Twin Ports Testing
1301 N 3rd St. • Superior WI 54880 • 715-392-7114 • 1-800-373-2562 • F 715-392-7163 • www.twinportstesting.com

Geotechnical Evaluation Report

Sheet Pile Bulkhead Wall
C Reiss Dock
Superior, Wisconsin

Prepared for:

Krech Ojard & Associates, Inc.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Wisconsin.

Michael A Haapala

Michael A. Haapala, PE
License Number: E-40299
May 27, 2022

MICHAEL A.
HAAPALA
E-40299
SUPERIOR
WI

TPT Project Number: 21G1417

May 27, 2022 TPT Project No. 21G1417

Lauran Larson, PE, SE
Krech Ojard & Associates, Inc.
227 W 1st St, Suite 500
Duluth, MN 55802

Re: Geotechnical Evaluation Report
C Reiss Dock - Sheet Pile Bulkhead Wall
Superior, Wisconsin

Dear Mr. Larson:

Enclosed is our geotechnical evaluation report for the above referenced project. We have prepared this report and based our conclusions upon current applicable professional standards.

If you have any questions concerning the data, the recommendations presented, or if we may be of further service on this project, please contact us at 715.392.7114. We appreciate the opportunity to be of service to you.

Sincerely,

Twin Ports Testing

Brett Carlson, PE (MN)
Geotechnical Engineer

Michael D Haapala

Michael A. Haapala, PE (MN, WI, ND)
Principal Engineer

Attachment: Geotechnical Evaluation Report

CONTENTS

Appendix: Boring Location Sketch, CPT logs CPT-1 through CPT-3, Boring Log Notes and Soil Classification Data

1 Introduction

This report presents the results of our geotechnical evaluation for the Sheet Pile Bulkhead Wall on the C Reiss Dock in Superior, Wisconsin.

1.1 Scope of Services

The scope of this geotechnical evaluation, as outlined in our Proposal 21G1417 dated August 19, 2021 included:

- Performing an exploration program consisting of three (3) Cone Penetration Test (CPT_u) soundings and one (1) Flat Plate Dilatometer (DMT) sounding along the existing sheet pile wall to depths of 60 feet or refusal; three (3) direct push (DPT) borings adjacent to the CPT_u soundings to depths of 30 feet or refusal.
- Performing laboratory tests and observations of soil samples to evaluate pertinent engineering properties of materials encountered.
- Preparing a report containing a description of the drilling program, a description of the geology and subsurface conditions encountered, groundwater conditions, boring logs with a boring location sketch, results of laboratory testing, estimate unit weight of soils, and recommendations for sheet pile design including passive and active Lateral Earth Pressures (LEP), L-Pile inputs, drivability of common sheet piles sections, and tieback anchoring and supplementary anchor configurations.

Twin Ports Testing II, Inc (TPT) has prepared this report for design purposes only. It may not have sufficient subsurface information to prepare an accurate construction bid. We recommend that contractors preparing bids or proposals for this project be provided with a complete copy of this report as a supplement to the plans and specifications.

1.2 Proposed Project

We understand that Krech Ojard & Associates is proposing to provide engineering design services for developing a sheet pile bulkhead wall and tieback system for the rehabilitation of the C Reiss Dock in Superior, Wisconsin. It is our understanding that an existing crane foundation may be used to provide lateral anchor wall resistance.

Changes in the nature, design, and location of all or parts of this project may occur. The conclusions and recommendations contained in this report shall not be considered applicable to changes unless they are reviewed by the geotechnical engineer of record. We will then make necessary changes or modifications to this report in writing only.

1.2.1 Reference Information

We referenced the following as part of this project:

- Geological Map titled, “Glacial Deposits of Wisconsin” - prepared by University of Wisconsin Extension– dated 1976
- Google Earth™

2 Site Conditions

2.1 Site Location and Existing Conditions

This site is located approximately 0.8 miles north of the intersection of Np Railroad and Winter Street in Superior, Wisconsin. The site is bordered to the north by the St. Louis River, to the east by Midwest Energy Resources, to the south by wooded areas, and to the west by St. Louis Bay channel near Hallet dock No. 8. Areas within C Reiss Dock consist of concrete pavement, brush and trees. The proposed site location is shown in Figure 1 below.

Figure 1: Project Location (Google Earth™)

2.1.1 Review of Historical Images

As part of our evaluation we looked at historical images of the site using Google Earth. Based upon available aerial photographs, this site has changed little since the first available image dated 1991.

2.2 Topography

This project site has been graded and is relatively flat.

2.3 Geologic Setting

Through an understanding of the geologic history and processes of an area, we are better able to define and understand the range of geotechnical properties observed in the geological materials encountered at the site. Knowledge of the anticipated subsurface profile at the site is important for interpreting and correlating the borings from the field exploration program.

Based upon information from geologic survey reports and previous soil explorations in the area, the geology local to the site generally consists of glacio-lacustrine soils, overlying a thin mantle of glacial till and bedrock. The glacio-lacustrine soils (Glacial Lake Duluth) consist mainly of fat clay inter-bedded with thin layers of silt and fine sand from higher glacial stages of Lake Superior. The glacio-lacustrine deposits in the area range in thickness from about 100 to 300 feet (locally from 100 to 150 feet). Layers of alluvial sand deposits are commonly found in explorations nearer the St. Louis River and the St. Louis Bay (based on nearby TPT explorations.)

2.3.1 Geologic Hazards

The potential for most geologic hazards is generally low for this site. A hazard potential summary is shown in Table 1.

Table 1: Geologic Hazard Summary

Geologic Hazard	Present?	Comments
Earthquake/Seismic Activity	No	The site is in an area of low seismic activity.
Flooding	Possible	This site is on St. Louis River.
Slope Failure/Landslides	Unlikely	This site is relatively flat with little potential for slope failure.
Made Ground	Yes	This site has been previously graded and fill soils exist.
Swelling/Shrinking Soil	Yes	Existing fill and lacustrine soils near the site have moderate shrinking and swelling potential when exposed to freezing temperatures and changes in water content.

3 Field Procedures

Field procedures for this project included performing Cone Penetration Test (CPT_u) soundings at three (3) locations to sounding refusal depths of 46 feet in CPT-1 and 54 feet in CPT-2, and the termination depth of 60 feet in CPT-3. We also performed three (3) Direct Push (DPT) borings adjacent to the CPT_u soundings to depths of 30 feet.

CPT_u soundings and DPT borings were performed with a Geoprobe 6625CPT track mounted drill rig. Test procedures were performed on October 13, 2021 and October 14, 2021.

