Depth:	60.0
Date Boring Started:	2/8/24
Date Boring Completed:	2/8/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 26.8 ft. after 24 hours. Sampler refusal at 39.4 ft. *Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries. In situations, the transition may be gradual.

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LOG OF BORING NO. B-08

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
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(816) 599-7965 (816) 599-7967 FAX

Surface El.: **870***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
				SHALE, dark gray, soft, highly weathered, aphanitic										
		RUN4		- 1.0" limestone seam at 52.0 ft.	100	15								
55				- 1.0" limestone seam at 53.9 ft. - fissile below 54.2 ft.										
		RUN5		- embedded limestone fragments from 56.0 to 57.0 ft.	100	0								
60				Boring terminated at 60.0 ft.										
65														
70														
75														

Completion Depth: 60.0
Date Boring Started: 2/8/24
Date Boring Completed: 2/8/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using HSA and auto SPT. Groundwater encountered at 26.8 ft. after 24 hours. Sampler refusal at 39.4 ft. *Elevation estimated using Google Earth data

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

LOG OF BORING NO. B-09

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **880***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown and gray, lean CLAY (CL), with sand - shaley, with gravel from 1.0 to 2.5 ft.	56		8 14 39	3.00			28			
		SS-2		- brown, trace sand below 3.5 ft.	83		7 6 8	3.25			23			
5		ST-3			100			3.75	0.69	101	22	40	19	21
		SS-4			100		4 5 6	3.00			21			
10		SS-5		- trace gravel from 11.0 to 12.5 ft. (92% passing No. 200 sieve)	100		14 32 37	2.75			20			
		SS-6			100		7 13 16	1.00			23			
15				▼										
		SS-7		- trace gravel below 18.5 ft.	100		2 5 3	0.75			27			
20				Boring terminated at 20.0 ft.										
25														

Completion Depth:	20.0
Date Boring Started:	1/31/24
Date Boring Completed:	1/31/24
Engineer/Geologist:	AB
Project No.:	20242002.00

Remarks: Boring drilled with CME-550 using FA and auto SPT.
Groundwater encountered at 17.6 ft. after 24 hours.
*Elevation estimated using Google Earth data

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

LOG OF BORING NO. B-10

Project Description: **Todd Creek WWTP - Phase II**
Kansas City, Missouri

TSi Geotechnical Inc.
8248 NW 101st Terrace, #5
Kansas City, Missouri 64153
(816) 599-7965 (816) 599-7967 FAX

Surface El.: **884***

Location: **See Site and Boring Location Plan.**

Depth, feet	Samples	Sample #	Graphic Log	MATERIAL DESCRIPTION	Recovery %	RQD	Penetration Blows Per 6 inches	Hand Penetrometer, Qu TSF	Undrained Shear Strength, TSF	Unit Dry Weight, lb/cu ft.	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SS-1		Brown and gray, shaley lean CLAY (CL), trace shale fragments	56		10 19 26	4.00			19	39	20	19
		SS-2		- trace shaley limestone fragments below 3.5 ft.	17		13 13	>4.5			16			
5		SS-3					12 50/0.0"							
				Boring terminated at 5.1 ft.										
10														
15														
20														
25														

Completion Depth: 5.1
Date Boring Started: 1/31/24
Date Boring Completed: 1/31/24
Engineer/Geologist: AB
Project No.: 20242002.00

Remarks: Boring drilled with CME-550 using FA and auto SPT. Groundwater not encountered during drilling or after 24 hours. Auger refusal at 5.1 ft. *Elevation estimated using Google Earth data

KC LOG WITH LAB TODD CREEK PHASE II.GPJ 4/3/24

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

GENERAL NOTES

The number of borings is based on: topographic and geologic factors; the magnitude of structure loading; the size, shape, and value of the structure; consequences of failure; and other factors. The type and sequence of sampling are selected to reduce the possibility of undiscovered anomalies and maintain drilling efficiency. Attempts are made to detect and/or identify occurrences during drilling and sampling such as the presence of water, boulders, gas, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation in resistance to driving split-spoon samplers, unusual odors, etc. However, lack of notation regarding these occurrences does not preclude their presence.

Although attempts are made to obtain stabilized groundwater levels, the levels shown on the Logs of Boring may not have stabilized, particularly in more impermeable cohesive soils. Consequently, the indicated groundwater levels may not represent present or future levels. Groundwater levels may vary significantly over time due to the effects of precipitation, infiltration, or other factors not evident at the time indicated.

Unless otherwise noted, soil classifications indicated on the Logs of Boring are based on visual observations and are not the result of classification tests. Although visual classifications are performed by experienced technicians or engineers, classifications so made may not be conclusive.

Generally, variations in texture less than one foot in thickness are described as layers within a stratum, while thicker zones are logged as individual strata. However, minor anomalies and changes of questionable lateral extent may appear only in the verbal description. The lines indicating changes in strata on the Logs of Borings are approximate boundaries only, as the actual material change may be between samples or may be a gradual transition.

Samples chosen for laboratory testing are selected in such a manner as to measure selected physical characteristics of each material encountered. However, as samples are recovered only intermittently and not all samples undergo a complete series of tests, the results of such tests may not conclusively represent the characteristics of all subsurface materials present.

NOTATION USED ON BORING LOGS

APPROXIMATE PROPORTIONS

TRACE	<15%
WITH	15-30%
MODIFIER	>30%

Clay or clayey may be used as major material or modifier, regardless of relative proportions, if the clay content is sufficient to dominate the soil properties.

PARTICLE SIZE

BOULDERS		>12 Inches
COBBLES		12 Inches – 3 Inches
GRAVEL		
	Coarse	3 Inches – ¾ Inch
	Fine	¾ Inch – No. 4 Sieve (4.750 mm)
SAND		
	Coarse	No. 4 – No. 10 Sieve (2.000 mm)
	Medium	No. 10 – No. 40 Sieve (0.420 mm)
	Fine	No. 40 – No. 200 Sieve (0.074 mm)
SILT		No. 200 Sieve - 0.002 mm
CLAY		< 0.002 mm

PENETRATION – BLOWS

Number of impacts of a 140-pound hammer falling a distance of 30 inches to cause a standard split-barrel sampler, 1 3/8 inches I.D., to penetrate a distance of 6 inches. The number of impacts for the first 6 inches of penetration is known as the seating drive. The sum of the impacts for the last 12 inches of penetration is the Standard Penetration Test Resistance or "N" value, blows per foot. For example, if blows = 6-8-9, "N" = 8+9 or 17.

OTHER NOTATIONS

Recovery % – length of recovered soil divided by length of sample attempted.

50/2"	Impacts of hammer to cause sampler to penetrate the indicated number of inches
WR	Sampler penetrated under the static loading of the weight of the drill rods
WH	Sampler penetrated under the static loading the weight of the hammer and drill rods
HSA	Hollow stem auger drilling method
FA	Flight auger drilling method
RW	Rotary wash drilling methods with drilling mud
AH	Automatic hammer used for Standard Penetration Test sample
SH	Safety hammer with rope and cathead used for Standard Penetration Test sample

GRAPHIC SYMBOLS


Depth at which groundwater was encountered during drilling


Depth at which groundwater was measured after drilling


Standard Penetration Test Sample, ASTM D1586


3-inch diameter Shelby Tube Sample, ASTM D1587

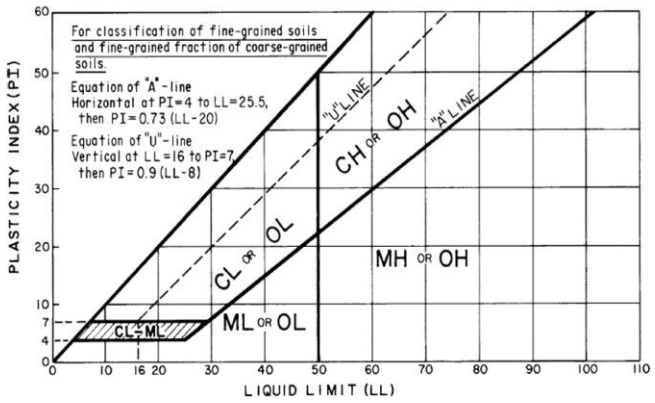
Sample grabbed from auger


NX Size rock core sample

TSi geotechnical

UNIFIED SOIL CLASSIFICATION SYSTEM, (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*	
Coarse-grained soils (More than half of materials is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-Grained soils are classified as follows: Less than 5 per cent GW, GP, SW, SP; More than 12 per cent GM, GC, SM, SC; 5 to 12 per cent Borderline cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.1. less than 4	Above "A" line with P.1. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			
			GC		Clayey gravels, gravel-sand-clay mixtures	Atterberg limits below "A" line with P.1. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-mix mixtures	Atterberg limits about "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u			
			SC		Clayey sands, sand-clay mixtures	Atterberg limits about "A" line with P.I. greater than 7	
Fine-grained soils (More than half of materials is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL		Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH		Inorganic clays of medium to high plasticity, organic silts		
			OH		Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt		Peat and other highly organic soils		



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 26 or less and the P.1. is 6 or less; the suffix u used when L.L. is greater than 28.

