NOTICE OF ADDENDUM AND CLARIFICATION NO. 2
OHIO RIVER GREENWAY PROJECT
JANUARY 15, 2025
CITY OF JEFFERSONVILLE, INDIANA

To All Plan Holders of Record:

This document shall serve as notice of an addendum and clarification to the plans and specifications for the project. Each bidder shall acknowledge receipt of this addendum on the ACKNOWLEDGMENT OF RECEIPT OF ADDENDUM FORM in the Project's Contract Book. Failure to acknowledge the receipt of addendum could result in a bid being considered non-responsive and or non-responsible.

The following changes and clarifications are hereby made to the contract documents and officially incorporate this and all referenced documents into the requirements and bid documents for the project.

All registered plan holders will receive notice of this Addendum.

Plans and Specifications are revised or amended as follows:

The City of Jeffersonville has agreed to extend the bid date for the project to February 5th, 2025

1. DELETE: All references to the previous bid date of January 22, 2025
   ADD: A new bid date of February 5, 2025 to replace all references in the bid documents.
   CLARIFICATION: Revise seal proposal/bid submittal requirements below:

   Sealed proposals shall be submitted to: Clerk's Office
   City of Jeffersonville
   City Hall
   Suite 250
   500 Quartermaster Court
   Jeffersonville, IN 47130

   Sealed proposals may be submitted by registered mail or delivered in person prior to **9:30 a.m. local time, February 5, 2025,** at which time the proposals will be publicly opened and read aloud. **Proposals received after 9:30 a.m. local time will not be considered and will be returned to the bidder unopened.**

2. DELETE: The original Itemized Proposal in the Contract Documents
   ADD: The revised attached Itemized Proposal Dated January 15, 2025.
   CLARIFICATION: Bid Item 21. Railing Ornamental

   The actual quantity to be manufactured and installed by the Contractor is 1670 feet. The City desires approximately 318 to 323 feet (rough quantity, post spacing dependent) of railing to be manufactured and provided to the City for stock. The railing provided should be fabricated in duplication of the rail fabricated for Station 23+00 to 26+00. Bid Item 63, ORNAMENTAL RAILING FOR STOCK, has been added to the new Itemized Proposal. Contractor will be paid by measurement of quantities both provided and installed.

3. DELETE: Sheet Number 8 from the original plan set.
   ADD: The revised Sheet 8 from Addendum #2.

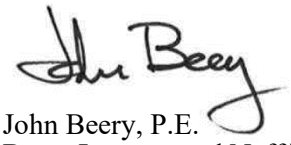
   Note: The change to Sheet 8 for Addendum #2 is to remove Structure No. 201 to below revetment rip rap grade. Removal of this item shall be paid for under Item 64 of the revised Itemized Proposal. Work complete for this item shall be to remove the existing railing and stair/ramp structure to subgrade for proposed rip rap. Revetment Rip Rap, Geotextiles and Curb Quantities have been updated for proposed restoration quantities for the proposed removal. The removal of the stair/ramp structure shall include the removal of the existing railing and guardrail. All other restoration not specifically paid for by individual items shall be included in the cost for removal of this item.

4. An additional copy of the Geotechnical Report for the project is provided as part of this Addendum to be included in the contract documents.

5. The last day for questions on the project is Monday, January 27 at 12:00 PM.

Please make a note an amend all project related information and bids as required.

Respectfully Submitted,



John Beery, P.E.
Beam Longest and Neff/Egis Group

egis | BLN
BEAM·LONGEST·NEFF

IMAGINE. CREATE. ACHIEVE.
a sustainable future

January 13, 2025

PRE-BID MEETING MINUTES

Meeting Date: January 13, 2025
Project: Ohio River Greenway Trail Construction

Attended By: Tyler Payne, Libs
Alex Bend, Libs
John Beery, Director, Urban Transport and Urban Development, Egis BLN
Ryan Whelchel, Bridge Engineer, Egis BLN
Jeff Jameson, Apex Design
Shaq Parker
Marty Sabla, Hall Contracting
Rob Waiz, City of Jeffersonville
Theresa Treadway, City of Jeffersonville
Delynn Campbell, City of Jeffersonville
John Kraft, MAC Construction
Eric Stumler, MAC Construction

A pre-construction meeting was held on January 13, 2025 for the referenced project. A list of all attendees is reported above. The following is a summary of comments made at the meeting:

1. After a few introductions, Mr. Beery called the meeting to order at approximately 10:00 am (EST) and provided a brief overview of the proposed scope of work.
2. Prior to the meeting there was a request to extend the advertisement period to give contractors more time to develop their estimates. At that time, the City of Jeffersonville agreed to a 1 week extension, which was issued in Addendum #1.
    a. During the meeting, it was requested that an additional week be added to provide time for estimating. The previously approved time extension set the bid opening date to 1/29/2025. The proposed request was to set the bid opening date to 2/5/2025. The City of Jeffersonville decided to discuss the additional time internally and provide clarification to the contractors.
3. Prior to the meeting, a railing contractor reached out to Mr. Berry to confirm that the additional railing quantity in the contractor was for stock railing, to be used for repairs in case of damage. Mr. Beery confirmed the intent of the additional railing quantity. The railing contractor pointed out that the proposed railing would have a custom profile based on the proposed trail profile, which would be difficult to repair with stock railing.
    a. During the meeting, Mr. Waiz stated that paying for stock railing as part of this contract would be the best path forward to avoid future disputes over funding for damage repairs. The sections of railing most likely to be damaged during flood events would be stocked for future repairs. No change to the original quantity would be needed.
4. Mr. Beery stated that, per the project specifications, the substantially complete date for the project is July 1, 2025.
5. Mr. Beery announced that all bid documents are posted on Eastern Engineering's website for any interested contractor.
6. Mr. Beery stated that all permits for the project, CSGP, IDNR, and Army Core 401/404, have been received for the proposed work and included in the book of specifications.

7. Mr. Beery opened the floor to questions and comments on the proposed bid documents.
    a. A link to the plan room was requested by Apex Design. Mr. Beery will send a link to the contact information provided on the sign-in sheet.
    b. MAC Construction requested additional details on the proposed cut walls. Mr. Whelchel stated that the procurement of the cut walls will follow Section 734 of the 2024 Indiana Standard Specifications. This section allows a contractor to select their preferred wall system in accordance with the approved geotechnical report.
    c. MAC Construction requested the full geotechnical report. Mr. Beery stated that he would check the bid documents and provide clarification.
    d. Mac Construction asked if there were any work restrictions. Ms. Rutherford stated that no work would be allowed during Thunder on the Ohio and added that work on the project would be requested to shut down on the preceding Wednesday or Thursday.
8. The meeting was adjourned at 10:21 am.

This is our understanding of the comments made at the meeting. If you have any additional comments or revisions, please contact us.

Very truly yours,
Egis BLN USA, Inc.

John Beery, P.E., PTOE, PTP

RTW/jb
Enclosure
xc: All Attendees
Bill Stuart, Project Coordinator, Egis BLN
File #230005

BEAM, LONGEST & NEFF, LLC

PAGE____ OF____

JOB Ohio River Greenway

ITEM

DES. ____ DATE ____

CK. ____ DATE ____

MEETING ATTENDANCE SHEET

NAME	Phone	COMPANY	EMAIL	Phone
John Beery		EGIS-BLN	John.Beery@Egisgroup.com	
Ryan Welchel		"		
Tyler Payne		Libs Paving	tylerp@libspaving.com	
Alex Beard		Libs Pavers	Alex@libspavers.com	
Jeff Jameson		Apex Design	JeffJ@Apexdesigninc.com	
Shaq Parker ←			Shaq.Parker@Mypool and patio.com	
Marty Sabla	502-295-0735	Hall Contracting	MSabla@Hallky.com	
Rob Walz		City of Jeff		
Theresa Treadway		City of Jeff		
Delynn Campbell		City of Jeff	dCampbell@cityofjeffind	
John Kraft		MAC Const.	Estimator@macconstructionco	
Eric Stumler		MAC Const	eric s@macconstruction.com	

CTL Engineering, Inc.
1310 S. Franklin Road
Indianapolis, Indiana 46239
Phone: (317) 295-8650 • Fax: (317) 295-8395
www.ctleng.com

Consulting Engineers – Testing – Inspection Services – Analytical Laboratories

June 4, 2023

Beam, Longest and Neff, LLC
8320 Craig Street
Indianapolis, Indiana 46250

Attention: Mr. John Beery, PE, PTOE, PTP
Traffic, Pedestrian, and Planning Services Manager

Reference: Geotechnical Exploration
Jeffersonville Ohio River Greenway Phase II
Clark County, IN
CTL Project No.: 23050035IND

Dear Mr. Beery:

CTL Engineering, Inc. has completed the geotechnical exploration for the above referenced site. This report includes the results of the field and laboratory testing, and geotechnical recommendations for the proposed Jeffersonville Ohio River Greenway, retaining walls, and earthwork related activities of the project.

Thank you for the opportunity to be of service to you on this project. If you have any questions or need further information, please contact us at (317) 295-8650.

Sincerely,

CTL ENGINEERING, INC.

Shawn M. Marcum, PE
Geotechnical Service Line Manager

GEOTECHNICAL EXPLORATION

JEFFERSONVILLE OHIO RIVER GREENWAY PHASE II
CLARK COUNTY, IN
CTL PROJECT NO.: 23050035IND

PREPARED FOR:

BEAM, LONGEST AND NEFF, LLC
8320 CRAIG STREET
INDIANAPOLIS, INDIANA 46250

PREPARED BY:

CTL ENGINEERING, INC.
1310 S. FRANKLIN ROAD
INDIANAPOLIS, INDIANA 46239

JUNE 4, 2023

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LIST OF APPENDICES

I. PROJECT LOCATION AND DESCRIPTION

The project identified as Jeffersonville Ohio River Greenway – Phase II is located adjacent to the Ohio River between US 31 and I-65 in the City of Jeffersonville, Indiana. The project involves the design and construction of a trail extension starting at Station 10+00.00 at Riverside Drive, extending southward and eastward along the Ohio River and ending at Station 26+72.30 Line "A", approximately 1,672 feet in length. The plans dated 3/23/2016 indicate that the Greenway will be constructed at or near the existing grade, in cut of approximately 2 feet in maximum depth and on fill up to approximately 12 feet in height. The proposed Greenway is expected to be 10 feet in width with 2-foot compacted aggregate shoulder on each side. Retaining walls are proposed at the locations summarized below in Table 1.

Table 1 – Locations of Proposed Retaining Walls

Station		Offset	Line	Wall Length	Wall Exposed Height
From	To			(feet)	(feet)
19+25±	19+65±	7.5' Rt	A	40±	3.7
20+75±	26+73±	7.5' to 8.0' Rt	A	623±	6.6
24+00±	26+73±	7.5' Lt	A	273±	3.5

II. SUBSURFACE INVESTIGATION

Seven test borings, designated as B-1 through B-7, were drilled for the proposed greenway to depths ranging from 13.9 to 32 feet below existing grade. Approximate locations of the test borings are shown on the attached Boring Location Plan in Appendix A.

The test borings were advanced with an ATV mounted drilling rig utilizing hollow stem augers (HSA) between the time period of April 11th and April 14th, 2023. Standard Penetration Tests were conducted using a 140-pound automatic hammer falling 30 inches to drive 2-inch O.D. split barrel sampler for 18 inches. Rock coring was performed in B-7 using a 2-inch NQ core barrel and diamond bits.

Soil and rock samples obtained from the drilling and coring operation were preserved in glass jars or core boxes, and visually classified in the field by the drilling crew and in the laboratory by an engineer. The recovered soil samples were tested for Natural Moisture Content. Representative soil samples were tested for Atterberg Limits, Grain Size Distribution, Unconfined Compressive Strength, Specific Gravity, One-dimensional Consolidation, Triaxial Testing and pH testing.

Drilling, soil sampling and laboratory testing were performed following standard geotechnical engineering practices, INDOT and current AASHTO/ASTM procedures. Results from field tests are shown on the enclosed Test Boring Records in Appendix B and laboratory test results in Appendix C.

Latitude and Longitude coordinates of the test borings were estimated from Google Earth and then located using a GPS system. Station, offsets and surface elevations of the test borings were interpolated from the plans dated 3/26/15. Boring locations and surface elevations shown on the Boring Location Plans in Appendix A and on Test Boring Records in Appendix B should be considered approximate.

III. FINDINGS

Test borings B-1, B-4 and B-5 encountered a surface cover consisting of approximately 4 inches of hot-mix asphalt (HMA) pavement over 0 to 12 inches of sand and gravel base material. Borings B-6 and B-7 drilled within the existing trail encountered 4 to 5 inches of cement concrete pavement (PCC). Test boring B-3 encountered 2 inches of surficial soil (topsoil).

Below the surficial soil/pavement, test borings B-1, B-3 and B-5 encountered fill material to depths ranging from 3 to 12 feet. The fill material consisted of silty clay loam of A-4 and A-6 soil categories. Crushed stone with sand fill was encountered to a depth of 6 feet in Test Boring B-7. Below the fill in these borings and below the surface cover in the remaining borings, unstratified, unsorted soils consisting of silty clay loam, silty loam, sandy loam and/or sandy clay of soil categories A-4 and A-6 were encountered overlying sand, gravelly sand and/or sand and gravel of the A-1-b soil category. Standard Penetration Blowcount (N-values) values of the upper cohesive soils ranged from 3 to 11 blows per foot (bpf) and natural moisture content values ranging from 6 to 34 percent. Standard Penetration Blowcounts (N-values) values of the natural granular soils ranged from 4 to 25 blows per foot (bpf). Blowcounts in excess of 50 bpf for several inches of penetration are due to striking on bedrock, coarse aggregate, cobbles and/or boulders.

The cohesive soils exhibited Liquid Limit (LL) values ranging from 26 to 38 and Plasticity Index (PI) values ranging from 7 to 13. The pH values of the soils ranged from 5.8 to 6.5. Detailed information of soil types and standard penetration values are shown in the Test Boring Records in Appendix B and Laboratory Test Results in Appendix C. A generalized soil profile is included in Appendix D.

Below the soil overburden, the test borings encountered highly weathered to weathered, hard, highly fractured to fractured, limestone bedrock at depths summarized below in Table 2. Rock coring was performed in test boring B-7. The recovered bedrock

exhibited rock recovery values ranging from 95 to 98 percent and Rock Quality Designation (RQD) values of 10 and 45 percent, averaging 35 percent. The recovered rock exhibited a compressive strength of 6,220 psi. Detailed information of rock type and RQD values are shown in the Test Boring Records in Appendix B. The photograph of the rock core is also included in Appendix B.

Table 2 – Bedrock Location and Depth

Test Boring No.	Surface Elevation (1)	Bedrock		Auger Refusal on Rock	
		Depth (ft)	Elevation	Depth (ft)	Elevation
B-1	447.2	30.5	416.7	32.0	415.2
B-2	430.0	13.0	417.0	14.0	416.0
B-3	427.0	13.0	414.0	13.9	413.1
B-4	435.0	21.0	414.0	23.0	412.0
B-5	436.2	20.5	415.7	20.5	414.2
B-6	426.8	16.0	410.8	16.4	410.4
B-7 (2)	424.2	14.5	409.7	15.0	409.2

(1) *Surface elevations were estimated from Stage 1 plans dated 3/26/15 and should be considered an estimate.*

(2) *Rock coring was performed.*

Groundwater was recorded during the drilling operation as shown on the attached Test Boring Records in Appendix B and summarized below in Table 3. It should be noted that fluctuations in groundwater levels should be expected over time and variations in precipitation and fluctuation in the pool elevation of the adjacent Ohio River. Based on available Indiana Department of Natural Resources mapping, the 100-year flood level in the project area is at Elevation 449.7.

Table 3 – Groundwater Readings

Boring No.	Groundwater Depth (feet)			Cave-in Depth (feet)
	During Drilling	At Completion	Delayed Reading	
B-1	28.0	Dry	Dry @ 1 hour	20.0
B-2	7.0	Dry	Dry @ 24 hours	5.8
B-3	6.0	Dry	Dry @ 24 hours	5.6
B-4	18.0	Dry	Dry @ 24 hours	13.3
B-5	17.0	Dry	Dry @ 24 hours	5.3
B-6	10.0	Dry	Dry @ 24 hours	5.0
B-7	6.0 (1)	Dry	3.7 @ 24 hours (1)	4.2

(1) *Water introduced in the borehole during rock coring.*

IV. DISCUSSION AND RECOMMENDATIONS

A. Seismic Coefficients

Based on the soil type and Standard Penetration Test (SPT), the Site Class for the specific site meets the requirements of Class C in accordance with AASHTO LRFD Bridge Design Specifications 9th Edition (2020) Table 3.10.3.1-1. From Table 3.10.6-1, Seismic Zones, an Acceleration Coefficient (S_{D1}) of 0.120 indicates the site is in Seismic Zone 1. The Site Modified Peak Ground Acceleration Coefficient (A_s, PGA_M) is 0.114. In accordance with INDOT Geotechnical Design Memorandum No. 2010-02, liquefaction assessment is not required because the site is determined to be in Seismic Zone 1. Additional seismic coefficients are provided in Appendix E.

B. Embankments

The proposed section of the Ohio River Greenway Phase II will be constructed mainly along the Ohio River. The proposed embankment will be constructed up to 12 feet in height. The side slope of the proposed embankment facing the Ohio River is proposed to be constructed at a slope rate of 2:1 (H:V). The inside slope of the proposed embankment will be constructed at a slope rate of 4:1 (H:V) or flatter. This construction will create a V-shape channel between the existing and proposed embankments.

Based on visual observation during field checks in 2016 and 2022, the toe of the existing embankment between approximately Stations 12+00 and 15+00 has experienced erosion and scouring. Also, at the time of field checks, the existing embankment within the proposed project area exhibited soft surface condition which may be a result seepage from the higher elevation areas and adjacent parking lots.

Based on the above considerations, construction of the proposed embankment using cohesive soil material is not recommended due to:

1. The V-channel between existing and proposed embankments and water seepage from higher elevations could result in unwanted heavy volume of seepage water within the proposed embankment. Water accumulation and/or seepage within the new embankment will reduce the strength of the fill with time and increase the risk of embankment failure.

2. Steepness of the proposed embankment side slope facing the Ohio River.

3. Possible erosion and scoring along the toe of the new embankment during flood events of the Ohio River.

4. Frequent flooding of the Ohio River in the project area resulting in possible rapid drawdown conditions within the proposed embankment.

Based on the above concerns, it is recommended that the new embankment be constructed using rock fill over permeable geotextiles up to 2 ft below the proposed trail pavement. The toe of embankment shall be protected and the face of the rock fill shall be sized to protect the slope against scour based on the velocity adjacent Ohio River.

Site preparation and recommendations for embankment construction are provided in the following paragraphs.

a. Total settlement of the embankment fills may vary due to variations on the foundation soil's composition, thickness of fill, void ratio, depth to groundwater and loading. However, it is estimated that the total settlement below the maximum fill height (12 ft) is on the order of 1-1/2 inches.

b. Proposed embankment fills placed on existing embankments shall be benched and compacted in accordance with Section 203.21. Soft/wet soils or loose/wet soils may be encountered beneath the proposed embankment fills depending upon time of construction, amount of precipitation and pool elevation of the Ohio River. If such soils are encountered, the soils shall be removed to a depth of 12 inches±. Geotextiles 918.02 (a) Type 2A (NW) shall be placed at the base of the rock fill. Foundation improvement will be at the discretion of the Engineer.

c. As shown in Appendix F, slope stability analysis performed at Station 11+50 indicated a minimum safety factor of 1.7 for the embankment constructed at a slope rate of 2H:1V for a height of about 12 feet. Therefore, fill embankment side slopes constructed at a slope rate of 2H:1V or flatter as shown on the plans and cross sections are considered safe against deep seated failure if rock fill is used for the embankment construction. All slopes should be protected from erosion and scouring.

d. Backfill materials required for subgrade construction should be placed and compacted in accordance with ISS Section 203.

e. Temporary excavations more than 5.0 feet in depth should be sloped and/or shored according to OSHA requirements.

C. Retaining Walls

Approximately 40% of the length of the proposed trail will be constructed and/or contained within retaining walls. Conventional concrete retaining walls with footings as shown on the plans are not recommended due to complexity of construction (shoring for excavations, dewatering, soft soils, etc) and the potential of reducing the slope stability of the adjacent existing embankment slopes. Therefore, we recommend the use of permanent soldier pile and lagging walls and/or sheet pile walls.

As shown in Appendix G, preliminary analyses for a soldier pile and lagging wall for the maximum exposed wall height (6.6 feet) at Station 23+00 has been performed. The preliminary analyses for this wall indicate for an exposed face of 6.6 feet, a soldier pile and lagging wall consisting of HP 12x53 steel piles spaced at 6 feet (center to center) may support the Greenway. An estimated deflection of 1/2-inch has been calculated for this model. The preliminary analyses are included in Appendix G.

Preliminary analyses for a soldier pile and lagging wall for the maximum exposed wall height (3.7 feet) at Station 19+50 has been performed. The preliminary analyses for this wall indicate for an exposed face of 3.7 feet, a soldier pile and lagging wall consisting of HP 12x53 steel piles spaced at 8 feet (center to center) may support the Greenway. An estimated deflection of 1/2-inch has been calculated for this model. The preliminary analyses are included in Appendix G.

Based on our preliminary analyses, the retaining walls along the banks of Ohio River may be constructed using soldier pile and lagging walls socketed into the underlying limestone bedrock. We recommend a 4 feet minimum socket into competent limestone for the soldier piles. After predrilling through the soil overburden, coring of the bedrock and placement of the soldier pile, the cored hole shall be backfilled with concrete and the predrilled hole through the soil overburden shall be backfill with B-borrow. Temporary casing will be needed to prevent caving of the overburden soils.

D. Pavement Considerations

The proposed greenway trail may be designed using the soil parameters provided in Table 4. The recommended subgrade treatment should be performed in accordance with INDOT Standard Specification Section 207.

After removal of existing pavement, surficial soils, trees including stumps, roots, and/or organically contaminated soils, the exposed foundation soils should be proofrolled in accordance with 203.26, where applicable. Depending upon the

time of construction and amount of precipitation, the foundation soils may exhibit unstable condition under proofrolling. In such an event, the foundations soils shall be improved in accordance with 203.09. Foundation improvement will be at the discretion of the Engineer.

Table 4 – Soil Parameters for Pavement Design

Resilient Modulus (M_R) of Prepared Subgrade	4,500 psi
Resilient Modulus (M_R) of Natural Subgrade	3,000 psi
Predominant Soil Type	Silty Clay Loam, A-6
% Passing #200	74
% Silt	51
LL	34
PL	21
PI	13
Depth to Water Table	6 feet below existing grade
Natural Density (pcf) of Natural Subgrade	125
% Moisture of Natural Subgrade	22
% Organic Content	N/A
% Marl Content	N/A
Sulfate Content, ppm	N/A
Rock Elevation	> 13 feet
Subgrade Treatment	Type II

E. General Site Preparation and Earthwork

The following general site preparation and earthwork recommendations are provided for full depth pavement.

1. All surface objects, pavement, grass, vegetation, topsoil and roots, located within the construction limits, shall be cleared and grubbed in accordance with ISS Section 201.

2. Subsequent to site grading and breaking and/or removing the existing pavement following ISS 203.22, the exposed foundation soils should be proofrolled following ISS procedures, where applicable. Soft and/or wet

foundation soils not meeting the proofrolling requirements shall be removed and treated in general accordance with ISS 203.09.

3. Fluctuations in the groundwater level can occur with seasonal weather conditions and the pool elevation of the Ohio River. Excavations during construction may encounter groundwater at or near the depths shown on the attached Test Boring Records in Appendix B and will be effected by the pool level in the adjacent Ohio River. Temporary dewatering during excavation should be anticipated. Dewatering, if needed, may be accomplished using well points, sump pumps or as proposed by the contractor and approved by the Engineer.

4. During earthwork operations, care should be taken to provide adequate drainage on the exposed soils. The subgrade should be graded at the end of each day, to facilitate good drainage.

5. Borrow material needed in fill areas should be in accordance with ISS Section 211. Topsoil and/or organically contaminated materials are not acceptable for use as backfill.

6. The backfill should be placed and compacted in accordance with ISS Section 203. The engineered fill should not be placed in a frozen condition or over a frozen subgrade.

7. All subgrade soils and pavement materials should conform to the latest issue of INDOT Construction and Material Specifications.

V. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year. If the scope of the project changes the recommendations may change and may require additional investigation.

VI. TESTING AND OBSERVATION

During the design process, it is recommended that CTL work with the project designers to confirm that the mentioned geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing. CTL is not responsible for independent conclusions, opinions and recommendations made by others based on the data and the recommendations provided in this report.

VII. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of the Client in accordance with an executed contract. The Client's use of or reliance on this report is limited by the terms and conditions of the contract and by the qualifications and limitations stated in the report. It is also acknowledged that the Client's use of and reliance of this report is limited for reasons which include actual site conditions that may change with time; hidden conditions, not discoverable within the scope of the assessment, may exist at the site; and the scope of the investigation may have been limited by time, budget and other constraints imposed by the Client.

Neither the report, nor its contents, conclusions or recommendations, are intended for the use of any party other than the Client. Consultant and the Client assume no liability for any reliance placed on this report by such party. The rights of the Client under contract may not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld.

This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

To the fullest extent permitted by law, the Consultant and Client agree to indemnify and hold each other, and their officers and employees harmless from and against claims, damages, losses and expenses arising out of unknown or concealed conditions. Furthermore, neither the Consultant nor its employees shall be liable to the Owner in an amount in excess of the available professional liability insurance coverage of the Consultant. In addition, Client and Consultant agree neither shall be liable for any special, indirect or consequential damages of any kind or nature.

The Consultant's services have been provided consistent with its professional standard of care. No other warranties are made, either expressed or implied.

Sincerely,

CTL ENGINEERING, INC.

Shawn M. Marcum, PE
Senior Geotechnical Engineer

Anthony Mason, PE
Senior Geotechnical Engineer

APPENDIX A

GENERAL SITE PLAN
BORING LOCATION PLANS

CITY OF JEFFERSONVILLE
TRAIL CONSTRUCTION PLANS

CONSTRUCTION PLANS

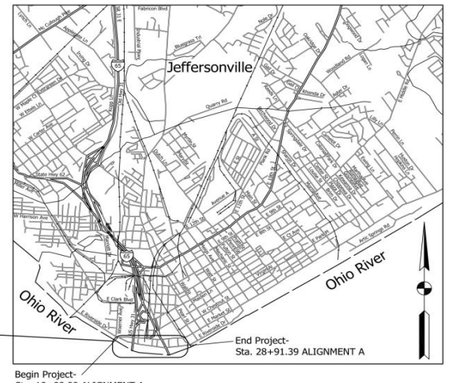
ROUTE: JEFFERSONVILLE OHIO RIVER GREENWAY

PROJECT NO. 140007 P.E.

Net Length: 1,891.39'
Maxmimum Grade: 6.0%

PROJECT LOCATION SHOWN BY
CLARK COUNTY

LATITUDE: 38°16'3.50"N LONGITUDE: 85°44'52.32"W



LOCATION MAP
SCALE: NONE

INDIANA DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS DATED 2016
TO BE USED WITH THESE PLANS.

PLANS PREPARED BY:

BLN Beam, Longest and Neff, LLC
Consulting Engineers, Land Surveyors, Land Planners & Landscape Architects

8126 Castleton Road, Indianapolis, IN 46250 Phone: 317.849.5832 www.B-L-N.com Fax: 317.841.4281

FOR INTERNAL USE ONLY

PLANS PREPARED BY: BEAM, LONGEST & NEFF, LLC (317)849-5832 PHONE NUMBER

CERTIFIED BY: SIG_DATE DATE

APPROVED FOR LETTING: INDIANA DEPARTMENT OF TRANSPORTATION DATE

BRIDGE FILE	
DESIGNATION	
DRAWING NO.	SHEETS
	1 of 42
CONTRACT	PROJECT
	140007

jpatel | p:\140007 - jeffersonville o.r. greenway\dwgs\cd\cover sheet.dwg | title sheet | 3/23/2016 7:43:11 AM ||

GENERAL SITE PLAN

Source: Beam, Longest and Neff, LLC		**Date** 5/24/2023	Ohio River Greenway Phase II Jeffersonville, IN		
	CTL ENGINEERING, INC. GEOTECHNICAL ENGINEERS TESTING * INSPECTION LABORATORY SERVICES	**Scale** None			
		Drawn By SAH	**Reviewed By** AK	**Page** 1 of 1	**Project No.** 23050035IND

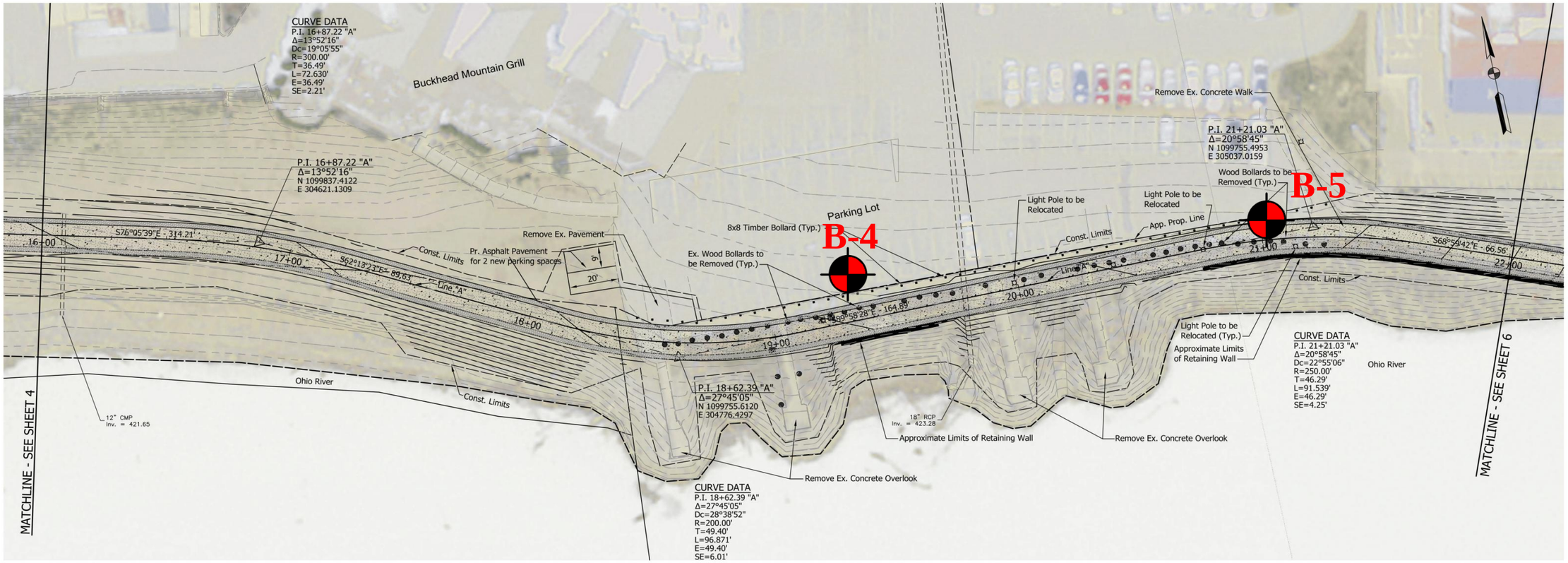
LEGEND

Test Borings

BORING LOCATION PLAN					
Source: Beam, Longest and Neff, LLC		**Date** 6/2/2023	Ohio River Greenway Phase II Jeffersonville, IN		
CTL ENGINEERING	***CTL ENGINEERING, INC.*** GEOTECHNICAL ENGINEERS TESTING * INSPECTION LABORATORY SERVICES	**Scale** None			
		Drawn By SAH	**Reviewed By** AK	**Page** 1 of 2	**Project No.** 23050035IND

LEGEND

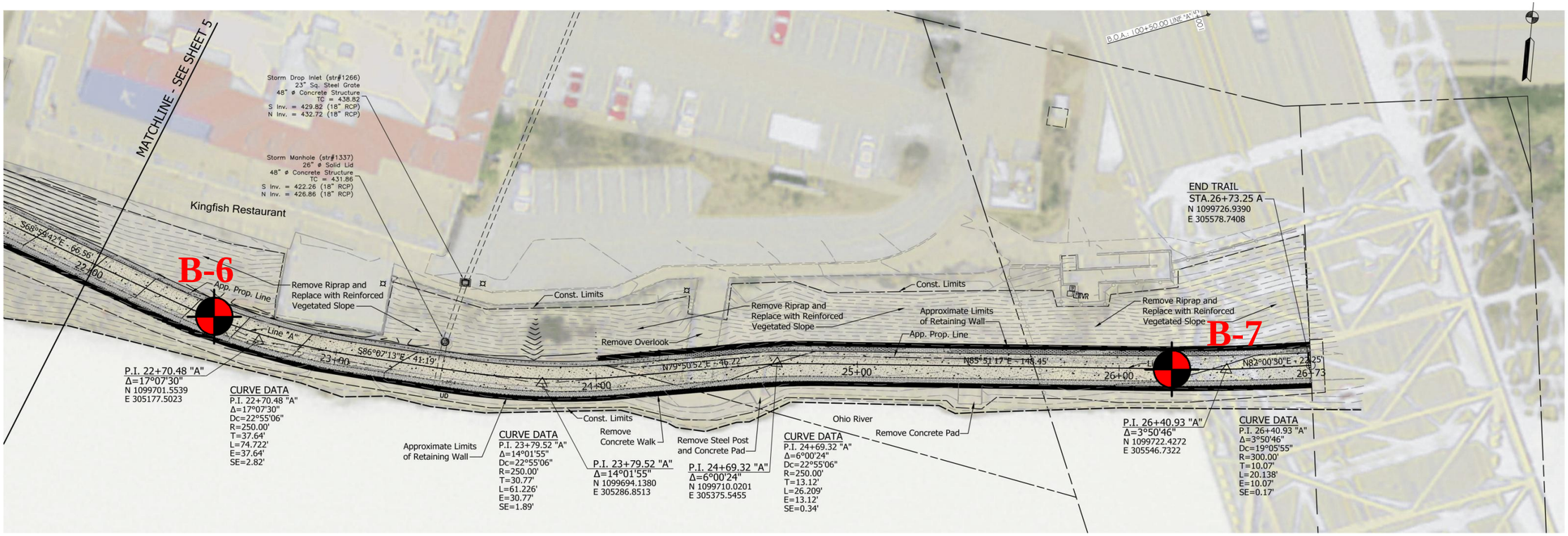
Test Borings



BORING LOCATION PLAN					
Source: Beam, Longest and Neff, LLC		**Date** 6/2/2023	Ohio River Greenway Phase II Jeffersonville, IN		
CTL ENGINEERING	***CTL ENGINEERING, INC.*** GEOTECHNICAL ENGINEERS TESTING * INSPECTION LABORATORY SERVICES	**Scale** None			
		Drawn By SAH	**Reviewed By** AK	**Page** 2 of 3	**Project No.** 23050035IND

