September 6, 2019 976.031 (50)

To: Prospective Bidders
Contract 13.0 – Dutchman's Creek Parallel Sewer
City of Mount Holly

Subject: Subsurface Investigation Report
Terracon Consultants, Inc.
September 4, 2019

The attached Report is provided to you in accordance with the Contract Documents for the proposed facilities. Pertinent subsurface information contained in this Report is reflected in the Contract Drawings and Contract Documents, but this Report and the data related thereto shall not be considered a part of either.

The Report is being made available to those who have asked about such information, and others to whom it appears that such information might be beneficial. Any reliance made upon the content of the Report shall be subject to the limitations defined in the Contract Documents.

WILLIS ENGINEERS

Attachment

September 4, 2019

Willis Engineers
10700 Sikes Place, Ste 115
Charlotte, North Carolina 28277

Attn: Mr. Charles Willis Jr., P.E.
P: (704) 377 9844
E: chuck@willisengineers.com

Re: Subsurface Investigation Report
Dutchman's Creek Parallel Sewer
Mount Holly, North Carolina
Terracon Project No. 71185133

Dear Mr. Willis:

We have completed the geotechnical investigation services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P71185133 dated August 6, 2018. This report presents the findings of the subsurface exploration.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

for: Preston D. McCloud, P.E.
Geotechnical Project Engineer

Christopher R. Briggs, P.E.
Geotechnical Department Manager

Attachments
- Exploration and Testing Procedures
- Site Location
- Exploration Plan
- Boring Logs (15 pages)
- Unified Soil Classification System
- General Notes

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring	Boring Depth (feet)	Approximate Location [1,2]
B-01	15	Manhole #2
B-02	14.8	Manhole #3
B-03	10	Manhole #4
B-04	15	Manhole #6
B-05	10	Manhole #7
B-06	14.2	Manhole #9
B-07	10	Manhole #11
B-08	10	Manhole #13
B-09	10	Manhole #14
B-10	10	Manhole #16
B-11	10	Manhole #18
B-12	10	Manhole #20
B-13	10	Manhole #23
B-14	10	Manhole #26
B-15	7.5	Manhole #29

1. Manhole numbers based off *Preliminary Plan and Profile* dated July 2018 by Willis Engineers.
2. Boring locations were laid out by Willis Engineers.

Boring Layout and Elevations: The boring locations were laid out on the site by Willis Engineers before Terracon arriving at the site. Elevations listed on the boring logs were estimated utilizing the provided *Preliminary Plan and Profile* dated July 2018 by Willis Engineers. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous flight, hollow stem augers. Soil sampling was performed using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations.

BORING LOG NO. B-01

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 591 (Ft.) +/-

DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS
SILTY SAND (SM), fine to medium grained, light brown and orange, loose, residual			
			4-5-2 N=7
3.0	588+/-		
SILTY SAND (SM), fine to medium grained, light brown, medium dense, residual			
			10-12-13 N=25
		5	
			7-6-9 N=15
			8-10-13 N=23
		10	
12.0	579+/-		
SILTY SAND (SM), fine to medium grained, brown, white, and orange, dense, residual			
			9-14-18 N=32
15.0	576+/-	15	
Boring Terminated at 15 Feet			

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #2.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-02

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 590 (Ft.) +/-

DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
0.1	590+/-	**TOPSOIL**, 1-inch				
		FILL - SILTY SAND (SM), trace gravel and organics, fine to medium grained, light brown, loose to medium dense				7-7-6 N=13
						6-4-4 N=8
			5			3-2-2 N=4
8.0	582+/-	**LEAN CLAY WITH SAND (CL)**, light brown and red, soft, residual				1-1-2 N=3
			10			
12.0	578+/-	**PARTIALLY WEATHERED ROCK**, sampled as gray silty SAND, fine to medium grained				18-42-50/3"
14.8	575.5+/-	***Boring Terminated at 14.75 Feet***				

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #3.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-03

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 586 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.1	586+/-	**TOPSOIL**, 1-inch	
		FILL - SILTY SAND (SM), trace mica, fine to medium grained, light brown, very loose to loose	3-3-3 N=6
			2-1-2 N=3
5.5	580.5+/-		
		LEAN CLAY (CL), trace sand, light brown and red, medium stiff, alluvial	2-2-2 N=4
8.0	578+/-		
		CLAYEY SAND (SC), with organics, fine to medium grained, gray, soft, alluvial	1-0-1 N=1
10.0	576+/-		
		Boring Terminated at 10 Feet	

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #4.

