CHATHAM COUNTY PURCHASING & CONTRACTING DEPARTMENT

ADDENDUM NO. 1 TO 18-0027-4

FOR: TRUMAN LINEAR PARK TRAIL - PHASE 2A

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PLEASE SEE THE FOLLOWING FOR ADDITIONS, CLARIFICATIONS AND/OR CHANGES:

1. **SEE ATTACHED:** ***RESPONSES TO QUESTIONS (5 pages)***

2. **SEE ATTACHED:** ***REVISED BID SHEETS (6 pages)***

3. **SEE ATTACHED:** ***Bridge Foundation Investigation Report (BFI #1) (37 pages)***

4. **SEE ATTACHED:** ***Bridge Foundation Investigation Report (BFI #2) (37 pages)***

NOTE: There will be an ADDENDUM 2 issued no later than Tuesday, June 26, 2018. The cut off time to submit questions REMAINS 3PM, Thursday, June 21, 2018.

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NOTE: BID OPENING HAS BEEN EXTENDED TO:
2PM, TUESDAY, JULY 3, 2018

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THE PROPOSER IS RESPONSIBLE FOR MAKING THE NECESSARY CHANGES AND MUST ACKNOWLEDGE RECEIPT OF ADDENDUM.

6/20/18
DATE

ROBERT E. MARSHALL
SENIOR PROCUREMENT SPECIALIST
CHATHAM COUNTY

PI 0007631 Responses to Questions for Addendum No. 1
Revised 6/20/18 at 9:30am

Responses to Questions

1) Verify the location of the sawcut joints shown on the typicals. Typicals say every 12', but note 2 says control point shall be the width of the trail, which is 10'. Where should the sawcut be located?

Sawcut joints shall be provided every 10' along the length of the 10' wide trails.
Amended plan sheets will be provided with Addendum No. 2.

2) What type of concrete is to be used for the wooden safety rail? Are all costs associated with construction of the rail (gravel, concrete, etc.) included in the overall cost?

The price bid for 502-9000 - TIMBER RAILING shall include all costs associated with the construction of the rail per the detail, including, but not limited to: Class B concrete footing, gravel, posts, rails and fasteners.

3) I don't see where the typicals or mainline plans call for 8-inch concrete, but the pay item is set-up. Verify this is needed.

Note 9 on Sheet 04-0001 shall be revised as follows:
ALL ADA RAMPS AND SIDEWALK WITHIN THE INTERSECTION RADII ARE TO BE 8 INCH CONCRETE AND PAID FOR UNDER BID ITEM 441-0108 - CONC SIDEWALK, 8 IN. THE COST FOR CONSTRUCTING THE ADA RAMPS SHALL BE INCLUDED IN THE PRICE BID FOR CONCRETE SIDEWALK.
Amended plan sheets will be provided with Addendum No. 2.

4) Please reference drawings 37-0003 and 37-0005. On drawing 37-0003, the handrail posts appear to have blocking between the post and the outside stringer but on the typical section shown on 37-0005, no blocking is called out. Should there be blocking between the handrail posts and the outside stringer and if so, what size?

Wood Blocking should be placed between the Timber post and exterior stringers. They should be 8" x 6" x 12" S4S Blocking.
Amended plan sheets will be provided with Addendum No. 2.

5) There does not appear to be a bid item for the wood pile. Will the wood pile be paid for under Bid Item 502-1200 "Bridge Timber, Treated or will a new bid item be created?

A bid item for timber piling has been added in the attached revised bid tab sheet to reflect the following:
520-2500 PILING, TIMBER - TREATED 5,800 LF
Amended plan sheets will be provided with Addendum No. 2.

6) Please reference drawing 37-0005. How many 3/8" x 6" HDG lags shall be used to fasten the 3"x8" timbers to each post? The text call out states (2) but detail A-A shows (4).

The intent is to have two 3/8" x 6" HDG lags per row - 4 total per location.
Amended plan sheets will be provided with Addendum No. 2.

7) The area shown for riprap cover at the bridges (Sheets13-0001 & 13-0009) is approximately 200 sq yd, however the notes say 300 sq yd on each side of the bridges and the bid quantity is 1,200 sq yd. Would it be possible to adjust the bid quantity to reflect the job quantity of 200 sq. yds total? The same needs to be adjusted for filter fabric.

For Structures, the following quantities have been modified in the attached revised bid tab sheet to reflect the following:
603-2024 STN DUMPED RIP RAP, TP 1, 24 IN 200 SY
603-7000 PLASTIC FILTER FABRIC 200 SY
Amended plan sheets will be provided with Addendum No. 2.

8) Please confirm we are to drive 2 indicator piles 50 ft. long at each bridge?

Yes. Test Piles are required at Bridge sites. One of the uses will be to determine pile order lengths.

9) On the bid schedule the pile length item is 340 LF. Does this quantity exclude the test piles?

Yes. The 340 LF pile lengths excludes the lengths for the Test Piles.

10) The bid schedule has no item for the timber piles

A bid item for timber piling has been added in the attached revised bid tab sheet to reflect the following:
520-2500 PILING, TIMBER - TREATED 5,800 LF
Amended plan sheets will be provided with Addendum No. 2.

11) The bid schedule has no item for the timber piles and the bid schedule item 502-1200 has 293 MBM for bridge timber treated. A first estimate results in less than half that amount for the 971 ft. of boardwalks. Could bid for boardwalk be per linear feet and include piles in this item?

No, the boardwalk will not be bid per linear foot. The bridge timber quantity has been modified and a bid item for timber piling has been added in the attached revised bid tab sheet to reflect the following:
502-1200 BRIDGE TIMBER, TREATED 120 MBM
520-2500 PILING, TIMBER - TREATED 5,800 LF
Amended plan sheets will be provided with Addendum No. 2.

12) Please clarify where stringer blocking goes. The details for the boardwalk do not show any stringer blocking at the rail post locations. Usually, we see blocking at mid-span and at the outer stringers at rail posts locations. Do you want to add blocking at these locations?

Wood Blocking should be placed between the Timber post and exterior stringers. They should be 8" x 6" x 12" S4S Blocking. Drawing No. 37-0004, Note 1 provides description of where blocking is required. For Spans less than 20' bracing shall be installed at Stringer Ends. 20' span requires bracing at the ends and mid-span.

13) The boardwalk section at station 426+94 crosses a ditch. Is the intent to make this a one span boardwalk or can an intermediate bent be placed on the middle of the ditch?

The Contractor shall avoid placement of boardwalk bents within a drainage channel unless permitted by the Engineer. The 21 linear foot boardwalk beginning at Station 426+94 is expected to be constructed as a single span, with a span length of 20-feet.
Amended plan sheets will be provided with Addendum No. 2.

14) Pile driving formulas contain safety factors when calculating capacities. GDOT piling formulas use more stringent coefficients making actual capacities 3 to 4 times design load. GDOT projects seldom use pile load tests because of their formulas. Can the bid item for load tests be deleted?

No. Load test are required at bridge sites.

15) Note 8 on Sheet 37-0003 calls for 3x8 decking attached with 80d HDG nails. Are these plain shank, ring shank or spiral shank nails?

Ring Shank Nails shall be used.
Amended plan sheets will be provided with Addendum No. 2.

16) Sheet 24-0009 shows a gas main and an overhead power line. The drawings do not say if these are relocated. Are these lines being relocated if they interfere with the bridge abutment? Will these lines be off while pile driving occurs? Is there a bid item for the gas main piping and tie-ins?

The Contractor shall adhere to the "Call Before You Dig Law" by calling the Underground Protection Center before beginning construction. The Contractor shall be responsible for all utilities and shall coordinate work with utility companies. Existing utilities shown on the plans are approximate, based on the best available information and may not reflect all facilities. It shall be the Contractor's responsibility to field verify existing utility locations prior to construction. Should the Contractor

identify a conflict with a utility, the Engineer shall be notified prior to continuing with work around conflict. The Engineer will determine if a utility conflicts with the work and will initiate coordination with the utility company should relocation of their facilities be required. The Contractor will not be responsible for relocation of utilities that conflict with the work. The Contractor will not be compensated for any delay or damage caused by utility facilities, obstruction, or any other item not being removed or relocated in advance of their work.

Amended plan sheets will be provided with Addendum No. 2 to include the note above.

Chatham County will facilitate the relocation of the water gauge and associated overhead power and communication lines on the west side of the bridge at Station 218+50 prior to bridge construction.

17) Is a Geotech report on the boardwalk areas available? If so please provide.

A Geotech report is not available for the boardwalk areas.

18) Pile embedment per note 11 on sheet 37-003 is 25' below grade. Please confirm this depth is correct. Must these be driven the entire depth or will contractor be able to pre auger?

The intention is to have 25'of pile embedment. Pre auger may be used but should be stopped approximately 3' above final tip elevation.
Amended plan sheets will be provided with Addendum No. 2.

19) Full depth Blocking – Sheet 37-0006, Details show blocking for the boardwalks. Will full depth blocking be allowed as an equal to shorter blocking with angle underneath? If not please identify what hardware is being used to hold the shorter blocking up.

3/4 depth blocking should be used to provide visual inspection of backwall blocking planks at the abutments. Full depth blocking may be used at Intermediate Bents. Regardless of blocking depth used, wood blocking should be bolted to stringers with steel angles or suspended in steel hangers that are nailed to blocks and stringer sides.

Square Bar - Sheet – 37-0006, Will a 1" diameter hex bolt and 5/8" diameter hex bolt be accepted as an equal to the square bar showed in the detail?

Yes, 1" square bar & 5/8 square bar may be substituted with similar size bolts or bars (#8 rebar & #5 rebars respectively).
Amended plan sheets will be provided with Addendum No. 2.

20) Lumber Grades – 37-0003 Note Number 5, Is the 90 PSF/H5 design load based on #2 grades lumber or the lumber specified in the GDOT standard specifications, section 860, table 1?

The 90 PSF / H5 Design Load is based on AASHTO Pedestrian Bridge Design Requirements for Clear Deck Width 10' or less. Stringers were evaluated to assure they met the requirements of GDOT Standard Specification, Section 860.

21) Will the contractor be able to submit for approval, GA professional Engineer signed and sealed shop drawings and calculations meeting the 90 PSF/H5 design load?

Per General Note 3 (Sheet 37-0003) the Contractor shall submit calculations and plans sealed by a GA Professional Engineer prior to beginning work.

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
	ROADWAY				
150-1000	TRAFFIC CONTROL - 0007631	LS	1		
207-0203	FOUND BKFILL MATL, TP II	CY	157		
210-0100	GRADING COMPLETE - 0007631	LS	1		
310-1101	GR AGGR BASE CRS, INCL MATL	TN	554		
318-3000	AGGR SURF CRS	TN	30		
402-3121	RECYCLED ASPH CONC 25 MM SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIM	TN	23		
402-3130	RECYCLED ASPH CONC 12.5 MM SUPERPAVE, GP 2 ONLY, INCL BITUM MATL & H L	TN	56		
402-3190	RECYCLED ASPH CONC 19 MM SUPERPAVE, GP 1 OR 2,INCL BITUM MATL & H LIME	TN	72		
413-0750	TACK COAT	GL	41		
439-0300	PERVIOUS CONCRETE PAVEMENT, 6 IN THK	SY	378		
441-0104	CONC SIDEWALK, 4 IN	SY	195		
441-0105	CONC SIDEWALK, 5 IN	SY	16920		
441-0106	CONC SIDEWALK, 6 IN - CLASS AA CONC	SY	639		
441-0108	CONC SIDEWALK, 8 IN	SY	272		
441-0300	CONC SPILLWAY, SPCL DES	EA	8		
441-0748	CONCRETE MEDIAN, 6 IN	SY	134		
441-4030	CONC VALLEY GUTTER, 8 IN	SY	25		
441-5002	CONCRETE HEADER CURB, 6 IN, TP 2	LF	543		
441-6222	CONC CURB & GUTTER, 8 IN X 30 IN, TP 2	LF	675		
500-3201	CLASS B CONCRETE, RETAINING WALL	CY	39		
500-3800	CLASS A CONCRETE, INCL REINF STEEL	CY	10		
500-3900	CLASS B CONCRETE, INCL REINF STEEL	CY	7		
500-9999	CLASS B CONC, BASE OR PVMT WIDENING	CY	2		
502-9000	TIMBER RAILING	LF	1841		
515-2020	GALV STEEL PIPE HANDRAIL, 2 IN, ROUND	LF	192		
550-1180	STORM DRAIN PIPE, 18 IN, H 1-10	LF	319		
550-1240	STORM DRAIN PIPE, 24 IN, H 1-10	LF	127		
550-1300	STORM DRAIN PIPE, 30 IN, H 1-10	LF	107		

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
550-1360	STORM DRAIN PIPE, 36 IN, H 1-10	LF	62		
550-1480	STORM DRAIN PIPE, 48 IN, H 1-10	LF	24		
550-4218	FLARED END SECTION 18 IN, STORM DRAIN	EA	19		
550-4224	FLARED END SECTION 24 IN, STORM DRAIN	EA	5		
550-4230	FLARED END SECTION 30 IN, STORM DRAIN	EA	4		
550-4236	FLARED END SECTION 36 IN, STORM DRAIN	EA	2		
611-3010	RECONSTR DROP INLET, GROUP 1	EA	8		
611-8000	ADJUST CATCH BASIN TO GRADE	EA	3		
611-8050	ADJUST MANHOLE TO GRADE	EA	2		
617-1060	PERM ANCH SLOPE STAB SYS	LS	1		
634-1200	RIGHT OF WAY MARKERS	EA	6		
643-0050	TEMPORARY FIELD FENCE	LF	125		
643-1152	CH LK FENCE, ZC COAT, 6 FT, 9 GA	LF	4286		
643-8010	GATE, CHAIN LINK ZC COAT -	EA	8		
643-8200	BARRIER FENCE (ORANGE), 4 FT	LF	6713		
668-2100	DROP INLET, GP 1	EA	2		
668-4300	STORM SEWER MANHOLE, TP 1	EA	7		
668-4311	STORM SEWER MANHOLE, TP 1, ADDL DEPTH, CL 1	LF	11		
	TEMPORARY EROSION CONTROL				
163-0232	TEMPORARY GRASSING	AC	20		
163-0240	MULCH	TN	229		
163-0300	CONSTRUCTION EXIT	EA	5		
163-0502	CONSTRUCT AND REMOVE SILT CONTROL GATE, TP 2	EA	6		
163-0503	CONSTRUCT AND REMOVE SILT CONTROL GATE, TP 3	EA	13		
163-0528	CONSTRUCT AND REMOVE FABRIC CHECK DAM - TYPE C SILT FENCE	LF	432		
163-0550	CONSTRUCT AND REMOVE INLET SEDIMENT TRAP	EA	21		
165-0030	MAINTENANCE OF TEMPORARY SILT FENCE, TP C	LF	13659		
165-0041	MAINTENANCE OF CHECK DAMS - ALL TYPES	LF	216		

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
165-0086	MAINTENANCE OF SILT CONTROL GATE, TP 2	EA	6		
165-0087	MAINTENANCE OF SILT CONTROL GATE, TP 3	EA	13		
165-0101	MAINTENANCE OF CONSTRUCTION EXIT	EA	10		
165-0105	MAINTENANCE OF INLET SEDIMENT TRAP	EA	21		
167-1000	WATER QUALITY MONITORING AND SAMPLING	EA	3		
167-1500	WATER QUALITY INSPECTIONS	MO	16		
171-0030	TEMPORARY SILT FENCE, TYPE C	LF	27318		
	PERMANENT EROSION CONTROL				
603-2024	STN DUMPED RIP RAP, TP 1, 24 IN	SY	94		
603-2181	STN DUMPED RIP RAP, TP 3, 18 IN	SY	108		
603-7000	PLASTIC FILTER FABRIC	SY	202		
700-6910	PERMANENT GRASSING	AC	10		
700-7000	AGRICULTURAL LIME	TN	60		
700-8000	FERTILIZER MIXED GRADE	TN	7		
700-8100	FERTILIZER NITROGEN CONTENT	LB	500		
716-2000	EROSION CONTROL MATS, SLOPES	SY	1667		
	SIGNING & MARKING				
611-5551	RESET SIGN	EA	23		
636-1033	HIGHWAY SIGNS, TP 1 MATL, REFL SHEETING, TP 9	SF	374		
636-1036	HIGHWAY SIGNS, TP 1 MATL, REFL SHEETING, TP 11	SF	71		
636-2070	GALV STEEL POSTS, TP 7	LF	1230		
636-2080	GALV STEEL POSTS, TP 8	LF	165		
636-2090	GALV STEEL POSTS, TP 9	LF	32		
636-5020	DELINEATOR, TP 2	EA	40		
652-5452	SOLID TRAFFIC STRIPE, 5 IN, YELLOW	LF	2668		
652-5701	SOLID TRAF STRIPE, 24 IN, WHITE	LF	70		
652-6502	SKIP TRAFFIC STRIPE, 5 IN, YELLOW	GLF	13073		

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
653-0110	THERMOPLASTIC PVMT MARKING, ARROW, TP 1	EA	1		
653-0120	THERMOPLASTIC PVMT MARKING, ARROW, TP 2	EA	5		
653-1501	THERMOPLASTIC SOLID TRAF STRIPE, 5 IN, WHITE	LF	175		
653-1502	THERMOPLASTIC SOLID TRAF STRIPE, 5 IN, YELLOW	LF	404		
653-1704	THERMOPLASTIC SOLID TRAF STRIPE, 24 IN, WHITE	LF	298		
653-1804	THERMOPLASTIC SOLID TRAF STRIPE, 8 IN, WHITE	LF	4299		
653-6004	THERMOPLASTIC TRAF STRIPING, WHITE	SY	26		
653-6006	THERMOPLASTIC TRAF STRIPING, YELLOW	SY	20		
654-1001	RAISED PVMT MARKERS TP 1	EA	11		
654-1003	RAISED PVMT MARKERS TP 3	EA	8		
656-0050	REMOVE EXIST SOLID TRAF STRIPE, 5 IN, THERMOPLASTIC	LF	200		
	SIGNALIZATION				
636-1033	HIGHWAY SIGNS, TP 1 MATL, REFL SHEETING, TP 9	SF	24		
636-1036	HIGHWAY SIGNS, TP 1 MATL, REFL SHEETING, TP 11	SF	40		
636-1041	HIGHWAY SIGNS, TP 2 MATL, REFL SHEETING, TP 9	SF	30		
639-3004	STEEL STRAIN POLE, TP IV , INCL 65FT MAST ARM	EA	1		
647-1000	TRAFFIC SIGNAL INSTALL NO - 1, PED SIGNAL UPGRADE, EISEN AT SALLIE M	LS	1		
647-1000	TRAFFIC SIGNAL INSTALL NO - 1, PED SIGNAL UPGRADE, EISEN AT TRUMAN SB	LS	1		
647-1000	TRAFFIC SIGNAL INSTALL NO - 1, PED SIGNAL UPGRADE, EISEN AT TRUMAN NB	LS	1		
647-1000	TRAFFIC SIGNAL INSTALL NO - 1, PED HYBRID BEACON ON DERENNE	LS	1		
682-6233	CONDUIT, NONMETL, TP 3, 2 IN	LF	240		
682-9950	DIRECTIONAL BORE - 7 IN	LF	90		
926-2075	900 Mhz DIRECTIONAL RADIO ANTENNA AND CONNECTING CABLE	EACH	2		

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
	STRUCTURES				
500-3101	CLASS A CONCRETE	CY	30		
502-1200	BRIDGE TIMBER, TREATED	MBM	120		
511-1000	BAR REINF STEEL	LB	3240		
520-2214	PILING, PSC, 14 IN SQ	LF	340		
520-2500	PILING, TIMBER - TREATED	LF	5800		
520-3214	TEST PILE, PSC, 14 IN SQ	EA	4		
520-4214	LOAD TEST, PSC, 14 IN SQ	EA	2		
534-1000	PEDESTRIAN OVERPASS BRIDGE, STA - BR 1 & 2	LS	2		
603-2024	STN DUMPED RIP RAP, TP 1, 24 IN	SY	200		
603-7000	PLASTIC FILTER FABRIC	SY	200		
	WATER				
611-5590	RELOCATE WATER METER, 1 1/2 IN	EA	1		
611-8050	ADJUST MANHOLE TO GRADE	EA	6		
611-8120	ADJUST WATER METER BOX TO GRADE	EA	1		
611-8140	ADJUST WATER VALVE BOX TO GRADE	EA	6		
660-2330	INSERTION VALVE, 10 IN	EA	2		
670-1100	WATER MAIN, 10 IN	LF	32		
670-1500	CAP OR REMOVE EXISTING WATER MAIN	EA	2		
670-2060	GATE VALVE, 6 IN	EA	3		
670-3066	TAPPING SLEEVE & VALVE ASSEMBLY, 6 IN X 6 IN	EA	2		
670-4000	FIRE HYDRANT	EA	3		
670-5015	WATER SERVICE LINE, 1 1/2 IN	LF	35		
670-9742	RELOCATE EXISTING BACKFLOW PREVENTION ASSEMBLY, 1 1/2IN	EA	1		
670-9920	REMOVE EXISTING FIRE HYDRANT	EA	2		

