

CASE STUDY

STELCOR DDMS TOUCHING DOWN AT JFK AIRPORT



DESIGN LOADS:

70 Tons Compression
25 Tons Tension
4 Tons Lateral

PILE DETAIL:

STELCOR 1600
18" Drive Plate
16" Corrugated Grout Column
11" Reverse Grout Auger
7.00" O.D. X 0.408" W.T. – 80 ksi
Central Shaft

PILE LENGTH: 60'

NUMBER OF PILES: 178

GEOLOGY:

Subsurface explorations at this site encountered a layer of hydraulic fill, marsh deposits, and sands. The upper layer of hydraulic fill ranged from 3-14 feet deep and was underlain by native marsh deposits consisting of gray organic clay and peat. Glacially deposited medium-grained sands extended from the marsh deposit layer to where borings were terminated at 102' and ranged from loose to medium dense.

OVERVIEW:

Another successful STELCOR install at JFK Airport in New York City. This time around, we had the opportunity to provide a deep foundation solution for the expansion of the terminal 4 headhouse. In layman's terms, the part of the airport where you get tickets, drop off baggage, stand in long lines, or wait for bags that may or may not arrive. The terminal 4 project results from the partnership between Delta airlines and PANYNJ, the Port Authority of New York and New Jersey. The \$1.5 billion transformation will allow Delta airlines to consolidate its operations at JFK into one terminal while also updating and expanding its current facilities. The expansion will include additional self-serve kiosks and updates to the baggage claim and arrival areas. In addition to the changes in the headhouse, there will also be ten new gates and additional seating added to the terminal. The renovations and expansion are scheduled to be completed in 2023.



THE PROCEDURE C TESTS ATTEMPTED TO REACH PILE FAILURE BY APPLYING 300% OF THE DESIGNED LOAD. EVEN AT THE MAX LOAD OF 225 TONS IN COMPRESSION, THE PILE TOP DISPLACEMENT WAS JUST OVER 1/2".

Load Test Results	Max Applied Load(Tons)	Pile Top Displacement at Max Applied Load(in)	Net Pile Settlement(in)
Compression B	170	.376	.135
Compression C	255	.504	.084
Tension B	52.7	.104	.008
Tension C	75	.190	.071
Lateral B	8.3	.508	.151
Lateral C	12	.756	.158

CASE STUDY

STELCOR DDMS TOUCHING DOWN AT JFK AIRPORT



CHALLENGES:

The most significant challenge on this site was the headroom restrictions. The headhouse expansion extends under the existing elevated 4-lane departures roadway and the parallel AirTrain. The majority of the piles were to be installed under the roadway, and a few were required under the Airtrain. Both the overpass and AirTrain had to remain operational during the installation. With as little as 12 feet of overhead clearance in areas, traditional driven pile methods were deemed unsafe to install.

Equipment necessary needed to be compact as there was limited site space. The restricted site space also created concerns about managing spoils. Spoils would have to be contained and then trucked away from the site, which would be costly and time-consuming. Lastly, vibrations from installation also need to be considered due to the surrounding structures.



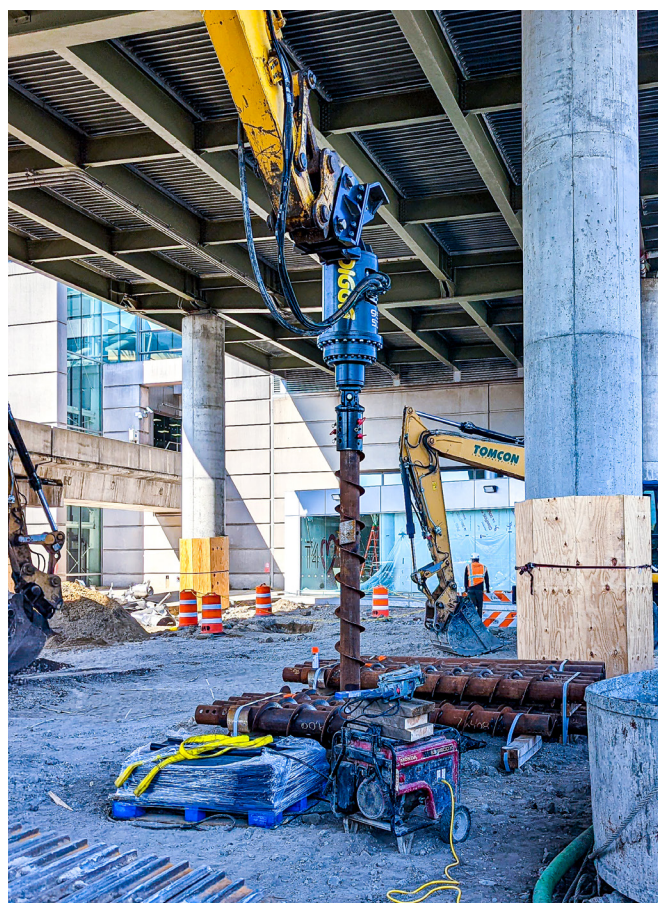
SOLUTION:

Drilled displacement micropiles were specified for this project by ARUP. DDMS were specified as they worked well within the confines of the project and could be installed with relatively minimal and readily available construction equipment. The ease and speed of installation, even with the overhead restrictions, was another advantage of using STELCOR for this project. A further advantage was the vibrationless installation which would not disrupt the surrounding properties or utilities. Using a displacement pile also saved time and money by eliminating spoils. With the above elements considered, STELCOR DDMS proved the ideal solution for supporting the headhouse expansion.

A STELCOR SC1600 pile was designed to resist the required 70 tons in compression, 25 tons in tension, and 4 tons in lateral. It was then tested to 255 tons in compression, 75 tons in tension, and 12 tons in lateral and passed with flying colors. The Procedure C tests attempted to reach pile failure by applying 300% of the design load. Even at the max load of 225 tons in compression, the pile top displacement was just over 1/2". STELCOR was approved by the Port Authority of New York and New Jersey. Urban Foundation/Engineering, LLC, a certified STELCOR installer, was contracted to perform the Deep foundation installation. In total, 178 STELCOR piles were installed to 60 feet, and the AirTrains remained fully operational throughout the project.



THE HEADHOUSE EXPANSION EXTENDS UNDER THE EXISTING ELEVATED 4-LANE DEPARTURES ROADWAY AND THE PARALLEL AIRTRAIN, BOTH OF WHICH HAD TO REMAIN OPERATIONAL DURING INSTALLATION.



PROJECT NUMBER

132040

HOLE ID

HHE-01-MW

LOGGED BY: K. Ficarra
 BEGIN DATE: Nov-02-10
 COMPLETION DATE: Nov-03-10

DRILLING CONTRACTOR: Warren George inc

IN-SITU TESTING

SURFACE ELEVATION: 11.9 ft (NAVD88)

DRILLING METHOD: CORE(0'-5'), ROTARY(5'-102')

DRILL RIG: Acker AK 135G

BOREHOLE DIAMETER: 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE: Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI: 65%

BOREHOLE BACKFILL AND COMPLETION: 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)

GROUNDWATER DURING DRILLING: Not Recorded
 AFTER DRILLING (DATE): 9.7 feet (11/15/2010)

TOTAL DEPTH OF BORING: 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Boring cleared to 5.0' prior to drilling.															
5	(SP) POORLY GRADED SAND, gray, medium dense, fine moist. NYCBC (Class 7) [FILL]	[Dotted pattern]	SPT		5	19-15 -11-15	100									
	Grades loose. NYCBC (Class 7)		SPT		7.5	6-5-4 -3	100									
10			SPT		10	2-2-1 -4	100					21.4				
	(SP-SM) POORLY GRADED SAND WITH SILT, gray, loose - moist. NYCBC (Class 7)	[Dotted pattern]	SPT		12.5	3-4-4 -4	100					32.1				PP: S _u < 250 psf
15	(OH) ORGANIC CLAY, gray, soft - moist. NYCBC (Class 6) [MARSH DEPOSITS]	[Cross-hatched pattern]	ST		15		42									
			ST		17		100									
20	(SP) POORLY GRADED SAND, gray, loose, fine - wet. NYCBC (Class 6) [GLACIAL SAND]	[Dotted pattern]	U		20	6-8-12 -16	100					130.3	17.1			
	Grades medium dense. NYCBC (Class 3b)															
	Grades very dense. NYCBC (Class 3a)		SPT		22.5	14-26 -32-37	100						30.1			
25	(SP-SM) POORLY GRADED SAND WITH SILT, gray, medium dense - wet. NYCBC (Class 3b)	[Dotted pattern]	SPT		25	7-8-8 -7	100					119.4 120.9 121.9	25.3 24.1 23.4			
	(SP) POORLY GRADED SAND WITH SILT, gray, medium dense - wet. NYCBC (Class 3b)	[Dotted pattern]	SPT		27.5	7-10 -10-13	100									

