**ADDENDUM NO. 1**

**PROJECT TP2373**

**LINDEN CONNECTOR TRAIL**

GLADSTONE, MISSOURI

DATE: 9/17/24

This Addendum forms a part of the Contract described above. The original Contract Documents and any prior addenda remain in force and effect except as modified by the following which shall take precedence over any provisions in the prior documents.

**Addendum No. 1:**

Corrections/Clarifications:

Insert attached "REPORT OF GEOTECHNICAL EXPLORATION" which was previously omitted from the bid documents.

*********

Each Bidder shall acknowledge receipt of this addendum by fixing his signature below, by noting this addendum on his Proposal, and by attaching this addenda to his Bid.

City of Gladstone , 7010 N. Holmes, Gladstone, Missouri 64118

**ACKNOWLEDGEMENT**

The undersigned acknowledges receipt of this addendum and the Bid submitted is in accordance with information, instructions and stipulations set forth herein.

Bidder _____

By: _____

Date: _____

# REPORT OF GEOTECHNICAL EXPLORATION
# LINDEN CONNECTOR TRAIL PEDESTRIAN BRIDGE
# GLADSTONE, MISSOURI

Presented to:

**CITY OF GLADSTONE PUBLIC WORKS**
Gladstone, Missouri

Attn: Mr. Tim Nebergall

Prepared by:

Otto J. Kruger, Jr., P.E.

Kruger Technologies, Inc.
Lenexa, Kansas

KTI Project No. 224148G

August 29, 2024

# KRUGER TECHNOLOGIES, INC.

GEOTECHNICAL ■ ENVIRONMENTAL ■ TESTING ■ INSPECTION
8271 MELROSE DRIVE ■ LENEXA, KANSAS 66214 ■ VOICE 913-498-1114 ■ FAX 913-498-1116 ■ EMAIL KTIKC@KTIONLINE.COM


August 29, 2024

Mr. Tim Nebergall
City of Gladstone Public Works
4000 NE 75th Streer
Gladstone, MO 641119

Re: KTI Project No. 224148G
Linden Connector Trail Pedestrian Bridge
Gladstone, Missouri

Dear Mr. Nebergall:

Kruger Technologies, Inc. (KTI) has completed the subsurface exploration and geotechnical report for the above referenced project. The purpose of this report is to describe the surface and subsurface conditions encountered at the site, analyze and evaluate this information, and prepare a summary of existing conditions, subsurface material characteristics, and give site specific geotechnical design recommendations.

We thank you for the opportunity to work with the City of Gladstone. If you have any questions, please contact us at 913.498.1114.

Respectfully submitted,
Kruger Technologies, Inc.


Otto J. Kruger, Jr., P.E.
Missouri P.E: 23994

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KTI Project No. 224148G
August 29, 2024

# REPORT OF GEOTECHNICAL EXPLORATION
# LINDEN CONNECTOR TRAIL PEDESTRIAN BRIDGE
# GLADSTONE, MISSOURI

## AUTHORIZATION

The following table presents the authorization documentation history for the work performed and presented in this report by Kruger Technologies, Inc.

| Project: Linden Connector Trail Pedestrian Bridge in Gladstone, Missouri | | |
|---|---|---|
| **Document:** | **Date:** | **Requested/Provided:** |
| Request for Proposal | 7-29-24 | Tim Nebergall – City of Gladstone Public Works |
| KTI Proposal 24GT139 | 7-30-24 | Dylan Kruger - Kruger Technologies Inc. |
| Notice to Proceed | 7-30-24 | Tim Nebergall – City of Gladstone Public Works |

## PURPOSE AND SCOPE

The purpose of this investigation was to explore the surface and subsurface conditions present within the site and provide recommendations regarding the following:

- Site Preparation and Engineered Fill
- Deep Foundations Bearing on Rock
- Excavation Considerations

## SITE CONDITIONS

The proposed Pedestrian Bridge site is located to the west of Missouri Route 1 (MO-1) and along the alignment of 68$^{th}$ Street in Gladstone, Missouri. At the time of field exploration, the site area had dense tree cover with the grade sloping to the creek.

## PROJECT DESCRIPTION

We understand that the project will consist of constructing a pedestrian bridge located west of Missouri Route 1 (MO-1) and along the alignment of 68$^{th}$ Street in Gladstone, Missouri. The proposed Linden Connector Trail Pedestrian Bridge will be a prefabricated Pratt truss bridge structure approximately 150 feet long.

## FIELD EXPLORATION PROCEDURES

Two (2) test borings were completed on August 12, 2024. The borings were selected by the client and field located by Kruger Technologies using site layout plans provided by the client. The boring locations are shown on an attached Boring Location Diagram.

The borings were drilled using a CME-55 Track Unit. Advancement of the test holes was accomplished using 4-inch Hollow Stem augers. Soil sampling was performed by hydraulically pushing thin wall steel (Shelby) tubes and Standard Penetration Test (SPT).

Site soils were visually and manually classified in general accordance with ASTM D 2488 by the drill crew chief as drilling progressed. All of the soil samples were delivered to the laboratory for applicable testing and verification of the field classifications. The boring logs were created as the borings were advanced, and the logs were supplemented with information from the laboratory tests to present data concerning the depth and classification of the various strata, water levels, and other pertinent information. The boring logs are attached in Appendix I.

During advancement of the borings, groundwater was not encountered at any boring location. It should be noted that water level determinations made in relatively impervious (clay) soils might not present a reliable indication of the actual water table. However, water level determinations made in relatively pervious (sand/silt) soils are considered an accurate indication of the water table at the time that those measurements are made. Fluctuations in the water table should be expected with changing seasons and annual differences.

## LABORATORY TESTS

Laboratory tests were performed on the recovered samples to determine the engineering characteristics and for additional verification of the field classifications in accordance with ASTM D 2487. The results of these tests, including moisture/density, plasticity (Atterberg Limits), and unconfined compressive strength of soil are presented in Appendix II.