[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

ROCK CORE DESCRIPTIONS AND CRITERIA

Hardness

Very Soft	- Easily indented with the thumb
Soft	- Able to be scratched with a fingernail
Moderately Hard	- Easily scratched with a knife; cannot be scratched with the fingernail
Hard	- Difficult to scratch with a knife
Very Hard	- Cannot be scratched with a knife

Crystallinity (Soluble Rock Only)

Aphanitic	- Crystals cannot be distinguished with the naked eye
Very Finely Crystalline	- Crystals are barely discernable with the naked eye
Finely Crystalline	- Crystals are easily discernable with the naked eye
Medium Crystalline	- Crystals are medium size; up to 1/8" in diameter
Coarsely Crystalline	- Crystals are 1/8" to 1/4" in diameter
Very Coarsely Crystalline	- Crystals are larger than 1/4" in diameter

Grain Size

Very Fine Grained	- Less than or equal to 0.0029" (#200 Sieve)
Fine Grained	- 0.0029" to 0.0165" (#200 to #40 Sieve)
Medium Grained	- 0.0165" to 0.07087" (#40 to #10 Sieve)
Coarse Grained	- Greater than 0.0787" (#10 Sieve)

Mass Bedding

Parting	- Less than 0.02 foot
Band	- 0.02 to 0.2 foot
Thin Bed	- 0.2 to 0.5 foot
Medium Bed	- 0.5 to 1.0 foot
Thick Bed	- 1.0 to 2.0 feet
Massive	- Greater than 2.0 feet

Weathering

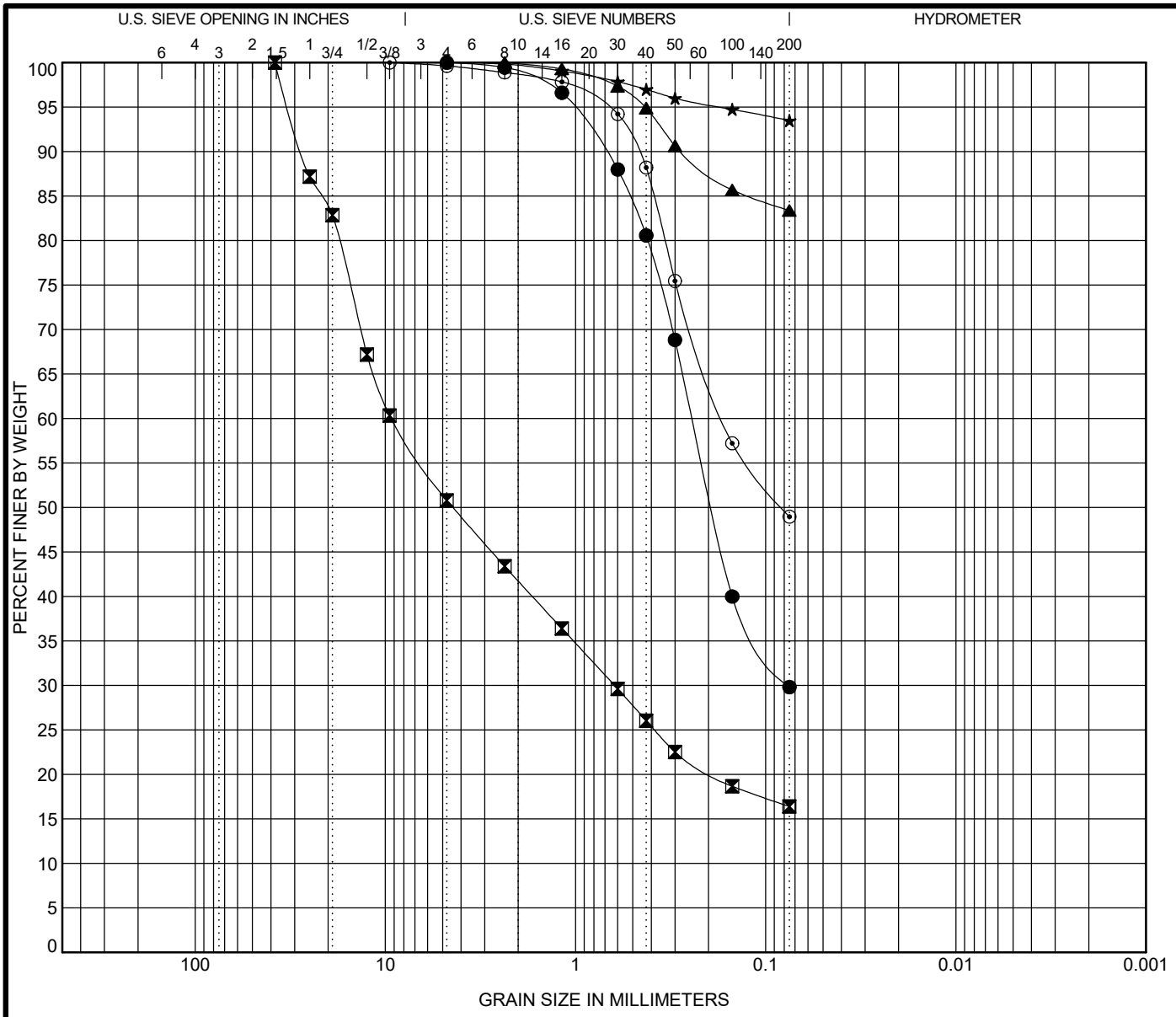
Fresh	- No visible signs of decomposition or discoloration
Slightly Weathered	- Slight discoloration inward from open fractures
Moderately Weathered	- Discoloration throughout, slight loss of strength, texture intact
Highly Weathered	- Specimen can be broken by hand, texture indistinct, fabric intact
Completely Weathered	- Specimen easily crumbled, minerals decomposed to soil

Voids

Dense	- Usually not discernable with the naked eye
Pitted	- Discernable to ¼"
Vuggy	- ¼" to diameter of the core
Cavity	- Larger than 6" in diameter

APPENDIX C

Laboratory Test Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

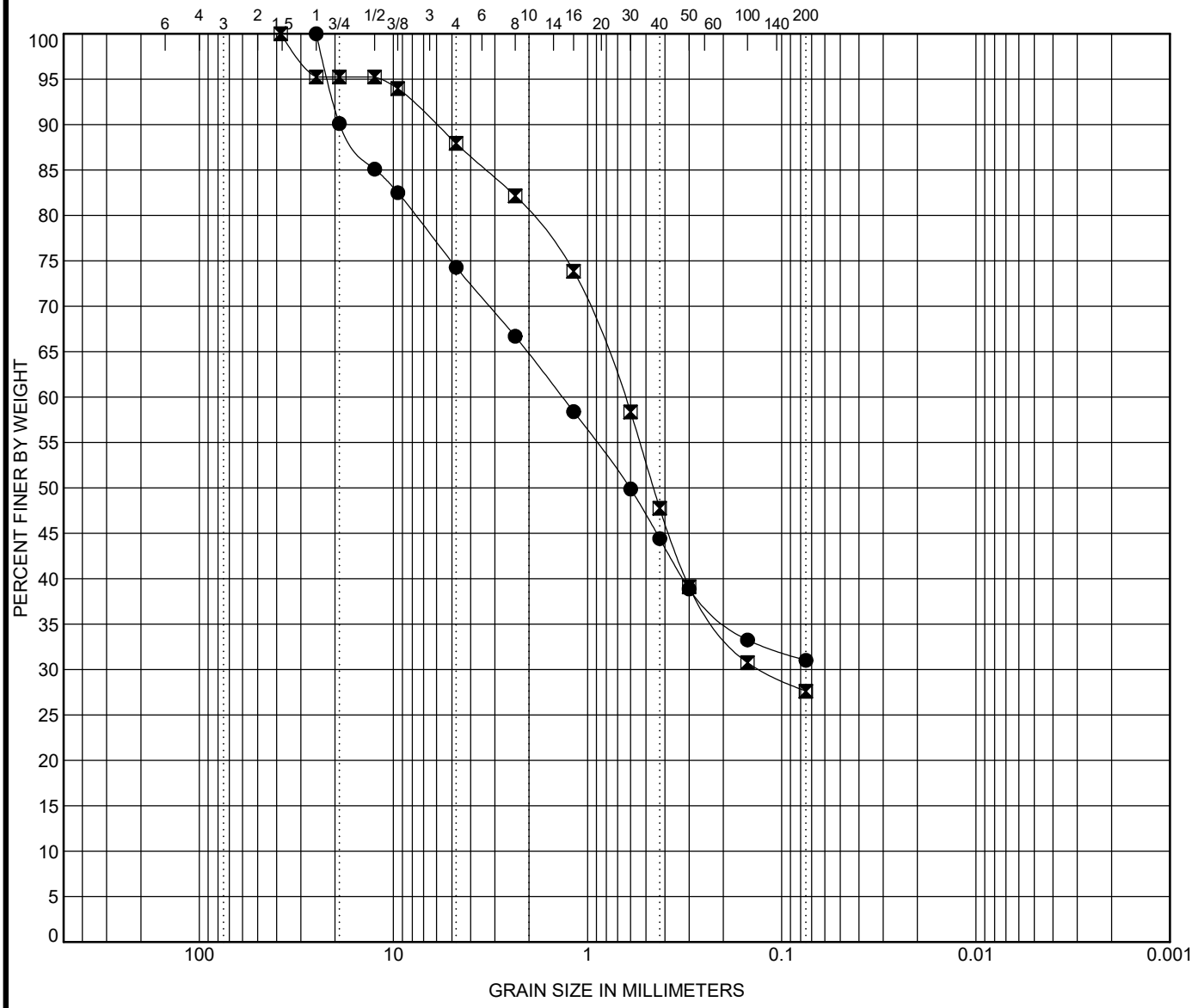
	Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	B-01	SS-8	23.5	Clayey Sand (SC)					
⊠	B-02	SS-7	18.5	Clayey Gravel with Sand (GC)					
▲	B-04	SS-4	8.5	Lean Clay with Sand (CL)					
★	B-06	SS-3	6.0	Lean Clay (CL)					
⊙	B-07	ST-7	18.0	Clayey Sand (SC)					

	Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	SS-8	23.5	4.75	0.243	0.076		0.0	70.2	29.81	
⊠	B-02	SS-7	18.5	38.1	9.277	0.624		49.2	34.4	16.39	
▲	B-04	SS-4	8.5	2.36				0.0	16.6	83.38	
★	B-06	SS-3	6.0	4.75				0.0	6.5	93.48	
⊙	B-07	ST-7	18.0	9.5	0.167			0.4	50.7	48.97	

TSI geotechnical, inc.
1340 NORTH PRICE ROAD
ST. LOUIS, MISSOURI 63132

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Todd Creek WWTP - Phase II	Tested By: MN
PROJECT LOCATION: Kansas City, Missouri	Calculated By: MN
PROJECT NUMBER: 20242002.00	Checked By: TBS & FH



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	B-07	SS-9	28.5	**Clayey Sand with Gravel (SC)**					
⊠	B-08	SS-10	33.5	**Clayey Sand (SC)**					

	Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-07	SS-9	28.5	**25**	**1.349**			**25.7**	**43.3**	**31.01**	
⊠	B-08	SS-10	33.5	**38.1**	**0.645**	**0.127**		**12.1**	**60.3**	**27.62**	

TSI GRAIN SIZE TODD CREEK PHASE II.GPJ US_LAB.GDT 3/26/24

TSI geotechnical, inc.
1340 NORTH PRICE ROAD
ST. LOUIS, MISSOURI 63132

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Todd Creek WWTP - Phase II	Tested By: MN
PROJECT LOCATION: Kansas City, Missouri	Calculated By: MN
PROJECT NUMBER: 20242002.00	Checked By: TBS & FH

