DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

GEOTECHNICAL ENGINEERING REPORT
NAUGATUCK RIVER GREENWAY PROJECT
PEDESTRIAN BRIDGE OVER BROAD BROOK
THOMASTON, CONNECTICUT

Prepared for:

BL Companies
100 Constitution Plaza
Hartford, Connecticut 06103

Prepared by:

Down To Earth Consulting, LLC
122 Church Street
Naugatuck, Connecticut 06770

October 2019
File No. 0038-010.00

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

October 25, 2019
File No. 0038-010.00

Chad Perkoski, P.E.
BL Companies
100 Constitution Plaza
Hartford, Connecticut 06103

Via email: CPerkoski@blcompanies.com

Re: Geotechnical Engineering Report
Naugatuck River Greenway
Pedestrian Bridge Over Broad Brook
Thomaston, Connecticut

Dear Mr. Perkoski:

Down To Earth Consulting, LLC (DTE) is pleased to submit this geotechnical engineering report for the proposed pedestrian bridge that will span the Naugatuck River Greenway over Broad Brook in Thomaston, Connecticut. We appreciate this opportunity to work with you. Please call if you have any questions.

Sincerely,

Down To Earth Consulting, LLC

Daniel F. LaMesa, P.E.
Principal

Raymond P. Janeiro, P.E.
Reviewer/Principal

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1.0 INTRODUCTION

Down To Earth Consulting, LLC (DTE) is pleased to submit this geotechnical engineering report for the proposed pedestrian bridge that will span the Naugatuck River Greenway over Broad Brook in Thomaston, Connecticut. Refer to Figures 1 and 2 (in Appendix 1) for the approximate site and proposed bridge location, respectively.

Our geotechnical engineering services included: reviewing project plans, observing test borings, performing soils laboratory testing, characterizing subsurface conditions within the project limits, performing geotechnical engineering analyses, and providing geotechnical design and construction recommendations for the proposed pedestrian bridge. Our services were performed in accordance with our October 28, 2018 (revised September 26, 2019) proposal, which was based in part on the scope of work BL Companies developed for this project, dated December 21, 2018 (revised February 7, 2019).

Our recommendations are based on load and resistance factor design and the following references:

- 2012 AASHTO LRFD Bridge Design Specifications
- The Connecticut Department of Transportation (CTDOT) Geotechnical Manual, 2005 edition (revised February 2009)
- CTDOT Bridge Design Manual, 2003 edition (revised February 2011)
- CTDOT Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 (2016).

Elevations (El.) and stationing stated in this report are in feet and based on the vertical datum and stationing in the Construction Plan (PLN-01) prepared by VHB, dated July 26, 2018.

2.0 BACKGROUND

The project site is located about 300 to 400 feet west from the end of York Road between CT Route 8 and the Naugatuck River. Refer to Figures 1 and 2 (in Appendix 1) for the site location and site plan. The proposed pedestrian bridge will be about 60 feet long by 12 feet wide consisting of a single span deck that is supported on concrete abutments with wingwalls. Foundation loads and river scour depths were not available at the time this report was prepared.

3.0 SUBSURFACE DATA

3.1 GENERAL SITE GEOLOGY

Published surficial and bedrock geological map data (*1:125,000 scale, Surficial Materials Map of Connecticut, Janet Radway Stone, 1992 and Bedrock Geological Map of Connecticut, John Rodgers, 1985*) was reviewed. The site surficial materials are mapped alluvial deposits over sand and gravel deposits. The underlying bedrock is mapped as Schist, Gneiss, and/or Amphibolite.

3.2 TEST BORINGS

We observed and logged two test borings (B-1 and B-2) drilled by our subcontractor Soil Testing, Inc. on October 3 and 4, 2019. Boring locations are depicted on Figure 2 (Appendix 1) and the logs are included in Appendix 2. Borings were located in the field by taping/pacing from existing site features and their elevations were scaled from the above referenced construction plan. The boring locations and elevations should be considered approximate.

The borings were drilled to explore the general soil and groundwater conditions in the project area. Drive and wash drilling methods were used to advance borings to depths of approximately 19 to 39 feet (approximate El. 313.5 to 290) below existing grades. Borings were terminated in bedrock.

Representative soil samples were obtained for soil classification and laboratory testing by split barrel sampling procedures in general accordance with ASTM D-1586. The split-spoon sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the middle 12-inches of a normal 24-inch penetration is recorded as the Standard Penetration Resistance Value (N). The blows (i.e., “N-Value”) are indicated on the boring logs at their depth of occurrence and provide an indication of the relative consistency of the material.

Rock coring was performed at the borings using a double-tube core barrel. Descriptions of the rock cores are presented on the logs in addition to Recovery and Rock Quality Designation (RQD). Recovery is defined as the length of core obtained expressed as a percentage of the total length cored. RQD is the total length of core pieces, 4 inches or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the quality of the rock mass and relative extent of foliations and rock mass jointing.

Groundwater levels were measured using a weighted tape in open drill holes.

3.3 LABORATORY SOIL TESTING

Gradation testing was performed in general accordance with ASTM D422 on one sample obtained from the brook streambed and three samples obtained from the test borings. Testing was performed to confirm field classifications and for streambed scour analyses (performed by others). Refer to Appendix 3 for the gradation test results.

4.0 SUBSURFACE CONDITIONS

4.1 SUBSURFACE PROFILE

The subsurface conditions from the borings were consistent with published geologic mappings and generally consisted of uncontrolled Fill over natural Gravelly Sand and Bedrock. The following is a more detailed description of the primary subsurface materials encountered at the site.

4.1.1 Fill

Fill was encountered at Boring B-1 and extended about 9 feet (approximate El. 320) below the existing site grade. This stratum typically consisted of loose to medium dense, light brown, fine to medium sand with trace to little (5 to 15%) amounts of silt and trace (0 to 10%) amounts of fine gravel and roots. Fill was not encountered at Boring B-2. The thickness, character, and consistency of the Fill will vary between boring locations.

4.1.2 Gravelly Sand Deposits

Natural Gravelly Sand Deposits were encountered directly below the Fill at Boring B-1 and at the ground surface of Boring B-2. This material was about 9 to 20 feet thick and generally consisted of medium dense to dense, gray/brown, fine to coarse sand with varying (15 to 40%) amounts of fine to coarse gravel and trace amounts of silt. Cobbles and boulders were also inferred in this stratum based on split spoon refusal and auger chatter.

4.1.3 Bedrock

Bedrock was encountered at both borings from about 9 to 29 feet (approximate El. 323.5 to 300) below the ground surface.