WATER LEVEL OBSERVATIONS

While drilling

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-04

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 588 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.1	588+/-	**TOPSOIL**, 1-inch	
		FILL - SILT WITH SAND (ML), with organics, light brown, medium stiff	3-3-4 N=7
3.0	585+/-	**FILL - POORLY GRADED GRAVEL WITH SILT (GP-GM)**, coarse grained, angular, gray, dense	3-18-16 N=34
6.0	582+/-	**NO RECOVERY**, Gravel and cobbles encountered from 5' to 11.5' while drilling.	4-3-5 N=8
7.5	580.5+/-	**FILL - SILT WITH SAND (ML)**, trace gravel, light brown, very stiff	9-11-9 N=20
11.5	576.5+/-	Auger refusal on cobbles at 11.5'. Spoon was advanced past auger refusal. **SILTY SAND WITH GRAVEL (SM)**, fine to medium grained, gray, medium dense, residual	9-12-14 N=26
15.0	573+/-	***Boring Terminated at 15 Feet***	

DEPTH (Ft.): 5, 10, 15

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #6.

WATER LEVEL OBSERVATIONS

At completion of drilling

Wet Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-05

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 588 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.1	588+/-	**TOPSOIL**, 1-inch	
		FILL - SILTY SAND (SM), fine to medium grained, brown, very loose	2-2-1 N=3
3.0	585+/-		
		FILL - SANDY SILT (ML), brown, soft	1-1-1 N=2
5.5	582.5+/-		
		FILL - SILTY SAND (SM), fine to medium grained, brown, loose	1-2-2 N=4
8.0	580+/-		
		SILTY SAND (SM), trace mica, fine to medium grained, brown, very loose, alluvial	1-1-1 N=2
10.0	578+/-		
		Boring Terminated at 10 Feet	

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS: ▽ While drilling

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #7.

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-06

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 593 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.2	593+/-	**TOPSOIL**, 2-inches	
		FILL - CLAYEY SAND (SC), fine to medium grained, light brown, gray and black, very loose	2-1-1 N=2
			1-0-1 N=1
5.0	588+/-	**SILTY SAND (SM)**, light brown and gray, dense, residual	7-20-27 N=47
8.0	585+/-	**PARTIALLY WEATHERED ROCK**, sampled as light brown and gray silty SAND	20-50/5"
14.2	579+/-	***Boring Terminated at 14.2 Feet***	49-50/2"

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE

5 10

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #9.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-07

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 589 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.2	589+/-	**TOPSOIL**, 2-inches	
		FILL - SILTY SAND (SM), fine to medium grained, light brown, loose	5-4-4 N=8
			2-2-3 N=5
5.5	583.5+/-	**SILT WITH SAND (ML)**, trace organics, brown, medium stiff, alluvial	4-4-4 N=8
8.0	581+/-	**LEAN CLAY WITH SAND (CL)**, light brown and gray, soft, alluvial	1-1-2 N=3
10.0	579+/-	***Boring Terminated at 10 Feet***	

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #11.

WATER LEVEL OBSERVATIONS

While drilling

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019 | Boring Completed: 08-19-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-08

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 591 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	FIELD TEST RESULTS
0.3	590.5+/-	**TOPSOIL**, 4-inches	
		FILL - SILT WITH SAND (ML), light brown, medium stiff to stiff	2-3-4 N=7
			3-4-6 N=10
5.0	586+/-	**SILTY SAND (SM)**, fine to medium grained, light brown, loose, alluvial	2-2-3 N=5
8.0	583+/-	**SILTY SAND (SM)**, fine to medium grained, light brown, loose, alluvial	4-3-4 N=7
10.0	581+/-	***Boring Terminated at 10 Feet***	

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #13.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-19-2019
Boring Completed: 08-19-2019
Drill Rig: Geoprobe
Driller: B. Burnett
Project No.: 71185133

BORING LOG NO. B-09

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 590 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
0.1	590+/-	**TOPSOIL**, 1-inch				
		FILL - SANDY SILT (ML), trace mica, brown and gray, medium stiff				2-2-3 N=5
						1-1-2 N=3
			5			
						2-2-1 N=3
8.0	582+/-	**LEAN CLAY (CL)**, trace sand, gray, very soft, alluvial				
						0-0-1 N=1
10.0	580+/-	***Boring Terminated at 10 Feet***	10			

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #14.