LEGEND

Test Borings



BORING LOCATION PLAN					
Source: Beam, Longest and Neff, LLC		**Date** 6/2/2023	Ohio River Greenway Phase II Jeffersonville, IN		
CTL ENGINEERING	***CTL ENGINEERING, INC.*** GEOTECHNICAL ENGINEERS TESTING * INSPECTION LABORATORY SERVICES	**Scale** None			
		Drawn By SAH	**Reviewed By** AK	**Page** 3 of 3	**Project No.** 23050035IND

APPENDIX B

TEST BORING RECORDS
ROCK CORE PHOTOGRAPH

SOIL DESCRIPTION

NON-COHESIVE SOIL DESCRIPTION	STANDARD PENETRATION BLOWCOUNTS PER FOOT (BPF)
Very Loose	0 - 5
Loose	6 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	STANDARD PENETRATION BLOWCOUNTS PER FOOT (BPF)
Very Soft	0 - 3
Soft	4 - 5
Medium Stiff	6 - 10
Stiff	11 - 15
Very Stiff	16 - 30
Hard	Over 30

GRADATION COMPONENT	SIZE
Boulders	Retained on 8"
Cobbles	Passing 8" Retained on 3"
Gravel	Passing 3" Retained on #10
Sand	Passing #10 Retained on #200
Silt	0.075 mm to 0.002 mm
Clay	Smaller than 0.002 mm

MOISTURE TERMS	DESCRIPTION
Dry	Powdery
Slightly Moist	Below Plastic Limit
Moist	Above Plastic, Below Liquid
Very Moist	At Liquid
Wet	Above Liquid

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-1**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 2
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-14-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-14-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 447.2 feet
Latitude : 38.268455
Longitude -85.750015
Boring Depth : 32.0 feet
Station : 11+04
Offset : 45.0 feet Lt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency : 89.9
Driller/Inspector : ED/SAH
Temperature : 70° F
Weather : Cloudy

GROUNDWATER: ▽ Encountered at 28.0 feet ▼ At completion Dry ▼ Dry After 1 hours ▨ Caved in at 20.0 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
446.9		**ASPHALT CONCRETE** (4") (Visual)	0.3										
		SAND AND GRAVEL BASE (14") (Visual)											
445.7			1.5		2								
	2.5	Brown, Moist, Soft, **SILTY CLAY LOAM (FILL)** A-6 (8), Lab 4		SS-1	2 3	5	67	25.1			34	21	14
443.7			3.5										
	5.0	Brown, Moist, Soft to Medium Stiff, **SILTY CLAY LOAM (FILL)** A-4, As Lab 1		SS-2	2 2 2	4	83	23.8					
	7.5			SS-3	2 3 3	6	67	23.6					
439.2			8.0										
	10.0	Brown, Moist, Soft, **SILTY CLAY LOAM (FILL)** A-6, As Lab 4		SS-4	2 2 3	5	83	16.1					
435.2			12.0										
	12.5	Brown, Moist, Soft, **SILTY CLAY LOAM** A-4, As Lab 1		SS-5	2 2 3	5	83	22.6					
	15.0												
431.2			16.0										
	17.5	Brown, Moist, Medium Stiff, **SANDY LOAM** A-4, Lab 5		SS-6	3 3 3	6	100	15.2			NP	NP	NP
	▨20.0												

Continued on next page

BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

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TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC

BORING NO. : **B-1**

PROJECT : Ohio River Greenway Phase II

SHEET : 2 OF 2

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
425.2		Brown, Moist, Medium Stiff, **SANDY LOAM** A-4, Lab 5	22.0										
	22.5				4								
				SS-7	6	13	83	6.1					
	25.0				7								
		Brown, Slightly Moist to Wet, Medium Dense, **GRAVELLY SAND** A-1-b, As Lab 2											
	27.5												
					3								
				SS-8	5	11	67	12.9					
	30.0				6								
416.7			30.5										
		Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)		SS-9	50/2"		50						
415.2			32.0										
	32.5	**Auger refusal encountered at 32.0 feet**											
		Bottom of Boring at 32.0 feet											
		Boring backfilled in accordance with INDOT guidelines and pavement restored with concrete patch.											
	35.0												
	37.5												
	40.0												
	42.5												
	45.0												

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-2**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 1
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-11-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-12-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 430.0 feet
Latitude : 38.268247
Longitude: -85.749975
Boring Depth : 14.0 feet
Station : 11+42
Offset : 13.0 feet Rt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency: 89.9
Driller/Inspector : ED/SAH
Temperature : 75° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 7.0 feet ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 5.8 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
		Brown, Moist, Soft, **SILTY CLAY LOAM** with Some Organic Matter A-6, As Lab 4		SS-1	2 2 3	5	83	32.3					
427.0	2.5		3.0										
		Brown, Slightly Moist, Medium Stiff, **SANDY CLAY** (Visual)		SS-2	3 4 4	8	83	9.0					
425.0	5.0		5.0										
		Brown, Moist, Very Soft, **SILTY CLAY LOAM** A-6, As Lab 4											
423.0 ▽	7.5		7.0	SS-3	1 1 2	3	33	21.2					
	10.0	Brown, Wet, Very Loose, **GRAVELLY SAND** A-1-b, As Lab 2		SS-4	2 2 3	5	100	16.0					
417.0	12.5		13.0										
416.0		Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)	14.0	SS-5	50/2"		50						
		Auger refusal encountered at 14.0 feet											
	15.0	**Bottom of Boring at 14.0 feet**											
		Boring backfilled in accordance with INDOT guidelines.											
	17.5												
	20.0												

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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling	AC - Auger Cuttings	DCP - Dynamic Cone Penetrometer Test
HA - Hand Auger	SBS - Subbase Sample	

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-3**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 1
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-11-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-11-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 427.0 feet
Latitude : 38.268012
Longitude: -85.748981
Boring Depth : 13.9 feet
Station : 15+00
Offset : 4.0 feet Rt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency: 89.9
Driller/Inspector : ED/SAH
Temperature : 75° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 6.0 feet ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 5.6 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
426.8		**TOPSOIL** (2") (Visual)	0.2										
		Brown, Moist, Medium Stiff, **SILTY CLAY LOAM (FILL)** A-6, As Lab 4			3								
	2.5			SS-1	3	6	83	13.3					
424.0			3.0		3								
					4								
				SS-2	5	10	83	16.0					
	5.0				5								
					4								
				SS-3	4	8	56	11.0					
	7.5	Brown, Slightly Moist to Wet, Loose to Very Loose, **GRAVELLY SAND** A-1-b, As Lab 2			4								
					2								
				SS-4	2	4	33	13.5			NP	NP	NP
	10.0				2								
	12.5												
414.0			13.0										
413.1		Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)	13.9	SS-5	50/4"		50						
		Auger refusal encountered at 13.9 feet											
	15.0	**Bottom of Boring at 13.9 feet**											
		Boring backfilled in accordance with INDOT guidelines.											
	17.5												
	20.0												

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-3A**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 1
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-11-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-11-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 427.0 feet
Latitude : 38.267931
Longitude: -85.748410
Boring Depth : 3.5 feet
Station : 15+05
Offset : 4.0 feet Rt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency: 89.9
Driller/Inspector : ED/SAH
Temperature : 75° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at Dry ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 3.5 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
426.8		**TOPSOIL** (2") (Visual)	0.2										
		SILTY CLAY LOAM A-6, As Lab 4 **(Refer to boring B-3 for soil description)**											
	2.5			ST-1			83	9.6	135.1	0.331 @ 2.4%			
424.0		**GRAVELLY SAND**	3.0										
423.5		A-1-b, As Lab 2 **(Refer to boring B-3 for soil description)**	3.5										
		Bottom of Boring at 3.5 feet											
	5.0	Boring backfilled in accordance with INDOT guidelines.											
	7.5												
	10.0												
	12.5												
	15.0												

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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling	AC - Auger Cuttings	DCP - Dynamic Cone Penetrometer Test
HA - Hand Auger	SBS - Subbase Sample	

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-4**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 2
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-12-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-12-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 435.0 feet
Latitude : 38.267718
Longitude -85.747595
Boring Depth : 23.0 feet
Station : 19+35
Offset : 25.0 feet Lt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency : 89.9
Driller/Inspector : ED/SAH
Temperature : 75° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 18.0 feet ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 13.3 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
434.7		**ASPHALT CONCRETE** (4") (Visual)	0.3										
		Brown, Moist, Medium Stiff, **SILTY CLAY LOAM** A-6, As Lab 4		SS-1	3 3 3	6	100	22.0					
	2.5												
432.0			3.0										
				SS-2	2 2 3	5	100	25.3					
	5.0												
				SS-3	2 2 3	5	100	31.4					
	7.5												
				SS-4	3 3 4	7	83	25.1	127.3	3.796 @ 15.0%			
	10.0	Brown, Moist to Very Moist, Soft to Medium Stiff, **SILTY CLAY LOAM** A-4, As Lab 1											
	12.5												
				SS-5	2 2 3	5	100	22.9					
	15.0												
	17.5												
417.0 ▽			18.0										
		Brown, Wet, Very Loose, **SAND AND GRAVEL** (Visual) A-1-b		SS-6	1 2 2	4	22	19.0					
	20.0												

Continued on next page

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC

BORING NO. : **B-4**

PROJECT : Ohio River Greenway Phase II

SHEET : 2 OF 2

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
413.0			22.0	SS-7	50/2"		50						
	22.5	Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)											
412.0			23.0										
		Auger refusal encountered at 23.0 feet											
		Bottom of Boring at 23.0 feet											
	25.0	Boring backfilled in accordance with INDOT guidelines and pavement restored with concrete patch.											
	27.5												
	30.0												
	32.5												
	35.0												
	37.5												
	40.0												
	42.5												
	45.0												

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	- Hollow Stem Auger	SS	- Split Spoon Sample	*	- Hand Penetrometer
SFA	- Solid Flight Auger	ST	- Shelby Tube Sample	LL	- Liquid Limit
RC	- Rock Coring	CR	- Rock Core Sample	PL	- Plastic Limit
MD	- Mud Drilling	BS	- Bag Sample	PI	- Plasticity Index
WD	- Wash Drilling	AC	- Auger Cuttings	DCP	- Dynamic Cone Penetrometer Test
HA	- Hand Auger	SBS	- Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-5**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 2
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-12-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-12-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 436.2 feet
Latitude : 38.267660
Longitude -85.746942
Boring Depth : 22.0 feet
Station : 21+00
Offset : 13.0 feet Lt
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency : 89.9
Driller/Inspector : ED/SAH
Temperature : 80° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 17.0 feet ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 5.3 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
435.9		**ASPHALT CONCRETE** (4") (Visual)	0.3										
		SAND AND GRAVEL BASE (14") (Visual)											
434.7			1.5		4								
	2.5			SS-1	5 6	11	100	17.9					
		Brown, Moist, Stiff to Medium Stiff, **SILTY CLAY LOAM** with Traces of Brick Fragments and Wood **(FILL)**			4								
		A-6, As Lab 4		SS-2	4 5	9	100	14.9					
	5.0												
430.2			6.0										
					3								
				SS-3	2 3	5	100	25.3					
	7.5												
					3								
		Brown and Gray, Moist, Soft to Medium Stiff, **SILTY CLAY LOAM**		SS-4	3	6	100	20.5					
	10.0	A-4, As Lab 1			3								
				ST-1			100	22.3					
	12.5												
423.2			13.0										
					3								
				SS-5	2	4	100	24.4					
	15.0	Brown, Moist, Soft, **SILTY LOAM**			2								
		A-4, As Lab 6											
419.2 ▽			17.0	ST-2			0						
	17.5												
		Brown, Wet, Very Loose, **GRAVELLY SAND**			2								
		A-1-b, As Lab 2		SS-6	1	4	83	13.8					
	20.0				3								
415.7			20.5										

Continued on next page

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC

BORING NO. : **B-5**

PROJECT : Ohio River Greenway Phase II

SHEET : 2 OF 2

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
414.2	22.5	Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)	22.0	SS-7	50/2"		50						
		Auger refusal encountered at 22.0 feet											
		Bottom of Boring at 22.0 feet											
		Boring backfilled in accordance with INDOT guidelines and pavement restored with concrete patch.											
	25.0												
	27.5												
	30.0												
	32.5												
	35.0												
	37.5												
	40.0												
	42.5												
	45.0												

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	- Hollow Stem Auger	SS	- Split Spoon Sample	*	- Hand Penetrometer
SFA	- Solid Flight Auger	ST	- Shelby Tube Sample	LL	- Liquid Limit
RC	- Rock Coring	CR	- Rock Core Sample	PL	- Plastic Limit
MD	- Mud Drilling	BS	- Bag Sample	PI	- Plasticity Index
WD	- Wash Drilling	AC	- Auger Cuttings	DCP	- Dynamic Cone Penetrometer Test
HA	- Hand Auger	SBS	- Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-6**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 1
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-12-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-12-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 426.8 feet
Latitude : 38.267522
Longitude: -85.746567
Boring Depth : 16.4 feet
Station : 22+50
Offset : C/L
Line : '"A"'
Boring Method : HSA
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size :
Hammer : Automatic
Hammer Efficiency: 89.9
Driller/Inspector : ED/SAH
Temperature : 75° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 10.0 feet ▼ At completion Dry ▼ Dry After 24 hours ▨ Caved in at 5.0 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
426.4		**CEMENT CONCRETE** (5") (Visual)	0.4										
		CRUSHED STONE (19") (Visual)			3								
424.8	2.5		2.0	SS-1	7 5	12	33	4.5					
	5.0	Brown, Moist, Very Soft to Soft, **SILTY CLAY LOAM** with Traces of Brick Fragments and Wood **(FILL)** A-4 (5), Lab 1		SS-2	1 1 2	3	100	26.6					
	7.5			SS-3	1 2 2	4	67	25.6			27	19	8
418.8			8.0										
		Brown, Moist, Very Soft, **SILTY LOAM** A-4 (3), Lab 6		SS-4	1 1 2	3	83	23.7			26	19	7
416.8 ▽	10.0		10.0										
	12.5	Brown, Wet, Medium Dense, **SAND** (Visual)											
				SS-5	2 2 23	25	22	27.2					
411.8	15.0		15.0										
		Gray, Hard, Highly Weathered, **LIMESTONE** (Visual)											
410.4			16.4	SS-6	50/3"		33						
		Auger refusal encountered at 16.4 feet											
	17.5	**Bottom of Boring at 16.4 feet**											
		Boring backfilled in accordance with INDOT guidelines and pavement restored with concrete patch.											
	20.0												

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC
BORING NO. : **B-7**
PROJECT : Ohio River Greenway Phase II
SHEET : 1 OF 2
ROUTE NO. : Jeffersonville Ohio River Greenway
COUNTY : Clark
DATE STARTED : 04-13-23
LOCATION : Jeffersonville, IN
DATE COMPLETED : 04-13-23
DES NO. :
PROJECT NO: 140007
CTL PROJECT NO : 23050035IND

Boring Elevation: 424.2 feet
Latitude : 38.267546
Longitude: -85.745157
Boring Depth : 25.0 feet
Station : 26+25
Offset : C/L
Line : '"A"'
Boring Method : HSA, RC
Rig Type : CME 550 ATV
Casing Diameter : 3.25" ID
Core Size : 2" NQ
Hammer : Automatic
Hammer Efficiency : 89.9
Driller/Inspector : ED/SAH
Temperature : 78° F
Weather : Sunny

GROUNDWATER: ▽ Encountered at 6.0 feet ▼ At completion 4.0 feet ▼ 3.7 feet After 24 hours 🖼 Caved in at 4.2 feet

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
423.9		**CEMENT CONCRETE** (4") (Visual)	0.3										
	2.5	**CRUSHED STONE with SAND (FILL)** (Visual)		SS-1	10 19 27	46	67	4.1					
	5.0			SS-2	12 20 31	51	56	12.2					
418.2 ▽			6.0										
	7.5	Gray, Moist, Soft, **SILTY LOAM** A-4, As Lab 6		SS-3	2 2 2	4	100	26.5					
416.2			8.0										
	10.0			SS-4	1 2 3	5	100	34.4			NP	NP	NP
	12.5	Gray, Very Moist to Moist, Soft to Hard, **SILTY LOAM** A-4 (0), Lab 3											
409.7			14.5	SS-5	3 7 46	53	67	9.1					
409.2	15.0	Gray, Soft to Hard, Highly Weathered, **LIMESTONE** (Visual) **Auger refusal encountered at 15.0 feet**	15.0										
	17.5	Gray, Hard, Highly Fractured to Moderately Fractured, Moderately Weathered, **LIMESTONE** (Visual)		RC-1 RQD= 10%			98						
	20.0												

Continued on next page

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BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	Hollow Stem Auger	SS	Split Spoon Sample	*	Hand Penetrometer
SFA	Solid Flight Auger	ST	Shelby Tube Sample	LL	Liquid Limit
RC	Rock Coring	CR	Rock Core Sample	PL	Plastic Limit
MD	Mud Drilling	BS	Bag Sample	PI	Plasticity Index
WD	Wash Drilling	AC	Auger Cuttings	DCP	Dynamic Cone Penetrometer Test
HA	Hand Auger	SBS	Subbase Sample		

TEST BORING RECORD

CLIENT : Beam, Longest and Neff, LLC

BORING NO. : **B-7**

PROJECT : Ohio River Greenway Phase II

SHEET : 2 OF 2

Stratum Elevation	Sample Depth	SOIL/MATERIAL DESCRIPTION	Stratum Depth	Sample Number	SPT per 6"	SPT per 12"	Recovery (%)	Moisture Content (%)	Total Unit Weight (pcf)	Unconfined Compression (ksf)	Atterberg Limits LL	PL	PI
	22.5	Gray, Hard, Highly Fractured to Moderately Fractured, Moderately Weathered, **LIMESTONE** (Visual)		RC-2 RQD= 45%			95						
399.2	25.0		25.0										
		Bottom of Boring at 25.0 feet											
		Boring backfilled in accordance with INDOT guidelines and pavement restored with concrete patch.											
	27.5												
	30.0												
	32.5												
	35.0												
	37.5												
	40.0												
	42.5												
	45.0												

CTL Engineering, Inc.
Phone: 317-295-8650

BORING METHOD		SAMPLING METHOD		ABBREVIATIONS	
HSA	- Hollow Stem Auger	SS	- Split Spoon Sample	*	- Hand Penetrometer
SFA	- Solid Flight Auger	ST	- Shelby Tube Sample	LL	- Liquid Limit
RC	- Rock Coring	CR	- Rock Core Sample	PL	- Plastic Limit
MD	- Mud Drilling	BS	- Bag Sample	PI	- Plasticity Index
WD	- Wash Drilling	AC	- Auger Cuttings	DCP	- Dynamic Cone Penetrometer Test
HA	- Hand Auger	SBS	- Subbase Sample		

ROCK CORE PHOTOGRAPH

Ohio River Greenway Phase II
Jeffersonville, IN
CTL Project No.: 23050035IND

Boring No.: B-8			
Core Size: 2" NQ			
Core Run	Depth (Ft.)	Recovery (%)	RQD (%)
RC-1	15.0 – 20.0	98	10
RC-2	20.0 – 25.0	95	45

Note: Core run increases in depth from left to right and top to bottom

APPENDIX C

LABORATORY TESTING

Summary of Classification Test Results
Grain Size Distribution Curves
Unconfined Compressive Strength Test Results
1-D Consolidation Testing
Triaxial Testing
Summary of Special Laboratory Test Results

Lab No.	Boring No.	Sample No.	Depth (feet)	Textural Classification	AASHTO Classification	Gravel %	Sand %	Silt %	Clay %	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Moisture %
Lab 1	B-6	SS-3	6.0-7.5	SILTY CLAY LOAM	A-4 (5)	0.0	18.9	61.0	20.1	27.3	19.3	8.0	25.6
Lab 2	B-3	SS-4	8.5-10.0	GRAVELLY SAND	A-1-b (0)	29.4	52.3	16.3	1.9	NP	NP	NP	13.5
Lab 3	B-7	SS-4	8.5-10.0	SILTY LOAM	A-4 (0)	0.8	31.6	58.1	9.5	NP	NP	NP	34.4
Lab 4	B-1	SS-1	1.0-2.5	SILTY CLAY LOAM	A-6 (8)	9.0	17.1	50.7	23.2	34.2	20.6	13.6	25.1
Lab 5	B-1	SS-6	18.5-20.0	SANDY LOAM	A-4 (0)	6.1	57.5	32.5	4.0	NP	NP	NP	15.2
Lab 6	B-6	SS-4	8.5-10.0	SILTY LOAM	A-4 (3)	0.0	25.7	58.2	16.1	25.9	19.1	6.8	23.7

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CTL Engineering, Inc.
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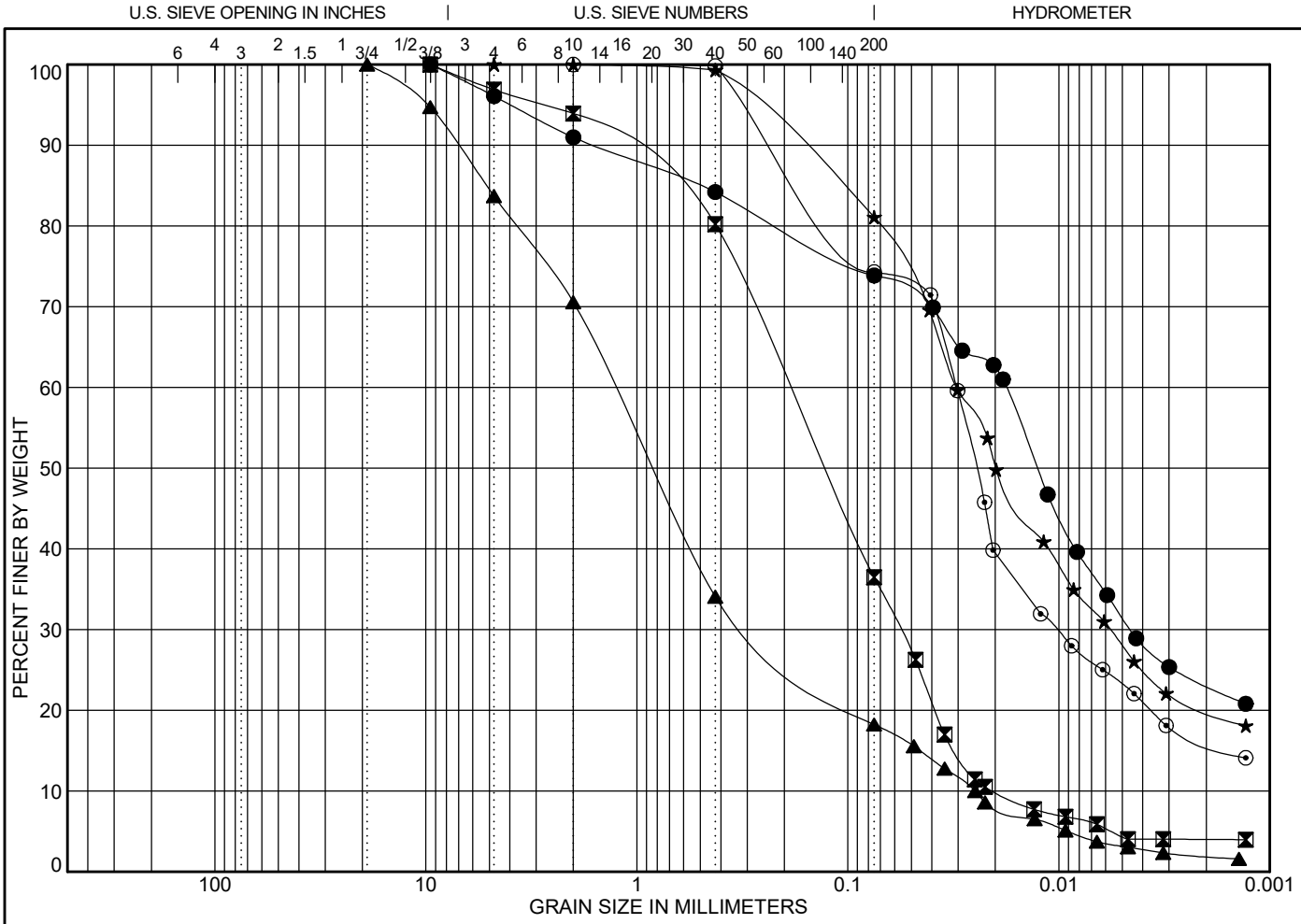
SUMMARY OF CLASSIFICATION TEST RESULTS

Des. No. :
Project No. : 140007
Project Type : Ohio River Greenway Phase II
County : Clark
Route : Jeffersonville Ohio River Greenway
CTL Proj. No. : 23050035IND
Location : Jeffersonville, IN



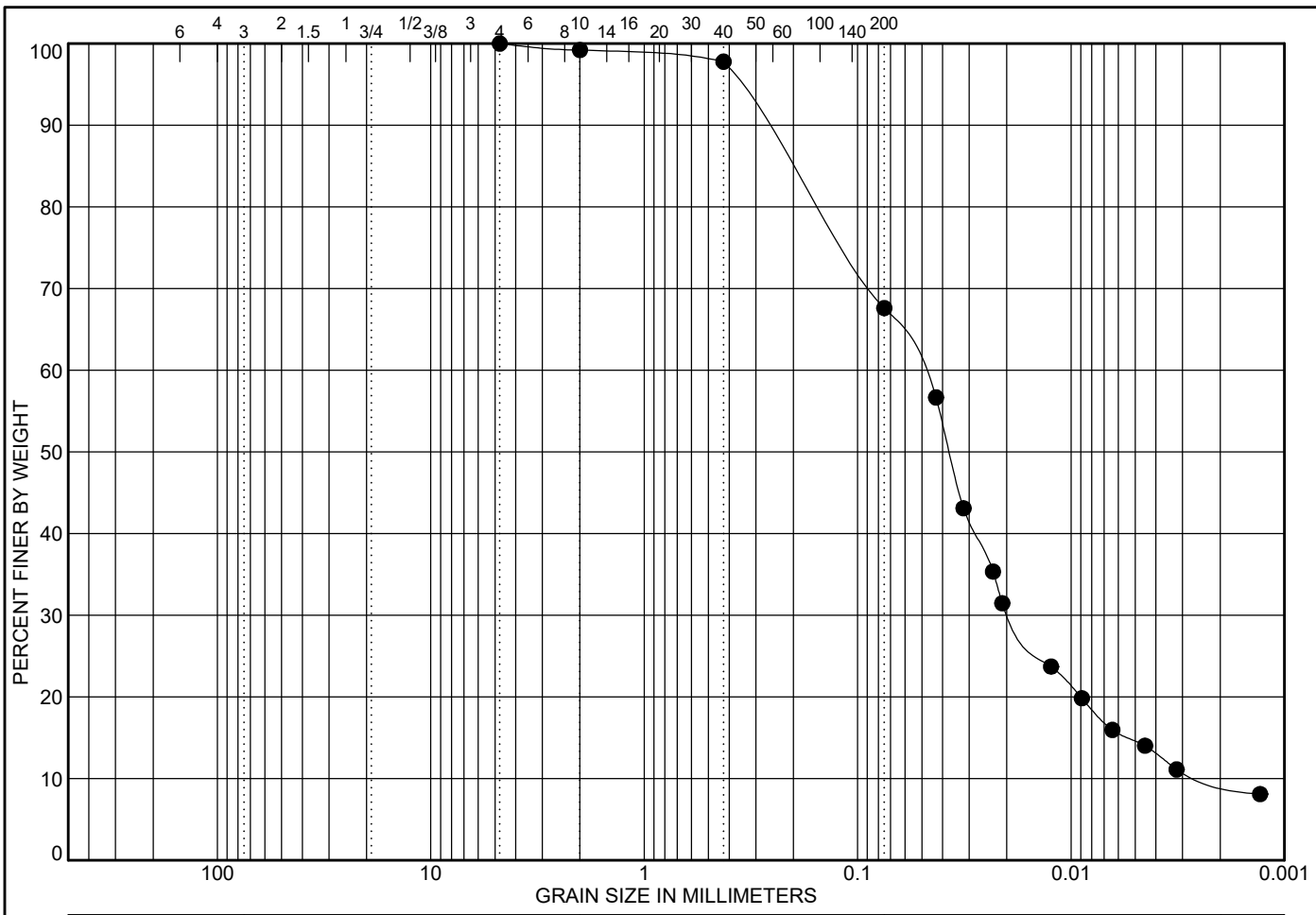
Cobbles	Gravel	Sand	Silt	Clay

Boring No.	B-1	B-1	B-3	B-6	B-6
Sample	SS-1	SS-6	SS-4	SS-3	SS-4
Depth	1.0-2.5	18.5-20.0	8.5-10.0	6.0-7.5	8.5-10.0
Station	1104	1104	1500	2250	2250
Offset	Rt	Rt	Rt	Rt	Rt
Line	"A"	"A"	"A"	"A"	"A"
Curve Designation	●	⊠	▲	★	⊙
Moisture Content	**25.1**	**15.2**	**13.5**	**25.6**	**23.7**
Liquid Limit	**34.2**	**NP**	**NP**	**27.3**	**25.9**
Plastic Limit	**20.6**	**NP**	**NP**	**19.3**	**19.1**
Plasticity Index	**13.6**	**NP**	**NP**	**8.0**	**6.8**
% Gravel	**9.0**	**6.1**	**29.4**	**0.0**	**0.0**
% Sand	**17.1**	**57.5**	**52.3**	**18.9**	**25.7**
% Silt	**50.7**	**32.4**	**16.4**	**61.0**	**58.2**
% Clay	**23.2**	**4.0**	**1.9**	**20.1**	**16.1**
Classification	**SILTY CLAY LOAM**	**SANDY LOAM**	**SAND**	**SILTY CLAY LOAM**	**SILTY LOAM**
AASHTO Group	**A-6 (8)**	**A-4 (0)**	**A-1-b (0)**	**A-4 (5)**	**A-4 (3)**
Lab No.	**Lab 4**	**Lab 6**	**Lab 2**	**Lab 1**	**Lab 6**

GRAIN SIZE DISTRIBUTION

CTL ENGINEERING
CTL Engineering, Inc.
Phone: 317-295-8650

Client : Beam, Longest and Neff, LLC
Des No. :
Route : Jeffersonville Ohio River Greenway
County : Clark
Location : Jeffersonville, IN



Cobbles	Gravel	Sand	Silt	Clay

Boring No.	B-7				
Sample	SS-4				
Depth	8.5-10.0				
Station	2625				
Offset	Rt				
Line	"A"				
Curve Designation	●				
Moisture Content	**34.4**				
Liquid Limit	**NP**				
Plastic Limit	**NP**				
Plasticity Index	**NP**				
% Gravel	**0.8**				
% Sand	**31.6**				
% Silt	**58.1**				
% Clay	**9.5**				
Classification	**SILTY LOAM**				
AASHTO Group	**A-4 (0)**				
Lab No.	**Lab 3**				

