



**DOWN TO EARTH
CONSULTING, LLC**
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

**GEOTECHNICAL ENGINEERING REPORT
REPLACEMENT OF BRIDGE NO. 007002
EDGEWOOD ROAD OVER JOHN HALL BROOK
BERLIN, CONNECTICUT**

Prepared for:

AI Engineers, Inc.
919 Middle Street
Middletown, Connecticut

Prepared by:

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

August 2021
File No. 0070-012.00

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**DOWN TO EARTH
CONSULTING, LLC**
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

August 5, 2021
File No. 0070-012.00

Erik Jarboe, P.E.
AI Engineers
919 Middle Street
Middletown, CT. 06457

Via email: EJarboe@aiengineers.com

Re: Geotechnical Engineering Report
Edgewood Road Culvert - Bridge No. 007002
Berlin, Connecticut

Dear Mr. Jarboe,

Down To Earth Consulting, LLC (DTE) is pleased to submit this geotechnical engineering report for the proposed replacement culvert that will span Edgewood Road over John Hall Brook in Berlin, Connecticut. We appreciate this opportunity to work with you. Please call if you have any questions.

Sincerely,

Down To Earth Consulting, LLC

Thomas J. Orszulak, P.E.
Project Manager

Daniel F. LaMesa, P.E.
Reviewer/Principal



TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	SUBSURFACE DATA.....	1
2.1	GENERAL SITE GEOLOGY	1
2.2	TEST BORINGS	1
3.0	SUBSURFACE CONDITIONS	2
3.1	SUBSURFACE PROFILE	2
3.1.1	Fill.....	2
3.1.2	Silty Sand	2
3.1.3	Glacial Till	3
3.1.4	Bedrock	3
3.2	GROUNDWATER.....	3
4.0	GEOTECHNICAL RECOMMENDATIONS.....	3
4.1	SOIL AND BEDROCK DESIGN PROPERTIES	3
4.2	FOUNDATIONS.....	3
4.3	DRAINAGE	4
4.4	LATERAL EARTH PRESSURES	4
4.5	SEISMIC DESIGN	5
5.0	MATERIALS RECOMMENDATIONS.....	5
5.1	ON-SITE MATERIALS	5
5.2	BACKFILL MATERIALS.....	5
5.3	COMPACTION REQUIRMENTS.....	5
6.0	CONSTRUCTION RECOMMENDATIONS.....	6
6.1	SUBGRADE PREPARATION	6
6.2	TEMPORARY EXCAVATIONS	6
6.3	TEMPORARY GROUNDWATER CONTROL.....	6
7.0	REVIEW OF FINAL DESIGN, PLANS, AND SPECIFICATIONS	6
8.0	CONSTRUCTION QUALITY CONTROL.....	7
9.0	LIMITATIONS	7

APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – BORING LOGS

APPENDIX 3 – LIMITATIONS



1.0 INTRODUCTION

Down To Earth Consulting, LLC (DTE) is pleased to submit this geotechnical engineering report for the proposed culvert that will replace the existing culvert spanning John Hall Brook in Berlin, Connecticut. Refer to Figures 1 and 2 (in Appendix 1) for the approximate site and proposed culvert location, respectively.

The project site is located approximately 0.6 miles south of Orchard Hill Road along Edgewood Road in Berlin, Connecticut. The proposed construction consists of replacing the existing structure with an approximate 22-foot long by 21-foot wide precast concrete culvert supported on shallow foundations with concrete wingwalls. At the time of drafting this report, proposed foundation loads and brook scour levels were not available.

Our geotechnical engineering services included: reviewing project plans, observing test borings, characterizing subsurface conditions within the project limits, performing geotechnical engineering analyses, and providing geotechnical design and construction recommendations for the proposed culvert and wingwalls. Our services were performed in accordance with our June 10, 2021 agreement.