3.1 Test Locations and Elevations

Test locations were staked in the field by TPT personnel using a boring location sketch provided by KOA. Surveyed elevations of the test locations were not collected at the time of this report. Based upon available topographic maps (MnTOPO) the surface elevations of the test locations is around elevation 605.0 feet. The approximate boring and test locations are shown on the Boring Location Sketch found in the Appendix.

3.2 Sampling/Soundings

3.2.1 Direct Push Borings

Continuous sampling of soil stratigraphy was performed in five foot increments at the boring locations. Direct push or percussion hammer techniques were used to advance the sample tube. Collected samples were sealed in the field to preserve natural water content and returned to the laboratory for classification and testing.

3.2.2 Cone Penetration Test (CPT_u) Soundings

CPT_u soundings were performed at five locations in accordance with ASTM D5778 procedures. A 10 square centimeter cone with a maximum point capacity of 100 MPa was used to perform the soundings. Observed values of point resistance, side friction, pore pressure (U_2 position), and tilt angle were recorded continuously throughout the length of the soundings.

3.3 Direct Push/CPT Logs

Field DPT boring logs were prepared for each boring by our field supervisor. These logs contain interpretation of the soil conditions observed, as described in compliance with ASTM D420 and D2488.

Final DPT boring logs are included in the Appendix. The final logs represent our interpretation of the contents of the field logs after laboratory observations by our geotechnical engineer and laboratory tests of collected field samples were complete. Soils are described in this report according to the Unified Soil Classification System (USCS), as outlined in the Boring Log Notes and Soil Classification Data which can be found in the Appendix.

CPT logs were prepared for each sounding using collected field data. Soil properties and interpretations are shown using accepted methodology and calculations. CPT logs are included in the Appendix.

3.4 Water Level Readings

Water level readings were observed in the CPT soundings at the times and under the conditions stated on the CPT soundings. We have reviewed the data and have reported interpretations in the text of this report. However, it must be noted that fluctuations in the level of ground water may occur because of variations in rainfall, temperature, subsurface materials and other conditions or factors different from those observed at the time of our measurements. It should be noted that such conditions are subject to change.

4 Subsurface Conditions

The subsurface conditions encountered at this site generally consist of five stratigraphic units; (1) Concrete Pavement and Topsoil, (2) Fill and Possible Fill, (3) Peat, (4) Sand, and (5) Silt.

4.1 Soil

4.1.1 Concrete Pavement and Topsoil

Concrete pavement was encountered at the surface of boring DPT-1 and DPT-3 with thicknesses of six inches. Topsoil was encountered at the surface of DPT-2 to a depth of three inches.

4.1.2 Fill and Possible Fill

Fill and possible fill soils were encountered beneath the concrete pavement and topsoil in all DPT borings to depths up to 24 feet. Fill soils generally consisted of poorly graded sand with silt and gravel, poorly graded sand, silt, and clay soils. Fill soils generally contained trace organics, roots, and fibers, were brown to dark brown, and moist to waterbearing.

4.1.3 Peat

Peat soils were encountered beneath the fill soils at depths between 6 ½ feet and 8 ½ feet at all boring locations; in Boring DPT-3 peat was encountered at 22 ½ feet to 24 ½ feet. Peat soils were generally fibric, contained pieces of wood, dark brown, and wet.

4.1.4 Sand

Native poorly graded sand and silty sand soils were encountered beneath the peat and fill soils in all boring locations at varying depths. Native sand soils generally contained trace organics, fibers, and wood, were fine to coarse grained, brown, and waterbearing.

Data from CPT soundings performed at the site suggests that sand soils generally range from loose to medium dense in relative density.

4.1.5 Silt

Native silt soils were encountered beneath the sand soils in Boring DPT-2 to the boring termination depth of 30 feet. Native silt soils generally contained sand, trace organics, fibers, and wood, were brown, and wet.

Data from CPT soundings performed at the site suggests that silt soils generally range from medium to stiff in consistency.

4.2 CPT Soundings

In general terms the CPT sounding uses pressure sensors to continuously measure soil resistance and pore pressures as the penetrometer is advanced. Since no samples are recovered from the CPT sounding, visual identifiers such as color or texture cannot be determined. In addition, the CPT results cannot readily identify or distinguish “fill” from “native” soils.

CPT_u soundings generally correlated with soils identified in the direct push borings which show variable fills soils to depths of about 24 feet, underlain by medium dense sand and medium dense silt soils to 30 feet. Where CPT soundings advanced deeper than DPT borings, soil behavior type generally consisted of medium silty clay and sandy silt to 35 feet, underlain by medium dense to dense sand to the sounding termination depths of 46 feet in CPT-1, 54 feet in CPT-2, and 60 feet in CPT-3. CPT soundings were “pre-drilled” through the concrete surface and apparent aggregate base to depths of about one foot below existing ground surface as shown on the attached CPT logs in the Appendix.

4.3 Groundwater

Groundwater was encountered in all direct push borings at depths ranging from 2 ½ feet to three feet during field procedures at this site. Increases in pore pressure measurement from collected CPT data suggest a hydrostatic groundwater level exists at a depth of around 2 ½ feet below existing ground surface. A detailed evaluation of groundwater levels at the site would require long term monitoring of piezometers and was not included in the scope of this evaluation.

5 Laboratory Testing

Results of the field testing and observed subsurface conditions were evaluated to develop a laboratory testing program. Laboratory testing of collected samples included visual classification by a geotechnical engineer and water content testing. Results of laboratory tests are shown on the boring logs in the Appendix.

5.1 Water Content

Laboratory water content testing was performed in accordance with ASTM D2216-10 on collected samples from the field exploration. Values of water content are shown on the Boring Logs in the Appendix.

5.2 Sieve Analysis

Sieve analysis testing of material passing the #200 sieve was performed in general accordance with ASTM D114 procedures on one individual split spoon sample. Test results are provided in Table 2 below and on the boring logs in the Appendix.

Table 2: Summary of Sieve Analysis Results

Boring	Depth (feet)	Description of Material	% Passing #200
DPT-2	10.0-11.0	SP	2.6

SP = Poorly Graded Sand

6 Analyses and Design Recommendations

6.1 Design Considerations

Shallow Groundwater

Groundwater levels during field procedures were encountered at depths of around two to three feet below the existing ground surface at all boring/sounding locations. Excavations extending below the groundwater table would require an advanced dewatering program consisting of multiple well points and sumps/pumps or cofferdams.

