Culvert Foundation Investigation Report

Honey Ridge Road Bridge Replacement
Guyton, Effingham County, Georgia

August 20, 2018
Terracon Project No. ES185187

Prepared for:
EOM Operations
Richmond Hill, Georgia

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

August 20, 2018

EOM Operations
480 Edsel Drive, Suite 100
Richmond Hill, Georgia 31324

Attn: Mr. Daniel McFee
P: (912) 445 0050
E: dmcfee@eomworx.com

Re: Culvert Foundation Investigation Report
Honey Ridge Road Bridge Replacement
Guyton, Effingham County, Georgia
Terracon Project No.: ES185187

Dear Mr. McFee:

Terracon Consultants, Inc. (Terracon) is pleased to submit this Culvert Foundation Investigation Report for the installation of a concrete box culvert at Mill Creek on Honey Ridge Road in Guyton, Georgia. The services were performed in general accordance with our proposal No. PES185187 dated July 27, 2018.

Terracon appreciates the opportunity to be of service to you on this project. Should you have any questions concerning this report, or if we may be of further service, please feel free to contact us.

Sincerely,
Terracon Consultants, Inc.

Thomas C. Brackett "Chap", P.G., E.I.T.
Senior Staff Geotechnical Engineer

Guoming Lin, Ph.D., P.E., D.GE.
Senior Principal/Senior Consultant

cc: 1 – Client (PDF) 1 – File

CULVERT FOUNDATION INVESTIGATION
For
Honey Ridge Road Bridge Replacement
Guyton, Effingham County, Georgia

Project Description

The project includes replacing the existing bridge crossing under Honey Ridge Road to outfall to Mill Creek. The bridge will be replaced with a triple 10 foot concrete box culvert constructed in accordance with GDOT Construction Standard 2327. The general location of the project site and its vicinity are shown on the Site Location Map in **Exhibit A-1**, **Appendix A**.

Geology

The project is geologically sited in the Wicomico Shoreline Complex of the Georgia Coastal Plain Region.

Elevations

The existing surface elevation and the culvert bottom elevation are not available at this time. Based on drawings provided by EOM Operations, we understand the culvert bottom will be approximately 8 feet below the existing surface elevations where the soil borings were performed.

Subsurface Information

A total of two (2) Standard Penetration Test (SPT) borings (B1 and B2) were performed on each side of proposed culvert location. After penetrating the existing asphalt road, the borings were drilled to an average depth of 65 feet (BGS). The locations of the SPT borings are shown in **Exhibit A-2**, **Appendix A**.

In general, the subsurface profiles consist of medium dense silty to clayey sands in the upper 22 feet below ground surface (BGS), followed by stiff/hard sandy silt to approximately 65 feet BGS.

The groundwater table was encountered at approximately 7 feet BGS at the time of our field exploration. Please note groundwater level fluctuations may occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Theoretical Scour

The side embankments and the subgrade for the culvert should be protected against erosion and scouring.

Foundation Recommendation

The culvert can be supported by the prepared subgrade with a net allowable bearing capacity of 2,000 psf.

The stream may have isolated weak areas where ground improvement

using undercut and rock stabilization may be necessary. As such, the contractor should be prepared for undercut and rock stabilization which involves excavation to the bottom of the weak layer and backfilling with riprap stones. The need or the depth of excavation should be determined in the field during construction. The stones should be pushed into the soft soils using an excavator bucket. Additional stones may be needed until the bucket has an adequate resistance that can achieve a stable subgrade.

Terracon should be retained to confirm and test the subgrade during construction to provide more specific recommendations on subgrade repair based on the conditions encountered during construction.

The excavation bottom should be protected from standing water and surface run-off. The culvert should be installed as soon as practical after the subgrade is prepared.

Special Problem

The following special conditions should be considered for the shallow foundation system.

1. Because the groundwater table was encountered above the culvert bottom in our soil borings, dewatering of the excavations will be required. If deep excavation is needed to achieve a stable subgrade, temporary shoring may be necessary to support the excavation. The need for the temporary shoring should be evaluated by an engineer during construction. The shoring should be designed by an engineer retained by the contractor.
2. Due to groundwater near the culvert bottom, we recommend that 12 inches of Type II Foundation Backfill Material be used below the culvert.

August 20, 2018

Reported By: Thomas C. Brackett, P.G., E.I.T.

Reviewed By: Guoming Lin, Ph.D., P.E., D.GE.

Enclosed:

Appendix A

Field Exploration

Exhibit A-1 Site Location Map
Exhibit A-2 Exploration Location Plan
Exhibit A-3 Field Exploration Description
Exhibit A-4 SPT Boring Cross Section
Exhibit A-5 SPT Boring Logs

Appendix B

Supporting Document

Exhibit B-1 General Notes

Exhibit B-2 Unified Soil Classification System

APPENDIX A
FIELD EXPLORATION

Exhibit A-1 Site Location Map
Exhibit A-2 Exploration Location Plan
Exhibit A-3 Field Exploration Description
Exhibit A-4 SPT Boring Cross Section
Exhibit A-5 SPT Boring Logs

Image Courtesy of
Google Maps™

Project Manager:	TCB
Drawn by:	TCB
Checked by:	GL
Approved by:	GL

Project No.	ES185187
Scale:	N.T.S.
File Name:	
Date:	08-20-18

Terracon
Consulting Engineers & Scientists
2201 Rowland Avenue Savannah, Georgia 31404
Phone (912) 629 4000 Fax (912) 629 4001

SITE LOCATION MAP

Honey Ridge Road Bridge Replacement
Guyton, Effingham County, Georgia

Exhibit:

A-1

LEGEND

SPT Boring Location

Image Courtesy of
Google Maps™

Project Manager:	TCB
Drawn by:	TCB
Checked by:	GL
Approved by:	GL

Project No.	ES185187
Scale:	N.T.S.
File Name:	
Date:	08-20-18

Terracon
Consulting Engineers & Scientists
2201 Rowland Avenue Savannah, Georgia 31404
Phone (912) 629 4000 Fax (912) 629 4001

EXPLORATION LOCATION PLAN

Honey Ridge Road Bridge Replacement
Guyton, Effingham County, Georgia

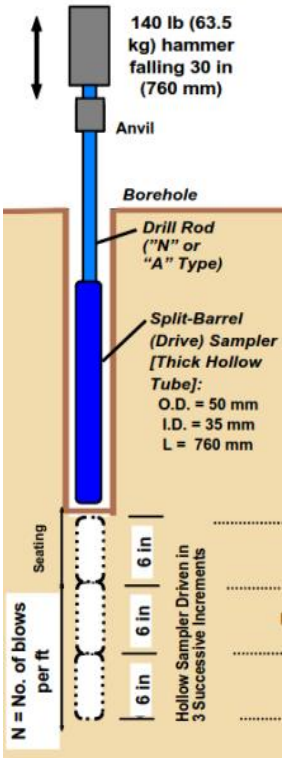
Exhibit: A-2

Field Exploration Description

The locations of Standard Penetration Test (SPT) borings are determined by Terracon based on the proposed construction and were located in the field using a hand-held GPS unit and in reference to existing features. These locations are shown in the Exploration Location Plan in **Exhibit A-2** and should be considered approximate.

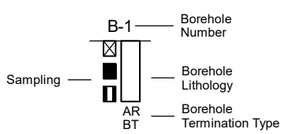
Standard Penetration Testing

The SPT borings were performed in accordance with ASTM D1586 with a trailer-mounted CME drilling rig using mud rotatory drilling techniques. Samples of the soil encountered in the borings were obtained using split-barrel sampling procedures. In the split barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in situ relative density of cohesionless soils and consistency of cohesive soils. A rope and cathead hammer was used to advance the split-barrel sampler in the borings performed on this site.



Source: FHWA NHI-06-088

EXPLANATION



Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:
See Exhibit B for orientation of soil profile.
See General Notes in Appendix B for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: TCB	Project No.: ES185187	
Drawn by: TCB	Scale: NTS	
Approved by: GL	File Name:	
Date: 08-20-2018		

Terracon
2201 Rowland Avenue
Savannah, Georgia
PH. 912-629-4000 FAX. 912-629-4001

SUBSURFACE PROFILE

HONEY RIDGE ROAD BRIDGE REPLACEMENT
MILL CREEK
EFFINGHAM COUNTY, GA

EXHIBIT

A-4

BORING LOG NO. B-1

Page 1 of 1

PROJECT: Honey Ridge Road Bridge Replacement

CLIENT: EOM Operations
Richmond Hill, GA

SITE: Mill Creek
Effingham County, GA

LOCATION See Exhibit A-2

DEPTH		GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE
0.6	**ASPHALT**, 7.5 inches						
2.0	**SILTY SAND (SM)**, fine grained, brown and orange, dense				X	11-26-23 N=49	SS-1
4.0	**CLAYEY SAND (SC)**, fine grained, brown and orange, medium dense				X	8-12-14-14 N=26	SS-2
	SILTY SAND (SM), fine grained, brown and orange, medium dense		5		X	9-10-11-11 N=21	SS-3
	fine grained, dark brown, loose			▽	X	3-2-2-3 N=4	SS-4
	with wood debris, fine grained, dark brown, very loose		10		X	3-2-1-3 N=3	SS-5
12.0	**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine to coarse grained, gray, medium dense				X	9-14-11 N=25	SS-6
	fine to medium grained, orange, medium dense		15				
22.0	**SANDY SILT (ML)**, fine to medium grained, dark gray, stiff		20		X	5-11-13 N=24	SS-7
	fine to medium grained, dark gray, stiff		25		X	4-5-7 N=12	SS-8
	fine grained, dark gray, very stiff		30		X	4-6-6 N=12	SS-9
	fine grained, dark gray, hard		35		X	6-11-13 N=24	SS-10
	fine grained, dark gray, hard		40		X	14-18-32 N=50	SS-11
	fine grained, dark gray, hard		45		X	16-30-40 N=70	SS-12
	fine grained, dark gray, hard		50		X	14-22-29 N=51	SS-13
	fine grained, dark gray, hard		55		X	11-19-28 N=47	SS-14
	fine grained, dark gray, hard		60		X	14-24-46 N=70	SS-15
65.0	fine grained, dark gray, hard		65		X	20-30-33 N=63	SS-16
	Boring Terminated at 65 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2 7/8" Chevron Bit

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At completion of drilling*

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 08-08-2018 | Boring Completed: 08-08-2018

Drill Rig: BR 2500 Track Rig | Driller: Matt

Project No.: ES185187 | Exhibit: A-5-1

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ES185187 HONEY RIDGE ROAD BRIDGE REPLACEMENT.GPJ TERRACON_DATATEMPLATE.GDT 8/14/18

BORING LOG NO. B-2

Page 1 of 1

PROJECT: Honey Ridge Road Bridge Replacement

CLIENT: EOM Operations
Richmond Hill, GA

SITE: Mill Creek
Effingham County, GA

LOCATION See Exhibit A-2

DEPTH		GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE
0.7	**ASPHALT**, 8.5 inches						
	SILTY SAND (SM), fine to medium grained, brown and orange, dense				X	17-21-21 N=42	SS-1
	fine grained, brown and orange, dense				X	22-15-16-20 N=31	SS-2
	fine grained, brown and orange, loose		5	▽	X	6-2-2-2 N=4	SS-3
8.0	with wood debris, fine grained, brown and dark brown, medium dense				X	7-2-13-2 N=15	SS-4
	SANDY SILT (ML), with wood debris, fine grained, dark brown, medium stiff		10		X	3-2-4-6 N=6	SS-5
12.0	**SILTY SAND (SM)**, fine to coarse grained, brown and gray, medium dense				X	19-10-6 N=16	SS-6
17.0	**CLAYEY SAND (SC)**, fine to medium grained, light brown and light orange, dense		15				
22.0	**SANDY SILT (ML)**, fine grained, dark gray, very stiff		20		X	13-13-20 N=33	SS-7
			25		X	9-9-13 N=22	SS-8
	fine to coarse grained, dark gray, very stiff		30		X	12-12-15 N=27	SS-9
	fine grained, dark gray, very stiff		35		X	7-9-12 N=21	SS-10
	with some wood debris, fine grained, dark gray, hard		40		X	15-16-28 N=44	SS-11
	fine grained, dark gray, hard		45		X	16-21-32 N=53	SS-12
	fine grained, dark gray and olive, hard		50		X	14-17-27 N=44	SS-13
	with wood debris from side wall, fine grained, dark gray and olive, very stiff		55		X	11-15-22 N=37	SS-14
	fine grained, dark gray and olive, hard		60		X	12-16-42 N=58	SS-15
65.0	fine grained, dark gray and olive, hard				X	18-24-32 N=56	SS-16
	Boring Terminated at 65 Feet		65				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2 7/8" Chevron Bit

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At completion of drilling*

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 08-09-2018 | Boring Completed: 08-09-2018

Drill Rig: BR 2500 Track Rig | Driller: Matt

Project No.: ES185187 | Exhibit: A-5-2

APPENDIX B
SUPPORTING DOCUMENTS

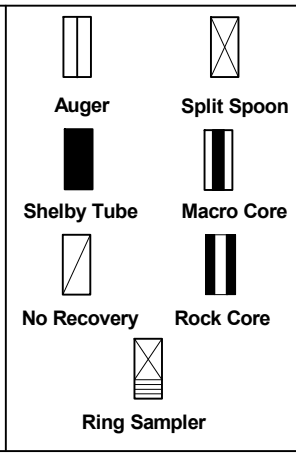
Exhibit B-1 General Notes

Exhibit B-2 Unified Soil Classification System

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



GROUNDWATER

Groundwater Initially Encountered

Groundwater Level After a Specified Period of Time

Static Groundwater Level After a Specified Period of Time

No Groundwater Observed

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Std. Penetration Resistance (blows per foot)**	**Descriptive Term (Consistency)**	**Undrained Shear Strength (kips per square foot)**	**Std. Penetration Resistance (blows per foot)**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium-Stiff	0.50 to 1.00	5 - 7
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 14
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	above 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Descriptive Term(s) of other constituents	Percent of Dry Weight
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils	Gravels	Clean Gravels	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
More than 50% retained	More than 50% of coarse fraction retained on No. 4 sieve	Less than 5% fines[C]	$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
on No. 200 sieve		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands	Clean Sands	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
	50% or more of coarse fraction passes No. 4 sieve	Less than 5% fines[D]	$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils	Silts and Clays	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
50% or more passes the No. 200 sieve	Liquid limit less than 50		PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			Organic silt[K,L,M,O]
	Silts and Clays	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
	Liquid limit 50 or more		PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.