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-01-MW

LOGGED BY
K. Ficarra
BEGIN DATE
Nov-02-10
COMPLETION DATE
Nov-03-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.9 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded 9.7 feet (11/15/2010)	TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30			SPT		30	10-12 -11-13	100									
35			SPT		35	10-12 -11-13	100						29.3			
40	Grades loose. NYCBC (Class 6)		SPT		40	2-4-5 -5	100									
45	Grades medium dense. NYCBC (Class 3b)		SPT		45	4-4-7 -14	100									
50			SPT		50	6-8-11 -14	100									
55			SPT		55	4-12 -13-15	100									
60																

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHE-01-MW

LOGGED BY: K. Ficarra
 BEGIN DATE: Nov-02-10
 COMPLETION DATE: Nov-03-10

DRILLING CONTRACTOR: Warren George inc

IN-SITU TESTING

SURFACE ELEVATION: 11.9 ft (NAVD88)

DRILLING METHOD: CORE(0'-5'), ROTARY(5'-102')

DRILL RIG: Acker AK 135G

BOREHOLE DIAMETER: 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE: Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI: 65%

BOREHOLE BACKFILL AND COMPLETION: 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)

GROUNDWATER DURING DRILLING: Not Recorded
 AFTER DRILLING (DATE): 9.7 feet (11/15/2010)

TOTAL DEPTH OF BORING: 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	6-9-14 -17	100									
65			SPT		65	8-14 -13-13	100									
70			SPT		70	8-11 -14-19	100									
75			SPT		75	7-12 -12-15	100									
80	(SP) POORLY GRADED SAND WITH GRAVEL, gray, dense, fine to coarse - wet. NYCBC (Class 3a)		U		80	36-40 -39-49	100									
85	(SP) POORLY GRADED SAND, gray, very dense, fine - wet. NYCBC (Class 3a)		SPT		85	18-23 -29-40	100									
90																

(continued)

For Information Purposes Only



LOGGED BY K. Ficarra			BEGIN DATE Nov-02-10	COMPLETION DATE Nov-03-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-01-MW
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		SURFACE ELEVATION 11.9 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)			GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded 9.7 feet (11/15/2010)		HAMMER EFFICIENCY, ERI 65%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	Grades dense. NYCBC (Class 3a)	[Material Graphic]	SPT		90	20-22 -16-32	100									
95	Grades medium dense. NYCBC (Class 3b)	[Material Graphic]	SPT		95	10-11 -14-16	100									
100	Grades dense. NCYBC (Class 3a)	[Material Graphic]	SPT		100	15-18 -18-23	100									
105	Drilling not observed by Arup. Log based on samples and field log prepared by Pillori Associates.															
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
110																
115																
120																

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-02

LOGGED BY
A. Littlejohn
BEGIN DATE
Oct-14-10
COMPLETION DATE
Oct-16-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.3 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 In Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Boring cleared to 5.0' prior to drilling.															
5	(SP-SM) POORLY GRADED SAND WITH SILT, yellow brown, medium dense, fine - moist. NYCBC (Class 7) [FILL]	[Pattern]	U	5	6-17	100							12.1			Concrete/gravel obstruction, sample collected in jar
7.5	(SP) POORLY GRADED SAND, yellow brown, medium dense, fine - moist. NYCBC (Class 7)	[Pattern]	SPT	7.5	9-10 -12-12	54							21.7			
10	Trace silt.	[Pattern]	SPT	10	5-6-7 -10	67							24.7			
12.5	Grades loose. NYCBC (Class 7)	[Pattern]	SPT	12.5	4-4-4 -4	58										
15	(OH) ORGANIC CLAY, dark brown, soft, with strong organic odor, decomposing vegetative matter - moist. NYCBC (Class 6) [MARSH DEPOSITS]	[Pattern]	ST	15		100						97.3	65.9 68.3 73.9	103		
17		[Pattern]	ST	17		100						97.2	76.4 72.6 69.9			UU = 300
19	(SP) POORLY GRADED SAND, yellow brown to gray, loose, fine, trace silt - moist. NYCBC (Class 6) [GLACIAL SAND]	[Pattern]	SPT	19	3-4-6 -7	67						99.8 100.5	70.1 71.3 62.2 24.1			
21.5	(SM) SILTY SAND, yellow brown to gray, medium dense, fine - moist. NYCBC (Class 3b)	[Pattern]	U	21.5	8-17 -37-45	100						123.4 122.5 119.7	22.3 22.4 25.1			
24	(SP) POORLY GRADED SAND, yellow brown to gray, medium dense, fine - moist. NYCBC (Class 3b)	[Pattern]	SPT	24	8-10 -11-12	79										
26.5	Grades loose. NYCBC (Class 6)	[Pattern]	SPT	26.5	4-5-4 -5	71										
29	Grades medium dense. NYCBC (Class 3b)	[Pattern]	SPT	29	6-10 -14-18	58										

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHE-02

LOGGED BY: A. Littlejohn
 BEGIN DATE: Oct-14-10
 COMPLETION DATE: Oct-16-10

DRILLING CONTRACTOR: Warren George inc

IN-SITU TESTING

SURFACE ELEVATION: 12.3 ft (NAVD88)

DRILLING METHOD: CORE(0'-5'), ROTARY(5'-102')

DRILL RIG: Acker AK 135G

BOREHOLE DIAMETER: 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE: Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI: 65%

BOREHOLE BACKFILL AND COMPLETION: Neat Cement Grout

GROUNDWATER DURING DRILLING: Not Recorded
 AFTER DRILLING (DATE): Not Recorded

TOTAL DEPTH OF BORING: 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30																
35			SPT		35	4-6-7-11	67									
40			SPT		40	6-11-8-10	67									
45			SPT		45	5-7-8-11	100									From Pillori log
50			SPT		50	3-4-10-17	100					24.9				
55			SPT		55	7-8-11-16	100									
60																

(continued)

For Information Purposes Only

ARUP

BOREHOLE NO. HHE-02
 SHEET 2 OF 4

PROJECT NUMBER
132040
 HOLE ID
HHE-02

LOGGED BY
 A. Littlejohn
 BEGIN DATE
 Oct-14-10
 COMPLETION DATE
 Oct-16-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.3 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60	(SP-SM) POORLY GRADED SAND WITH SILT, yellow brown to gray, medium dense, fine - moist. NYCBC (Class 3b)		SPT		60	4-5-8 -10	100						23.9			
65	(SP) POORLY GRADED SAND WITH SILT, yellow brown to gray, medium dense, fine - moist. NYCBC (Class 3b)		SPT		65	5-6-6 -6	100									
70			SPT		70	8-10 -11-16	100									
75			U		75	13-27 -30-33	100									
80			SPT		80	7-11 -15-18	100									
85			SPT		85	10-14 -14-20	100									

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For Information Purposes Only

ARUP

BOREHOLE NO. HHE-02
 SHEET 3 OF 4

LOGGED BY A. Littlejohn			BEGIN DATE Oct-14-10	COMPLETION DATE Oct-16-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-02
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		SURFACE ELEVATION 12.3 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	(SP) POORLY GRADED SAND WITH GRAVEL, gray, dense, fine to coarse - wet. NYCBC (Class 3a)		SPT		90	11-19 -22-26	100									
95	Grades very dense. NYCBC (Class 3a)		SPT		95	23-31 -36-38	100									
100			SPT		100		100									
105	Drilling not observed by Arup from depth 45' to end of borehole. For depths greater than 45', log is based on samples and field log prepared by Pillori Associates.															
110	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
115																
120																