## GEOLOGY/SUBSURFACE CONDITIONS

The site overburden consists of 6 to 12 inches of topsoil underlain by native soil materials. There was concrete debris at the original boring B-2 location which was offset to approximately 20 feet east of the original location. The majority of the native soils are comprised of low plasticity clays. The native soils exhibit soft to stiff consistency and were moist. The Unified Soil

Classification System classifies silty lean clays as CL-ML, low plasticity (lean) clay soils as CL, medium plasticity (lean to fat) clay soils as CL/CH, and high plasticity (fat) clay soils as CH. Weathered shale bedrock material was encountered at both test borings at depths ranging from 14.5 to 19.5 feet below existing ground. As previously stated, no free groundwater was encountered at any of the boring locations.

## DESIGN CRITERIA AND RECOMMENDATIONS

Laboratory test results of the recovered samples showed the following characteristics that were used as criteria for determining the recommendations for bearing values and design data:

| | |
|---|---|
| Natural Dry Density | 97.0 to 105.5 pcf |
| Natural Moisture Content | 10.6 to 24.9 % |
| Liquid Limit | 32 to 42 |
| Plasticity Index | 9 to 21 |
| Unconfined Compressive Strength of Soil | 997 to 4,058 psf |

Site Preparation and Engineered Fill

Areas to receive fill should be stripped of vegetation, topsoil, and any other deleterious materials. Any isolated areas of soft or deleterious materials encountered at subgrade elevation should be removed and replaced with engineered fill. The moisture content of the subgrade soils should be appropriate to achieve the required compaction.

Proper drainage of the construction area should be provided to protect foundation and floor slab subgrade soils from the detrimental effects of weather conditions. Excavations should be kept as dry as possible. Any loose or soft materials that accumulate or develop on subgrade or bearing surfaces should be removed prior to the placement of concrete. Construction traffic, including foot traffic, should be minimized. Concrete should be placed in footing excavations as soon as possible after excavations are complete.

Trucks and other heavy construction vehicles should be restricted as much as possible from trafficking on the finished subgrade in the building to prevent unnecessary disturbances of subgrade soils. Excessive rutting or pumping of the subgrade could occur from construction traffic, particularly during periods of wet weather. If such disturbed areas develop, the subgrade may have to be excavated and replaced with properly compacted fill.

Supplemental engineered fill should be placed in uniform horizontal lifts, with loose thicknesses not exceeding eight inches. The thickness must be appropriate for the method of compaction and the type of equipment used. The geotechnical engineer should approve any off-site material proposed for use as fill. Engineered fill should be compacted to a minimum of 95 percent of maximum density as determined by ASTM D698 (standard Proctor test) at moisture content between 0 and 4 percent above optimum moisture for high plasticity clay material and from -2 to +2 from optimum moisture content for low plasticity clays.

The fill should be benched in any sloped areas greater than one vertical to five horizontal in order to maintain relatively horizontal lifts. The benching should be placed at not less than 12-inch rises over those areas where it is required as the work is brought up in layers.

Deep Foundations Bearing on Site Bedrock

Due to the presence of soft soils at Boring B-1 approximately 10 feet below existing grade, shallow foundations are not recommended. The deep foundation option suggested would consist of drilled shafts. Drilled shaft foundations can be designed for an allowable end bearing capacity of 15 kips per square foot (ksf) for weathered shale bedrock. The shale bedrock is present at depths ranging from 14.5 to 19.5 feet below existing. In order for drilled pier foundations to bear in this competent shale material, the drilled piers may need to penetrate at least 1.5 shaft diameters into the weathered shale, to achieve bearing on highly weathered to slightly weathered shale bedrock. An allowable side friction of 1.5 ksf may be assigned to that portion of the shaft extending through the upper, highly weathered shale layer after the first 5 feet of the layer. The embedment length in the clay overburden should not be used in the side resistance estimate.

We anticipate that the majority of the shale can be drilled out with a rock auger or core bucket. However, competent and harder beds of shale will likely require the use of a core barrel. A drilled shaft foundation system supported by shale bedrock should result in essentially no settlement of the new structure. Elastic shortening of the shaft would be expected to be less than ¼ inch.

Allowable shaft adhesion for the shale bedrock can be assumed 2 kips/sq. ft. Lateral resistance of deep foundation elements is dependent on structural design, embedment length, and soil

conditions. The pier must remain in contact with the undisturbed materials or engineered fill as long as a lateral load condition exists.

Excavation Considerations

We believe that the project soils are Type B as classified in the OSHA Excavation Standard Handbook 29 CFR Parts 1926.650 through 1926.652. Type B soils are characterized by cohesive soils above the water table with unconfined compressive strengths greater than 0.5 tons per square foot (tsf) but less than 1.5 tsf. Type B soils include any fill soils meeting or exceeding the above criteria, as well as undisturbed soils with unconfined compressive strengths of >1.5 tsf which are subject to vibration from traffic. Temporary excavation slopes for Type B soils can be one horizontal to one vertical with a maximum excavation depth of 20 feet.

Excavations deeper than 20 feet may require the use of supplemental shoring and will require the preparation of an excavation design prepared by a registered professional engineer. Competent bedrock material may generally be cut vertically.

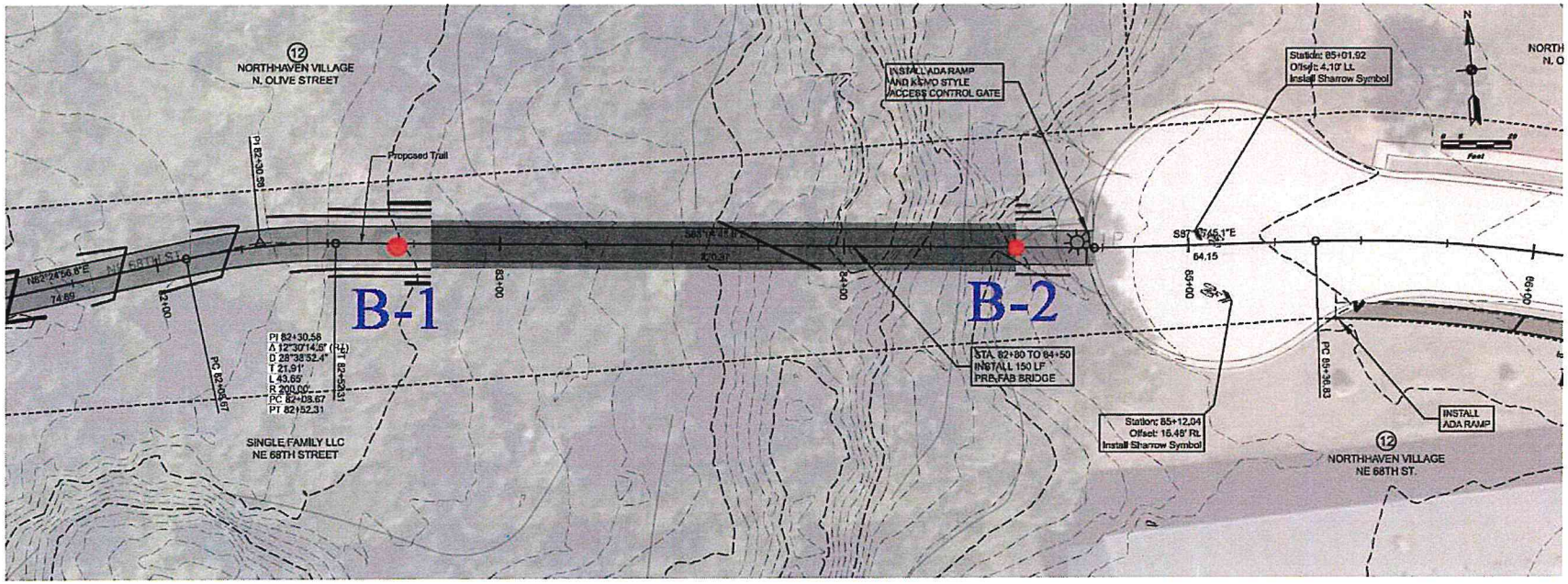
## REMARKS

It is recommended that the geotechnical engineer be retained to review the plans and specifications for the project so that an evaluation and comments can be provided regarding the proper incorporation of information from this geotechnical report into the final construction documents. We further recommend that the geotechnical engineer be retained during construction phases for earthwork and foundations to provide observation and testing to aid in determining that design intent has been accomplished.

The findings in this report are based on data acquired to date and are assumed to be representative of conditions at locations between borings. Due to the fact that the area at the borings is very small relative to the overall site, and for other reasons, we make no statement warranting the conditions below our borings or at other locations throughout the site. In addition, we do not warrant that the general strata logged at the borings are necessarily typical of the remaining areas of the site.

Reports shall not be reproduced, except in full, without written approval of KTI. Information in this report applies only to the referenced project in its present configuration and location and shall not be used for any other project or location.

# BORING LOCATION DIAGRAM




Boring Location Diagram
Linden Connector Trail Pedestrian Bridge
Gladstone, Missouri

KRUGER TECHNOLOGIES, INC.

| Drawn: TMA | Date: 8/26/24 | KTI Project No. 224148G |
|---|---|---|

# APPENDIX I

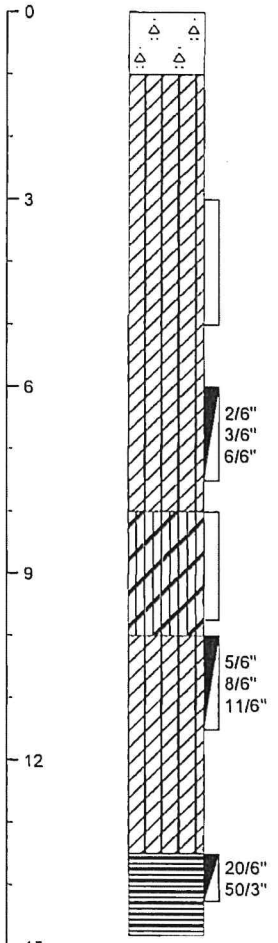
## Boring Logs

# LOG OF TEST BORING
## BORING B-1

**PROJECT:** Linden Connector Trail Pedestrian Bridge
**CLIENT:** City of Gladstone Public Works
**PROJECT NO.:** 224148G **START:** 8/12/24
**BORING LOCATION:** See Boring Location Plan
**METHOD OF DRILLING:** 4" Continuous Flight Augers
**DEPTH TO - water** None **caving**

**DATE:** 8/26/2024
**ELEVATION:**
**FINISH:** 8/12/24

**LOGGER:** JC
**DATE CHECKED:**




| ELEVATION/ DEPTH | SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA | USCS | Description | Sample # & Type | Density pcf | Moisture, % | Qu, psf |
|---|---|---|---|---|---|---|---|
| 0 | | T | Topsoil | | | | |
| | | CL | Lean clay, stiff, dark grayish brown, moist | | | | |
| 3 | | CL | Lean clay, grayish brown, moist | 1, ST | 97.0 | 24.3 | 2940 |
| 6 | 2/6" 3/6" 6/6" | CL | Lean clay, stiff, light and dark brown, moist | 1, SS | | 24.1 | |
| 9 | | CL-ML | Silty lean clay, medium stiff, gray and dark brown, moist | 2, ST | 102.3 | 19.0 | 997 |
| | 5/6" 8/6" 11/6" | CL | Lean clay, stiff, grayish brown, moist | 2, SS | | 21.0 | |
| 12 | | | | | | | |
| | 20/6" 50/3" | W | Weathered shale, hard, gray, moist | 3, SS | | 14.3 | |
| 15 | | | Drilling discontinued at sample refusal at 14.8 feet | | | | |
| 18 | | | | | | | |
| 21 | | | | | | | |