BID SHEET

Truman Linear Park Ph 2-A
0007631 Revised 6/20/2018, changes shown in BOLD

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	AMOUNT
	LIGHTING				
647-2120	PULL BOX, PB-2	EA	18		
681-1120	LIGHTING STD, ALUM 12 FG MH, POST TOP	EA	7		
681-1150	LIGHTING STD, ALUM, 14 FT MH, POST TOP	EA	90		
681-6268	LUMINAIRE, TP 2, LED, 4000k	EA	90		
682-1404	CABLE, TP XHHW, AWG NO 10	LF	3680		
682-1405	CABLE, TP XHHW, AWG NO 8	LF	6800		
682-1406	CABLE, TP XHHW, AWG NO 6	LF	19200		
682-1407	CABLE, TP XHHW, AWG NO 4	LF	7210		
682-1408	CABLE, TP XHHW, AWG NO 2	LF	22300		
682-6222	CONDUIT, NONMETL, TP 2, 2 IN	LF	9800		
682-6225	CONDUIT, NONMETL, TP 2, 2 1/2 IN	LF	300		
682-9000	MAIN SERVICE PICK UP POINT	LS	3		
682-9022	ELECTRICAL JUNCTION BOX, REINFORCED PLASTIC MORTAR	EA	28		
682-9950	DIRECTIONAL BORE - 3 IN	LF	4440		
936-1000	CCTV SYSTEM - 3 PEDESTRIAN CALL BOXES WITH COVERT CAMERAS	EA	1		
	LANDSCAPING				
222-1002	AGGREGATE DRAINAGE COURSE, TP 2	TN	448		
457-1005	GEOGRID REINFORCEMENT, TP A	SY	862		
702-0675	MYRICA CERIFERA - 30 GAL	EA	102		
				TOTAL CONSTRUCTION COST:	

NAME / TITLE

COMPANY

ADDRESS

PHONE / FAX

E-MAIL

Bridge Foundation Investigation
(BFI # 1)

Truman Liner Park Trail- Phase II
P.I. No. 0007631
CSHPP-0007-00 (631), Chatham County

January 22, 2018
Terracon Project No. ES165111

Prepared for:
McGee Partner, Inc.
Atlanta, Georgia

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

January 22, 2018

McGee Partner, Inc.
13 Corporate Blvd., N.E.
Suite 200
Atlanta, Georgia 30329

Attn: Tommy Crochet
P: (770) 938-6400
E: tcrochet@mcgeepartners.com

Re: Bridge Foundation Investigation (BFI # 1)-Revision 5
Truman Liner Park Trail- Phase II
P.I.No. 0007631
CSHPP-0007-00 (631), Chatham County
Terracon Project No.: ES165111

Dear Mr. Crochet:

Terracon Consultants, Inc. (Terracon) is pleased to submit this report of Bridge Foundation Investigation for the design and construction of the prefabricated bridge over Casey Canal. This report has been prepared in general accordance with the QA / QC Manual by the Geotechnical Engineering Bureau of the Georgia Department of Transportation.

This report has been revised from the previous version dated December 21, 2017 to address the comments made by the Georgia Department of Transportation via. phone conversation.

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.

Biraj Gautam, P.E.
Project Geotechnical Engineer

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

cc: 1 – Client (PDF) 1 – File

Bridge Foundation Investigation (LRFD)
CHSHPP-0007-00(631), Chatham County
PI No. 0007631
January 22, 2018
Revision No. 5

LOCATION (See Map)

Casey Canal near Lake Mayer in Savannah, Chatham County, Georgia.

GENERAL INFORMATION

GEOLOGIC FORMATION

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

SUBSURFACE FEATURES

In general, the subsurface soils predominantly consist of loose to dense clean / silty sands in the upper 42 feet below grade (approx. EL -37), followed by very dense silty sands to the termination of borings at approximately 55 and 60 feet below grade (approx. El. -50 and -56). Groundwater was encountered at approximately 5 to 6 feet below grade (approx. El. -1) at the time of field exploration.

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.

SITE CLASSIFICATION

We recommend a site class of D per AASHTO LRFD 3.10.3.1.

1.0 FOUNDATION RECOMMENDATIONS

Bents	Drilled Shaft	Spread Footing	Pile Footing (Type)	Pile Bent (Type)
Bridge Begin (Sta. 100+53)	--	--	--	PSC
Bridge End (Sta. 101+33)	--	--	--	PSC

1.1 Pile Properties

Pile Type	Pile Size (in)	Nominal Compression Stress (ksi)	Nominal Tension Stress (ksi)		Maximum Factored Structural Resistance (kips)
			Normal Env.	Severe Env.	
PSC	14 x 14	3.214	1.248	-	473

1.2 DESIGN LOADS

Bents	Maximum Factored Foundation Load (kips)	Service Load (kips)
Bridge Begin (Sta. 100+53)	60	40
Bridge End (Sta. 101+33)	60	40

2.0 FOUNDATION LOADS

2.1 PILE FOUNDATION LOADS

Bents	Pile Type	Size (in)	Down Drag (kips)	Scour (kips)	Driving Resistance (kips)*
Bridge Begin (Sta. 100+53)	PSC	14	-	-	93
Bridge End (Sta. 101+33)	PSC	14	-	-	93

3.0 FOUNDATION ELEVATIONS

Bents	Bottom of Spread Footing	Minimum Tip (Elevation)	Estimated Tip (Elevation)
Bridge Begin (Sta. 100+53)	--	-35	-40
Bridge End (Sta. 101+33)	--	-35	-40

5.0 GENERAL NOTES

Elevations The elevations are based on the drawing (Drawing Sheet No. 13-0001) provided by McGee Partners, Inc. Below are the elevations of the existing ground surface at each borehole location.

	B1: 5.0	B2: 4.0
Waiting Period	None required.	
As Built Foundation Information	The as built foundation information should be forwarded to the Geotechnical Engineering Bureau upon completion of the foundation system.	

5.1 PILE FOUNDATION NOTES

PDO

Driving resistance after minimum tip elevations are achieved in conjunction with Special Provision 520 Piling for LRFD and Special Provision 523 Dynamic Pile Testing. Perform one PDA test at Bridge Begin (Sta. 100+53) and Bridge End (Sta. 101+33) bents with a total of two PDA tests. These should be performed before any additional production piles are driven.

*** Nominal Bearing Resistance of Single Pile**

Diving resistance is based on the following field verification method and resistance factor $\emptyset_{dyn}$ AASHTO LRFD 2010 (10.5.5.2.3-1):

Resistance Determination Method	Resistance Factor
Driving criteria established by dynamic testing of at least two piles based on the site conditions, but no less than 2% of the production piles. The pile resistance should be based on PDA restrike test performed at least four days after the initial driving to account for the setup effect.	0.65

Drivability

A drivability analysis has been completed on the above-mentioned piles to their respective estimated tips with APE Model D16-42 Single Acting Diesel Impact Hammer used.

Pre-drilling

The Contractor may choose pre-drilling to assist in the installation of PSC piles through dense soil layers at both end bents as per Special Provision Section 520. If pre-drilling is used, it should be to 3 feet above the minimum tip elevations and may be adjusted by the Engineer during construction:

No separate payment will be made if the Contractor chooses to use pre-drilling. The maximum diameter of the pre-drilled hole should be determined from the following table:

Pile Size - PSC	Maximum Pre-Drill Hole Size - PSC
14“	12“

Test Piles We recommend that PSC test piles be set up at Bridge Begin (Sta. 100+53) and Bridge End (Sta. 101+33) bents (the same locations as the PDA tests) to help determine pile order lengths. The test piles should be of sufficient length to reach a depth of 5 feet below the Estimated Tip Elevation.

Special Problems

i. Erratic pile lengths can be expected.

ii. The contractor should be made aware of the utility and transmission lines near the proposed bridge area.

6.0 QA / QC

Prepared By Biraj Gautam, P.E.

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	Typical Soil Profile and the Proposed Bridge
Exhibit A-6	SPT Boring Logs

Appendix B (Laboratory Testing)

Exhibit B-1 Summary of Laboratory Test Results

(a) Grain Size Analysis Result

(b) Atterberg Limit Test Result

Appendix C (Supporting Document)

Exhibit C-1	Pile Axial Capacity Analysis Results
Exhibit C-2	General Notes
Exhibit C-3	Unified Soil Classification System
Exhibit C-4	Special Provision Section 520- Piling for LRFD
Exhibit C-5	Special Provision Section 523- Dynamic Pile Testing
Exhibit C-6	GRLWEAP Analysis Results

APPENDIX A
FIELD EXPLORATION

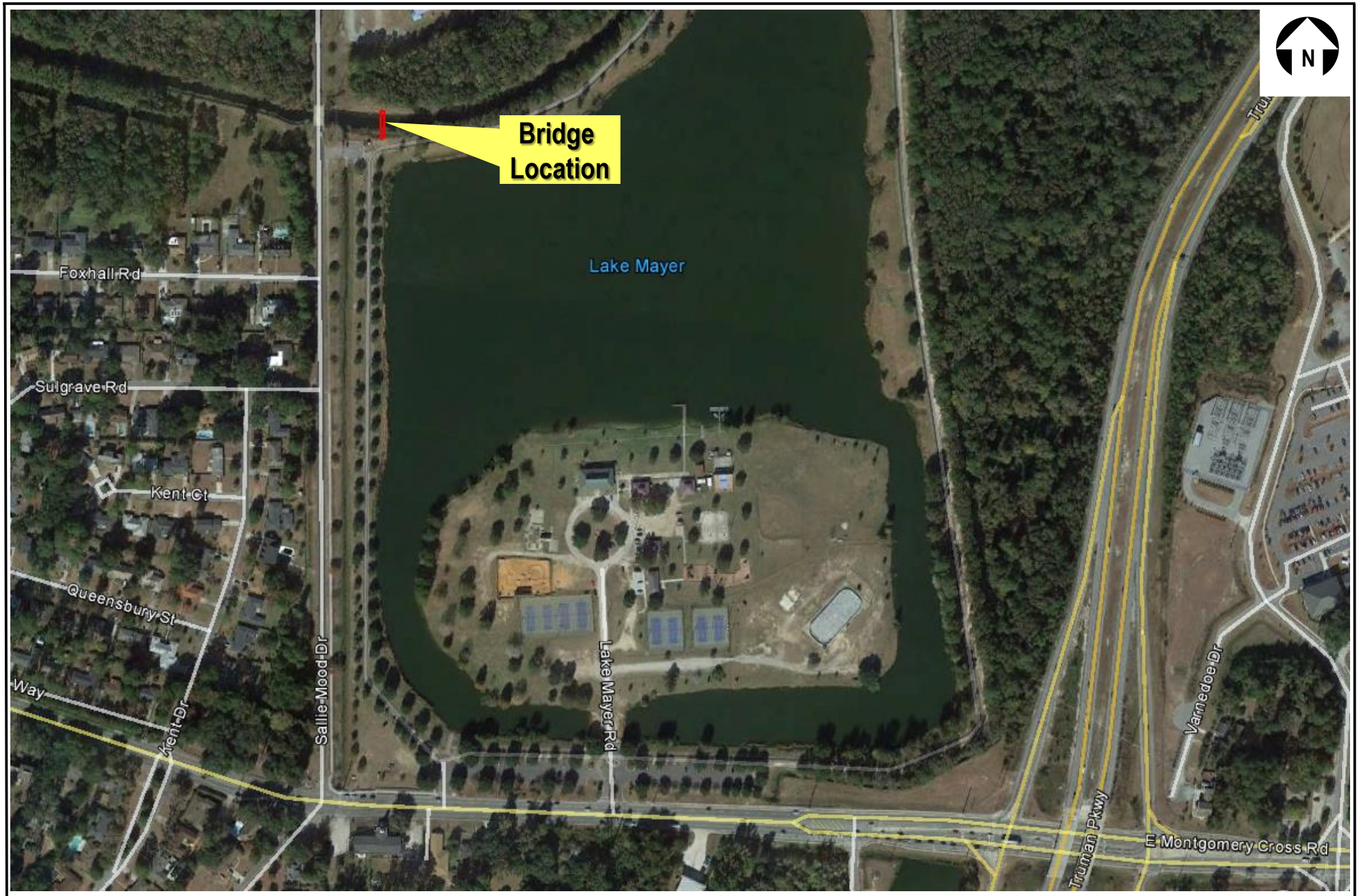


Image Courtesy of
Google Earth™

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

PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

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

SITE LOCATION MAP

Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

Exhibit:

A-1

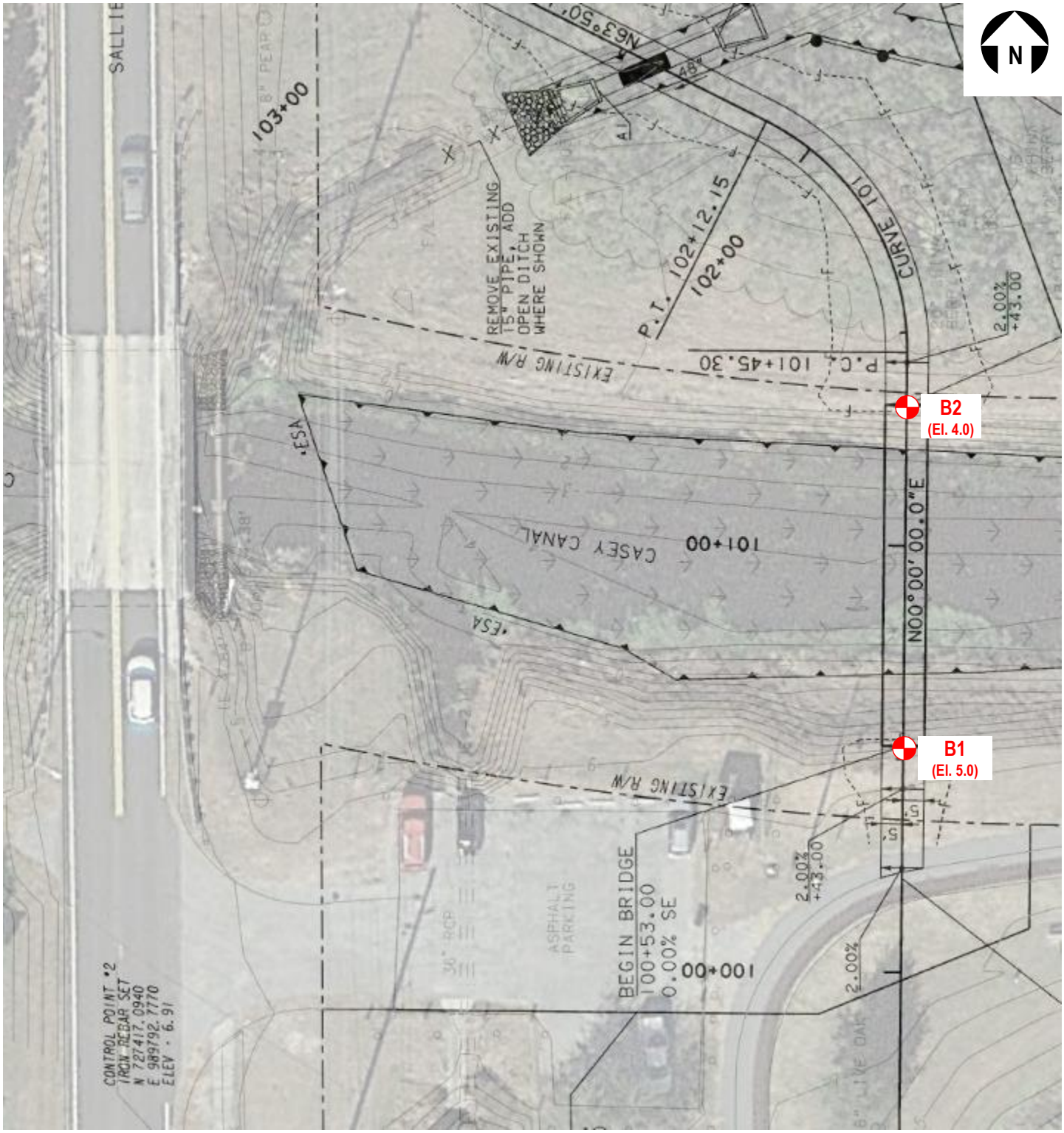


Image Courtesy of
Google Earth™

NOTE:

ALL THE EXPLORATION LOCATIONS WERE LOCATED IN THE FIELD USING A GPS UNIT, AND THE EXPLORATION LOCATIONS SHOULD BE CONSIDERED APPROXIMATE. DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

LEGEND

SPT Boring

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

PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

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

EXPLORATION LOCATION PLAN

Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

Exhibit:
A-2

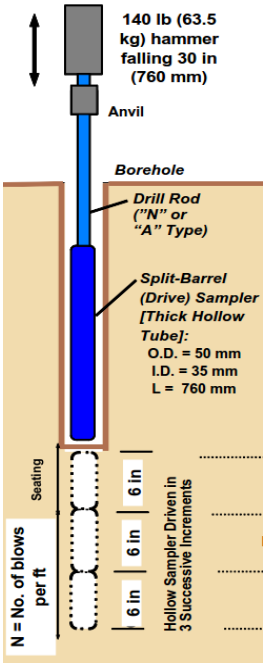
Field Exploration Description

The locations of the SPT borings were determined by Terracon based on the proposed plan and discussed with the civil engineers prior to performing the field exploration. The boring locations were located in the field using a hand-held GPS unit and in reference to the existing features. The locations of the exploration points are shown in the Exploration Location Plan and should be considered approximate.

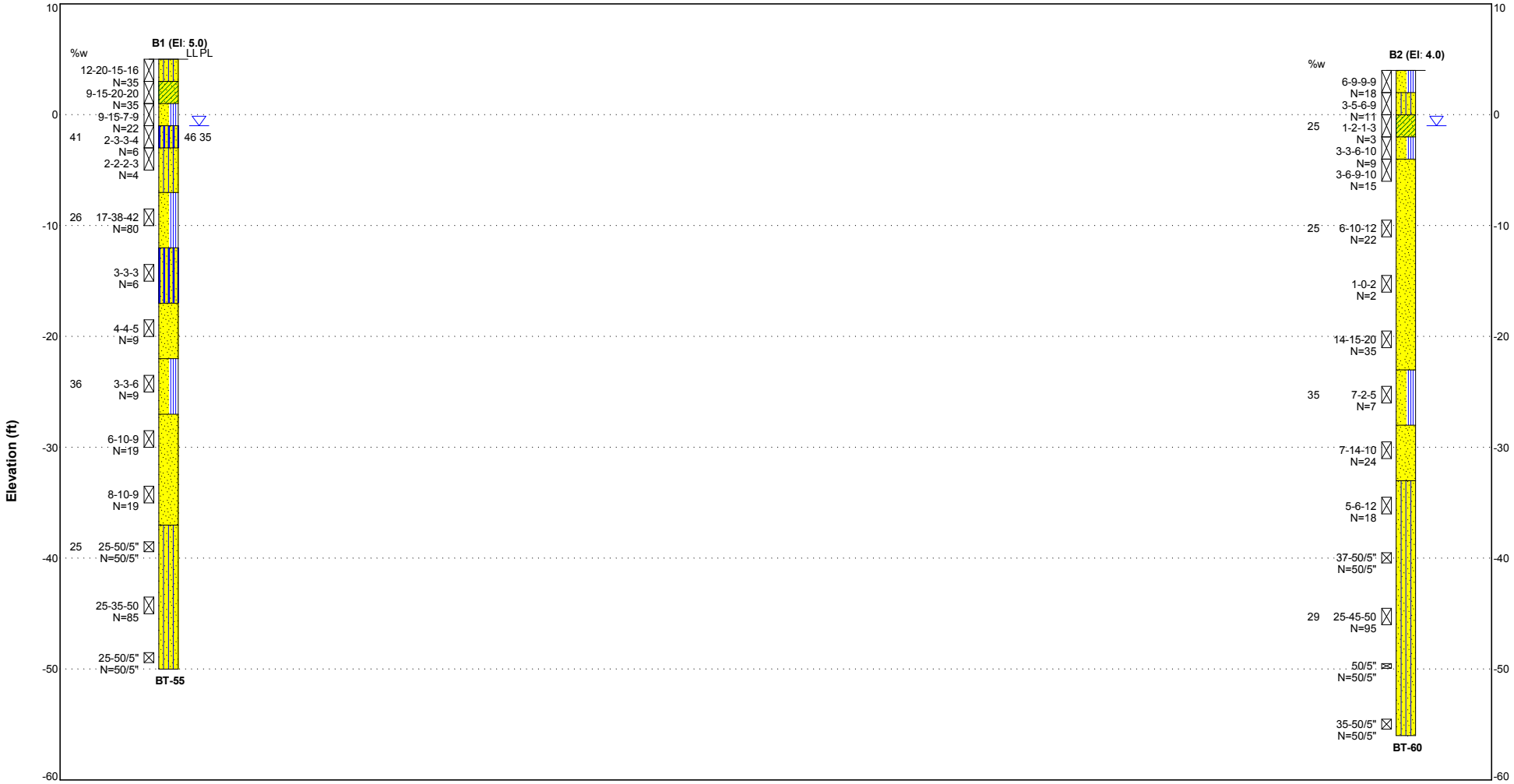
Standard Penetration Testing

The SPT borings were performed in accordance with ASTM D 1586 with a track-mounted drilling rig using hollow stem auger methods. 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.

Upon completion, the data collected were analyzed and processed by the project engineer.



Source: FHWA NHI-06-088



Explanation

B1 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling — Borehole Lithology
AR / BT — Borehole Termination Type
Water Level Reading at time of drilling.
Water Level Reading after drilling.

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

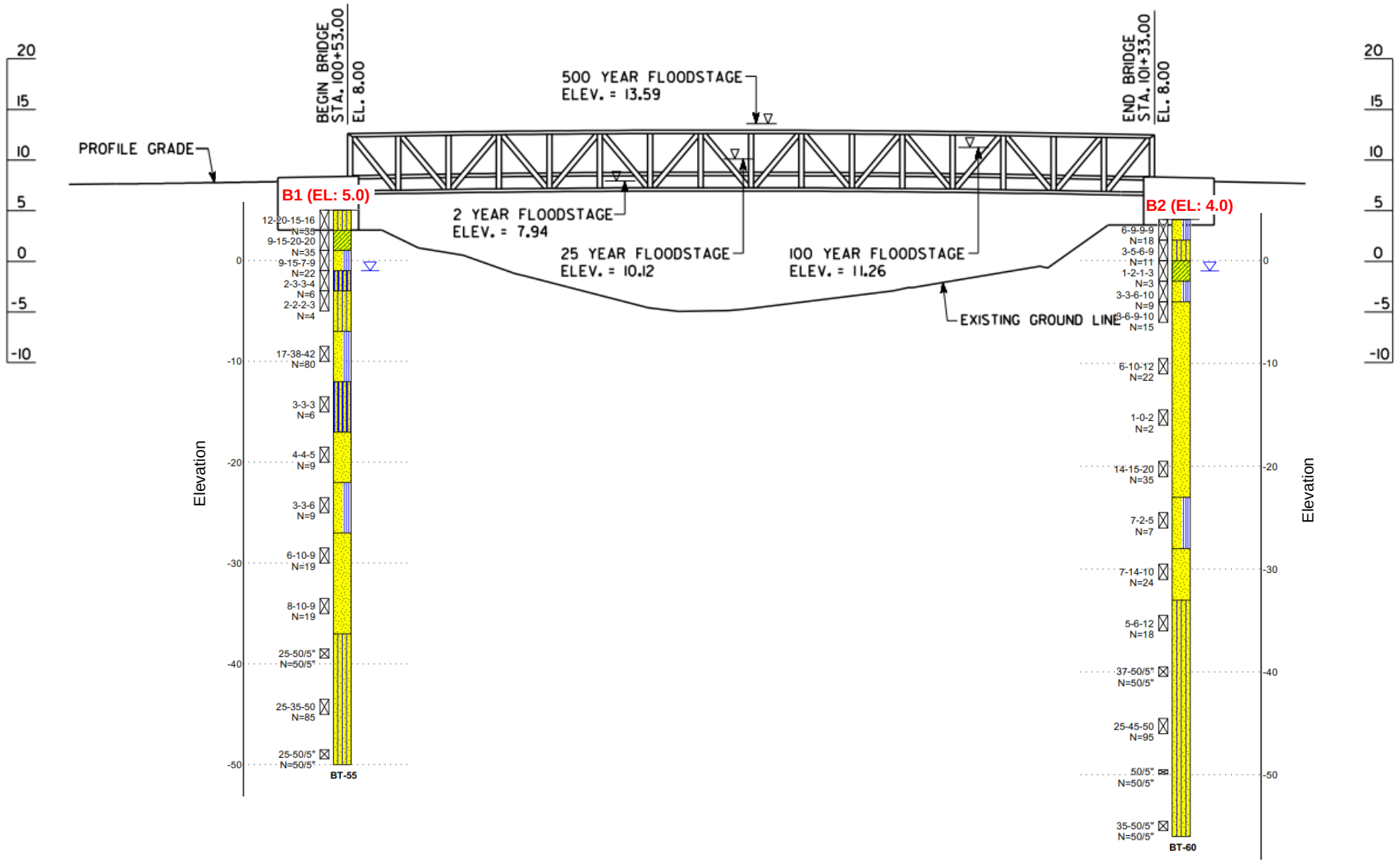
Project Manager: BG	PI No.: 0007631
Drawn by: BG	Scale: N.T.S.
Approved by: GL	File Name: ES165111
Date: 12/6/2016	

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

SUBSURFACE PROFILE

Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

EXHIBIT
A-4



Project Manager: BG	PI No. 0007631	Terracon Consulting Engineers & Scientists	SOIL PROFILE AND THE PROPOSED BRIDGE	Exhibit:
Drawn by: BG	Scale: N.T.S.	2201 Rowland Avenue Savannah, Georgia 31404	Truman Liner Park Trail- Phase II	A-5
Checked by: GL	File Name: ES165111	Phone (912) 629 4000 Fax (912) 629 4001	BFI # 1- Near Lake Mayer	
Approved by: GL	Date: 12/6/2016		Savannah, Chatham County, Georgia	

BORING LOG NO. B1

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 31.9957° Longitude: -81.0899°

Surface Elev.: 5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
2.0	3				12-20-15-16 N=35			
					9-15-20-20 N=35			
4.0	1							
		5	▽		9-15-7-9 N=22			
6.0	-1							
					2-3-3-4 N=6		41	46-35-11
8.0	-3							
					2-2-2-3 N=4			
12.0	-7	10						
					17-38-42 N=80	10.1	26	
17.0	-12	15						
					3-3-3 N=6			
22.0	-17	20						
					4-4-5 N=9			
27.0	-22	25						
					3-3-6 N=9	10.9	36	
32.0	-27	30						
					6-10-9 N=19			
		35						
					8-10-9 N=19			
		40						

SILTY SAND (SM), fine grained, brown, dense

SANDY LEAN CLAY (CL), dark brown, hard

POORLY GRADED SAND WITH CLAY (SP-SM), fine grained, brown, medium dense

SANDY SILT (ML), dark brown, medium stiff

SILTY SAND (SM), fine grained, dark brown, loose

POORLY GRADED SAND WITH CLAY (SP-SM), fine grained, dark gray, very dense

SANDY SILT (ML), gray, medium stiff

POORLY GRADED SAND (SP), fine to coarse grained, gray, loose

POORLY GRADED SAND WITH SILT (SP-SM), fine grained, dark gray, loose

POORLY GRADED SAND (SP), fine grained, gray, medium dense

fine grained, gray, medium dense

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon

2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/29/2016 Boring Completed: 7/29/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-1

BORING LOG NO. B1

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 31.9957° Longitude: -81.0899°

Surface Elev.: 5 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		POORLY GRADED SAND (SP), fine grained, gray, medium dense *(continued)*							
	42.0	-37							
		SILTY SAND (SM), fine grained, gray, very dense							
			45			25-50/5" N=50/5"	13.0	25	
		fine grained, dark gray, very dense	50			25-35-50 N=85			
		very dense, No recovery				25-50/5" N=50/5"			
	55.0	-50	55						
		Boring Terminated at 55 Feet	60						
			65						
			70						
			75						
			80						

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon
2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/29/2016 Boring Completed: 7/29/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-1

BORING LOG NO. B2

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 31.996° Longitude: -81.0899°

Surface Elev.: 4 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
2.0	2	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, brown, medium dense			6-9-9-9 N=18			
4.0	0	**SILTY SAND (SM)**, fine grained, dark brown, medium dense			3-5-6-9 N=11			
6.0	-2	**SANDY LEAN CLAY (CL)**, dark brown, soft	5		1-2-1-3 N=3		25	
8.0	-4	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, dark gray, loose			3-3-6-10 N=9			
		POORLY GRADED SAND (SP), fine grained, gray, medium dense			3-6-9-10 N=15			
			10					
		fine grained, gray, medium dense			6-10-12 N=22	4.7	25	
			15					
		fine grained, gray, very loose			1-0-2 N=2			
			20					
		fine grained, gray, dense			14-15-20 N=35			
27.0	-23		25					
		POORLY GRADED SAND WITH SILT (SP-SM), fine grained, dark gray, loose			7-2-5 N=7	10.2	35	
32.0	-28		30					
		POORLY GRADED SAND (SP), fine grained, gray, medium dense			7-14-10 N=24			
37.0	-33		35					
		SILTY SAND (SM), fine grained, dark gray, medium dense			5-6-12 N=18			
			40					

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon

2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/28/2016 Boring Completed: 7/28/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-2

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE SPT.GPJ TERRACON2012.GDT 11/30/16

BORING LOG NO. B2

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 31.996° Longitude: -81.0899°

Surface Elev.: 4 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		SILTY SAND (SM), fine grained, dark gray, medium dense *(continued)*							
		fine grained, dark gray, very dense	45			37-50/5" N=50/5"			
		fine grained, dark gray, very dense	50			25-45-50 N=95	24.5	29	
		very dense, No recovery	55			50/5" N=50/5"			
	60.0	very dense, No recovery -56				35-50/5" N=50/5"			
		Boring Terminated at 60 Feet	60						
			65						
			70						
			75						
			80						

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon

2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/28/2016 Boring Completed: 7/28/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-2

APPENDIX B
LABORATORY TESTING

Exhibit B-1 Summary of Laboratory Test Results

(a) Atterberg Limit Test Result

(b) Grain Size Analysis Result

Terracon Project Name: Truman Liner Park Trail-Phase II

Terracon Project No.: ES165111

Project Location: Savannah, Chatham County, Georgia

PI No.: 0007631

Summary of Soil Laboratory Test

Borehole	Sample Depth (ft)	Elevation (ft)	Material Description	USCS	Natural Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Cu	Cc	D90 (mm)	D60 (mm)	D30 (mm)	% Gravel	%Sand	%Fine
B1	6 to 8	-1 to -3	Sandy silt	ML	41.3	46	35	11	--	--	--	--	--	--	--	--
	13.5 to 15	-8.5 to -10	Fine sand with silt	SP-SM	26.4	--	--	--	2.11	0.87	0.230	0.158	0.102	0.0	89.9	10.1
	28.5 to 30	-23.5 to -25	Fine sand with silt	SP-SM	35.8	--	--	--	2.43	0.81	0.600	0.179	0.103	0.8	88.2	10.9
	43.5 to 45	-38.5 to -40	Silty sand	SM	25.3	--	--	--	--	--	0.130	0.112	0.087	0.0	86.9	13.0
B2	4 to 6	0 to -2	Sandy clay	CL	25.3	--	--	--	--	--	--	--	--	--	--	--
	13.5 to 15	-9.5 to -11	Poorly graded sand	SP	24.8	--	--	--	2.11	0.96	0.240	0.173	0.117	0.0	95.2	4.7
	28.5 to 30	-24.5 to -26	Fine sand with silt	SP-SM	34.7	--	--	--	2.26	0.86	0.550	0.169	0.104	0.0	86.4	10.2
	48.5 to 50	-44.5 to -46	Silty sand	SM	29.2	--	--	--	--	--	0.130	0.105	0.079	0.0	75.2	24.5

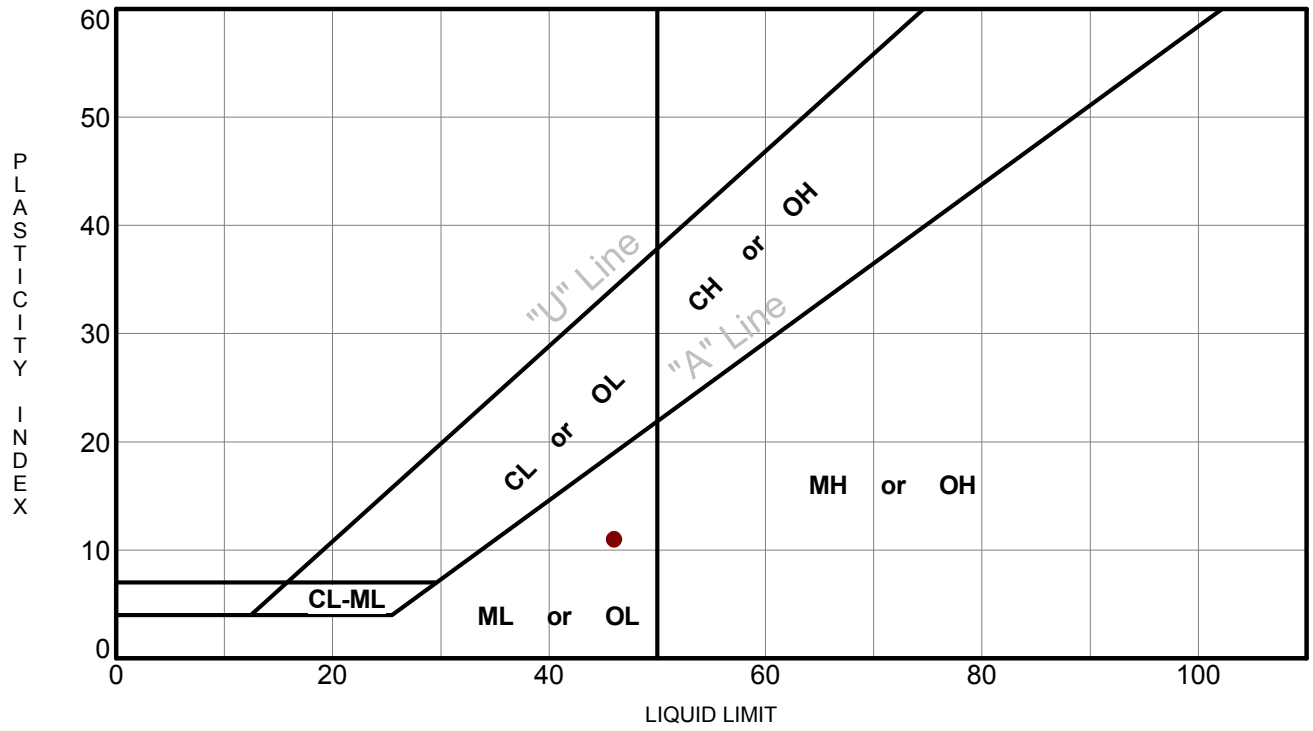
Note: Following surface elevations are based on the drawing (Drawing Sheet No. 13-0001) provided by McGee Partners, Inc.

B1: 5

B2: 4

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth (ft)	LL	PL	PI	Fines	USCS	Description
●	**B1**	**6.0 - 8.0**	**46**	**35**	**11**		**ML**	**Sandy silt**

PROJECT: Truman Liner Park Trail-Phase II

SITE: Savannah, Chatham County, Georgia

Terracon
2201 Rowland Avenue
Savannah, Georgia

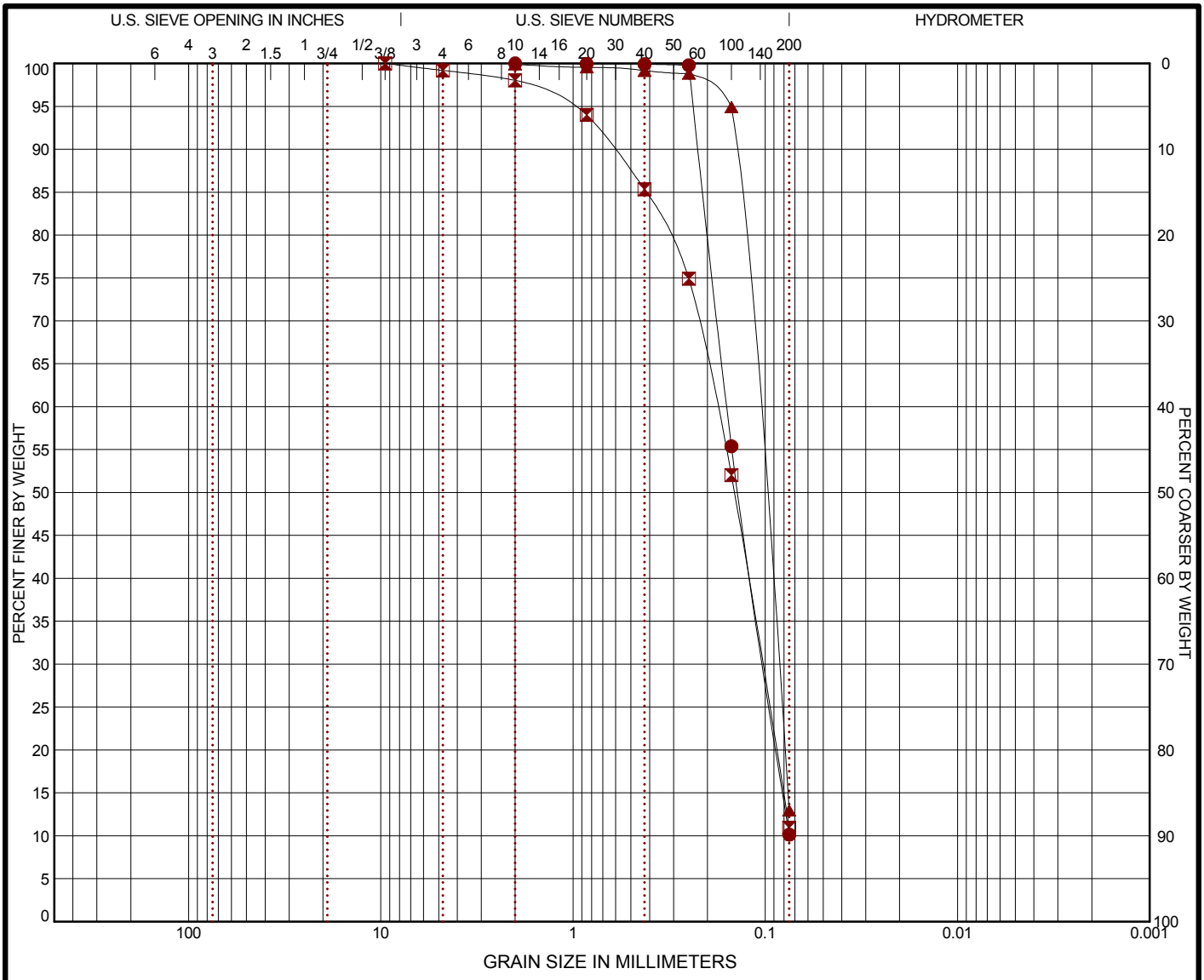
PROJECT NUMBER: ES165111

CLIENT: McGee Partner, Inc.
Atlanta, Georgia

EXHIBIT: B-1

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B1**	**13.5 - 15**	**0.0**	**0.0**	**89.9**		**10.1**		**SP-SM**
⊠	**B1**	**28.5 - 30**	**0.0**	**0.8**	**88.2**		**10.9**		**SP-SM**
▲	**B1**	**43.5 - 44.5**			**86.9**		**13.0**		**SM**

	GRAIN SIZE		
	●	⊠	▲
D_{60}	**0.158**	**0.179**	**0.112**
D_{30}	**0.102**	**0.103**	**0.087**
D_{10}			
	COEFFICIENTS		
C_C	**0.87**	**0.81**	
C_U	**2.11**	**2.43**	

SIEVE (size)	PERCENT FINER ●	PERCENT FINER ⊠	PERCENT FINER ▲
1 1/2"			
1"			
3/4"			
1/2"			
3/8"		100.0	
#4		99.18	
#10	100.0	98.02	99.9
#20	99.95	93.99	99.55
#40	99.91	85.35	99.14
#60	99.79	74.91	98.81
#100	55.39	52.02	94.92
#200	10.13	10.95	12.97

SOIL DESCRIPTION
- ● Fine sand with silt
- ⊠ Fine sand with silt
- ▲ Silty sand

REMARKS
- ●
- ⊠
- ▲

PROJECT: Truman Liner Park Trail-Phase II

SITE: Savannah, Chatham County, Georgia

Terracon
2201 Rowland Avenue
Savannah, Georgia

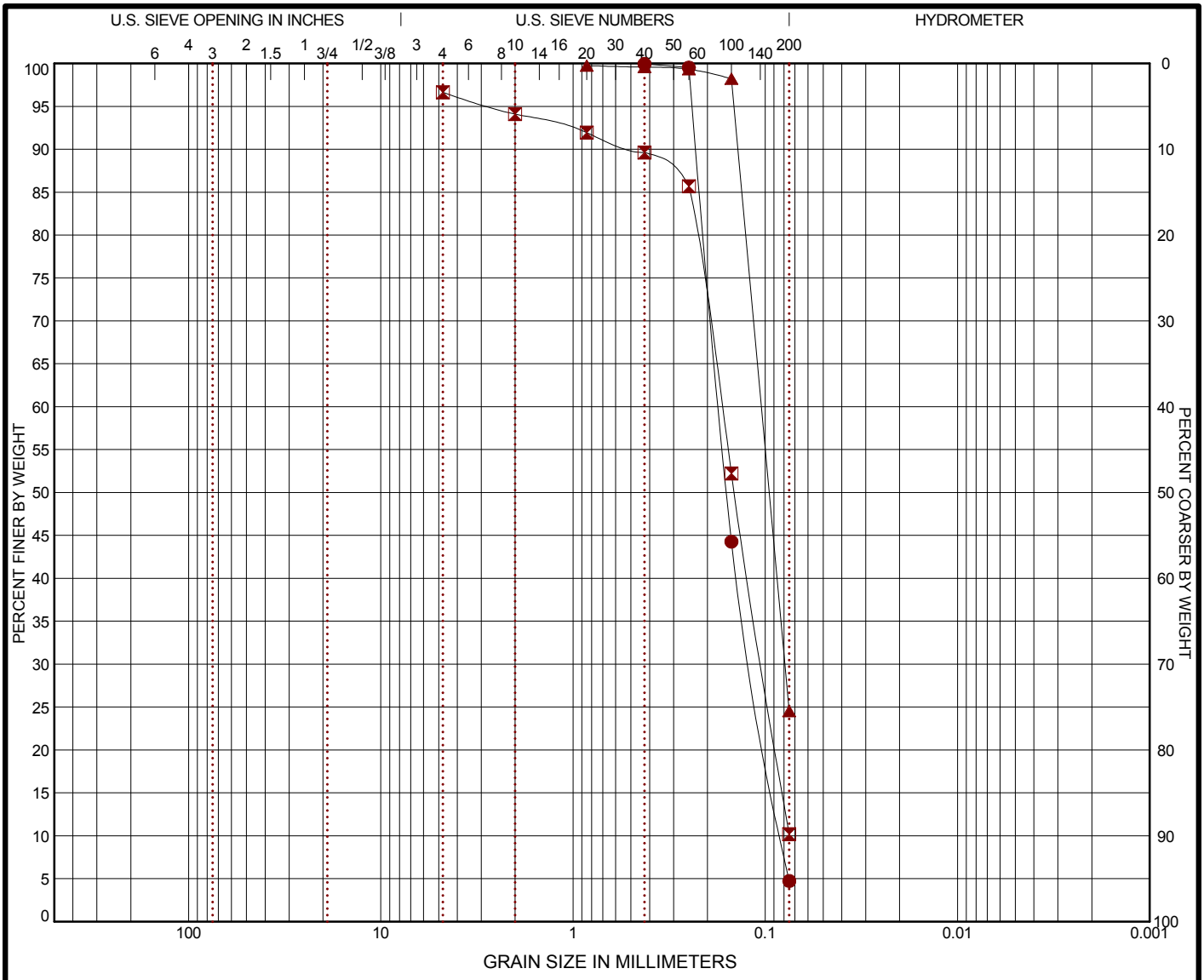
PROJECT NUMBER: ES165111

CLIENT: McGee Partner, Inc.
Atlanta, Georgia

EXHIBIT: B-1

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B2**	**13.5 - 15**			**95.2**		**4.7**		**SP**
⊠	**B2**	**28.5 - 30**			**86.4**		**10.2**		**SP-SM**
▲	**B2**	**48.5 - 50**			**75.2**		**24.5**		**SM**

	GRAIN SIZE		
	●	⊠	▲
D_{60}	**0.173**	**0.169**	**0.105**
D_{30}	**0.117**	**0.104**	**0.079**
D_{10}	**0.082**		
	COEFFICIENTS		
C_C	**0.96**	**0.86**	
C_U	**2.11**	**2.26**	

SIEVE (size)	PERCENT FINER		
	●	⊠	▲
1 1/2"			
1"			
3/4"			
1/2"			
3/8"			
#4		**96.63**	
#10		**94.09**	
#20		**91.92**	**99.74**
#40	**99.94**	**89.62**	**99.57**
#60	**99.52**	**85.7**	**99.32**
#100	**44.28**	**52.22**	**98.22**
#200	**4.74**	**10.19**	**24.54**

SOIL DESCRIPTION
- ● Poorly graded sand
- ⊠ Fine sand with silt
- ▲ Silty sand

REMARKS
- ●
- ⊠
- ▲

PROJECT: Truman Liner Park Trail-Phase II

SITE: Savannah, Chatham County, Georgia

Terracon
2201 Rowland Avenue
Savannah, Georgia

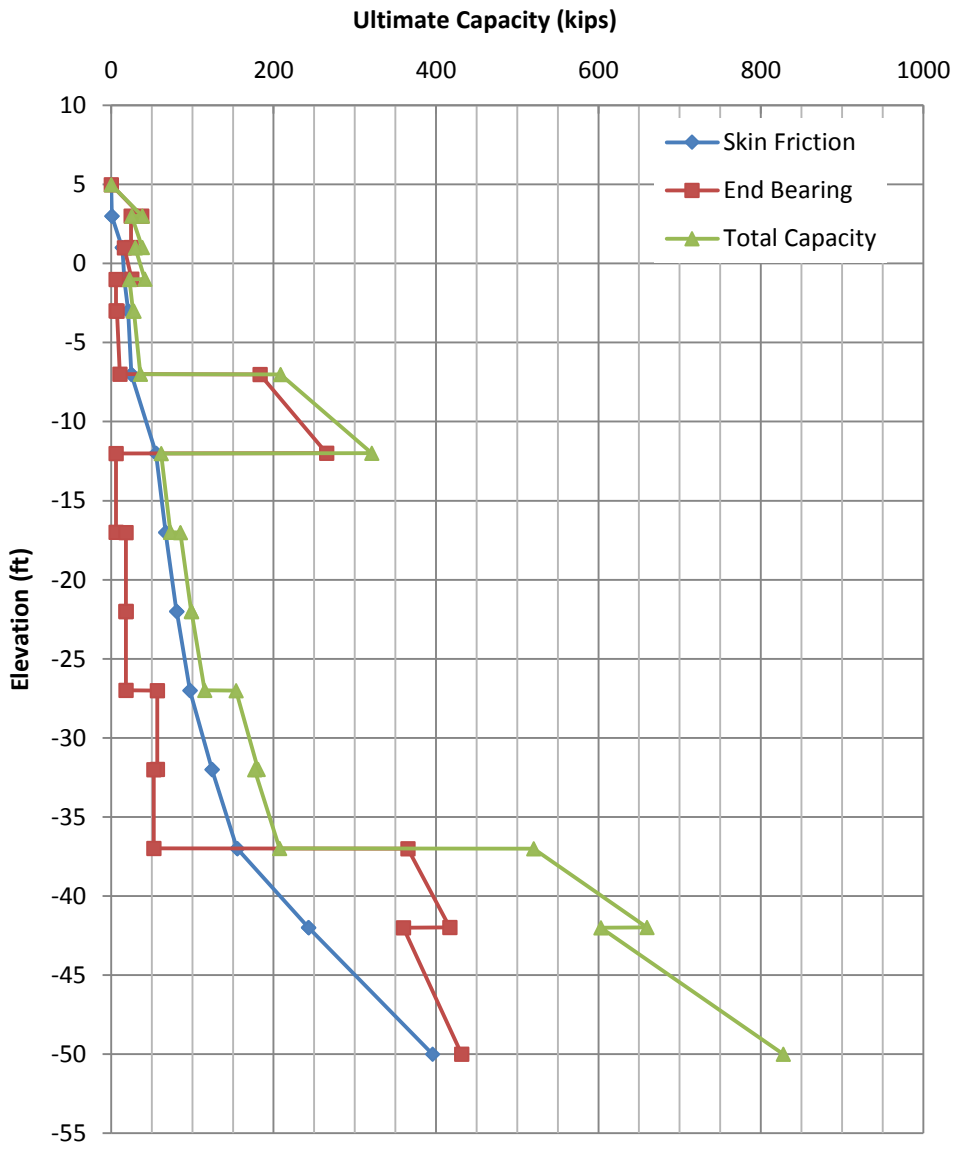
PROJECT NUMBER: ES165111

CLIENT: McGee Partner, Inc.
Atlanta, Georgia

EXHIBIT: B-1

APPENDIX C
SUPPORTING DOCUMENT

Exhibit C-1 Pile Axial Capacity Analyses
Exhibit C-2 General Notes
Exhibit C-3 Unified Soil Classification System
Exhibit C-4 Special Provision Section 520- Piling
Exhibit C-5 Special Provision Section 520- Piling for LRFD
Exhibit C-6 Special Provision Section 523- Dynamic Pile Testing
Exhibit C-7 GRLWEAP Analysis Results



DRIVEN Software Output

Depth (ft)	Elevation (ft)	Skin Friction (kips)	End Bearing (kips)	Total Capacity (kips)
0.01	4.99	0.00	0.19	0.2
1.99	3.01	0.89	37.55	38.4
2.01	2.99	0.96	24.50	25.5
3.99	1.01	13.62	24.50	38.1
4.01	0.99	13.69	16.02	29.7
5.99	-0.99	16.20	25.12	41.3
6.01	-1.01	16.24	6.12	22.4
7.99	-2.99	20.86	6.12	27.0
8.01	-3.01	20.89	7.32	28.2
11.99	-6.99	24.97	10.87	35.8
12.01	-7.01	25.03	183.39	208.4
16.99	-11.99	55.29	265.35	320.6
17.01	-12.01	55.39	6.12	61.5
21.99	-16.99	67.01	6.12	73.1
22.01	-17.01	67.05	18.13	85.2
26.99	-21.99	80.61	18.13	98.7
27.01	-22.01	80.67	18.13	98.8
31.99	-26.99	96.94	18.13	115.1
32.01	-27.01	97.03	56.81	153.8
36.99	-31.99	124.08	56.81	180.9
37.01	-32.01	124.19	52.35	176.54
41.99	-36.99	154.99	52.35	207.34
42.01	-37.01	155.22	365.15	520.37
46.99	-41.99	242.7	417.02	659.72
47.01	-42.01	243.06	359.94	603.00
54.99	-49.99	395.8	431.64	827.44

- PSC 14 inch
- Begin Bridge (Sta. 100+53)

Project Manager:	BG
Drawn by:	BG
Checked by:	GL
Approved by:	GL
PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

Terracon
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2201 Rowland Avenue Savannah, Georgia 31404
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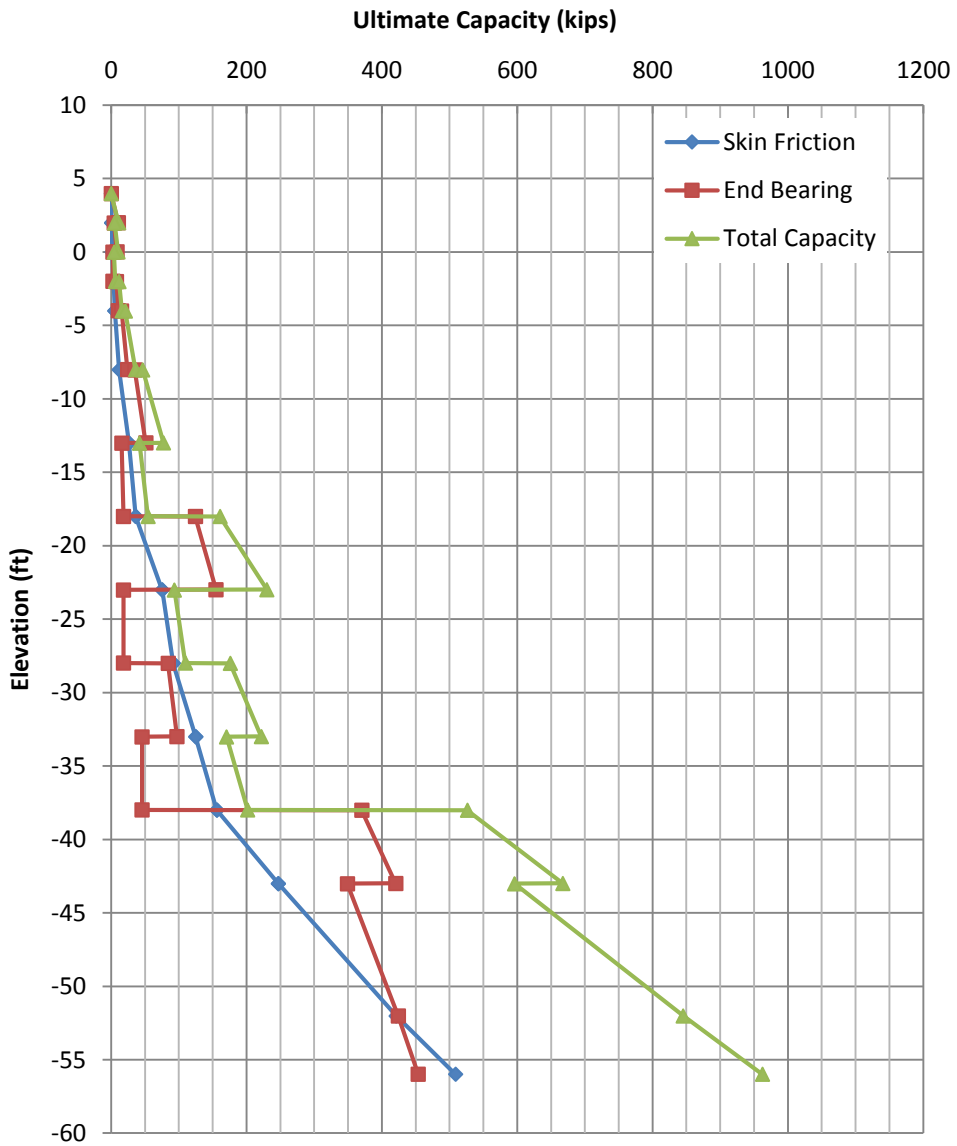
Pile Axial Capacity Analyses

Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

Exhibit
C-1-1



DRIVEN Software Output

Depth (ft)	Elevation (ft)	Skin Friction (kips)	End Bearing (kips)	Total Capacity (kips)
0.01	3.99	0.00	0.05	0.1
1.99	2.01	0.61	10.26	10.9
2.01	1.99	0.62	4.21	4.8
3.99	0.01	1.65	8.36	10.0
4.01	-0.01	1.67	2.45	4.1
5.99	-1.99	3.75	2.45	6.2
6.01	-2.01	3.77	7.75	11.5
7.99	-3.99	5.42	10.57	16.0
8.01	-4.01	5.44	15.21	20.7
11.99	-7.99	11.72	24.12	35.8
12.01	-8.01	11.76	34.85	46.6
16.99	-12.99	26.22	50.92	77.1
17.01	-13.01	26.27	15.43	41.7
21.99	-17.99	36.19	18.13	54.3
22.01	-18.01	36.28	124.40	160.7
26.99	-22.99	75.19	154.83	230.0
27.01	-23.01	75.30	18.13	93.4
31.99	-27.99	91.54	18.13	109.7
32.01	-28.01	91.64	84.11	175.8
36.99	-32.99	124.67	97.07	221.7
37.01	-33.01	124.80	45.58	170.38
41.99	-37.99	155.92	45.58	201.5
42.01	-38.01	156.16	370.18	526.34
46.99	-42.99	246.69	420.36	667.05
47.01	-43.01	247.06	348.93	595.99
56.01	-52.01	420.94	424.17	845.11
59.99	-55.99	508.63	453.61	962.24

- PSC 14 inch
- End Bridge (Sta. 101+33)

Project Manager:	BG
Drawn by:	BG
Checked by:	GL
Approved by:	GL
PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

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Pile Axial Capacity Analyses

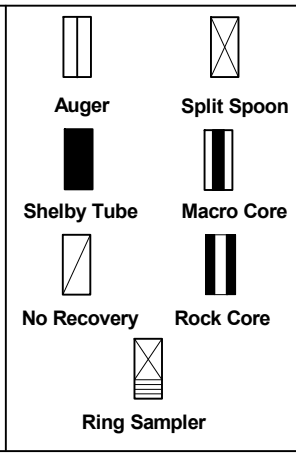
Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

Exhibit
C-1-2

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

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 More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		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 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ 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 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / 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.

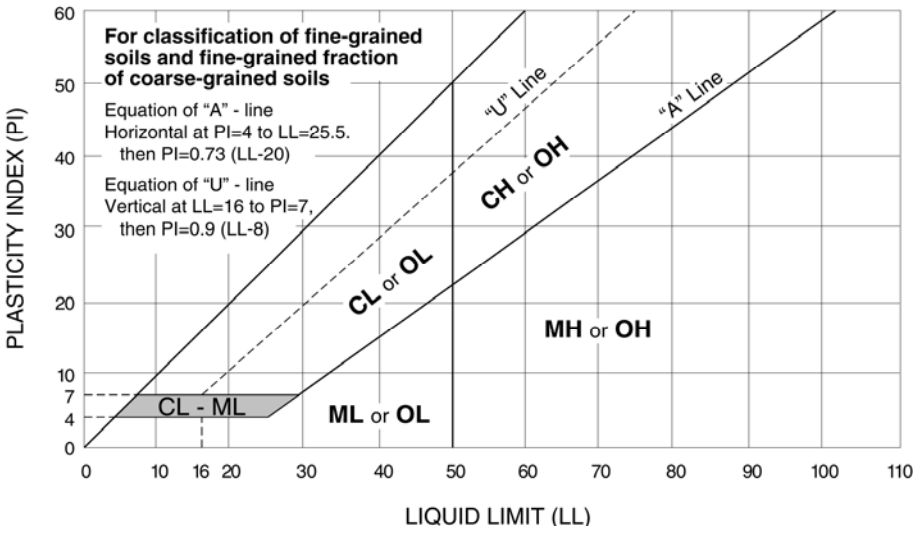
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



Terracon

Exhibit C-3

Revised: November 15, 2003

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

CSHPP-0007-00 (631) , Chatham County
P.I. NO. 0007631

SECTION 520—PILING

Add the following to Subsection 520.3.05.G:

At the Contractor's option, predrilling may be used to loosen dense soil layers to assist in the installation of piling in lieu of spudding or jetting. To predrill, drill an auger into the ground to the required elevation at the pile location. It is not necessary to remove all material or to provide casing. Use one of the following maximum auger diameters corresponding to the pile size:

PSC Pile Size	**Maximum Pre-drill Auger Size**
14" (350 mm)	12" (300 mm)
16" (400 mm)	18" (450 mm)
18" (450 mm)	18" (450 mm)
20" (500 mm)	24" (600 mm)
24" (600 mm)	24" (600 mm)
30" (750 mm)	30" (750 mm)
36" (900 mm)	36" (900 mm)

Metal Pile Size	**Maximum Pre-drill Auger Size**
14" (350 mm)	12" (300 mm)
16" (400 mm)	12" (300 mm)
18" (450 mm)	12" (300 mm)

There will not be any separate payment made for predrilling.

Office of Materials and Testing

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

CSHPP-0007-00 (631) , Chatham County
P.I. NO. 0007631

SECTION 520—PILING

Delete Sub-Section 520.3.05.D.1 and substitute the following:

520.3.05.D.1. Determine Driving Resistance
Drive piles in one continuous operation. Determine the driving resistance of the piling based on the method specified in the plans, which will be one of the following methods (a – c):

a. Upon completion of the dynamic pile testing in accordance with Special Provision Section 523. The pile bearing will be determined by computing the penetration per blow with less than ¼-inch (6-mm) rebound averaged through 12 inches (305 mm) each of penetration. When it is considered necessary by the Engineer, the average penetration per blow may be determined by averaging the penetration per blow through the last 10 to 20 blows of the hammer. In soft material the driving resistance may be determined, at the Engineer's discretion, after delaying driving operations and performing pile re-strikes.

b. Upon completion of the loading test in accordance with Sub-Section 520.3.05.D.2.

c. Shall not be used when driving pile to hard rock. Using FHWA-modified Gates Formula as provided below:

$R_{ndr} = 1.75\ (E_d)^{0.5} \log_{10}(10N_b) - 100$	(kips)	U.S units
$R_{ndr} = 7\ (E_d)^{0.5} \log_{10}(10N_b) - 550$	(kN)	S.I. units

Where:

R_{ndr} = nominal pile driving resistance measured during pile driving

E_d = developed hammer energy. This is the kinetic energy in the ram at impact for a given blow. If ram velocity is not measured, it may be assumed equal to the potential energy of the ram at the height of the stroke, taken as the ram weight times the actual stroke (ft-lb for U.S units, kN-m for S.I. units)

N_b = Number of hammer blows for 1.0 inch of pile permanent set (blows/in)

These resistance formulas apply only when:

- The hammer has a free fall.
- The head of the pile is not broomed, crushed, spalled, or excessively crimped.
- The penetration rate is reasonably uniform.

Determining driving resistance by formula is not a Pay Item. Provide the facilities for determining driving resistance by formula as an incidental part of the work.

Once the driving resistance has been determined by one of the methods noted above, do not continue to drive piles if the Engineer determines that the piles have reached practical refusal. Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than ¼-inch (6-mm) rebound per blow. The Engineer will generally make this determination within 2 inches (51 mm) of driving. However, the Engineer will not approve the continuation of driving at practical refusal for more than 12 inches (305 mm). When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting, spudding, predrilling or other methods approved by the Engineer.

d. Wave Equation: Use the Wave Equation Analysis for Piles (WEAP) program to evaluate the suitability of the proposed driving system chosen from the methods noted above (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance to achieve the pile bearing requirements and to evaluate pile driving stresses. Use the WEAP program to show that the hammer is capable of driving to a driving resistance equal 130% (1.3 times) the driving resistance shown in the Plans without overstressing the piling in compression or tension and without reaching practical refusal.

Perform the WEAP analysis with personnel who are experienced in this type work, and have performed this analysis on a minimum of 15 projects. Provide a list of the qualifications and experience of the personnel to perform the WEAP analysis for this Project.

The Engineer may modify the scour resistance shown in the plans if the dynamic pile test is used to determine the actual soil resistance through the scour zone. Also, the Engineer may make modifications in scour resistance when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

A minimum of two weeks prior to beginning any pile driving operations, submit to the Engineer for evaluation and approval the following information on all of the proposed pile driving system(s) to be used on the Project including but not limited to:

i. Items on Pile Driving Equipment Data Sheet
ii. Other information on the driving system required by the Engineer
iii. A WEAP program output indicating the approximate depth or elevation where the pile will achieve the bearing required
iv. Valid Driving Criteria.

Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile.

If WEAP analyses show that the hammer(s) will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. Resubmit the modified pile driving system information and WEAP program output to the Engineer for re-evaluation. Do not begin pile driving operations until the Engineer has approved the qualifications of the personnel, the WEAP program output, and the pile driving system(s).

Approval of the pile driving system(s) is also based on satisfactory field trials with dynamic pile testing. Obtain approval from the Engineer for the pile driving system(s) based on satisfactory field performance.

If piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided that the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

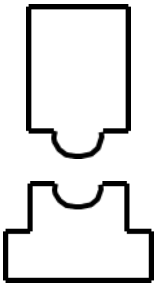
For penetration of weak soils by concrete piles, use thick cushions and/or reduced stroke to control tension stresses during driving.

Revised: February 15, 2016

Pile Driving Data Form

Contract ID:
PI Number:
County

Structure Name:
Structure No.:
Pile Driving Contractor:



Hammer

Manufacturer: _____ Model No. _____
Hammer Type: _____ Serial No. _____
Manufacturers Maximum Rated Energy: _____(ft-k)
Stroke at Maximum Rated Energy: _____(ft)
Range in Operating Energy: _____ to _____(ft-k)
Range in Operating Stroke: _____ to _____(ft)
Ram Weight: _____ (kips)
Modifications: _____

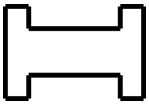
Striker Plate

Weight: _____(kips) Diameter: _____(in)
Thickness: _____(in)

Hammer Cushion

Material 1	Material 2
Name: _____	Name: _____
Area: _____(in^2)	Area: (in^2)
Thickness/Plate: _____(in)	Thickness/Plate:_____(in)
No. of Plates: _____	No. of Plates: _____

Total Thickness of Hammer Cushion: _____(in)

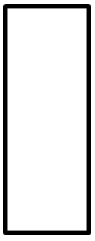


Helmet

Weight including inserts: _____(kips)

Pile Cushion

Material: _____
Area: _____(in^2) Thickness/Sheet: _____(in)
No. of Sheets: _____
Total Thickness of Pile Cushion: _____(in)



Pile

Pile Type: _____
Wall Thickness: _____(in) Taper: _____
Cross Sectional Area: ___(in^2) Weight/Meter: _____
Ordered Length: _____(ft)
Driving Resistance: _____(kips)
Description of Splice: _____
Driving Shoe/Closure Plate Description: _____

Submitted By: _____ Date: _____

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

CSHPP-0007-00 (631) , Chatham County
P.I. NO. 0007631

SECTION 523 - DYNAMIC PILE TESTING

523.1 General Description

The work consists of performing dynamic pile testing using the Pile Driving Analyzer (PDA) to monitor the driving of piles with accelerometer and strain gauges attached to the piles. Piles to be dynamically tested will be identified in the Special Provision or on the Plans. Prior to pile driving, the Engineer will determine production or test piles to be dynamically tested. Perform the dynamic pile testing in accordance with ASTM D4945-12.

Take dynamic measurements during driving of any required piles. Drive the pile as shown in the Special Provisions or on the Plans.

523.2 Materials

Furnish measuring instruments for dynamic pile testing. Attach instruments near the top of the piles with bolts placed in drilled holes. Furnish materials, labor and equipment necessary for installation of the instruments.

523.3 Construction Requirements

Measure wave speed prior to driving piles. Wave speed measurements will not be required for Steel H piles or metal shell piles. When wave speed measurements are performed, place the piles in a horizontal position not in contact with other piles.

Perform dynamic pile testing during driving. Modify the driving to reduce the stress and/or eliminate the damage, should the recommended stress level be exceeded or if damage occurs (determined visually or as indicated by the instrumentation).

Do not exceed the following maximum driving stresses, as determined by the dynamic pile testing:

1. For Steel piles:

0.9 Fy, where Fy = Yield strength of steel

2. For Prestressed Concrete Piles:

   Compression:

   $\sigma_{dr} = (0.85f'_c - f_{pe})$

   Tension in Normal Environments:

   $\sigma_{dr} = (0.095\sqrt{f'_c} + f_{pe})$

   Tension in Severe Corrosive Environments:

   $\sigma_{dr} = \varphi_{da} f_{pe}$

   where;
   σ_{dr} = maximum allowed driving stress, ksi
   $f'c$= specified minimum 28-day compressive strength of concrete, ksi
   f_{pe}= effective prestress in concrete, ksi, (after all losses) at the time of driving taken as 0.78 times the initial prestress force

Re-drive friction piles that do not obtain bearing after a freeze period of a minimum of 24 hours or for a period designated on the Plans, whichever is longer. Reset the gauges if required. Re-strike the pile with a warm hammer until a maximum penetration of 3 inches (76 mm) or 40 blows is reached, whichever occurs first. The Engineer may modify the Pile Driving Objective based on the results of the PDA work.

Provide two weeks' notice prior to the driving of designated piles and cooperate with the Engineer in connection with the performance of Dynamic Pile Testing.

Provide a complete report consisting of but not limited to PDA field monitoring data, results of CAPWAP computer analyses, and recommendations such as pile lengths, hammer fuel setting, and valid driving criteria. Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile. Submit the report electronically in PDF format and the electronic data files of the PDA analysis and CAPWAP to the Geotechnical Bureau and allow seven (7) calendar days for review and approval before proceeding with driving production piles.

523.4 Measurement

The Dynamic Pile Tests performed in accordance with these Specifications will be counted separately for payment. (Refer to plans summary sheet for the required amount of PDA testing.)

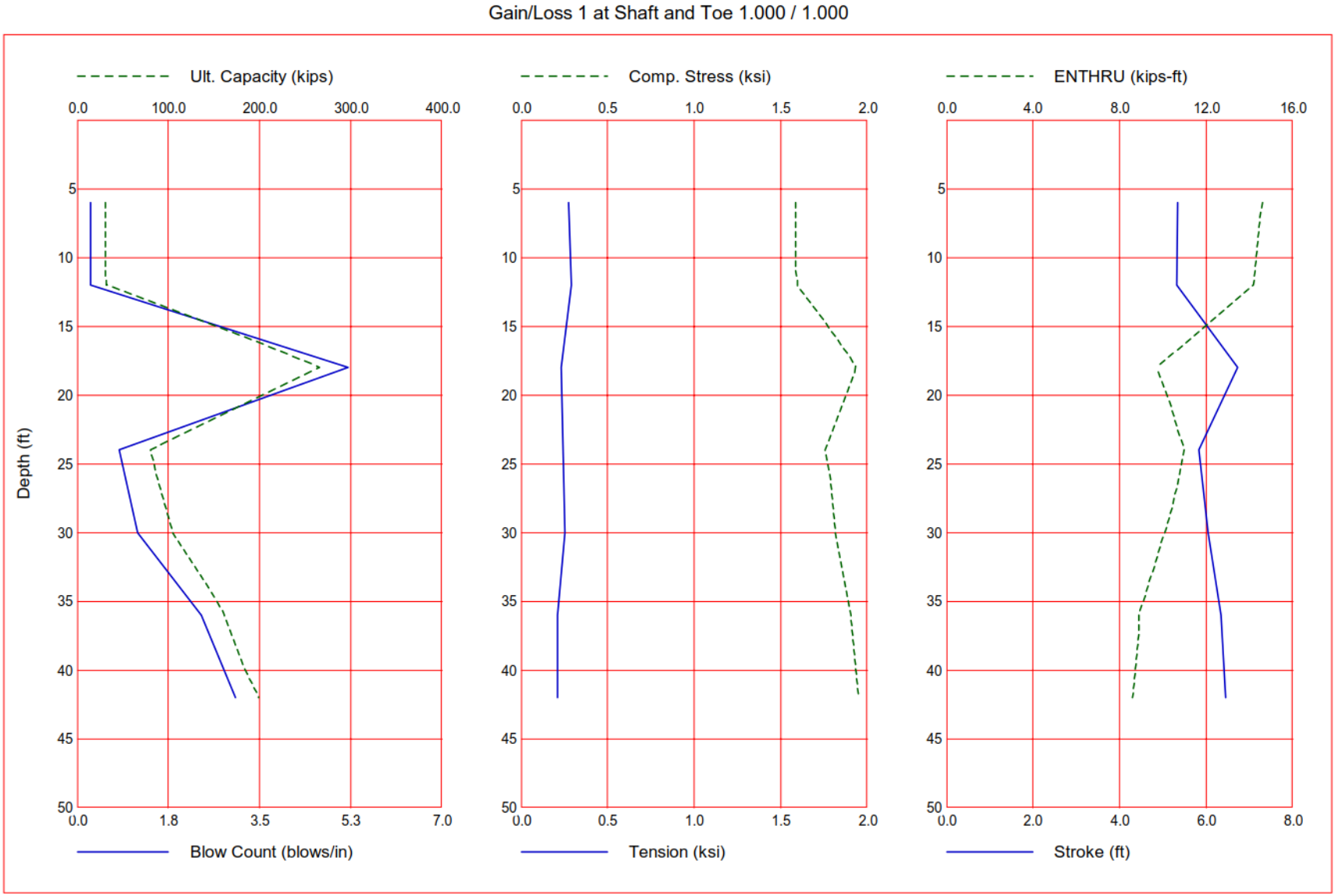
523.5 Payment

The Dynamic Pile Test completed and accepted will be paid for at the Contract unit Price. This payment will be full compensation for all costs of complying with this specification, including incidentals, additional work, and any delays incurred in conjunction therewith.

Payment will be made under:

Item No. 523. Dynamic Pile Test_____ . . . . . Per Each

Office of Materials and Testing



- **Pile: PSC 14 inch**
- **Hammer: APE D16-42**
- **Soil Boring: B1**
- **Pile cushion: 8" plywood**

Project Manager: BG	PI No. 007631
Drawn by: BG	Scale: N.T.S.
Checked by: GL	File Name: ES165111
Approved by: GL	Date: 11/17/2017

Terracon
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Phone (912) 629 4000 Fax (912) 629 4001

GRLWEAP Drivability Analysis

Truman Liner Park Trail- Phase II
BFI # 1- Near Lake Mayer
Savannah, Chatham County, Georgia

Exhibit
C-7-1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	31.1	15.1	16.0	0.3	1.588	-0.275	5.34	14.6
12.0	31.8	24.5	7.3	0.3	1.596	-0.290	5.32	14.2
18.0	265.4	51.9	213.5	5.2	1.938	-0.231	6.72	9.7
24.0	80.7	69.7	10.9	0.8	1.757	-0.242	5.84	11.0
30.0	104.6	86.4	18.1	1.2	1.817	-0.251	6.04	10.1
36.0	161.3	112.3	49.1	2.4	1.906	-0.209	6.34	8.9
42.0	199.2	146.9	52.3	3.0	1.949	-0.209	6.46	8.6

Total Continuous Driving Time 18.00 minutes; Total Number of Blows 826 (starting at penetration 6.0 ft)

APE D 16-42

Ram Weight	3.53	kips
Efficiency	0.800	
Pressure	1368 (93%)	psi
Helmet Weight	3.00	kips
Hammer Cushion	34825	kips/in
Pile Cushion	735	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.116	in
Skin Damping	0.064	s/ft
Toe Damping	0.150	s/ft
Pile Length	44.00	ft
Pile Penetration	44.00	ft
Pile Top Area	196.00	in2

- **Pile: PSC 14 inch**
- **Hammer: APE D16-42**
- **Soil Boring: B1**
- **Pile cushion: 8” plywood**

Project Manager: BG	PI No. 007631	Terracon Consulting Engineers & Scientists 2201 Rowland Avenue Savannah, Georgia 31404 Phone (912) 629 4000 Fax (912) 629 4001	GRLWEAP Drivability Analysis	Exhibit:
Drawn by: BG	Scale: N.T.S.		Truman Liner Park Trail- Phase II BFI # 1- Near Lake Mayer Savannah, Chatham County, Georgia	C-7-2
Checked by: GL	File Name: ES165111			
Approved by: GL	Date: 11/17/2017			

Bridge Foundation Investigation
(BFI # 2)

Truman Liner Park Trail- Phase II
P.I. No. 0007631
CSHPP-0007-00(631), Chatham County

January 22, 2018
Terracon Project No. ES165111

Prepared for:
McGee Partner, Inc.
Atlanta, Georgia

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

January 22, 2018

McGee Partner, Inc.
13 Corporate Blvd., N.E.
Suite 200
Atlanta, Georgia 30329

Attn: Tommy Crochet, P.E.
P: (770) 938-6400
E: tcrochet@mcgeepartners.com

Re: Bridge Foundation Investigation (BFI # 2) Revision 5
Truman Liner Park Trail- Phase II
P.I. No. 0007631
CSHPP-0007-00 (631), Chatham County
Terracon Project No.: ES165111

Dear Mr. Crochet:

Terracon Consultants, Inc. (Terracon) is pleased to submit this report of Bridge Foundation Investigation for the design and construction of the prefabricated bridge over Casey Canal. This report has been prepared in general accordance with the QA / QC Manual by the Geotechnical Engineering Bureau of the Georgia Department of Transportation.

This report has been revised from the previous version dated December 21, 2017 to address the comments made by the Georgia Department of Transportation via. phone conversation.

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.

Biraj Gautam, P.E.
Project Geotechnical Engineer

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

cc: 1 – Client (PDF) 1 – File

Bridge Foundation Investigation (LRFD)
CSHPP-0007-00(631), Chatham County
PI No. 0007631
December 21, 2017
Revision No. 5

LOCATION (See Map)

Casey Canal alongside Eisenhower Drive in Savannah, Chatham County, Georgia.

GENERAL INFORMATION

GEOLOGIC FORMATION

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

SUBSURFACE FEATURES

In general, the subsurface soils predominantly consist of soft to medium stiff sandy silts to sandy clays in the upper 12 to 17 feet below grade (approx. El. -7 to -11), followed by medium dense clean / silty / clayey sands to approximately 32 to 42 feet below grade (approx. EL -27 to -36). The medium dense sandy soils are followed by very dense fine sands with silts to silty sands to the termination of borings at approximately 60 feet below grade (approx. El. -54 to -55). Groundwater was encountered at approximately 5.5 to 10 feet below grade (approx. El. -0.5 to -4) at the time of field exploration.

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.

SITE CLASSIFICATION

We recommend a site class of D per AASHTO LRFD 3.10.3.1.

1.0 FOUNDATION RECOMMENDATIONS

Bents	Drilled Shaft	Spread Footing	Pile Footing (Type)	Pile Bent (Type)
Bridge Begin (Sta. 218+15)	--	--	--	PSC

Bridge End (Sta. 218+95)	--	--	--	PSC

1.1 Pile Properties

Pile Type	Pile Size (in)	Nominal Compression Stress (ksi)	Nominal Tension Stress (ksi)		Maximum Factored Structural Resistance (kips)
			Normal Env.	Severe Env.	
PSC	14 x 14	3.214	1.248	-	473

1.2 DESIGN LOADS

Bents	Maximum Factored Foundation Load (kips)	Service Load (kips)
Bridge Begin (Sta. 218+15)	60	40
Bridge End (Sta. 218+95)	60	40

2.0 FOUNDATION LOADS

2.1 PILE FOUNDATION LOADS

Bents	Pile Type	Size (in)	Down Drag (kips)	Scour (kips)	Driving Resistance (kips)*
Bridge Begin (Sta. 218+15)	PSC	14	-	-	93
Bridge End (Sta. 218+95)	PSC	14	-	-	93

3.0 FOUNDATION ELEVATIONS

Bents	Bottom of Spread Footing	Minimum Tip (Elevation)	Estimated Tip (Elevation)
Bridge Begin (Sta. 218+15)	--	-25	-30
Bridge End (Sta. 218+95)	--	-35	-40

5.0 GENERAL NOTES

Elevations

The elevations are based on the drawing (Drawing Sheet No. 13-0009) provided by McGee Partners, Inc. Below are the elevations of the existing ground surface at each borehole location.

B3: 5.0 B4: 6.0

Waiting Period

None required.

Theoretical Scour

Appears feasible for the material encountered.

As Built Foundation Information

The as built foundation information should be forwarded to the Geotechnical Engineering Bureau upon completion of the foundation system.

5.1 PILE FOUNDATION NOTES

PDO

Driving resistance after minimum tip elevations are achieved in conjunction with Special Provision 520 Piling for LRFD and Special Provision 523 Dynamic Pile Testing. Perform one PDA test at Bridge Begin (Sta. 218+15) and Bridge End (Sta. 218+95) bents with a total of two PDA tests. These should be performed before any additional production piles are driven.

*** Nominal Bearing Resistance of Single Pile**

Diving resistance is based on the following field verification method and resistance factor $\emptyset_{dyn}$ AASHTO LRFD 2010 (10.5.5.2.3-1):

Resistance Determination Method	Resistance Factor
Driving criteria established by dynamic testing of at least two piles based on the site conditions, but no less than 2% of the production piles. The pile resistance should be based on PDA restrike test performed at least four days after the initial driving to account for the setup effect.	0.65

Drivability

A drivability analysis has been completed on the above mentioned piles to their respective estimated tips with APE Model D19-42 Single Acting Diesel Impact Hammer used.

Pre-drilling

The Contractor may choose pre-drilling to assist in the installation of PSC piles through dense soil layers at both end bents as per Special Provision Section 520. If pre-drilling is used, it should be to 3 feet above the minimum tip elevations and may be adjusted by the Engineer during construction:

No separate payment will be made if the Contractor chooses to use pre-drilling. The maximum diameter of the pre-drilled hole should be determined from the following table:

Pile Size - PSC	Maximum Pre-Drill Hole Size - PSC
14“	12“

Test Piles

We recommend that PSC test piles be set up at Bridge Begin (Sta. 218+15) and Bridge End (Sta. 218+95) bents (the same bent locations as PDA tests) to help determine pile order lengths. The test piles should be of sufficient length to reach a depth of 5 feet below the Estimated Tip Elevation.

Special Problems

i. Erratic pile lengths can be expected.

ii. The contractor is made aware of the utility and transmission lines near the proposed bridge area.

iii. Vibrations from pile driving may cause damages to the existing road or nearby bridge. Necessary measures should be taken to avoid the damages to the existing structures. We recommend that the Project Engineer contact the Geotechnical Engineering Bureau prior to construction to evaluate the need for vibration monitoring.

6.0 QA / QC

Prepared By Biraj Gautam, P.E.

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	Typical Soil Profile and the Proposed Bridge
Exhibit A-6	SPT Boring Logs

Appendix B (Laboratory Testing)

Exhibit B-1	Summary of Laboratory Test Results
	(a) Grain Size Analysis Result
	(b) Atterberg Limit Test Result

Appendix C (Supporting Document)

Exhibit C-1	Pile Axial Capacity Analysis Results
Exhibit C-2	General Notes
Exhibit C-3	Unified Soil Classification System
Exhibit C-4	Special Provision Section 520- Piling for LRFD
Exhibit C-5	Special Provision Section 523- Dynamic Pile Testing
Exhibit C-6	GRLWEAP Analysis Results

APPENDIX A
FIELD EXPLORATION

Image Courtesy of
Google Earth™

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

PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

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

SITE LOCATION MAP

Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

Exhibit:

A-1

NOTE:
ALL THE EXPLORATION LOCATIONS WERE LOCATED IN THE FIELD USING A GPS UNIT AND IN REFERENCE TO THE EXISTING FEATURES AND THE STAKED MARKS FOR BRIDGE BENTS. THE EXPLORATION LOCATIONS SHOULD BE CONSIDERED APPROXIMATE. DIAGRAM IS FOR GENERAL LOCATION ONLY AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

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

PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

Terracon
Consulting Engineers & Scientists
2201 Rowland Avenue Savannah, Georgia 31404
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EXPLORATION LOCATION PLAN

Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

Exhibit:

A-2

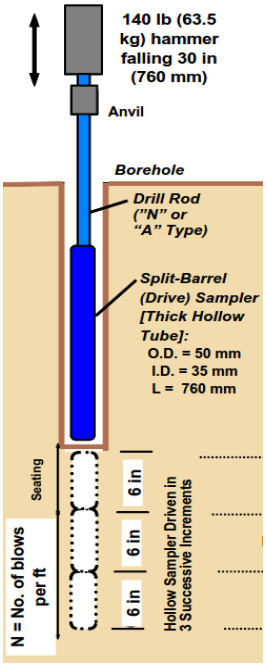
Field Exploration Description

The locations of the SPT borings were determined by Terracon based on the proposed plan and discussed with the civil engineers prior to performing the field exploration. The boring locations were located in the field using a hand-held GPS unit and in reference to the existing features. The locations of the exploration points are shown in the Exploration Location Plan and should be considered approximate.

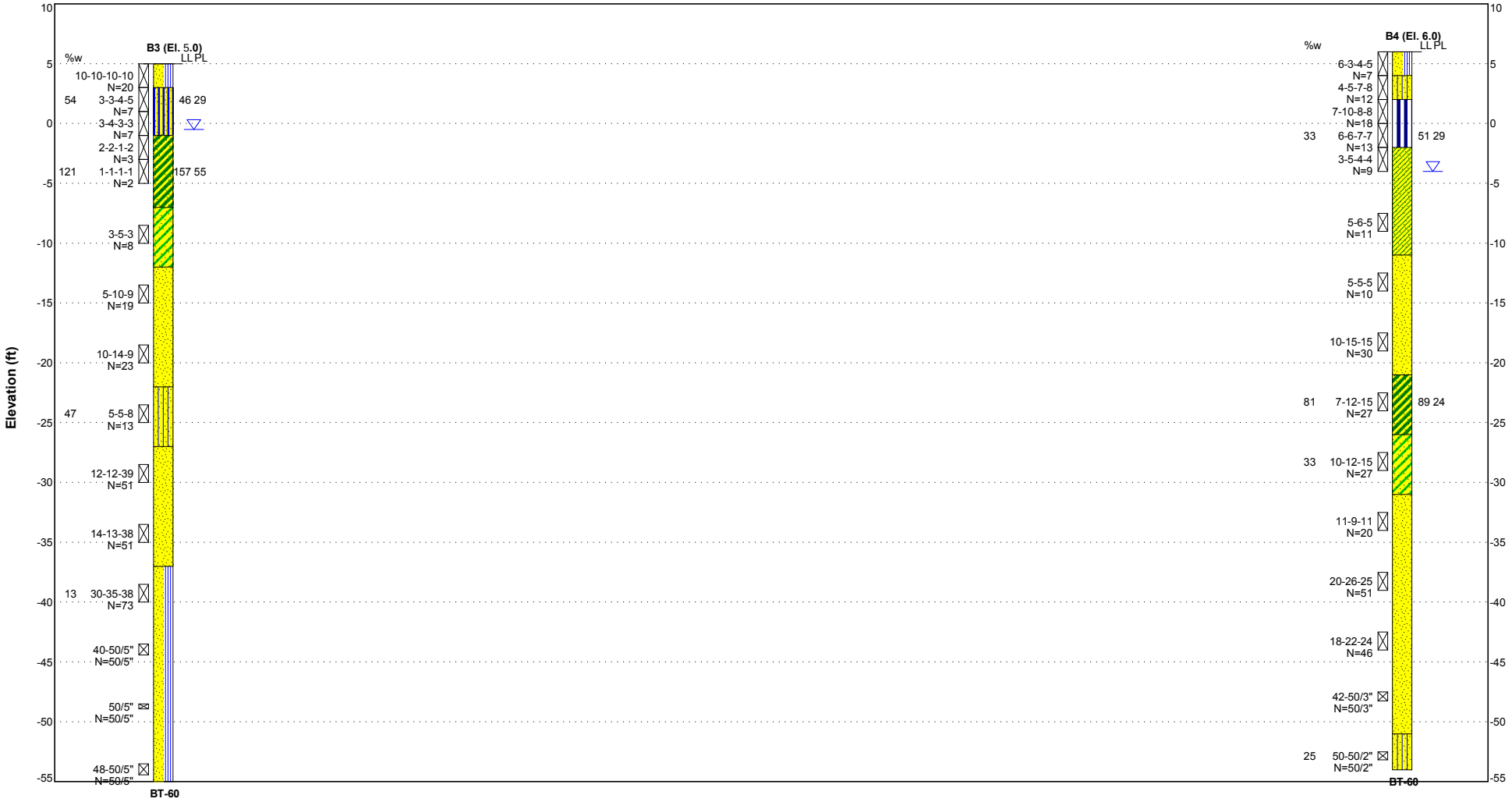
Standard Penetration Testing

The SPT borings were performed in accordance with ASTM D 1586 with a track-mounted drilling rig using hollow stem auger methods. 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.

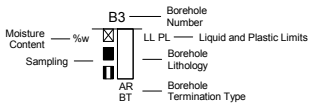
Upon completion, the data collected were analyzed and processed by the project engineer.



Source: FHWA NHI-06-088



Explanation



Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:
See Exhibit for orientation of soil profile.
See General Notes in Appendix 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: BG	PI No.: 0007631
Drawn by: BG	Scale: N.T.S.
Approved by: GL	File Name: ES165111
Date: 12/6/2016	

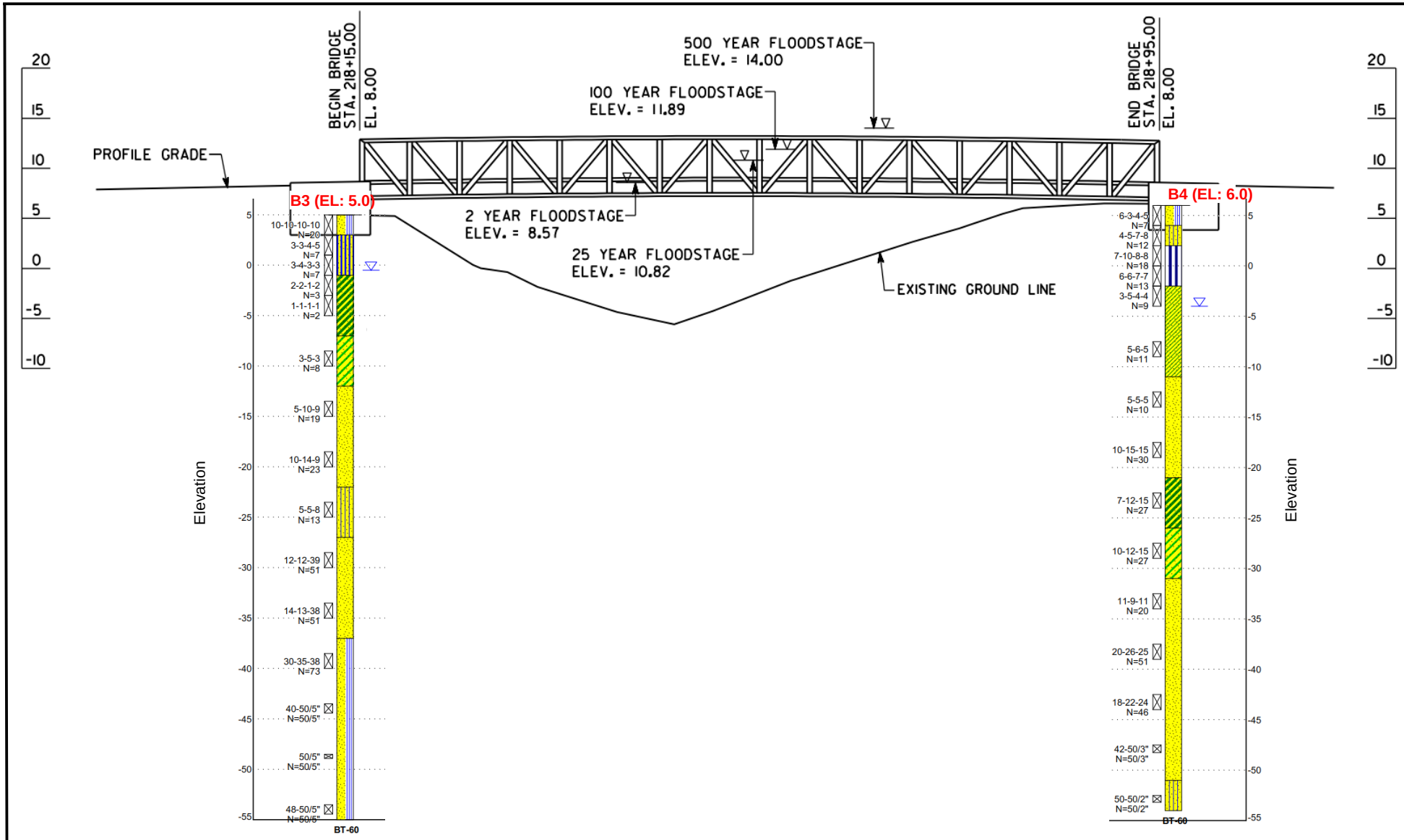
Terracon
2201 Rowland Avenue
Savannah, Georgia
PH. 912-629-4000 FAX. 912-629-4001

SUBSURFACE PROFILE

Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

EXHIBIT

A-4



Project Manager:	BG	PI No.	0007631	Terracon Consulting Engineers & Scientists	SOIL PROFILE AND THE PROPOSED BRIDGE
Drawn by:	BG	Scale:	N.T.S.	2201 Rowland Avenue Savannah, Georgia 31404	Truman Liner Park Trail- Phase II
Checked by:	GL	File Name:	ES165111	Phone (912) 629 4000 Fax (912) 629 4001	BFI # 2- Alongside Eisenhower Drive
Approved by:	GL	Date:	12/6/2016		Savannah, Chatham County, Georgia

Exhibit: **A-5**

BORING LOG NO. B3

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 32.0026° Longitude: -81.0857°

Surface Elev.: 5 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
2.0	3	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, light brown, medium dense				10-10-10-10 N=20			
		SANDY SILT (ML), dark gray, medium stiff				3-3-4-5 N=7		54	46-29-17
		dark gray, medium stiff	5	▽		3-4-3-3 N=7			
6.0	-1								
		SANDY FAT CLAY (CH), dark gray, soft				2-2-1-2 N=3			
		dark gray, soft				1-1-1-1 N=2		121	157-55-102
12.0	-7		10						
		CLAYEY SAND (SC), fine grained, dark gray, loose				3-5-3 N=8			
17.0	-12		15						
		POORLY GRADED SAND (SP), fine to coarse grained, gray, medium dense, with shell fragments				5-10-9 N=19			
			20						
		fine to coarse grained, gray, medium dense, with shell fragments				10-14-9 N=23			
27.0	-22		25						
		SILTY SAND (SM), fine grained, dark gray, medium dense				5-5-8 N=13	23.9	47	
32.0	-27		30						
		POORLY GRADED SAND (SP), fine to coarse grained, dark gray, very dense, with shell fragments				12-12-39 N=51			
			35						
		fine to coarse grained, dark gray, very dense, with shell fragments				14-13-38 N=51			
			40						

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon

2201 Rowland Avenue
Savannah, Georgia

Boring Started: 8/1/2016 | Boring Completed: 8/1/2016

Drill Rig: CME-45 | Driller: Carl

Project No.: ES165111 | Exhibit: A-6-1

BORING LOG NO. B3

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 32.0026° Longitude: -81.0857°

Surface Elev.: 5 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
42.0	-37	**POORLY GRADED SAND (SP)**, fine to coarse grained, dark gray, very dense, with shell fragments *(continued)*						
		POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained, gray, very dense, with shell fragments	45		30-35-38 N=73	7.0	13	
		very dense, no recovery	50		40-50/5" N=50/5"			
		very dense, no recovery	55		50/5" N=50/5"			
60.0	-55	very dense, no recovery	60		48-50/5" N=50/5"			
		Boring Terminated at 60 Feet	65					
			70					
			75					
			80					

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon
2201 Rowland Avenue
Savannah, Georgia

Boring Started: 8/1/2016 Boring Completed: 8/1/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-1

BORING LOG NO. B4

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 32.0025° Longitude: -81.0854°

Surface Elev.: 6 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
2.0	4	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, brown, loose				6-3-4-5 N=7			
4.0	2	**SILTY SAND (SM)**, fine grained, dark brown, medium dense				4-5-7-8 N=12			
		ELASTIC SILT (MH), dark brown, very stiff	5			7-10-8-8 N=18			
8.0	-2	dark brown, very stiff				6-6-7-7 N=13		33	51-29-22
		SANDY LEAN CLAY (CL), dark brown to gray, stiff, with wood debris				3-5-4-4 N=9			
			10	▽					
		dark brown to gray, stiff, with wood debris				5-6-5 N=11			
17.0	-11		15						
		POORLY GRADED SAND (SP), fine to coarse grained, gray, medium dense, with shell fragments				5-5-5 N=10			
			20						
		fine to coarse grained, gray, dense, with shell fragments				10-15-15 N=30			
27.0	-21		25						
		SANDY FAT CLAY (CH), gray, very stiff				7-12-15 N=27		81	89-24-65
32.0	-26		30						
		CLAYEY SAND (SC), fine to medium grained, gray, medium dense				10-12-15 N=27	23.8	33	
37.0	-31		35						
		POORLY GRADED SAND (SP), fine to coarse grained, gray, medium dense, with shell fragments				11-9-11 N=20			
			40						

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon

2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/28/2016 Boring Completed: 7/28/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-2

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE SPT.GPJ TERRACON2012.GDT 11/30/16

BORING LOG NO. B4

PROJECT: Truman Liner Park Trail-Phase II

CLIENT: McGee Partner, Inc. Atlanta, Georgia

SITE: Savannah, Chatham County, Georgia

LOCATION See Exhibit A-2

Latitude: 32.0025° Longitude: -81.0854°

Surface Elev.: 6 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)
POORLY GRADED SAND (SP), fine to coarse grained, gray, medium dense, with shell fragments *(continued)*						
fine to coarse grained, gray, very dense, with shell fragments		45		20-26-25 N=51		
fine to coarse grained, gray, very dense, with shell fragments		50		18-22-24 N=46		
fine to coarse grained, gray, very dense, with shell fragments		55		42-50/3" N=50/3"		
57.0	-51					
SILTY SAND (SM), fine grained, dark gray, very dense				50-50/2" N=50/2"	21.8	25
60.0	-54	60				
Boring Terminated at 60 Feet		65				
		70				
		75				
		80				

ATTERBERG LIMITS: LL-PL-PI

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

Hammer Type: Rope and Cathead

Advancement Method: Mud Rotary

Abandonment Method:

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *At the time of drilling*

Terracon
2201 Rowland Avenue
Savannah, Georgia

Boring Started: 7/28/2016 Boring Completed: 7/28/2016

Drill Rig: CME-45 Driller: Carl

Project No.: ES165111 Exhibit: A-6-2

APPENDIX B
LABORATORY TESTING

Exhibit B-1 Summary of Laboratory Test Results

(a) Atterberg Limit Test Result

(b) Grain Size Analysis Result

Terracon Project Name: Truman Liner Park Trail-Phase II

Terracon Project No.: ES165111

Project Location: Savannah, Chatham County, Georgia

PI No.: 0007631

Summary of Soil Laboratory Test

Borehole	Sample Depth (ft)	Elevation (ft)	Material Description	USCS	Natural Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Cu	Cc	D90 (mm)	D60 (mm)	D30 (mm)	% Gravel	%Sand	%Fine
B3	2 to 4	3 to 1	Sandy silt	ML	53.5	46	29	17	--	--	--	--	--	--	--	--
	8 to 10	-3 to -5	Sandy clay	CH	121.2	157	55	102	--	--	--	--	--	--	--	--
	28.5 to 30	-23.5 to -25	Silty sand	SM	46.9	--	--	--	--	--	0.220	0.124	0.082	0.0	75.7	23.9
	43.5 to 45	-38.5 to -40	Fine sand with silt	SP-SM	13.0	--	--	--	9.01	1.46	4.750	0.910	0.366	0.0	83.0	7.0
B4	6 to 8	0 to -2	Elastic silt	MH	32.8	51	29	22	--	--	--	--	--	--	--	--
	28.5 to 30	-22.5 to -24	Sandy clay	CH	80.7	89	24	65	--	--	--	--	--	--	--	--
	33.5 to 35	-27.5 to -29	Clayey sand	SC	33.3	--	--	--	--	--	0.270	0.140	0.083	0.0	75.6	23.8
	58.5 to 59.2	-52.5 to -53.2	Silty sand	SM	25.3	--	--	--	--	--	0.140	0.107	0.081	0.0	78.1	21.8

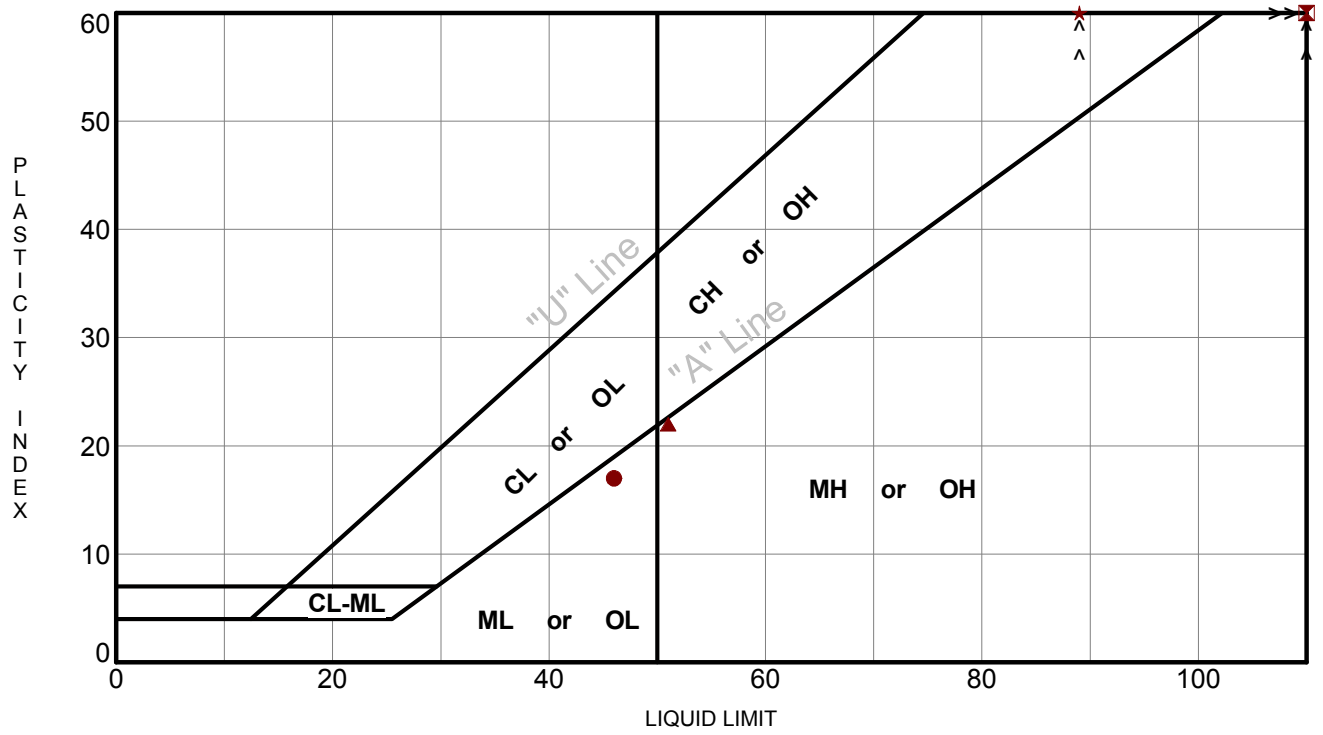
Note: Following surface elevations are based on the drawing (Drawing Sheet No. 13-0009) provided by McGee Partners, Inc.

B3: 5

B4: 6

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth (ft)	LL	PL	PI	Fines	USCS	Description
●	B3	2.0 - 4.0	46	29	17		ML	Sandy silt
⧓	B3	8.0 - 10.0	157	55	102		CH	Sandy clay
▲	B4	6.0 - 8.0	51	29	22		MH	Elastic silt
★	B4	28.5 - 30.0	89	24	65		CH	Sandy clay

PROJECT: Truman Liner Park Trail-Phase II

SITE: Savannah, Chatham County, Georgia

Terracon
2201 Rowland Avenue
Savannah, Georgia

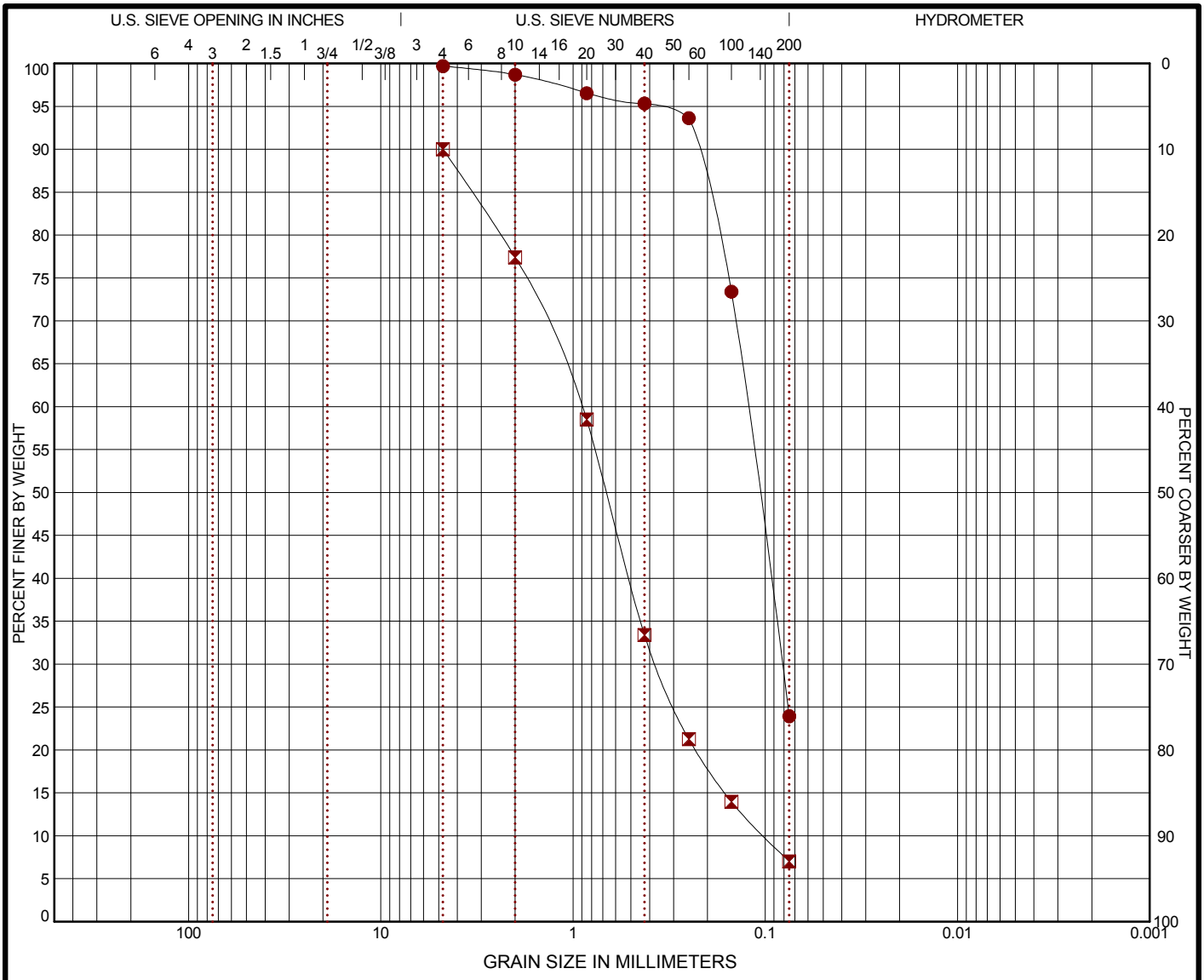
PROJECT NUMBER: ES165111

CLIENT: McGee Partner, Inc.
Atlanta, Georgia

EXHIBIT: B-1

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B3**	**28.5 - 30**			**75.7**		**23.9**		**SM**
⊠	**B3**	**43.5 - 45**			**83.0**		**7.0**		**SP-SM**

	GRAIN SIZE		
	●	⊠	
D_{60}	**0.124**	**0.91**	
D_{30}	**0.082**	**0.366**	
D_{10}		**0.101**	
	COEFFICIENTS		
C_C		**1.46**	
C_U		**9.01**	

SIEVE (size)	PERCENT FINER ●	PERCENT FINER ⊠
1 1/2"		
1"		
3/4"		
1/2"		
3/8"		
#4	**99.68**	**90.0**
#10	**98.69**	**77.39**
#20	**96.53**	**58.51**
#40	**95.33**	**33.39**
#60	**93.62**	**21.28**
#100	**73.4**	**13.96**
#200	**23.94**	**7.02**

SOIL DESCRIPTION
● Silty sand
⊠ Fine sand with silt

REMARKS
●
⊠

PROJECT: Truman Liner Park Trail-Phase II

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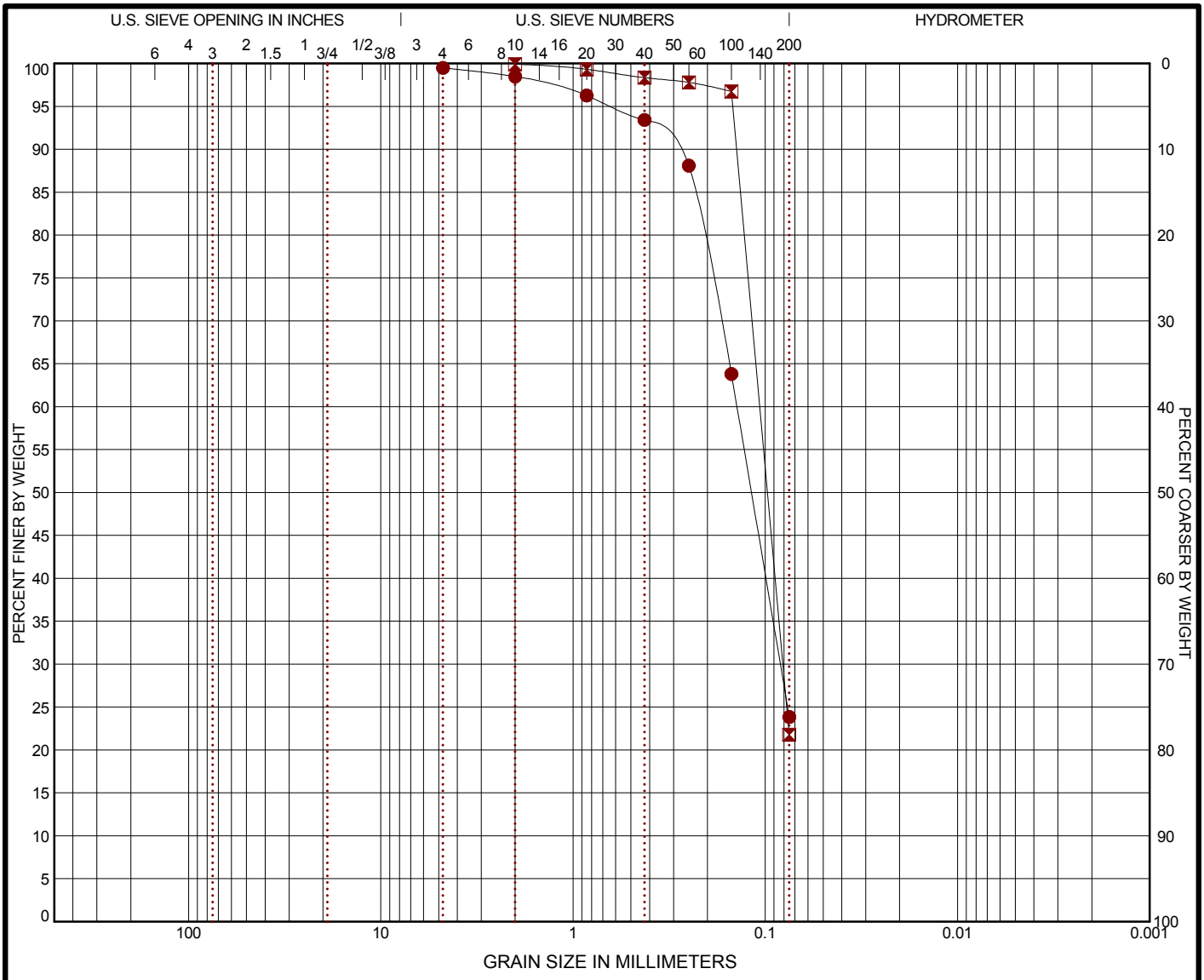
Atlanta, Georgia

EXHIBIT: B-1

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B4**	**33.5 - 35**			**75.6**		**23.8**		**SC**
⊠	**B4**	**58.5 - 59.167**			**78.1**		**21.8**		**SM**

	GRAIN SIZE		
	●	⊠	
D_{60}	**0.14**	**0.107**	
D_{30}	**0.083**	**0.081**	
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SIEVE (size)	PERCENT FINER ●	PERCENT FINER ⊠	
1 1/2"			
1"			
3/4"			
1/2"			
3/8"			
#4	**99.48**		
#10	**98.47**	**99.91**	
#20	**96.26**	**99.32**	
#40	**93.41**	**98.33**	
#60	**88.09**	**97.79**	
#100	**63.81**	**96.73**	
#200	**23.85**	**21.78**	

SOIL DESCRIPTION
● Clayey sand
⊠ Silty sand

REMARKS
●
⊠

PROJECT: Truman Liner Park Trail-Phase II

SITE: Savannah, Chatham County, Georgia

Terracon
2201 Rowland Avenue
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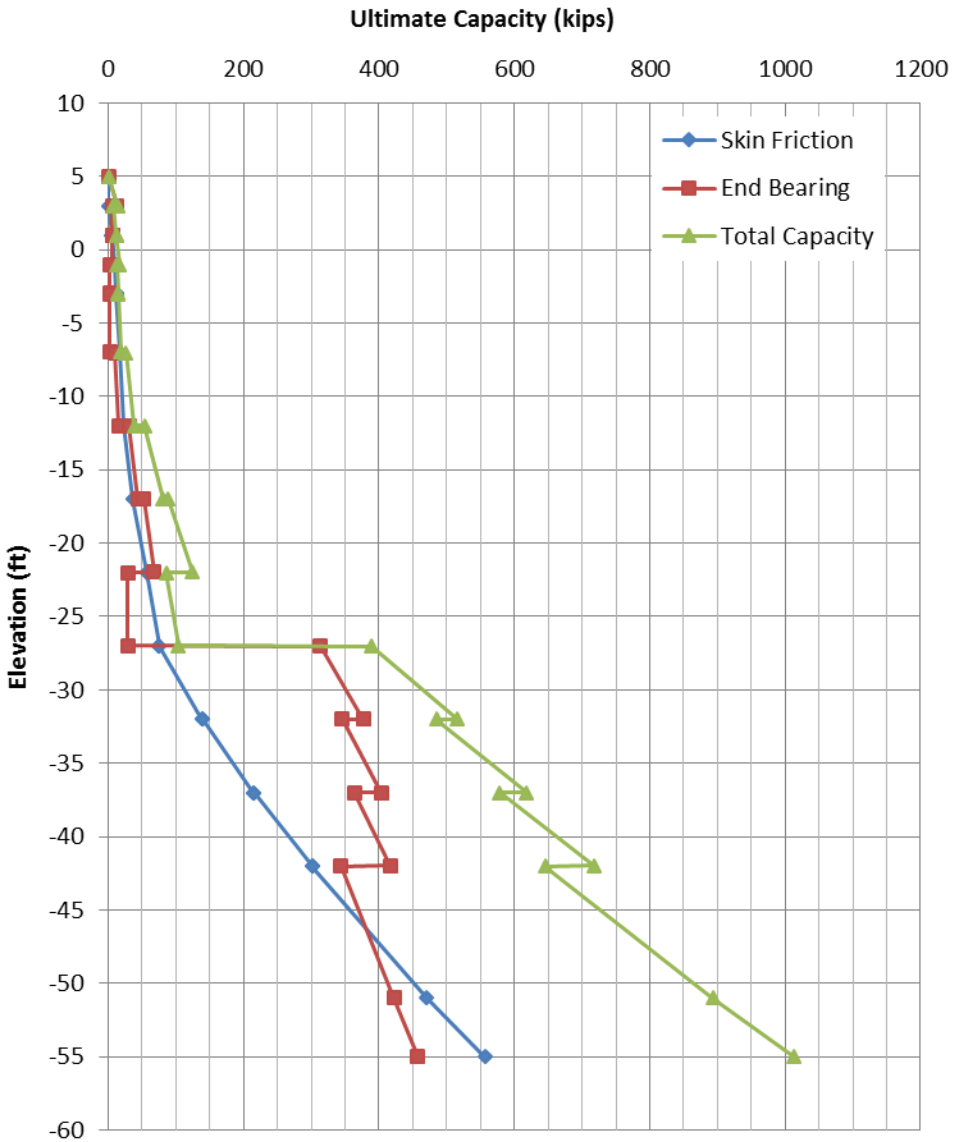
Atlanta, Georgia

EXHIBIT: B-1

APPENDIX C
SUPPORTING DOCUMENT

Exhibit C-1 Pile Axial Capacity Analyses
Exhibit C-2 General Notes
Exhibit C-3 Unified Soil Classification System
Exhibit C-4 Special Provision Section 520- Piling for LRFD
Exhibit C-5 Special Provision Section 523- Dynamic Pile Testing
Exhibit C-6 GRLWEAP Analysis Results



DRIVEN Software Output

Depth (ft)	Elevation (ft)	Skin Friction (kips)	End Bearing (kips)	Total Capacity (kips)
0.01	4.99	0.00	0.06	0.1
1.99	3.01	0.70	12.86	13.6
2.01	2.99	0.73	6.12	6.9
3.99	1.01	5.35	6.12	11.5
4.01	0.99	5.39	6.12	11.5
5.99	-0.99	10.01	6.12	16.1
6.01	-1.01	10.05	2.45	12.5
7.99	-2.99	12.14	2.45	14.6
8.01	-3.01	12.16	2.45	14.6
11.99	-6.99	16.35	2.45	18.8
12.01	-7.01	16.37	9.66	26.0
16.99	-11.99	22.44	15.81	38.3
17.01	-12.01	22.48	31.10	53.6
21.99	-16.99	36.35	44.32	80.7
22.01	-17.01	36.42	52.10	88.5
26.99	-21.99	56.91	67.16	124.1
27.01	-22.01	56.99	28.39	85.4
31.99	-26.99	74.87	28.39	103.3
32.01	-27.01	75.02	313.72	388.7
36.99	-31.99	138.87	377.28	516.2
37.01	-32.01	139.15	345.24	484.39
41.99	-36.99	214.37	403.36	617.73
42.01	-37.01	214.7	364.01	578.71
46.99	-41.99	301.11	416.43	717.54
47.01	-42.01	301.47	344.12	645.59
56.01	-51.01	470.77	422.37	893.14
59.99	-54.99	556.67	456.97	1013.64

- **PSC 14 inch**
- **Begin Bridge (Sta. 218+15)**

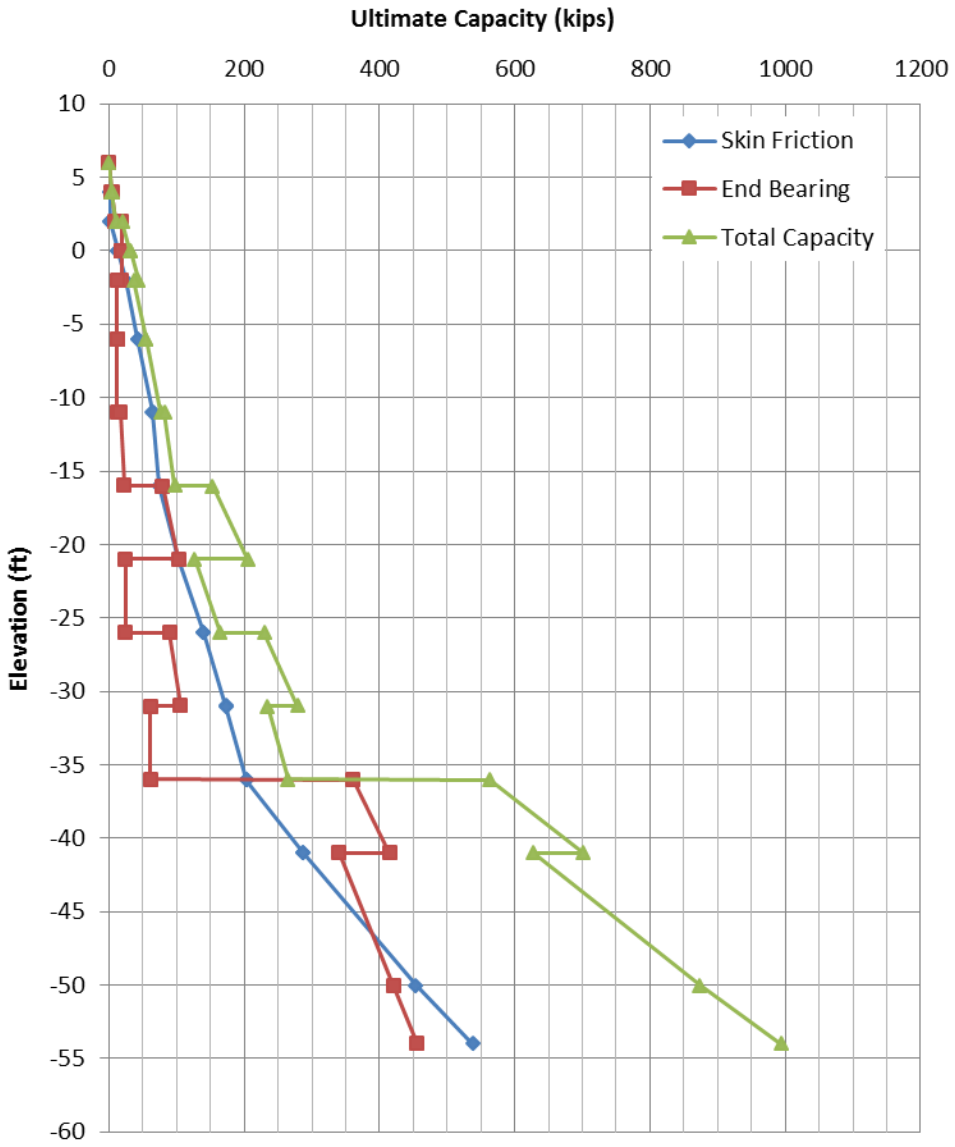
Project Manager:	BG
Drawn by:	BG
Checked by:	GL
Approved by:	GL
PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

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

Pile Axial Capacity Analyses

Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

Exhibit
C-1-1



DRIVEN Software Output

Depth (ft)	Elevation (ft)	Skin Friction (kips)	End Bearing (kips)	Total Capacity (kips)
0.01	5.99	0.00	0.02	0.0
1.99	4.01	0.27	2.99	3.3
2.01	3.99	0.27	4.27	4.5
3.99	2.01	1.29	8.87	10.2
4.01	1.99	1.36	18.38	19.7
5.99	0.01	12.91	18.38	31.3
6.01	-0.01	13.03	18.38	31.4
7.99	-1.99	24.58	18.38	43.0
8.01	-2.01	24.68	12.25	36.9
11.99	-5.99	42.35	12.25	54.6
12.01	-6.01	42.44	12.25	54.7
16.99	-10.99	64.05	12.25	76.3
17.01	-11.01	65.11	16.79	81.9
21.99	-15.99	74.53	22.75	97.3
22.01	-16.01	74.60	78.65	153.3
26.99	-20.99	102.04	102.83	204.9
27.01	-21.01	102.17	24.50	126.7
31.99	-25.99	139.88	24.50	164.4
32.01	-26.01	140.02	89.37	229.4
36.99	-30.99	172.52	105.80	278.3
37.01	-31.01	172.64	61.32	233.96
41.99	-35.99	202.96	61.32	264.28
42.01	-36.01	203.18	360.47	563.65
46.99	-40.99	286.75	414.37	701.12
47.01	-41.01	287.1	340.42	627.52
56.01	-50.01	453.48	420.41	873.89
59.99	-53.99	538.21	455.78	993.99

- PSC 14 inch
- End Bridge (Sta. 218+95)

Project Manager:	BG
Drawn by:	BG
Checked by:	GL
Approved by:	GL
PI No.	0007631
Scale:	N.T.S.
File Name:	ES165111
Date:	12/6/2016

Terracon
Consulting Engineers & Scientists
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Pile Axial Capacity Analyses

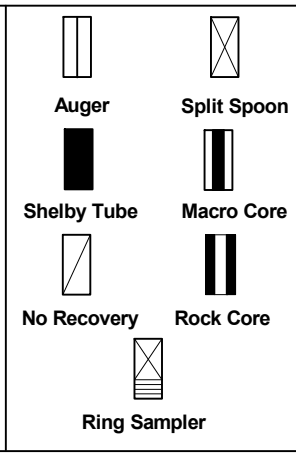
Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

Exhibit
C-1-2

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

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 More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		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 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ 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 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / 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.

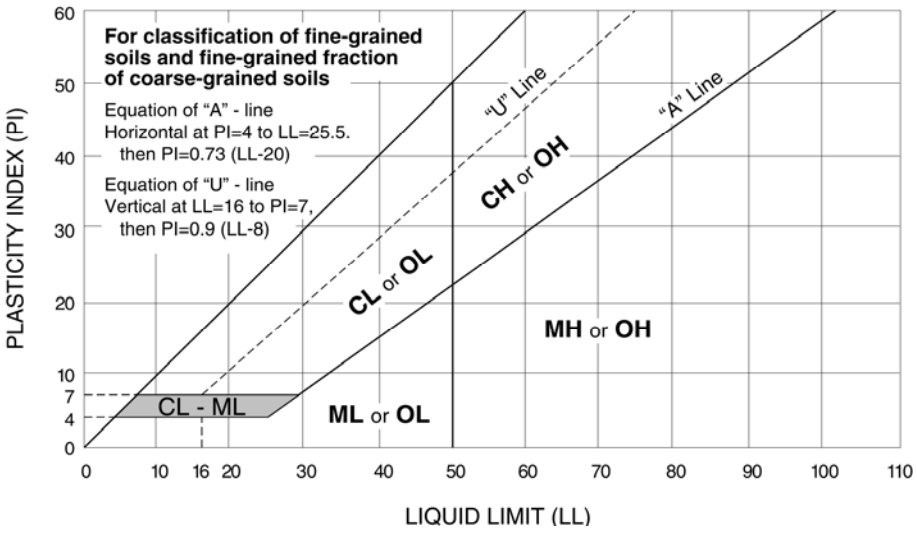
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



Terracon

Exhibit C-3

Revised: November 15, 2003

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

PROJECT NO. CSHPP-0007-00(631), Chatham County
P.I. NO. 0007631

SECTION 520—PILING

Add the following to Subsection 520.3.05.G:

At the Contractor's option, predrilling may be used to loosen dense soil layers to assist in the installation of piling in lieu of spudding or jetting. To predrill, drill an auger into the ground to the required elevation at the pile location. It is not necessary to remove all material or to provide casing. Use one of the following maximum auger diameters corresponding to the pile size:

PSC Pile Size	**Maximum Pre-drill Auger Size**
14" (350 mm)	12" (300 mm)
16" (400 mm)	18" (450 mm)
18" (450 mm)	18" (450 mm)
20" (500 mm)	24" (600 mm)
24" (600 mm)	24" (600 mm)
30" (750 mm)	30" (750 mm)
36" (900 mm)	36" (900 mm)

Metal Pile Size	**Maximum Pre-drill Auger Size**
14" (350 mm)	12" (300 mm)
16" (400 mm)	12" (300 mm)
18" (450 mm)	12" (300 mm)

There will not be any separate payment made for predrilling.

Office of Materials and Testing

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

PROJECT NO. CSHPP-0007-00(631), Chatham County
P.I. NO. 0007631

SECTION 520—PILING

Delete Sub-Section 520.3.05.D.1 and substitute the following:

520.3.05.D.1. Determine Driving Resistance
Drive piles in one continuous operation. Determine the driving resistance of the piling based on the method specified in the plans, which will be one of the following methods (a – c):

a. Upon completion of the dynamic pile testing in accordance with Special Provision Section 523. The pile bearing will be determined by computing the penetration per blow with less than ¼-inch (6-mm) rebound averaged through 12 inches (305 mm) each of penetration. When it is considered necessary by the Engineer, the average penetration per blow may be determined by averaging the penetration per blow through the last 10 to 20 blows of the hammer. In soft material the driving resistance may be determined, at the Engineer's discretion, after delaying driving operations and performing pile re-strikes.

b. Upon completion of the loading test in accordance with Sub-Section 520.3.05.D.2.

c. Shall not be used when driving pile to hard rock. Using FHWA-modified Gates Formula as provided below:

$R_{ndr} = 1.75\ (E_d)^{0.5} \log_{10}(10N_b) - 100$	(kips)	U.S units
$R_{ndr} = 7\ (E_d)^{0.5} \log_{10}(10N_b) - 550$	(kN)	S.I. units

Where:

R_{ndr} = nominal pile driving resistance measured during pile driving

E_d = developed hammer energy. This is the kinetic energy in the ram at impact for a given blow. If ram velocity is not measured, it may be assumed equal to the potential energy of the ram at the height of the stroke, taken as the ram weight times the actual stroke (ft-lb for U.S units, kN-m for S.I. units)

N_b = Number of hammer blows for 1.0 inch of pile permanent set (blows/in)

These resistance formulas apply only when:

- The hammer has a free fall.
- The head of the pile is not broomed, crushed, spalled, or excessively crimped.
- The penetration rate is reasonably uniform.

Determining driving resistance by formula is not a Pay Item. Provide the facilities for determining driving resistance by formula as an incidental part of the work.

Once the driving resistance has been determined by one of the methods noted above, do not continue to drive piles if the Engineer determines that the piles have reached practical refusal. Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than ¼-inch (6-mm) rebound per blow. The Engineer will generally make this determination within 2 inches (51 mm) of driving. However, the Engineer will not approve the continuation of driving at practical refusal for more than 12 inches (305 mm). When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting, spudding, predrilling or other methods approved by the Engineer.

d. Wave Equation: Use the Wave Equation Analysis for Piles (WEAP) program to evaluate the suitability of the proposed driving system chosen from the methods noted above (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance to achieve the pile bearing requirements and to evaluate pile driving stresses. Use the WEAP program to show that the hammer is capable of driving to a driving resistance equal 130% (1.3 times) the driving resistance shown in the Plans without overstressing the piling in compression or tension and without reaching practical refusal.

Perform the WEAP analysis with personnel who are experienced in this type work, and have performed this analysis on a minimum of 15 projects. Provide a list of the qualifications and experience of the personnel to perform the WEAP analysis for this Project.

The Engineer may modify the scour resistance shown in the plans if the dynamic pile test is used to determine the actual soil resistance through the scour zone. Also, the Engineer may make modifications in scour resistance when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

A minimum of two weeks prior to beginning any pile driving operations, submit to the Engineer for evaluation and approval the following information on all of the proposed pile driving system(s) to be used on the Project including but not limited to:

i. Items on Pile Driving Equipment Data Sheet
ii. Other information on the driving system required by the Engineer
iii. A WEAP program output indicating the approximate depth or elevation where the pile will achieve the bearing required
iv. Valid Driving Criteria.

Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile.

If WEAP analyses show that the hammer(s) will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. Resubmit the modified pile driving system information and WEAP program output to the Engineer for re-evaluation. Do not begin pile driving operations until the Engineer has approved the qualifications of the personnel, the WEAP program output, and the pile driving system(s).

Approval of the pile driving system(s) is also based on satisfactory field trials with dynamic pile testing. Obtain approval from the Engineer for the pile driving system(s) based on satisfactory field performance.

If piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided that the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

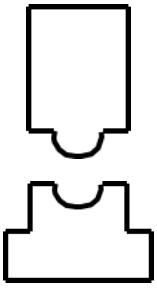
For penetration of weak soils by concrete piles, use thick cushions and/or reduced stroke to control tension stresses during driving.

Revised: February 15, 2016

Pile Driving Data Form

Contract ID:
PI Number:
County

Structure Name:
Structure No.:
Pile Driving Contractor:



Hammer

Manufacturer: _____ Model No. _____
Hammer Type: _____ Serial No. _____
Manufacturers Maximum Rated Energy: _____(ft-k)
Stroke at Maximum Rated Energy: _____(ft)
Range in Operating Energy: _____ to _____(ft-k)
Range in Operating Stroke: _____ to _____(ft)
Ram Weight: _____ (kips)
Modifications: _____

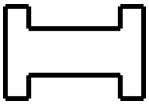
Striker Plate

Weight: _____(kips) Diameter: _____(in)
Thickness: _____(in)

Hammer Cushion

Material 1	Material 2
Name: _____	Name: _____
Area: _____(in^2)	Area: (in^2)
Thickness/Plate: _____(in)	Thickness/Plate:_____(in)
No. of Plates: _____	No. of Plates: _____

Total Thickness of Hammer Cushion: _____(in)

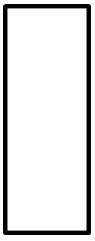


Helmet

Weight including inserts: _____(kips)

Pile Cushion

Material: _____
Area: _____(in^2) Thickness/Sheet: _____(in)
No. of Sheets: _____
Total Thickness of Pile Cushion: _____(in)



Pile

Pile Type: _____
Wall Thickness: _____(in) Taper: _____
Cross Sectional Area: ___(in^2) Weight/Meter: _____
Ordered Length: _____(ft)
Driving Resistance: _____(kips)
Description of Splice: _____
Driving Shoe/Closure Plate Description: _____

Submitted By: _____ Date: _____

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION

PROJECT NO. CSHPP-0007-00(631), Chatham County
P.I. NO. 0007631

SECTION 523 - DYNAMIC PILE TESTING

523.1 General Description

The work consists of performing dynamic pile testing using the Pile Driving Analyzer (PDA) to monitor the driving of piles with accelerometer and strain gauges attached to the piles. Piles to be dynamically tested will be identified in the Special Provision or on the Plans. Prior to pile driving, the Engineer will determine production or test piles to be dynamically tested. Perform the dynamic pile testing in accordance with ASTM D4945-12.

Take dynamic measurements during driving of any required piles. Drive the pile as shown in the Special Provisions or on the Plans.

523.2 Materials

Furnish measuring instruments for dynamic pile testing. Attach instruments near the top of the piles with bolts placed in drilled holes. Furnish materials, labor and equipment necessary for installation of the instruments.

523.3 Construction Requirements

Measure wave speed prior to driving piles. Wave speed measurements will not be required for Steel H piles or metal shell piles. When wave speed measurements are performed, place the piles in a horizontal position not in contact with other piles.

Perform dynamic pile testing during driving. Modify the driving to reduce the stress and/or eliminate the damage, should the recommended stress level be exceeded or if damage occurs (determined visually or as indicated by the instrumentation).

Do not exceed the following maximum driving stresses, as determined by the dynamic pile testing:

1. For Steel piles:

0.9 Fy, where Fy = Yield strength of steel

2. For Prestressed Concrete Piles:

   Compression:

   $\sigma_{dr} = (0.85f'_c - f_{pe})$

   Tension in Normal Environments:

   $\sigma_{dr} = (0.095\sqrt{f'_c} + f_{pe})$

   Tension in Severe Corrosive Environments:

   $\sigma_{dr} = \varphi_{da} f_{pe}$

   where;
   σ_{dr} = maximum allowed driving stress, ksi
   $f'c$= specified minimum 28-day compressive strength of concrete, ksi
   f_{pe}= effective prestress in concrete, ksi, (after all losses) at the time of driving taken as 0.78 times the initial prestress force

Re-drive friction piles that do not obtain bearing after a freeze period of a minimum of 24 hours or for a period designated on the Plans, whichever is longer. Reset the gauges if required. Re-strike the pile with a warm hammer until a maximum penetration of 3 inches (76 mm) or 40 blows is reached, whichever occurs first. The Engineer may modify the Pile Driving Objective based on the results of the PDA work.

Provide two weeks' notice prior to the driving of designated piles and cooperate with the Engineer in connection with the performance of Dynamic Pile Testing.

Provide a complete report consisting of but not limited to PDA field monitoring data, results of CAPWAP computer analyses, and recommendations such as pile lengths, hammer fuel setting, and valid driving criteria. Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile. Submit the report electronically in PDF format and the electronic data files of the PDA analysis and CAPWAP to the Geotechnical Bureau and allow seven (7) calendar days for review and approval before proceeding with driving production piles.

523.4 Measurement

The Dynamic Pile Tests performed in accordance with these Specifications will be counted separately for payment. (Refer to plans summary sheet for the required amount of PDA testing.)

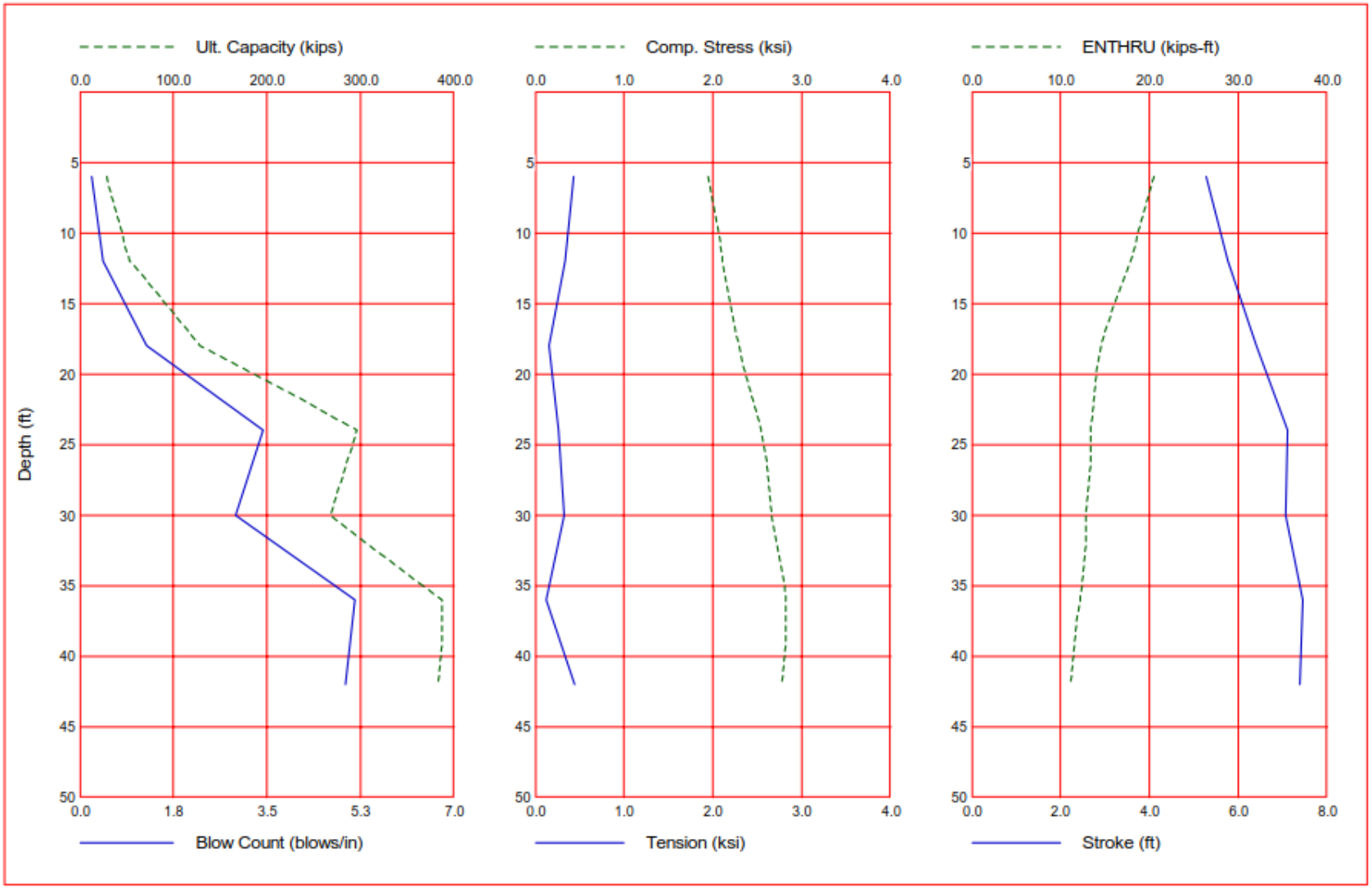
523.5 Payment

The Dynamic Pile Test completed and accepted will be paid for at the Contract unit Price. This payment will be full compensation for all costs of complying with this specification, including incidentals, additional work, and any delays incurred in conjunction therewith.

Payment will be made under:

Item No. 523. Dynamic Pile Test_____ . . . . . Per Each

Office of Materials and Testing



- **Pile: PSC 14 inch**
- **Hammer: APE D19-42**
- **Soil Boring: B4**
- **Pile cushion: 6" plywood**

Project Manager: BG	PI No. 007631
Drawn by: BG	Scale: N.T.S.
Checked by: GL	File Name: ES165111
Approved by: GL	Date: 11/17/2017

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

GRLWEAP Drivability Analysis

Truman Liner Park Trail- Phase II
BFI # 2- Alongside Eisenhower Drive
Savannah, Chatham County, Georgia

Exhibit
C-7-1

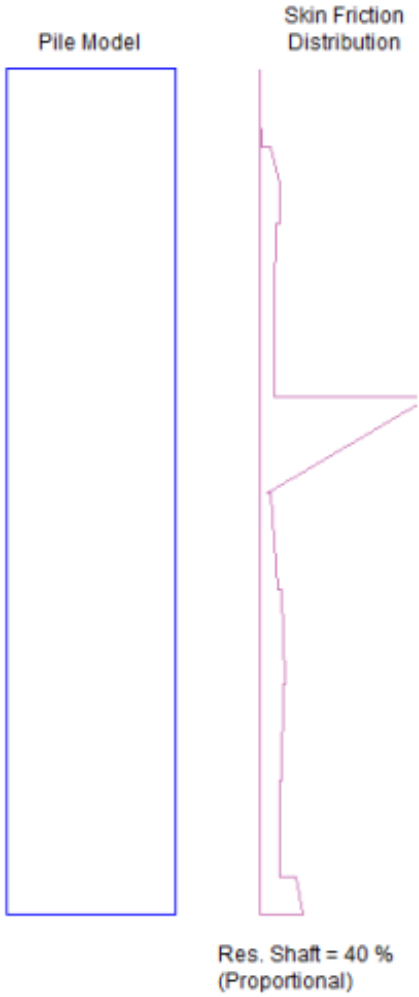
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/in	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	28.4	10.0	18.4	0.2	1.951	-0.434	5.27	20.5
12.0	52.9	40.7	12.2	0.4	2.110	-0.333	5.76	17.9
18.0	128.6	110.6	18.0	1.2	2.297	-0.157	6.42	14.6
24.0	296.2	207.8	88.3	3.4	2.541	-0.264	7.11	13.4
30.0	267.5	243.0	24.5	2.9	2.662	-0.330	7.08	12.8
36.0	387.4	284.9	102.5	5.2	2.819	-0.127	7.45	12.2
42.0	383.0	321.7	61.3	5.0	2.774	-0.441	7.40	11.1

Total Continuous Driving Time 26.00 minutes; Total Number of Blows 1134 (starting at penetration 6.0 ft)

APE D 19-42

Ram Weight	4.19	kips
Efficiency	0.800	
Pressure	1710 (100%)	psi
Helmet Weight	3.00	kips
Hammer Cushion	34825	kips/in
Pile Cushion	980	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.116	in
Skin Damping	0.118	s/ft
Toe Damping	0.150	s/ft
Pile Length	44.00	ft
Pile Penetration	44.00	ft
Pile Top Area	196.00	in2



- **Pile: PSC 14 inch**
- **Hammer: APE D19-42**
- **Soil Boring: B4**
- **Pile cushion: 6” plywood**

Project Manager: BG	PI No. 007631	Terracon Consulting Engineers & Scientists 2201 Rowland Avenue Savannah, Georgia 31404 Phone (912) 629 4000 Fax (912) 629 4001	**GRLWEAP Drivability Analysis**	Exhibit:
Drawn by: BG	Scale: N.T.S.		**Truman Liner Park Trail- Phase II** BFI # 2- Alongside Eisenhower Drive Savannah, Chatham County, Georgia	**C-7-2**
Checked by: GL	File Name: ES165111			
Approved by: GL	Date: 11/17/2017			