For Information Purposes Only



PROJECT NUMBER 132040
HOLE ID HHE-03-PS
SURFACE ELEVATION 10.5 ft (NAVD88)
BOREHOLE DIAMETER 4 in
HAMMER EFFICIENCY, ERI 81%
TOTAL DEPTH OF BORING 102 ft

LOGGED BY Z. Khan	BEGIN DATE Oct-13-10	COMPLETION DATE Oct-14-10
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DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING P-S Suspension Logging
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded Not Recorded

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 5.0'															
5	(SP) POORLY GRADED SAND WITH SILT, gray, medium dense, fine to medium - moist. NYCBC (Class 7) [FILL]	[Dotted pattern]	U		5	13-21 -24-29	75									
			SPT		7	6-6-13 -17	75						25.9			
10	(SP-SM) POORLY GRADED SAND, gray, loose, fine to medium - wet. NYCBC (Class 7)	[Dotted pattern]	SPT		10	3-5-4 -5	50						28.3			
12.5	(OH) ORGANIC CLAY, dark gray, soft, strong organic odor with decaying vegetative matter - moist. NYCBC (Class 6)	[Cross-hatched pattern]	SPT		12.5	2-2-1 -4	75									PP: S _u = 500 psf
15			ST		15		NR									
17			ST		17		NR									
20	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 7) [GLACIAL SAND]	[Dotted pattern]	SPT		20	9-11 -14-18	75									
			SPT		22.5	9-12 -15-16	50									
			SPT		25	5-7-9 -13	50									
	Grades dense. NYCBC (Class 3a)		SPT		27.5	7-12 -20-22	50									

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHE-03-PS

LOGGED BY: Z. Khan
 BEGIN DATE: Oct-13-10
 COMPLETION DATE: Oct-14-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING P-S Suspension Logging	SURFACE ELEVATION 10.5 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded
		TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30	Grades medium dense. NYCBC (Class 3b)		SPT		30	6-9-9 -14	50									
35			SPT		35	5-6-7 -8	NR									No recovery (1" collected in sample jar)
40			U		40	12-19 -20-22	NR									Finished drilling for day at 4:30 am on 10/13/2010; Started drilling at 12:00 am on 10/14/2010
45	Grades light gray - wet		SPT		45	4-5-6 -9	50						28.2			
50	Grades very dense. NYCBC (Class 3a)		SPT		50	16-26 -28-32	100									
55	Grade medium dense, layer 1" thick with black staining. NYCBC (Class 3b)		SPT		55	4-4-10 -25	75									

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
 HOLE ID
HHE-03-PS

LOGGED BY
 Z. Khan
 BEGIN DATE
 Oct-13-10
 COMPLETION DATE
 Oct-14-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING P-S Suspension Logging	SURFACE ELEVATION 10.5 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded
		TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60	Grades without black staining		SPT		60	8-10 -14-16	50									
65			SPT		65	6-7-10 -15	50									
70	(SP-SM) POORLY GRADED SAND WITH SILT, gray, dense, fine to medium - moist. NYCBC (Class 3a)		U		70	22-35 -40-44	100					124.4	24.2			
75	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 3b)		SPT		75	10-11 -15-15	50						28			
80	(SP) POORLY GRADED SAND WITH GRAVEL, yellowish brown, very dense, fine to coarse, gravel is subangular, about 1/4" in diameter - moist. NYCBC (Class 3a)		SPT		80	26-51 -42-43	75									
85	(SP) POORLY GRADED SAND, dense, fine to medium - moist. NYCBC (Class 3a)		SPT		85	8-35 -10-89	75									

(continued)

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Oct-13-10	COMPLETION DATE Oct-14-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING P-S Suspension Logging		HOLE ID HHE-03-PS
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AD II		SURFACE ELEVATION 10.5 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	(SC) CLAYEY SAND, dark gray, loose - moist. NYCBC (Class 6)		SPT		90	6-4-6 -11	75									
95	(SP) POORLY GRADED SAND, gray, dense, fine to medium - moist. NYCBC (Class 3a)		SPT		95	11-14 -30-41	75									
100			SPT		100	15-21 -28-39	50									
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
110																
115																
120																

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Oct-15-10	COMPLETION DATE Oct-21-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-04
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AD II		SURFACE ELEVATION 12.2 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout			GROUNDWATER DURING DRILLING Not Recorded		AFTER DRILLING (DATE) Not Recorded
			READINGS		TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 5.0'															
5	Undefined		SPT		5	7-8-13 -17	NR									At 5' - 7' no recovery
7	(SP-SM) POORLY GRADED SAND WITH SILT, grayish brown, medium dense, fine to medium - moist. NYCBC (Class 7) [FILL]		SPT		7	10-10 -13-20	50						18.6			
10	(SP) POORLY GRADED SAND, grayish brown, medium dense, fine to medium, moist. NYCBC (Class 7)		U		10	11-14 -14-12	100					121.7	18.2			
12	(OH) ORGANIC CLAY, dark gray, medium stiff, strong organic odor, with decaying vegetative matter - moist. NYCBC (Class 4c) [MARSH DEPOSITS]		SPT		12	1-3-2 -5	50						29			
15			ST		15		100					106.9	74.7 41.7 32.8			Sample at depth 15' fell; High disturbance expected
17			ST		17		100					95.8	41.7 74.7 92.7	93		
19			ST		19		100					95.3 93.7 93.2	74.2 70.8 71.9			
20	(SP) POORLY GRADED SAND, grayish brown, medium dense, fine to medium - moist. NYCBC (Class 3b) [GLACIAL SAND]		SPT		21	4-9-12 -18	50						97.3 80 71.1 74.5			UU = 430
23	Grades very dense. NYCBC (Class 3a)		SPT		23	16-20 -32-47	75									Continuous sampling - N-value high
25	Grades light gray, medium dense. NYCBC (Class 3b)		SPT		25	11-12 -12-15	50									
27	(SM) SILTY SAND, grayish brown, very dense, fine to medium - moist. NYCBC (Class 3a)		SPT		27	10-22 -40-40	75						25.4			Continuous sampling - N-value high

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-04

LOGGED BY
Z. Khan
BEGIN DATE
Oct-15-10
COMPLETION DATE
Oct-21-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.2 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)		Moisture Content (%)		Plasticity Index (%)	Strength (psf)	Remarks
30	Grades medium dense - wet. NYCBC (Class 3b)		SPT		30	8-10 -13-18	50											
35			SPT		35	8-10 -11-13	50											
40	Grades dense. NYCBC (Class 3a)		U		40	20-22 -40-100	75					116.4 117.7 112.8	24.5 25.5 24.4					
45	Grades medium dense. NYCBC (Class 3b)		SPT		45	6-5-5 -7	50											
50			SPT		50	6-6-6 -6	75											
55			SPT		55	9-9-9 -11	75											

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-04

LOGGED BY
Z. Khan
BEGIN DATE
Oct-15-10
COMPLETION DATE
Oct-21-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.2 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	10-8-8 -13	50									
65			SPT		65	16-15 -10-15	75									
70			SPT		70	12-15 -14-13	100									
75			SPT		75	11-11 -16-20	50									
80	(SP) POORLY GRADED SAND WITH GRAVEL, gray, very dense, fine to medium, gravel is subrounded - wet. NYCBC (Class 3a)		U		80		25					134.5	12.4			
85	(SP-SM) POORLY GRADED SAND WITH SILT, gray, very dense, fine to medium - wet. NYCBC (Class 3a)		SPT		85	41-39 -57-87	75						15.8			
90																

(continued)

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Oct-15-10	COMPLETION DATE Oct-21-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-04
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AD II		SURFACE ELEVATION 12.2 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	(SM) SILTY SAND, dark gray, medium dense, trace clay - moist. NYCBC (Class 3b)		SPT		90	11-12 -12-15	50						20.4			
95	(ML) INORGANIC SILT, dark gray, medium dense, moist. NYCBC (Class 3b)		SPT		95	7-5-13 -25	100									
100	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 3b)		SPT		100	14-11 -7-15	100									
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
110																
115																
120																