Pace Analytical Services, LLC
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

March 13, 2024

Anderson Borges
TSi Geotechnical, Inc.
8248 NW 101st Terr. #5
Kansas City, MO 64153

RE: Project: TODD CREEK WWTP
Pace Project No.: 60448084

Dear Anderson Borges:

Enclosed are the analytical results for sample(s) received by the laboratory on February 29, 2024. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Kansas City

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Alice Spiller

Alice Spiller
alice.spiller@pacelabs.com
(913)599-5665
PM Lab Management

Enclosures

cc: Brooke Sidebottom, TSI Geotech

Pace Analytical Services, LLC
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CERTIFICATIONS

Project: TODD CREEK WWTP
Pace Project No.: 60448084

Pace Analytical Services Kansas

9608 Loiret Boulevard, Lenexa, KS 66219
Arkansas Inorganic Drinking Water Certification
Arkansas Certification #: 88-00679
Illinois Certification #: 2000302023-6
Colorado Division of Oil and Public Safety
Iowa Certification #: 118
Kansas Field Laboratory Certification #: E-92587
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Missouri Inorganic Drinking Water Certification
Nevada Certification #: KS000212024-1
Oklahoma Certification #: 2023-073
Texas Certification #: T104704407-23-17
Utah Certification #: KS000212022-13

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SAMPLE SUMMARY

Project: TODD CREEK WWTP
Pace Project No.: 60448084

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	Solid	02/12/24 08:00	02/29/24 15:25

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SAMPLE ANALYTE COUNT

Project: TODD CREEK WWTP
Pace Project No.: 60448084

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	ASTM D2974	DWC	1	PASI-K
		EPA 9045	KVI	1	PASI-K
		SM 2580B	SR1	1	PASI-K
		EPA 120.1 Resistivity	KVI	1	PASI-K
		EPA 9056	RKA	2	PASI-K

PASI-K = Pace Analytical Services - Kansas City

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Lenexa, KS 66219
(913)599-5665

ANALYTICAL RESULTS

Project: TODD CREEK WWTP
Pace Project No.: 60448084

Sample: B-7, SS-2, 3.5-5.0 FT. **Lab ID: 60448084001** Collected: 02/12/24 08:00 Received: 02/29/24 15:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974 Pace Analytical Services - Kansas City							
Percent Moisture	**21.4**	%	0.50	1		03/01/24 11:16		
9045 pH Soil	Analytical Method: EPA 9045 Pace Analytical Services - Kansas City							
pH at 25 Degrees C	**6.6**	Std. Units	0.10	1		03/01/24 13:57		
Oxidation/Reduction Potential	Analytical Method: SM 2580B Pace Analytical Services - Kansas City							
Oxidation/Reduction Potential	**244.2**	mV	1.0	1		03/12/24 13:30		H3
Resistivity	Analytical Method: EPA 120.1 Resistivity Pace Analytical Services - Kansas City							
Resistivity	**16900**	ohms-cm	100	1		03/08/24 14:15		
9056 IC Anions	Analytical Method: EPA 9056 Preparation Method: EPA 9056 Pace Analytical Services - Kansas City							
Chloride	ND	mg/kg	121	10	03/05/24 07:55	03/05/24 13:19	16887-00-6	
Sulfate	ND	mg/kg	121	10	03/05/24 07:55	03/05/24 13:19	14808-79-8	

REPORT OF LABORATORY ANALYSIS

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Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: TODD CREEK WWTP
Pace Project No.: 60448084

QC Batch: 885101
QC Batch Method: ASTM D2974
Analysis Method: ASTM D2974
Analysis Description: Dry Weight/Percent Moisture
Laboratory: Pace Analytical Services - Kansas City
Associated Lab Samples: 60448084001

METHOD BLANK: 3503556 Matrix: Solid
Associated Lab Samples: 60448084001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Percent Moisture	%	ND	0.50	03/01/24 11:16	

SAMPLE DUPLICATE: 3503557

Parameter	Units	60448093001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	22.0	22.1	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: TODD CREEK WWTP
Pace Project No.: 60448084

QC Batch: 885137
QC Batch Method: EPA 9045
Analysis Method: EPA 9045
Analysis Description: 9045 pH
Laboratory: Pace Analytical Services - Kansas City

Associated Lab Samples: 60448084001

SAMPLE DUPLICATE: 3503726

Parameter	Units	60447975001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH at 25 Degrees C	Std. Units	8.2	7.8	5	3	D6

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: TODD CREEK WWTP
Pace Project No.: 60448084

QC Batch: 886204
QC Batch Method: SM 2580B
Analysis Method: SM 2580B
Analysis Description: Oxidation/Reduction Potential
Laboratory: Pace Analytical Services - Kansas City

Associated Lab Samples: 60448084001

SAMPLE DUPLICATE: 3508142

Parameter	Units	60448125019 Result	Dup Result	RPD	Max RPD	Qualifiers
Oxidation/Reduction Potential	mV	230.5	227.0			H3,H6

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: TODD CREEK WWTP
Pace Project No.: 60448084

QC Batch: 885349
QC Batch Method: EPA 9056
Analysis Method: EPA 9056
Analysis Description: 9056 IC Anions
Laboratory: Pace Analytical Services - Kansas City

Associated Lab Samples: 60448084001

METHOD BLANK: 3504629 Matrix: Solid
Associated Lab Samples: 60448084001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chloride	mg/kg	ND	99.8	03/05/24 08:07	
Sulfate	mg/kg	ND	99.8	03/05/24 08:07	

LABORATORY CONTROL SAMPLE: 3504630

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/kg	502	516	103	80-120	
Sulfate	mg/kg	502	540	108	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 3504631 3504632

Parameter	Units	60447975001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/kg	ND	590	568	726	602	110	93	80-120	19	15	R1
Sulfate	mg/kg	ND	590	568	823	601	123	89	80-120	31	15	M1,R1

SAMPLE DUPLICATE: 3504633

Parameter	Units	60447975002 Result	Dup Result	RPD	Max RPD	Qualifiers
Chloride	mg/kg	153	161	5	15	
Sulfate	mg/kg	ND	ND		15	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: TODD CREEK WWTP
Pace Project No.: 60448084

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

D6	The precision between the sample and sample duplicate exceeded laboratory control limits.
H3	Sample was received or analysis requested beyond the recognized method holding time.
H6	Analysis initiated outside of the 15 minute EPA required holding time.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
R1	RPD value was outside control limits.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: TODD CREEK WWTP
Pace Project No.: 60448084

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	ASTM D2974	885101		
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	EPA 9045	885137		
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	SM 2580B	886204		
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	EPA 120.1 Resistivity	885903		
60448084001	**B-7, SS-2, 3.5-5.0 FT.**	EPA 9056	885349	EPA 9056	885543

WO# : 60448084

60448084

Pace ANALYTICAL SERVICES	DC#_Title: ENV-FRM-LENE-0009_Sample Co	
	Revision: 2	Effective Date: 01/12/2022

Client Name: TSi Geotechnical

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☐ Client ☑ Other ☐

Tracking #: _____ Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☐ No ☑ Seals intact: Yes ☐ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☑ Other ☐

Thermometer Used: T-298 **Type of Ice:** (Wet) Blue None

Cooler Temperature (°C): **As-read** 0.5 **Corr. Factor** −0.3 **Corrected** 0.2

Date and initials of person examining contents: 2/29/24

Temperature should be above freezing to 6°C

Chain of Custody present:	☑Yes ☐No ☐N/A	
Chain of Custody relinquished:	☑Yes ☐No ☐N/A	
Samples arrived within holding time:	☑Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☐No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☐No ☐N/A	
Sufficient volume:	☑Yes ☐No ☐N/A	
Correct containers used:	☑Yes ☐No ☐N/A	
Pace containers used:	☑Yes ☐No ☐N/A	
Containers intact:	☑Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☑N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☑N/A	
Sample labels match COC: Date / time / ID / analyses	☑Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: SL	☐Yes ☐No ☐N/A	
Containers requiring pH preservation in compliance? (HNO3, H2SO4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO) **LOT#:**	☐Yes ☐No ☑N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only)	☐Yes ☐No	
Potassium iodide test strip turns blue/purple? (Preserve)	☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☑N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☑N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☑N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☑N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: _____ Date: _____

Qualtrax Document ID: 30468

Page 1 of 1

Pace® Location Requested (City/State):

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevant fields

LAB USE ONLY- Affix Workorder/Login Label Here

Scan QR Code for instructions

Company Name: TSi Geotechnical
Street Address: 8248 MW 101st Terrace, #5
Kansas City, MO 64153
Customer Project #: 20242002
Project Name: Todd Creek WWTP
Site Collection Info/Facility ID (as applicable):

Contact/Report To: Anderson Borges
Phone #: 816-519-5423
E-Mail: alborges@tsigeotech.com
Cc E-Mail: Bsidebottom@tsigeotech.com
Invoice to: Rhonda Rankins
Invoice E-mail: RRankins@tsigeotech.com
Purchase Order # (if applicable):
Quote #:

Time Zone Collected: [ ] AK [ ] PT [ ] MT [X] CT [ ] ET

County / State origin of sample(s):

Data Deliverables: [ ] Level II [ ] Level III [ ] Level IV [ ] EQUIS [ ] Other ____

Regulatory Program (DW, RCRA, etc.) as applicable: Reportable [ ] Yes [ ] No

Rush (Pre-approval required): [ ] Same Day [ ] 1 Day [ ] 2 Day [ ] 3 Day Other ____

Date Results Requested:

DW PWSID # or WW Permit # as applicable:

Field Filtered (if applicable): [ ] Yes [ ] No

Analysis:

* Matrix Codes (insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SS), Oil (OL), Wipe (WP), Tissue (TS), Bioassay (B), Vapor (V), Surface Water (SW), Sediment (SED), Sludge (SL), Caulk (CK), Leachate (LL), Biosolid (BS), Other (OT)

Specify Container Size **

Identify Container Preservative Type***

Analysis Requested

** Container Size: (1) 1L, (2) 500mL, (3) 250mL, (4) 125mL, (5) 100mL, (6) 40mL vial, (7) EnCore, (8) TerraCore, (9) 90mL, (10) Other