WATER LEVEL OBSERVATIONS

While drilling

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-10

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 592 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.2	592+/-	**TOPSOIL**, 2-inches	
		FILL - SILT WITH SAND (ML), trace organics, light brown, soft	1-1-1 N=2
3.0	589+/-	**SILTY SAND (SM)**, fine to medium grained, light brown, very loose to loose, alluvial	2-2-2 N=4
			2-1-1 N=2
8.0	584+/-	**SILT WITH SAND (ML)**, light brown and gray, medium stiff, residual	3-3-3 N=6
10.0	582+/-	***Boring Terminated at 10 Feet***	

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #16
.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019
Drill Rig: Geoprobe | Driller: B. Burnett
Project No.: 71185133

BORING LOG NO. B-11

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 592 (Ft.) +/-

DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS
0.2	592+/-	**TOPSOIL**, 2-inches	
		FILL - SANDY SILT (ML), trace mica, light brown, very soft to soft	1-2-1 N=3
			0-0-0 N=0
5.5	586.5+/-	**SANDY LEAN CLAY (CL)**, light brown and gray, medium stiff to stiff, alluvial	2-2-3 N=5
8.0	584+/-	**SILT WITH SAND (ML)**, light brown and gray, residual	3-6-6 N=12
10.0	582+/-	***Boring Terminated at 10 Feet***	

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #18.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-12

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 593 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.2	593+/-	**TOPSOIL**, 2-inches
		FILL - SANDY SILT (ML), trace mica, brown, medium stiff
3.0	590+/-	
		FILL - SILT (ML), trace sand, brown, medium stiff
5.5	587.5+/-	
		SILT WITH SAND (ML), gray and light brown, medium stiff, alluvial
8.0	585+/-	
		SILTY SAND (SM), fine to medium grained, gray, very loose, alluvial
10.0	583+/-	
		Boring Terminated at 10 Feet

DEPTH (Ft.)	FIELD TEST RESULTS
	1-2-3 N=5
5	2-2-3 N=5
	2-2-2 N=4
	2-1-1 N=2
10	

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #20.

WATER LEVEL OBSERVATIONS

While drilling

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-13

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 596 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.1	596+/-	**TOPSOIL**, 1-inch	
		FILL - SILTY SAND (SM), fine to medium grained, light brown, medium dense	5-6-5 N=11
3.0	593+/-	**FILL - SANDY SILT (ML)**, light brown, soft	2-1-2 N=3
5.5	590.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, light brown and gray, very loose, alluvial	2-2-1 N=3
8.0	588+/-	**SANDY SILT (ML)**, light brown and gray, soft, alluvial	1-1-1 N=2
10.0	586+/-	***Boring Terminated at 10 Feet***	

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #23.

WATER LEVEL OBSERVATIONS
No free water observed

Dry Cave-In

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-14

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 598 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS
0.1	598+/-	**TOPSOIL**, 1-inch	
		FILL - SILTY SAND (SM), fine to medium grained, light brown, medium dense	6-12-10 N=22
3.0	595+/-	**SILTY SAND (SM)**, fine to medium grained, gray, medium stiff, alluvial	7-6-3 N=9
5.5	592.5+/-	**SILT WITH SAND (ML)**, brown, medium stiff, alluvial	3-2-2 N=4
8.0	590+/-	**LEAN CLAY WITH SAND (CL)**, light brown, medium stiff, alluvial	2-2-2 N=4
10.0	588+/-	***Boring Terminated at 10 Feet***	

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS

5

10

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #26.

WATER LEVEL OBSERVATIONS

▽ *At completion of drilling*

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

BORING LOG NO. B-15

PROJECT: Dutchman's Creek Parallel Sewer

CLIENT: Willis Engineers
Charlotte, NC

SITE: Dutchman's Creek Parallel Sewer
Mt. Holly, NC

LOCATION See Exploration Plan

Approximate Surface Elev.: 597 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
0.2	597+/-	**TOPSOIL**, 2-inches				
0.4	596.5+/-	**POORLY GRADED GRAVEL (GP)**, 2-inches				
		FILL - SANDY SILT (ML), light brown to dark gray, stiff				6-6-4 N=10
3.0	594+/-					
		LEAN CLAY WITH SAND (CL), gray, stiff, alluvial				3-4-5 N=9
5.5	591.5+/-		5			
		SILT WITH SAND (ML), light brown and gray, medium stiff, alluvial				2-2-3 N=5
7.5	589.5+/-					
		Boring Terminated at 7.5 Feet				

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

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
Drilled near Manhole #29.

WATER LEVEL OBSERVATIONS

Groundwater level unobtainable due to mud rotary.

Terracon
2701 Westport Rd
Charlotte, NC

Boring Started: 08-20-2019 | Boring Completed: 08-20-2019

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 71185133

GENERAL NOTES
DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Split Spoon	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time 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.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (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.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		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)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
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	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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. 4 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 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 ³ 6 and 1 £ Cc £ 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”		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: 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	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (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 ³ 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 ³ 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 ³ 30% plus No. 200 predominantly sand, add “sandy” to group name.

[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ³ 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.