For Information Purposes Only



PROJECT NUMBER 132040
HOLE ID HHE-05
SURFACE ELEVATION 11.3 ft (NAVD88)
BOREHOLE DIAMETER 4 in
HAMMER EFFICIENCY, ERI 65%
TOTAL DEPTH OF BORING 102 ft

LOGGED BY K. Ficarra	BEGIN DATE Oct-18-10	COMPLETION DATE Nov-02-10
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DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded Not Recorded

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Borehole cleared to 5.0' prior to drilling.															
5	(SP) POORLY GRADED SAND, yellowish brown, medium dense, fine to medium. NYCBC (Class 7) [FILL]	[Dotted pattern]	SPT		5	6-10 -11-13	100						16.7			
	Grades gray, fine to coarse.		U		7.5	13-21 -21-23	100					120.2 125.9 121.4	15.6 14.1 14.3			
10	Grades fine to medium.		SPT		10	5-6-6 -9	100						26.3			
			SPT		12.5	4-4-4 -3	100									
15	(OH) ORGANIC CLAY, gray, medium stiff. NYCBC (Class 4c) [MARSH DEPOSITS]	[Cross-hatched pattern]	ST		14.5		100									
			ST		16.5		100									
20	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium. NYCBC (Class 3b) [GLACIAL SAND]	[Dotted pattern]	SPT		19	4-8-11 -16	100									
			SPT		21.5	9-16 -22-24	100						28.7			
25	(SP) POORLY GRADED SAND WITH SILT, gray, dense, fine to medium. NYCBC (Class 3a)	[Dotted pattern]	U		24	59-78 -100/3	75					122.9	22.1			
			SPT		26.5	10-10 -16-22	100									

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHE-05

LOGGED BY K. Ficarra	BEGIN DATE Oct-18-10	COMPLETION DATE Nov-02-10
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DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.3 ft (NAVD88)
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DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
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SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
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BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS	AFTER DRILLING (DATE) Not Recorded	TOTAL DEPTH OF BORING 102 ft
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DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30	Grades dense, fine to medium. NYCBC (Class 3b)		SPT		30	9-15 -23-23	100						25.6			
35	Grades medium dense. NYCBC (Class 3b)		SPT		35	4-5-9 -10	100									
40			SPT		40	2-5-5 -6	100									
45			SPT		45	5-6-9 -10	100									
50	(SP-SM) POORLY GRADED SAND WITH SILT, gray, medium dense, fine to medium. NYCBC (Class 3b)		SPT		50	3-9-16 -23	100						25.2			
55	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium. NYCBC (Class 3b)		SPT		55	4-5-5 -9	100									
60																

(continued)

For Information Purposes Only

ARUP

BOREHOLE NO. HHE-05
SHEET 2 OF 4

PROJECT NUMBER
132040
HOLE ID
HHE-05

LOGGED BY
K. Ficarra
BEGIN DATE
Oct-18-10
COMPLETION DATE
Nov-02-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.3 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	3-4-7 -10	100									
65	Grades dense. NYCBC (Class 3a)		SPT		65	9-16 -18-20	100									
70	Grades medium dense. NYCBC (Class 3b)		SPT		70	4-6-13 -22	100									
75			SPT		75	8-11 -18-28	100									
80	(SP) POORLY GRADED SAND WITH GRAVEL, gray, very dense, fine to coarse. NYCBC (Class 3a)		SPT		80	26-28 -32-37	100									
85	(SP) POORLY GRADED SAND, gray, very dense, fine. NYCBC (Class 3a)		SPT		85	22-24 -30-31	100									

(continued)

For Information Purposes Only



LOGGED BY K. Ficarra			BEGIN DATE Oct-18-10	COMPLETION DATE Nov-02-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-05
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		SURFACE ELEVATION 11.3 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Neat Cement Grout			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					HAMMER EFFICIENCY, ERI 65%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	Grades medium dense. NYCBC (Class 3b)		SPT		90	10-11 -13-18	100									
95			SPT		95	9-13 -16-19	100									
100			SPT		100	7-7-14 -20	100									
105	Drilling not observed by Arup. Log based on samples and field log prepared by Pillori Associates.															
110	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
115																
120																

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-06

LOGGED BY
T. Carroll
BEGIN DATE
Nov-03-10
COMPLETION DATE
Nov-03-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.0 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Previously hand augered to 5.0'.															
5	Undefined		U		5	6-3-2 -4	NR									At 5' - 7' no recovery
	(SP) POORLY GRADED SAND WITH GRAVEL, brownish gray, medium dense, sand is fine, gravel is coarse to fine (subangular) - moist. NYCBC (Class 7) [FILL]		SPT		7	1-1-4 -6	33						16.8			First 2 blows set SPT to correct depth, i.e., only 18" done 1-4-6 with N=10
10	(SP) POORLY GRADED SAND, brownish gray, medium dense, fine - moist.		SPT		10	7-8-10 -11	58						24.8			
	Layer of coarse gravel 3" thick at 13.5'		SPT		12.5	7-10 -18-29	100									
15	(PT) PEAT, dark brown, soft to stiff, with organic clay, roots and decomposed vegetation are up to 1/8" thick - moist. NYCBC (Class 6) [MARSH DEPOSITS]		SPT		15	1-2-2 -3	75									PP: S _u = 750, 1,000 psf
	(OH) ORGANIC CLAY, dark gray, medium stiff, trace fine sand, with decomposed vegetation up to 1/8" thick - moist. NYCBC (Class 4c)		ST		17		100									PP: S _u = 750, 1,000, 750 psf TV: S _u = 600, 600 psf
20			ST		19		NR									
	21.0', grades to dark brown SANDY CLAY, sand is fine, clay is organic, medium dense - wet.		SPT		21	2-5-9 -12	100									
	(SP) POORLY GRADED SAND, grayish brown, medium dense, fine, trace silt, decayed vegetation - wet. NYCBC (Class 3b) [GLACIAL SAND]		SPT		23	8-12 -12-13	100						26.2			
	Grades trace coarse sand, strong sulfur odor.															
25	Grades gray, without coarse sand.		SPT		25	6-8-10 -18	100									
	Grades without sulfur odor, with coarse sand.		SPT		27.5	1-4-10 -13	75									

(continued)

For Information Purposes Only

ARUP

BOREHOLE NO. HHE-06
SHEET 1 OF 4

PROJECT NUMBER

132040

HOLE ID

HHE-06

LOGGED BY T. Carroll
 BEGIN DATE Nov-03-10
 COMPLETION DATE Nov-03-10

DRILLING CONTRACTOR Warren George inc

IN-SITU TESTING

SURFACE ELEVATION 12.0 ft (NAVD88)

DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')

DRILL RIG Acker AD II

BOREHOLE DIAMETER 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI 81%

BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop

GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded Not Recorded

TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30	Grades without coarse sand.		U		30	14-18 -26-30	42									
35	Grades loose, with sulfur odor. NYCBC (Class 6)		SPT		35	2-3-3 -5	83					122	23			
40	Grades medium dense, with coarse sand, without sulfur odor. NYCBC (Class 3b)		SPT		40	5-6-8 -12	75						30.5			
45	Grades loose, without coarse sand. NYCBC (Class 6)		SPT		45	3-5-3 -6	67									
50			SPT		50	4-4-4 -6	75									
55	Grades medium dense, very fine. NYCBC (Class 3b)		SPT		55	6-7-6 -8	50									