Ten feet of bedrock was cored at each boring location. The cores were classified as very poor to fair quality, moderately hard, moderately weathered, black/gray/white, fine to coarse grained Gneiss and Schist with quartzite inclusions. The core recoveries and RQDs ranged from 37% to 88% and 7% to 62%, respectively.

4.2 GROUNDWATER

Groundwater was measured at about 10 to 13 feet (approximate El. 319) below existing grades in the borings. Groundwater levels measured in the boreholes may not have had sufficient time to stabilize and should be considered approximate. Groundwater levels will vary depending on factors such as temperature, season, precipitation, Broad Brook level, construction activity, and other conditions, which may be different from those at the time of these measurements.

5.0 GEOTECHNICAL RECOMMENDATIONS

We offer the following geotechnical design recommendations based on the subsurface conditions encountered at the site, available project information, and the proposed construction.

5.1 FOUNDATIONS

The proposed bridge abutments can be supported on conventional shallow foundations. This option is typically more economical but would likely require temporary excavation support systems (e.g., sheet piling), cofferdams, dewatering, and scour protection (e.g., sheeting, riprap, etc.) around the foundations not bearing directly on bedrock. The bridge could also be supported on stub abutments bearing on deep foundations (e.g., piles). Piles are generally more expensive than shallow foundations, but would likely require less earthwork and dewatering and may not require scour protection.

Both shallow and deep foundation options are presented below. We recommend that a cost comparison be performed between the options and that project stakeholders discuss the merits and challenges of each option before selecting one or a combination thereof (e.g., proposed west abutment supported on shallow foundations bearing directly on bedrock and proposed east abutment supported on piles).

5.1.1 Shallow Foundation Option

The proposed bridge abutments may be supported on shallow footings bearing on natural Gravelly Sand Deposits, Bedrock, or on Structural Fill (hereinafter specified as Granular Fill) over natural Gravelly Sand Deposits and Bedrock. Existing Fill is not considered a suitable bearing material, and must be excavated in the area of the proposed footings during site preparation. When Granular Fill is used beneath the footings, we recommend that it be placed one foot beyond the edge of the footings and at a one horizontal to one vertical slope away and down from the bottom outside edge of the footings. Crushed Stone can be used in place of Granular Fill as it is much easier to compact.

Footings should be constructed at a minimum depth of 48-inches below proposed site grades, two feet below the anticipated scour depth, or directly on Bedrock. Although scour analyses are not part of our scope, we recommend that the depth of scour be estimated prior to setting bottom of footing elevations. The minimum footing width should be 24-inches.

We recommend a maximum nominal bearing resistance of 4.5 tons per square foot and using services and strength resistance factors of 1.0 and 0.45, respectively, for footings bearing on the recommended bearing materials. Higher pressures can be accommodated on Bedrock should they be desired by the project's structural engineer, in which case DTE should be consulted. Based on the recommended bearing materials and anticipated loads, we estimate that the footings will undergo less than a half inch of total and differential settlement. Settlements will occur as the loads are applied and are expected to be complete at the end of construction

DTE should be provided with the final foundation loads and geometries once they are available to verify the above bearing capacity and settlement estimate.

5.1.2 Deep Foundation Option

The proposed bridge abutments and wingwalls may be supported on drilled micropiles socketed into Bedrock. A rock socketed pile is required for this project due to the shallow depth to rock and anticipated scour depth. Other than having the ability to be socketed into Bedrock, micropiles have the following other advantages:

- The drilling and grouting equipment used for micropile installation is relatively small and lightweight and can be mobilized within the tight site area.

- Proper drilling and grouting procedures associated with micropile installation controls risk of damage to the existing nearby structures and utilities versus driven piles as vibrations, soil displacements, and pile drifting are minimized.

- Micropiles can be installed through possible obstructions (e.g., boulders), without damaging the integrity of the piles or causing excessive vibrations.

We recommend using 7-inch diameter micropiles that develop their capacity in side friction (bedrock to grout bond). Based on the available subsurface information, we anticipate the top of bedrock is at about El. 323.5 and 300 for the west and east abutment piles, respectively. Pile lengths will vary based on the actual top of bedrock elevation at each pile location. The Contractor should be prepared to increase anticipated pile lengths as conditions are exposed in the field.

Micropiles should be constructed with permanent steel casing to the top of the rock socket with a center reinforcing bar that extends the full length of the micropile. Casing joints should not be permitted within the top 5 feet of the pile. Joints below 5 feet may have to be reinforced with a smaller inner casing depending on structural requirements.

The minimum spacing of micropiles should be at least 30 inches or three diameters measured center to center (whichever one is greater). Piles should be embedded in the abutment footings a minimum of one to two feet and be reinforced adequately to attain a fixed connection. A minimum steel section corrosion loss of 1/16-inch all around the piles should be used. A different corrosion loss may be considered if site-specific corrosive soil studies are performed.

We recommend a factored micropile grout to bedrock bond capacity of 13.8 ksf. This bond capacity assumes a nominal bond capacity of 25 ksf and resistance factor of 0.55. The rock socket bond capacity must be verified with a minimum of one static load test that is performed in accordance with ASTM D 3689-07. Based on the recommended pile type, bearing material, and anticipated loads, we estimate negligible pile settlements.

We recommend performing a lateral pile analysis during final design once the pile loads and foundation geometry are known. The analysis should be performed by modeling the non-linear soil behavior with p-y curves and the following soil parameters and assume a fix connection at the bedrock surface:

- Unit weight of soil above the water table = 122 pcf
- Unit weight of soil below the water table = 63 pcf
- Angle of internal friction (Φ') of soil = 33°
- Lateral soil modulus (k) of soil above the water table = 90 pci
- Lateral soil modulus (k) of soil below the water table = 60 pci

5.2 ABUTMENT AND WINGWALLS

5.2.1 Backfill and Drainage

We recommend backfilling earth retention structures with Pervious Structural Fill in accordance with CTDOT Standard Specifications Form 817, Section 2.16, and installing footing drains. The limits of backfill should extend upwards from the wall heel at a slope of 1.5H:1V (Horizontal to Vertical) to the intersection of unexcavated, undisturbed materials. The drains should consist of 6-inch diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, wrapped in non-woven filter fabric. The drains should be gravity drained and fitted with rodent screens.

5.2.2 Lateral Earth Pressures

Assuming that the abutments are backfilled with Pervious Structure Backfill in accordance with CTDOT standards, we recommend the following design parameters:

- Unit weight of backfill above the water table = 125 pcf
- Unit weight of backfill below the water table = 66.6 pcf
- Angle of internal friction (Φ') of backfill = 34°
- Coefficient of friction for soil against concrete walls (tan delta) = 0.40
- Earth pressure calculations should assume a surface traffic surcharge of a minimum of 24 inches of soil depth or 250 psf.