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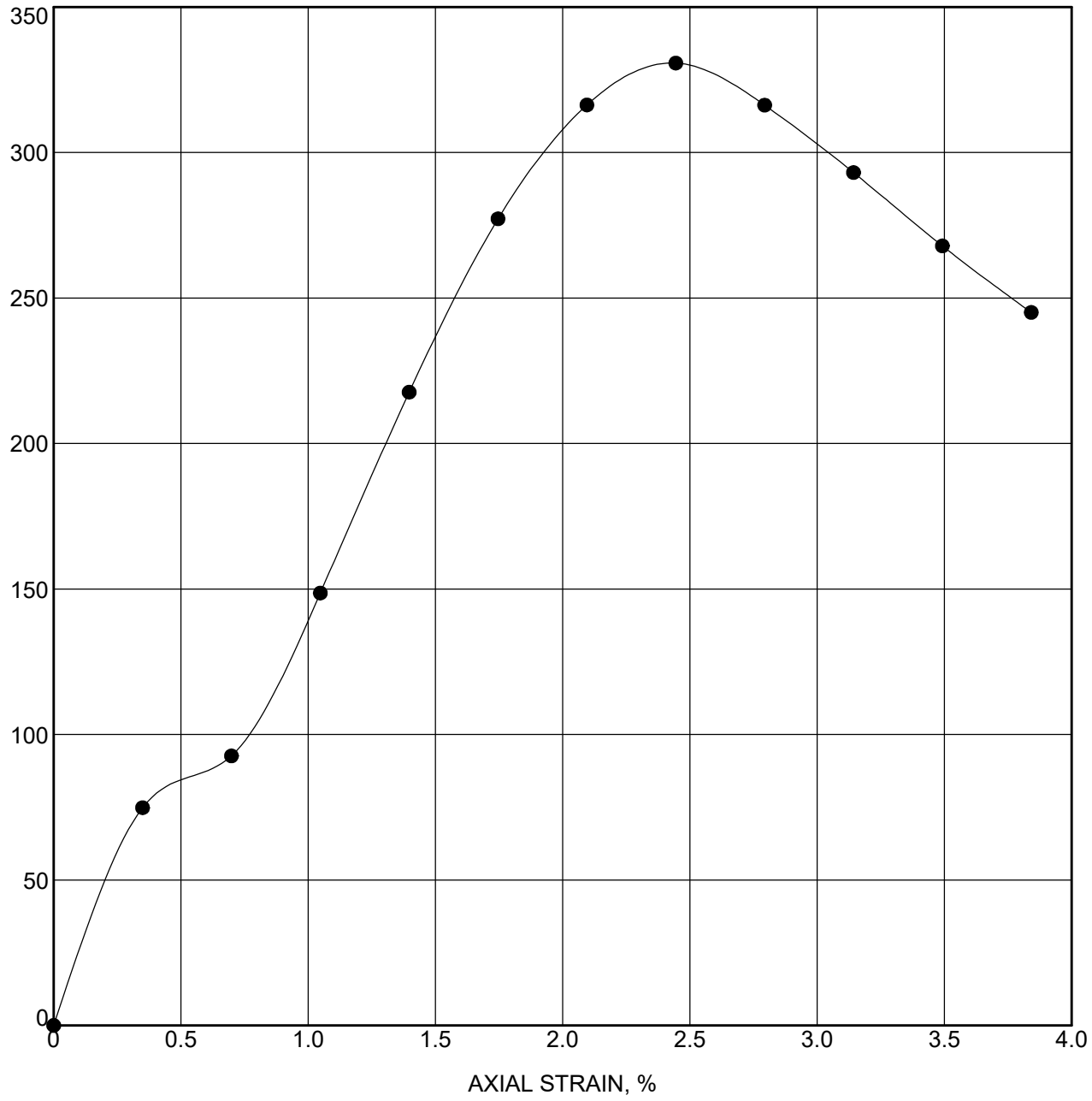
GRAIN SIZE DISTRIBUTION

Client : Beam, Longest and Neff, LLC
Des No. :
Route : Jeffersonville Ohio River Greenway
County : Clark
Location : Jeffersonville, IN



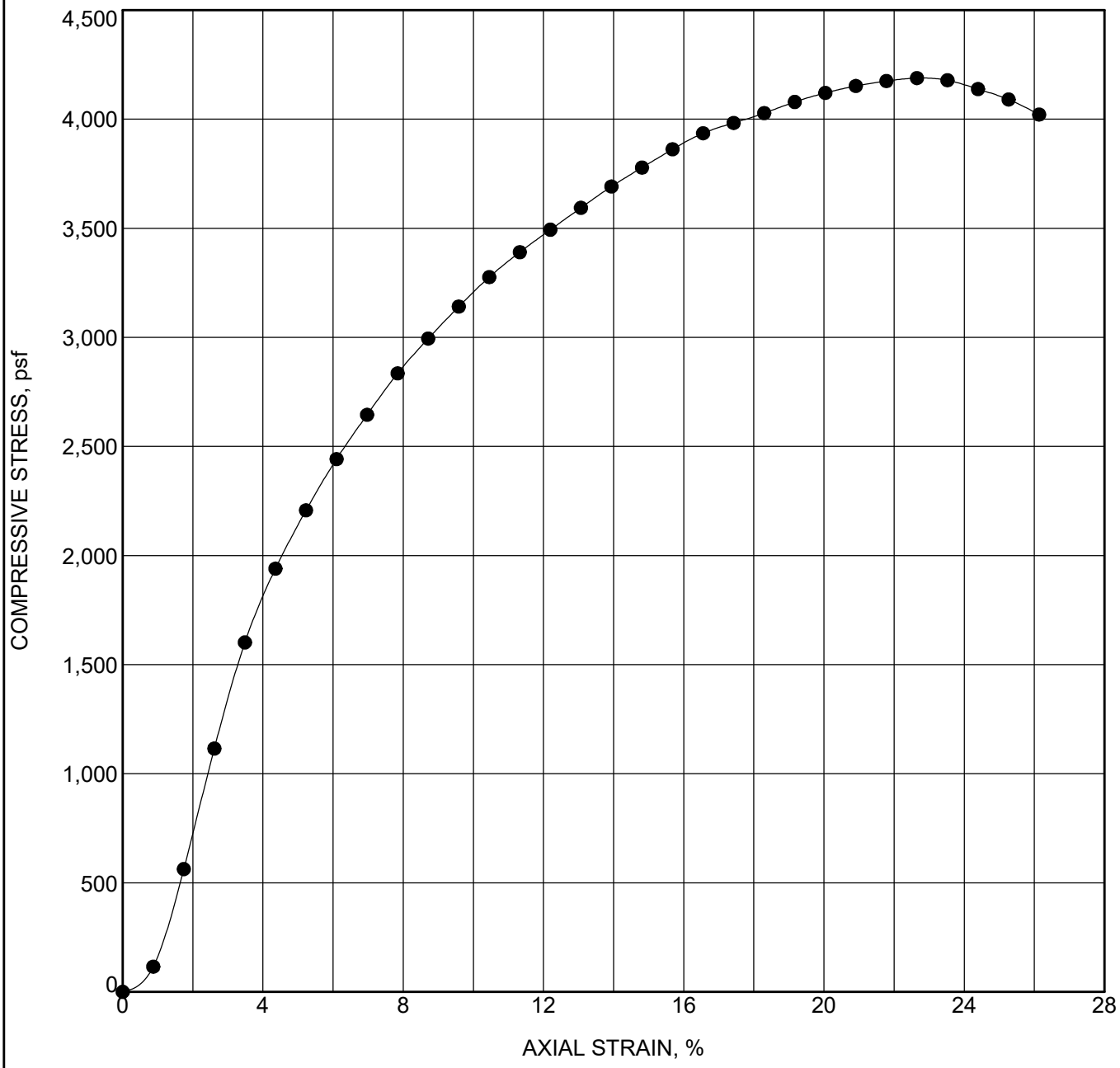
Boring No.	Sample No.	Depth	Classification
B-3A	**ST-1**	**1.5 - 3.5**	**SILTY CLAY LOAM (A-6)**

Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Unconfined Strength (psf)	Strain Rate (%)	Failure Strain (%)
9.6	**135.1**	**123.3**	**331**	**0.4**	**2.4**
Shear Strength (psf)	Saturation (%)	Void Ratio	Specimen Diameter (mm)	Specimen Height (mm)	Height/Diameter Ratio
165	**70**	**0.367**	**72.1**	**181.8**	**2.5**

CTL Engineering, Inc.
Phone: 317-295-8650

UNCONFINED COMPRESSIVE STRENGTH TEST

Des. No. :
Project No. : 140007
Route : Jeffersonville Ohio River Greenway
County : Clark
Location : Jeffersonville, IN



Boring No.	Sample No.	Depth	Classification
B-4	**SS-4**	**8.5 - 10.0**	**SILTY CLAY LOAM (A-4)**

Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Unconfined Strength (psf)	Strain Rate (%)	Failure Strain (%)
25.1	**127.3**	**101.8**	**3796**	**1.0**	**15.0**
Shear Strength (psf)	Saturation (%)	Void Ratio	Specimen Diameter (mm)	Specimen Height (mm)	Height/Diameter Ratio
1898	**99**	**0.705**	**34.9**	**72.9**	**2.1**

CTL Engineering, Inc.
Phone: 317-295-8650

UNCONFINED COMPRESSIVE STRENGTH TEST

Des. No. :
Project No. : 140007
Route : Jeffersonville Ohio River Greenway
County : Clark
Location : Jeffersonville, IN

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK SPECIMENS

ASTM D 7012 (Method C) / ASTM D 4543

Client:	Beam, Longest and Neff, LLC
Project:	Ohio River Greenway Phase II
Location:	Jeffersonville, IN
CTL Project No.:	23050035IND

Boring No.	Core Run No.	Rock Type	Depth (feet)	Core Weight (lb)	Diameter D (inches)	Length L (inches)	L/D Ratio	Area (in^2)	**Unit Weight (pcf)**	Total Load (lbs)	Tested Strength (psi)	**Compressive Strength (psi)**
B-8	RC-2	Limestone	22.1	1.228	2.00	4.05	2.03	3.14	**166.8**	19,523	6,224	**6,220**

One Dimensional Consolidation and Swell Properties of Soil - ASTM D 2435

CTL ENGINEERING, INC.
2860 Fisher Road
Columbus, OH 43204

Project No.:	23050035IND		
Project:	Ohio River Greenway Phase II	Sample Type:	Undisturbed Specimen
Client:	Beam, Longest & Neff,LLC	Test Date:	5/5/2023
Boring No.:	B-5	Checked By:	SM
Sample No.:	ST-1_11'-13'	Tested By:	MW
Soil Description:	Brown, Lean Clay (CL)	LL:	37
Specific Gravity:	2.670	PL:	22
Initial Dry Unit Weight	99.4 pcf	Initial Moisture	21.3%

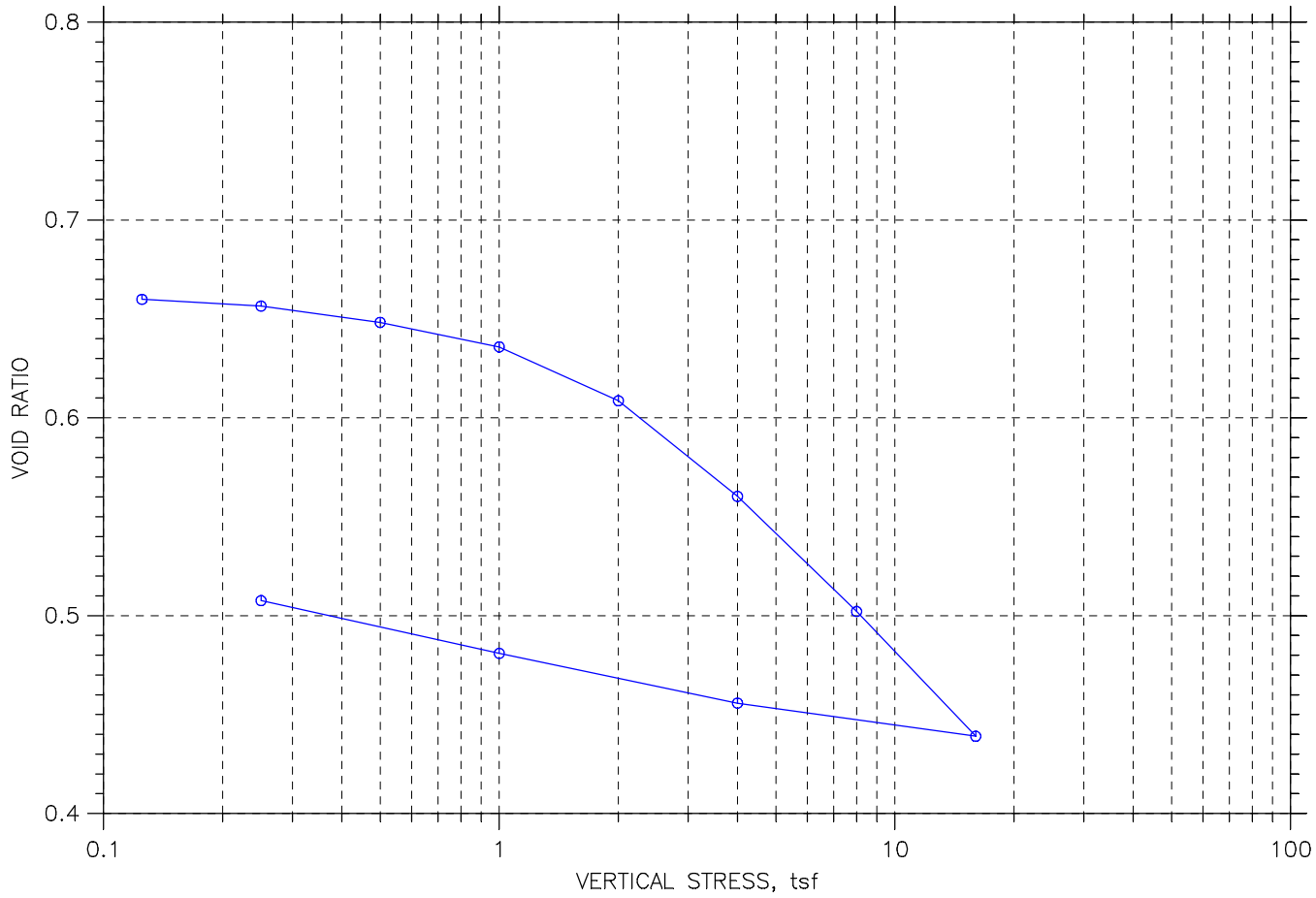
Step No.	Applied Stress (tsf)	Final Displacement (in)	Void Ratio	Strain at End (%)	Sqrt T_{90} (min)	Cv (ft^2/sec)
1	0.125	0.00275	0.66	0.27		
2	0.25	0.00482	0.656	0.47		
3	0.5	0.009867	0.648	0.97		
4	1	0.01747	0.636	1.72		
5	2	0.0341	0.609	3.35	4.6	5.30E-06
6	4	0.06366	0.56	6.25	3.9	5.97E-06
7	8	0.09925	0.502	9.75	4.2	5.14E-06
8	16	0.1378	0.439	13.54	13.9	1.43E-06
9	4	0.1276	0.456	12.53		
10	1	0.1122	0.481	11.02		
11	0.25	0.09589	0.508	9.42		

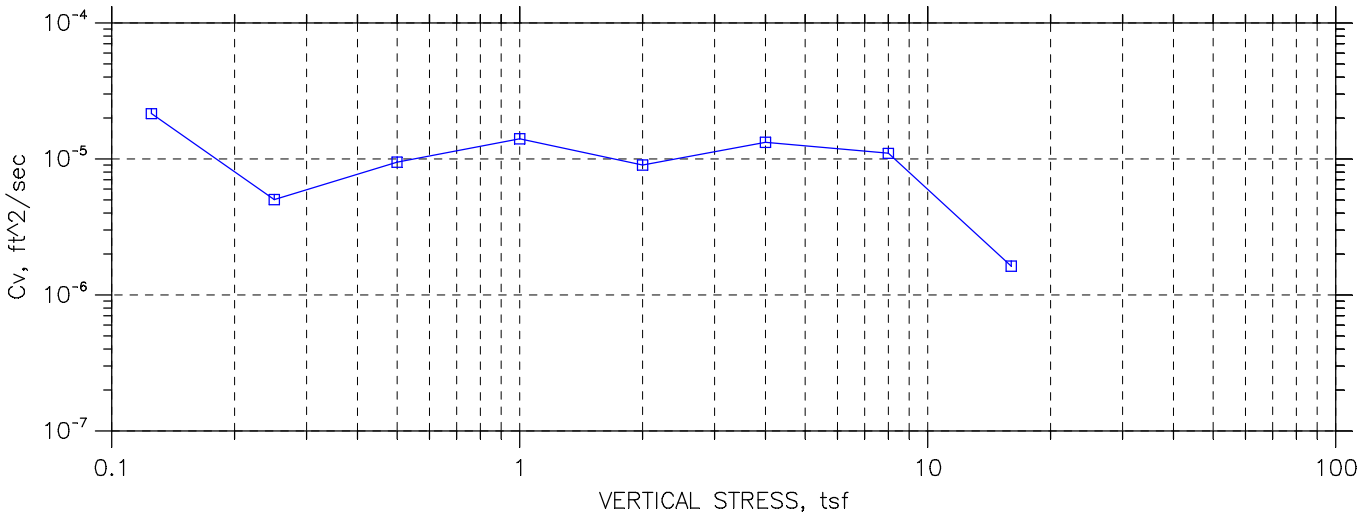
CONSOLIDATION PARAMETERS

Preconsolidation Pressure (tsf): 2.00	Initial Void Ratio: 0.66
Compression Index (C_c): 0.21	Compression Ratio : 0.13
Recompression Index (C_r): 0.028	Recompression Ratio: 0.017