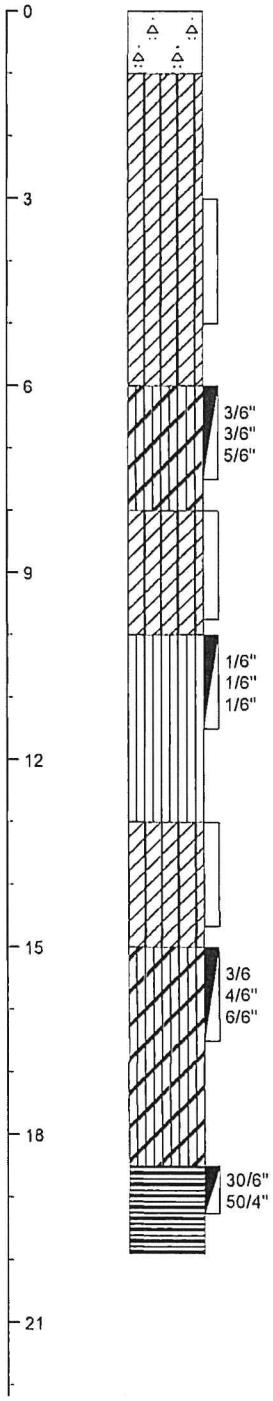
**Notes:**

# LOG OF TEST BORING
## BORING B-2

**PROJECT:** Linden Connector Trail Pedestrian Bridge
**CLIENT:** City of Gladstone Public Works
**PROJECT NO.:** 224148G **START:** 8/12/24
**BORING LOCATION:** See Boring Location Plan
**METHOD OF DRILLING:** 4" Continuous Flight Augers
**DEPTH TO - water** None **caving**

**DATE:** 8/26/2024
**ELEVATION:**
**FINISH:** 8/12/24

**LOGGER:** JC
**DATE CHECKED:**




| ELEVATION/ DEPTH | USCS | Description | Sample # & Type | Density pcf | Moist-ure, % | Qu, psf |
|---|---|---|---|---|---|---|
| | T | Topsoil | | | | |
| | CL | Lean clay, stiff, dark grayish brown | | | | |
| | CL | Lean clay, stiff, grayish brown, moist | 1, ST | 99.8 | 24.0 | 4058 |
| | CL-ML | Silty lean clay, medium stiff, brown, moist | 1, SS | | 24.9 | |
| | CL | Lean clay, stiff, dark brown, moist to dry | 2, ST | 105.5 | 19.9 | 2053 |
| | ML | Silt, soft, grayish brown, moist | 2, SS | | 18.0 | |
| | CL | Lean clay, stiff, grayish brown, moist | 3, ST | | | |
| | CL-ML | Silty lean clay, stiff, brown, moist | 3, SS | | 17.8 | |
| | W | Weathered shale, hard, grayish brown, moist | 4, SS | | 10.6 | |
| | | Drilling discontinued at sample refusal at 19.9 feet | | | | |

**Notes:**

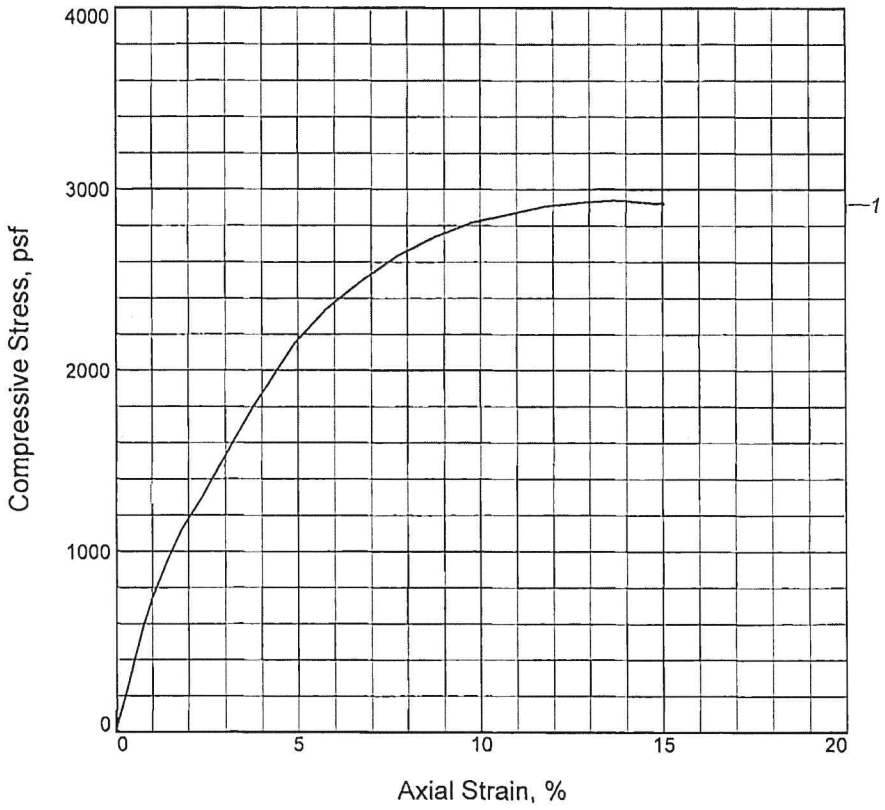
# APPENDIX II

## Laboratory Results

## SUMMARY OF LABORATORY TEST RESULTS OF UNDISTURBED SAMPLE

| Boring | Depth (Ft) | Sample No./Type | Natural Moisture % | Natural Dry Density (pcf) | Unconfined Compressive Strength (psf) | Atterberg Limits | | Soil Type |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Liquid Limit % | Plasticity Index % | |
| B-1 | 3.0-5.0 | ST-1 | 24.3 | 97.0 | 2940 | 42 | 21 | CL |
| B-1 | 6.0-7.5 | SS-1 | 24.1 | | | | | |
| B-1 | 8.0-10.0 | ST-2 | 19.0 | 102.3 | 997 | | | |
| B-1 | 10.0-11.5 | SS-2 | 21.0 | | | | | |
| B-1 | 13.5-14.5 | SS-3 | 14.3 | | | | | |
| B-2 | 3.0-5.0 | ST-1 | 24.0 | 99.8 | 4058 | 32 | 9 | CL |
| B-2 | 6.0-7.5 | SS-1 | 24.9 | | | | | |
| B-2 | 8.0-10.0 | ST-2 | 19.9 | 105.5 | 2053 | | | |
| B-2 | 10.0-11.5 | SS-2 | 18.0 | | | | | |
| B-2 | 15.5-16.5 | SS-3 | 17.8 | | | | | |
| B-2 | 18.5-19.5 | SS-3 | 10.6 | | | | | |

# UNCONFINED COMPRESSION TEST




| | | | | |
|---|---|---|---|---|
| Sample No. | 1 | | | |
| Unconfined strength, psf | 2940 | | | |
| Undrained shear strength, psf | 1470 | | | |
| Failure strain, % | 13.8 | | | |
| Strain rate, in./min. | 0.050 | | | |
| Water content, % | 24.3 | | | |
| Wet density, pcf | 120.6 | | | |
| Dry density, pcf | 97.0 | | | |
| Saturation, % | 88.2 | | | |
| Void ratio | 0.7508 | | | |
| Specimen diameter, in. | 2.89 | | | |
| Specimen height, in. | 5.61 | | | |
| Height/diameter ratio | 1.94 | | | |

**Description:** Lean clay, stiff, dark grayish brown, moist

| | | | | |
|---|---|---|---|---|
| **LL** = 42 | **PL** = 21 | **PI** = 21 | **Assumed GS=** 2.72 | **Type:** ST |

**Project No.:** 224148G
**Date Sampled:** 8/12/24
**Remarks:**

**Client:** City of Gladstone Public Works

**Project:** Linden Connector Trail Pedestrian Bridge

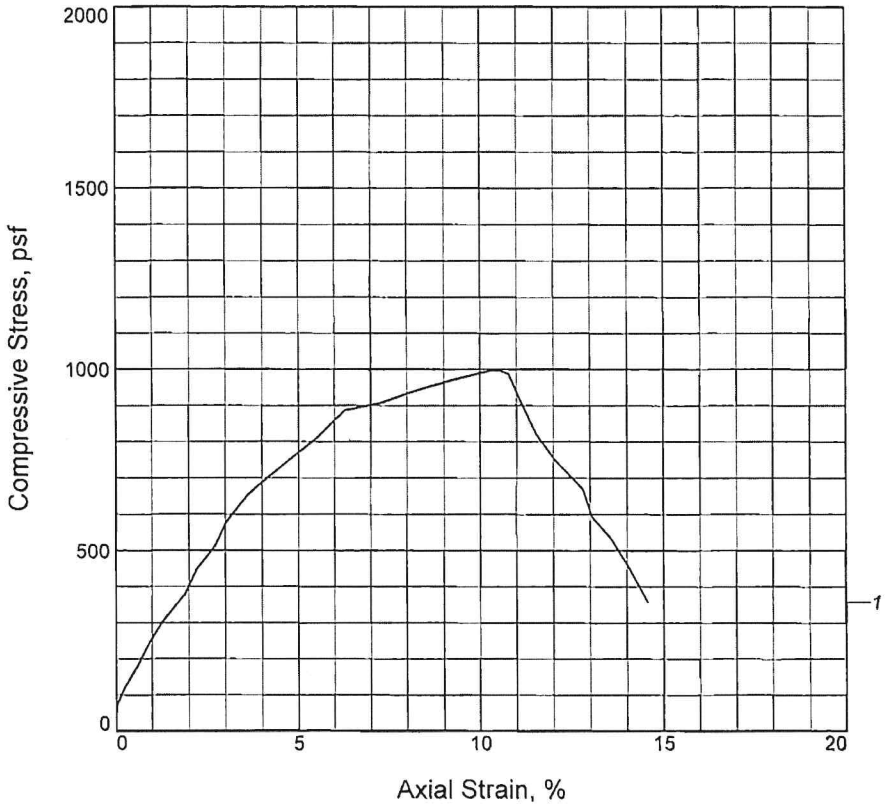
**Source of Sample:** B-1 **Depth:** 1

**Figure** _____

KTI

**Tested By:** TA **Checked By:** OJK

# UNCONFINED COMPRESSION TEST




| Sample No. | 1 | | | |
|---|---|---|---|---|
| Unconfined strength, psf | 997 | | | |
| Undrained shear strength, psf | 498 | | | |
| Failure strain, % | 10.5 | | | |
| Strain rate, in./min. | 0.050 | | | |
| Water content, % | 19.0 | | | |
| Wet density, pcf | 121.6 | | | |
| Dry density, pcf | 102.3 | | | |
| Saturation, % | 78.0 | | | |
| Void ratio | 0.6606 | | | |
| Specimen diameter, in. | 2.86 | | | |
| Specimen height, in. | 5.60 | | | |
| Height/diameter ratio | 1.96 | | | |

**Description:** Lean clay, grayish brown, moist

| LL = | PL = | PI = | **Assumed GS=** 2.72 | **Type:** ST |
|---|---|---|---|---|