Computation of lateral forces should be based on AASHTO Section 3.11, Earth Pressure, using the above recommended parameters and the appreciate load factors in AASHTO Section 3.4, Load Factors and Combinations.

5.2.3 Sliding Resistance

We recommend a maximum coefficient of friction of 0.45 and using a sliding resistance factor of 0.8 for cast-in-place foundations bearing on the natural Gravelly Sand or Granular Fill. The sliding resistance factor can be increased to 0.65 for foundations bearing directly on clean Bedrock.

5.3 SEISMIC DESIGN

The site class is "C" per AASHTO 2012 LRFD. Based on the standard penetration test results, visual soil classification, and design peak ground acceleration at this locale, the saturated site soils are not susceptible to liquefaction.

6.0 MATERIALS RECOMMENDATIONS

6.1 ON-SITE MATERIALS

Excavated materials are not anticipated to be suitable for re-use as Granular Fill or Pervious Structure Backfill. On-site materials can be reused as General Fill for site grading purposes.

6.2 BACKFILL MATERALS

We recommend that backfill materials conform to the following CTDOT Standards:

- Granular Fill - CTDOT Standard Form 817, Section M.02.01
- Crushed Stone - Size No. 8 per CTDOT Standard Form 817, Section M.01.01
- Pervious Structure Backfill - CTDOT Standard Form 817, Section M.02.05

6.3 COMPACTION REQUIRMENTS

Granular Fill and Pervious Structure Backfill should be placed and compacted to a minimum in-place dry density of 95-percent of laboratory maximum dry density, as per AASHTO T180, Method D, and within 2% of their optimum moisture content. Granular Fill and Pervious Structure Backfill should be placed in loose layers not exceeding 8-inches in thickness. Each layer should be placed horizontal and compacted before placing subsequent layers.

7.0 CONSTRUCTION RECOMMENDATIONS

7.1 SUBGRADE PREPARATION

Soil subgrades should be proof-compacted prior to Granular Fill or concrete placement under the observation of a qualified Geotechnical Engineer. The base of foundation excavations should be free of debris materials, water, ice, and loose and frozen soils prior to placing compacted fill or concrete. Should the materials at bearing level become disturbed, the affected materials should be removed prior to placing compacted fill or concrete. We recommend the use of smooth edged excavator buckets or clips (not back-bladed) to make the final subgrade excavations and placing a six-inch-thick layer of crushed stone over foundation subgrades to prevent disturbance during construction.

7.2 MICROPILE INSTALLATION

We recommended that micropiles be installed with a water flush system due to the loose overburden soils and close proximity to a slope. Drilling with air should not be permitted without authorization from the engineer. Drill bits should not be advanced ahead of the outer casing when drilling through overburden soils. Drill casing should have a full head of water (or possibly heavy drilling fluid if needed) to maintain the drill hole stability and prevent soils from blowing up into the casing.

7.3 TEMPORARY EXCAVATIONS

The Fill and natural site soils are classified as OSHA Class “C” soil and can be cut at a maximum one vertical to one and a half horizontal (1V:1.5H) slope up to a maximum excavation depth of 20 feet. These maximum slope and excavation depths assume no surcharge load (i.e., stockpiles, construction equipment, traffic, etc.) at the top of the excavations or groundwater seepage.

Care should be taken to not undermine the adjacent roads, sidewalks, and utilities. If excavations cannot be sloped in accordance with OSHA requirements or will potentially undermine adjacent structures, temporary excavation support systems will be required. These systems should be chosen and installed by the contactor and designed by a Professional Engineer registered in the State of Connecticut.

7.4 TEMPORARY GROUNDWATER CONTROL

Construction may occur below the adjacent river and groundwater levels. Water inflows will need to be temporarily controlled using cofferdams and sump pumps to allow construction of the bridge substructures in the dry. The contractor should review the plans and borings and interpret the means and methods best suited to control water during construction.

8.0 REVIEW OF FINAL DESIGN, PLANS, AND SPECIFICATIONS

When project plans and specifications are available they should be provided to DTE for review of conformance with our geotechnical recommendations. If any changes are made to the proposed bridge, the recommendations provided in this report will need to be verified by DTE for applicability.

9.0 CONSTRUCTION QUALITY CONTROL

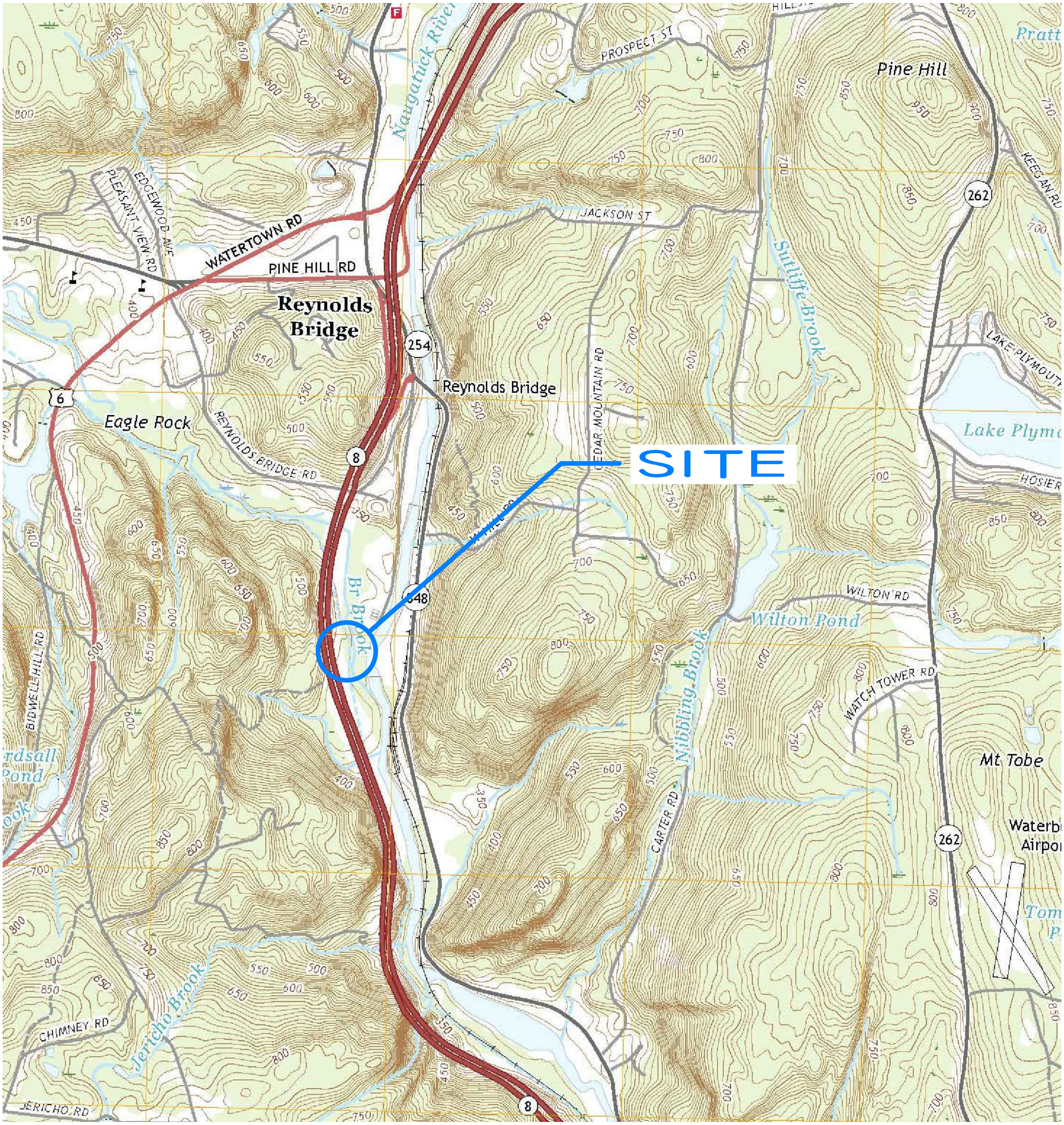
We recommend that DTE make field observations of excavations and foundation preparation to monitor compliance with our recommendations and project specifications. Specifically, we recommend field observation of excavations, removal of unsuitable materials, footing subgrades, pile installation, and Fill placement and compaction to monitor compliance with project specifications. We can also assist in classifying material on-site for the purpose of segregation and/or mixing for re-use on-site.