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

- 2020 AASHTO LRFD Bridge Design Specifications
- The Connecticut Department of Transportation (CTDOT) Geotechnical Manual, 2005 edition (revised January 2020)
- CTDOT Bridge Design Manual, 2003 edition (revised December 2019)
- CTDOT Standard Specifications for Roads, Bridges, and Incidental Construction, Form 818 (2020).

Elevations (El.) provided in this report are in feet and based on the datum referenced in the drawing titled *S-03 – General Plan and Notes, Replacement of Bridge No. 007002, Edgewood Road over John Hall Brook, Berlin, Connecticut* prepared by AI Engineering, Inc., dated June 7, 2021.

2.0 SUBSURFACE DATA

2.1 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 as Sand and Gravel Deposits. The underlying Bedrock is mapped as East Berlin Formation (Silty Shale).

2.2 TEST BORINGS

We observed and logged two test borings (B-1 and B-2) drilled by our subcontractor Associated Borings Co., Inc. on July 21, 2021. 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 should be considered approximate. Elevations at the boring locations were scaled from the drawing titled *S-03 – General Plan and Notes, Replacement of Bridge No. 007002, Edgewood Road over John Hall Brook, Berlin, Connecticut* prepared by AI Engineering, Inc., dated June 7, 2021.

The borings were drilled to explore the soil, bedrock, and groundwater conditions in the project area. The borings were advanced to depths of approximately 16 to 19.5 feet (approximate El. 352.5 to 343.5) below existing grades at Borings B-1 and B-2, respectively. Borings were terminated on Bedrock as inferred by auger refusal.

Representative soil samples were obtained for soil classification in the borings 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.

Groundwater levels were measured using a weighted tape in open drill holes and observations of wet samples recovered during drilling.

3.0 SUBSURFACE CONDITIONS

3.1 SUBSURFACE PROFILE

The subsurface conditions from the borings generally consisted of a surficial layer of asphalt underlain by uncontrolled Fill over Silty Sand, Glacial Till, and Inferred Bedrock. The following is a more detailed description of the primary subsurface materials encountered at the site.

3.1.1 Fill

Fill was encountered at the ground surface of both borings and was approximately 5 feet thick. The Fill typically consisted of medium dense to dense, reddish brown, fine to coarse sand with varying amounts of silt and gravel. At Boring B-1, auger refusal was encountered within the Fill at a depth of approximately 3 feet on an inferred boulder. The test boring was offset 3 feet to the north and re-advanced. The thickness, character, and consistency of the Fill will vary between boring locations.

3.1.2 Silty Sand

Silty Sand was encountered directly below the Fill at both test boring locations. The material generally consists of medium dense, reddish brown fine sand with varying amounts of silt. The Silty Sand ranged in thickness between 7 and 10 feet.



3.1.3 Glacial Till

Below the Silty Sand, a Glacial Till deposit was encountered. The material typically consists of very dense, reddish-brown/gray sand with varying amounts of silt and gravel. Depth to top of the Glacial Till deposit ranged between 14 and 15 feet below existing grade (approximately El. 265 and 264, respectively).

3.1.4 Bedrock

Bedrock was encountered at a depth of 16 feet (approximate El. 263) at B-1 and 19 feet (approximate El. 260) at B-2, as inferred by auger refusal. Geologic maps indicate that the Bedrock consists of Silty Shale.

3.2 GROUNDWATER

Groundwater was measured at approximately 5 feet (approximate El. 274) 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, John Hall Brook Levels, construction activity, and other conditions, which may be different from those at the time of these measurements.

4.0 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.

4.1 SOIL AND BEDROCK DESIGN PROPERTIES

We recommend the following soil and bedrock properties for the design of the culvert and wingwalls:

Material	Total Unit Weight (pcf)	Drained Friction Angle (°)	Drained Cohesion (psf)
Structural Fill	128	34	0
Existing Fill	115	31	0
Silty Sand	115	31	0
Glacial Till	138	36	0
Bedrock	145	-	-

4.2 FOUNDATIONS

The proposed structures can be supported on shallow footings over a minimum 12-inch-thick layer of compacted Crushed Stone (Size No. 8 per CTDOT Standard Form 818, Section M.01.01) bearing on natural Silty Sand, Glacial Till, or on Structural Fill (hereinafter specified as Granular Fill - CTDOT Standard Form 818, Section M.02.01) over natural Silty Sand and/or Glacial Till. Existing Fill is not considered suitable bearing materials and must be excavated in the area of the proposed foundations 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 and a minimum of 12-inches below the anticipated scour depth. Although scour analyses are not part of our scope, we recommend that the depth of scour be estimated prior to establishing bottom of footing elevations. The minimum footing width should be 48 inches.