CONSOLIDATION TEST DATA

SUMMARY REPORT





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

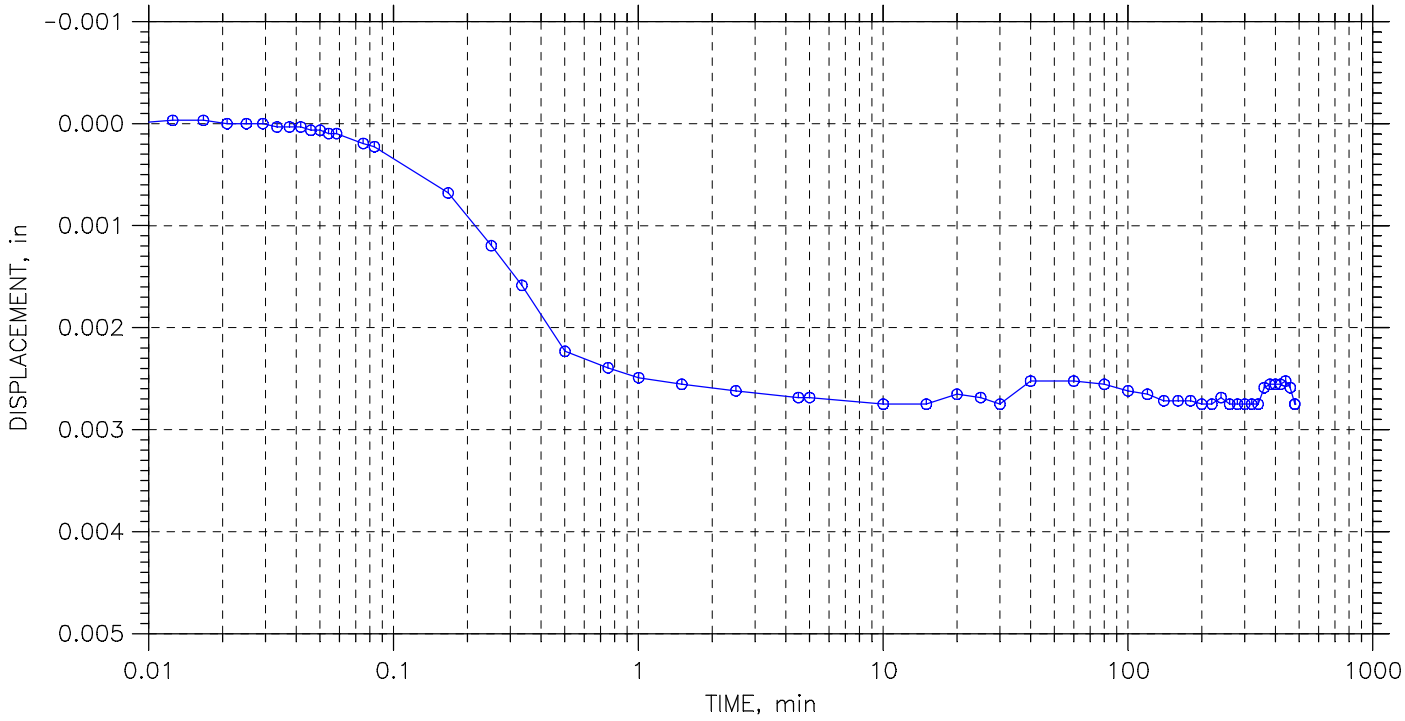
Thu, 11-MAY-2023 15:36:10

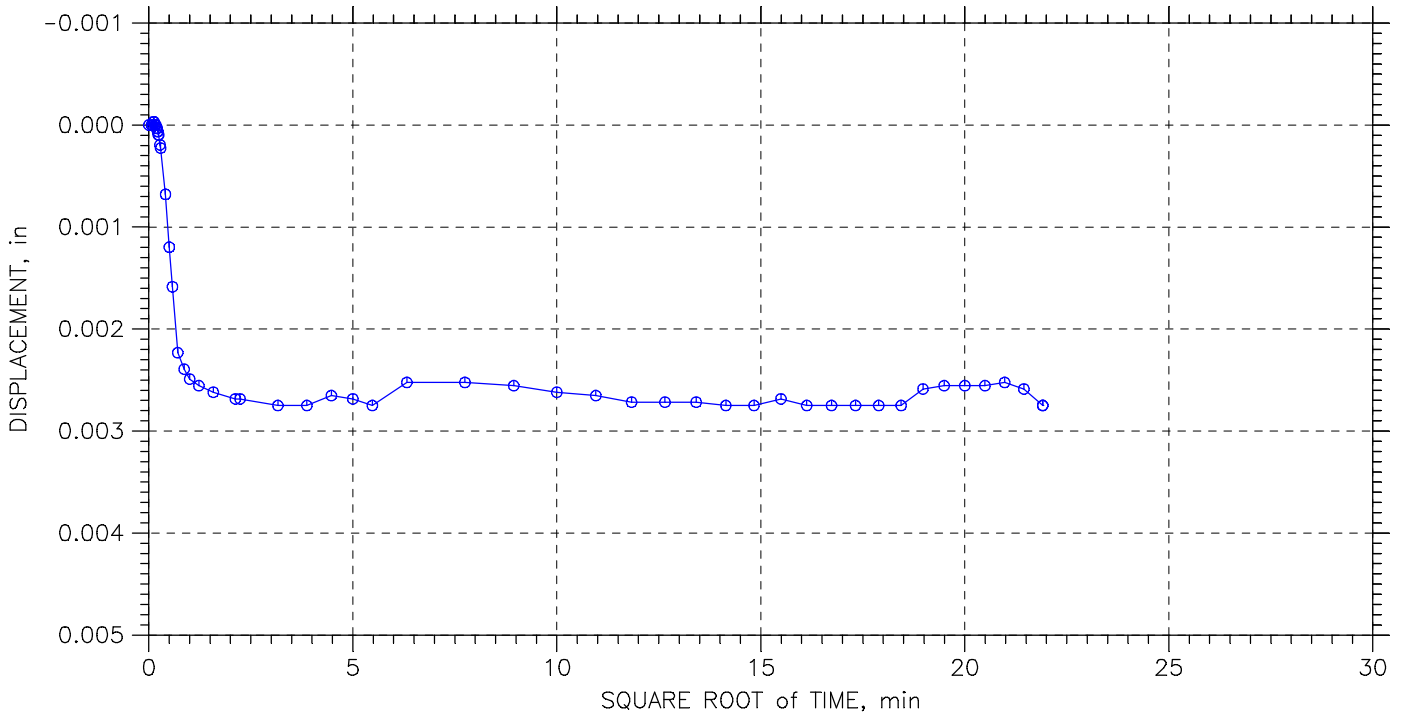
CONSOLIDATION TEST DATA

TIME CURVES

Step: 1 of 11

Stress: 0.125 tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

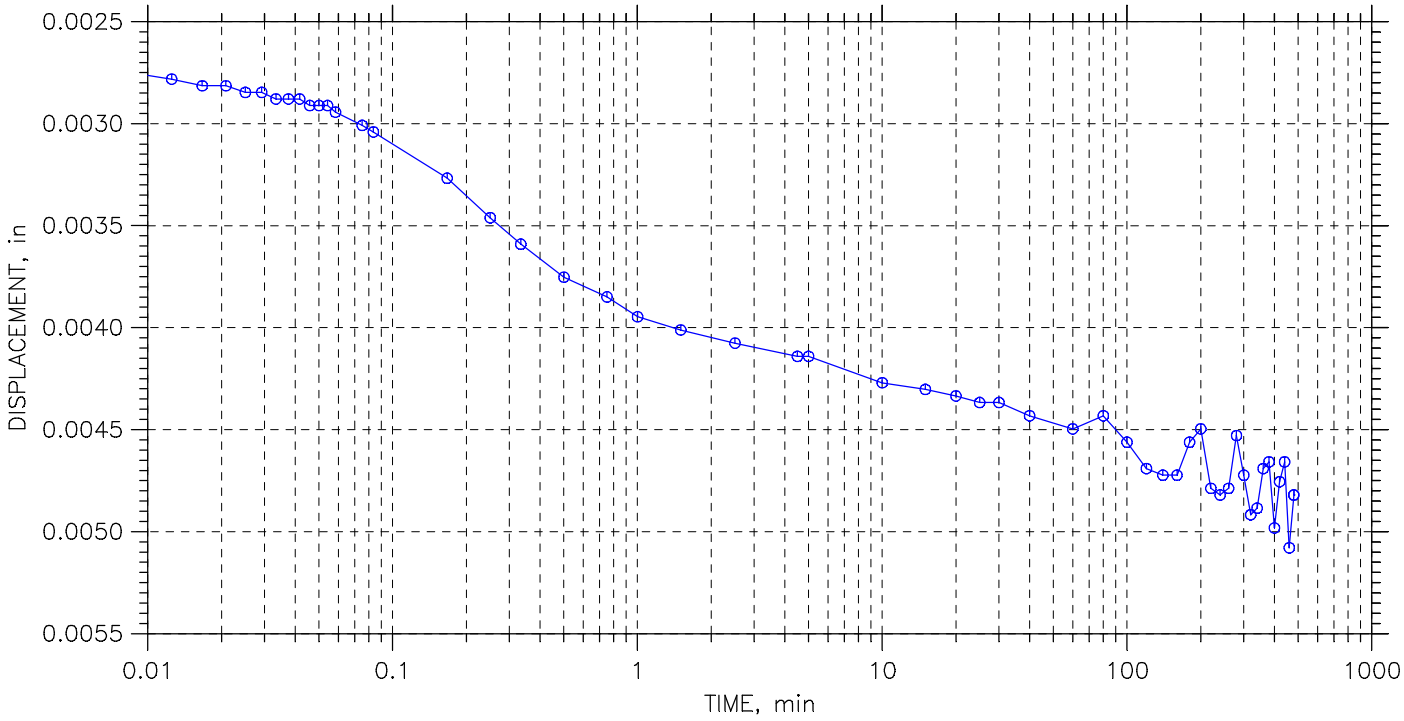
Thu, 11-MAY-2023 15:36:10

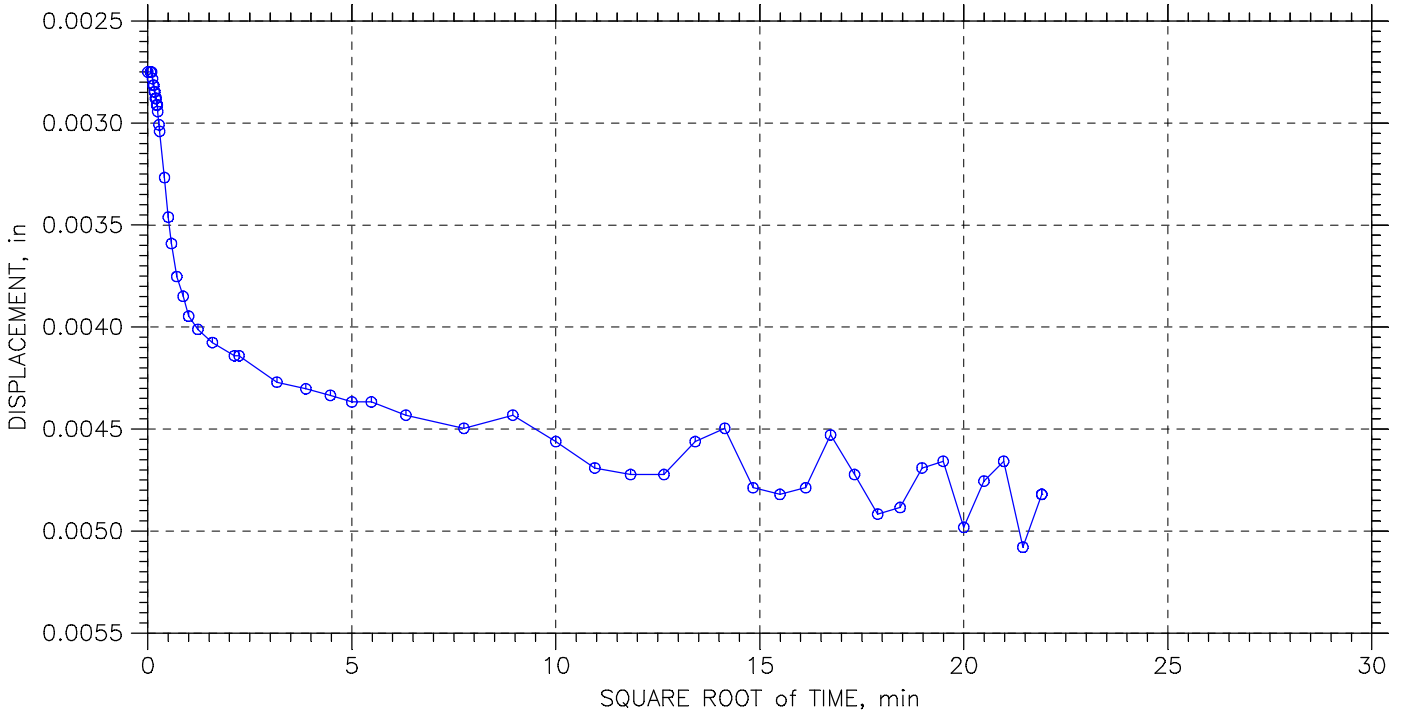
CONSOLIDATION TEST DATA

TIME CURVES

Step: 2 of 11

Stress: 0.25 tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

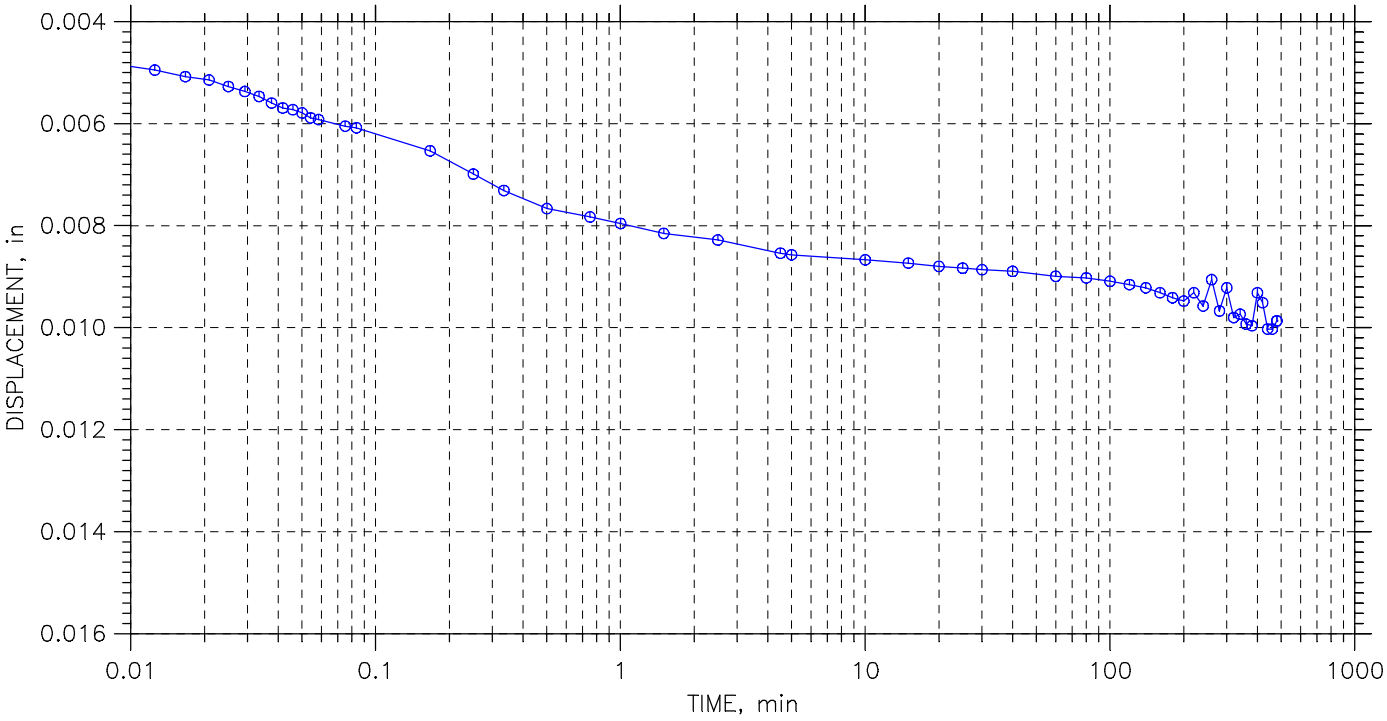
Thu, 11-MAY-2023 15:36:10

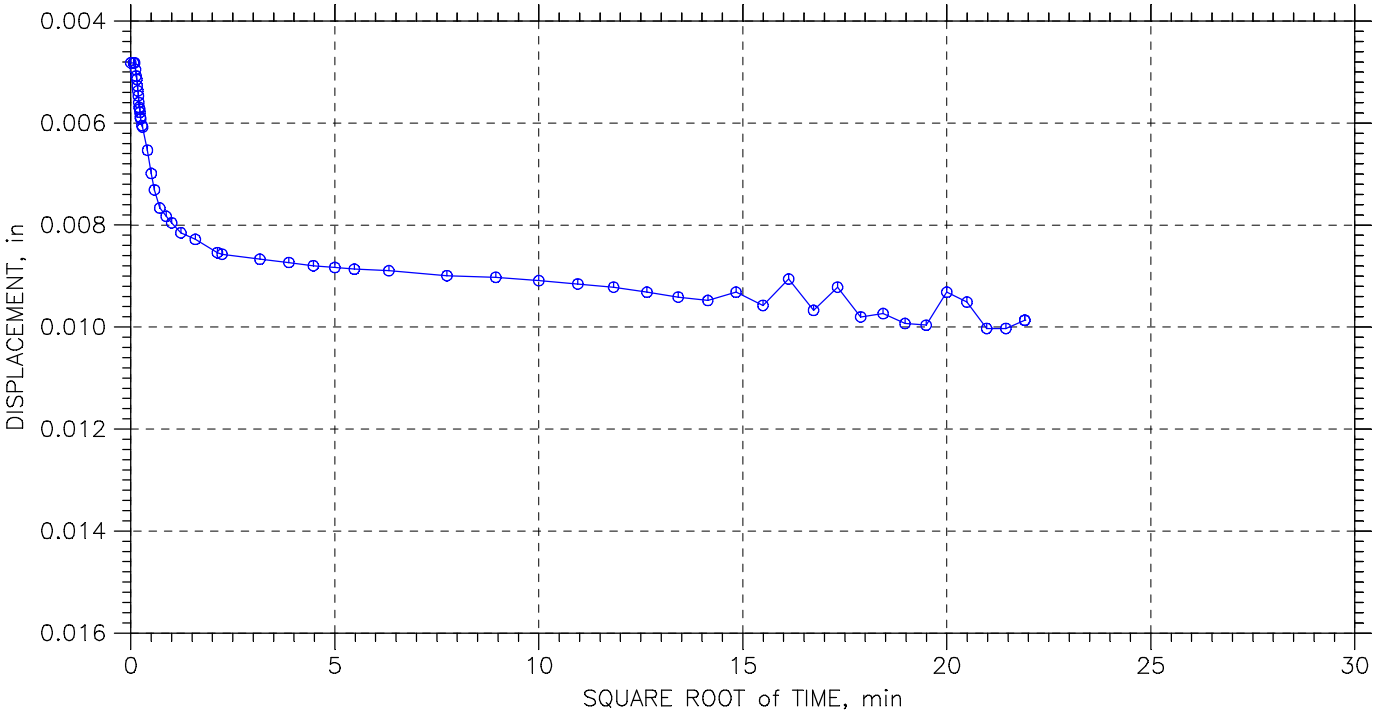
CONSOLIDATION TEST DATA

TIME CURVES

Step: 3 of 11

Stress: 0.5 tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

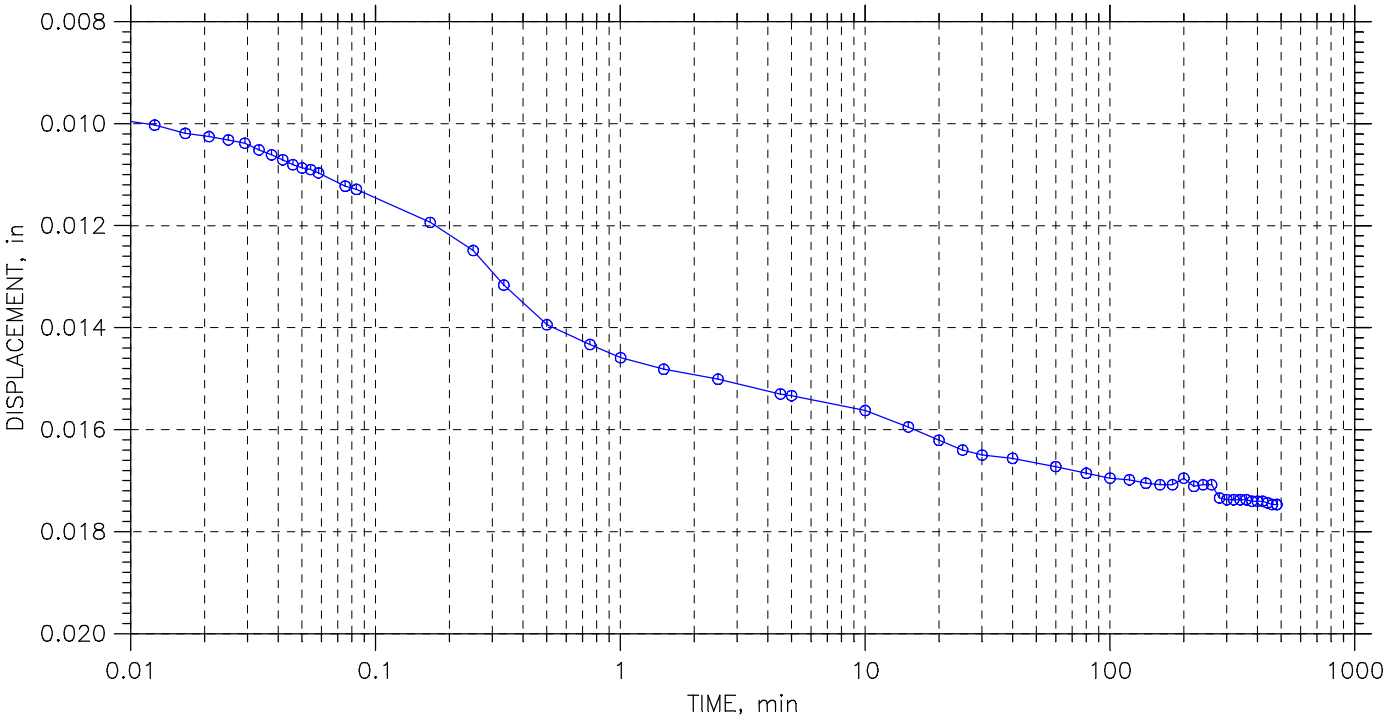
Thu, 11-MAY-2023 15:36:10

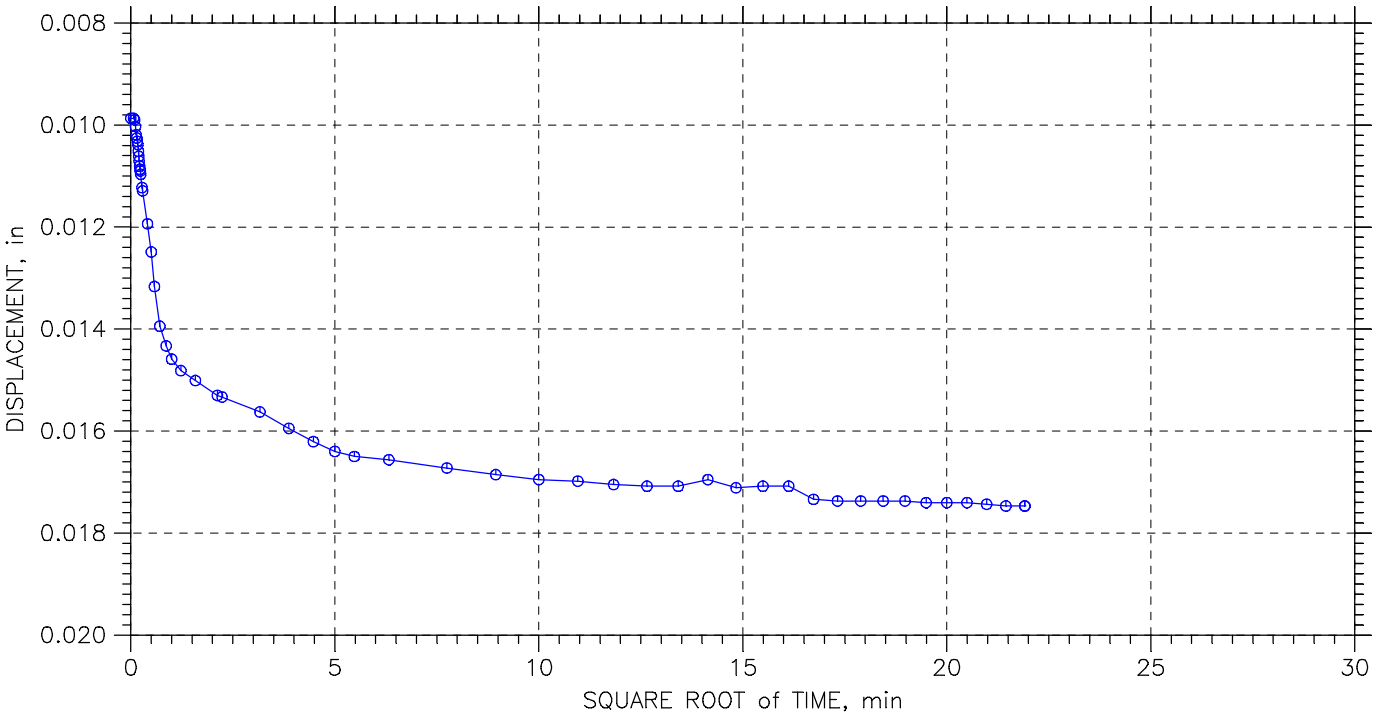
CONSOLIDATION TEST DATA

TIME CURVES

Step: 4 of 11

Stress: 1. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

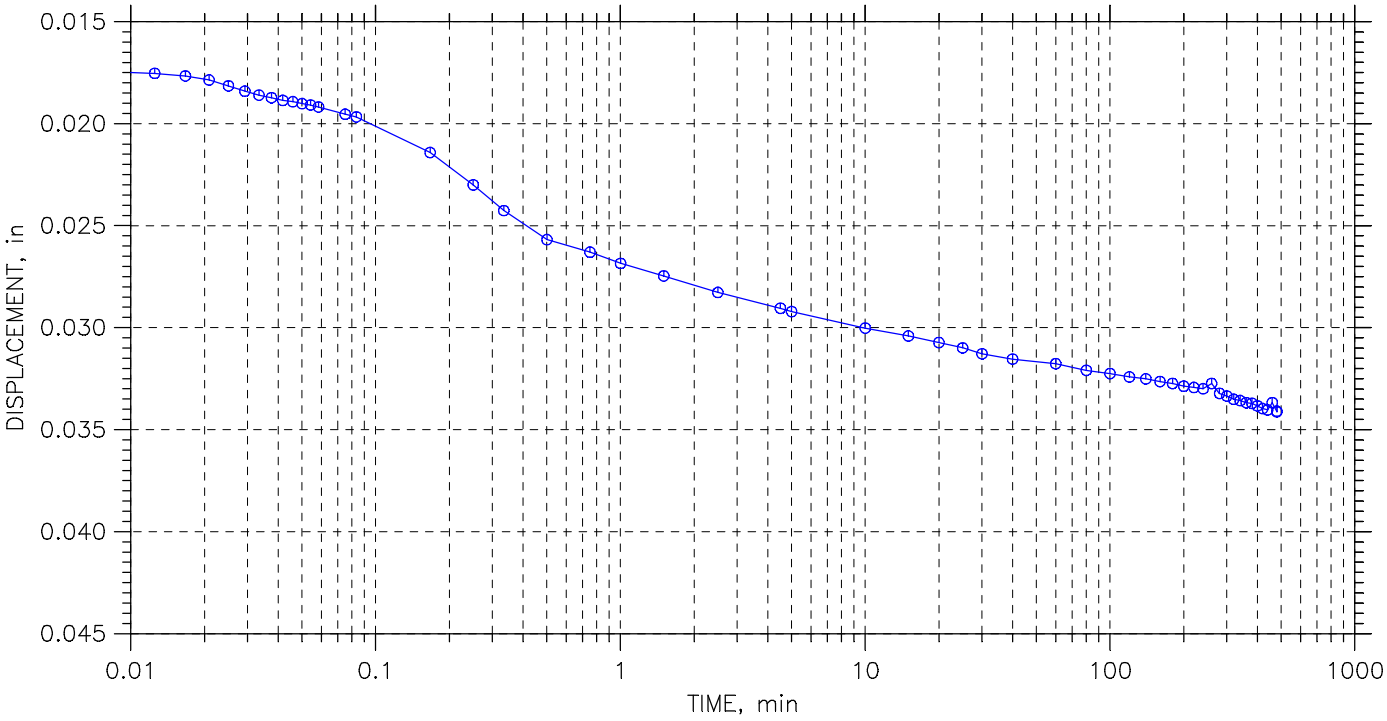
Thu, 11-MAY-2023 15:36:10

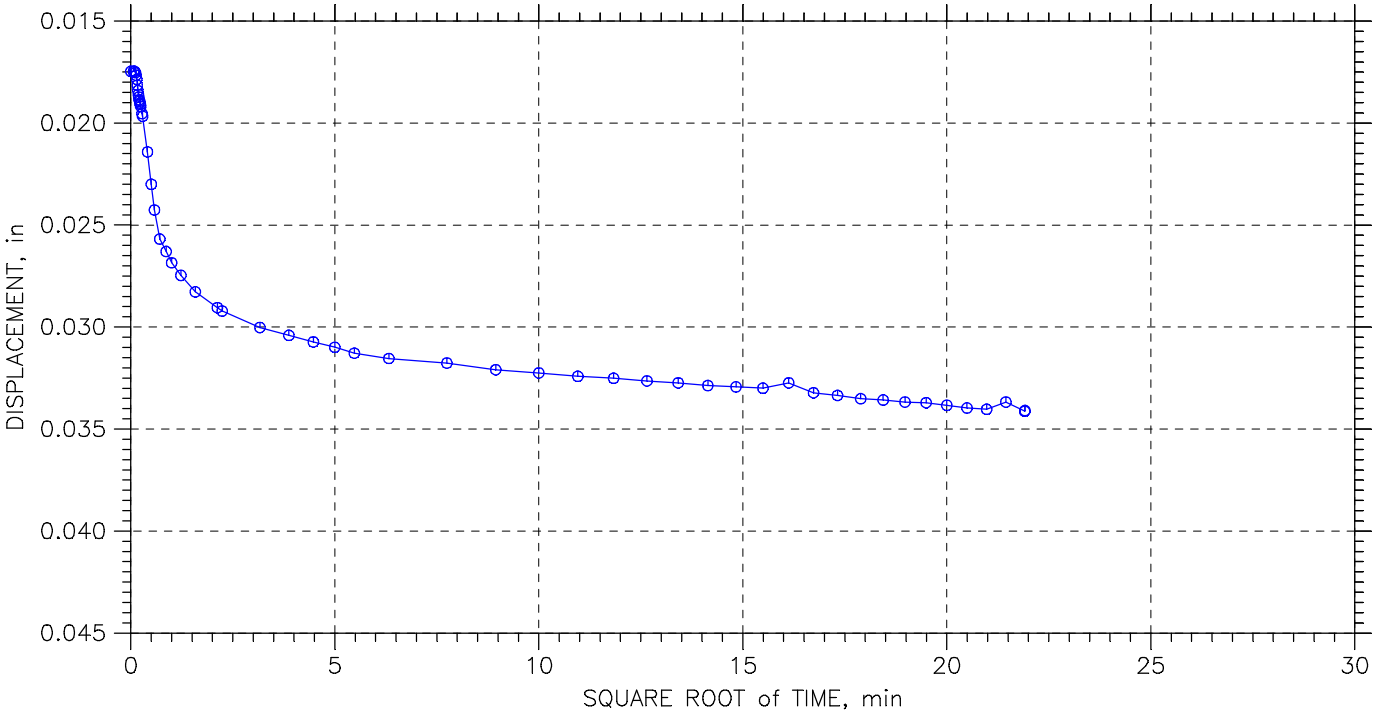
CONSOLIDATION TEST DATA

TIME CURVES

Step: 5 of 11

Stress: 2. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

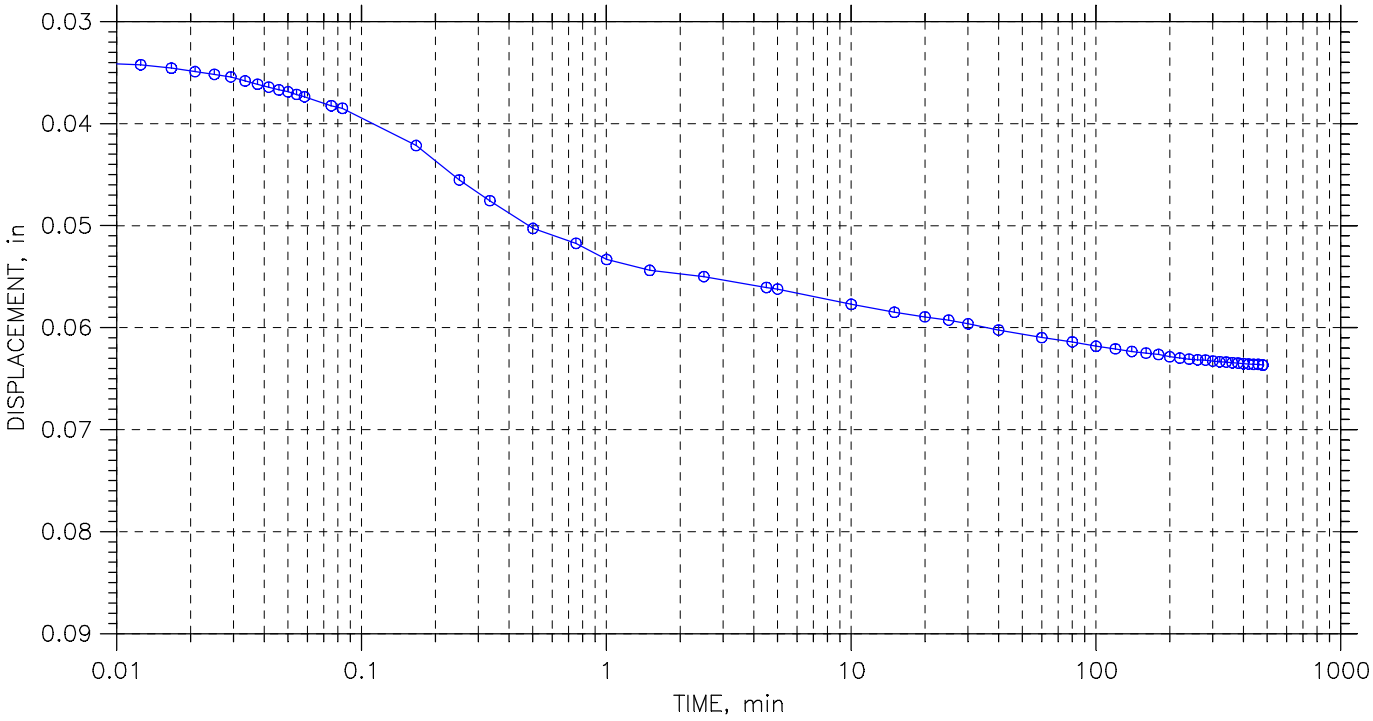
Thu, 11-MAY-2023 15:36:10

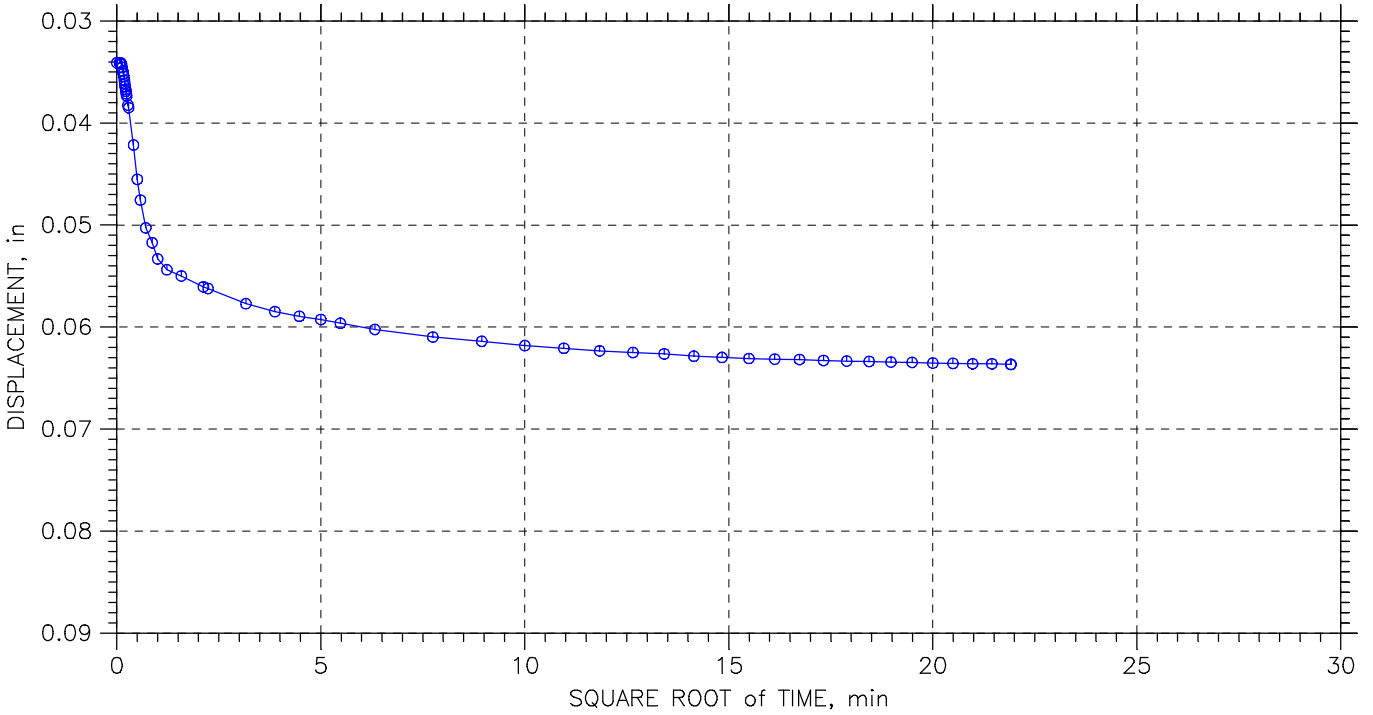
CONSOLIDATION TEST DATA

TIME CURVES

Step: 6 of 11

Stress: 4. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

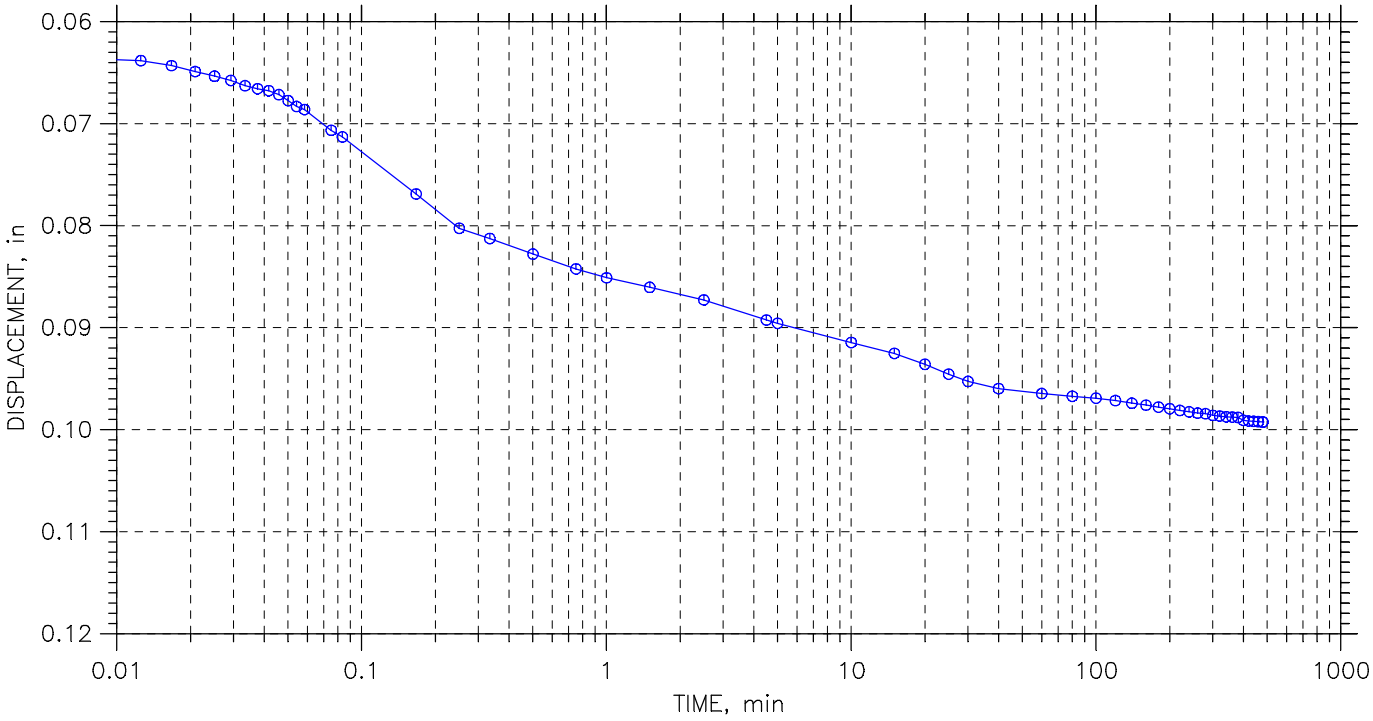
Thu, 11-MAY-2023 15:36:11

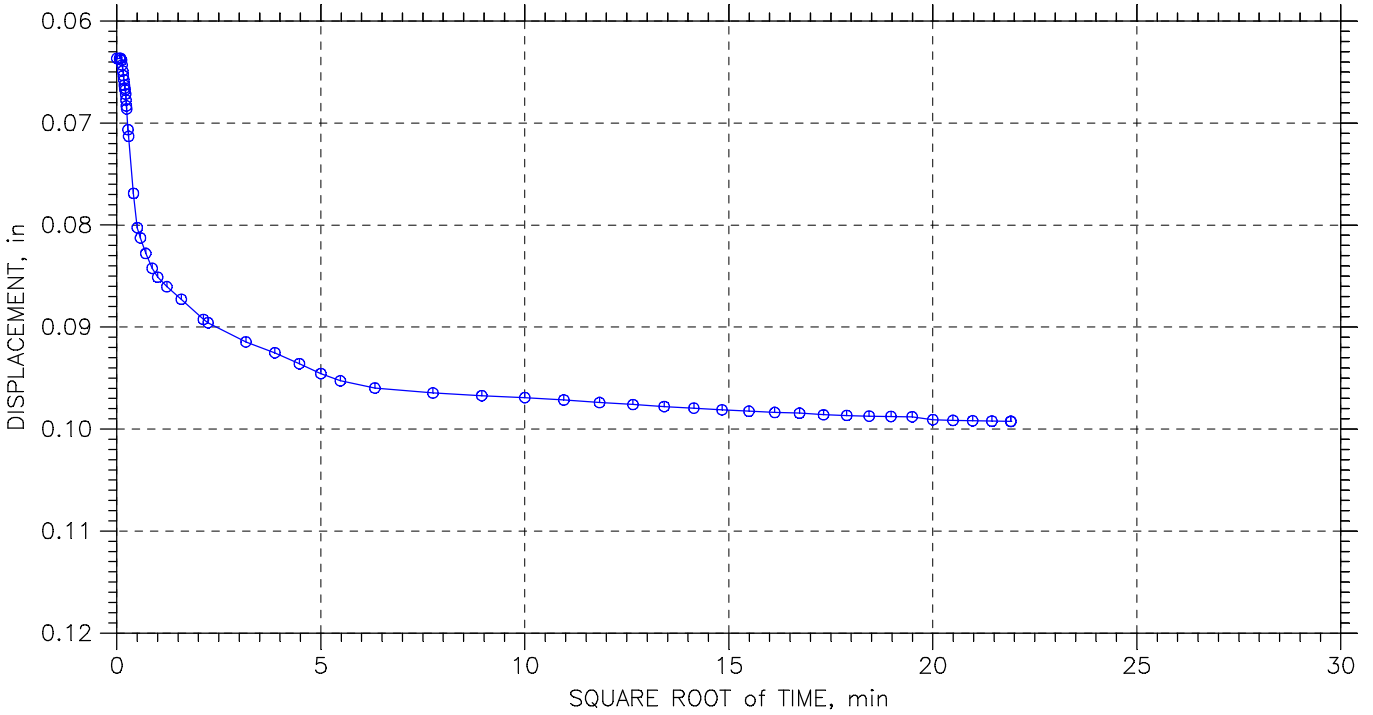
CONSOLIDATION TEST DATA

TIME CURVES

Step: 7 of 11

Stress: 8. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

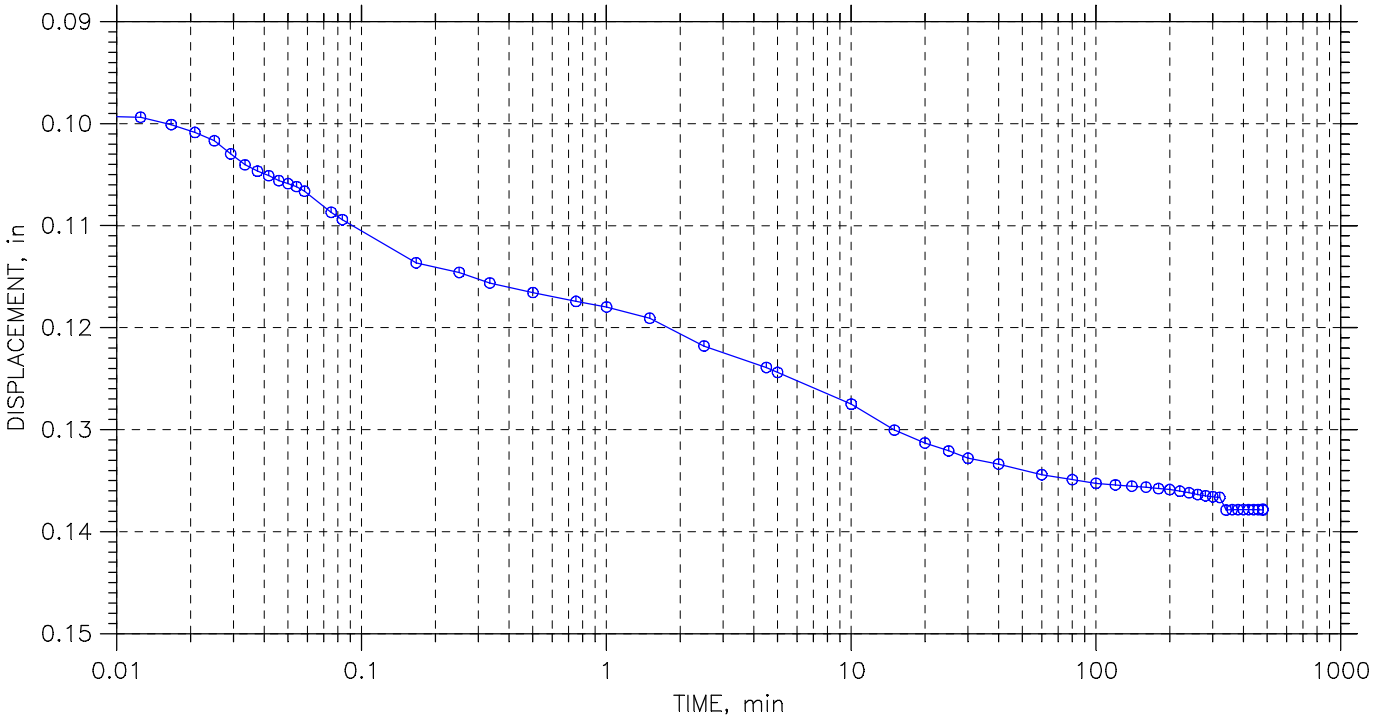
Thu, 11-MAY-2023 15:36:11

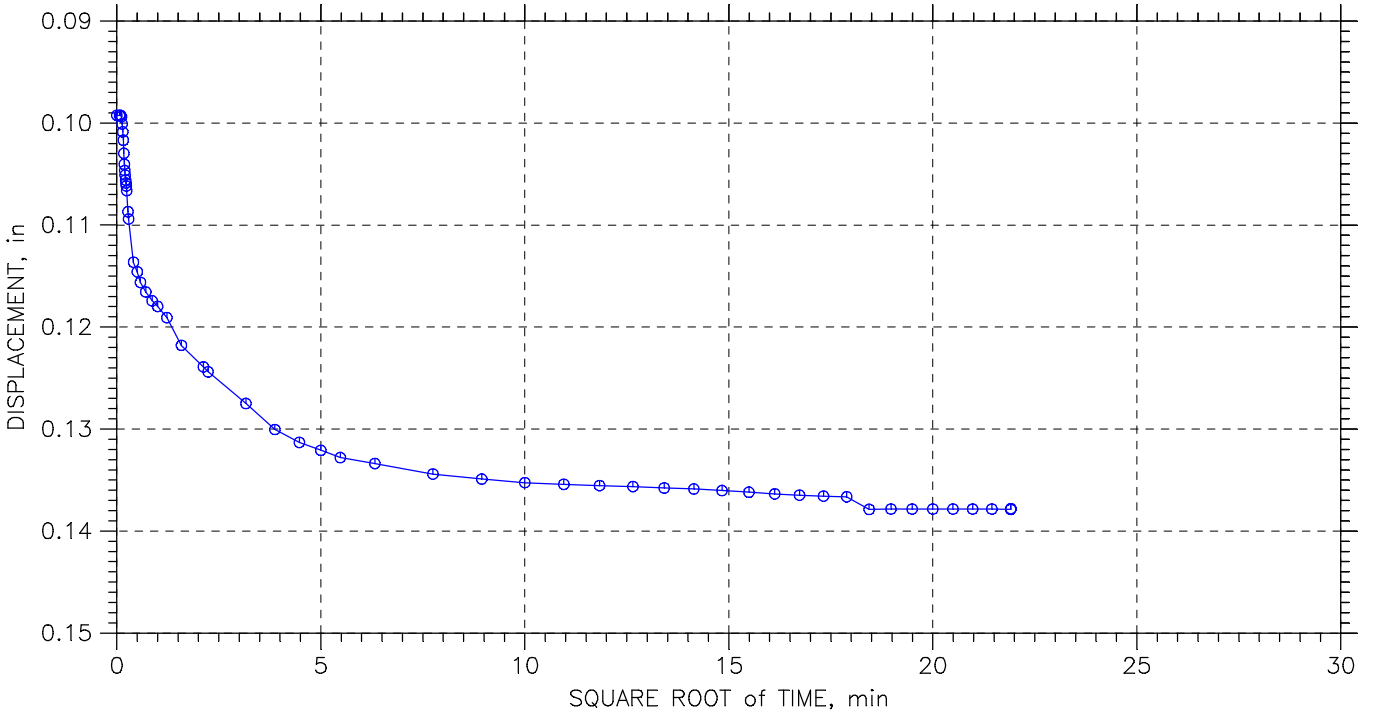
CONSOLIDATION TEST DATA

TIME CURVES

Step: 8 of 11

Stress: 16. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

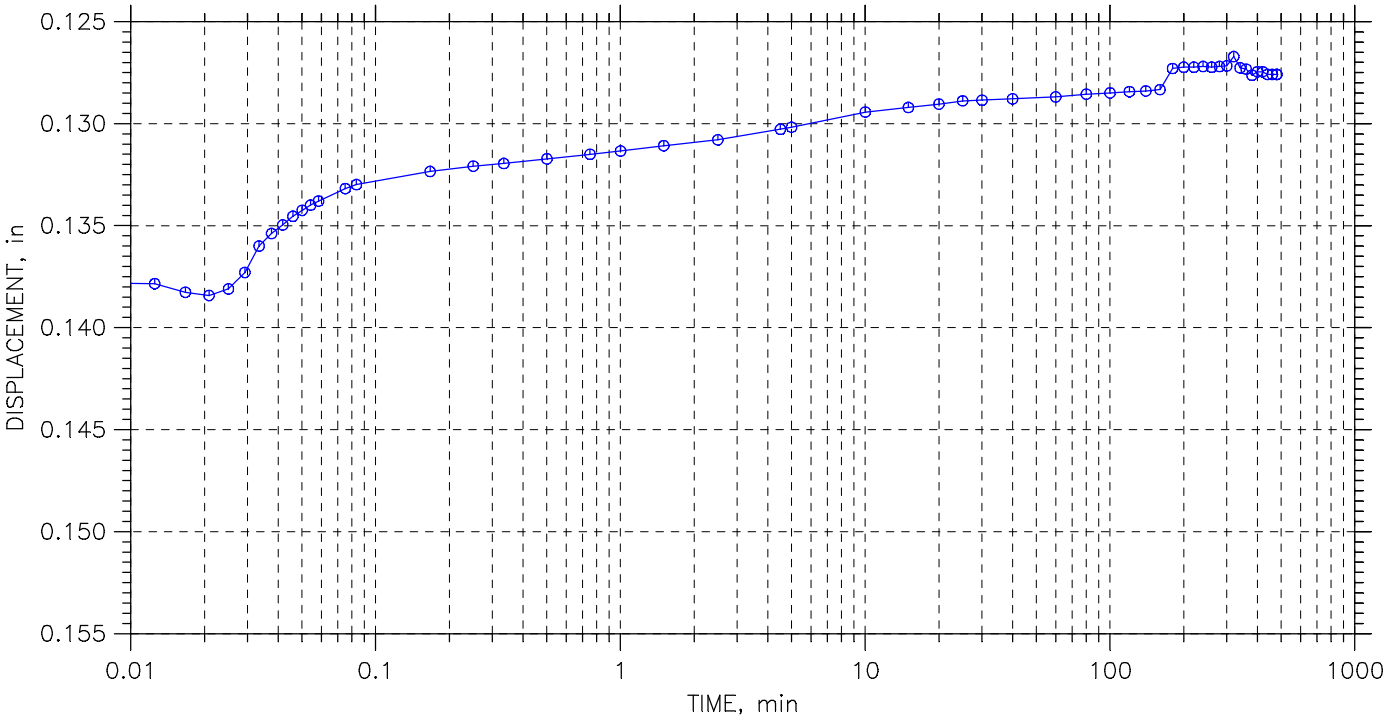
Thu, 11-MAY-2023 15:36:11

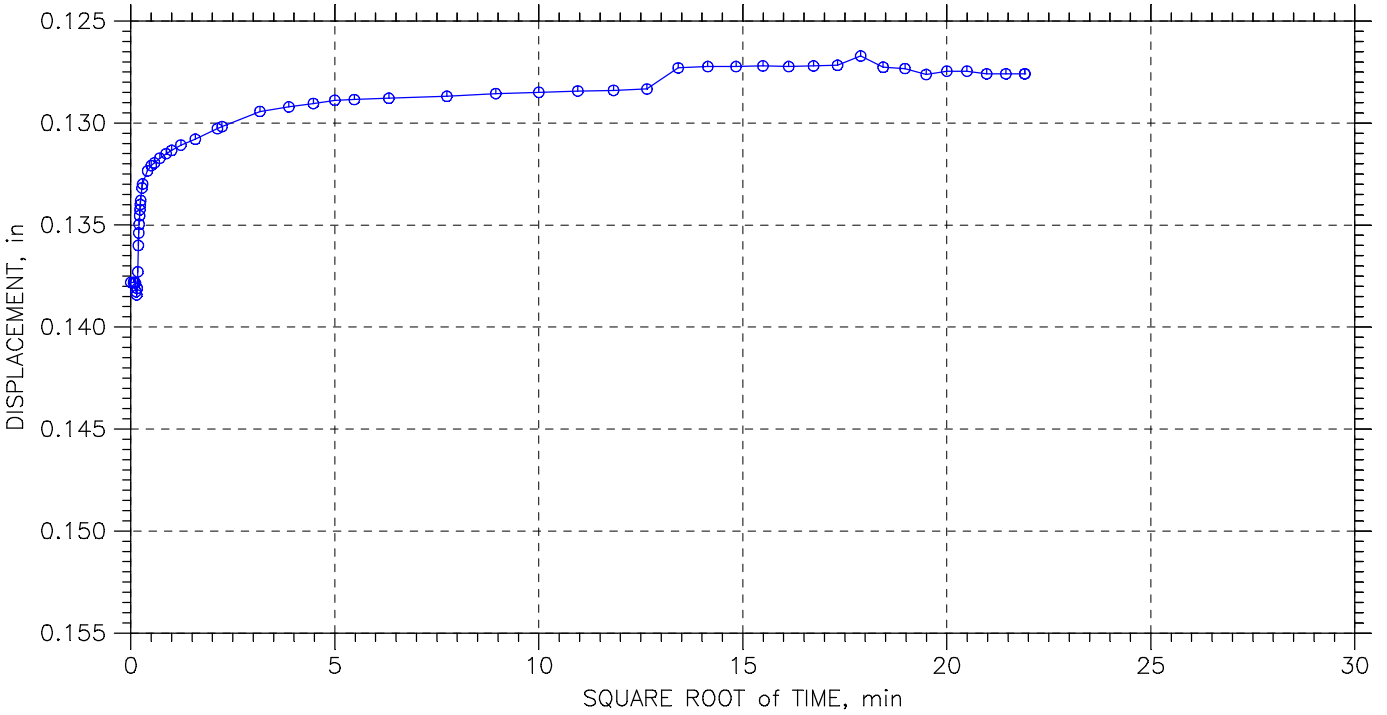
CONSOLIDATION TEST DATA

TIME CURVES

Step: 9 of 11

Stress: 4. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

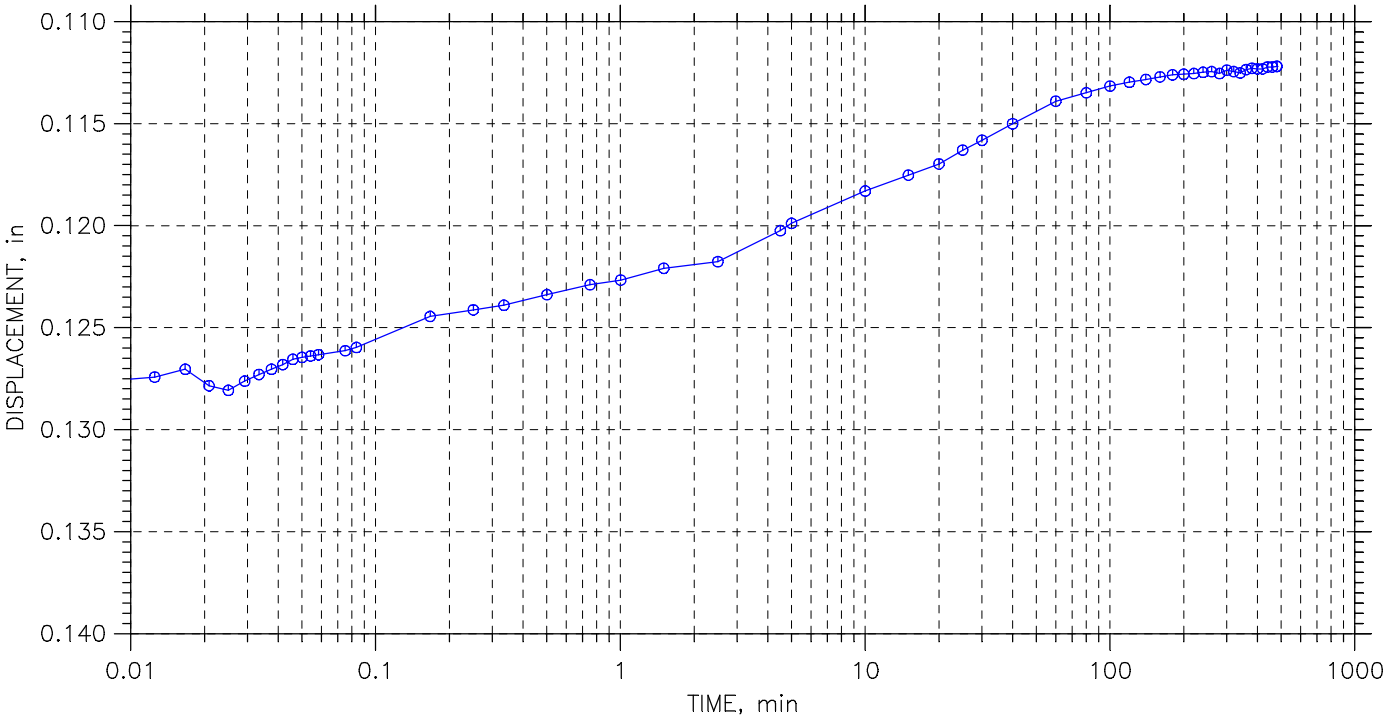
Thu, 11-MAY-2023 15:36:11

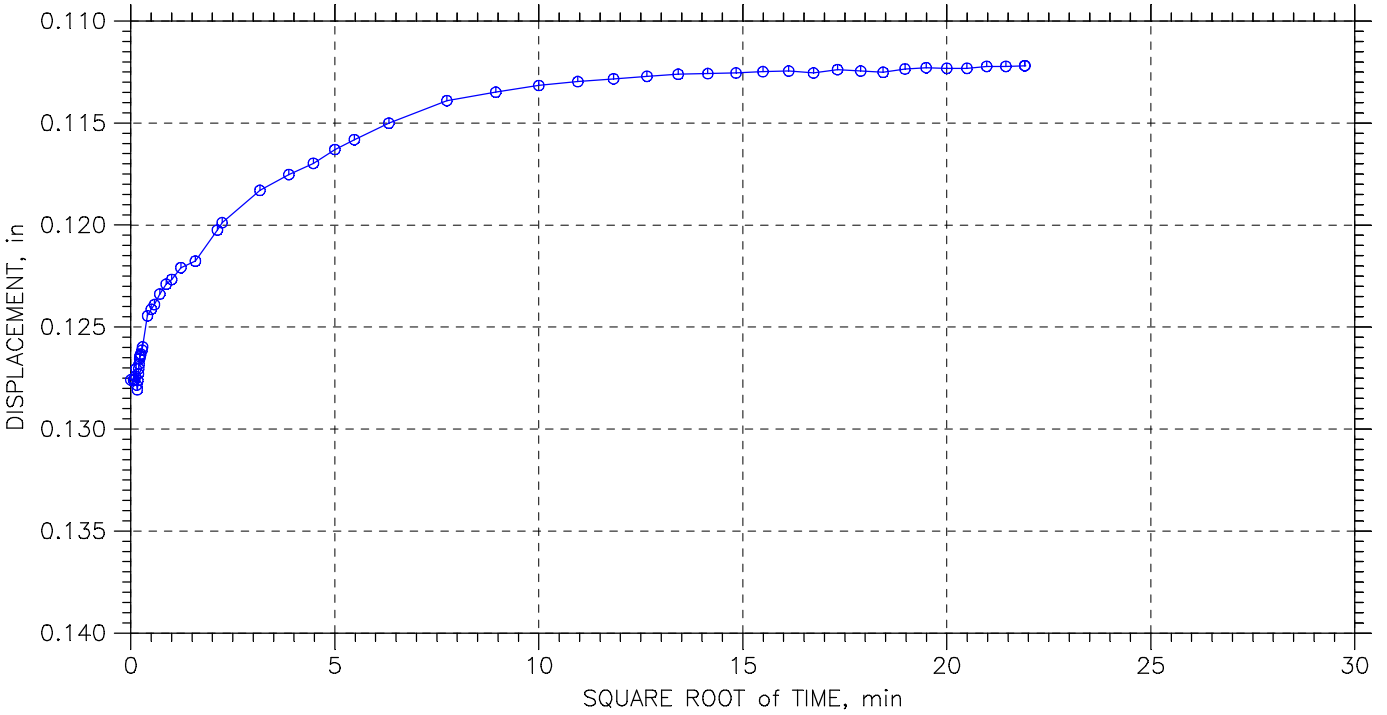
CONSOLIDATION TEST DATA

TIME CURVES

Step: 10 of 11

Stress: 1. tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

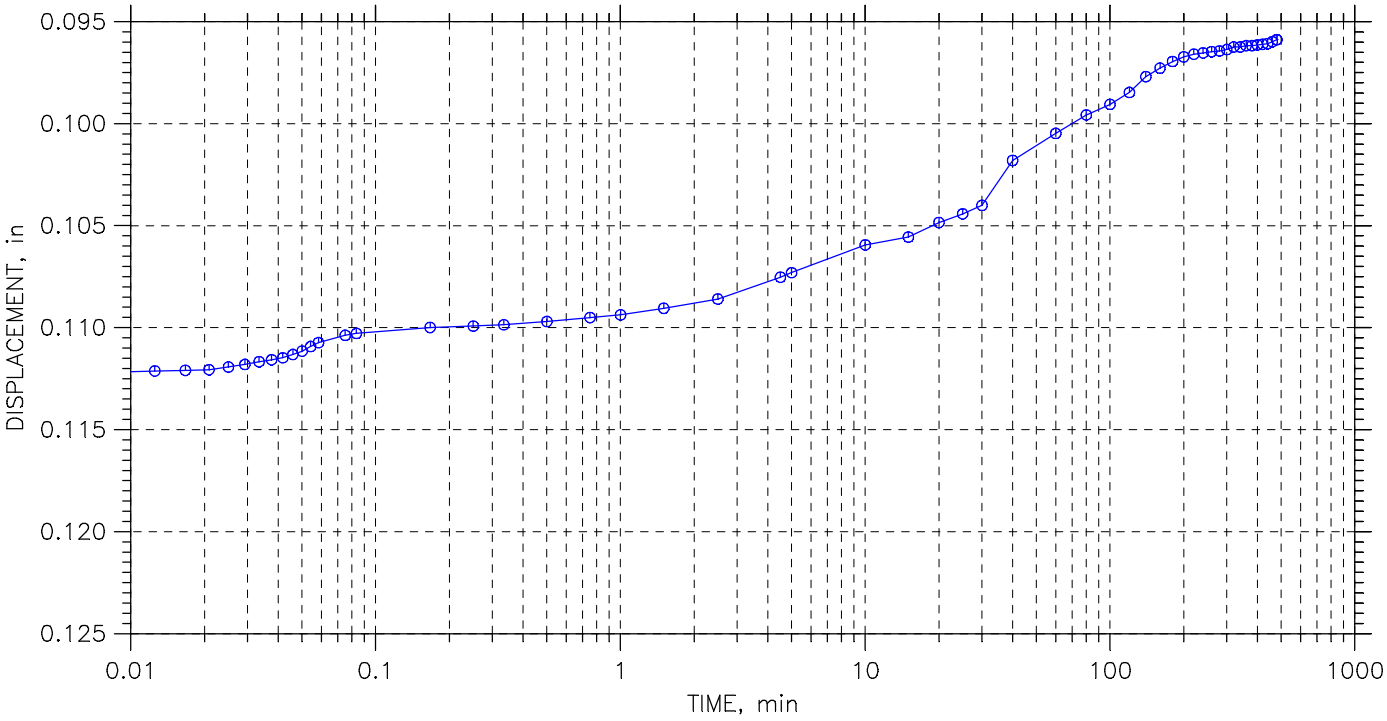
Thu, 11-MAY-2023 15:36:11

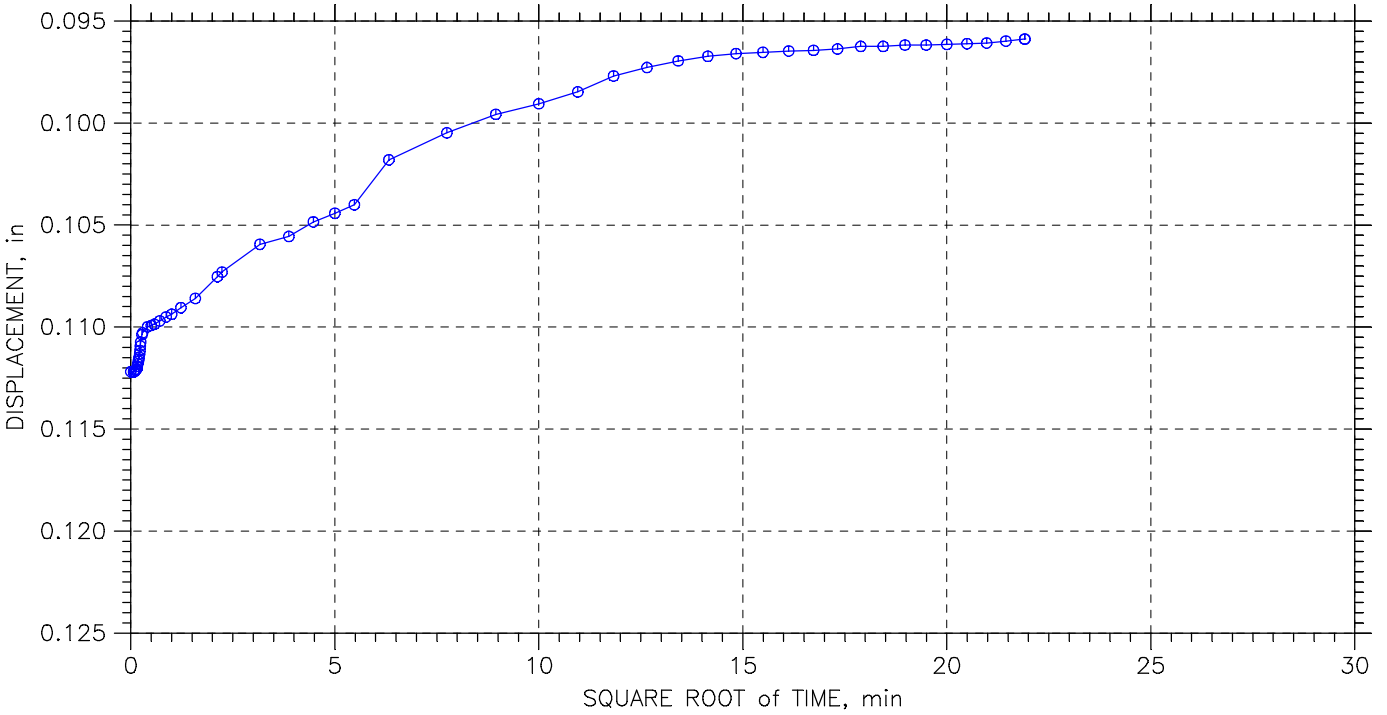
CONSOLIDATION TEST DATA

TIME CURVES

Step: 11 of 11

Stress: 0.25 tsf





Project: Ohio River Greenway Phase	Location:	Project No.: 23050035IND
Boring No.: B-5	Tested By: MW	Checked By: SM