10.0 LIMITATIONS

This report is subject to the limitations included in Appendix 4.

APPENDIX 1 -

FIGURES

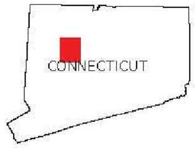


G:\My Drive\DTE Root Drive\Client Folders (new)\0038 – BL Companies\10 – Naugatuck River Greenway Pedestrian Bridge\CAD\0038-010.00 AREA AND SITE PLAN LT2010.dwg

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

122 CHURCH STREET
NAUGATUCK, CONNECTICUT 06770

CONNECTICUT



QUADRANGLE LOCATION

AREA PLAN
NAUGATUCK RIVER GREENWAY PEDESTRIAN BRIDGE
OVER BROAD BROOK
THOMASTON, CONNECTICUT

REFERENCE:
USGS TOPOGRAPHIC QUADRANGLE: THOMASTON, CT

SCALE 1"= 2,000'

2,000' 1,000' 0 2,000'

PROJECT NO. 0038-010.00

DATE: 09/30/19

FIGURE NO. 1

DRAWN BY: ARB

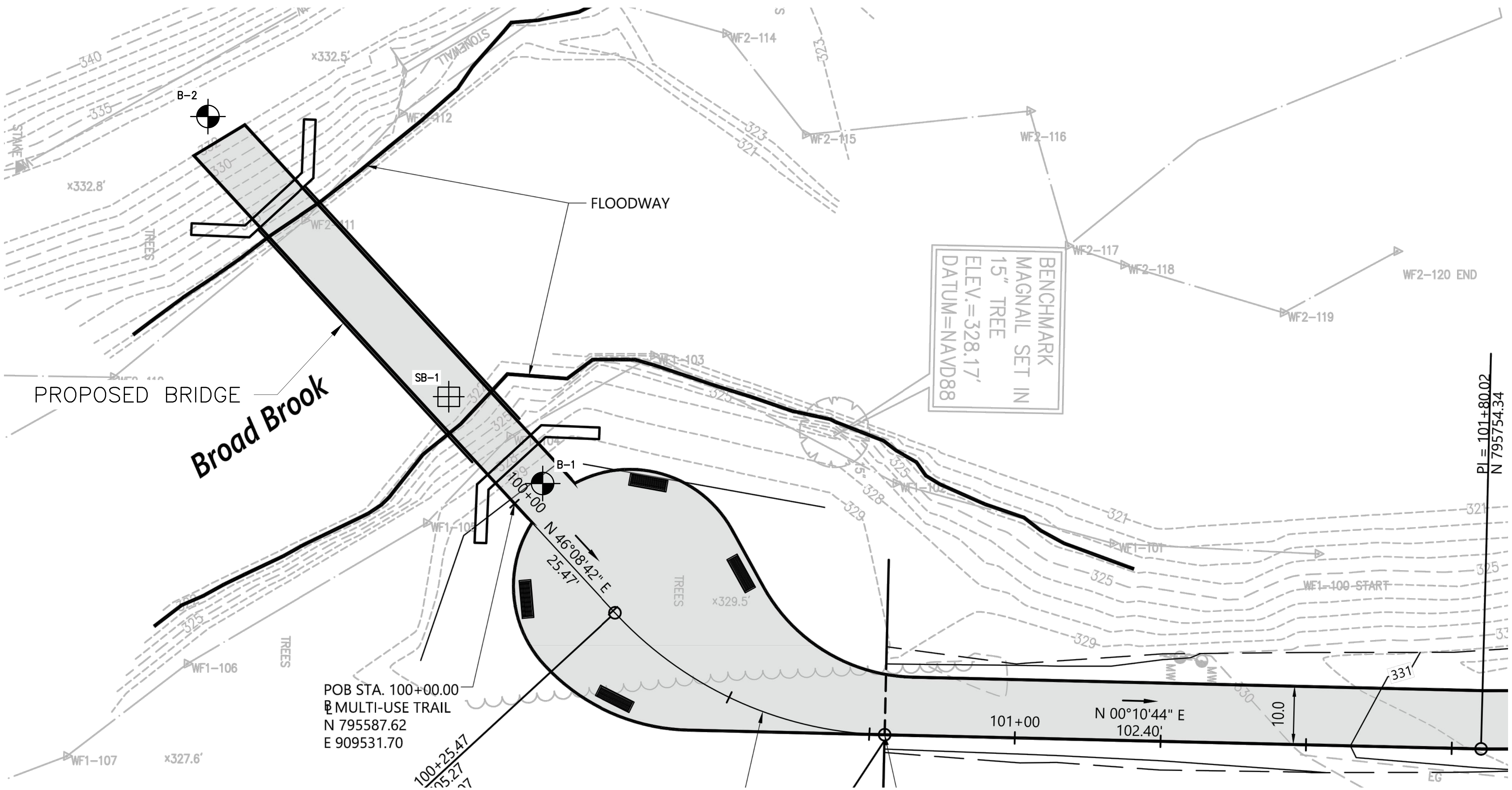
REVIEWED BY: DFL

G:\My Drive\DTE Root Drive\Client Folders (new)\0038 - BL Companies\10 - Naugatuck River Greenway Pedestrian Bridge\CAD\0038-010.00 AREA AND SITE PLAN LT2010 (1).dwg Roy 10/25/2019 11:47 AM Grayscale.ctb