We recommend a maximum coefficient of friction of 0.4 and using a sliding resistance factor of 0.8 for foundations bearing on the specified materials above. We recommend a maximum nominal bearing resistance of 4 tons per square foot and using service and strength resistance factors of 1.0 and 0.45, respectively, for footings bearing on the recommended bearing materials.

Based on the recommended bearing materials and anticipated loads, we estimate that the footings will undergo less than one inch of total settlement and less than a half inch of 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 estimates.

4.3 DRAINAGE

We recommend backfilling the structures with Pervious Structural Fill in accordance with CTDOT Standard Specifications Form 818, Section 2.16, and installing drainage in accordance with CTDOT Manual Standard, Plate Number 3.5.2 – U-Type Wingwall or Retaining Wall Drainage and Backfill Requirements. The limits of backfill behind walls should extend upwards from the wall heels at a slope of 2H:1V (Horizontal to Vertical) to the intersection of ground surface.

4.4 LATERAL EARTH PRESSURES

Computation of lateral earth pressures should be based on AASHTO Section 3.11, Earth Pressure, using the above recommended parameters and the appropriate load factors in AASHTO Section 3.4, Load Factors and Combinations. Passive soil resistance should be neglected in stability computations, unless the base of the wall extends below the depth of maximum scour, freeze-thaw, or other possible disturbances. Unacceptable wall deformations can occur before the full passive soil resistance is mobilized, thus, we recommend that DTE be consulted further if the wall designer intends on utilizing passive soil resistances.



We recommend using the following interface friction angles between soils and the walls:

Material	Soil-Structure Interface Friction Angle (°)	
	Steel and Wood	Concrete
Structural Fill	17	22
Existing Fill	14	20
Silty Sand	14	20
Glacial Till	17	22

Earth pressure calculations should assume a surface traffic surcharge of a minimum of 24 inches of soil depth or 250 psf.

4.5 SEISMIC DESIGN

The site class is “C” (Very Dense Soil Profile) per AASHTO 2020 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.

5.0 MATERIALS RECOMMENDATIONS

5.1 ON-SITE MATERIALS

Excavated fill 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.

5.2 BACKFILL MATERIALS

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

- Granular Fill - CTDOT Standard Form 818, Section M.02.01
- Crushed Stone - Size No. 8 per CTDOT Standard Form 818, Section M.01.01
- Pervious Structure Backfill - CTDOT Standard Form 818, Section M.02.05

5.3 COMPACTION REQUIREMENTS

Granular Fill and Pervious Structure Backfill should be placed and compacted to a minimum in-place dry density of 95-percent and 98-percent, respectively, 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 and 6-inches, respectively, in thickness. Each layer should be placed horizontal and compacted before placing subsequent layers.



6.0 CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

All existing substructures must be removed in their entirety within the limits of the proposed culvert and wingwalls. Existing Fill must be removed down to the level of firm, natural, granular, inorganic subgrade and the resulting excavations must be backfilled up to the bottom foundation levels with either Granular Fill or Crushed Stone compacted in accordance with Section 5.3.

Soil subgrades should be proof-compacted prior to Granular Fill, Crushed Stone, 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 or 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 twelve-inch-thick layer of granular fill/crushed stone over foundation subgrades to prevent disturbance during construction.

6.2 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. 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 contractor and designed by a Professional Engineer registered in the State of Connecticut.