Sample No.: ST-1	Test Date: 05/05/23	Depth: 11'-13'
Test No.: 1	Sample Type: Shelby Tube	Elevation:
Description: Brown Lean Clay (CL)		
Remarks:		

Thu, 11-MAY-2023 15:36:11

CTL Engineering, Inc.
Specific Gravity
ASTM D 854 / AASHTO T 100
Method B

Client: Beam, Longest & Neff,LLC
Project: Ohio River Greenway Phase II
Project #: 23050035IND

Date: 5/10/2023
Tech: MW
Reviewed by: SR

Visual Classification: Brown, Lean Clay (CL)
Weight of Oven Dry Soil passing #4 Sieve (g): 34.72
Material Excluded From Test: None
Mass of Pycnometer ($M_{p)}$: 108.28
Mass of Pyncometer, Water and Soil Solids ($M_{pws,t}$): 379.48

Test Temperature (°C): 21.3

Sample ID	Specific Gravity (20°C)
B-05, ST-1, 11'-13'	2.670

CTL ENGINEERING INC

CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS
AASHTO T 297 & ASTM D4767

CTL ENGINEERING, INC.
2860 Fisher Road Columbus, Ohio 43204

Client: Beam ,Longest & Neff,LLC
PID NO. NA
Project: Ohio River Greenway Phase II
Location: Jeffersonville, Indiana

Project No. 23050035IND
County, Rt. & Sec.: NA
Sample ID: B-5, ST-1, 11'-13'

Lab Code No. 23050735COL
Reviewed by: SM

Sample Type	Undisturbed		
Date Set-up:	5/3/2023	5/3/2023	5/3/2023
Date Sheared:	5/9/2023	05/089/23	5/9/2023
Avg. Sample Height (in.):	5.7753	5.7167	5.7573
Avg. Sample Diameter (in.):	2.8500	2.8500	2.8567
Height-to-diameter ratio:	2.03	2.01	2.02
Wet Density (pcf):	121.5	123.9	128.1
Dry Density (pcf):	99.9	100.6	105.0
Void Ratio:	0.686	0.675	0.605
Specific Gravity (assumed):	2.7	2.7	2.7
Moisture Content (%):	21.7	23.2	22.0
Cross Sectional Area (ft^2):	0.044	0.044	0.045
Volume (ft^3):	0.02	0.02	0.02
Confining Pressure (psf):	720	2160	3600
Rate of Axial Strain (%/min):	0.2078	0.2099	0.2084
Compressive Strength (psf):	2024	2569	4004
Minor Principal Stress at Failure (psf):	720	2160	3600
Major Principal Stress at Failure (psf):	2744	4729	7604
Failure Criterian (%):	Point of Maximum Obliquity		
β:	0.98	0.99	0.96
Specimen Saturation:	Wet Method		

POST SHEAR
720 psf

POST SHEAR
2160 psf

POST SHEAR
3600 psf

Grading (ASTM D422)

% Agg:	0
% Sand.:	11
% Silt:	22
% Clay:	37

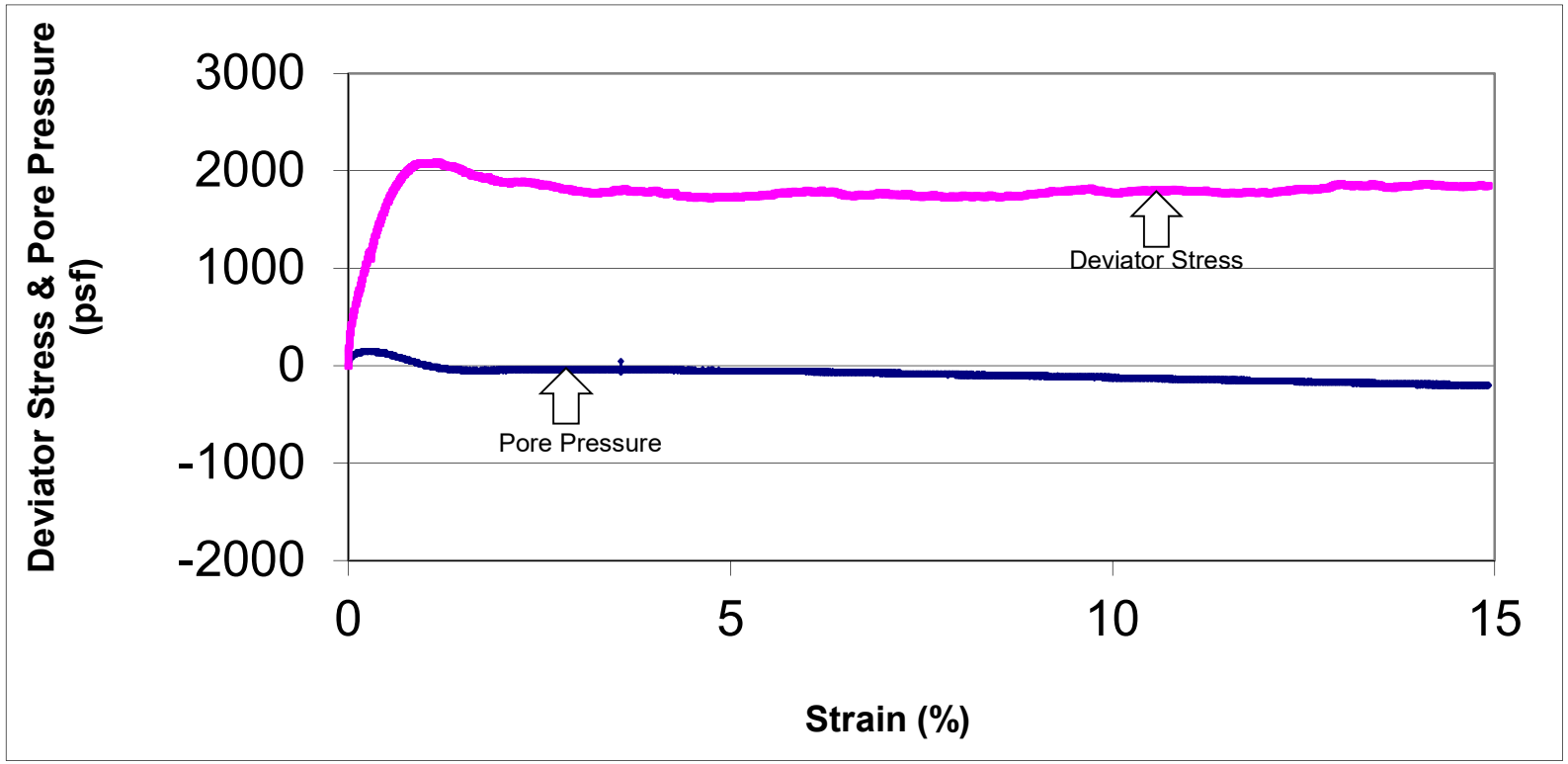
Atterberg Limits (ASTM D 4318)

L.L.:	37
P.L.:	22
P.I.:	15

Visual Classification: Brown, Lean Clay (CL)

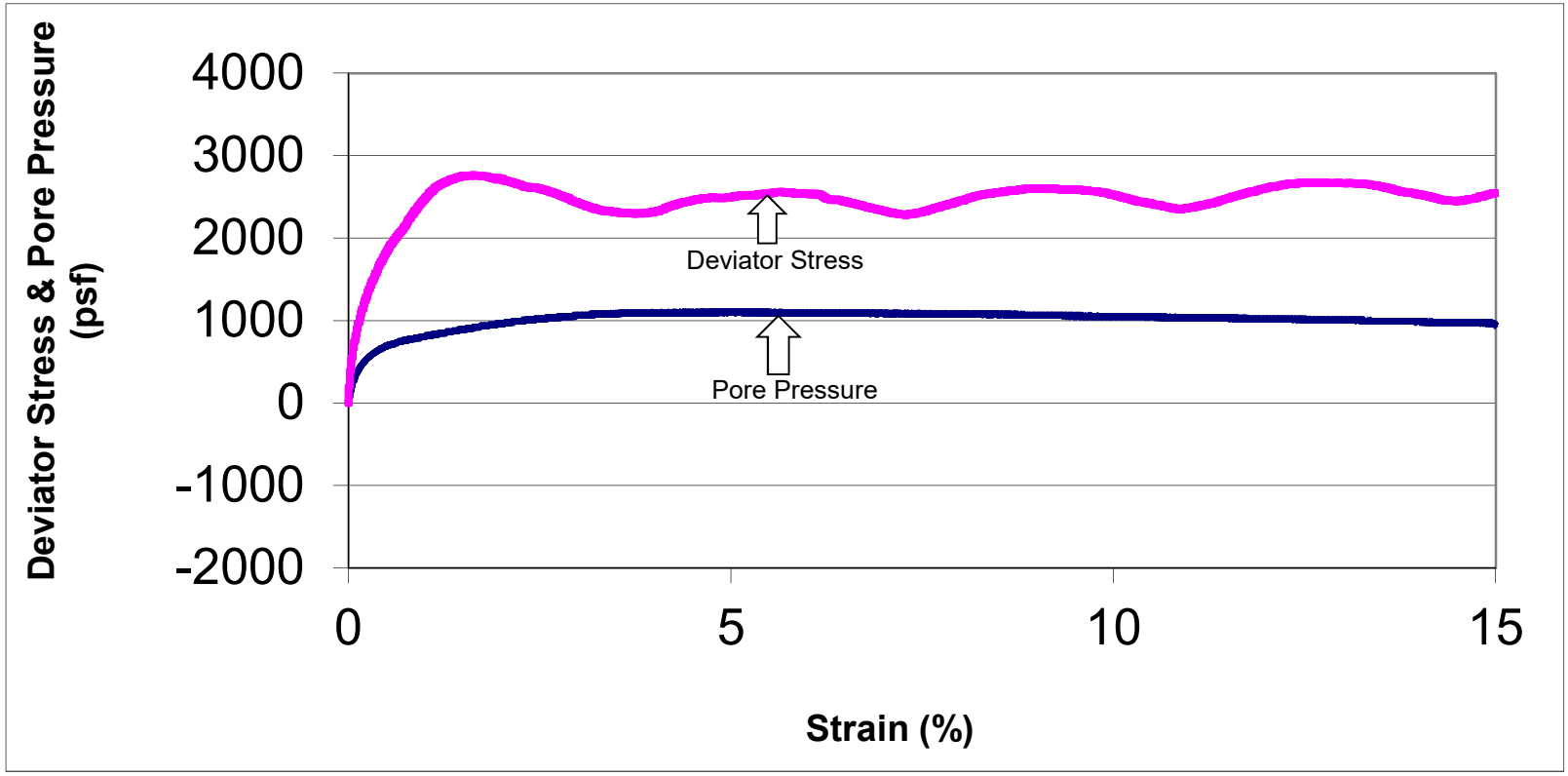
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID:	B-5, ST-1, 11'-13'
PROJECT:	Ohio River Greenway Phase II	Confining Pressure (psf):	720
LOCATION:	Jeffersonville, Indiana		
PROJECT #:	23050035IND		



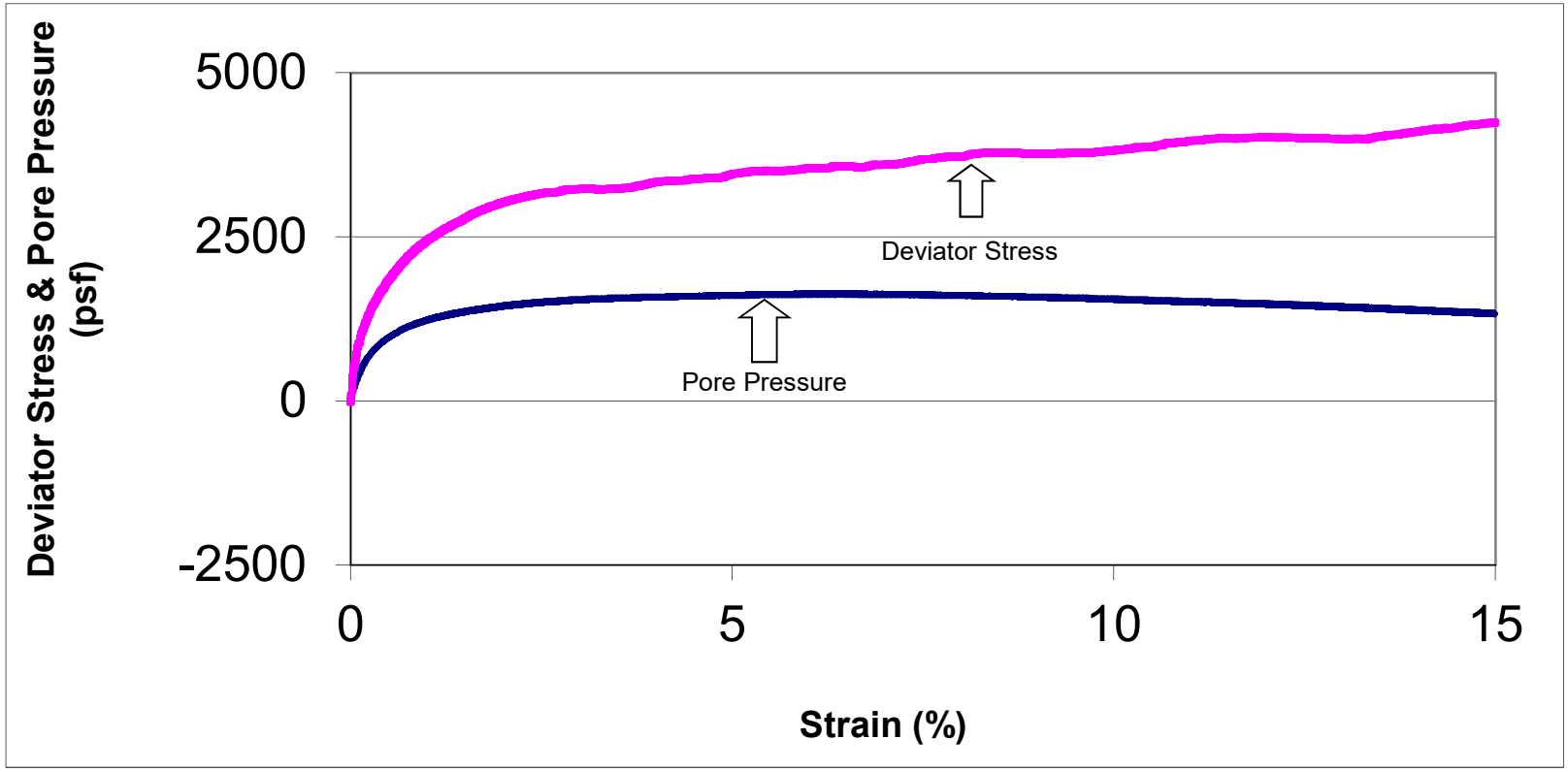
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID:	B-5, ST-1, 11'-13'
PROJECT:	Ohio River Greenway Phase II	Confining Pressure (psf):	2160
LOCATION:	Jeffersonville, Indiana		
PROJECT #:	23050035IND		