LEGEND

B-1 — TEST BORING NO. AND APPROXIMATE LOCATION

SB-1 — STREAM BED SAMPLE NO. AND APPROXIMATE LOCATION



NOTES:

1) BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PREPARED BY VHB, ENTITLED "NAUGATUCK RIVER GREENWAY, THOMASTON–WATERTOWN DESIGN PROJECT", DATED JULY 26, 2018, ORIGINAL SCALE 1" = 250'.
2) BORINGS WERE COMPLETED BY SOILTESTING, INC. AND OBSERVED BY DOWN TO EATRTH CONSULTING, LLC.
3) THE LOCATIONS OF THE BORINGS AND STREAMBED SAMPLES WERE DETERMINED BY TAPING AND VISUAL ESTIMATES FROM EXISTING SITE FEATURES. THESE LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

DESIGNED BY DFL					
DRAWN BY ARB					
CHECKED BY DFL	NO.	DATE	DRWN.	CHKD	APPVD
APPROVED BY RPJ	REVISIONS				

SCALE 1"= 20'
20' 10' 0 20'

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING
122 CHURCH STREET
NAUGATUCK, CONNECTICUT 06770

PROJECT
NAUGATUCK RIVER GREENWAY PEDESTRIAN BRIDGE OVER BROAD BROOK
THOMASTON, CONNECTICUT

DWG. TITLE.
SITE AND EXPLOARTION LOCATION PLAN

FILE NO. 0038–010.00
SCALE AS NOTED
DATE 10/18/19
FIGURE NO. 2

APPENDIX 2 -

TEST BORING LOGS

Down To Earth Consulting, LLC
122 Church Street
Naugatuck, CT 06770

Tel: (203) 683-4155

TEST BORING LOG

DRILLER: Mike Kennedy	Hole No.: B-1
TOWN: Thomaston, CT	Line & Station:
PROJECT NAME: Naugatuck River Greenway Pedestrian Bridge	Offset:
STATE PROJECT NUMBER: DEPA00002024287	DTE File No.: 0038-010.00
BORING CONTRACTOR: SoilTesting, Inc.	N. Coordinate
	E. Coordinate

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: 329														
Date Started: 10/3/2019	Utilized				X				X					X
Date Finished: 10/3/2019	Type	BW	NW	HW	Pipe	Solid	Hollow		SS	UP	B (s)	B (d)	NX (s)	NQ (d)
Groundwater Observations	Size I.D. (in)				3				1.375					
@ 10 ft after 10 min.	Hammer (lb)				300				140		Type	X	Diamond	
@ ft after	Fall (in)				30				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. in	REC. in	Type	BLOWS PER 6 INCHES ON SAMPLER 0 - 6	6 - 12	12 - 18	18 - 24	STRATA CHANGE: DEPTH	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		1 to 3	S1	24	5	SS	30	13	8	6	Fill	Medium dense, dark brown, fine to coarse SAND, little fine Gravel, trace Silt, trace Roots
		3 to 5	S2	24	8	SS	6	4	3	2		Loose, light brown, fine to medium SAND, little Silt, trace fine Gravel, trace Roots
5		5 to 7	S3	24	18	SS	6	5	6	19	Possible Fill	Medium dense, light brown, fine to medium SAND, little Silt, trace fine Gravel
		7 to 9	S4	24	20	SS	6	7	5	6		Medium dense, light brown, fine to medium SAND, little Silt, trace fine Gravel
10		10 to 12	S5	24	7	SS	15	12	8	6	Gravelly Sand	Medium dense, gray/brown, fine to coarse SAND and fine to coarse GRAVEL, trace Silt
15		15 to 17	S6	24	19	SS	9	10	11	11		Medium dense, gray/brown, fine to coarse SAND, some fine to coarse Gravel, trace Silt
20		20 to 22	S7	24	18	SS	10	13	34	49		Dense, gray/brown, fine to coarse SAND, little fine to coarse Gravel, trace Silt
25		25 to 27	S8	24	7	SS	10	14	14	16		Medium dense, gray/brown, fine to coarse SAND and fine to coarse GRAVEL, trace Silt
30		29 to 34	C1	60	22	C					Bedrock	Very poor quality, moderately hard, slightly weathered, black/gray/white, fine to coarse grained GNIESS and SCHIST with Quartz inclusions (core times: 3.7, 2.6, 5.6, 1.7, 2.3 min/ft) (RQD = 4"/60" = 7%)
35		34 to 39	C2	60	47	C						

Casing Size	From	To	Depth Earth	Rock
3" Pipe	0	29 ft	29 ft.	10 ft.
			No. of Samples	
			8	2

NOTES: 1. Safety hammer and cathead were used to drive the split spoon and casing.
2. Sporadic cobbles and possible boulders were inferred based on auger chatter from about 10 to 29 feet below grade

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.

Down To Earth Consulting, LLC 122 Church Street Naugatuck, CT 06770	**TEST BORING LOG**	Hole No.: B-1
		Line & Station:
	DRILLER: Mike Kennedy	Offset:
	TOWN: Thomaston, CT	DTE File No.: 0038-010.00
	PROJECT NAME: Naugatuck River Greenway Pedestrian Bridge	
Tel: (203) 683-4155	STATE PROJECT NUMBER: DEPA00002024287	N. Coordinate
	BORING CONTRACTOR: SoilTesting, Inc.	E. Coordinate

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: 329														
Date Started: 10/3/2019	Utilized				X				X					X
Date Finished: 10/3/2019	Type	BW	NW	HW	Pipe	Solid	Hollow		SS	UP	B (s)	B (d)	NX (s)	NQ (d)
Groundwater Observations	Size I.D. (in)				3				1.375					
@ 10 ft after 10 min.	Hammer (lb)				300				140		Type	X	Diamond	
@ ft after	Fall (in)				30				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. in	REC. in	Type	BLOWS PER 6 INCHES ON SAMPLER 0 - 6	6 - 12	12 - 18	18 - 24	STRATA CHANGE: DEPTH	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
											Bedrock	Poor quality, moderately hard, slightly weathered, black/gray/white, fine to coarse grained, GNIESS and SCHIST with Quartz inclusions (core times: 3.5, 3.2, 5.6, 3, 5.1 min/ft) (RQD = 26"/60" = 43%)
40											End of boring at 39 feet	
45												
50												
55												
60												
65												
70												

Casing			Depth	
Size	From	To	Earth	Rock
3" Pipe	0	29 ft	29 ft.	10 ft.
			No. of Samples	
			8	2

NOTES: 1. Safety hammer and cathead were used to drive the split spoon and casing.
2. Sporadic cobbles and possible boulders were inferred based on auger chatter from about 10 to 29 feet below grade

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.