*** Preservative Types: (1) None, (2) HNO3, (3) H2SO4, (4) HCl, (5) NaOH, (6) Zn Acetate, (7) NaHSO4, (8) Sod. Thiosulfate, (9) Ascorbic Acid, (10) MeOH, (11) Other

Lab Use Only: Proj. Mgr: | AcctNum / Client ID: | Table #: | Profile / Template: 2140-1 | Prelog / Bottle Ord. ID:

Customer Sample ID	Matrix *	Comp / Grab	Composite Start Date	Composite Start Time	Collected or Composite End Date	Collected or Composite End Time	# Cont.	Residual Chlorine Result	Residual Chlorine Units	Moisture Content	PH	Resistivity	Redox	Soluable Sulfates	Chloride Ion					Sample Comment	Preservation non-conformance identified for sample.
B-7, SS-2, 3.5 - 5.0 ft.	SL	G	2/12/24	8:00AM	2/12/24	8:00AM				X	X	X	X	X	X					60448084	

Additional Instructions from Pace®:

Collected By: Printed Name: ANDERSON BORGES Signature: [signature]

Customer Remarks / Special Conditions / Possible Hazards:

Coolers: Thermometer ID: Correction Factor (°C): Obs. Temp. (°C): Corrected Temp. (°C): 0.2 [ ] On Ice

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	
[signature]	2/29 1525	[signature]	2/29 1525	Tracking Number:
				Delivered by: [ ] In-Person [ ] Courier [ ] FedEX [ ] UPS [ ] Other
				Page: of

Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace® Terms and Conditions found at https://www.pacelabs.com/resource-library/resource/pace-terms-and-conditions/

ENV-FRM-CORQ-0019_v02_110123 ©

Client: Tsi Geotechnical

Profile # 2140-1

Site: Todd Creek WWTP

Notes

COC Line Item	Matrix	VG9H	DG9H	DG9Q	VG9U	DG9U	DG9M	DG9B	BG1U	AG1H	AG1U	AG2U	AG3S	AG4U	AG5U	JGFU	WGKU	WGDU	BP1U	BP2U	BP3U	BP1N	BP3N	BP3F	BP3S	BP3C	BP3Z	WPDU	ZPLC	Other		
1	SL																													1		
2																																
3																																
4																																
5																																
6																																
7																																
8																																
9																																
10																																
11																																
12																																

Container Codes

Glass				Plastic		Misc.	
DG9B	40mL bisulfate clear vial	WGKU	8oz clear soil jar	BP1C	1L NAOH plastic	I	Wipe/Swab
DG9H	40mL HCl amber voa vial	WGFU	4oz clear soil jar	BP1N	1L HNO3 plastic	SP5T	120mL Coliform Na Thiosulfate
DG9M	40mL MeOH clear vial	WG2U	2oz clear soil jar	BP1S	1L H2SO4 plastic	ZPLC	Ziploc Bag
DG9Q	40mL TSP amber vial	JGFU	4oz unpreserved amber wide	BP1U	1L unpreserved plastic	AF	Air Filter
DG9S	40mL H2SO4 amber vial	AG0U	100mL unores amber glass	BP1Z	1L NaOH, Zn Acetate	C	Air Cassettes
DG9T	40mL Na Thio amber vial	AG1H	1L HCl amber glass	BP2C	500mL NAOH plastic	R	Terracore Kit
DG9U	40mL amber unpreserved	AG1S	1L H2SO4 amber glass	BP2N	500mL HNO3 plastic	U	Summa Can
VG9H	40mL HCl clear vial	AG1T	1L Na Thiosulfate clear/amber glass	BP2S	500mL H2SO4 plastic		
VG9T	40mL Na Thio. clear vial	AG1U	1liter unpres amber glass	BP2U	500mL unpreserved plastic		
VG9U	40mL unpreserved clear vial	AG2N	500mL HNO3 amber glass	BP2Z	500mL NaOH, Zn Acetate		
BG1S	1liter H2SO4 clear glass	AG2S	500mL H2SO4 amber glass	BP3C	250mL NaOH plastic		
BG1U	1liter unpres glass	AG3S	250mL H2SO4 amber glass	BP3F	250mL HNO3 plastic - field filtered		
BG3H	250mL HCL Clear glass	AG2U	500mL unpres amber glass	BP3N	250mL HNO3 plastic		
BG3U	250mL Unpres Clear glass	AG3U	250mL unpres amber glass	BP3U	250mL unpreserved plastic		
WGDU	16oz clear soil jar	AG4U	125mL unpres amber glass	BP3S	250mL H2SO4 plastic		
		AG5U	100mL unpres amber glass	BP3Z	250mL NaOH, Zn Acetate		
				BP4U	125mL unpreserved plastic		
				BP4N	125mL HNO3 plastic		
				BP4S	125mL H2SO4 plastic		
				WPDU	16oz unpresserved plstic		

Matrix	
WT	Water
SL	Solid
NAL	Non-aqueous Liquid
OL	OIL
WP	Wipe
DW	Drinking Water

Work Order Number: 60448084

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

March 13, 2024

Alice Spiller
Pace Analytical - Lenexa
9608 Loiret Blvd
Lenexa, KS 66219

RE: Pace Lenexa 60448084

Dear Alice Spiller:

Please find enclosed the analytical results for the **1** sample(s) the laboratory received on **3/5/24 9:30 am** and logged in under work order **HC00539**. All testing is performed according to our current TNI accreditations unless otherwise noted . This report cannot be reproduced, except in full, without the written permission of Pace Analytical Services, LLC.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

Pace Analytical Services appreciates the opportunity to provide you with analytical expertise . We are always trying to improve our customer service and we welcome you to contact the General Manager, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lisa.grant@pacelabs.com.

Amy Holmes
Project Manager
(314) 595-7336
amy.holmes@pacelabs.com

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

SAMPLE RECEIPT CHECK LIST

Items not applicable will be marked as in compliance

Work Order HC00539

YES	Samples received within temperature compliance when applicable
YES	COC present upon sample receipt
NO	COC completed & legible
YES	Sampler name & signature present
YES	Unique sample IDs assigned
YES	Sample collection location recorded
YES	Date & time collected recorded on COC
NO	Relinquished by client signature on COC
YES	COC & labels match
YES	Sample labels are legible
YES	Appropriate bottle(s) received
YES	Sufficient sample volume received
YES	Sample containers received undamaged
NO	Zero headspace, <6 mm present in VOA vials
NO	Trip blank(s) received
NO	All non-field analyses received within holding times
NO	Short hold time analysis
NO	Current PDC COC submitted
NO	Case narrative provided

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

ANALYTICAL RESULTS

Sample: HC00539-01
Name: B-7, SS-2, 3.5-5.0 FT
Alias: 60448084001

Sampled: 02/12/24 08:00
Received: 03/05/24 09:30
Matrix: Solid - Regular Sample

Parameter	Result	Unit	Qualifier	Dilution	MDL	MRL	Analyzed	Analyst	Method
General Chemistry - STL									
Sulfide	< 99.7	mg/kg	Ht	9.972078	64.3	99.7	03/13/24 15:20	MAS	EPA 9034

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B427853 - 04-No Prep WC Solid - EPA 9034									
Blank (B427853-BLK1)				Prepared & Analyzed: 03/13/24					
Sulfide	< 97.9	mg/kg							
LCS (B427853-BS1)				Prepared & Analyzed: 03/13/24					
Sulfide	189	mg/kg		267.4		71	60-115		
LCS Dup (B427853-BSD1)				Prepared & Analyzed: 03/13/24					
Sulfide	189	mg/kg		267.9		71	60-115	0.2	20

Pace Analytical Services, LLC
2231 W. Altorfer Drive
Peoria, IL 61615
(800)752-6651

NOTES

Specifications regarding method revisions, method modifications, and calculations used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

Qualifiers

Ht Sample received outside of holding time.

Amy F. Holmes

Certified by: Amy Holmes, Project Manager

Internal Transfer Chain of Custody

Pace

☐ Rush Multiplier_____X
☐ Samples Pre-Logged into eCOC

State Of Origin: MO
Cert. Needed: ☐ Yes ☒ No
Owner Received Date: 2/29/2024 Results Requested By: 3/15/2024

Workorder: 60448084 **Workorder Name:** TODD CREEK WWTP

Report To	Subcontract To
Alice Spiller Pace Analytical Kansas 9608 Loiret Blvd. Lenexa, KS 66219 Phone (913)599-5665	Pace Analytical Hazelwood 944 Anglum Rd. Hazelwood, MO 63042 Phone (800)333-3278

HC00539

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers: Unpreserved	Requested Analysis: Suflide	LAB USE ONLY
1	B-7, SS-2, 3.5-5.0 FT.	PS	2/12/2024 08:00	60448084001	Solid	1	X	MO2 U
2								
3								
4								
5								

Transfers	Released By	Date/Time	Received By	Date/Time
1				3/5/24 935
2				
3				

Comments

KS sample location: RECEIVING

Sample Spit needed

Cooler Temperature on Receipt 5.7 °C | **Custody Seal** Y or (N) | **Received on Ice** (Y) or N | **Samples Intact** (Y) or N

****In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document.*
This chain of custody is considered complete as is since this information is available in the owner laboratory.

IR Gun # P7 Correction Factor (Deg C) -1.2
Observed Temp (Deg C) 6.9 Corrected Temp (Deg C) 5.7
Delivery Method: FedEx UPS Walk-in USPS (Other)

INTER_LABORATORY WORK ORDER # 60448084
(To be completed by sending lab)

Ship To:
Pace Analytical Hazelwood
944 Anglum Rd.
Hazelwood, MO 63042
Phone (800)333-3278

Sending Project No:	60448084
Receiving Project No:	
Check Box for Consolidated Invoice:	☐
Date Prepared:	03/01/24
REQUESTED COMPLETION DATE:	**3/15/2024**

Sending Region	IR60-Kansas	Sending Project Mgr.	Alice Spiller
Receiving Region	S874	External Client	TSI Geotechnical
State of Sample Origin	MO	QC Deliverable	STD REPORT

All questions should be addressed to sending project manager.