6.2 Site Preparation

6.2.1 Site Grading

To facilitate pile installation, we recommend that any encountered pavements or concrete pads be stripped from the site prior to construction. Encountered soft areas may require additional removal and replacement with granular material to support equipment loads.

6.3 Estimated Soil Parameters

Estimated unit weight (dry and moist) of soils

Based upon the results of our CPT$_u$ Soundings, we recommend using the soil parameters outlined in Tables 3 through 9 below. Please note that the parameters shown are for long term analysis under effective stress conditions.

Table 3: Estimated Soil Strength Parameters for Effective Stress Analysis, Sounding CPT-1

Soil Type	Depth (ft)	Saturated Unit Weight* (pcf)	Dry Unit Weight (pcf)	Friction Angle (ϕ',degrees)	Cohesion (C',psf)
Existing Fill (SP-SM)	0.0-9.0	123	110	32	0
Existing Fill (SM)	9.0-26.0	123	110	32	0
Clay (CH)	26.0-33.0	128	95	18	400
Sand (SM)	33.0-46.0	129	115	33	0

*Subtract 62.4 pcf to determine buoyant (submerged) unit weight
SP-SM = Poorly Graded Sand with silt, SM = Silty Sand, CH = Fat Clay

Table 4: Estimated Lateral Earth Pressure Coefficients, Sounding CPT-3

Soil Type	Depth (ft)	Active (K_a)	Passive (K_p)	At Rest (K_o)
Existing Fill (SP-SM)	0.0-9.0	0.30	3.2	0.47
Existing Fill (SM)	9.0-26.0	0.30	3.2	0.47
Clay (CH)	26.0-33.0	0.52	1.9	0.69
Sand (SM)	33.0-46.0	0.28	3.4	0.45

Table 5: Estimated Soil Strength Parameters for Effective Stress Analysis, Sounding CPT-2

Soil Type	Depth (ft)	Saturated Unit Weight* (pcf)	Dry Unit Weight (pcf)	Friction Angle (ϕ',degrees)	Cohesion (C',psf)
Existing Fill (SM)	0-10.0	123	110	32	0
Clay (CH)	10.0-16.0	128	95	18	400
Clay (CL)	16.0-39.0	123	95	20	400
Sand (SM)	39.0-44.0	128	115	33	0
Silt (ML)	44.0-47.0	122	100	30	0
Sand (SM)	47.0-54.0	129	115	33	0

*Subtract 62.4 pcf to determine buoyant (submerged) unit weight
SM = Silty Sand, CH = Fat Clay, CL = Lean Clay, ML = Silt with sand

Table 6: Estimated Lateral Earth Pressure Coefficients, Sounding CPT-3

Soil Type	Depth (ft)	Active (K_a)	Passive (K_p)	At Rest (K_o)
Existing Fill (SM)	0-10.0	0.30	3.2	0.47
Clay (CH)	10.0-16.0	0.52	1.9	0.69
Clay (CL)	16.0-39.0	0.49	2.0	0.65
Sand (SM)	39.0-44.0	0.28	3.4	0.45
Silt (ML)	44.0-47.0	0.33	3.0	0.50
Sand (SM)	47.0-54.0	0.28	3.4	0.45

Table 7: Estimated Soil Strength Parameters for Effective Stress Analysis, Sounding CPT-3

Soil Type	Depth (ft)	Saturated Unit Weight* (pcf)	Dry Unit Weight (pcf)	Friction Angle (ϕ',degrees)	Cohesion (C’,psf)
Existing Fill (SM)	0-9.0	124	115	32	0
Existing Fill (CH)	9.0-23.0	128	95	18	400
Sand (SM)	23.0-34.0	129	115	33	0
Sand (SP-SM)	34.0-60.0	128	115	32	0

*Subtract 62.4 pcf to determine buoyant (submerged) unit weight
SM = Silty Sand, CH = Fat Clay, SP-SM = Poorly Graded Sand with silt

Table 8: Estimated Lateral Earth Pressure Coefficients, Sounding CPT-3

Soil Type	Depth (ft)	Active (K_a)	Passive (K_p)	At Rest (K_o)
Existing Fill (SM)	0-9.0	0.30	3.2	0.47
Existing Fill (CH)	9.0-23.0	0.52	1.9	0.69
Sand (SM)	23.0-34.0	0.28	3.4	0.45
Sand (SP-SM)	34.0-60.0	0.30	3.2	0.47

Table 9: Estimated LPILE Parameters

Soil Type	P-y Model	Effective Unit Weight* (pcf)	Modulus of Horizontal Subgrade Reaction (k, pci)	Strain Factor, ε_{50}
Clay (CH, CL)	Soft Clay (matlock)	123-128	NA	0.005
Silt (ML)	Silt (cemented c-phi)	122	25	0.01
Sand (SM, SP)	Sand (Reese)	123-129	50	NA*

*Subtract 62.4 pcf to determine buoyant (submerged) unit weight

6.3.1 Existing Timber Piles and Soil Reinforcement

The existing timber piles may provide soil reinforcement and a reduction/increase to lateral earth pressure coefficients. Due to the variability of the fill soils and the unknown condition of the timber piles it would be difficult to quantify the amount of reinforcement provided. As the most conservative approach we recommend that the soil could be considered unreienforced.

6.4 Anchor Systems and Configuration

Based upon the results of our field exploration it is our opinion that the use of grouted soil anchors will be the most feasible option for dock wall support at this site. Helical piles may also a feasible option, however the variability of soils encountered may require a higher level of field control and proof load testing to confirm design assumptions. Clay soils encountered in Test Location CPT-2 may not provide the required resistance without the use of large helices and/or multiple helices.

6.4 Sheet Piles

Results of our field exploration suggest that driven sheet piles may encounter some buried wood and possible other obstructions throughout the fill soils. In general, it appears that sheet piles may be installed using vibratory methods.

6.4 Backfill and Fill

A wide variety of materials can be considered as suitable for engineered backfill and fill. The choice of materials is a function of structural requirements, water table conditions, seasonal construction constraints, placement and compaction methods, and other site or project specific needs. Soils which classify as SP or SP-SM in the Unified Soil Classification System (ASTM D2487) are usually the most available suitable soils for engineered backfill and fill.

6.4.1 Recommended Gradation for Engineered Backfill and Fill

We recommend that engineered fill meet the gradation requirements outlined in the table below.

Table 10: Recommended Gradation for Engineered Backfill and Fill

Sieve Size	Percent Passing
3''	100
2''	85-100
3/4''	71-100
#4	35-100
#200	0-7

Alternative gradations should be evaluated by a geotechnical engineer for acceptability if these guidelines cannot be satisfied by locally available backfill materials.