TEST BORING LOG

Down To Earth Consulting, LLC 122 Church Street Naugatuck, CT 06770		Hole No.: B-2
		Line & Station:
	DRILLER: Mike Kennedy	Offset:
	TOWN: Thomaston, CT	DTE File No.: 0038-010.00
	PROJECT NAME: Naugatuck River Greenway Pedestrian Bridge	
Tel: (203) 683-4155	STATE PROJECT NUMBER: DEPA00002024287	N. Coordinate
	BORING CONTRACTOR: SoilTesting, Inc.	E. Coordinate

Surface Elevation: 332.5		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: 10/4/2019	Utilized				X				X					X
Date Finished: 10/4/2019	Type	BW	NW	HW	Pipe	Solid	Hollow		SS	UP	B (s)	B (d)	NX (s)	NQ (d)
Groundwater Observations	Size I.D. (in)				3				1.375					
@ 13 ft after 10 min.	Hammer (lb)				300				140		Type	X	Diamond	
@ ft after	Fall (in)				30				30		of Bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE: DEPTH IN FEET FROM - TO	NO.	PEN. in	REC. in	Type	BLOWS PER 6 INCHES ON SAMPLER: 0 - 6	6 - 12	12 - 18	18 - 24	STRATA CHANGE: DEPTH	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0 to 2	S1	24	3	SS	6	6	5	11	Gravelly Sand	Medium dense, brown, fine to coarse SAND, little Gravel, trace Silt
		3 to 5	S2	24	14	SS	4	4	8	10		Medium dense, light brown, fine to medium SAND and fine to coarse GRAVEL, trace Silt
5												
		5 to 7	S3	24	13	SS	6	13	9	15		Medium dense, light brown/gray, fine to medium SAND, some fine to coarse Gravel, trace Silt
		7 to 7.42	S4	5	5	SS	50/5"					Very dense, light brown/gray, fine to medium SAND, some fine to coarse Gravel, little Silt
10		9 to 14	C1	60	50	C					Bedrock	Fair quality, moderately hard, slightly weathered, black/gray, fine to coarse grained, GNIESS and SCHIST with Quartz inclusions (core times: 5.1, 4.8, 4, 4.3, 5.1 ft/min.) (RQD = 32/60" = 53%)
15		14 to 19	C2	60	53	C						Fair quality, moderately hard, slightly weathered, black/gray, fine to coarse grained, GNIESS and SCHIST with Quartz inclusions (core times: 7.8, 4.9, 6.8, 9.8, 8.8 ft/min.) (RQD = 37/60" = 62%)
20											End of boring at 19 feet	
25												
30												
35												

Casing			Depth		NOTES:
Size	From	To	Earth	Rock	1. Safety hammer and cathead were used to drive the split spoon and casing.
3" Pipe	0	9 ft	9 ft.	10 ft.	2. Sporadic cobbles and possible boulders were inferred based on auger chatter from about 5 to 9 feet below grade
			No. of Samples		
			4	2	

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.

APPENDIX 3 -

LABORATORY TEST RESULTS

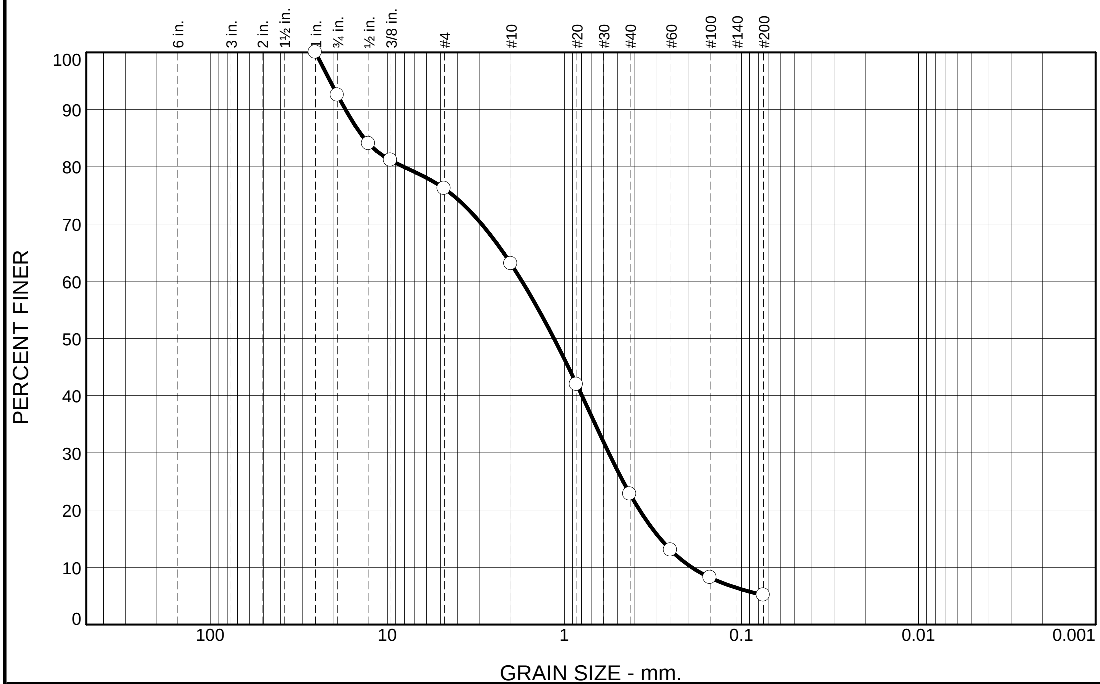
THIELSCH ENGINEERING	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 thielsch.com *Let's Build a Solid Foundation*	Client Information: Down to Earth Consulting Naugatuck, CT PM: Dan LaMesa Assigned By: Dan LaMesa Collected By: Client	Project Information: **Naugatuck River Greenway Pedestrian Bridge** **Thomaston, CT** DTE Project Number: 0038-010.00 Summary Page: 1 of 1 Report Date: 10.17.19