**Project No.:** 224148G
**Date Sampled:** 8/12/24
**Remarks:**

**Client:** City of Gladstone Public Works

**Project:** Linden Connector Trail Pedestrian Bridge

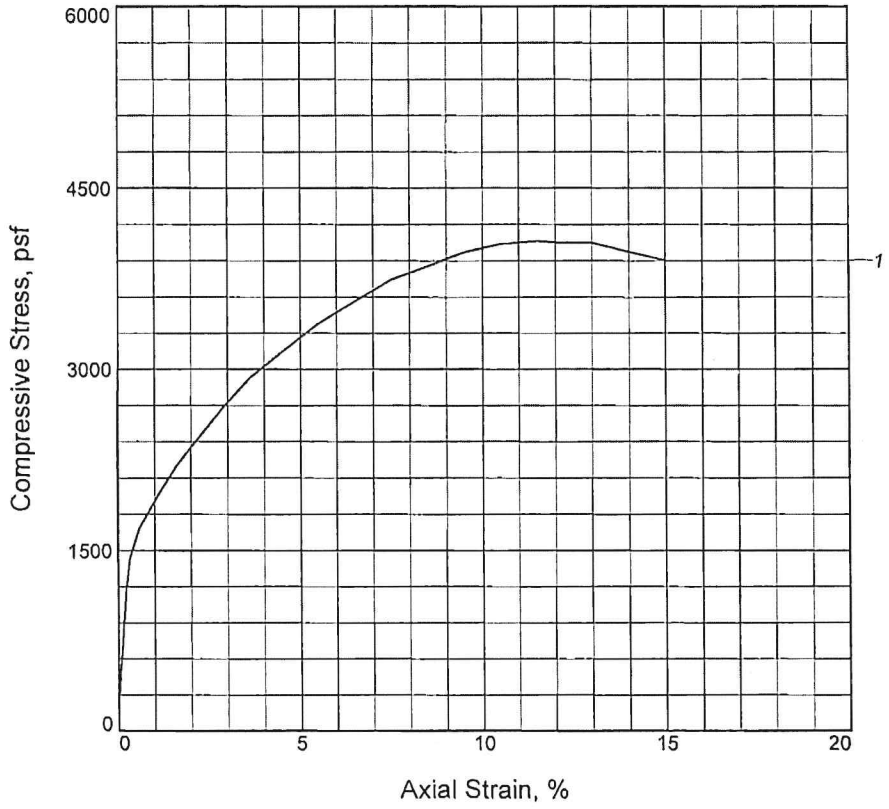
**Source of Sample:** B-1 **Depth:** 3
**Sample Number:** 1

Figure _____

[redacted]KTI[redacted]

**Tested By:** TA **Checked By:** OJK

# UNCONFINED COMPRESSION TEST




| | | | | |
|---|---|---|---|---|
| Sample No. | 1 | | | |
| Unconfined strength, psf | 4058 | | | |
| Undrained shear strength, psf | 2029 | | | |
| Failure strain, % | 11.5 | | | |
| Strain rate, in./min. | 0.050 | | | |
| Water content, % | 24.0 | | | |
| Wet density, pcf | 123.8 | | | |
| Dry density, pcf | 99.8 | | | |
| Saturation, % | 93.2 | | | |
| Void ratio | 0.7014 | | | |
| Specimen diameter, in. | 2.86 | | | |
| Specimen height, in. | 5.63 | | | |
| Height/diameter ratio | 1.97 | | | |

**Description:** Lean clay, stiff, dark grayish brown

| | | | | |
|---|---|---|---|---|
| **LL =** 32 | **PL =** 23 | **PI =** 9 | **Assumed GS=** 2.72 | **Type:** ST |

**Project No.:** 224148G
**Date Sampled:** 8/12/24
**Remarks:**

**Figure** _____

**Client:** City of Gladstone Public Works

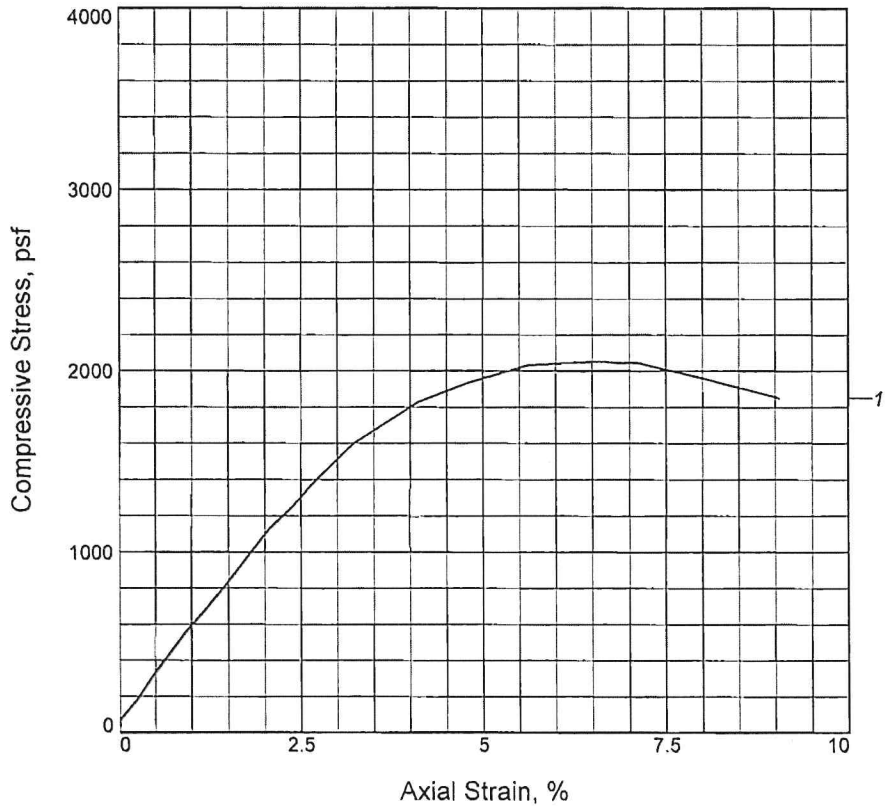
**Project:** Linden Connector Trail Pedestrian Bridge