Existing soils encountered at this site may be suitable for re-use as engineered fill. If soils are encountered during excavation activities that are desired for re-use we recommend that the suitability be confirmed with laboratory testing of bulk samples.

6.4.2 Compaction Standard

We recommend using ASTM D1557 – Modified Proctor as the laboratory compaction standard.

6.4.3 Density

We recommend compacting each lift to a minimum of the following percentage of the above compaction standard for the respective types of fill materials:

Table 11: Compaction Recommendation

Type of Engineered Fill	% Minimum Compaction
Foundation Structural Backfill	95%
Slab-on-Grade Backfill	95%
Non-structural Foundation Backfill	90%
Utility Trenches	90%

6.4.4 Lift Thickness

Place engineered backfill and fill materials in lifts not to exceed eight inches in a loose condition, unless the contractor can demonstrate satisfactory results when placing thicker lifts. Maximum compacted lift thickness should not exceed 12 inches in a loose condition.

6.4.5 Moisture

In general, granular fill materials should be placed and compacted within two percent of optimum moisture content, as determined by the above applicable compaction standard. When fill materials are not in this range of moisture content, compaction to the required density may be difficult if not impossible. The excavating contractor is responsible for controlling and adjusting moisture content of backfill materials.

7 Recommendations for Construction

We offer the following recommendations for use during construction of this project.

7.1 Excavation

7.1.1 Dewatering

Groundwater was encountered at elevations affecting construction during drilling and sampling. Excavations extending below the hydrostatic groundwater level will require an advanced dewatering program; an experienced dewatering contractor should be consulted prior to construction.

7.1.2 Over Sizing

Excavations for the placement of engineered backfill should extend horizontally at least a minimum of one foot beyond the bottom of footing for every one foot of over excavation depth required below the footing.

7.1.3 Frozen Materials

If construction occurs during temperatures below freezing, the base of all excavations and backfill materials should be protected from freezing. Excavated surfaces which become frozen should be completely thawed before placing of backfill or pavement. If freezing has loosened and reduced the bearing capacity of the excavation surface, remove the frozen material to the undisturbed surface. Frozen material should not be used as backfill.

7.1.4 Underground Utilities

Underground utilities, including electrical and gas lines, may be present at this site. We recommend that contractors make all necessary steps to completely locate all underground utilities at this site prior to performing any excavations.

7.2 Observation

7.2.1 Excavations

Excavation bottoms and engineered fill operations should be observed by a geotechnical engineer or a designated representative to assure that the recommendations in this report are being followed. In-place density testing should be performed to document that project specifications are met.

7.2.2 Foundations

Installation of foundations should be observed and documented by a qualified technician or engineer. We recommend that at a minimum, concrete be tested for air content, temperature, slump, and compressive strength.

7.3 Frequency of Testing and Materials

For this project, we recommend a minimum density testing frequency of one test per 1,000 square feet of backfill area of backfill and fill (per lift), with a minimum of one test per lift. For isolated locations or questionable areas, we recommend a minimum of one test per occasion.

8 Limitations of Evaluation and Report

8.1 Site Variations

We have based the analyses and recommendations submitted in this report in part on the data obtained from three CPT soundings and three DPT borings. The nature and extent of variations at the site will not become evident until construction. Where major variations appear it will be necessary for us to re-evaluate the recommendations of this report.

8.2 Design Review

As the geotechnical engineer for this project, we recommend that we be provided an opportunity to perform a general review of final plans and specifications for this project to determine that recommendations provided have been properly interpreted and included in the design. We assume no responsibility for misinterpretation or improper application of our recommendations and conclusions by others.

8.3 Continuity of Professional Responsibility

We recommend that we be retained to provide geotechnical engineering services during construction. This would allow us to observe compliance with the plans, compliance with the specifications and recommendations, provides continuity of professional responsibility, and allows design changes to be made in the event that subsurface conditions differ from those anticipated.

8.4 Safe Working Conditions

Responsibility to provide safe working conditions for earthwork and below grade aspects of this project is solely that of the contractors working on the project. It appears that the on site soils are generally OSHA Type B and C soils and should be excavated no steeper than 1 ½ :1 (horizontal:vertical). However, our site exploration was limited to three boring and test locations and therefore excavations should be evaluated individually at the time of construction by the contractor. All local, state and federal requirements, statutes, ordinances, and building codes relating to slopes or temporary sheeting and bracing of trenches and excavations must be observed during construction.

8.5 Exclusive Use

We have prepared this report for the exclusive use of the Krech Ojard & Associates for specific application to the design of the proposed Sheet Pile Bulkhead Wall on the C Reiss Dock in Superior, Wisconsin. Professional services provided to this project by us were completed, findings obtained, and recommendations prepared using generally accepted engineering principles and practices. Conclusions and recommendations contained herein are based upon the applicable standards of our profession at the time this report was prepared. No warranty, express or implied, is made.

APPENDIX

Boring Location Sketch (1 Page)
DPT Logs DPT-1 through DPT-3 (3 Pages)
CPT Logs CPT-1 through CPT-3 (3 Pages)
Soil Classification Data/Boring Log Notes (2 Pages)

TwinPortsTesting

TEST LOCATION SKETCH
C Reiss Dock Wall Rehabilitation
C Reiss Dock
Superior, Wisconsin

DRAWN BY: JJB	CHECKED BY: BMC
DATE: 12/28/2021	SCALE: N/A
DRAWING NO: 21G1417-01	DRAWING NO: 1/1
TPT PROJECT NO: 21G1417	REV: A

⊕ Approximate Boring Location

DPT-1

BORING LOG

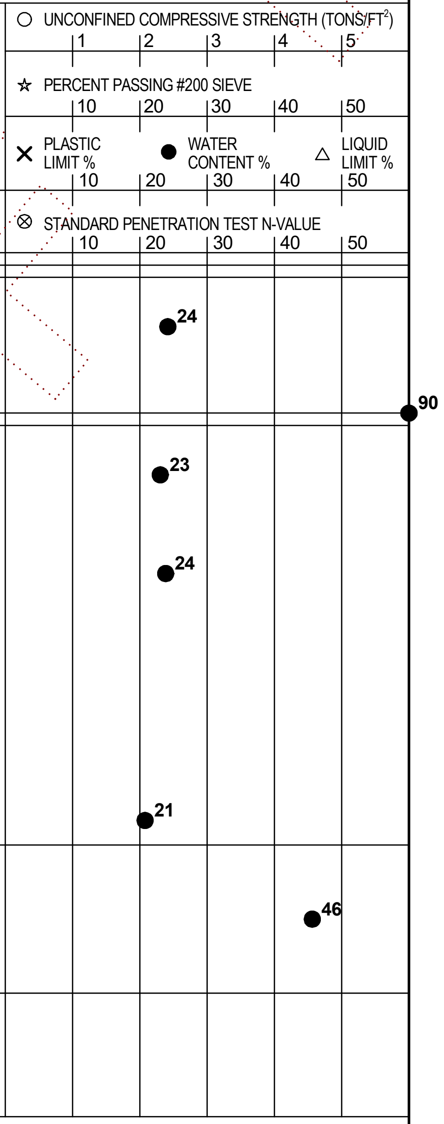
Page 1 of 1

PROJECT: **C Reiss Dock - Sheet Pile Bulkhead Wall**	CLIENT: **Krech Ojard & Associates, Inc.**	TPT Project No.: **21G1417**
ARCHITECT - ENGINEER: **Krech Ojard & Associates, Inc.**	SITE LOCATION: **Superior, Wisconsin**	
BORING LOCATION: **See Boring Location Sketch**	REPORT DATE: **5/27/22**	

SURFACE ELEVATION:

DEPTH (ft)	STRATA CHANGE DEPTH	DESCRIPTION OF MATERIAL
0.0	0.5	6 inches of concrete pavement
	1.0	(FILL) Poorly Graded Sand with silt and gravel, trace organics and fibers, fine to coarse grained, brown to dark brown, moist
		(FILL) Poorly Graded Sand, fine to coarse grained, trace gravel, trace organics and fibers, light brown to brown, moist to waterbearing
	6.5	(PT) PEAT, pieces of wood, fibric, dark brown, waterbearing
	7.0	(FILL) Poorly Graded Sand, trace silt, fine to coarse grained, brown, waterbearing
10.0		
		*No sample from 15 feet to 20 feet
20.0		*4 inch organic silt layer with shells at 22 feet
	24.0	(SM) SILTY SAND, layers of organic silt, some organics, wood, and fibers, trace shells, brown to dark brown, waterbearing
30.0	30.0	Boring then Backfilled with Bentonite End of Boring

SAMPLE NO.	SAMPLE TYPE
1	CS
2	CS
3	CS
4	CS
5	CS
6	CS



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

WATER LEVEL **2.5 ft WD**			
WATER LEVEL	BORING STARTED **10/13/21**	BORING COMPLETED **10/13/21**	ABBREVIATIONS: ACR-After Casing Removal, BCR-Before Casing Removal, AB-After Boring, WD-While Drilling, WS-While Sampling, NE-None Encountered, DB-Diamond Bit, HSA-Hollow Stem Auger, RB-Rock Bit, SS-Split Spoon, ST-Shelby Tube, PA-Power Auger, MR-Mud Rotary, CS-Continuous, RP-Rock Probe, PH-Percussion Hammer, WL-Water Level, WOH-Weight of Hammer, EIL-Exceeds Instrument Level, TS-Topsoil, PP-Pocket Penetrometer
WATER LEVEL	CAVE IN LEVEL		
SPT HAMMER **Percussion Hammer**	RIG **6625CPT**	CREW CHIEF **JJB**	

TwinPortsTesting

DPT-2

BORING LOG

Page 1 of 1

PROJECT:	CLIENT:	TPT Project No.:
C Reiss Dock - Sheet Pile Bulkhead Wall	**Krech Ojard & Associates, Inc.**	**21G1417**

ARCHITECT - ENGINEER:	SITE LOCATION:
Krech Ojard & Associates, Inc.	**Superior, Wisconsin**

BORING LOCATION:	REPORT DATE:
See Boring Location Sketch	**5/27/22**

SURFACE ELEVATION:

○ UNCONFINED COMPRESSIVE STRENGTH (TONS/FT^2) 1 2 3 4 5

☆ PERCENT PASSING #200 SIEVE 10 20 30 40 50

× PLASTIC LIMIT % ● WATER CONTENT % △ LIQUID LIMIT % 10 20 30 40 50

⊗ STANDARD PENETRATION TEST N-VALUE 10 20 30 40 50

DEPTH (ft) / ELEVATION (ft)	SAMPLE NO.	SAMPLE TYPE	WATER LEVEL	STRATA CHANGE DEPTH	DESCRIPTION OF MATERIAL	TEST RESULTS
0.0				0.3	3 inches of topsoil	
	1	CS	▼	0.8	(FILL) Poorly Graded Sand with silt and gravel, fine to coarse grained, light brown to brown, trace organics, roots, and fibers, moist	● 24
					(FILL) Poorly Graded Sand, fine to coarse grained, trace organics, roots, and fibers, orange-brown to brown, wet to waterbearing	
	2	CS		7.5	(PT) PEAT, pieces of wood, fibric, dark brown, waterbearing	● 232
				8.0	(FILL) Poorly Graded Sand, trace organics and fibers, fine to coarse grained, brown, waterbearing	
10.0	3	CS				● 25 ☆ 3
	4	CS				● 22
20.0				20.0	(FILL) Silt with sand, trace organics, fibers, and wood, brown, waterbearing	
	5	CS		20.5	(SP-SM) POORLY GRADED SAND with Silt, some organics, fibers, and pieces of wood, fine to coarse grained, brown, waterbearing	● 24
	6	CS				● 39
				28.0	(ML) SILT with Sand, trace organics, fibers, and wood, brown, waterbearing	
30.0				30.0	Boring the Backfilled with Bentonite End of Boring	

WATER LEVEL	*THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU, THE TRANSITION MAY BE GRADUAL.*		
2.5 ft WD			
WATER LEVEL	BORING STARTED **10/14/21**	BORING COMPLETED **10/14/21**	ABBREVIATIONS: ACR-After Casing Removal, BCR-Before Casing Removal, AB-After Boring, WD-While Drilling, WS-While Sampling, NE-None Encountered, DB-Diamond Bit, HSA-Hollow Stem Auger, RB-Rock Bit, SS-Split Spoon, ST-Shelby Tube, PA-Power Auger, MR-Mud Rotary, CS-Continuous, RP-Rock Probe, PH-Percussion Hammer, WL-Water Level, WOH-Weight of Hammer, EIL-Exceeds Instrument Level, TS-Topsoil, PP-Pocket Penetrometer
WATER LEVEL	CAVE IN LEVEL		
SPT HAMMER **Percussion Hammer**	RIG **6625CPT**	CREW CHIEF **JJB**	

TwinPortsTesting

DPT-3

BORING LOG

PROJECT: **C Reiss Dock - Sheet Pile Bulkhead Wall**

CLIENT: **Krech Ojard & Associates, Inc.**

TPT Project No.: **21G1417**

ARCHITECT - ENGINEER: **Krech Ojard & Associates, Inc.**

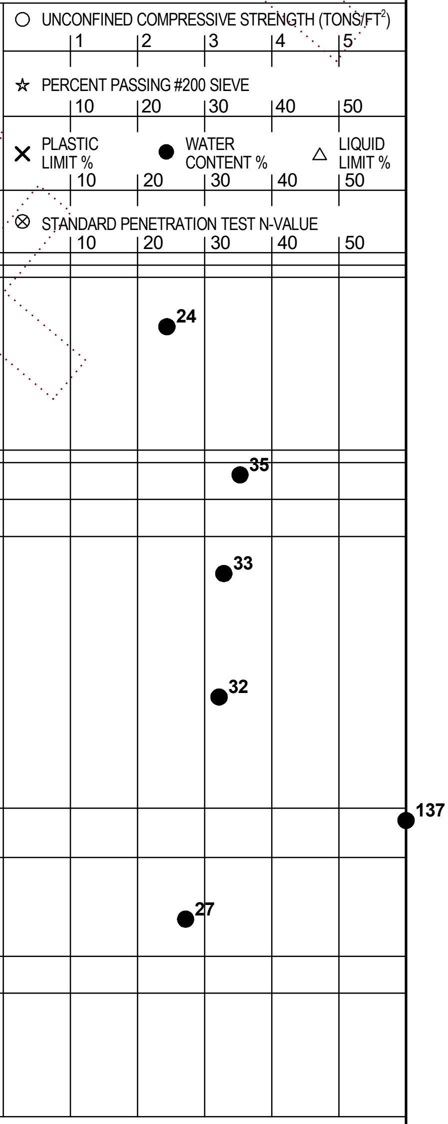
SITE LOCATION: **Superior, Wisconsin**

BORING LOCATION: **See Boring Location Sketch**

REPORT DATE: **5/27/22**

SURFACE ELEVATION:

DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	WATER LEVEL	STRATA CHANGE DEPTH	DESCRIPTION OF MATERIAL
0.0				0.5	6 inches of concrete pavement
	1	CS	▼	1.0	(FILL) Poorly Graded Sand with silt and gravel, fine to coarse grained, trace organics, roots, and fibers, brown to dark brown, moist
	2	CS			(FILL) Poorly Graded Sand, trace silt, trace organics and fibers, fine to coarse grained, light brown to brown, wet to waterbearing
				8.0	(PT) PEAT, trace organic silt, trace gravel, fibric, brown to dark brown, waterbearing
10.0				8.5	(FILL) Fat Clay, trace sand and gravel, brown to reddish brown, wet
	3	CS		10.0	(FILL) Poorly Graded Sand, trace silt, trace organics and fibers, light brown to brown, waterbearing
	4	CS		11.5	(FILL) Silt with sand, trace organics, fibers, and wood, brown, waterbearing *Shells at 13 feet 2 inch Peat layer at 13.3 feet
20.0	5	~~CS~~		22.5	(PT) PEAT, fibric, trace silt, waterbearing
	6	CS		24.5	(SM) SILTY SAND, some organics, fibers, and wood, fine to medium grained, brown, waterbearing
30.0				28.5	(SP) POORLY GRADED SAND, trace organics, fibers, and wood, fine to medium grained, brown, waterbearing
				30.0	End of Boring



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

WATER LEVEL: **3.0 ft WD**

WATER LEVEL:

WATER LEVEL:

BORING STARTED: **10/14/21**

BORING COMPLETED: **10/14/21**

CAVE IN LEVEL:

SPT HAMMER: **Percussion Hammer**

RIG: **6625CPT**

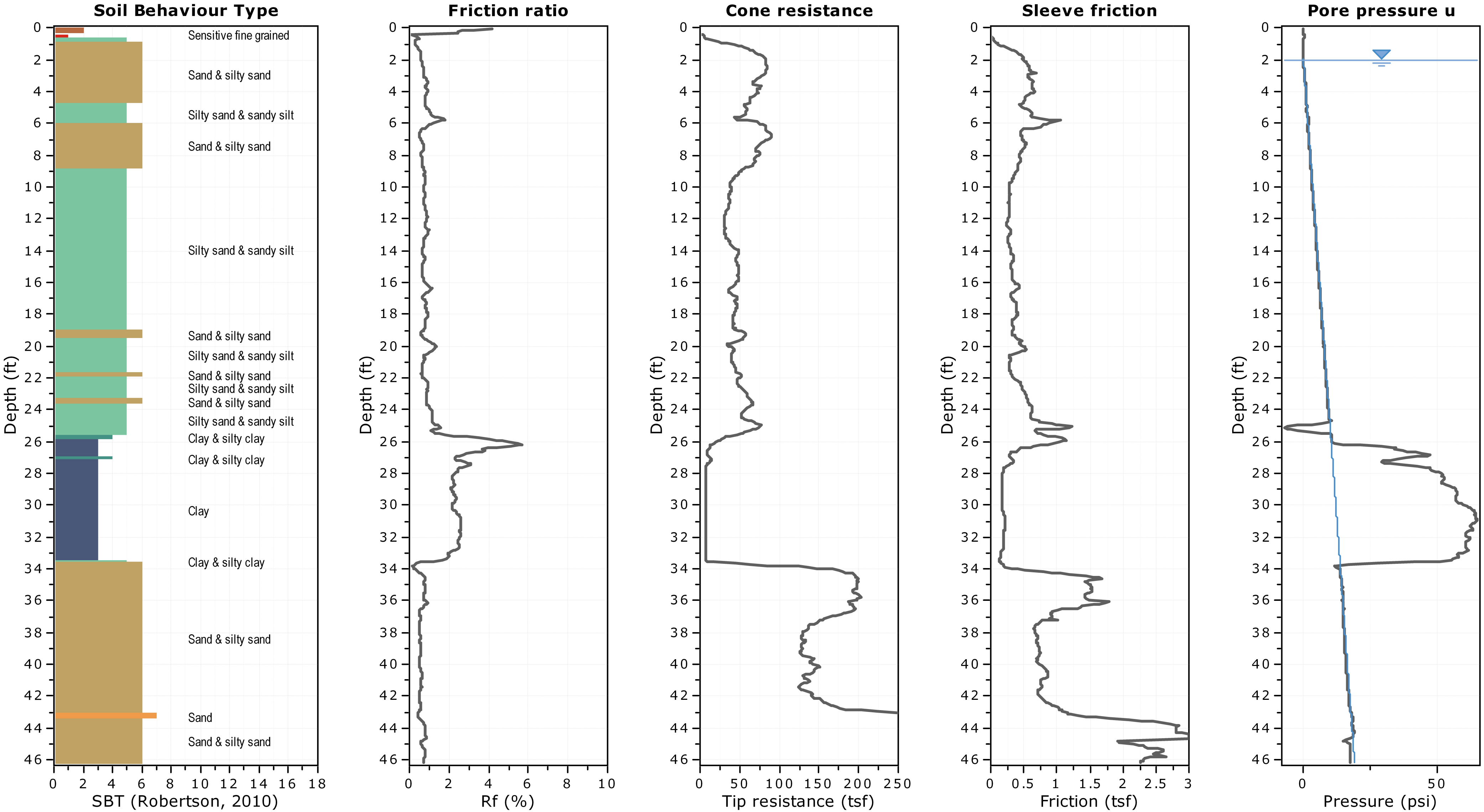
CREW CHIEF: **JJB**

ABBREVIATIONS: ACR-After Casing Removal, BCR-Before Casing Removal, AB-After Boring, WD-While Drilling, WS-While Sampling, NE-None Encountered, DB-Diamond Bit, HSA-Hollow Stem Auger, RB-Rock Bit, SS-Split Spoon, ST-Shelby Tube, PA-Power Auger, MR-Mud Rotary, CS-Continuous, RP-Rock Probe, PH-Percussion Hammer, WL-Water Level, WOH-Weight of Hammer, EIL-Exceeds Instrument Level, TS-Topsoil, PP-Pocket Penetrometer

Twin Ports Testing
1301 North 3rd Street
Superior, WI 54880
www.twinportstesting.com

CPT: CPT-1
Total depth: 46.19 ft, Date: 10/14/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 10 sq. cm. NOVA
Cone Operator: Jakob Bauer

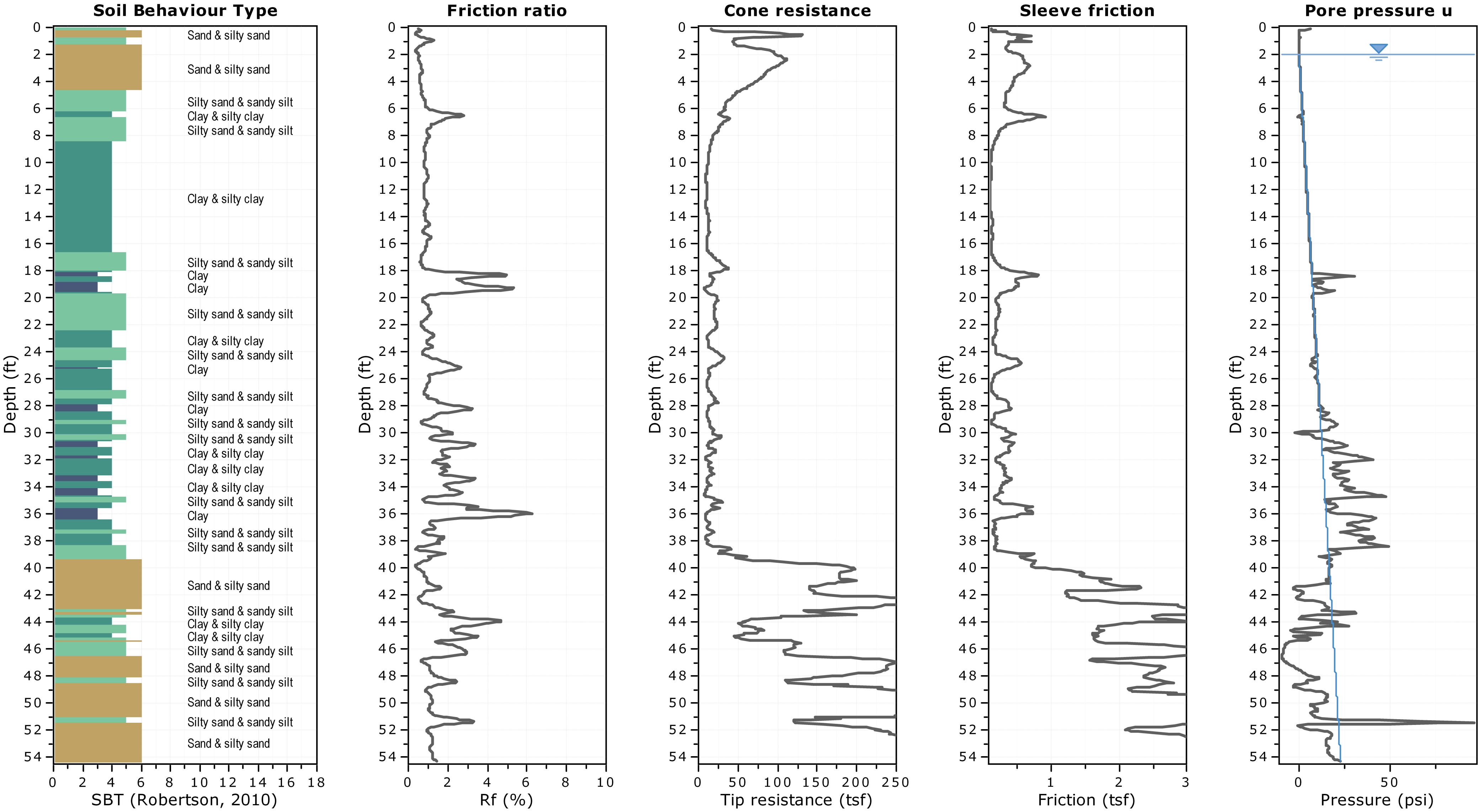
Project: **21G1417 C Reiss Dock Wall Rehabilitation**
Location: **Superior, WI**



Twin Ports Testing
1301 North 3rd Street
Superior, WI 54880
www.twinportstesting.com

CPT: CPT-2
Total depth: 54.33 ft, Date: 10/14/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 10 sq. cm. NOVA
Cone Operator: Jakob Bauer