LABORATORY TESTING DATA SHEET, Report No.: 7419-K-148

				Identification Tests								Proctor / CBR / Permeability Tests								
Boring No.	Sample No.	Depth (Ft)	Laboratory No.	As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Water Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Perme-ability cm/sec	Laboratory Log and Soil Description
				D2216	D4318		D6913			D2974	D854			D1557						
B-1	S-6	15-17	19-S-2101				23.8	71.1	5.1											Brown poorly graded sand with silt and gravel
B-1	S-7	20-22	19-S-2102				16.1	79.8	4.1											Brown poorly graded sand with gravel
B-2	S-2	3-5	19-S-2103				38.3	57.6	4.1											Brown poorly graded sand with gravel
SB-1	G-1	0.5-1.5	19-S-2104				30.5	65.1	4.4											Dark Brown Organic poorly graded sand with gravel

Date Received: 10.10.19   Reviewed By: [illegible]   Date Reviewed: 10.17.19

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.5	16.3	13.2	40.3	17.6	5.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	92.5		
0.5"	84.0		
0.375"	81.1		
#4	76.2		
#10	63.0		
#20	41.9		
#40	22.7		
#60	13.0		
#100	8.2		
#200	5.1		

* (no specification provided)

Material Description

Brown poorly graded sand with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 17.2027 D_{85}= 13.5145 D_{60}= 1.7336
D_{50}= 1.1447 D_{30}= 0.5615 D_{15}= 0.2873
D_{10}= 0.1908 C_u= 9.09 C_c= 0.95

Remarks

Date Received: 10.10.19 **Date Tested:** 10.17.19

Tested By: JM / IA

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Borings **Depth:** 15-17' **Date Sampled:**
Sample Number: B-1 / S-6

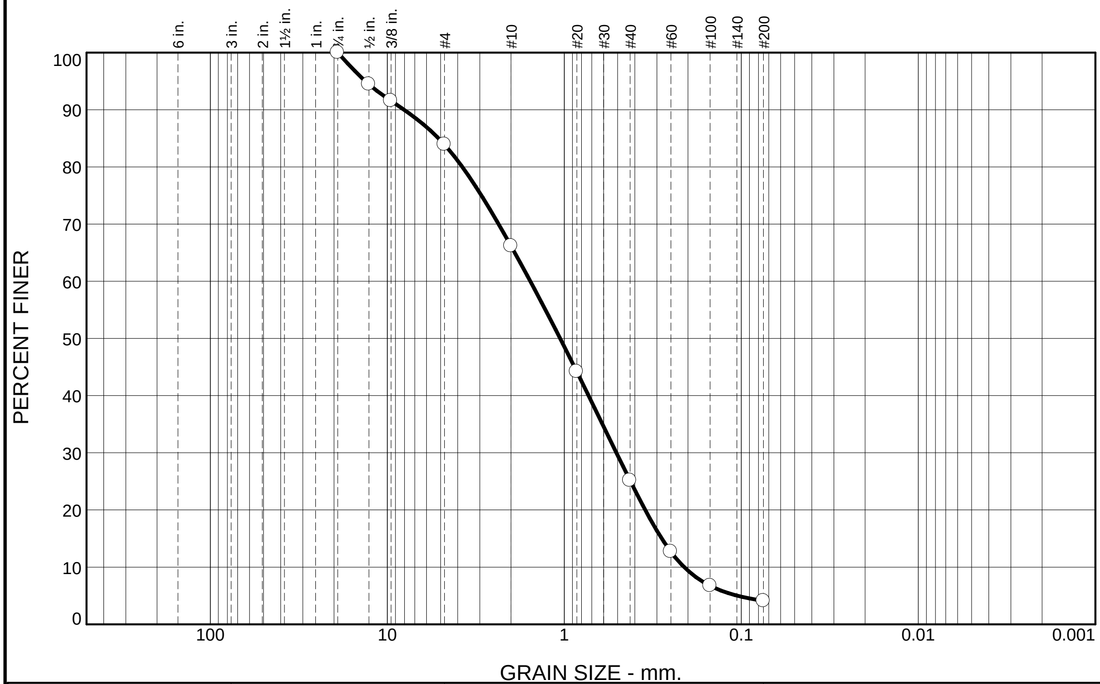
7419-K-138

Thielsch Engineering Inc.

Cranston, RI

Client: Down to Earth Consulting
Project: Naugatuck River Greenway Pedestrian Bridge
Thomaston, CT
Project No: 0038-010.00 **Figure** 19-S-2101

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.1	17.7	41.1	21.0	4.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	94.4		
0.375"	91.6		
#4	83.9		
#10	66.2		
#20	44.2		
#40	25.1		
#60	12.7		
#100	6.7		
#200	4.1		

* (no specification provided)

Material Description

Brown poorly graded sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 8.0361 D_{85}= 5.1286 D_{60}= 1.5563
D_{50}= 1.0560 D_{30}= 0.5082 D_{15}= 0.2817
D_{10}= 0.2101 C_u= 7.41 C_c= 0.79

Remarks

Date Received: 10.10.19 **Date Tested:** 10.17.19

Tested By: JM / IA

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Borings **Depth:** 20-22' **Date Sampled:**
Sample Number: B-1 / S-7