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHE-06

LOGGED BY
T. Carroll
BEGIN DATE
Nov-03-10
COMPLETION DATE
Nov-03-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.0 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	3-4-7-8	75									
65	Grades fine to medium.		SPT		65	12-13-8-10	92									
70			SPT		70	7-8-9-14	75									
75	Grades very dense. NYCBC (Class 3a)		U		75	59-89	NR					122.9 123.5 119.6	21.1 21.3 21.8			
80	(SP) POORLY GRADED SAND WITH GRAVEL, light yellowish brown, very dense, sand is coarse to fine (quartz, subrounded) - wet. NYCBC (Class 3a)		SPT		80		75									Automatic hammer malfunction and blow counts are approximately 29-55-40-15
85	(SP) POORLY GRADED SAND, brownish gray, very dense, fine to medium, trace silt, fine gravel - moist. NYCBC (Class 3a)		SPT		85	16-20-31-29	75									
90																


(continued)

For Information Purposes Only



BOREHOLE NO. HHE-06
SHEET 3 OF 4

LOGGED BY T. Carroll			BEGIN DATE Nov-03-10	COMPLETION DATE Nov-03-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-06
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AD II		SURFACE ELEVATION 12.0 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks	
90	Grades medium dense, without gravel. NYCBC (Class 3b)		SPT		90	17-14 -16-23	75										
95			SPT		95	12-14 -14-15	75										
100			SPT		100	8-12 -17-25	75										
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.																
110																	
115																	
120																	

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Nov-03-10	COMPLETION DATE Nov-03-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHE-PC-01
DRILLING METHOD CORE(0'-5'), ROTARY(5'-17')			DRILL RIG Acker AD II		SURFACE ELEVATION 11.7 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Gravel			GROUNDWATER DURING DRILLING Not Recorded		AFTER DRILLING (DATE) Not Recorded
			READINGS		HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 In Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 5.0'															
5	(SP) POORLY GRADED SAND, yellowish brown, loose, fine to medium - moist. NYCBC (Class 7) [HYDRAULIC FILL]		SPT	5	2-4-5-8	25										
7.5			SPT	7.5	4-5-3-13	NR										
10	Grades dark gray, trace silt - wet.		SPT	10	2-4-4-5	50										Driving 10' of casing before take Sample 10 - 12 - 1' is above ground
12.5	Top 6" grades very loose.		SPT	12.5	3-1-1-3	75										
15	(OH) ORGANIC CLAY, dark gray, soft, strong organic odor, with decaying roots (1/8") and vegetation - moist. NYCBC (Class 6) [MARSH DEPOSITS]		SPT	15	2-2-2-4	100										
20	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
25																
30																

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHE-PC-02

LOGGED BY Z. Khan
 BEGIN DATE Oct-19-10
 COMPLETION DATE Oct-19-10

DRILLING CONTRACTOR
 Warren George inc

IN-SITU TESTING

SURFACE ELEVATION
 11.3 ft (NAVD88)

DRILLING METHOD
 CORE(0'-5'), ROTARY(5'-17')

DRILL RIG
 Acker AD II

BOREHOLE DIAMETER
 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID)
 SPT(1-3/8")

SPT HAMMER TYPE
 Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI
 81%

BOREHOLE BACKFILL AND COMPLETION
 Neat Cement Grout

GROUNDWATER DURING DRILLING AFTER DRILLING (DATE)
 READINGS Not Recorded Not Recorded

TOTAL DEPTH OF BORING
 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 5.0'															
5	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - dense. NYCBC (Class 7) [FILL]		SPT	5	4-9-11 -11	50										
7.5			SPT	7.5	4-7-12 -15	50										
10			SPT	10	5-6-8 -10	50										
12.5	(OH) ORGANIC CLAY, dark gray, soft, with decaying vegetative matter - moist. NYCBC (Class 6) [MARSH DEPOSITS]		SPT	12.5	3-1-2 -3	75										PP: S _u = 500 psf
15			SPT	15	2-1-3 -4	100										
20	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															

For Information Purposes Only

ARUP

BOREHOLE NO. HHE-PC-02
 SHEET 1 OF 1

PROJECT NUMBER

132040

HOLE ID

HHE-PC-03

LOGGED BY Z. Khan
 BEGIN DATE Oct-20-10
 COMPLETION DATE Oct-20-10

DRILLING CONTRACTOR
 Warren George inc

IN-SITU TESTING

SURFACE ELEVATION
 12.2 ft (NAVD88)

DRILLING METHOD
 CORE(0'-5'), ROTARY(5'-17')

DRILL RIG
 Acker AD II

BOREHOLE DIAMETER
 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID)
 SPT(1-3/8")

SPT HAMMER TYPE
 Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI
 81%

BOREHOLE BACKFILL AND COMPLETION
 Sand & Blacktop

GROUNDWATER DURING DRILLING AFTER DRILLING (DATE)
 READINGS Not Recorded Not Recorded

TOTAL DEPTH OF BORING
 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 In Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 7.0'.															
7	(SP) POORLY GRADED SAND, grayish brown, medium dense, fine to medium - moist. NYCBC (Class 7) [FILL]	[Dotted pattern]	SPT		7	8-11 -13-22	50									
9	Grades very dense.		SPT		9	10-21 -30-30	50									
11.5	11.5', grades medium dense with black staining.		SPT		11	3-7-9 -19	50									
13	(OH) ORGANIC CLAY, dark gray, soft, with decaying vegetative matter - moist. NYCBC (Class 6) [MARSH DEPOSITS]	[Cross-hatched pattern]	SPT		13	1-1-1 -3	75									
15			SPT		15	1-WOH -1-3	75									
See Borehole Log Legend for soil classification chart and key to test data and sampler type.																

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHW-01-MW

LOGGED BY Z. Khan	BEGIN DATE Sep-24-10	COMPLETION DATE Sep-30-10
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DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.7 ft (NAVD88)
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DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
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SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
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BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING READINGS 9.6 feet (10/27/2010)	AFTER DRILLING (DATE) Not Recorded	TOTAL DEPTH OF BORING 102 ft
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DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Boring cleared to 5.0' prior to drilling.															
5	(SP) POORLY GRADED SAND, yellowish brown, loose, fine to medium, grades reddish brown at tip - moist. NYCBC (Class 7) [HYDRAULIC FILL]		SPT	5	2-3-4 -4	50							17			
	Grades wet.		SPT	7.5	3-3-7 -8	50							21.2			
10	Grades grayish brown, medium dense. NYCBC (Class 7)		SPT	10	9-10 -12-11	50										
12.5	(OH) ORGANIC CLAY, dark gray, very soft, slight organic odor, with decomposed vegetative matter - moist. NYCBC (Class 6) [MARSH DEPOSITS]		SPT	12.5	3-2-2	50										PP: S _u = 500 psf
15			ST	15		NR										No recovery, direct push
17			ST	17		100										
20	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 3b) [GLACIAL SAND]		SPT	19	8-11 -15-17	50										
22.5	(SP-SM) POORLY GRADED SAND WITH SILT, gray, medium dense, fine to medium - moist. NYCBC (Class 3b)		SPT	22.5	9-11 -14-18	50							26			
25	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 3b)		SPT	25	7-7-10 -11	50							30.7			
27.5	Grades very loose - wet. NYCBC (Class 6)		SPT	27.5	3-2-2 -6	42										

(continued)

For Information Purposes Only

ARUP

BOREHOLE NO. HHW-01-MW
SHEET 1 OF 4

PROJECT NUMBER
132040
 HOLE ID
HHW-01-MW

LOGGED BY
 Z. Khan
 BEGIN DATE
 Sep-24-10
 COMPLETION DATE
 Sep-30-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.7 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS 9.6 feet (10/27/2010) Not Recorded	TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30	Grades medium dense. NYCBC (Class 3b)	[Dotted pattern]	SPT		30	5-6-12 -18	50									
35	Grades dense. NYCBC (Class 3a)	[Dotted pattern]	SPT		35	10-17 -26-32	100									
40	Grades light gray, medium dense, fine. NYCBC (Class 3b)	[Dotted pattern]	SPT		40	11-13 -11-11	50									
45	Grades yellowish brown, fine to medium.	[Dotted pattern]	SPT		45	6-4-7 -9	50									
50		[Dotted pattern]	SPT		50	7-13 -13-32	50									
55		[Dotted pattern]	SPT		55	16-8-7 -8	75									