Project: **21G1417 C Reiss Dock Wall Rehabilitation**
Location: **Superior, WI**

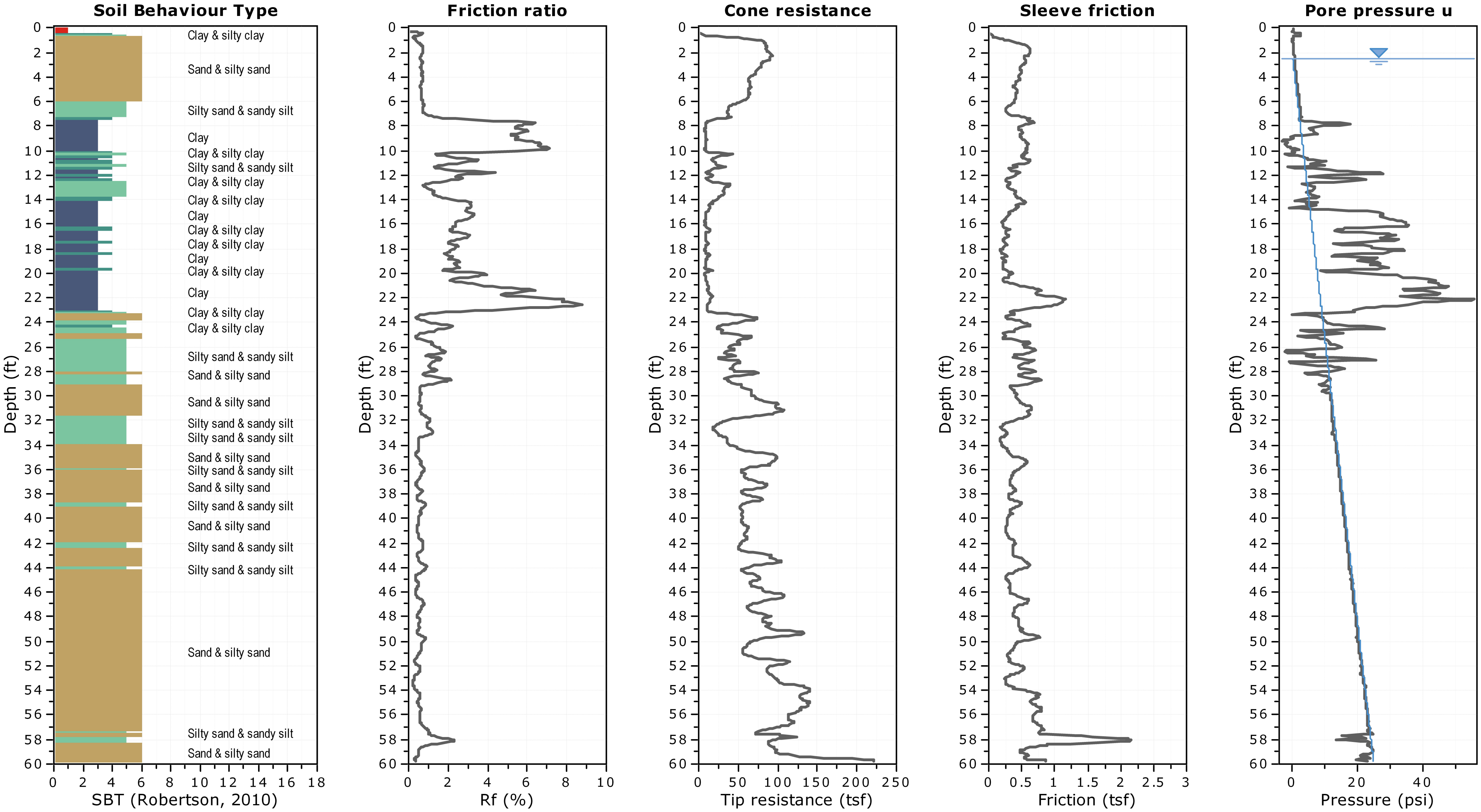


Twin Ports Testing
1301 North 3rd Street
Superior, WI 54880
www.twinportstesting.com

CPT: CPT-3

Total depth: 59.78 ft, Date: 10/14/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 10 sq. cm. NOVA
Cone Operator: Jakob Bauer

Project: **21G1417 C Reiss Dock Wall Rehabilitation**
Location: **Superior, WI**



Twin Ports Testing Inc.

BORING LOG NOTES

Water Level

Water levels indicated on the boring logs are as measured at stated times. In clean sand soils, the elevations indicated are considered relatively reliable levels. However, in less permeable soils, even after several days of monitoring, accurate determinations may not be possible. Therefore, additional/alternative methods of groundwater elevation monitoring should be sought.

Commonly Used Moisture Conditions of Soils

Term	Meaning
Dry	Requires the addition of considerable moisture to attain optimum for compaction
Moist	Near optimum moisture for compaction
Wet	Requires drying to attain optimum moisture for compaction
Waterbearing	Saturated granular soils

Gradation Description and Terminology

Soil Type	Particle Name	Size Range
Coarse Grained Soils	Boulders	Over 12"
	Cobbles	3"-12"
	Gravels	#4-3"
	Gravels – Coarse	¾"-3"
	Gravels – Fine	#4-¾"
	Sands	#200-#4
	Sands – Coarse	#10-#4
	Sands – Medium	#40-#10
	Sands – Fine	#200-#40
Fine Grained Soils	Silt	0.005 mm-#200
	Clay	Less than 0.005 mm

Descriptive Terms of Components Present in Sample (other than ASTM D 2487)

Term	Percent of Dry Weight
Trace	1-5%
With	5-12%
Some	12-30%
And	30-50%

Relative Density of Granular Soils

N-Value (SPT)	Relative Density	Standard "N" Penetration
0-4	Very Loose	Blows per foot of a 140 pound hammer falling 30" on a 2" outside diameter split barrel sampler
5-10	Loose	
11-30	Medium Dense	
31-50	Dense	
Over 50	Very Dense	

Consistency of Cohesive Soils

N-Value (SPT)	Consistency	(Q, tsf or kg/cm^2)
0-2	Very Soft	Less than 0.25
3-4	Soft	0.25-0.50
5-8	Medium	0.50-1.00
9-15	Stiff	1.00-2.00
16-30	Very Stiff	2.00-4.00
Over 30	Hard	4.00-8.00

Twin Ports Testing Inc.

UNIFIED SOIL CLASSIFICATION SYSTEM – ASTM D 2487

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS
(more than 50% of material is larger than No. 200 sieve size.)

		Clean Gravels (Less than 5% fines)
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines (More than 12% fines)
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
		Clean Sands (Less than 5% fines)
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with fines (More than 12% fines)
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

FINE-GRAINED SOILS
(50% or more of material 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 of 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 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

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 percent	GW, GP, SW, SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

PLASTICITY CHART