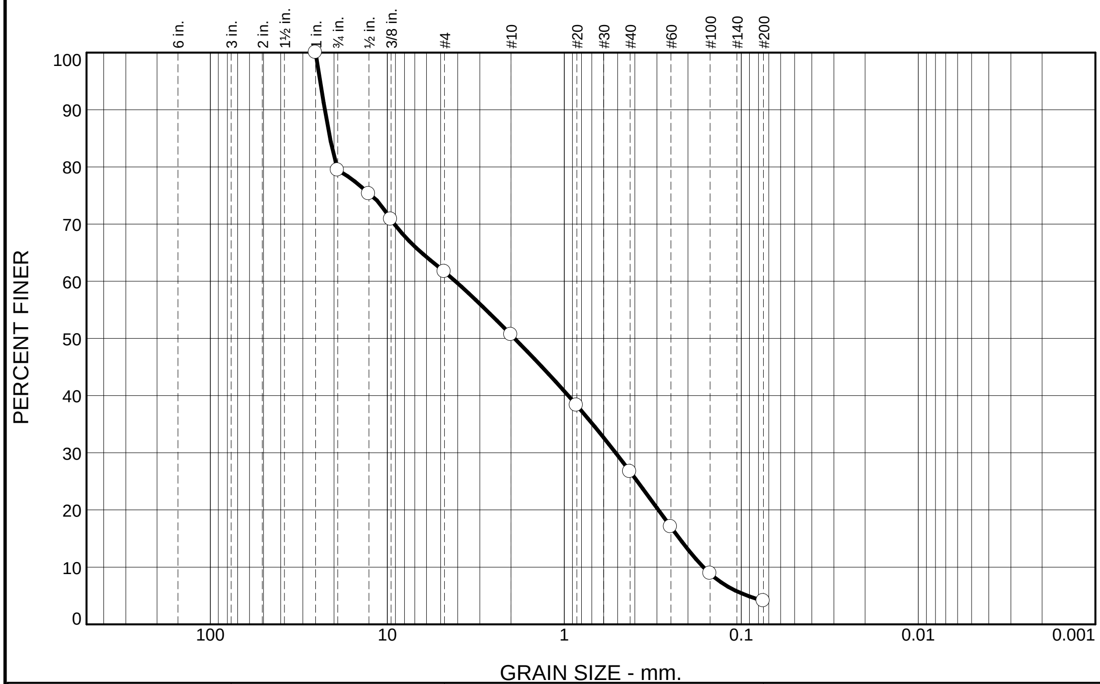
7419-K-138

Thielsch Engineering Inc.

Cranston, RI

Client: Down to Earth Consulting
Project: Naugatuck River Greenway Pedestrian Bridge
Thomaston, CT
Project No: 0038-010.00 **Figure** 19-S-2102

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	20.6	17.7	11.1	23.9	22.6	4.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	79.4		
0.5"	75.3		
0.375"	70.8		
#4	61.7		
#10	50.6		
#20	38.3		
#40	26.7		
#60	17.0		
#100	8.9		
#200	4.1		

* (no specification provided)

Material Description

Brown poorly graded sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 22.5298 D_{85}= 21.0453 D_{60}= 4.1172
D_{50}= 1.9102 D_{30}= 0.5132 D_{15}= 0.2233
D_{10}= 0.1638 C_u= 25.14 C_c= 0.39

Remarks

Date Received: 10.10.19 **Date Tested:** 10.17.19

Tested By: JM / IA

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Borings **Depth:** 3-5' **Date Sampled:**
Sample Number: B-2 / S-2

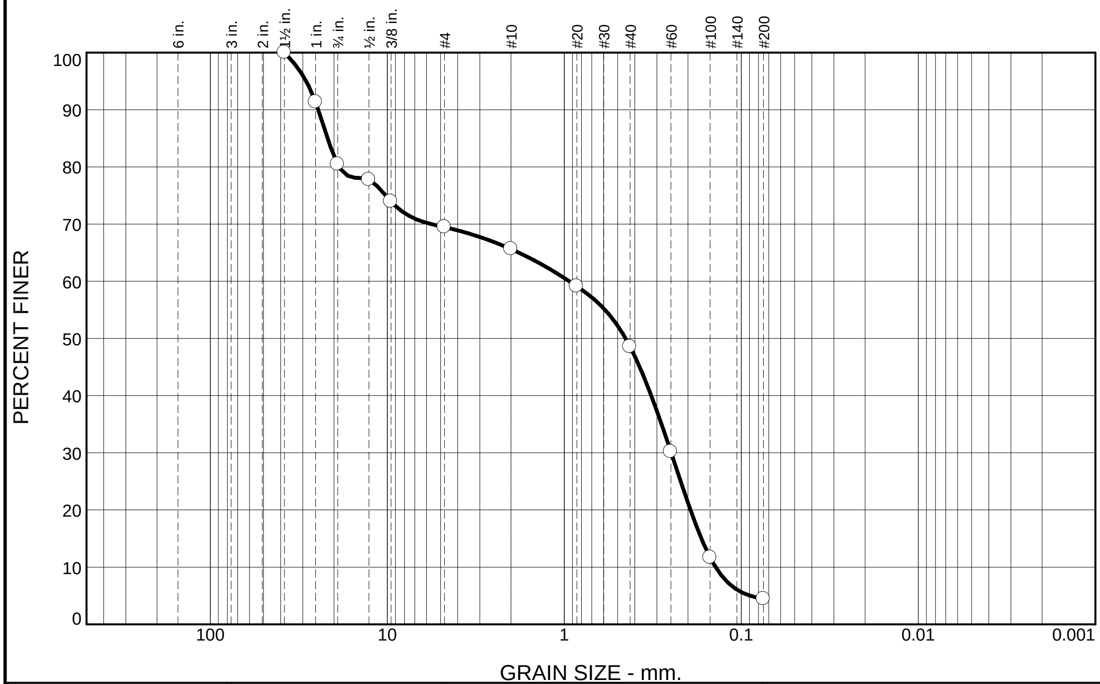
7419-K-138

Thielsch Engineering Inc.

Cranston, RI

Client: Down to Earth Consulting
Project: Naugatuck River Greenway Pedestrian Bridge
Thomaston, CT
Project No: 0038-010.00 **Figure** 19-S-2103

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.6	10.9	3.9	17.0	44.2	4.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1-1/2"	100.0		
1"	91.3		
3/4"	80.4		
1/2"	77.8		
3/8"	73.9		
#4	69.5		
#10	65.6		
#20	59.1		
#40	48.6		
#60	30.2		
#100	11.7		
#200	4.4		

* (no specification provided)

Material Description

Dark Brown Organic poorly graded sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 24.5345 D_{85}= 21.7351 D_{60}= 0.9361
D_{50}= 0.4506 D_{30}= 0.2489 D_{15}= 0.1680
D_{10}= 0.1396 C_u= 6.71 C_c= 0.47

Remarks

Date Received: 10.10.19 **Date Tested:** 10.17.19

Tested By: JM / IA

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Borings **Depth:** 0.5-1.5' **Date Sampled:**
Sample Number: SB-1 / G-1

Thielsch Engineering Inc.

Cranston, RI

Client: Down to Earth Consulting
Project: Naugatuck River Greenway Pedestrian Bridge
Thomaston, CT
Project No: 0038-010.00 **Figure** 19-S-2104

7419-K-138

APPENDIX 4 -

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations by Down To Earth Consulting, LLC (DTE). The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, Broad Brook Level, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by DTE. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

5. It is recommended that this firm be retained to provide soil engineering services during construction of the earthworks and foundation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

6. This report has been prepared for the exclusive use of BL Companies and their design team for specific application to the project noted in this geotechnical report in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

7. This soil and foundation engineering report has been prepared for this project by DTE. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

8. This report may contain comparative cost estimates for the purpose of evaluating alternative foundation schemes. These estimates may also involve approximate quantity evaluations. It should be noted that quantity estimates may not be accurate enough for construction bids. Since DTE has no control over labor and materials cost and design, the estimates of construction costs have been made on the basis of experience. DTE does not guarantee the accuracy of cost estimates as compared to contractor's bids for construction costs.