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
 HOLE ID
HHW-01-MW

LOGGED BY
 Z. Khan
 BEGIN DATE
 Sep-24-10
 COMPLETION DATE
 Sep-30-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.7 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS 9.6 feet (10/27/2010) Not Recorded	TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60	Grades dense - moist. NYCBC (Class 3a)	[Material Graphic]	SPT		60	10-12 -30-54	75						22.8			
65	Grades medium dense. NYCBC (Class 3b) (SP-SM) POORLY GRADED SAND WITH SILT, gray, medium dense - moist. NYCBC (Class 3b)	[Material Graphic]	SPT		65	6-11 -15-15	75						25.9			
70	(SP) POORLY GRADED SAND, gray, medium dense - moist. NYCBC (Class 3b)	[Material Graphic]	SPT		70	10-15 -15-16	50									
75	Grades dense. NYCBC (Class 3a)	[Material Graphic]	SPT		75	15-18 -21-25	50									
80	Grades gray, trace gravel.	[Material Graphic]	SPT		80	6-13 -29-41	50									
85	(SP) POORLY GRADED SAND WITH GRAVEL, yellow brown, very dense - wet. NYCBC (Class 3a)	[Material Graphic]	SPT		85	28-41 -40-63	83									

(continued)

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Sep-24-10	COMPLETION DATE Sep-30-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHW-01-MW
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AD II		SURFACE ELEVATION 11.7 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)			GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS 9.6 feet (10/27/2010) Not Recorded		HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90			SPT		90	18-23 -34-53	33									
95			SPT		95	16-40 -79-100	83									
100			SPT		100	36-100	100									
105																
110																
115																
120																

See Borehole Log Legend for soil classification chart and key to test data and sampler type.

For Information Purposes Only

PROJECT NUMBER 132040
HOLE ID HHW-02-MW
SURFACE ELEVATION 12.6 ft (NAVD88)
BOREHOLE DIAMETER 4 in
HAMMER EFFICIENCY, ERI 65%
TOTAL DEPTH OF BORING 102 ft

LOGGED BY: A. Littlejohn
 BEGIN DATE: Oct-08-10
 COMPLETION DATE: Oct-13-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded 10.4 feet (10/27/2010)

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Boring cleared to 5.0' prior to drilling.															
5	(SP-SM) POORLY GRADED SAND WITH SILT, light yellow brown, loose, fine - moist. NYCBC (Class 7) [FILL]		U		5	7-7-9 -9	100						8.8			
	(SP) POORLY GRADED SAND, dark yellow brown, loose, fine - moist. NYCBC (Class 7) Grades dark yellow brown.		SPT		7	3-2-2 -3	86						22.7			
10			U		9.5	3-2-3 -2	NR									
			SPT		11.5	0-1-6 -6	63									
15			SPT		14	3-4-6 -7	58						27.6			
			SPT		16.5	6-5-5 -3	75									
20	(OH) ORGANIC CLAY, black, medium stiff - moist. NYCBC (Class 4c) [MARSH DEPOSITS]		SPT		19	2-3-3 -2	100									
	(PT) PEAT, light yellow brown, soft - moist. NYCBC (Class 4c)		ST		21		100					117.2	15.8			
	(OH) ORGANIC CLAY, black, medium stiff - moist. NYCBC (Class 4c)		ST		23		100					116.8	19.8			
	(SM) SILTY SAND, gray, medium dense, fine to coarse - moist. NYCBC (Class 3b) [GLACIAL SAND]		ST		25		100						22.3			
			SPT		25	4-12 -12-14	63						37.3			
			SPT		25	4-12 -12-14	63						26.9			
			SPT		25	4-12 -12-14	63						24.7			Sand at bottom of tube at depth 25' - 27'
			U		27	11-16 -23-25	100					127.3	18.1			
			U		27	11-16 -23-25	100					125.1	20.8			
			U		27	11-16 -23-25	100					124.8	22.2			

(continued)

For Information Purposes Only



LOGGED BY A. Littlejohn			BEGIN DATE Oct-08-10	COMPLETION DATE Oct-13-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHW-02-MW
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		SURFACE ELEVATION 12.6 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)			GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded 10.4 feet (10/27/2010)		HAMMER EFFICIENCY, ERI 65%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30	(SP) POORLY GRADED SAND, gray, loose, fine to coarse moist. NYCBC (Class 6)		SPT		30	3-3-5 -5	67						24.3			
35	Grades medium dense. NYCBC (Class 3b)		SPT		35	6-6-6 -9	75						24.8			
40			SPT		40	7-12 -12-14	67									
45			SPT		45	4-4-8 -11	71									
50			SPT		50	4-7-8 -9	67									
55			SPT		55	3-5-13 -21	67									
60																

(continued)

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHW-02-MW

LOGGED BY
A. Littlejohn
BEGIN DATE
Oct-08-10
COMPLETION DATE
Oct-13-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 12.6 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)	GROUNDWATER DURING DRILLING AFTER DRILLING (DATE) READINGS Not Recorded 10.4 feet (10/27/2010)	TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	7-9-13 -15	75									
65	Grades dark brown, dense. NYCBC (Class 3a)		SPT		65	6-18 -18-17	75									
70			U		70	15-24 -25-32	100					119 116.8 117.4	22.8 23.8 23.4			
75	Grades medium dense. NYCBC (Class 3b)		SPT		75	7-10 -12-16	63									
80			SPT		80	7-10 -18-10	63									
85	(SP) POORLY GRADED SAND WITH GRAVEL, gray to yellow brown, very dense - moist. NYCBC (Class 3a)		SPT		85	21-24 -28-32	63									
90																

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHW-02-MW

LOGGED BY: A. Littlejohn
 BEGIN DATE: Oct-08-10
 COMPLETION DATE: Oct-13-10

DRILLING CONTRACTOR: Warren George inc

IN-SITU TESTING

SURFACE ELEVATION: 12.6 ft (NAVD88)

DRILLING METHOD: CORE(0'-5'), ROTARY(5'-102')

DRILL RIG: Acker AK 135G

BOREHOLE DIAMETER: 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE: Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI: 65%

BOREHOLE BACKFILL AND COMPLETION: 2" Dia. Standpipe Piezometer (Screen Depth: 70-80 ft)

GROUNDWATER DURING DRILLING: Not Recorded
 AFTER DRILLING (DATE): 10.4 feet (10/27/2010)

TOTAL DEPTH OF BORING: 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	Grades dense. NYCBC (Class 3a) (SM) SILTY SAND, dark brown, dense, fine - moist. NYCBC (Class 3a)	[Material Graphic]	SPT		90	16-17 -19-28	58									
95	(ML) SANDY SILT, dark brown to gray, medium dense, fine - moist. NYCBC (Class 5b)	[Material Graphic]	SPT		95	9-12 -13-16	100									
100	(SP) POORLY GRADED SAND, gray brown, very dense, fine, trace fine gravel, trace silt - moist. NYCBC (Class 3a)	[Material Graphic]	SPT		100	19-27 -37-54	71									
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
110																
115																
120																

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHW-03-PS

LOGGED BY
A. Littlejohn
BEGIN DATE
Oct-02-10
COMPLETION DATE
Oct-07-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING P-S Suspension Logging	SURFACE ELEVATION 11.8 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')	DRILL RIG Acker AK 135G	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 65%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING READINGS Not Recorded	AFTER DRILLING (DATE) Not Recorded
		TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Boring cleared to 5.0' prior to drilling.															
5	(SP) POORLY GRADED SAND, dark yellow brown, medium dense, fine to medium - moist. NYCBC (Class 7) [FILL]		U		5	9-11 -16-17	100									
7	(SP-SM) POORLY GRADED SAND WITH SILT, dark yellow brown, medium dense, fine to medium - moist. NYCBC (Class 7)		SPT		7	4-4-6 -7	79						41.6			
10			U		10	8-16 -13-10	33						67.6			
12	(OH) ORGANIC CLAY, dark brown, medium stiff, strong organic odor - moist. NYCBC (Class 4c) [MARSH DEPOSIT]		SPT		12	3-4-3 -4	100									
15			ST		15		100					115	26	25.8	26.8	
17			ST		17		83					122.9	22.6			
19	(SP-SM) POORLY GRADED SAND WITH SILT, yellow brown, medium dense, fine to medium - moist. NYCBC (Class 3b) [GLACIAL SAND]		SPT		19	3-5-10 -10	54					125	20.8	25.4		
21	(SP) POORLY GRADED SAND, yellow brown, medium dense, fine to medium - moist. NYCBC (Class 3b)		U		21	6-16 -19-23	54									
23.5			SPT		23.5	4-4-6 -10	75									
26			SPT		26	2-4-7 -9	63									
28.5			SPT		28.5	3-5-6 -7	58									