**Source of Sample:** B-2 **Depth:** 1

KTI

**Tested By:** TA **Checked By:** OJK

# UNCONFINED COMPRESSION TEST




| | | | | |
|---|---|---|---|---|
| Sample No. | 1 | | | |
| Unconfined strength, psf | 2053 | | | |
| Undrained shear strength, psf | 1027 | | | |
| Failure strain, % | 6.6 | | | |
| Strain rate, in./min. | 0.050 | | | |
| Water content, % | 19.9 | | | |
| Wet density, pcf | 126.6 | | | |
| Dry density, pcf | 105.5 | | | |
| Saturation, % | 89.0 | | | |
| Void ratio | 0.6090 | | | |
| Specimen diameter, in. | 2.83 | | | |
| Specimen height, in. | 5.75 | | | |
| Height/diameter ratio | 2.03 | | | |

**Description:** Sandy lean clay, stiff, dark brown, moist

| LL = | PL = | PI = | **Assumed GS=** 2.72 | **Type:** ST |
|---|---|---|---|---|

**Project No.:** 224148G
**Date Sampled:** 8/12/24
**Remarks:**

**Client:** City of Gladstone Public Works

**Project:** Linden Connector Trail Pedestrian Bridge

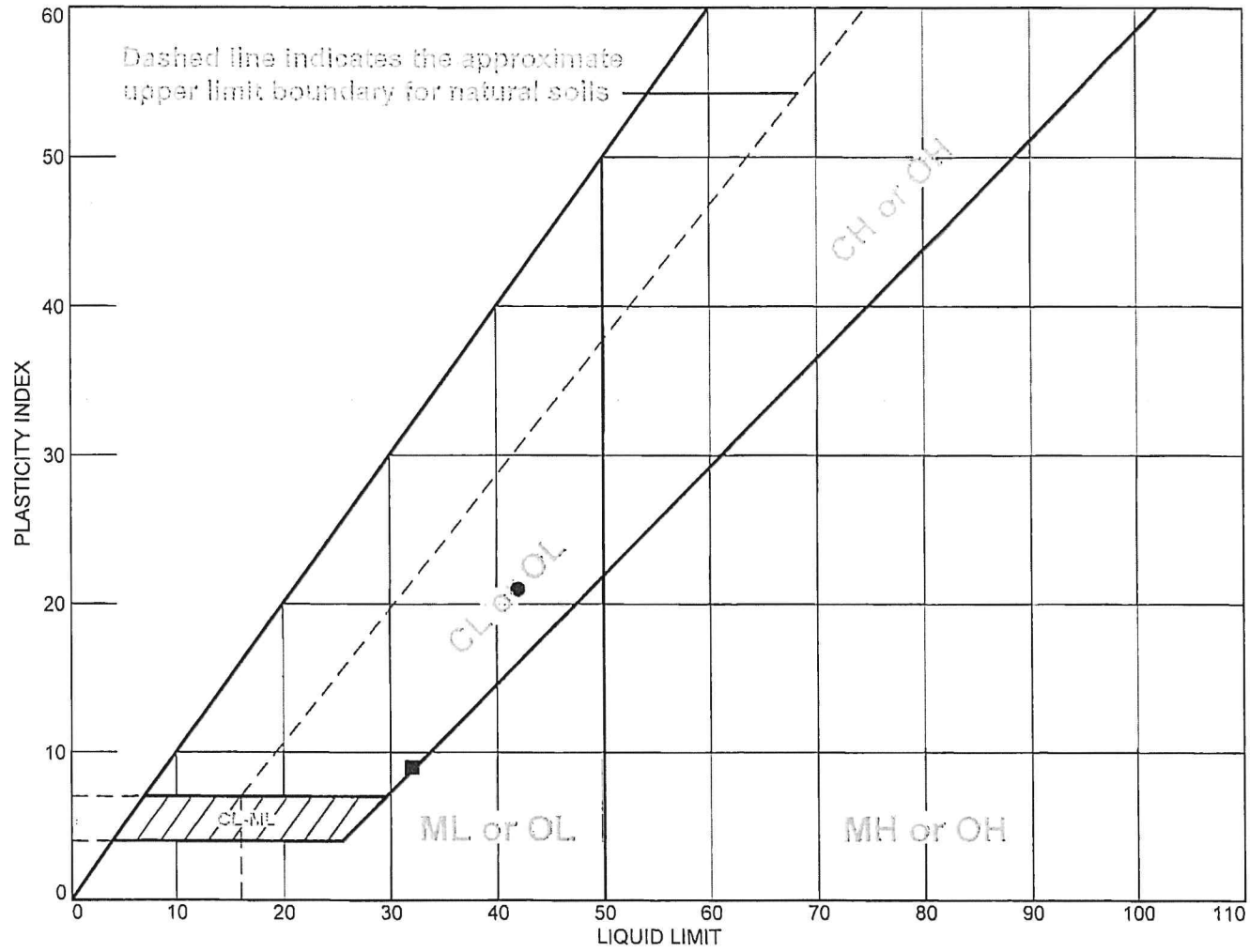
**Source of Sample:** B-2 **Depth:** 8
**Sample Number:** 2

Figure _____

[redacted]KTI[redacted]

**Tested By:** TA **Checked By:** OJK

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D 4318




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Lean clay, stiff, dark grayish brown, moist | 42 | 21 | 21 | | | CL |
| ■ | Lean clay, stiff, dark grayish brown | 32 | 23 | 9 | | | CL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 224148G **Client:** City of Gladstone Public Works