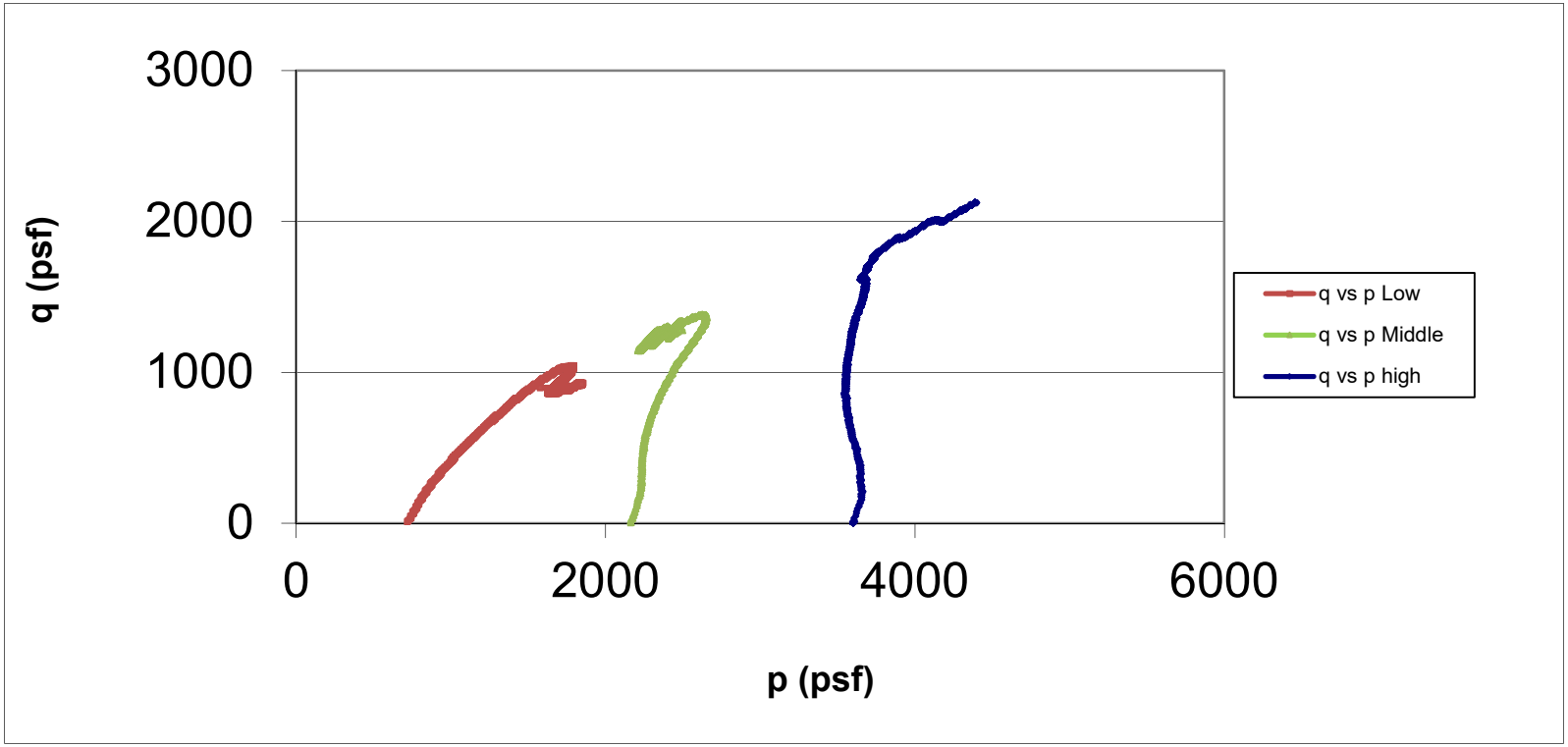
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID:	B-5, ST-1, 11'-13'
PROJECT:	Ohio River Greenway Phase II	Confining Pressure (psf):	3600
LOCATION:	Jeffersonville, Indiana		
PROJECT #:	23050035IND		



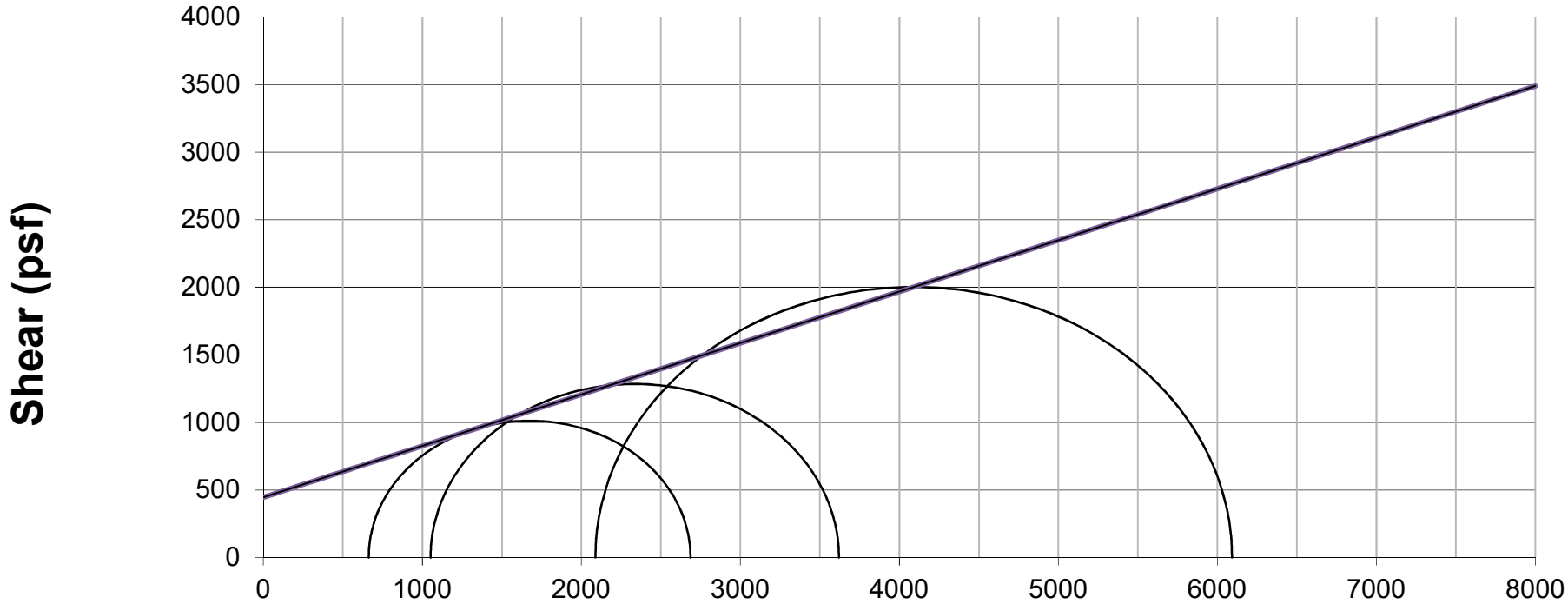
q vs. p

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID:	B-5, ST-1, 11'-13'		
PROJECT:	Ohio River Greenway Phase II				
LOCATION:	Jeffersonville, Indiana	Confining Pressure (psf):	Low	Middle	High
PROJECT #:	23050035IND		720	2160	3600



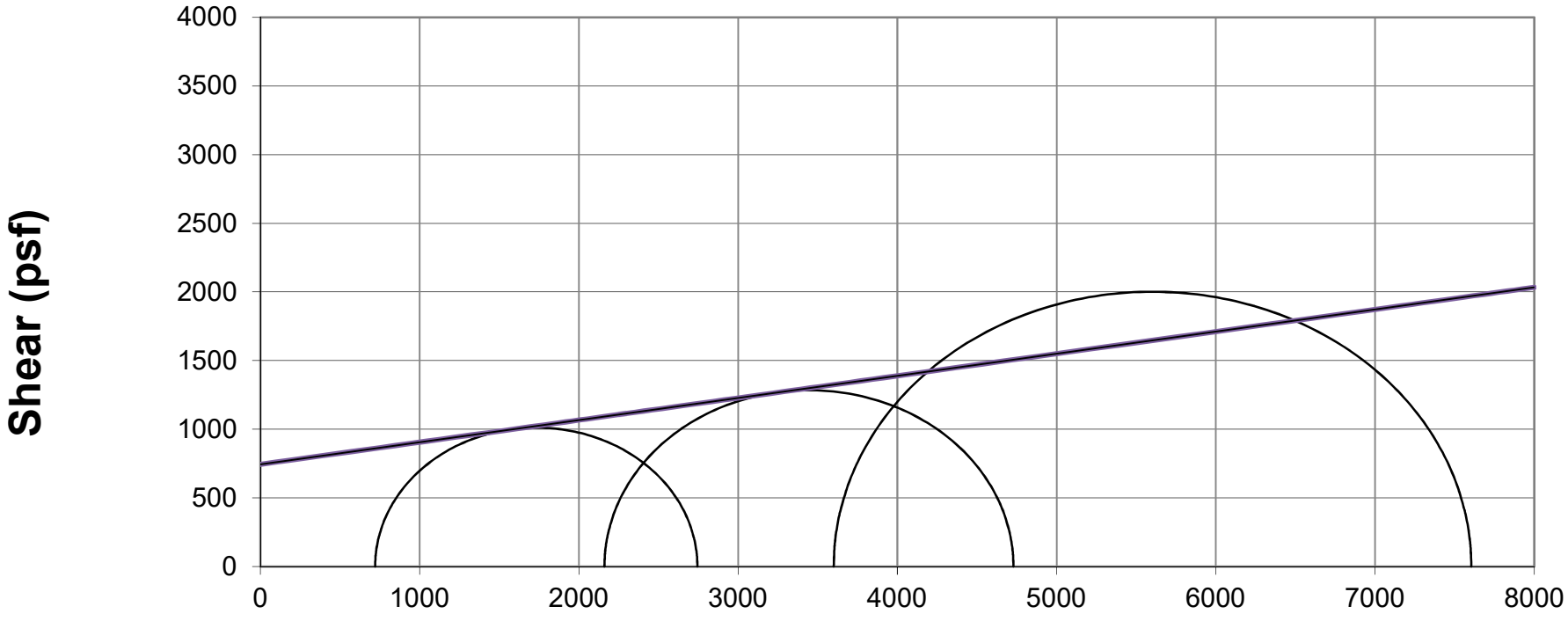
Mohr Circle Effective Stress

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID: B-5, ST-1, 11'-13'			
PROJECT:	Ohio River Greenway Phase II				
LOCATION:	Jeffersonville, Indiana	Confining Pressure (psf):	720	2160	3600
PROJECT #:	23050035IND	Cohesion(psf):	445		
		Angle of Friction(°):	20		



Mohr Circle Total Stress

CLIENT:	Beam ,Longest & Neff,LLC	Sample ID: B-5, ST-1, 11'-13'			
PROJECT:	Ohio River Greenway Phase II				
LOCATION:	Jeffersonville, Indiana	Confining Pressure (psf):	720	2160	3600
PROJECT #:	23050035IND	Cohesion(psf):	745		
		Angle of Friction(°):	9		



Boring	Sample	Depth	Wet Density (pcf)	Dry Density (pcf)	Qu (ksf)	c (ksf)	Moisture %	Max Dry Density (pcf)	Optimum Moisture %	Resilient Modulus			Sulfate (ppm)	Phosphorus (ppm)	Potassium (ppm)	LOI (%)	Calcium Carbonate (%)	pH
										@ Opt.	+2% of Opt.	In-situ						
B-1	SS-1	1.0-2.5					25.1											6.2
B-1	SS-2	3.5-5.0					23.8											
B-1	SS-3	6.0-7.5					23.6											
B-1	SS-4	8.5-10.0					16.1											
B-1	SS-5	13.5-15.0					22.6											
B-1	SS-6	18.5-20.0					15.2											6.2
B-1	SS-7	23.5-25.0					6.1											
B-1	SS-8	28.5-30.0					12.9											
B-2	SS-1	1.0-2.5					32.3									6.2	7.7	
B-2	SS-2	3.5-5.0					9.0											
B-2	SS-3	6.0-7.5					21.2											
B-2	SS-4	8.5-10.0					16.0											
B-3	SS-1	1.0-2.5					13.3											
B-3	SS-2	3.5-5.0					16.0											
B-3	SS-3	6.0-7.5					11.0											
B-3	SS-4	8.5-10.0					13.5											6.5
B-3A	ST-1	1.5-3.5	135.1	123.3	0.331	0.165	9.6											
B-4	SS-1	1.0-2.5					22.0											
B-4	SS-2	3.5-5.0					25.3											
B-4	SS-3	6.0-7.5					31.4									3.5	5.4	
B-4	SS-4	8.5-10.0	127.3	101.8	3.796	1.898	25.1											
B-4	SS-5	13.5-15.0					22.9											
B-4	SS-6	18.5-20.0					19.0											
B-5	SS-1	1.0-2.5					17.9											
B-5	SS-2	3.5-5.0					14.9											
B-5	SS-3	6.0-7.5					25.3											

ENGINEERING
CTL Engineering, Inc.
Phone: 317-295-8650

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Des. No. :
Project Type : Ohio River Greenway Phase II
Route : Jeffersonville Ohio River Greenway
Location : Jeffersonville, IN

Project No. : 140007
County : Clark
CTL Proj. No. : 23050035IND

Boring	Sample	Depth	Wet Density (pcf)	Dry Density (pcf)	Qu (ksf)	c (ksf)	Moisture %	Max Dry Density (pcf)	Optimum Moisture %	Resilient Modulus			Sulfate (ppm)	Phosphorus (ppm)	Potassium (ppm)	LOI (%)	Calcium Carbonate (%)	pH
										@ Opt.	+2% of Opt.	In-situ						
B-5	SS-4	8.5-10.0					20.5											
B-5	ST-1	11.0-13.0					22.3											
B-5	SS-5	13.5-15.0					24.4											
B-5	SS-6	18.5-20.0					13.8											
B-6	SS-1	1.0-2.5					4.5											
B-6	SS-2	3.5-5.0					26.6											
B-6	SS-3	6.0-7.5					25.6											5.9
B-6	SS-4	8.5-10.0					23.7											5.8
B-6	SS-5	13.5-15.0					27.2											
B-7	SS-1	1.0-2.5					4.1											
B-7	SS-2	3.5-5.0					12.2											
B-7	SS-3	6.0-7.5					26.5											
B-7	SS-4	8.5-10.0					34.4									2.4	6.4	5.8
B-7	SS-5	13.5-15.0					9.1											

CTL Engineering, Inc.
Phone: 317-295-8650

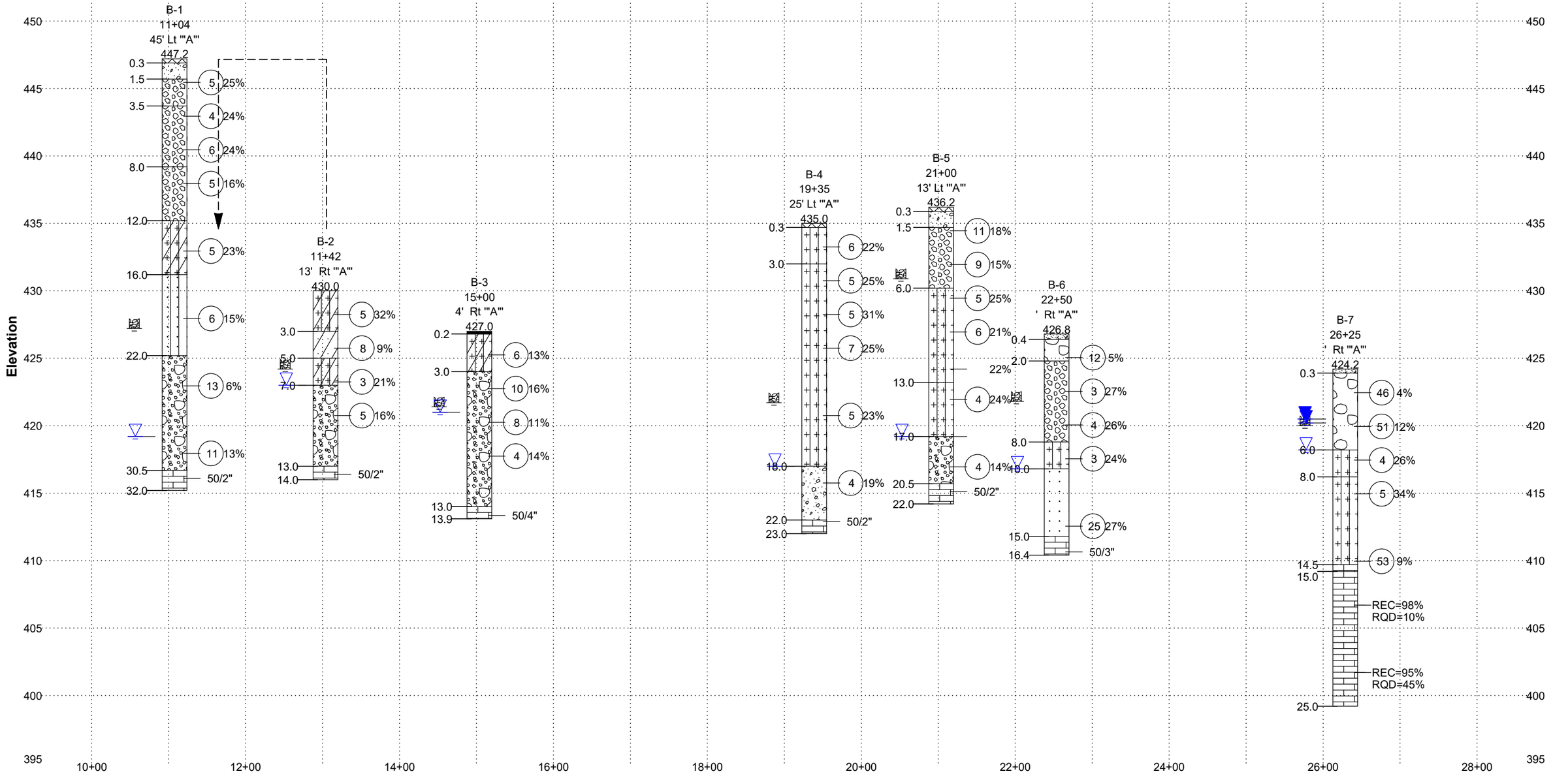
SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Des. No. :
Project Type : Ohio River Greenway Phase II
Route : Jeffersonville Ohio River Greenway
Location : Jeffersonville, IN

Project No. : 140007
County : Clark
CTL Proj. No. : 23050035IND

APPENDIX D

SOIL PROFILE



LEGEND

Asphalt	Sand & Gravel	Fill	Silty Clay Loam	Sandy Loam
Gravelly Sand	Limestone	Sandy Clay	Topsoil	Silty Loam
Concrete	Gravel	Sand		

(N)	STANDARD PENETRATION IN BLOWS PER FOOT (N)
W%	PERCENT MOISTURE CONTENT(w)
REC	PERCENT ROCK CORE RECOVERY
RQD	ROCK QUALITY DESIGNATION (%)

	GROUNDWATER DURING DRILLING
	GROUND WATER AT COMPLETION OF DRILLING
	GROUNDWATER AT "N" HOURS AFTER COMPLETION
	CAVED IN DEPTH

GENERALIZED SOIL PROFILE

CTL Engineering, Inc.
www.ctleng.com

Scale	As Shown
Date	6/2/23
Drawn By	
Reviewed By	

Beam, Longest and Neff, LLC
Ohio River Greenway Phase II
Jeffersonville Ohio River Greenway
Clark County, Indiana

CTL Project No.: 23050035IND

Sheet 1

INDOT_SO 23050035IND.GPJ INDOT_DATA TEMPLATE.GDT 6/2/23

APPENDIX E

SEISMIC COEFFICIENTS

Ohio River Greenway

Latitude, Longitude: 38.267718, -85.747595

Date	6/2/2023, 7:17:53 AM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	0.205	MCE_R ground motion. (for 0.2 second period)
S_1	0.106	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.246	Site-modified spectral acceleration value
S_{M1}	0.179	Site-modified spectral acceleration value
S_{DS}	0.164	Numeric seismic design value at 0.2 second SA
S_{D1}	0.12	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.694	Site amplification factor at 1.0 second
PGA	0.095	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.114	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.205	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.229	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.106	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.124	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.095	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.894	Mapped value of the risk coefficient at short periods
C_{R1}	0.856	Mapped value of the risk coefficient at a period of 1 s
C_V		Vertical coefficient

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APPENDIX F

EMBANKMENT SETTLEMENT ANALYSES
EMBANKMENT SLOPE STABILITY

SETTLEMENT ANALYSIS
Station 11+50, Borings B-1 and B-2

Project:	Ohio River Greenway
Location:	Jeffersonville, IN
CTL Project No.:	23050035IND

DATA

Existing Grade	= 431.0	feet
Groundwater Depth	= 424.0	feet
Proposed Embankment Elevation	= 442.5	feet
Embankment Fill, unit weight	= 125	pcf
Embankment Height	= 11.5	feet
Estimated Embankment Pressure	= 1437.5	psf

Calculation

Delta S = H [C_c / (1+ e_o)] log [((Po + Delta P) / Po)] Normally Consolidated

Delta S = H [C_r / (1+ e_o)] log [((Po + Delta P) / Po)] Overconsolidated with $P_F < P_c$

Delta S = H[C_c/(1+ e_o)] log[((Po+Delta P)/Pc)]+H[C_r/(1+ eo)] log[((Pc)/Po)] OC with $P_o < P_c < P_F$

Delta S= H [(1 / BCI)] log [(Po + Delta P) / Po)] Cohesionless

Soil Layer	A	B	C	D	E	F
Soil Type	Silty Clay Loam	Silty Clay Loam	Sand	Sand		
Strata Top Elevation (E1)	431.0	427.0	423.0	420.0		
Strata Bottom Elevation (E2)	427.0	423.0	420.0	416.0		
Soil Strata Thickness (H = E1-E2)), feet	4.0	4.0	3.0	4.0		
Midpoint Elevation (E3 = E1-H/2)	429.0	425.0	421.5	418.0		
Total Depth to Midpoint (d = E1-E3), feet	13.5	17.5	21.0	24.5		
Depth from Bottom Elevation to Midpoint (Z), ft	2.0	6.0	9.5	13.0		

Moisture Content, w	32.0	21.0	16.0	13.0		
Specific Gravity, Gs	2.67	2.67	2.65	2.65		
Soil Total Unit Weight (d), pcf	125.0	125.0	125.0	125.0		
Effective Soil Unit Weight (d'), pcf	125.0	135.0	62.6	62.6		
Liquid Limit, LL	37	37	NP	NP		
Plastic Limit, PL	22	22	NP	NP		
Average Blowcounts, N	5	6	5	11		
Overburden Correction Factor, CN	1.70	1.32	1.19	1.13		
Hammer Efficiency, (%)	90	90	90	90		
Average Corrected Blowcounts, $N1_{60}$	13	12	9	19		

SETTLEMENT ANALYSIS
Station 11+50, Borings B-1 and B-2

Project: Ohio River Greenway
Location: Jeffersonville, IN
CTL Project No.: 23050035IND

Void Ratio, eo = (Gs * w) / 100	0.854	0.561	---	---		
Compression Index, Cc (From Consol. Test)	0.210	0.210	---	---		
Compression Index, Cr (From Consol. Test)	0.028	0.028	---	---		
Undrained Shear Strength, S_u (psf)	1000	1000	---	---		
S_u/P_0	4.00	1.30	---	---		
OCR	6.00	3.30	---	---		
Preconsolidation Pressure, Pc (psf)*	1500	2540	---	---		
BCI' (FHWA)	---	---	55	75		
Overburden Pressure, Po (psf)	250	770	1134	1353		

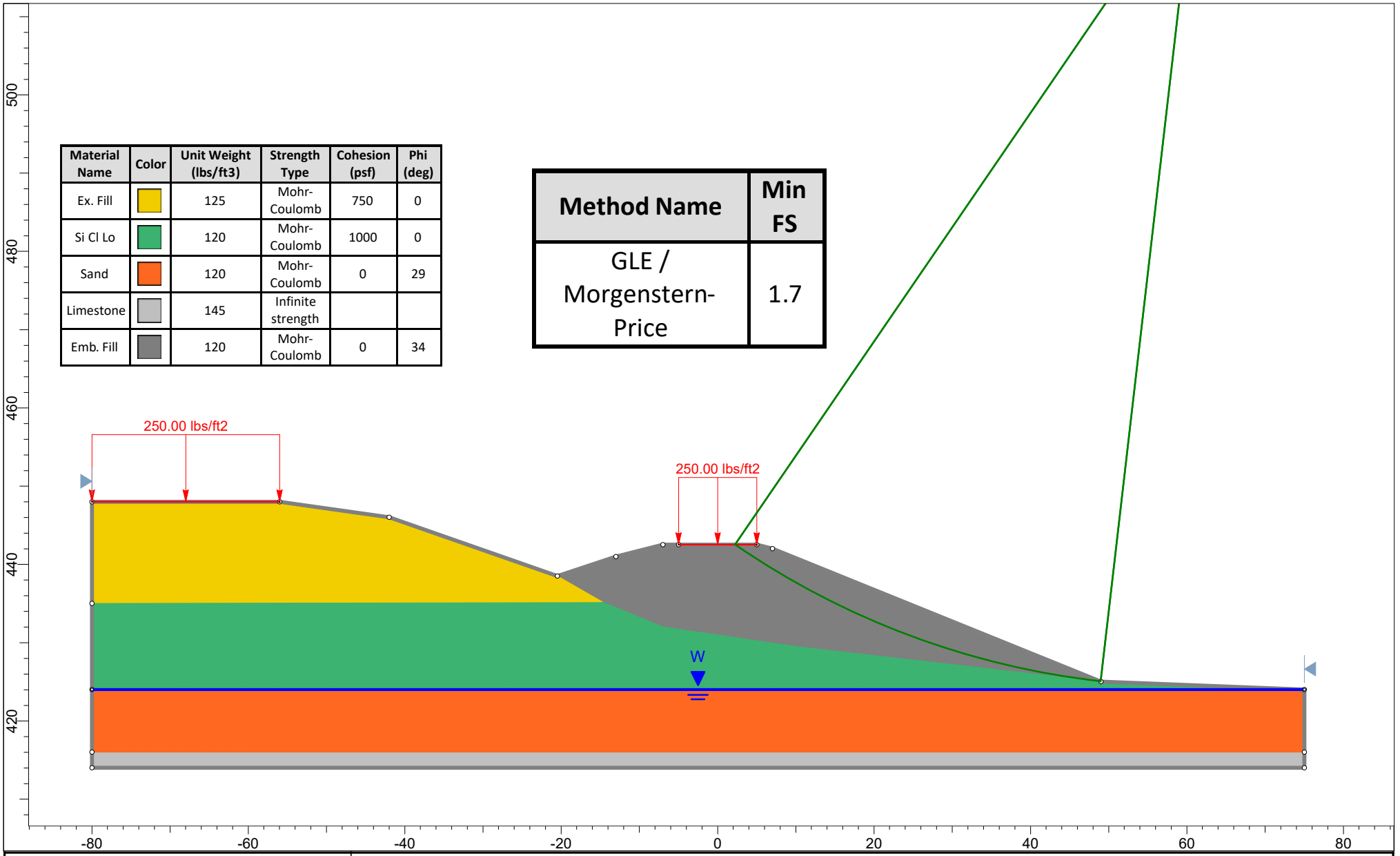
Soil parameters eo, Cc, Cr, OCR and C' were estimated using FHWA-NHI-05-123 and FHWA-06-088

Settlement Calculation

Half Embankment Width (b), feet=	5				**1438**	
Embankment Slope Width (a), feet=	20					
Soil Layer	A	B	C	D		
Influence Factor, a/Z	10.0	3.3	2.1	1.5		
Influence Factor, b/Z	2.5	0.8	0.5	0.4		
Influence Factor, I (Boussinesq)	1.00	0.94	0.86	0.82		
Pressure Increase, ΔP = Qn x I	1438	1351	1236	1179		
Settlement/Layer (inches)	0.8	0.4	0.2	0.2		
Cumulative Settlement from bottom up (in)	1.6	0.8	0.4	0.2		
Estimated Total Settlement (inches)	**1.6**					

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ex. Fill		125	Mohr-Coulomb	750	0
Si Cl Lo		120	Mohr-Coulomb	1000	0
Sand		120	Mohr-Coulomb	0	29
Limestone		145	Infinite strength		
Emb. Fill		120	Mohr-Coulomb	0	34

Method Name	Min FS
GLE / Morgenstern-Price	1.7



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Project	Ohio River Greenway - Phase II		
Group	11+50_EoC.slim	Scenario	11+50_EoC.slim
Drawn By	SM	Company	CTL
Date	5/26/2023	File Name	11+50_EoC.slim

SLIDEINTERPRET 9.018

Slide Analysis Information

Ohio River Greenway - Phase II

Project Summary

Slide Modeler Version:	9.018
Author:	SM
Company:	CTL
Date Created:	5/26/2023

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary
Distributed Load 2	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary

Materials

Ex. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	750
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Si Cl Lo	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1
Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	29
Water Surface	Water Table
Hu Value	1
Limestone	
Color	
Strength Type	Infinite strength
Unit Weight [lbs/ft3]	145
Allow Sliding Along Boundary	Yes
Water Surface	Water Table
Hu Value	0
Emb. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	34
Water Surface	Water Table
Hu Value	1

Entity Information

Water Table

X	Y
-80	424
75	424

Distributed Load

X	Y
-56	448
-80	448

Distributed Load

X	Y
5	442.5
-5	442.5

External Boundary

X	Y
-80	448
-80	435
-80	424
-80	416
-80	414
75	414
75	416
75	424
49	425
7	442
5	442.5
-5	442.5
-7	442.5
-13	441
-20.5	438.5
-42	446
-56	448

Material Boundary

X	Y
-20.5	438.5
-14.603	435.104
-7	432
10	429.5
49	425

Material Boundary

X	Y
-80	435
-14.603	435.104

Material Boundary

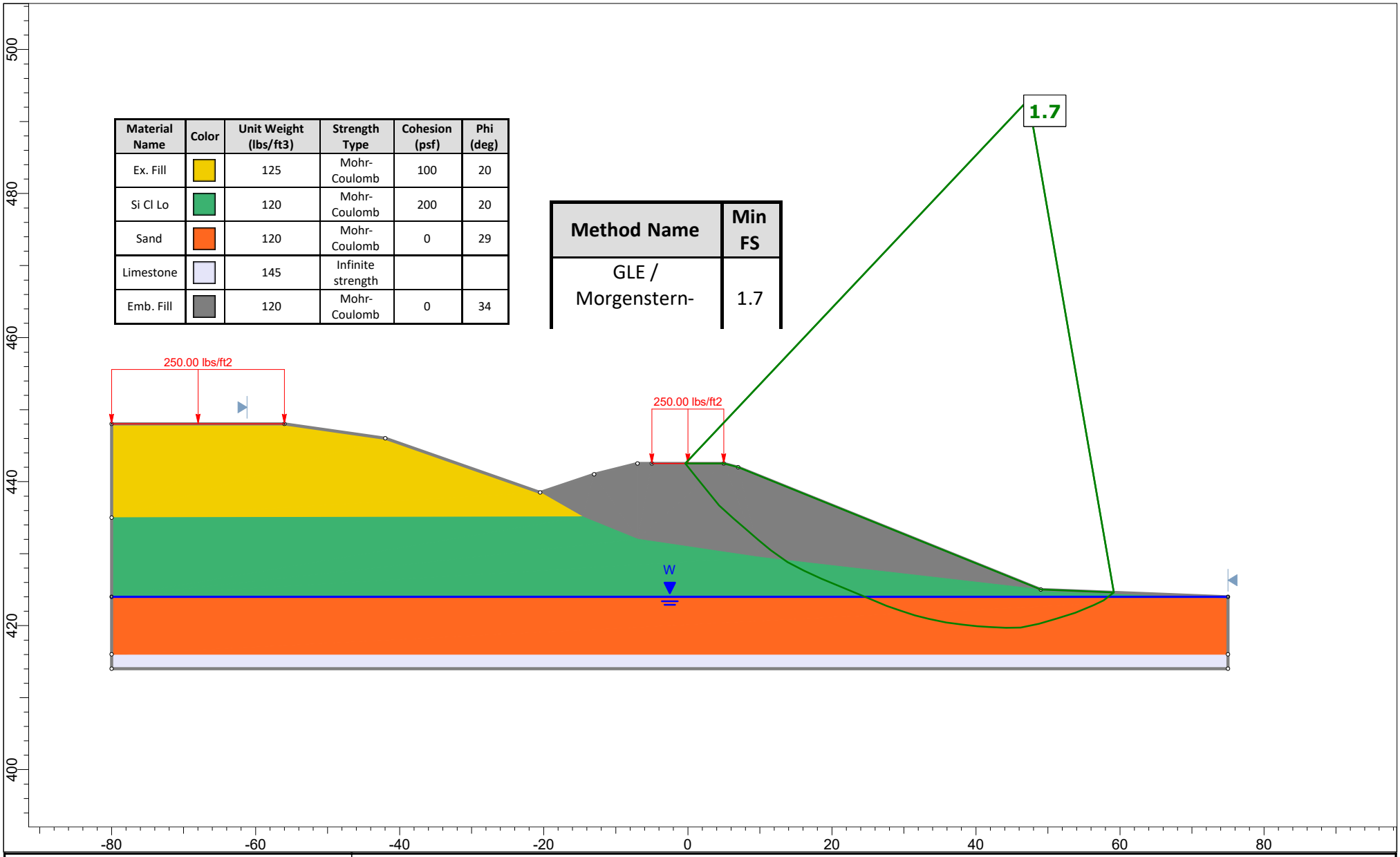
X	Y
-80	424
75	424

Material Boundary

X	Y
-80	416
75	416

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ex. Fill		125	Mohr-Coulomb	100	20
Si Cl Lo		120	Mohr-Coulomb	200	20
Sand		120	Mohr-Coulomb	0	29
Limestone		145	Infinite strength		
Emb. Fill		120	Mohr-Coulomb	0	34