(continued)

For Information Purposes Only



LOGGED BY A. Littlejohn			BEGIN DATE Oct-02-10	COMPLETION DATE Oct-07-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING P-S Suspension Logging		HOLE ID HHW-03-PS
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		SURFACE ELEVATION 11.8 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING READINGS Not Recorded		AFTER DRILLING (DATE) Not Recorded
					HAMMER EFFICIENCY, ERI 65%
					TOTAL DEPTH OF BORING 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
30																
35			U		35		42									
40	Grades loose. NYCBC (Class 6)		SPT		40	3-5-4 -5	63									
45			SPT		45	2-3-5 -9	63									
50			SPT		50	2-3-4 -5	71									
55	Grades medium dense. NYCBC (Class 3b)		SPT		55	5-5-6 -7	75									
60																

(continued)

For Information Purposes Only

ARUP

BOREHOLE NO. HHW-03-PS
SHEET 2 OF 4

LOGGED BY A. Littlejohn			BEGIN DATE Oct-02-10	COMPLETION DATE Oct-07-10	PROJECT NUMBER 132040	HOLE ID HHW-03-PS
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING P-S Suspension Logging		SURFACE ELEVATION 11.8 ft (NAVD88)	
DRILLING METHOD CORE(0'-5'), ROTARY(5'-102')			DRILL RIG Acker AK 135G		BOREHOLE DIAMETER 4 in	
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8"), ST(2-7/8"), U(2-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		HAMMER EFFICIENCY, ERI 65%	
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING READINGS		AFTER DRILLING (DATE) Not Recorded	
			Not Recorded		TOTAL DEPTH OF BORING 102 ft	

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
60			SPT		60	6-6-9 -7	83									
65			SPT		65	8-11 -11-10	88									
70	Grades dense. NYCBC (Class 3a)		U		70	27-40 -33-35	50									
75	Grades medium dense. NYCBC (Class 3b)		SPT		75	9-10 -18-16	63									
80	(SP) POORLY GRADED SAND WITH GRAVEL, gray brown, dense, fine to coarse - moist. NYCBC (Class 3a)		SPT		80	17-23 -20-27	71									
85	Grades very dense. NYCBC (Class 3a)		SPT		85	19-26 -34-31	67									

(continued)

For Information Purposes Only



PROJECT NUMBER

132040

HOLE ID

HHW-03-PS

LOGGED BY: A. Littlejohn
 BEGIN DATE: Oct-02-10
 COMPLETION DATE: Oct-07-10

DRILLING CONTRACTOR: Warren George inc

IN-SITU TESTING: P-S Suspension Logging

SURFACE ELEVATION: 11.8 ft (NAVD88)

DRILLING METHOD: CORE(0'-5'), ROTARY(5'-102')

DRILL RIG: Acker AK 135G

BOREHOLE DIAMETER: 4 in

SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8"), ST(2-7/8"), U(2-3/8")

SPT HAMMER TYPE: Automatic, 140 lbs, 30-inch drop

HAMMER EFFICIENCY, ERI: 65%

BOREHOLE BACKFILL AND COMPLETION: Sand & Blacktop

GROUNDWATER DURING DRILLING: Not Recorded
 AFTER DRILLING (DATE): Not Recorded

TOTAL DEPTH OF BORING: 102 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
90	Grades medium dense. NYCBC (Class 3b)	[Material Graphic]	SPT		90	19-14 -24-38	75									
95			SPT		95	14-19 -18-30	67									
100	(SP) POORLY GRADED SAND, yellowish brown to gray, dense, fine to coarse. NYCBC (Class 3a)	[Material Graphic]	SPT		100	14-17 -17-14	71									
105	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
110																
115																
120																

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Oct-05-10	COMPLETION DATE Oct-05-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHW-PC-01
DRILLING METHOD CORE(0'-5'), ROTARY(5'-17')			DRILL RIG Acker AD II		SURFACE ELEVATION 11.2 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING Not Recorded		AFTER DRILLING (DATE) Not Recorded
			READINGS		HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand-augered to 5.0'															
5	(SP) POORLY GRADED SAND, yellowish brown, loose, fine to medium - moist. NYCBC (Class 7) [FILL]	[Dotted pattern]	SPT		5	4-4-6 -7	50									
	Grades grayish brown.		SPT		7.5	2-4-5 -9	75									
10	Grades gray.		SPT		10	4-4-5 -4	75									
	(OL) ORGANIC CLAY, dark gray, soft, strong organic odor, with decomposed vegetation - moist. NYCBC (Class 6) [MARSH DEPOSITS]	[Cross-hatched pattern]	SPT		12.5	2-2-2 -4	100									
15	(SP) POORLY GRADED SAND, grayish brown, loose, fine to medium - moist. NYCBC (Class 6) [GLACIAL SAND]	[Dotted pattern]	SPT		15	1-3-4 -6	75									PP: S _u = 500 psf
	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															

For Information Purposes Only



PROJECT NUMBER
132040
HOLE ID
HHW-PC-02

LOGGED BY
Z. Khan
BEGIN DATE
Oct-05-10
COMPLETION DATE
Oct-05-10

DRILLING CONTRACTOR Warren George inc	IN-SITU TESTING	SURFACE ELEVATION 11.6 ft (NAVD88)
DRILLING METHOD CORE(0'-5'), ROTARY(5'-17')	DRILL RIG Acker AD II	BOREHOLE DIAMETER 4 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8")	SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop	HAMMER EFFICIENCY, ERI 81%
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop	GROUNDWATER DURING DRILLING Not Recorded	AFTER DRILLING (DATE) Not Recorded
		TOTAL DEPTH OF BORING 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 In Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand-augered to 5.0'															
5	(SP) POORLY GRADED SAND, yellowish brown, loose, fine to medium - moist. NYCBC (Class 7) [FILL]	[Dotted pattern]	SPT	5	2-3-3-5	50										
7.5			SPT	7.5	5-6-9-15	75										
10	Grades grayish brown/gray.		SPT	10	2-3-3-4	50										
12.5	(OH) ORGANIC CLAY, dark gray, medium stiff - moist. NYCBC (Class 4c) [MARSH DEPOSITS]	[Cross-hatched pattern]	SPT	12.5	4-3-3-10	10										
15	(SP) POORLY GRADED SAND, grayish brown, very loose, fine to medium - moist. NYCBC (Class 6) [GLACIAL SAND]	[Dotted pattern]	SPT	15	2-1-2-4	100										
20	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
25																
30																

For Information Purposes Only



LOGGED BY Z. Khan			BEGIN DATE Oct-05-10	COMPLETION DATE Oct-05-10	PROJECT NUMBER 132040
DRILLING CONTRACTOR Warren George inc			IN-SITU TESTING		HOLE ID HHW-PC-03
DRILLING METHOD CORE(0'-5'), ROTARY(5'-17')			DRILL RIG Acker AD II		SURFACE ELEVATION 7.8 ft (NAVD88)
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8")			SPT HAMMER TYPE Automatic, 140 lbs, 30-inch drop		BOREHOLE DIAMETER 4 in
BOREHOLE BACKFILL AND COMPLETION Sand & Blacktop			GROUNDWATER DURING DRILLING Not Recorded		AFTER DRILLING (DATE) Not Recorded
			READINGS		HAMMER EFFICIENCY, ERI 81%
					TOTAL DEPTH OF BORING 17 ft

DEPTH (ft)	Description	Material Graphics	Sample Type	Sample Location	Sample Depth (ft)	Blows per 6 in Resistance	Recovery (%)	RQD (%)	Fractures/ft	Casing Depth	Coring Rate (min/ft)	Total Unit Wt (pcf)	Moisture Content (%)	Plasticity Index (%)	Strength (psf)	Remarks
0	Hand augered to 5.0'															
5	(SP) POORLY GRADED SAND, gray, medium dense, fine to coarse, with gravel - moist. NYCBC (Class 7) [FILL] Grades dense. NYCBC (Class 7)		SPT		5	5-4-7 -5	50									
7.5	(OH) ORGANIC CLAY, grayish brown, hard, strong organic odor, with decomposed vegetation - moist. NYCBC (Class 4a) [MARSH DEPOSITS] Grades soft. NYCBC (Class 6)		SPT		7.5	9-13 -19-21	75									
10	(SP) POORLY GRADED SAND, gray, medium dense, fine to medium - moist. NYCBC (Class 3b) [GLACIAL SAND] Grades medium stiff. NYCBC (Class 4c)		SPT		10	2-1-2 -3	100									
12.5			SPT		12.5	4-3-4 -5	100									
15			SPT		15	4-6-7 -12	75									
15	PP: S _v = 500 psf															
15	See Borehole Log Legend for soil classification chart and key to test data and sampler type.															