Requested Reportable Units _____ Report Wet or Dry Weight? Dry Weight ☐ IRWO Lab Need to run? Cert. Needed NO

WORK REQUESTED

Method Description	Container Type	Quantity of containers	Preservative	Quantity of Samples	Acode	Acode Desc
Suflide	JGFU	1	Unpreserved	1	SI-21WET	SUB PASI WET

Special Requirements: Report C, QC Limits (C),FR Only no EDD (0)

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Return Samples to Sending Region: ☐ Yes ☒ No

DISPOSITION of FORM

Original sent to the receiving lab - Copy kept at the sending lab.
When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project: Todd Creek WWTP Phase II | Boring Number: B-2 | Date: 2/26/2024
Project Number: 20242002 | Sample Number: R-1 | Depth: 22.5-22.8

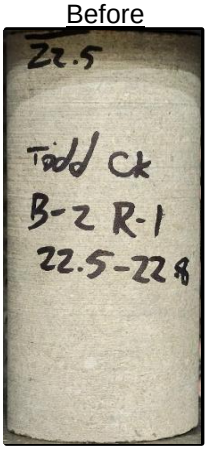
Visual Description: LIMESTONE

Specimen Weight	509.38	g
Diameter	1.862	inches
Length	4.220	inches
Volume	**0.0066**	ft^3

Wet unit weight	**168.9**	pcf
Length:Diameter Ratio	**2.27**	

Specimen Area (metric)	**1756.776**	mm^2
Specimen Area	**2.723**	in^2
Total Load on Specimen	**46980**	lbs
Unconfined Strength (qu)	**17253**	**psi**
Unconfined Strength (qu)	**1242**	**tsf**
Unconfined Strength (qu)	**119**	**MPa**

Before



After

Tested by: SLY | Date: 2/26/2024
Calculated by: SLY | Date: 2/27/2024
Checked by: TBS | Date: 4/1/2024

PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

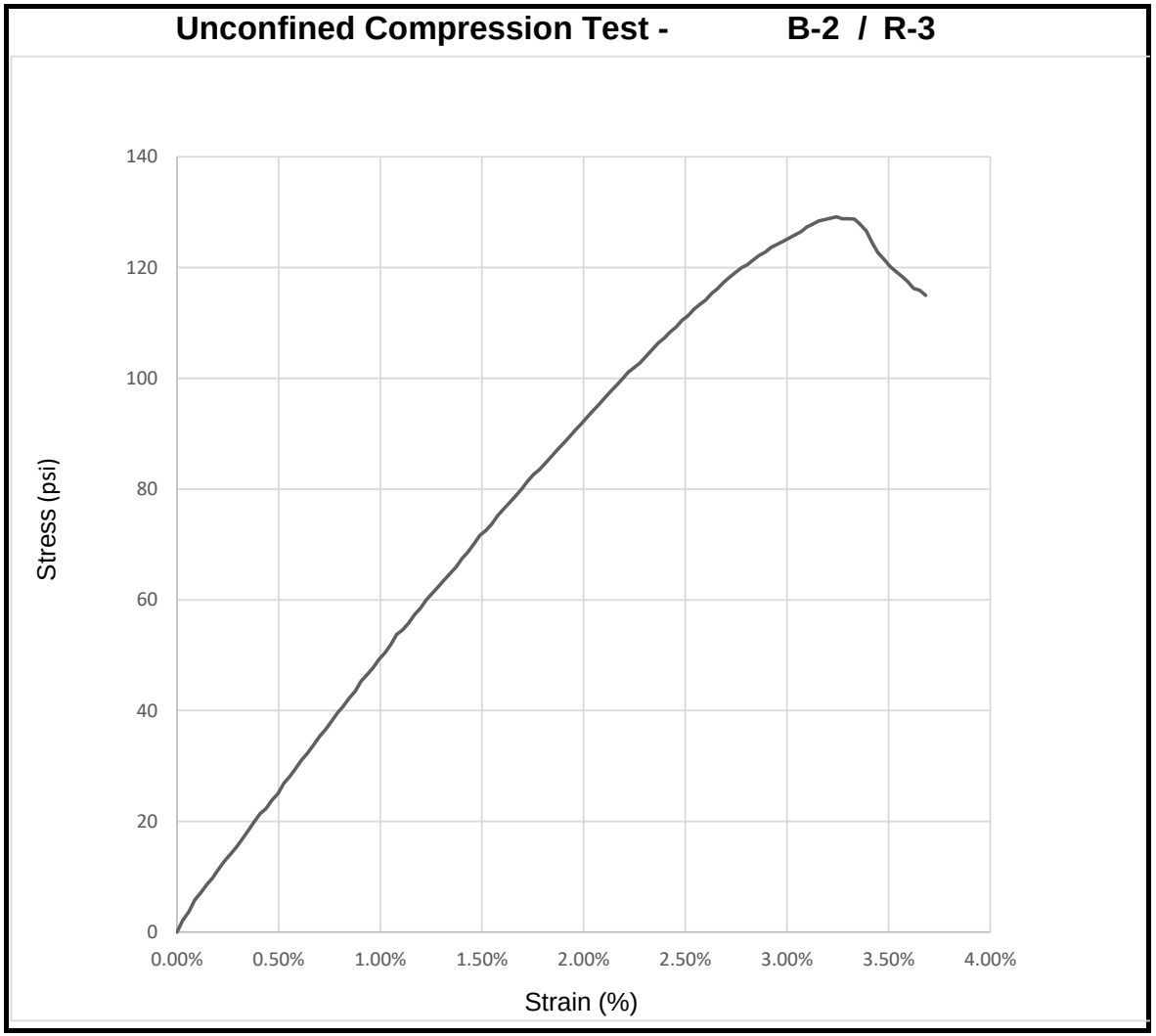
BORING NO.	B-2
SAMPLE NO.	R-3
SAMPLE DEPTH (ft)	34.0-34.3
RECOVERY (%)	100
VISUAL CLASS. (USCS)	SHALE

SPECIFICATIONS	
Unconfined Compression	ASTM D7012
VISUAL CLASS. (USCS)	SHALE

DENSITY & MOISTURE	
Wet unit weight (pcf)	143.5
Moisture Content (%)	9.8%
Dry unit weight (pcf)	130.7

STRENGTH	
Unconfined Strength qu (psi)	129.2
% Strain at qu	3.24

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

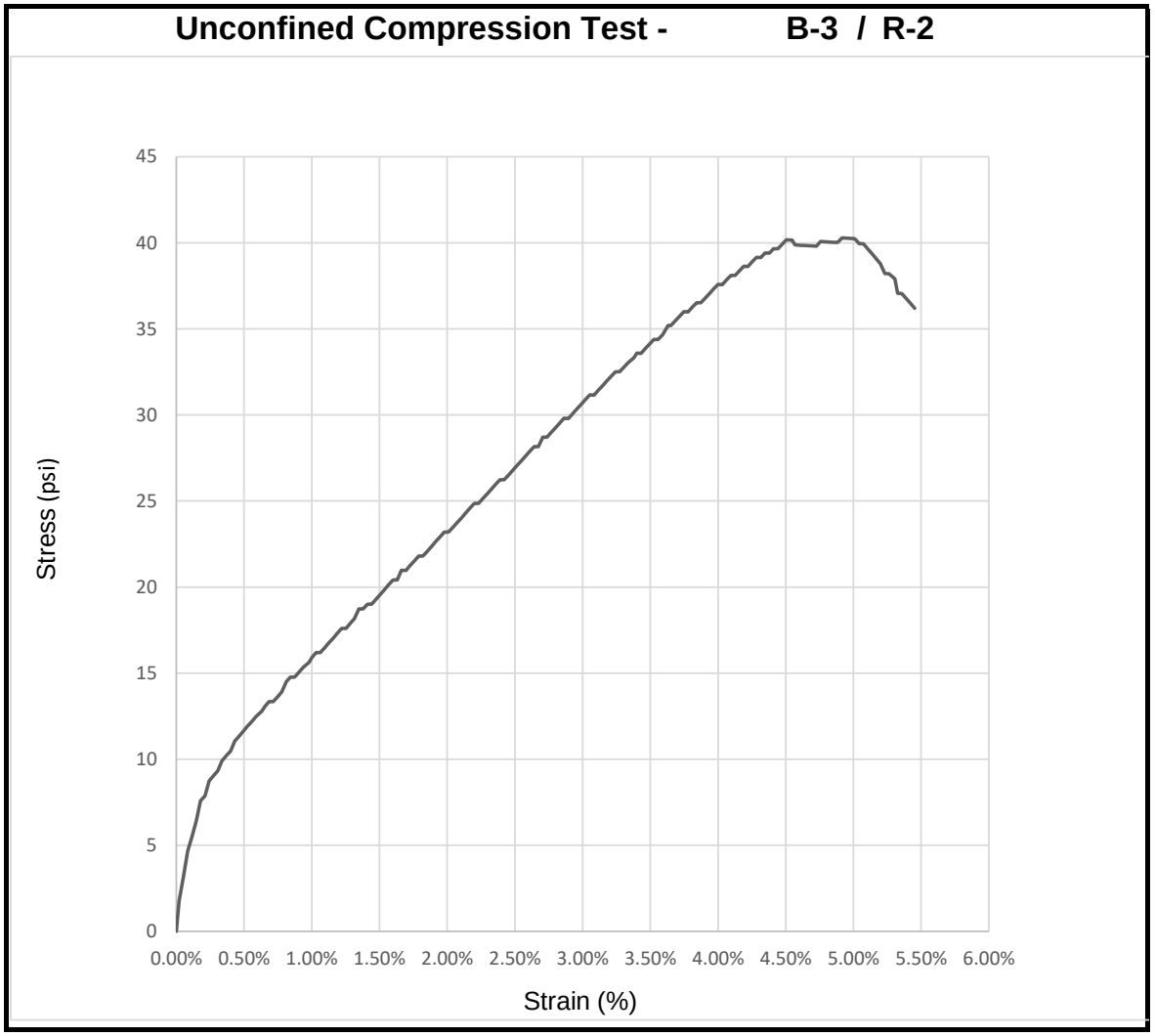
BORING NO.	**B-3**
SAMPLE NO.	**R-2**
SAMPLE DEPTH (ft)	**17.0-17.3**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**Clayey SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**139.5**
Moisture Content (%)	**11.7%**
Dry unit weight (pcf)	**125.0**

STRENGTH	
Unconfined Strength qu (psi)	**40.3**
% Strain at qu	**4.92**

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

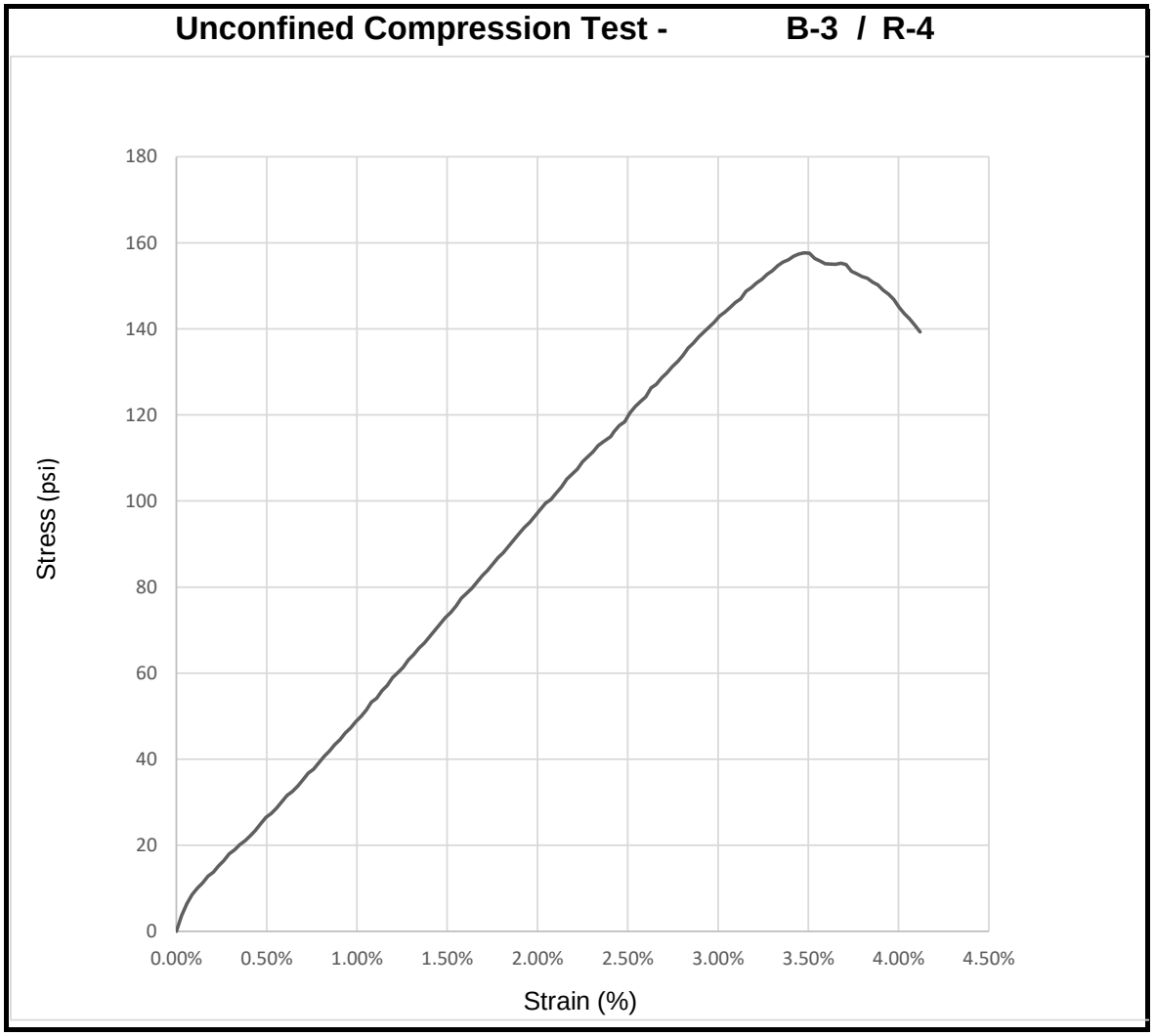
BORING NO.	**B-3**
SAMPLE NO.	**R-4**
SAMPLE DEPTH (ft)	**26.0-26.3**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**144.1**
Moisture Content (%)	**9.1%**
Dry unit weight (pcf)	**132.0**

STRENGTH	
Unconfined Strength qu (psi)	**157.7**
% Strain at qu	**3.48**

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project:	Todd Creek WWTP Phase II	Boring Number:	B-6	Date:	2/26/2024
Project Number:	20242002	Sample Number:	R-1	Depth:	18.3-18.6

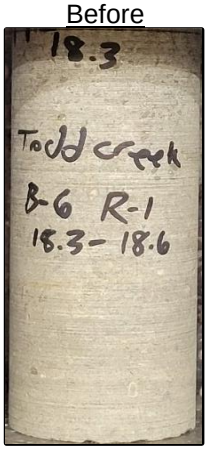
Visual Description: LIMESTONE

Specimen Weight	510.22	g
Diameter	1.864	inches
Length	4.210	inches
Volume	**0.0066**	ft^3

Wet unit weight	**169.2**	pcf
Length:Diameter Ratio	**2.26**	

Specimen Area (metric)	**1760.552**	mm^2
Specimen Area	**2.729**	in^2
Total Load on Specimen	**44710**	lbs
Unconfined Strength (qu)	**16385**	**psi**
Unconfined Strength (qu)	**1180**	**tsf**
Unconfined Strength (qu)	**113**	**MPa**

Before



After

Tested by:	SLY	Date:	2/26/2024
Calculated by:	SLY	Date:	2/27/2024
Checked by:	TBS	Date:	4/1/2024

PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

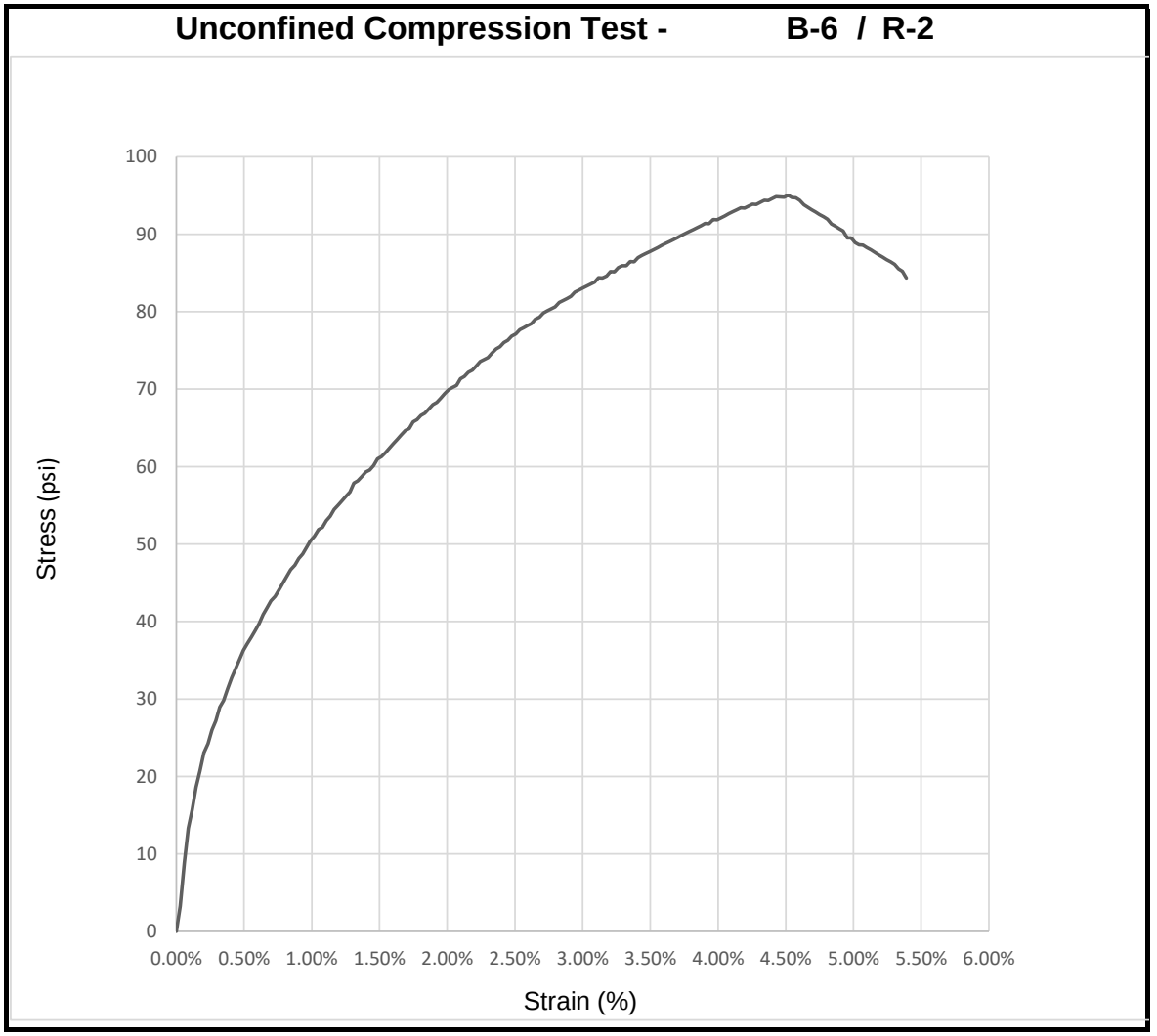
BORING NO.	**B-6**
SAMPLE NO.	**R-2**
SAMPLE DEPTH (ft)	**22.9-23.2**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**139.9**
Moisture Content (%)	**13.3%**
Dry unit weight (pcf)	**123.4**

STRENGTH	
Unconfined Strength qu (psi)	**95.0**
% Strain at qu	**4.52**

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project:	Todd Creek WWTP Phase II	Boring Number:	B-7	Date:	3/7/2024
Project Number:	20242002	Sample Number:	R-2	Depth:	30.5-30.8

Visual Description: LIMESTONE

Specimen Weight	509.00	g
Diameter	1.863	inches
Length	4.204	inches
Volume	**0.0066**	ft^3

Wet unit weight	**169.2**	pcf
Length:Diameter Ratio	**2.26**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**52020**	lbs
Unconfined Strength (qu)	**19084**	**psi**
Unconfined Strength (qu)	**1374**	**tsf**
Unconfined Strength (qu)	**132**	**MPa**

Before

After

Tested by:	SLY	Date:	3/7/2024
Calculated by:	SLY	Date:	3/11/2024
Checked by:	TBS	Date:	4/1/2024

PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

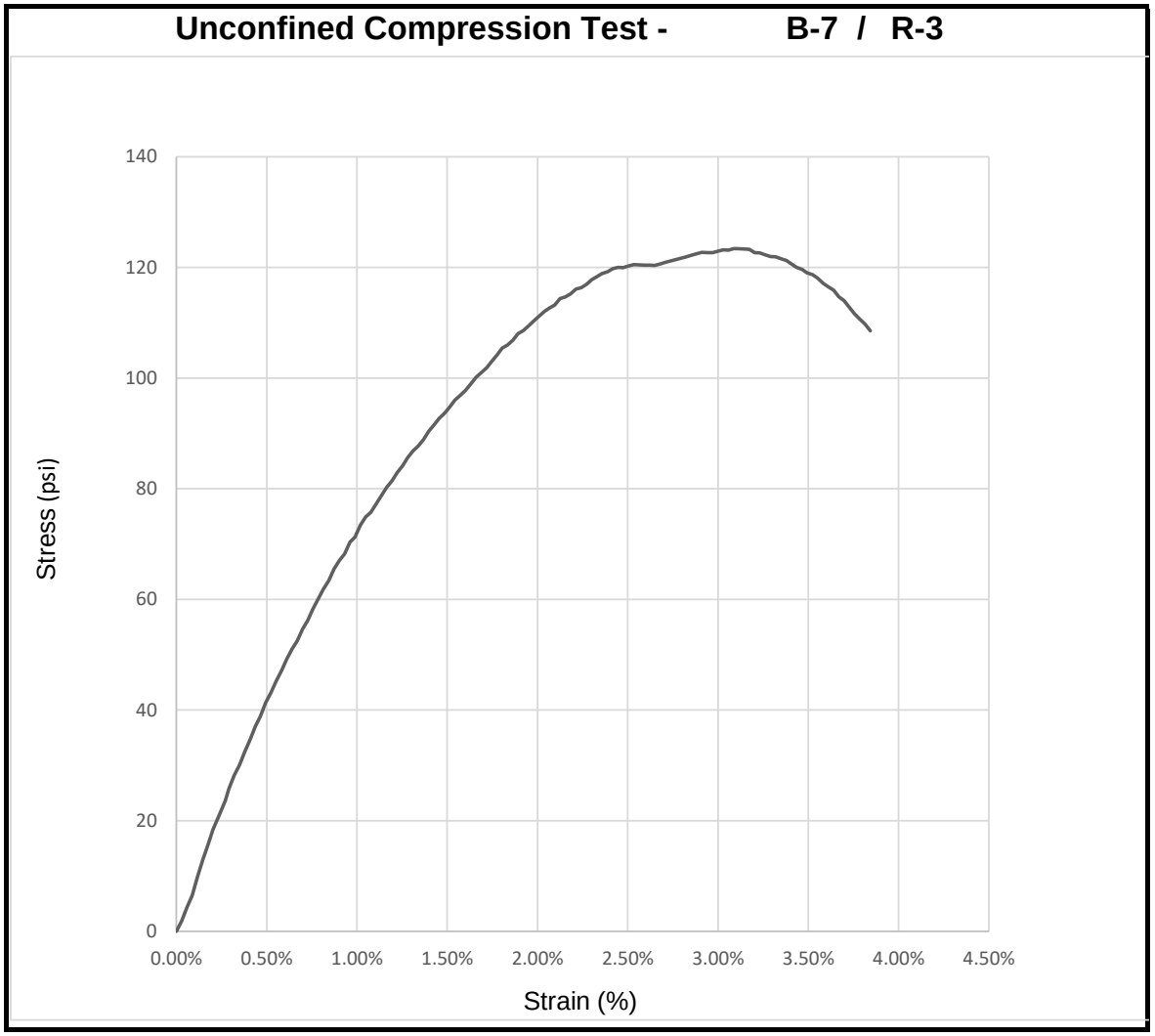
BORING NO.	**B-7**
SAMPLE NO.	**R-3**
SAMPLE DEPTH (ft)	**38.9-39.2**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**142.7**
Moisture Content (%)	**11.7%**
Dry unit weight (pcf)	**127.7**

STRENGTH	
Unconfined Strength qu (psi)	**123.4**
% Strain at qu	**3.09**

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



Uniaxial Compressive Strength Test of Rock Core

(ASTM D7012-14, method C)

Project:	Todd Creek WWTP Phase II	Boring Number:	B-8	Date:	2/26/2024
Project Number:	20242002	Sample Number:	R-2	Depth:	43.9-44.2

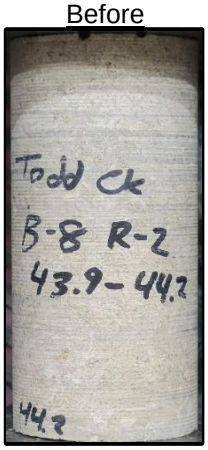
Visual Description: LIMESTONE

Specimen Weight	499.00	g
Diameter	1.863	inches
Length	4.153	inches
Volume	**0.0066**	ft^3

Wet unit weight	**167.9**	pcf
Length:Diameter Ratio	**2.23**	

Specimen Area (metric)	**1758.663**	mm^2
Specimen Area	**2.726**	in^2
Total Load on Specimen	**41420**	lbs
Unconfined Strength (qu)	**15195**	**psi**
Unconfined Strength (qu)	**1094**	**tsf**
Unconfined Strength (qu)	**105**	**MPa**

Before



After

Tested by:	SLY	Date:	2/26/2024
Calculated by:	SLY	Date:	2/27/2024
Checked by:	TBS	Date:	4/1/2024

PROJECT NAME: Todd Creek WWTP Phase II

PROJECT No.: 20242002

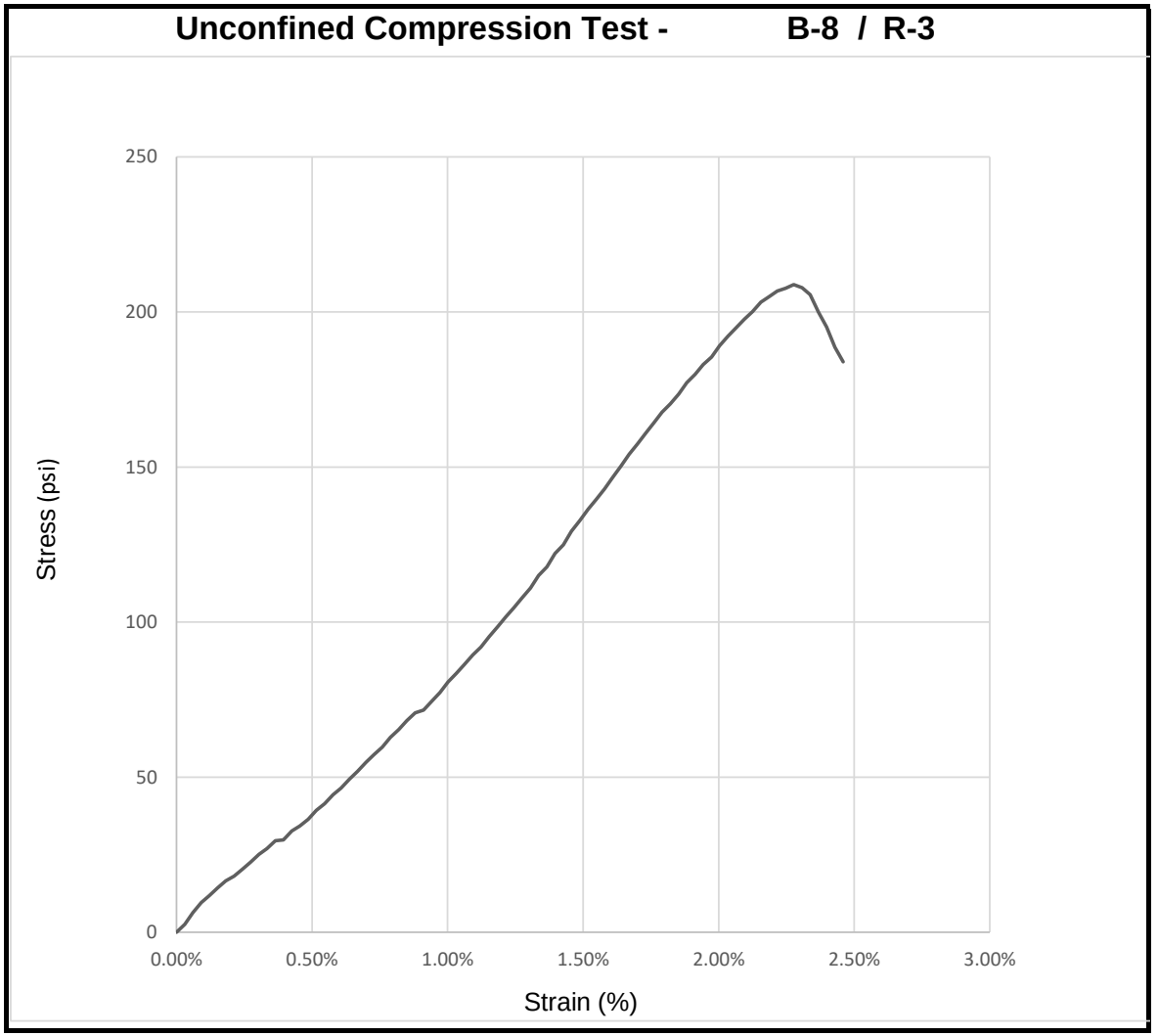
BORING NO.	**B-8**
SAMPLE NO.	**R-3**
SAMPLE DEPTH (ft)	**48.8-49.1**
RECOVERY (%)	**100**
VISUAL CLASS. (USCS)	**SHALE**

SPECIFICATIONS	
Unconfined Compression	**ASTM D7012**
VISUAL CLASS. (USCS)	**SHALE**

DENSITY & MOISTURE	
Wet unit weight (pcf)	**152.3**
Moisture Content (%)	**8.3%**
Dry unit weight (pcf)	**140.7**

STRENGTH	
Unconfined Strength qu (psi)	**208.8**
% Strain at qu	**2.28**

Tested by: SLY	2/26/2024
Calculated by: SLY	3/11/2024
Checked by: TBS	4/1/2024



APPENDIX D

Rock Core Photographs

BORING B-2

Run	Depth, Ft.	Recovery, %	RQD, %
1	20.5-25.0	70	26
2	25.0-30.0	100	55

BORING B-2

Run	Depth, Ft.	Recovery, %	RQD, %
3	30.0-35.0	100	53
4	35.0-40.0	100	63

BORING B-2

Run	Depth, Ft.	Recovery, %	RQD, %
5	40.0-45.0	100	72

BORING B-3

Run	Depth, Ft.	Recovery, %	RQD, %
1	12.0-15.0	31	0
2	15.0-20.0	100	90

BORING B-3

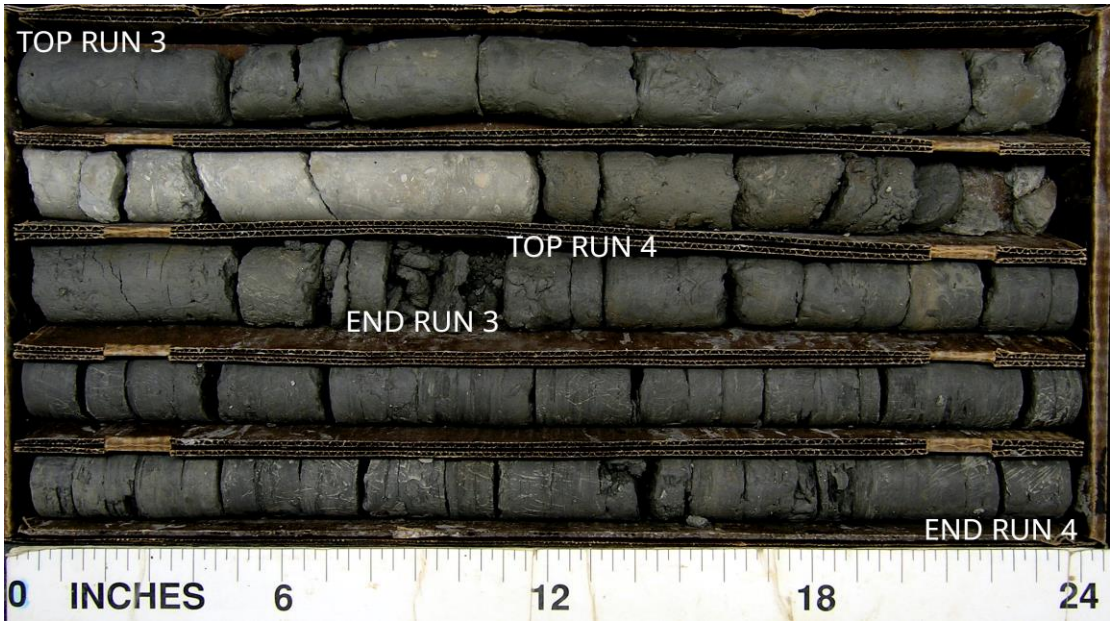
Run	Depth, Ft.	Recovery, %	RQD, %
3	20.0-25.0	100	58
4	25.0-30.0	100	78

BORING B-3

Run	Depth, Ft.	Recovery, %	RQD, %
5	30.0-35.0	100	48

BORING B-6

Run	Depth, Ft.	Recovery, %	RQD, %
1	16.0-20.0	100	77
2	20.0-25.0	100	70



BORING B-6

Run	Depth, Ft.	Recovery, %	RQD, %
3	25.0-30.0	97	38
4	30.0-35.0	98	15

BORING B-6

Run	Depth, Ft.	Recovery, %	RQD, %
5	35.0-40.0	100	25

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
1	29.2-30.0	97	92
2	30.0-35.0	100	23

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
3	35.0-40.0	100	48
4	40.0-45.0	100	44

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
5	45.0-50.0	97	0
6	50.0-55.0	100	35

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
7	55.0-60.0	100	77
8	60.0-65.0	100	0

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
9	65.0-70.0	100	0
10	70.0-75.0	35	0

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
11	75.0-80.0	72	45
12	80.0-85.0	77	35

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
13	85.0-90.0	100	100

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
14	90.0-95.0	99	91
15	95.0-100.0	97	75

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
16	100.0-105.0	100	97
17	105.0-110.0	100	80

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
18	110.0-112.0	83	21
19	112.0-115.0	100	61

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
20	115.0-120.0	94	40
21	120.0-125.0	100	95

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
22	125.0-130.0	95	48
23	130.0-135.0	95	0

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
24	135.0-140.0	100	0
25	140.0-145.0	100	55

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
26	145.0-150.0	100	85

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
27	150.0-155.0	100	85
28	155.0-160.0	100	0

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
29	160.0-163.3	58	0
30	163.3-165.0	100	100
31	165.0-170.0	100	8

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
32	170.0-174.0	100	60
33	174.0-175.0	100	100
34	175.0-180.0	100	95

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
35	180.0-185.0	100	93
36	185.0-190.0	100	100

BORING B-7

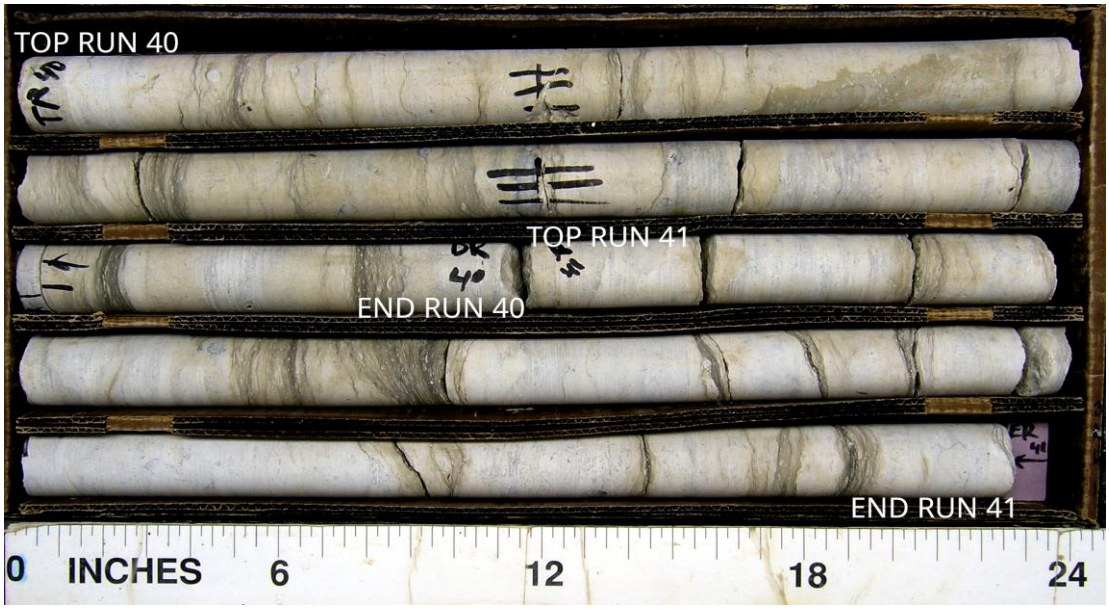
Run	Depth, Ft.	Recovery, %	RQD, %
37	190.0-195.0	100	83

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
38	195.0-200.0	98	83

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
39	200.0-205.0	100	100



BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
40	205.0-210.0	100	100
41	210.0-215.0	98	97

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
42	215.0-220.0	97	98
43	220.0-225.0	95	40

BORING B-7

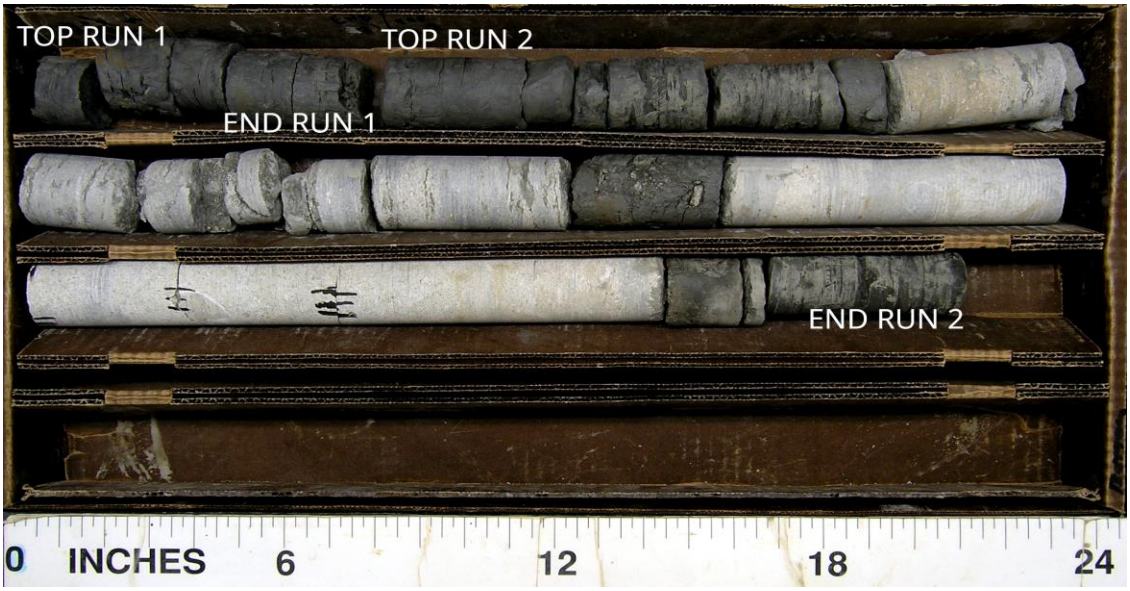
Run	Depth, Ft.	Recovery, %	RQD, %
44	225.0-230.0	100	83
45	230.0-235.0	100	83

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
46	235.0-240.0	100	83
47	240.0-245.0	98	80

BORING B-7

Run	Depth, Ft.	Recovery, %	RQD, %
48	245.0-250.0	100	70



BORING B-8

Run	Depth, Ft.	Recovery, %	RQD, %
1	39.4-40.0	100	0
2	40.0-45.0	100	47

BORING B-8

Run	Depth, Ft.	Recovery, %	RQD, %
3	45.0-50.0	100	15
4	50.0-55.0	100	15

BORING B-8

Run	Depth, Ft.	Recovery, %	RQD, %
5	55.0-60.0	100	0