**Project:** Linden Connector Trail Pedestrian Bridge

● **Source of Sample:** B-1 **Depth:** 1

■ **Source of Sample:** B-2 **Depth:** 1

**Remarks:**

KTI

**Figure**

# GLOSSARY OF GEOTECHNICAL TERMS

| | |
|---|---|
| ALLUVIUM | Sediments deposited by streams, including riverbeds and floodplains. |
| ARGILLACEOUS | Rocks composed of or having a notable portion of fine silt and/or clay in their composition. |
| ATTERBERG LIMITS | Water contents, in percentage of dry weight of soil, that correspond to the boundaries between the states of consistency, i.e. the boundary between the liquid and plastic states (liquid limit) and the boundary between the plastic and solid states (plastic limit). |
| BEDROCK-IN-PLACE | Continuous rock mass which essentially has not moved from its original depositional position. |
| CALCAREOUS | Containing calcium carbonate determined by effervescence when tested with dilute hydrochloric acid. |
| CHANNEL SANDSTONE | Sandstone that has been deposited in a streambed or other channel eroded into the underlying beds. |
| COLLUVIAL | Rock debris of various sizes loose from in-place bedrock mass, often shifted down gradient in conjunction with soil. |
| CROSS-BEDDING | Stratification which is inclined to the original horizontal surface upon which the sediment accumulated. |
| FISSILE BEDDING | Term applied to bedding which consists of laminae less than 2 millimeters in thickness. |
| FORMATION | A distinctive body of rock that serves as a convenient unit for study and mapping. |
| FOSSIL DETRITUS | The accumulation of broken, fragmented fossil debris. |
| FOSSILIFEROUS | Containing organic remains. |
| GLACIAL ERRATIC | A transported rock fragment different from the bedrock on which it lies, either free or as part of a sediment. |
| GLACIAL TILL | Nonsorted, nonstratified sediment carried or deposited by a glacier. |
| GLACIOFLUVIAL | Primarily deposited by streams from glaciers. |
| GROUP | A lithostratigraphic unit consisting of two or more formations. |
| JOINT | A fracture in a rock along which no appreciable displacement has occurred. |
| LIMESTONE | A sedimentary rock composed mostly of calcium carbonate ($CaCO_3$). |

| | |
|---|---|
| LOESS | A homogenous, nonstratified, unindurated deposit consisting predominantly of silt, with subordinate amounts of very fine sand and/or clay. |
| MICA | A mineral group, consisting of phyllosilicates, with sheetlike structures. |
| MEMBER | A specially developed part of a varied formation is called a member, if it has considerable geographic extent. |
| NODULE | A small, irregular, knobby, or rounded rock that is generally harder than the surrounding rock. |
| PERMEABILITY | The capacity of a material to transmit a fluid. |
| RECOVERY | The percentage of bedrock core recovered from a core run length. |
| RELIEF | The difference in elevation between the high and low points of a land surface. |
| RESIDUAL SOIL | Soil formed in place by the disintegration and decomposition of rocks and the consequent weathering of the mineral materials. |
| ROCK QUALITY DESIGNATION (RQD) | Refers to percentage of core sample recovered in unbroken lengths of 4 inches or more. |
| SANDSTONE | Sedimentary rock composed mostly of sand sized particles, usually cemented by calcite, silica, or iron oxide. |
| SERIES | A time-stratigraphic unit ranked next below a system. |
| SHALE | A fine-grained plastic sedimentary rock formed by consolidation of clay and mud. |
| STRATIGRAPHY | Branch of geology that treats the formation, compositions, sequence, and correlation of the stratified rocks as parts of the earth's crust. |
| SYSTEM | Designates rocks formed during a fundamental chronological unit, a period. |
| UNCONFORMITY | A surface of erosion or nondeposition, usually the former, which separates younger strata from older rocks. |
| WEATHERING | The physical and chemical disintegration and decomposition of rocks and minerals. |

## General Notes

| Laboratory Test Symbols | |
|---|---|
| **Symbol** | **Definition** |
| LL | Liquid Limit (ASTM D4318) |
| PL | Plastic Limit (ASTM D4318) |
| PI | Plasticity Index (LL minus PL) |
| Qu | Unconfined Compressive Strength, Pounds per Square Foot (psf) |
| Qp | Pocket Penetrometer Reading, Tons per Square Foot (TSF) |
| RQD | Rock Quality Designation % (Sum of rock core pieces >4 inches/length of core run) |

## Common Soil Classification Symbols

| Clay | |
|---|---|
| **Symbol** | **Soil Type** |
| CL | Low plasticity clay |
| CL-ML | Low plasticity clay and silt |
| CL/CH | Medium plasticity clay |
| CH | High plasticity clay |

| Silt | |
|---|---|
| **Symbol** | **Soil Type** |
| ML | Low plasticity silt |
| MH | High plasticity silt |

| Sand | |
|---|---|
| **Symbol** | **Soil Type** |
| SW | Well graded sand |
| SP | Poorly graded sand |
| SM | Silty sand |
| SC | Clayey sand |

| Gravel | |
|---|---|
| **Symbol** | **Soil Type** |
| GW | Well graded gravel |
| GP | Poorly graded gravel |
| GM | Silty gravel |
| GC | Clayey gravel |

## Descriptive Terminology

### Cohesionless Soils

| Relative Density Term | "N" Value |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 5 - 9 |
| Medium Dense | 10 - 29 |
| Dense | 30 – 49 |
| Very Dense | 50 or more |

### Cohesive Soils

| Consistency Term | "N" Value |
|---|---|
| Very soft | 0 – 2 |
| Soft | 3 – 4 |
| Medium | 5 – 8 |
| Stiff | 9 – 15 |
| Very Stiff | 16 - 30 |
| Hard | > 30 |

## Relative Proportions and Sizes

| Term | Range |
|---|---|
| Trace | < 5% |
| A Little | 5 – 15% |
| Some | 15 – 30% |
| With | 30 – 50% |

| Material | Size |
|---|---|
| Boulder | > 12" |
| Cobble | 3" – 12" |
| Gravel | 4.75 - 76.2 mm |
| Sand | 0.075 – 4.75 mm |
| Silt and Clay | < 0.075 mm |