6.3 TEMPORARY GROUNDWATER CONTROL

Construction will occur below the adjacent stream and groundwater levels. Water inflows will need to be temporarily controlled using cofferdams and sump pumps to allow construction of the substructures in the dry. Cofferdams (if needed) should be adequately sealed to prevent stream water from infiltrating into the excavations and have sufficient basal stability and pumping systems designed (e.g., filters) to prevent soil migration.

The construction dewatering system means and methods should be chosen by the contractor and designed by a Professional Engineer registered in the State of Connecticut. This should include providing a discharge water management plan that avoids endangering public health and nearby property and meets applicable local, state, and environmental regulations.

7.0 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



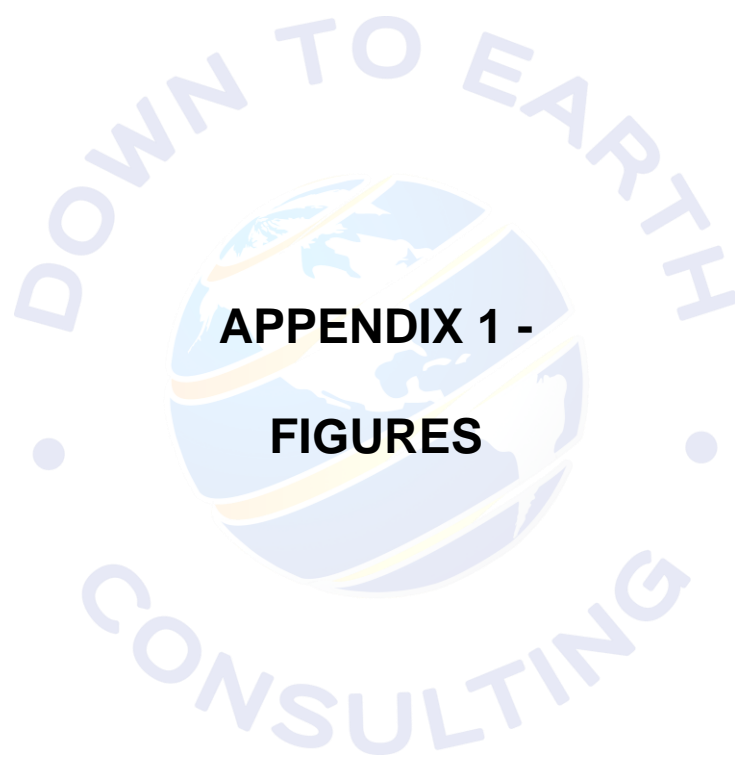
structures, the recommendations provided in this report will need to be verified by DTE for applicability.

8.0 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, 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.

9.0 LIMITATIONS

This report is subject to the limitations included in Appendix 3.



**APPENDIX 1 -
FIGURES**



**DOWN TO EARTH
CONSULTING, LLC**
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING



AREA PLAN
REPLACEMENT OF BRIDGE NO. 007002
EDGEWOOD ROAD OVER JOHN HALL BROOK
BERLIN, CONNECTICUT

REFERENCE:
USGS TOPOGRAPHIC QUADRANGLE: MERIDEN, CT

PROJECT NO. 0070-012.00

DATE: 8/5/2021

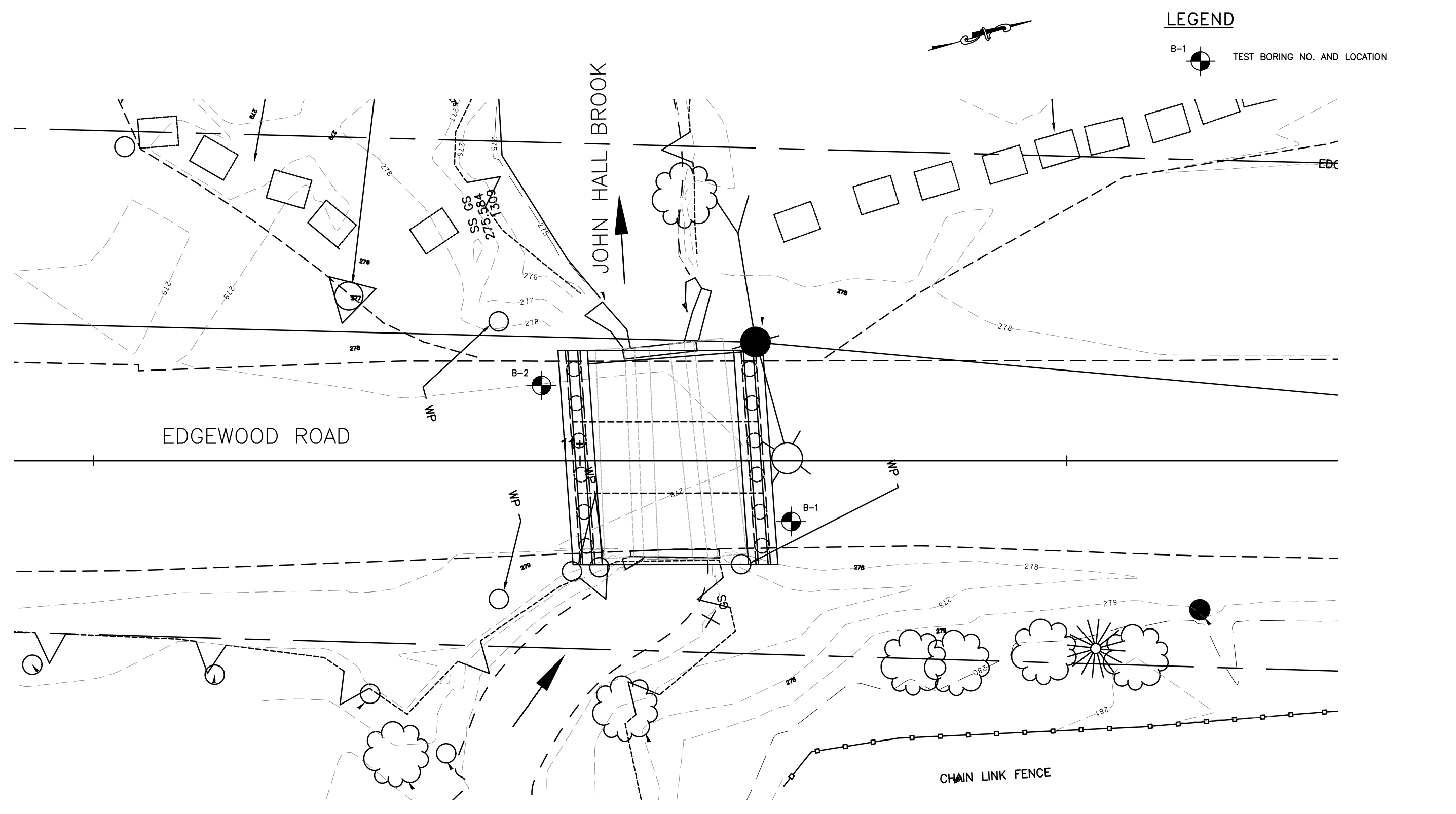
DRAWN BY: TJO

REVIEWED BY: DFL


SCALE 1"= 2,000'



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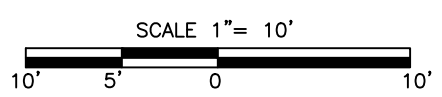


LEGEND

B-1  TEST BORING NO. AND LOCATION

NOTES:
1) BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PREPARED BY AI ENGINEERING, INC. ENTITLED "S-03: GENERAL PLAN & NOTES, REPLACEMENT OF BRIDGE No. 007002, EDGEWOOD ROAD OVER JOHN HALL BROOK", DATED: JUNE 7, 2021, ORIGINAL SCALE 1:10.
2) BORINGS WERE COMPLETED BY ASSOCIATED TEST BORINGS, CO. AND OBSERVED BY DOWN TO EARTH CONSULTING, LLC.
3) THE LOCATIONS OF THE EXPLORATIONS 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 OTHERS						
DRAWN BY TJO						
CHECKED BY DFL						
APPROVED BY DFL	NO.	DATE		DRWN.	CHKD	APPVD
REVISIONS						



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

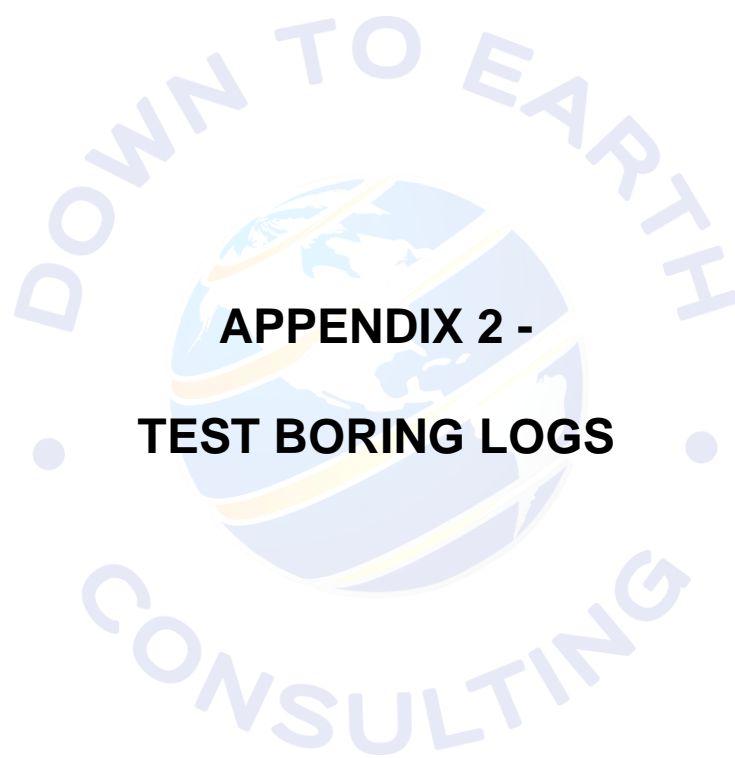
PROJECT
**REPLACEMENT OF BRIDGE NO. 007002
EDGEWOOD ROAD OVER JOHN HALL BROOK
BERLIN, CONNECTICUT**

DWG. TITLE.
**SITE AND BORING
LOCATION PLAN**


FILE NO. 0070-012.00

SCALE AS NOTED DATE 8/5/2021

FIGURE NO.
2



**APPENDIX 2 -
TEST BORING LOGS**

 DOWN TO EARTH CONSULTING, LLC <small>GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING</small>	PROJECT		BORING NO. <u>B-1</u>	
	REPLACEMENT OF BRIDGE NO. 007002		SHEET <u>1</u> of <u>1</u>	
	EDGEWOOD ROAD OVER JOHN HALL BROOK		FILE NO. <u>0070-012.00</u>	
	BERLIN, CONNECTICUT		CHKD. BY <u>TJO</u>	

Boring Co. <u>Associated Borings Company</u>	Boring Location <u>See Boring Location Plan</u>
Driller <u>Jaime Lloret</u>	Ground Surface El. <u>279</u> Datum <u>Not Available</u>
Logged By <u>Mateusz Fekieta</u>	Date Start <u>7/21/2021</u> Date End <u>7/21/2021</u>

Hammer Type: <u>Donut hammer driven by cathead with a 30 inch drop</u>	Groundwater Readings (from ground surface)			
Sampler Size: <u>1-3/8" I.D. Split Spoon</u>	Date	Time	Depth (ft)	Elev.
Type Drill Rig: <u>CME 55</u>	<u>7/21/21</u>		<u>5</u>	
Drilling Method: <u>3.25-inch I.D. Hollow-Stem Augers</u>				Stabilization Time
				Wet Sample

D E P T H	Casing Blows (ft)	SAMPLE INFORMATION					SAMPLE DESCRIPTION	STRATA
		Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)		
1								8" Asphalt FILL
2		S-1	4/18	1 to 2.5	8-16-22		Dense, brown/gray, fine to coarse GRAVEL and fine to coarse SAND, little Silt	
3								
4								
5								
6		S-2	5/24	5 to 7	7-8-8-14			Medium dense, reddish brown/gray, fine to coarse SAND and SILT, some fine to coarse Gravel, wet
7								
8		S-3	9/24	7 to 9	12-12-12-14		Medium dense, reddish brown, SILT, and fine SAND	
9								
10								
11		S-4	13/24	10 to 12	4-8-10-11			Medium dense, reddish brown, SILT, and fine Sand
12								
13								
14								
15		S-5	7/10	15 to 15.8	27-50/4"		Very dense, reddish brown/gray, fine to coarse SAND, some Silt, some fine to coarse Gravel	
16								
17							END OF EXPLORATION AT 16 FEET BELOW GROUND SURFACE DUE TO AUGER REFUSAL.	INFERRED BEDROCK
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY
0 to 4 - Very Loose 5 to 10 - Loose 11 to 30 - Medium Dense 31 to 50 - Dense Over 50 - Very Dense	0 to 2 - Very Soft 3 to 4 - Soft 5 to 8 - Medium Stiff 9 to 15 - Stiff 16 to 30 - Very Stiff Over 30 - Hard	Trace = 0 to 10% Little = 10 to 20% Some = 20 to 35% And = 35 to 50%	<div style="display: flex; justify-content: space-between;"> <div> 1. S denotes split-barrel sampler. 2. ST denotes 3-inch O.D. undisturbed sample. 3. UO denotes 3-inch Osterberg undisturbed sample. 4. PEN denotes penetration length of sampler. 5. REC denotes recovered length of sample. 6. SPT denotes Standard Penetration Test. </div> <div> 7. WH denotes weight of hammer 8. WR denotes weight of rods 9. PP denotes Pocket Penetrometer. 10. FVST denotes field vane shear test. 11. RQD denotes Rock Quality Designation. 12. C denotes core run number. </div> </div>


FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.

2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.

3) Auger refusal on inferred boulder at 3 feet. Boring relocated 3 feet North.

4) Cobbles and/or boulders were inferred based on auger chatter from about 12.5 to 16 feet.

5) Auger refusal at 16 feet on inferred bedrock.

 DOWN TO EARTH CONSULTING, LLC <small>GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING</small>	PROJECT			BORING NO. <u>B-2</u>	
	REPLACEMENT OF BRIDGE NO. 007002			SHEET <u>1</u> of <u>1</u>	
	EDGEWOOD ROAD OVER JOHN HALL BROOK			FILE NO. <u>0070-012.00</u>	
	BERLIN, CONNECTICUT			CHKD. BY <u>TJO</u>	

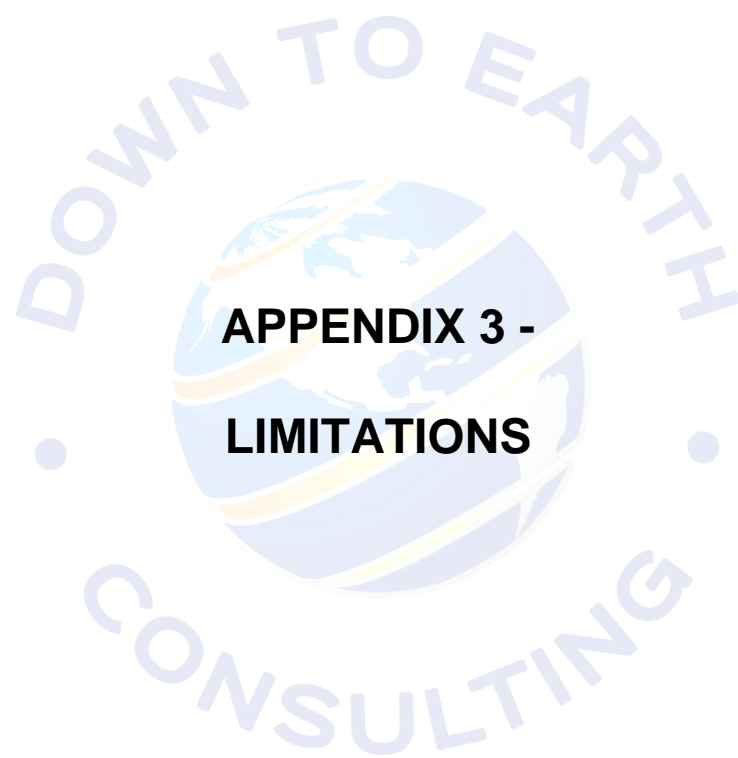
Boring Co. <u>Associated Borings Company</u>	Boring Location <u>See Boring Location Plan</u>
Driller <u>Jaime Lloret</u>	Ground Surface El. <u>279</u> Datum <u>Not Available</u>
Logged By <u>Mateusz Fekieta</u>	Date Start <u>7/21/2021</u> Date End <u>7/21/2021</u>

Hammer Type: <u>Donut hammer driven by cathead with a 30 inch drop</u>	Groundwater Readings (from ground surface)				
Sampler Size: <u>1-3/8" I.D. Split Spoon</u>	Date	Time	Depth (ft)	Elev.	Stabilization Time
Type Drill Rig: <u>CME 55</u>	<u>7/21/21</u>		<u>5</u>		<u>Wet Sample</u>
Drilling Method: <u>3.25-inch I.D. Hollow-Stem Augers</u>	<u>7/21/21</u>		<u>5</u>		<u>At River</u>

D E P T H	Casing Blows (ft)	SAMPLE INFORMATION					SAMPLE DESCRIPTION	STRATA
		Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)		
1								8" Asphalt
2		S-1	1/24	1 to 3	7-10-6-3			
3						Medium dense, reddish brown, fine to coarse SAND, little Silt		
4		S-2	2/24	3 to 5	3-5-13-16		Medium dense, reddish brown, fine to coarse SAND, little Silt	FILL
5								
6		S-3	14/24	5 to 7	3-6-8-9		Medium dense, reddish brown, fine SAND, some Silt. Wet	
7								SILTY SAND
8		S-4	14/24	7 to 9	9-12-10-12		Medium dense, reddish brown, fine SAND and SILT, stratified	
9								
10								
11		S-5	9/24	10 to 12	5-6-6-6		Medium dense, reddish brown, fine SAND, some Silt	
12								TILL
13								
14								
15								
16		S-6	8/15	15 to 16.3	40-42-50/3"		Very dense, reddish brown/gray, fine to coarse SAND, and SILT, some fine to coarse Gravel	
17								INFERRED BEDROCK
18								
19								
20								
21								
22								END OF EXPLORATION AT 19 FEET BELOW GROUND SURFACE DUE TO AUGER REFUSAL.
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose 5 to 10 - Loose 11 to 30 - Medium Dense 31 to 50 - Dense Over 50 - Very Dense	0 to 2 - Very Soft 3 to 4 - Soft 5 to 8 - Medium Stiff 9 to 15 - Stiff 16 to 30 - Very Stiff Over 30 - Hard	Trace = 0 to 10% Little = 10 to 20% Some = 20 to 35% And = 35 to 50%	1. S denotes split-barrel sampler. 2. ST denotes 3-inch O.D. undisturbed sample. 3. UO denotes 3-inch Osterberg undisturbed sample. 4. PEN denotes penetration length of sampler. 5. REC denotes recovered length of sample. 6. SPT denotes Standard Penetration Test.	7. WH denotes weight of hammer 8. WR denotes weight of rods 9. PP denotes Pocket Penetrometer. 10. FVST denotes field vane shear test. 11. RQD denotes Rock Quality Designation. 12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Cobbles and/or boulders were inferred based on auger chatter from about 14 to 19 feet.
4) Auger refusal at 19 feet on inferred bedrock.



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) and others. 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, tidal, 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 culvert 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 AI Engineers, Inc. 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.