For Information Purposes Only



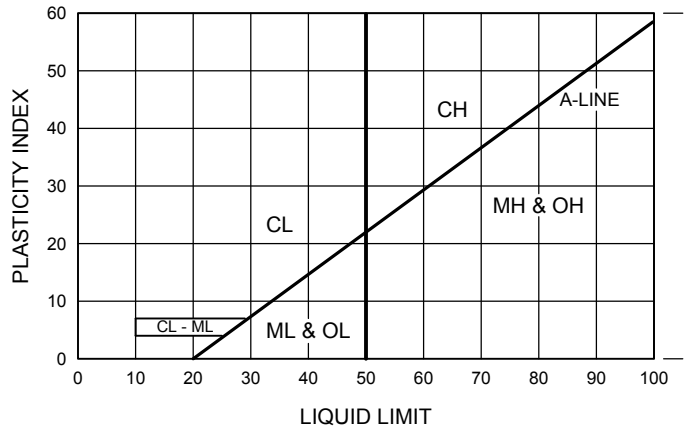
INDEXED SOIL CLASSIFICATIONS

GRAPHIC	SYMBOL	DESCRIPTION	MAJOR DIVISIONS			
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	CLEAN GRAVELS (LITTLE OR NO FINES)	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE	FOR VISUAL CLASSIFICATION, THE 1/4" SIZE MAY BE USED AS EQUIVALENT TO THE NO.4 SIEVE SIZE	COARSE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO.200 SIEVE SIZE
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES				
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)			
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES				
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	CLEAN SANDS (LITTLE OR NO FINES)	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE		
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES				
	SM	SILTY SANDS, SAND-SILT MIXTURES	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES				
	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	SILTS & CLAYS LIQUID LIMIT LESS THAN 50		FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO.200 SIEVE SIZE THE NO.200 U.S. STANDARD SIEVE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE	
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS				
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY				
	MH	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF HIGH PLASTICITY	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50			
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS				
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS				
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS			
	OS	OILY SEDIMENTS				

KEY TO TEST DATA

- TV = POCKET TORVANE
- PP = POCKET PENETROMETER

PLASTICITY CHART



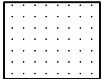
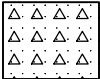
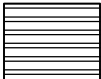

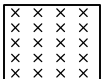

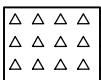
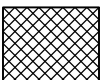
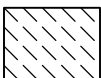
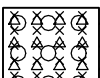
KEY TO SAMPLER TYPE

- BULK
- P = PISTON SAMPLER
- PS = PITCHER SAMPLER
- SPT = STANDARD PENETRATION TEST SAMPLER
- ST - SHELBY TUBE SAMPLER
- U = DAMES & MOORE "U" SAMPLER
- NO RECOVERY

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA



INDEXED ROCK CLASSIFICATION

	SANDSTONE		SANDSTONE BRECCIA
	SHALE		SHALE BRECCIA
	SILTSTONE		SILTSTONE BRECCIA
	BRECCIA		MELANGE
	GREENSTONE		SILTSTONE CONGLOMERATE BRECCIA

KEY TO ROCK CORE LOGS

Fracture Spacing

Crushed	less than ¼ inch (may be clayey)
Intensely Fractured	¼ to ¾ inch
Very Closely Fractured	¾ inch to 2.5 inches
Closely Fractured	2.5 to 8 inches
Medium Fractured	8 inches to 2 feet
Widely Fractured	2 to 6 feet
Very Widely Fractured	greater than 6 feet

Bedding Spacing

Laminated	less than ½ inch
Very Thin Bedded	½ to 1 inch
Thin Bedded	1 to 4 inches
Medium Bedded	4 to 12 inches
Thick Bedded	1 to 3 feet
Very Thick Bedded	3 to 10 feet
Massive	greater than 10 feet

Hardness

Friable	Easily crumbled, or deformed by hand if plastic; can cut through core with knife
Low Hardness	Can be gouged deeply and carved with knife; dull thud when struck with hammer
Moderately Hard	Can be scratched, and gouged with difficulty, with knife
Hard	Can be scratched by knife only with considerable effort
Very Hard	Cannot be scratched with knife; streak of knife metal left on core; sharp ring when struck

**ROCK CLASSIFICATION CHART
AND KEY TO DATA AND SYMBOLS**

ARUP

INDEXED ROCK CLASSIFICATION (CONT.)

KEY TO ROCK CORE LOGS (CONT.)

Strength

Plastic	Can be deformed or molded by hand; usually very clayey
Very Weak*	Can be crumbled by hand and easily pulverized with hammer; commonly crushed, sheared, or severely weathered
Weak	Outcrop would crumble under light hammer blows; core (2-inch + diameter) can be broken by hand; does not qualify for RQD
Moderately Strong	Several firm hammer blows required to break outcrop; core cannot be broken by hand but will generally break with a single light hammer blow; qualifies for RQD
Strong	Outcrop can be broken by several heavy hammer blows and will yield larger fragments; core usually breaks with single strong hammer blow
Very Strong	Many heavy hammer blows required to chip outcrop or produce only small fragments; several strong hammer blows may be required to break core

* This strength category was referred to as "friable" on the 2003 boring logs, and was changed to "very weak" on the 2005 logs for the purpose of not confusing "friable" strength with "friable" hardness; both "friable" strength and "friable" hardness are categories used on the 2003 logs.

Weathering

Severely Weathered	Very heavily Fe (iron oxide) stained throughout the rock mass and along fractures; usually significantly weakened as compared to fresh condition; can be soil-like but with recognizable rock fabric
Moderately Weathered	Considerable Fe-staining within the rock mass and on fracture surfaces, but less weakened
Slightly Weathered	Little or no Fe-staining within the rock mass, with stains limited to fracture surfaces; the rock mass is not noticeably weakened
Fresh	No Fe-staining within the rock mass or along fractures

Fracture Frequency

The average number of fractures per foot within the specified interval (excluding mechanical breaks). CR indicates crushed intervals, with fracture spacing less than ¼ inch and usually some amount of clay. "+" suggests some greater amount of fracturing beyond the indicated minimum number of natural core breaks (e.g., "10+"), due either to the presence of variably healed microfractures (typically tension cracks) that are common within Franciscan Complex rock units, or to some uncertainty that exists because of possible mechanical breakage.

RQD - Rock Quality Designation

The percent of each run recovered as intact lengths of sound rock core greater than 4 inches, between naturally-occurring fractures and measured along the core centerline. N/A indicates that none of the run meets the soundness criteria, and thus RQD is not applicable for the entire run length.

% Recovery

The length of recovered core divided by the length of the run, expressed as a percentage.

Drill Rate

The time required to core the run, in minutes, divided by the length of the run, in feet.

Field Notes

Notes on drilling characteristics and problems, core losses, etc.

**ROCK CLASSIFICATION CHART
AND KEY TO DATA AND SYMBOLS**

ARUP