Method Name	Min FS
GLE / Morgenstern-	1.7



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SLIDEINTERPRET 9.018

Project	Ohio River Greenway - Phase II		
Group	11+50_LT.slim	Scenario	11+50_LT.slim
Drawn By	SM	Company	CTL
Date	5/26/2023	File Name	11+50_LT.slim

Slide Analysis Information

Ohio River Greenway - Phase II

Project Summary

Slide Modeler Version:	9.018
Compute Time:	00h:00m:04.658s
Author:	SM
Company:	CTL
Date Created:	5/26/2023

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary
Distributed Load 2	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary

Materials

Ex. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	20
Water Surface	Water Table
Hu Value	1
Si Cl Lo	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	200
Friction Angle [deg]	20
Water Surface	Water Table
Hu Value	1
Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	29
Water Surface	Water Table
Hu Value	1
Limestone	
Color	
Strength Type	Infinite strength
Unit Weight [lbs/ft3]	145
Allow Sliding Along Boundary	Yes
Water Surface	Water Table
Hu Value	0
Emb. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	34
Water Surface	Water Table
Hu Value	1

Entity Information

Water Table

X	Y
-80	424
75	424

Distributed Load

X	Y
-56	448
-80	448

Distributed Load

X	Y
5	442.5
-5	442.5

External Boundary

X	Y
-80	448
-80	435
-80	424
-80	416
-80	414
75	414
75	416
75	424
49	425
7	442
5	442.5
-5	442.5
-7	442.5
-13	441
-20.5	438.5
-42	446
-56	448

Material Boundary

X	Y
-20.5	438.5
-14.603	435.104
-7	432
10	429.5
49	425

Material Boundary

X	Y
-80	435
-14.603	435.104

Material Boundary

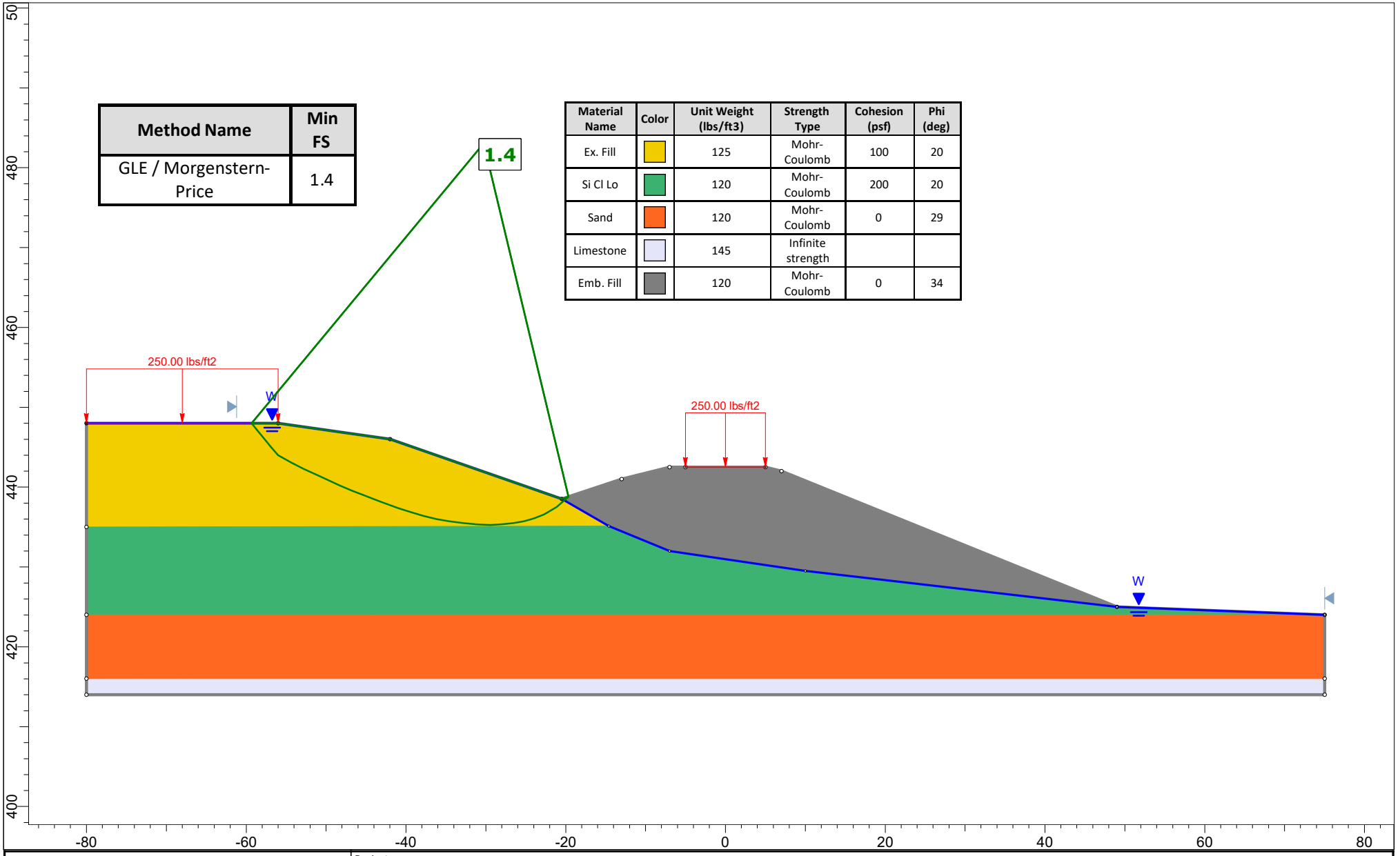
X	Y
-80	424
75	424

Material Boundary

X	Y
-80	416
75	416

Method Name	Min FS
GLE / Morgenstern-Price	1.4

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ex. Fill		125	Mohr-Coulomb	100	20
Si Cl Lo		120	Mohr-Coulomb	200	20
Sand		120	Mohr-Coulomb	0	29
Limestone		145	Infinite strength		
Emb. Fill		120	Mohr-Coulomb	0	34



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SLIDEINTERPRET 9.018

Project	Ohio River Greenway - Phase II		
Group	11+50_RD.slim	Scenario	11+50_RD.slim
Drawn By	SM	Company	CTL
Date	5/26/2023	File Name	11+50_RD.slim

Slide Analysis Information

Ohio River Greenway - Phase II

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary
Distributed Load 2	
Distribution:	Constant
Magnitude [psf]:	250
Orientation:	Normal to boundary

Materials

Ex. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	100
Friction Angle [deg]	20
Water Surface	Water Table
Hu Value	1
Si Cl Lo	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	200
Friction Angle [deg]	20
Water Surface	Water Table
Hu Value	1
Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	29
Water Surface	Water Table
Hu Value	1
Limestone	
Color	
Strength Type	Infinite strength
Unit Weight [lbs/ft3]	145
Allow Sliding Along Boundary	Yes
Water Surface	Water Table
Hu Value	0
Emb. Fill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	34
Water Surface	Water Table
Hu Value	1

Entity Information

Water Table

X	Y
-80	448
-56	448
-42	446
-20.5	438.5
-14.603	435.104
-7	432
10	429.5
49	425
75	424

Distributed Load

X	Y
-56	448
-80	448

Distributed Load

X	Y
5	442.5
-5	442.5

External Boundary

X	Y
-80	448
-80	435
-80	424
-80	416
-80	414
75	414
75	416
75	424
49	425
7	442
5	442.5
-5	442.5
-7	442.5
-13	441
-20.5	438.5
-42	446
-56	448

Material Boundary

X	Y
-20.5	438.5
-14.603	435.104
-7	432
10	429.5
49	425

Material Boundary

X	Y
-80	435
-14.603	435.104

Material Boundary

X	Y
-80	424
75	424

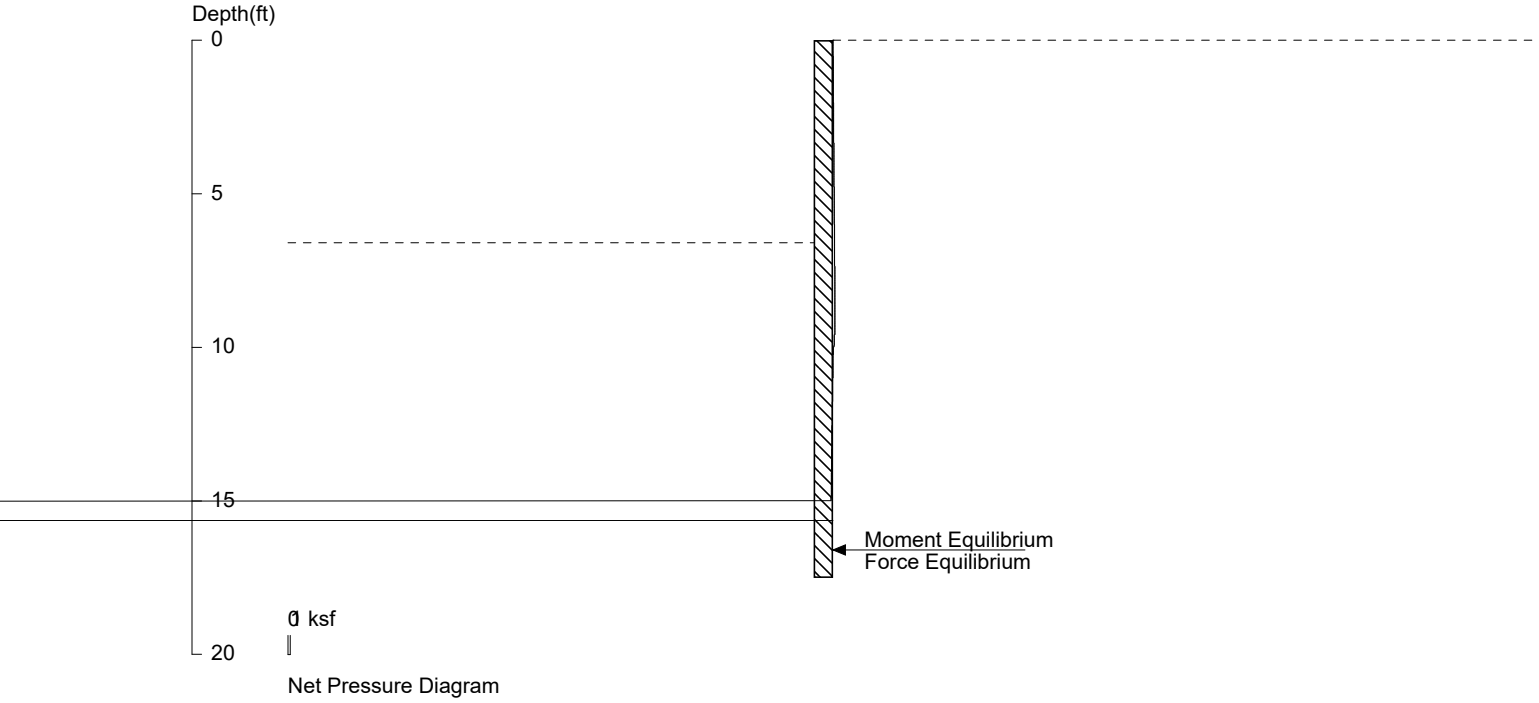
Material Boundary

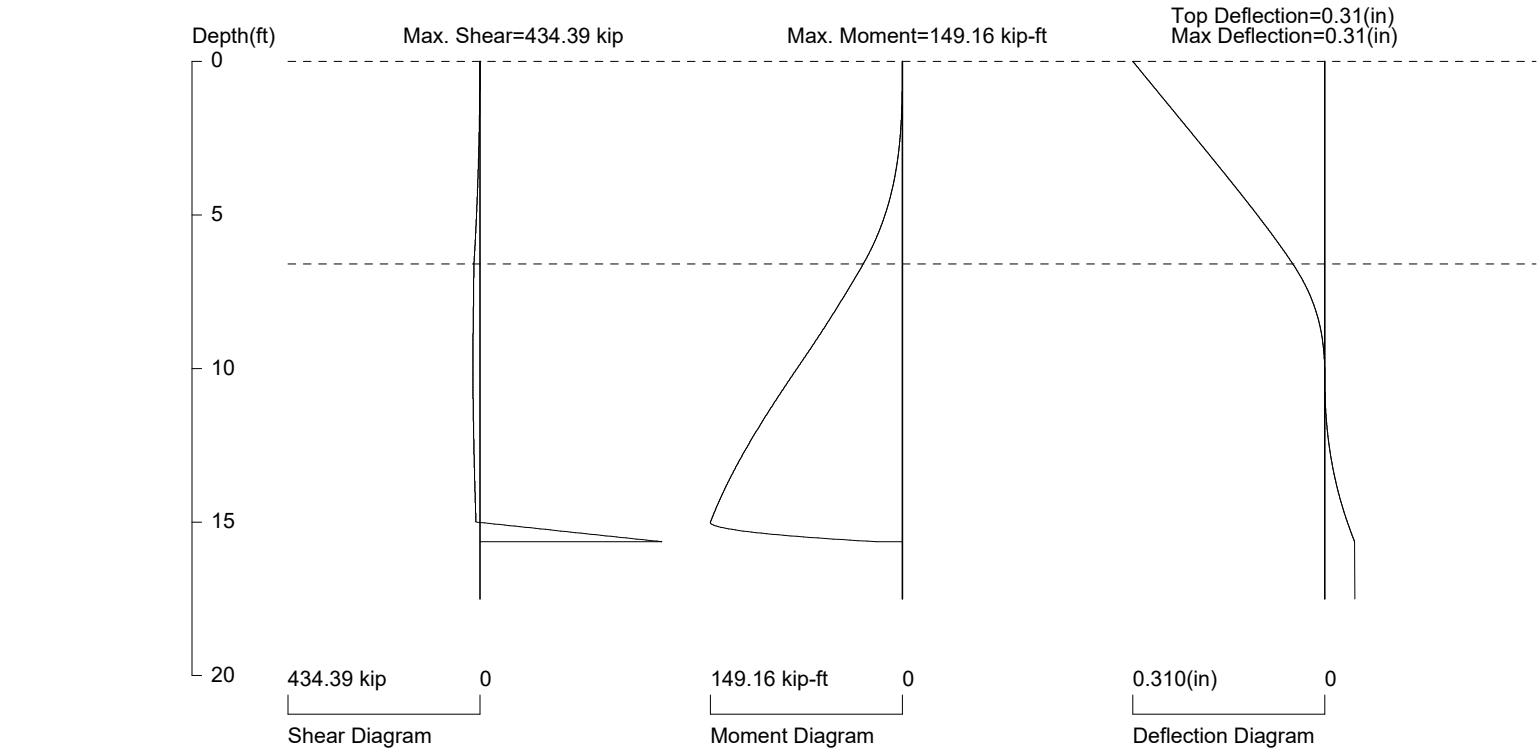
X	Y
-80	416
75	416

APPENDIX G

PRELIMINARY RETAINING WALL ANALYSES

Ohio River Greenway
Station 23+00





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

User Input Pile, HP12X53: E (ksi)=29000.0, I (in4)/pile=393.0

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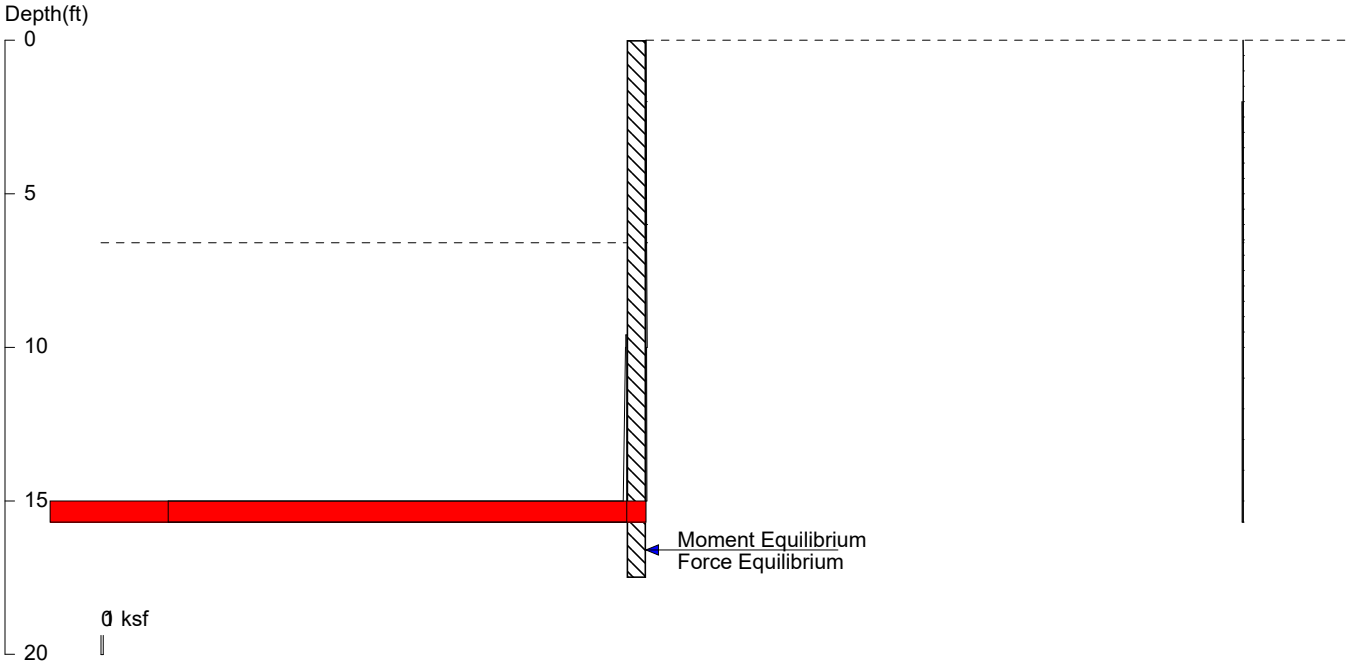
Ohio River Greenway
Station 23+00



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Wall Height=6.6 Pile Diameter=1.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=10.91 Min. Pile Length=17.51
MOMENT IN PILE: Max. Moment=149.16 per Pile Spacing=6.0 at Depth=15.01

PILE SELECTION:
Request Min. Section Modulus = 54.2 in3/pile=888.85 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP12X53 has Section Modulus = 66.7 in3/pile=1093.01 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.31(in) based on E (ksi)=29000.00 and I (in4)/pile=393.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE): Pressures below will be multiplied by a Factor =1.3

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	2.000	0.083	0.041667
2.000	0.083	6.000	0.167	0.020867
6.000	0.226	6.600	0.243	0.028071
*	Below	Base		
6.600	0.219	10.000	0.399	0.052895
10.000	0.241	15.000	0.295	0.010850
15.000	-199.038	59.400	-195.483	0.080057
*	Water	Pres.		
2.000	0.000	6.600	0.287	0.062400
6.600	0.287	59.400	0.287	0.000000
*	Sur-	charge		
0.000	0.000	0.500	0.031	0.061989
0.500	0.031	1.000	0.054	0.046686
1.000	0.054	1.500	0.068	0.027259
1.500	0.068	2.000	0.074	0.012008
2.000	0.074	2.500	0.075	0.002344
2.500	0.075	3.000	0.074	-0.003189

3.000	0.074	3.500	0.070	-0.006175
3.500	0.070	4.000	0.067	-0.007675
4.000	0.067	4.500	0.062	-0.008318
4.500	0.062	5.000	0.058	-0.008462
5.000	0.058	5.500	0.054	-0.008313
5.500	0.054	6.000	0.050	-0.007994
6.000	0.050	6.500	0.046	-0.007580
6.500	0.046	7.000	0.043	-0.007117
7.000	0.043	7.500	0.039	-0.006634
7.500	0.039	8.000	0.036	-0.006152
8.000	0.036	8.500	0.033	-0.005682
8.500	0.033	9.000	0.031	-0.005232
9.000	0.031	9.500	0.028	-0.004807
9.500	0.028	10.000	0.026	-0.004409
10.000	0.026	11.000	0.022	-0.003868
11.000	0.022	12.000	0.019	-0.003239
12.000	0.019	13.000	0.016	-0.002710
13.000	0.016	14.000	0.014	-0.002270
14.000	0.014	15.000	0.012	-0.001905
15.000	0.012	16.000	0.011	-0.001604
16.000	0.011	17.000	0.009	-0.001355
17.000	0.009	18.000	0.008	-0.001149

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
9.600	0.392	10.000	0.444	0.130643
10.000	0.607	15.000	1.566	0.191807
15.000	199.061	59.400	202.729	0.082633

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.00
2	6.60	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	6.60	2.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

****

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

****

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 6/4/2023 File: O:\PROJECT\2023\IND-05\23050035IND\Design\Analyses\Shoring\23+00_SPL.sh8

Title: Ohio River Greenway
Subtitle: Station 23+00

**********INPUT DATA**********

Wall Type: 2. Soldier Pile, Drilled
Wall Height: 6.60
Pile Diameter: 1.00
Pile Spacing: 6.00
Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.66
Elastic Module, E: 29000.00
Moment of Inertia, I: 393.00
User Input Pile: HP12X53

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
The pressures below will be multiplied by a Factor =1.3

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		

2	0.000	0.000	2.000	0.083	0.041667
3	2.000	0.083	6.000	0.167	0.020867
4	6.000	0.226	6.600	0.243	0.028071
5	*	Below	Base		
6	6.600	0.219	10.000	0.399	0.052895
7	10.000	0.241	15.000	0.295	0.010850
8	15.000	-199.038	59.400	-195.483	0.080057
9	*	Water	Pres.		
10	2.000	0.000	6.600	0.287	0.062400
11	6.600	0.287	59.400	0.287	0.000000
12	*	Sur-	charge		
13	0.000	0.000	0.500	0.031	0.061989
14	0.500	0.031	1.000	0.054	0.046686
15	1.000	0.054	1.500	0.068	0.027259
16	1.500	0.068	2.000	0.074	0.012008
17	2.000	0.074	2.500	0.075	0.002344
18	2.500	0.075	3.000	0.074	-0.003189
19	3.000	0.074	3.500	0.070	-0.006175
20	3.500	0.070	4.000	0.067	-0.007675
21	4.000	0.067	4.500	0.062	-0.008318
22	4.500	0.062	5.000	0.058	-0.008462
23	5.000	0.058	5.500	0.054	-0.008313
24	5.500	0.054	6.000	0.050	-0.007994
25	6.000	0.050	6.500	0.046	-0.007580
26	6.500	0.046	7.000	0.043	-0.007117
27	7.000	0.043	7.500	0.039	-0.006634
28	7.500	0.039	8.000	0.036	-0.006152
29	8.000	0.036	8.500	0.033	-0.005682
30	8.500	0.033	9.000	0.031	-0.005232
31	9.000	0.031	9.500	0.028	-0.004807
32	9.500	0.028	10.000	0.026	-0.004409
33	10.000	0.026	11.000	0.022	-0.003868
34	11.000	0.022	12.000	0.019	-0.003239
35	12.000	0.019	13.000	0.016	-0.002710
36	13.000	0.016	14.000	0.014	-0.002270
37	14.000	0.014	15.000	0.012	-0.001905
38	15.000	0.012	16.000	0.011	-0.001604
39	16.000	0.011	17.000	0.009	-0.001355
40	17.000	0.009	18.000	0.008	-0.001149
41	18.000	0.008	19.000	0.007	-0.000978
42	19.000	0.007	20.000	0.006	-0.000835
43	20.000	0.006	22.000	0.005	-0.000667
44	22.000	0.005	24.000	0.004	-0.000499
45	24.000	0.004	26.000	0.003	-0.000379
46	26.000	0.003	28.000	0.003	-0.000292
47	28.000	0.003	30.000	0.002	-0.000228
48	30.000	0.002	32.000	0.002	-0.000180
49	32.000	0.002	34.000	0.002	-0.000144
50	34.000	0.002	36.000	0.001	-0.000116
51	36.000	0.001	38.000	0.001	-0.000095
52	38.000	0.001	40.000	0.000	-0.000580

---

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope

1	*	Below	Base		
2	9.600	0.392	10.000	0.444	0.130643
3	10.000	0.607	15.000	1.566	0.191807
4	15.000	199.061	59.400	202.729	0.082633

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	6.00
2	6.60	1.00

* PASSIVE SPACE *

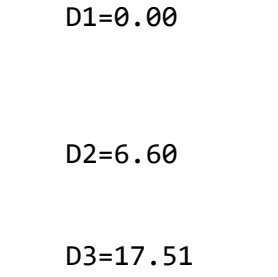
No.	Z depth	Spacing
1	6.60	2.00

*For Tieback: Input1 = Diameter; Input2 = Bond Strength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;
*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

**********CALCULATION**********

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00



D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP

MOMENT equilibrium   AT DEPTH=15.69 WITH EMBEDMENT OF 9.09
FORCE equilibrium   AT DEPTH=17.51 WITH EMBEDMENT OF 10.91

The program calculates an embedment for moment equilibrium, then increase the embedment by 1.2

**********RESULTS**********

* EMBEDMENT Notes *

Based on USS Design Manual, first calculate embedment for moment equilibrium, then increased the embedment to get the design depth.
The embedment for moment equilibrium is 9.09
The program calculates an embedment for moment equilibrium, then increase the embedment by 1.2
The total desigh embedment is 10.91

Embedment Information:
If 20% increased, the total design embedment is 10.91
If 30% increased, the total design embedment is 11.81
If 40% increased, the total design embedment is 12.72
If 50% increased, the total design embedment is 13.63

* MOMENT IN PILE (per pile spacing)*
Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.
Overall Maximum Moment = 149.16 at 15.01
Maximum Shear = 434.39
Moment and Shear are per pile spacing: 6.0 foot or meter

* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

**********SPECIFIED PILE **********

   Overall Maximum Moment = 149.16 at 15.01
   The pile selection is based on the magnitude of the moment only. Axial force is neglected.

   Request Min. Section Modulus = 54.24 in3/pile = 888.85 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

   HP12X53 has been found in Soldier Pile list!
   (English Units):
   Area= 15.5 in. Depth= 11.8 in. Width= 12 in. Height= 12 in.
   Flange thickness= 0.435 in.   Web thickness= 0.435 in.
   Ix= 393 in4/pile   Sx= 66.7 in3/pile   Iy= 127 in4/pile   Sy= 21.1 in3/pile
   (Metric Units):
   Ix= 163.57 x100cm4/pile   Sx= 1093.01 cm3/pile   Iy= 52.86 x100cm4/pile   Sy= 345.77 cm3/pile

   The pile selection is based on the magnitude of the moment only. Axial force is neglected.

   HP12X53 is capable to support the shoring!
   Top deflection = 0.310(in)
   Max. deflection = 0.310(in)

********** LAGGING SIZE ESTIMATION **********
Max. Pressure above base = 0.75
Piles are more rigid than timber lagging, due to arching, only portion of pressures

are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.37

Pile Spacing =6.0, Max. Moment in lagging = 1.68

For 4"x12" Timber, Section Modules S=23.47 in3. The request allowable bending strength, fb=M/S=0.86

For 6"x12" Timber, Section Modules S=57.98 in3. The request allowable bending strength, fb=M/S=0.35

If 30% loading is used for lagging design, Design Pressure = 0.22

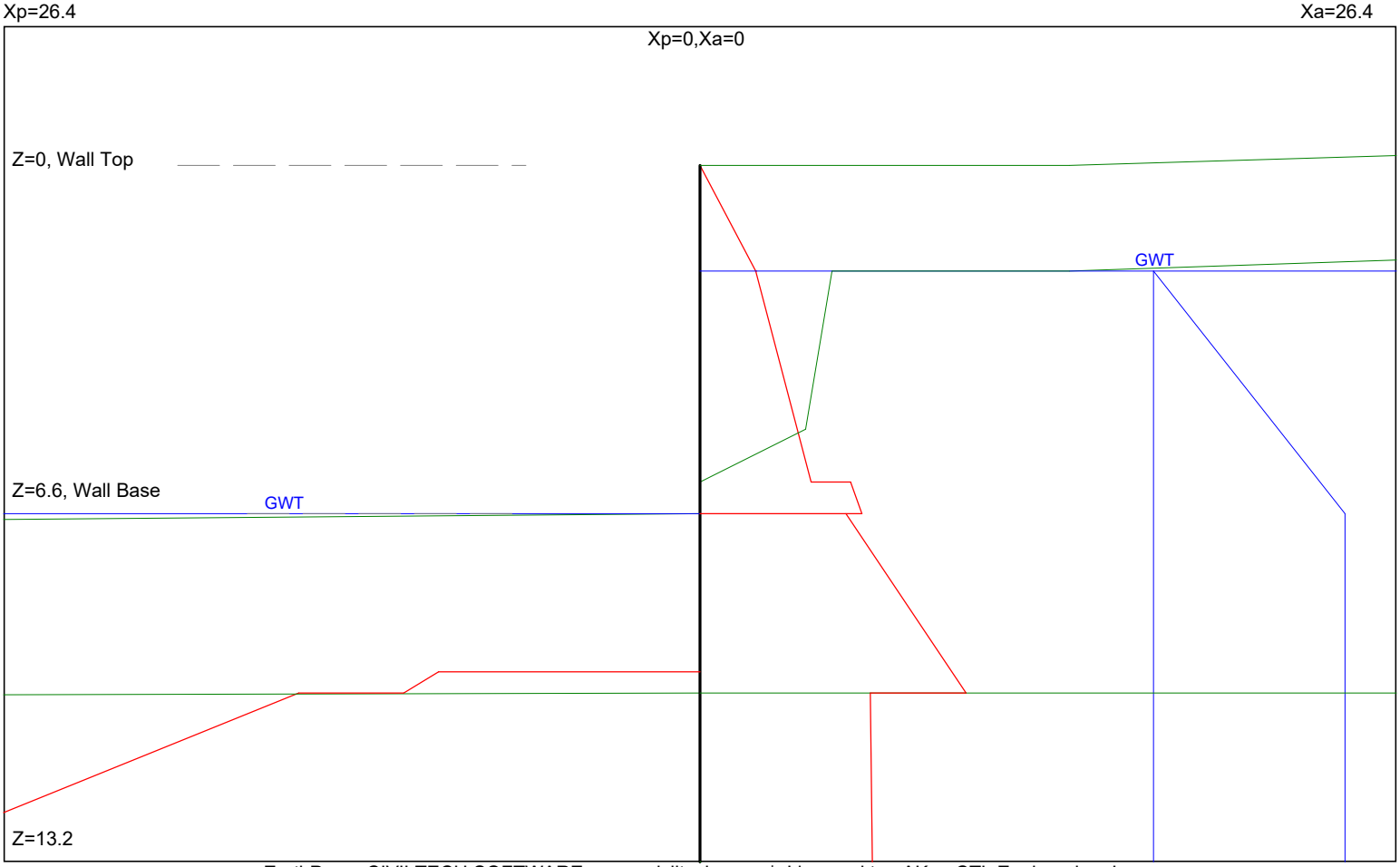
Pile Spacing =6.0, Max. Moment in lagging = 1.01

For 4"x12" Timber, Section Modules S=23.47 in3. The request allowable bending strength, fb=M/S=0.52

For 6"x12" Timber, Section Modules S=57.98 in3. The request allowable bending strength, fb=M/S=0.21

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Ohio River Greenway
Station 23+00



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf
Date: 6/4/2023 File: O:\PROJECT\2023\IND-05\23050035IND\Design\Analyses\Shoring\Station 23+00-6.6.ep8

* INPUT DATA *

Wall Height=6.6 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	30	0.0	0	4	Fill
2	120.0	120.0	23	0.0	0	1	Si Cl Lo
3	120.0	120.0	32	0.0	0	4	Sand
4	140.0	140.0	0	100	0	4	Limestone

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	14.0	1	Fill
2	0.0	14.0	-12.0	800.0	1	Fill
3	6.0	0.0	5.0	4.0	2	Si Cl Lo
4	5.0	4.0	2.0	5.0	2	Si Cl Lo
5	2.0	5.0	2.0	14.0	2	Si Cl Lo
6	2.0	14.0	-11.0	800.0	2	Si Cl Lo
7	10.0	0.0	10.0	800.0	3	Sand
8	15.0	0.0	15.0	800.0	4	Limestone

Water Table at Active Side:

Point	Z-water	X-water
1	2.0	0.0
2	2.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	6.6	0.0	10.0	800.0	2	Si Cl Lo
2	10.0	0.0	11.0	800.0	3	Sand
3	15.0	0.0	20.0	800.0	4	Limestone

Water Table at Passive Side:

Point	Z-water	X-water
1	6.6	0.0
2	6.6	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 0.72 per one linear foot (or meter) width along wall height
Total Static Force above Base= 0.72

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	2.00	0.08	0.0417	0.3333
2.00	0.08	6.00	0.17	0.0209	0.3623
6.00	0.23	6.60	0.24	0.0281	0.4873

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
6.60	0.22	10.00	0.40	0.0529	0.9183
10.00	0.26	13.20	0.26	0.0010	0.0177

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

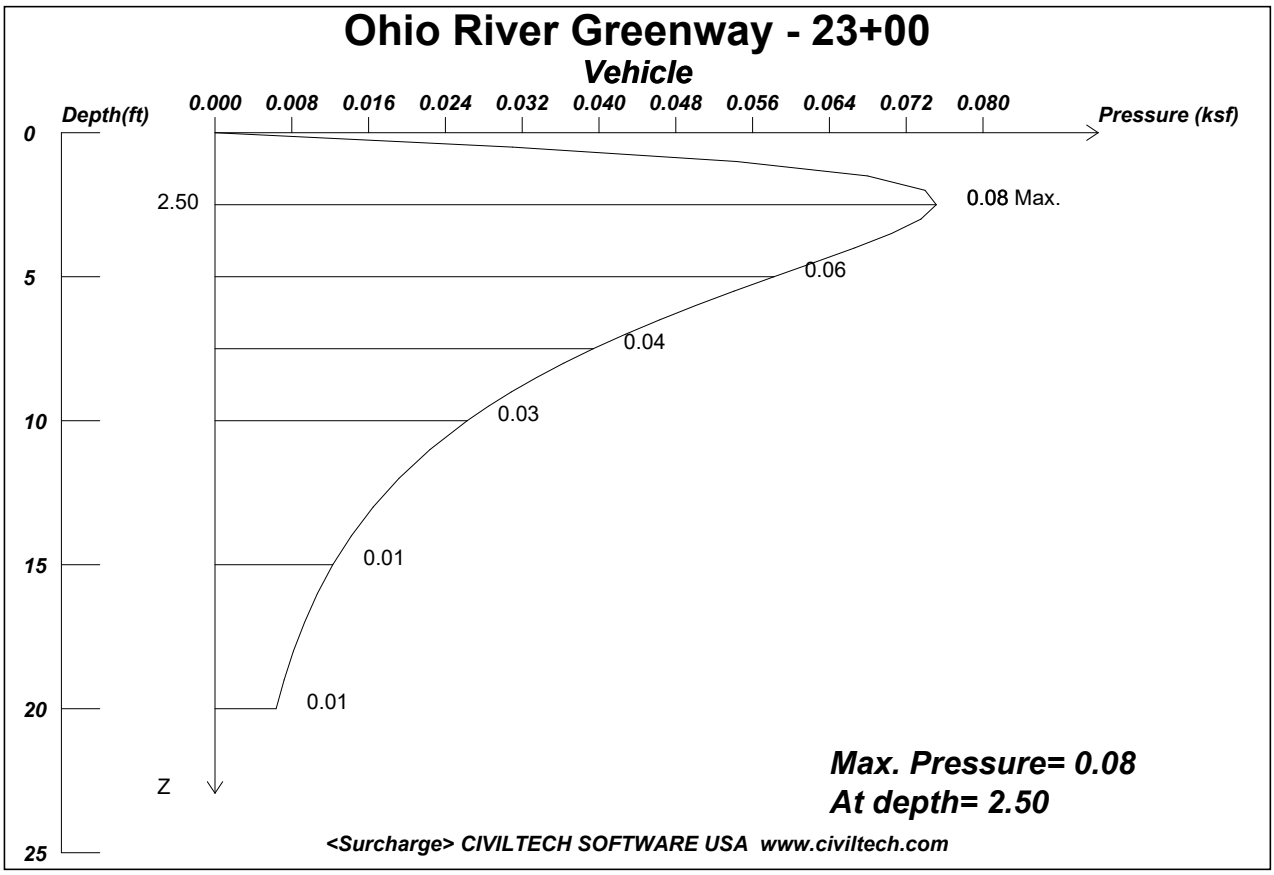
Z1	Pp1	Z2	Pp2	Slope	Kp
9.60	0.39	10.00	0.44	0.131	2.2681
10.00	0.60	13.20	1.23	0.195	3.3935

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	2.00	0.00	6.60	0.29	0.06
1	6.60	0.29	13.20	0.29	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 6/4/2023 File Name: O:\PROJECT\2023\IND-05\23050035IND\Design\Analyses\Shoring\Station 23+00-6.6.ep8



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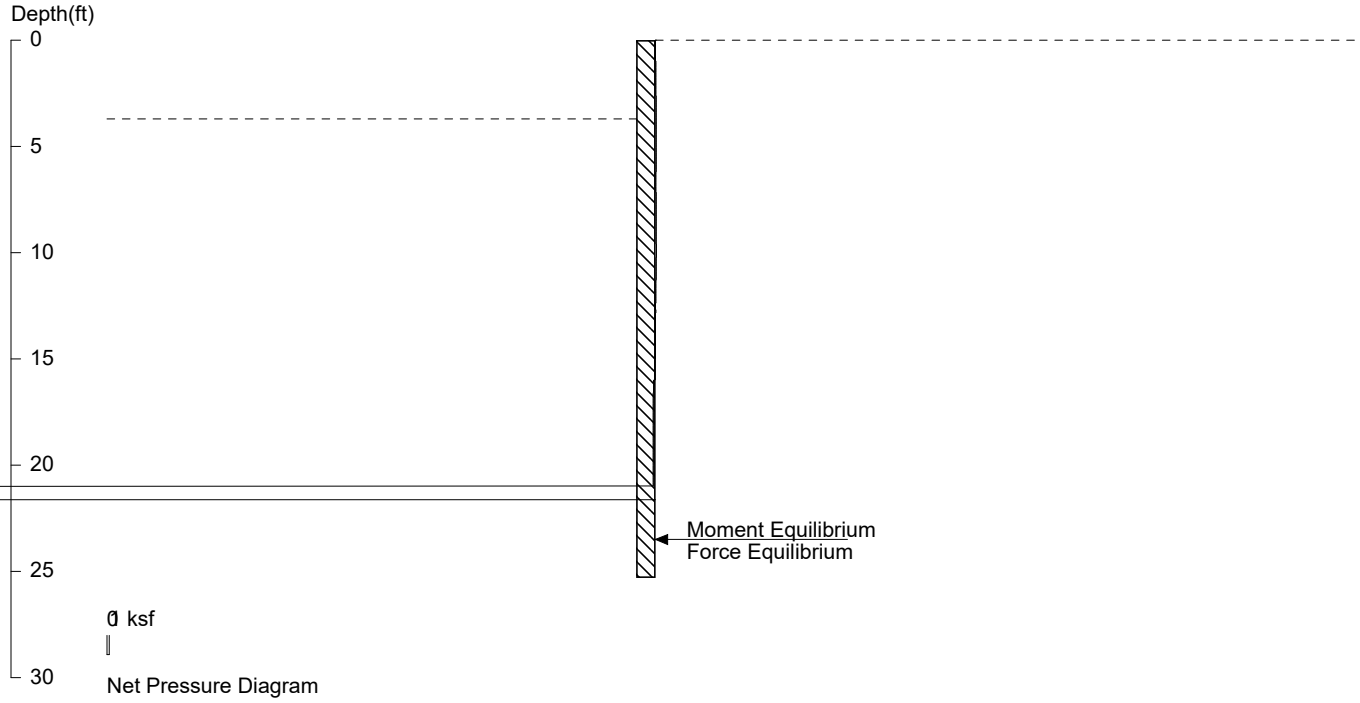
Date: 6/4/2023 File: O:\PROJECT\2023\IND-05\23050035IND\Design\Analyses\Shoring\23+00.lp8

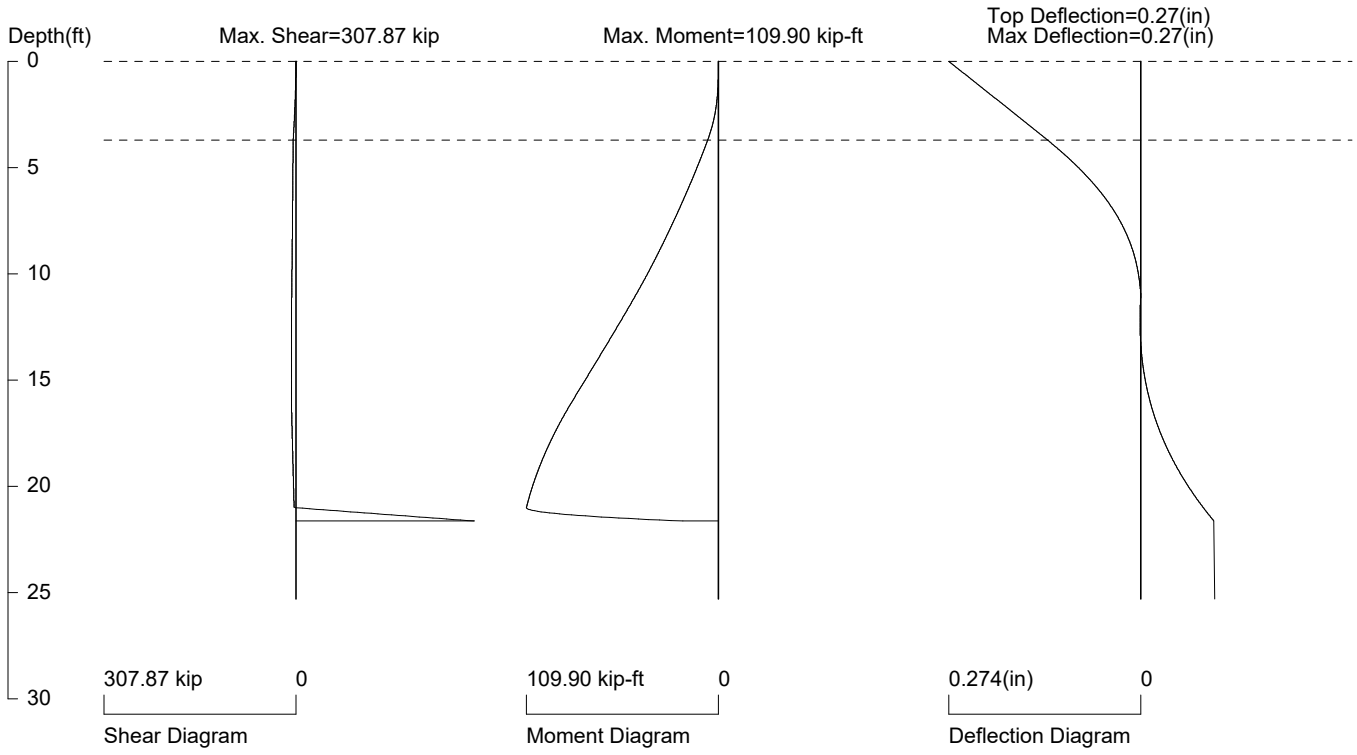
Wall Height, H= 10 Load Depth at Surface, D= 0
Load Factor of Surcharge Loading = 1
Flexible Wall Condition -- Movement or deflection are allowed.
Max. Pressure = 0.075 at depth = 2.50

X	Width	Strip Load
2.0	9.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

Ohio River Greenway
19+50





PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.0 foot or meter

User Input Pile, HP12X53: E (ksi)=29000.0, I (in4)/pile=393.0

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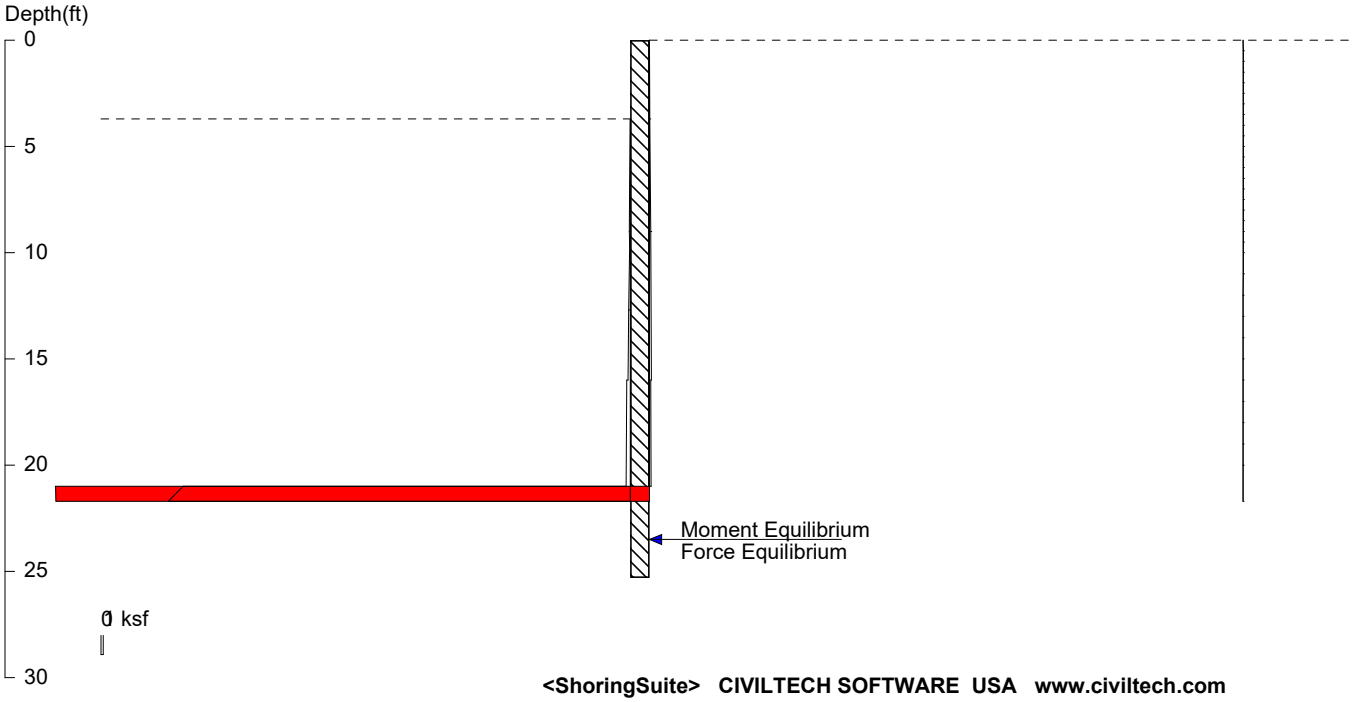
Ohio River Greenway
19+50



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Wall Height=3.7 Pile Diameter=1.0 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.60 Min. Pile Length=25.30
MOMENT IN PILE: Max. Moment=109.90 per Pile Spacing=6.0 at Depth=21.01

PILE SELECTION:
Request Min. Section Modulus = 40.0 in3/pile=654.86 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
HP12X53 has Section Modulus = 66.7 in3/pile=1093.01 cm3/pile. It is greater than Min. Requirements!
Top Deflection = 0.27(in) based on E (ksi)=29000.00 and I (in4)/pile=393.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE): Pressures below will be multiplied by a Factor =1.3

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	3.700	0.194	0.052564
*	Below	Base		
3.700	0.194	9.000	0.473	0.052564
9.000	0.473	16.000	0.650	0.025231
16.000	0.512	21.000	0.613	0.020198
21.000	-198.405	37.000	-196.925	0.092492
*	Sur-	charge		
0.000	0.000	0.500	0.031	0.061989
0.500	0.031	1.000	0.054	0.046686
1.000	0.054	1.500	0.068	0.027259
1.500	0.068	2.000	0.074	0.012008
2.000	0.074	2.500	0.075	0.002344
2.500	0.075	3.000	0.074	-0.003189
3.000	0.074	3.500	0.070	-0.006175
3.500	0.070	4.000	0.067	-0.007675
4.000	0.067	4.500	0.062	-0.008318
4.500	0.062	5.000	0.058	-0.008462

5.000	0.058	5.500	0.054	-0.008313
5.500	0.054	6.000	0.050	-0.007994
6.000	0.050	6.500	0.046	-0.007580
6.500	0.046	7.000	0.043	-0.007117
7.000	0.043	7.500	0.039	-0.006634
7.500	0.039	8.000	0.036	-0.006152
8.000	0.036	8.500	0.033	-0.005682
8.500	0.033	9.000	0.031	-0.005232
9.000	0.031	9.500	0.028	-0.004807
9.500	0.028	10.000	0.026	-0.004409
10.000	0.026	11.000	0.022	-0.003868
11.000	0.022	12.000	0.019	-0.003239
12.000	0.019	13.000	0.016	-0.002710
13.000	0.016	14.000	0.014	-0.002270
14.000	0.014	15.000	0.012	-0.001905
15.000	0.012	16.000	0.011	-0.001604
16.000	0.011	17.000	0.009	-0.001355
17.000	0.009	18.000	0.008	-0.001149
18.000	0.008	19.000	0.007	-0.000978
19.000	0.007	20.000	0.006	-0.000835
20.000	0.006	22.000	0.005	-0.000667
22.000	0.005	24.000	0.004	-0.000499
24.000	0.004	26.000	0.003	-0.000379

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
3.700	0.000	6.700	0.251	0.083732
6.700	0.251	9.000	0.328	0.033566
9.000	0.328	9.700	0.241	-0.124641
9.700	0.187	12.700	0.664	0.159187
12.700	0.612	16.000	0.921	0.093841
16.000	1.506	21.000	1.707	0.040251
21.000	194.213	21.700	200.704	9.272829
21.700	199.603	24.700	200.029	0.142114
24.700	200.025	27.700	200.409	0.128097

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	6.00
2	3.70	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	3.70	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

****

SHORING WALL CALCULATION SUMMARY
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ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Title: Ohio River Greenway
Subtitle: 19+50

**********INPUT DATA**********

Wall Type: 2. Soldier Pile, Drilled
Wall Height: 3.70
Pile Diameter: 1.00
Pile Spacing: 6.00
Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 1. No
Top Brace Increase (Multi-Bracing): Add 15%*
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.66
Elastic Module, E: 29000.00
Moment of Inertia, I: 393.00
User Input Pile: HP12X53

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
The pressures below will be multiplied by a Factor =1.3

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		

2	0.000	0.000	3.700	0.194	0.052564
3	*	Below	Base		
4	3.700	0.194	9.000	0.473	0.052564
5	9.000	0.473	16.000	0.650	0.025231
6	16.000	0.512	21.000	0.613	0.020198
7	21.000	-198.405	37.000	-196.925	0.092492
8	*	Sur-	charge		
9	0.000	0.000	0.500	0.031	0.061989
10	0.500	0.031	1.000	0.054	0.046686
11	1.000	0.054	1.500	0.068	0.027259
12	1.500	0.068	2.000	0.074	0.012008
13	2.000	0.074	2.500	0.075	0.002344
14	2.500	0.075	3.000	0.074	-0.003189
15	3.000	0.074	3.500	0.070	-0.006175
16	3.500	0.070	4.000	0.067	-0.007675
17	4.000	0.067	4.500	0.062	-0.008318
18	4.500	0.062	5.000	0.058	-0.008462
19	5.000	0.058	5.500	0.054	-0.008313
20	5.500	0.054	6.000	0.050	-0.007994
21	6.000	0.050	6.500	0.046	-0.007580
22	6.500	0.046	7.000	0.043	-0.007117
23	7.000	0.043	7.500	0.039	-0.006634
24	7.500	0.039	8.000	0.036	-0.006152
25	8.000	0.036	8.500	0.033	-0.005682
26	8.500	0.033	9.000	0.031	-0.005232
27	9.000	0.031	9.500	0.028	-0.004807
28	9.500	0.028	10.000	0.026	-0.004409
29	10.000	0.026	11.000	0.022	-0.003868
30	11.000	0.022	12.000	0.019	-0.003239
31	12.000	0.019	13.000	0.016	-0.002710
32	13.000	0.016	14.000	0.014	-0.002270
33	14.000	0.014	15.000	0.012	-0.001905
34	15.000	0.012	16.000	0.011	-0.001604
35	16.000	0.011	17.000	0.009	-0.001355
36	17.000	0.009	18.000	0.008	-0.001149
37	18.000	0.008	19.000	0.007	-0.000978
38	19.000	0.007	20.000	0.006	-0.000835
39	20.000	0.006	22.000	0.005	-0.000667
40	22.000	0.005	24.000	0.004	-0.000499
41	24.000	0.004	26.000	0.003	-0.000379
42	26.000	0.003	28.000	0.003	-0.000292
43	28.000	0.003	30.000	0.002	-0.000228
44	30.000	0.002	32.000	0.002	-0.000180
45	32.000	0.002	34.000	0.002	-0.000144
46	34.000	0.002	36.000	0.001	-0.000116
47	36.000	0.001	38.000	0.001	-0.000095
48	38.000	0.001	40.000	0.000	-0.000580

---

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	3.700	0.000	6.700	0.251	0.083732
3	6.700	0.251	9.000	0.328	0.033566

4	9.000	0.328	9.700	0.241	-0.124641
5	9.700	0.187	12.700	0.664	0.159187
6	12.700	0.612	16.000	0.921	0.093841
7	16.000	1.506	21.000	1.707	0.040251
8	21.000	194.213	21.700	200.704	9.272829
9	21.700	199.603	24.700	200.029	0.142114
10	24.700	200.025	27.700	200.409	0.128097
11	27.700	200.411	30.700	200.784	0.124033
12	30.700	200.772	33.700	201.071	0.099850
13	33.700	201.060	36.700	201.293	0.077432
14	36.700	201.293	37.000	201.316	0.077424

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	6.00
2	3.70	1.00

* PASSIVE SPACE *

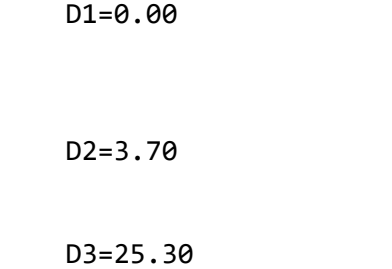
No.	Z depth	Spacing
1	3.70	1.00

*For Tieback: Input1 = Diameter; Input2 = Bond Strength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;
*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

**********CALCULATION**********

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00



D1 - TOP DEPTH
D2 - EXCAVATION BASE
D3 - PILE TIP

MOMENT equilibrium   AT DEPTH=21.70 WITH EMBEDMENT OF 18.00
FORCE equilibrium   AT DEPTH=25.30 WITH EMBEDMENT OF 21.60

The program calculates an embedment for moment equilibrium, then increase the

embedment by 1.2

**********RESULTS**********

* EMBEDMENT Notes *
Based on USS Design Manual, first calculate embedment for moment equilibrium, then increased the embedment to get the design depth.
The embedment for moment equilibrium is 18.00
The program calculates an embedment for moment equilibrium, then increase the embedment by 1.2
The total desigh embedment is 21.60

Embedment Information:
If 20% increased, the total design embedment is 21.60
If 30% increased, the total design embedment is 23.40
If 40% increased, the total design embedment is 25.20
If 50% increased, the total design embedment is 27.00

* MOMENT IN PILE (per pile spacing)*
Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.
Overall Maximum Moment = 109.90 at 21.01
Maximum Shear = 307.87
Moment and Shear are per pile spacing: 6.0 foot or meter

* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

**********SPECIFIED PILE **********

Overall Maximum Moment = 109.90 at 21.01
The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 39.96 in3/pile = 654.86 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

HP12X53 has been found in Soldier Pile list!
(English Units):
Area= 15.5 in. Depth= 11.8 in. Width= 12 in. Height= 12 in.
Flange thickness= 0.435 in. Web thickness= 0.435 in.
Ix= 393 in4/pile Sx= 66.7 in3/pile Iy= 127 in4/pile Sy= 21.1 in3/pile
(Metric Units):
Ix= 163.57 x100cm4/pile Sx= 1093.01 cm3/pile Iy= 52.86 x100cm4/pile Sy= 345.77 cm3/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

HP12X53 is capable to support the shoring!

Top deflection = 0.274(in)
Max. deflection = 0.274(in)

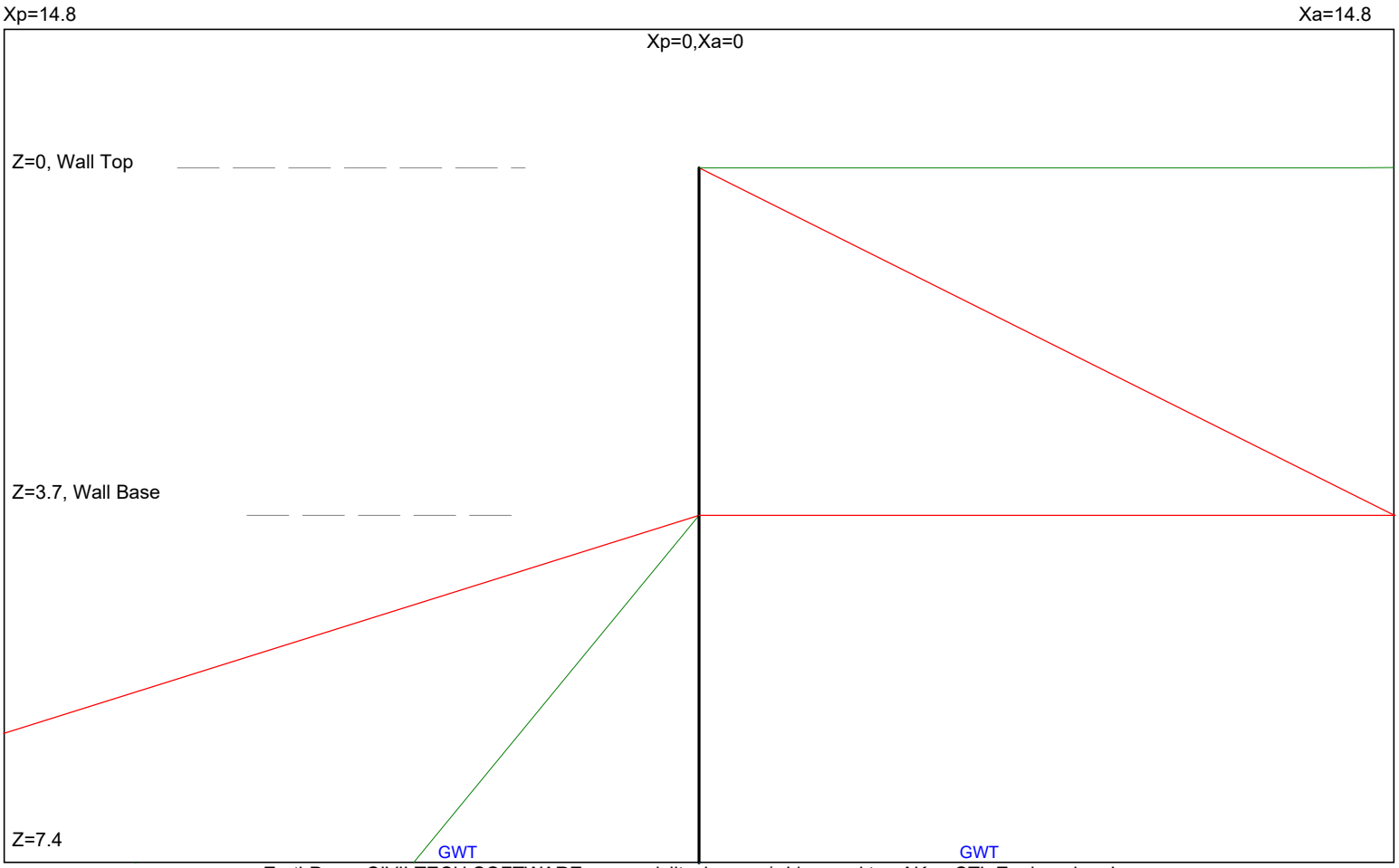
********** LAGGING SIZE ESTIMATION **********
Max. Pressure above base = 0.34
Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.17
Pile Spacing =6.0, Max. Moment in lagging = 0.77
For 4"x12" Timber, Section Modules S=23.47 in3. The request allowable bending strength, fb=M/S=0.39
For 6"x12" Timber, Section Modules S=57.98 in3. The request allowable bending strength, fb=M/S=0.16

If 30% loading is used for lagging design, Design Pressure = 0.10
Pile Spacing =6.0, Max. Moment in lagging = 0.46
For 4"x12" Timber, Section Modules S=23.47 in3. The request allowable bending strength, fb=M/S=0.24
For 6"x12" Timber, Section Modules S=57.98 in3. The request allowable bending strength, fb=M/S=0.10

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Ohio River Greenway
19+50



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf
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* INPUT DATA *

Wall Height=3.7 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	23	0.0	0	2	Si Cl Lo
2	120.0	120.0	29	0.0	0	4	Sand
3	140.0	140.0	0	100	0	4	Limestone

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	14.0	1	Si Cl Lo
2	0.0	14.0	-2.0	800.0	1	Si Cl Lo
3	16.0	0.0	16.0	800.0	2	Sand
4	21.0	0.0	21.0	800.0	3	Limestone

Water Table at Active Side:

Point	Z-water	X-water
1	9.0	0.0
2	9.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	3.7	0.0	11.0	12.0	1	Si Cl Lo
2	11.0	12.0	13.0	800.0	1	Si Cl Lo

3	16.0	0.0	18.0	800.0	2	Sand
4	21.0	0.0	23.0	800.0	3	Limestone

Water Table at Passive Side:

Point	Z-water	X-water
1	9.0	0.0
2	9.0	800.0

Wall Friction Options: 1.* No wall friction
Wall Batter Angle = 0
Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
Water Density = 62.4
Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 0.36 per one linear foot (or meter) width along wall height
Total Static Force above Base= 0.36

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	3.70	0.19	0.0526	0.4380

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
3.70	0.19	7.40	0.39	0.0526	0.4380

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
3.70	0.00	6.70	0.25	0.084	0.6978
6.70	0.25	7.40	0.31	0.084	0.6978

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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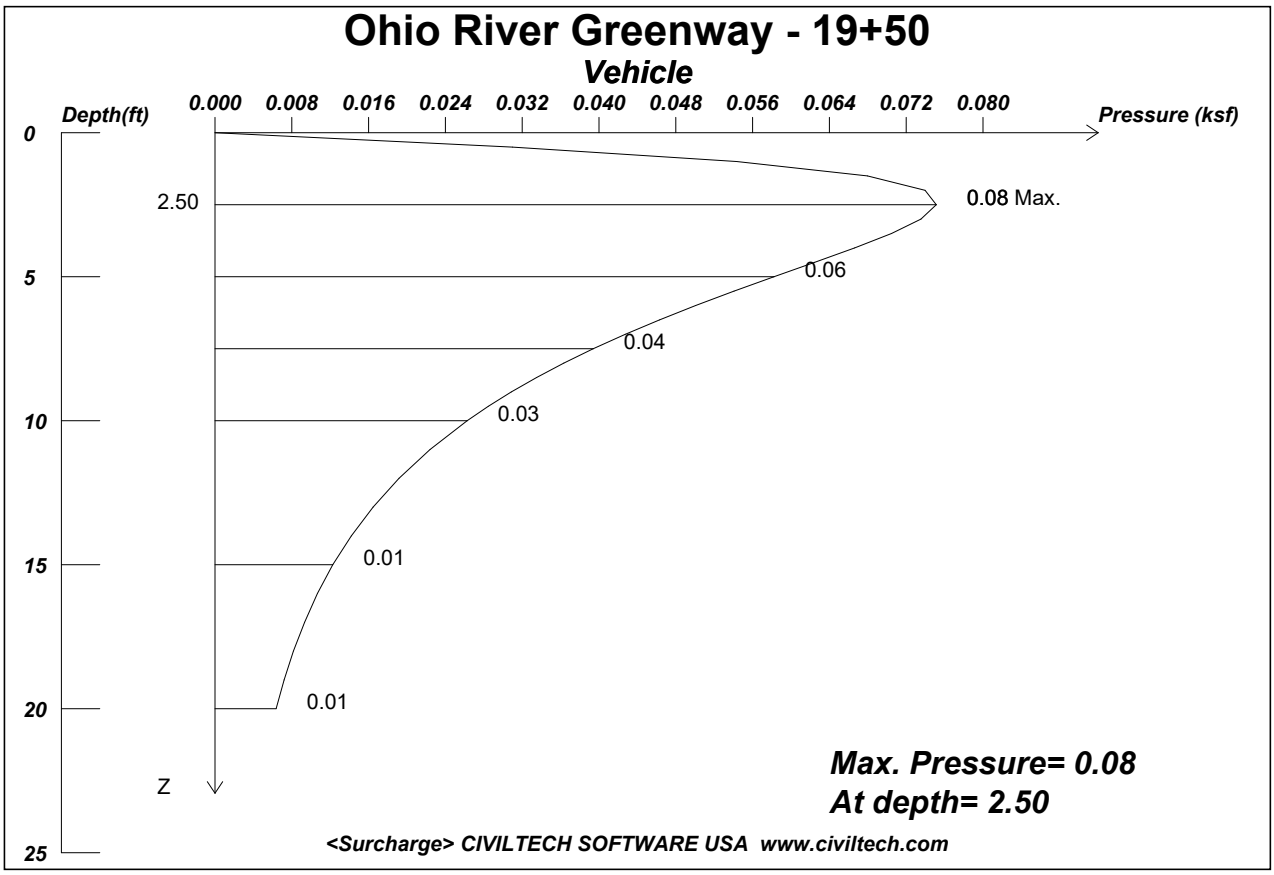

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Date: 6/4/2023 File: O:\PROJECT\2023\IND-05\23050035IND\Design\Analyses\Shoring\19+50.lp8

Wall Height, H= 10 Load Depth at Surface, D= 0
Load Factor of Surcharge Loading = 1
Flexible Wall Condition -- Movement or deflection are allowed.
Max. Pressure = 0.075 at depth = 2.50

X	Width	Strip Load
2.0	9.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf