City of Tampa
Jane Castor, Mayor

Contract Administration
Michael W. Chucran, Director
306 East Jackson Street, 4N
Tampa, FL 33602

Office (813) 274-8116
Fax: (813) 274-7368

ADDENDUM 2
Via E-Mail
DATE: May 26, 2020

Contract 19-C-00053 David L Tippin Facility Solids Processing System Improvements

Bidders on the above referenced project are hereby notified that the following addendum is made to the Contract Documents. BIDS TO BE SUBMITTED SHALL CONFORM TO THIS NOTICE.

Item 1: Replace plan sheet 23 with the attached plan sheet 23.

Item 2: Delete the following sentence from Specification Section 01 51 05 1.2A.4: Provide temporary lighting for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

Item 3: Plan sheet 2, Note 12: Replace "Permox-CTF" with "Cermapure PL90 by Induron".

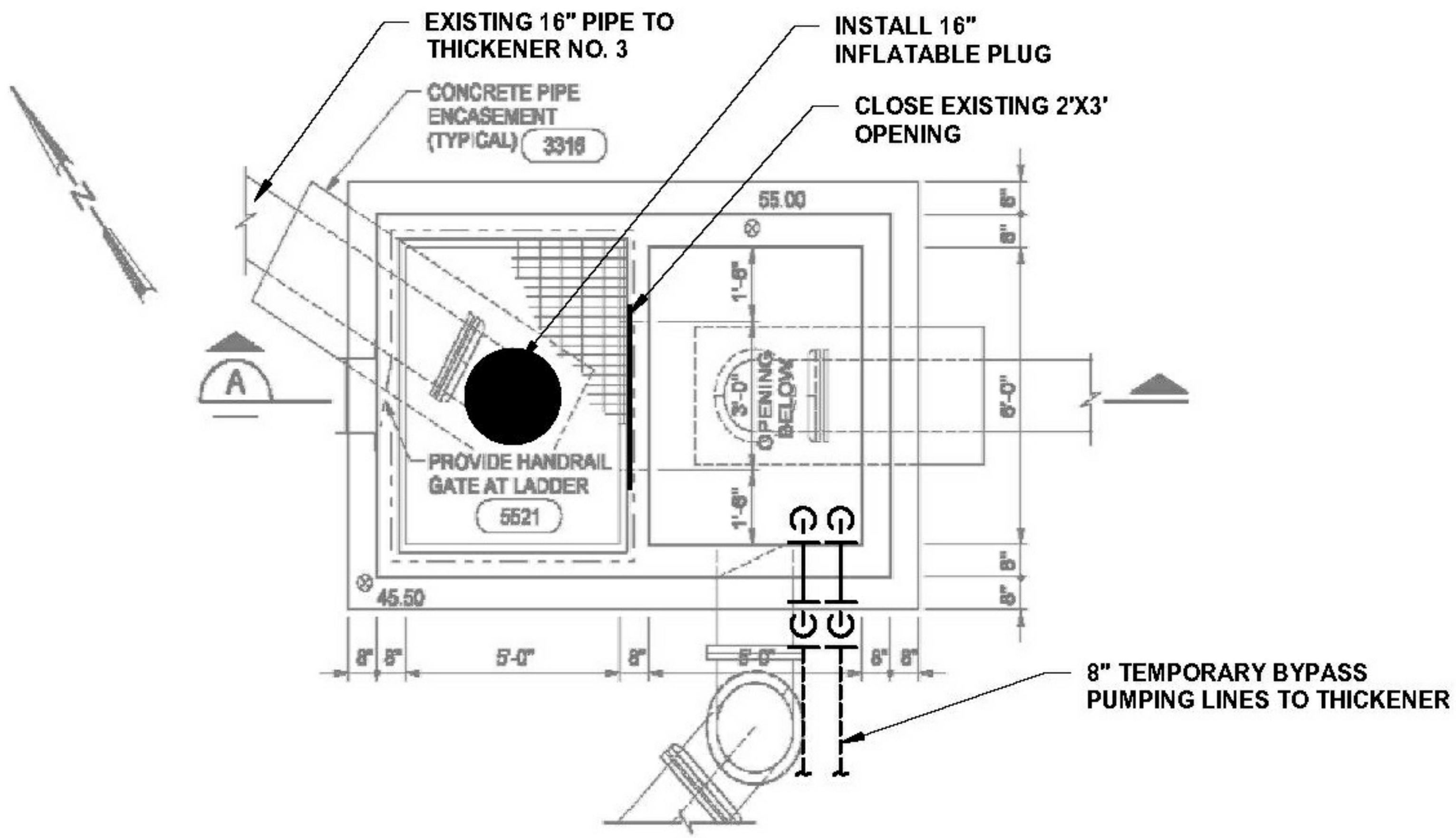
Item 4: Specification Section 40 05 19, 2.1, B.3b.3: Replace "High strength, low allow steel": with the following: "See a. above".

Item 5: Attached is a copy of the Geotechnical Engineering Services Report.

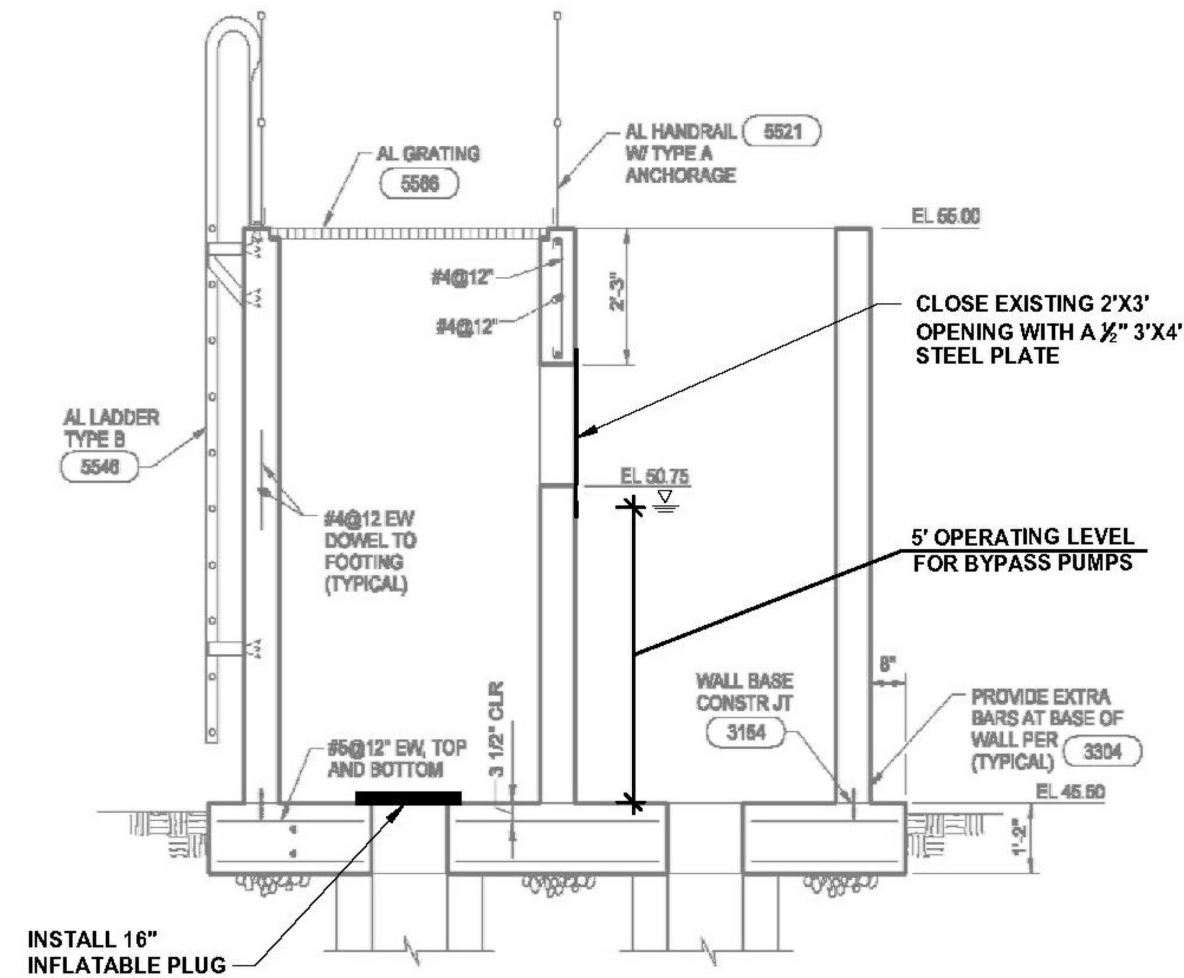
All other provisions of the Contract Documents and Specifications not in conflict with this Addendum shall remain in full force and effect. Questions are to be e-mailed to Contract Administration@tampagov.net.

Jim Greiner

Jim Greiner, P.E., Contract Management Supervisor



THICKENER SPLITTER BOX
NTS



SECTION A
NTS

ARCADIS

NITA NAIK
P.E. #79670
ARCADIS U.S., INC.
3109 WEST DR. MARTIN LUTHER KING JR BLVD, SUITE 350, TAMPA, FLA. 33607
C.A. NO. 7917

NO.	DATE	DESCRIPTION	BY
1	5/20/20	ADDENDUM NO. 1	NMN

DESIGNED NMN
DRAWN AGG
CHECKED FJB
DATE 05/20/20

DLTWTF SLUDGE PIPING REPLACEMENT

SPLITTER BOX DETAILS FOR BYPASS PUMPING

City of Tampa Florida
Water Department

WORK ORDER NO. WTR-18-0009
RECORD DRAWING NO.
ATLAS PAGE D-14
SHEET 23 OF 23

Geotechnical Engineering Services Report

David L. Tippin Water Treatment Plant (WTP) Sludge Piping Replacement
City of Tampa, Tampa Water Department
Hillsborough County, Florida

Prepared for: ***Arcadis***
3109 West Dr. Martin Luther King Jr. Boulevard
Suite 350
Tampa, Florida 33607

Prepared by: ***MC Squared, Inc.***
5808-A Breckenridge Parkway
Tampa, Florida 33610

Project No. T021808.026
October 2, 2018

GEOTECHNICAL • ENVIRONMENTAL
MATERIALS TESTING

October 2, 2018

Ms. Nita Naik, PE
Arcadis U.S., Inc.
3109 West Dr. Martin Luther King Jr. Boulevard
Suite 350
Tampa, Florida 33607

Subject: Geotechnical Engineering Services Report
David L. Tippin Water Treatment Plant (WTP) Sludge Piping Replacement
City of Tampa, Tampa Water Department
Hillsborough County, Florida
MC² Project No. T021808.026

Dear Mr. Naik:

MC Squared, Inc. (**MC²**) has completed our Geotechnical Engineering Services Report associated with the subject project in Hillsborough County, Florida. This report outlines the services provided for this project, and our recommendations.

We trust that this report will assist you in further design development and construction of the proposed project. We appreciate the opportunity to be of service on this project. Should you have any questions, please do not hesitate to contact us

Respectfully submitted,
MC²

Sergio Gomez
Staff Engineer

Winston L. Stewart, PE
Vice President/Chief Engineer
Florida PE No. 81643

Bradley A. Crowson, EI
Associate Project Manager

Jeffery L. Hooks, PE
Project Engineer
Florida PE No. 67882

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Subsurface Boring Profiles Legend – Sheet 5
Individual Soil Profile (1 Sheet)
Test Procedures

1 PROJECT INFORMATION

1.1 Project Authorization

MC² received written authorization to proceed with this project through a Subconsultant Agreement dated August 20, 2018. The project was performed in general accordance with **MC²** Proposal No. T021808.026 dated February 9, 2018, and subsequently revised July 10 and July 18, 2018.

1.2 Project Description

The proposed project site is located at David L. Tippin Water Treatment Plant (WTP). Project information has been provided by **Ms. Nita Naik, PE,** of **Arcadis** through e-mail and verbal communications, including partial plans of the site indicating the proposed soil test boring locations. Based on our understanding, geotechnical engineering services are required to provide subsurface soil and groundwater information for the replacement of sludge piping near Gravity Thickener No. 2 at the facility. At this time, it is unknown whether the pipeline will be installed by direct bury or horizontal directional drilling (HDD) methods.

Figure 1: Aerial of Project Site (Google Earth, photographed March 15, 2018)

If any of this project information is incorrect or has changed, please inform **MC²** so that we may amend, if appropriate, the recommendations presented in this report.

1.3 Scope of Services

We performed the following scope of services:

1. Conducted a visual reconnaissance of the project site to gauge any access issues for drilling equipment and personnel.

2. Reviewed the USDA Soil Survey for Hillsborough County and the USGS topographic maps.

3. Cleared utilities through Sunshine811 service, and requested and obtained locations of some existing utilities from Arcadis.

4. Performed one (1) Standard Penetration Test (SPT) boring to 35-ft. below ground surface (bgs) at the connection point for the proposed new sludge piping. The location of the SPT boring was determined by Arcadis prior to our notice to proceed. The borehole was restored immediately upon completion of drilling using bentonite chips.

5. Visually examined all recovered soil samples in the laboratory and performed laboratory tests on selected representative samples to characterize the subsurface soil profile. Description of the soil samples is in accordance with the Unified Soil Classification System (USCS). The laboratory testing includes percent passing the U.S. No. 200 sieve, Atterberg Limits tests and natural moisture content determinations.

Our report contains the following information:

1. General assessment of area geology based on published literature, past experience, and boring information.

2. General suitability of materials within the site for use as engineered fills and general backfill.

3. General location and description of potentially deleterious materials encountered in the borings, which may interfere with the proposed construction or performance, including existing fills, plastic clays, surficial organics, etc.

4. Critical design and/or construction considerations based on the soil and groundwater conditions developed from the borings.

5. Groundwater level in the boring was not apparent before mud-rotary operations; however, an estimate of the seasonal high water table (SHWT) depth is provided.

The scope of our services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials in the soil, bedrock, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of our client. In addition, our scope of services did not include an evaluation of sinkholes or sinkhole activity.

2 SITE CONDITIONS

2.1 Site Features

The project site is located at 7125 N. 30th St., Tampa, Florida 33610, near Rogers Park. The project location is shown in the **Appendix**. The site is generally level and is surrounded by residential properties and a golf course.

Figure 2: Project Site View from Gate C (Google Maps, photographed September of 2015)

2.2 USDA Soil Survey

Our review of the U.S. Department of Agriculture (USDA) - Soil Conservation Service (SCS) survey maps for Hillsborough County indicates the improvements are located within one (1) mapping unit: Candler fine sand, 0 to 5 percent slopes (7). Candler fine sand, 0 to 5 percent slopes (7) has a parent material of Eolian deposits and/or sandy and loamy marine deposits and a typical profile of fine sand from zero to 80 inches bgs. The material is excessively drained and has a high to very high capacity to transmit water. The depth to the groundwater table is more than 80 inches.

This information was published in a report titled *The Soil Survey of Hillsborough County, Florida* using Version 16, dated October 4, 2017. The aerial images used were photographed from December 19, 2013 to January 17, 2014. A portion of the **USDA Soil Survey Map** of the project area is included in the **Appendix**.

The USDA Soil Survey is not an exact representation of the soils on the site. The mapping by USGS is based on interpretation of aerial maps with scattered shallow borings for confirmation. Accordingly, borders between mapping units are approximate and the change may be transitional. Differences may also occur from the typical stratigraphy, and small areas of other similar and dissimilar soils may occur within the soil-mapping unit. As such, there may be differences in the mapped description and the boring descriptions obtained for this report. Development/urbanization can also cause differences in the typical stratigraphy. The survey is, however, a good basis for evaluating the shallow soil conditions of the area.

2.3 USGS Topographic Map

The U.S. Geological Survey (USGS) maintains a database of historical topographic maps. Based on our review of the USGS Topographic Maps, 7.5 Minute Series “Sulphur Springs Quadrangle”, the project site lies between the 40-ft. and 45-ft contour intervals (NGVD 1929 datum). The maps show that the general elevation of the site does not appear to have changed significantly overtime. A **USGS Topographic Map** is included in the **Appendix** for information and reference, as necessary.

3 FIELD EXPLORATION PROGRAM

3.1 General

The field exploration program consisted of performing one (1) SPT boring at the request of **Arcadis**. The soil test boring was performed on September 13, 2018. The field exploration service was supervised by **MC²'s** qualified staff engineers and overseen by one of its Florida State licensed geotechnical engineers.

3.2 Standard Penetration Test Borings

The SPT boring was completed at the site in general accordance with ASTM D-1586 (Standard Test Method for Penetration Test and Split Barrel Sampling of Soils) by a track-mounted drill rig using a safety hammer and a wet-rotary procedure. In this method, a 2-in. outer-diameter split-barrel sampler is driven into the soil by a 140-lb hammer operating over a free-fall of 30-in. The number of blows required to drive the sampler through a 12-in. interval, after its initial penetration of 6-in., is termed the Standard Penetration Resistance, or "N" value, and is indicated for each sample on the boring log. The "N" value may be taken as an indication of the relative density (cohesionless soils) or consistency (cohesive soils) of soils in-situ.

The first 4-ft. in the boring was augered by hand in order to avoid potentially unmarked utilities and to help in the determination of the seasonal high groundwater level (SHWT). This uppermost 4-ft. was augered using a 4-in. diameter bucket auger turned into the soil in 4 to 6-in. increments.

Groundwater, if encountered, is normally measured during the advancement of our borings and prior to the introduction of bentonite to the drilling fluid. Once bentonite is added, an accurate groundwater level measurement is difficult to obtain, and is normally not attempted. Groundwater conditions are presented under **Section 5** herein.

4 LABORATORY TESTING

4.1 Soil Classification Testing

A representative set of soil samples were tested in the laboratory to assist in the classification and determination of engineering characteristics of the soils, based on their mechanical and physical behavior. Laboratory testing was accomplished in general accordance with applicable USCS and ASTM standards. Laboratory tests completed on soil samples retrieved for this project include:

- Two (2) moisture content determinations (ASTM D-2216),
- Two (2) percent passing the No. 200 US standard sieve tests (ASTM D-1140),
- One (1) Atterberg limit determination test (ASTM D-4318), and
- Visual classification in general accordance with ASTM procedures (ASTM D-2487).

Results for each of these laboratory tests are summarized in **Table 1**, and are presented on the individual **Soil Profile** logs provided in the **Appendix.**

Table 1: Summary of Laboratory Testing

Boring No. (Depth) (ft.)	Moisture Content (%)	% Passing # 200 (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Class.
SPT-01 (2-4)	20.0	27.5	-	-	-	SC
SPT-01 (13.5-15)	42.4	53.4	67	33	34	CH

5 SUBSURFACE CONDITIONS

5.1 Subsurface Soil Conditions

One (1) SPT boring was performed to evaluate the subsurface conditions along the sludge piping route. The soil descriptions discussed below are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The soil profile included in the **Appendix** should be reviewed for specific information about the boring. The soil profile includes soil descriptions, stratification, penetration resistances and laboratory test results, as applicable. The stratification shown on the boring profile represents the conditions only at the actual boring location. Variations might occur and should be expected around the boring location.

Northwest Corner of Gravity Thickener No. 2 (SPT-01)
In general, the subsurface conditions encountered in the SPT boring consisted of poorly-graded fine SAND with silt (SP-SM) from 0 to 2-ft. bgs, and clayey SAND (SC) from 2 to 4-ft. bgs. This was followed by loose, poorly-graded fine SAND with silt (SP-SM) from 4 to 8-ft. bgs; loose, clayey SAND (SC) from 8 to 10-ft. bgs; and firm to stiff, fat CLAY (CH) from 10 to 34-ft. bgs. LIMESTONE was penetrated from 34-ft. bgs to the termination depth of 35-ft. bgs.

5.2 Groundwater Conditions

The groundwater table was not apparent (GNA). We estimate the SHWT to be at about 6-ft. bgs at our borehole location. This estimate is based on our review of the USDA Soil Survey and collected soil samples.

In general, groundwater levels tend to fluctuate during periods of prolonged drought and extended rainfall and are affected by tidal and man-made influences such as drainage conveyance systems. In addition, a seasonal effect will occur in which higher groundwater levels are normally recorded in rainy seasons. If the groundwater level is critical to design or construction, temporary observation wells should be installed along the alignment to monitor groundwater level fluctuations over an appropriate period of time that will permit more accurate determinations of wet and dry seasonal levels.

Fluctuation of the groundwater levels should be anticipated, and we recommend that the Contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedure.

6 RECOMMENDATIONS

6.1 General

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions encountered. If there are any changes in the project characteristics, including project location on the site, a review must be made by **MC²** to determine if any modifications in the recommendations would be required. Additionally, once final plans and specifications are available, a general review by **MC²** is strongly recommended, as a means to check that the evaluations made in the preparation of this report are correct and that our recommendations are properly interpreted and implemented.

6.2 Pipe Installation

The soils that may be encountered during the installation of the sludge piping are loose, poorly-graded, fine SAND with silt (SP-SM) and clay nodules, loose clayey fine SAND (SC) and/or stiff to firm fat CLAY (CH). Competent LIMESTONE was encountered at a depth of approximately 34-ft. bgs.

It is our understanding that the pipe may be installed using Horizontal Directional Drilling (HDD) methods and/or open trench excavations along the length of the project alignment. If groundwater control is needed, dewatering consisting of sump pumps and/or well points have been successful in the past. Dewatering must be conducted with care to avoid settlement of nearby structures, roads or utilities.

Corrosion series testing was not performed on soil samples collected. We recommend assuming the soils on site classify as extremely aggressive for all steel and concrete structures associated with the project. We recommend using the applicable provisions in the FDOT Structures Guidelines, January 2018 and FDOT Standard Specifications for corrosion protection.

All open excavations, if used to accommodate installation of the pipe, should be observed by the geotechnical engineer or his representative to explore the extent of any fill and excessively loose, compressible or otherwise undesirable materials. If the exposed soils in the excavation appear suitable as load bearing materials, they should be prepared for construction by compaction for a depth of at least 1-ft. below the excavation bottom.

If loose soils or yielding soils are encountered in the bottom of the excavations, the unsuitable materials should be removed and the proposed foundation elevations re-established by backfilling with suitable materials and compacted as described herein.

A density of at least 98% of the modified Proctor maximum dry density while within ±2% of the optimum moisture content (ASTM D-1557) is recommended for all pipeline backfill, fill materials and natural subgrade in excavated areas within a 1:2 control line from the edge of any structure or roadway. Any other backfill in “green areas” should be compacted to 95% of the modified Proctor maximum dry density while within ±2% of the optimum moisture content. The contractor should be mindful while compacting to prevent settlement of nearby structures induced from vibration.

Backfill materials should be clean, fine sand (free of clay, rubble, organics and debris) with less than 12% passing the No. 200 sieve and placed in compacted lifts. Soils suspected of being organic should be tested and should contain less than 5% organics for use as backfill or structural fill. Some contractors like to place a gravel working bed in wet areas. Fine gravel, such as No. 57, and No. 67 stone may be used, as long as the gravel is wrapped in a filter fabric (Mirafi N 140 or equivalent) to reduce the risk of fines filtering into the open voids in the gravel. The gravel, where used, should be compacted and the compaction confirmed by visual observation.

Any non-organic clean fine SAND and slightly silty or clayey fine SAND (SP/SP-SM/SP-SC) with less than 12 percent passing the No. 200 sieve encountered at the project site should be suitable construction backfill.

Roadway sections should be repaired and/or constructed in accordance with FDOT standards.

6.3 Directional Drilling Considerations

In our experience, and in our professional opinion, the soil conditions appear suitable for HDD installation. The soil types likely to be encountered are summarized in **Sections 5.1 and 6.2**.

Care will be required while performing HDD installation to keep the pipe at the design elevation and limit the hydraulic head associated with the drilling fluid, in order to reduce the risk of frac-out and heave. Drilling mud pressures should not exceed the resistance calculated based on a soil weight of 100 pounds per cubic foot above the drilling head.

6.4 Drainage and Groundwater Considerations

Groundwater may be a concern during construction, depending on final grades and the time of year construction is performed. We recommend that the Contractor determine the depth to groundwater prior to construction to determine the need for dewatering. We assume that if excavations are used for the installation of the pipe that they would be relatively shallow and the effective control of groundwater, if any, could be done using sump pumps and/or well points. It is recommended that the excavations be sloped towards one corner to facilitate the removal of groundwater and rainfall run-off. Recharge of groundwater a short distance from the dewatering location is recommended to avoid significant drawdowns, which may trigger undue subsidence/settlement of existing structures in the vicinity.

If temporary sheet pile walls or trench boxes are required during construction, they should be designed using the **Soil Parameters** presented in the **Appendix** of this report.

Groundwater levels should be kept at least 18 in. below the working area to facilitate proper material placing and compaction. Some contractors like to place a gravel working bed in wet areas. Fine gravel, such as No. 57, and No. 67 stone may be used, as long as the gravel is wrapped in a filter fabric (Mirafi N 140 or equivalent) to reduce the risk of fines filtering into the open voids in the gravel. The gravel, where used, should be compacted and the compaction confirmed by visual observation.

7 REPORT LIMITATIONS

The recommendations detailed herein are based on the available limited soil information obtained by **MC²** and information provided by **Arcadis** for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **MC²** should be notified immediately to determine if changes of recommendations are required. In the event that **MC²** is not retained to perform these functions, **MC²** cannot be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be provided the opportunity to review the final design plans and specifications to assess that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of **Arcadis and their client**.

APPENDIX

Summary of Soil Parameters – Table 2
Project Location Map – Sheet 1
Boring Location Map – Sheet 2
USDA Soil Survey and USGS Topographic Map – Sheet 3
Subsurface Boring Profiles – Sheet 4
Subsurface Boring Profiles Legend – Sheet 5
Individual Soil Profile (1 Sheet)
Test Procedures

Summary of Soil Parameters - Table 2
David L. Tippin Water Treatment Plant (WTP) Sludge Piping Replacement
City of Tampa, Tampa Water Department
Hillsborough County, Florida
MC[2] Project No. T021808.026

Boring ID	Depth (ft)	N-Value Average	Soil Classification	Average Unit Weight (γ)**		Angle of Internal Friction Ø ** (degrees)	Earth Pressure Coefficients*		Average Undrained Cohesion C_u ** (psf)	Ultimate Shear Strength (psf)
				Saturated (pcf)	Submerged (pcf)		Active (K_a)	Passive (K_p)		
SPT-01	0-10	7***	SP-SM, SC	105	42.6	29	0.347	2.88	0	-
	10-20	12	CH	120	27.6	0	1	1	1,500	-
	20-34	6	CH	115	52.6	0	1	1	700	-
	34-35	50+	LIMESTONE	135	72.6	0	1	1	0	15,000

*Values are for level (non-sloping) backfill; no surcharge loads on backfill

**Based on empirical correlations

***Hand augers (HA) were performed in the top 4 feet at the test boring location to avoid utilities. Soil in this range was assumed loose (N-Value 4 to 10).

LEGEND:

★ Project Location

Source: Google Earth
Image Date: 1/11/2017

0′ 500′ 1000′
Graphic Scale (feet)

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808-A Breckenridge Parkway
Tampa, FL 33610
Ph:813-623-3399 Fax:813-623-6636

MC² Geotechnical • Environmental Materials Testing

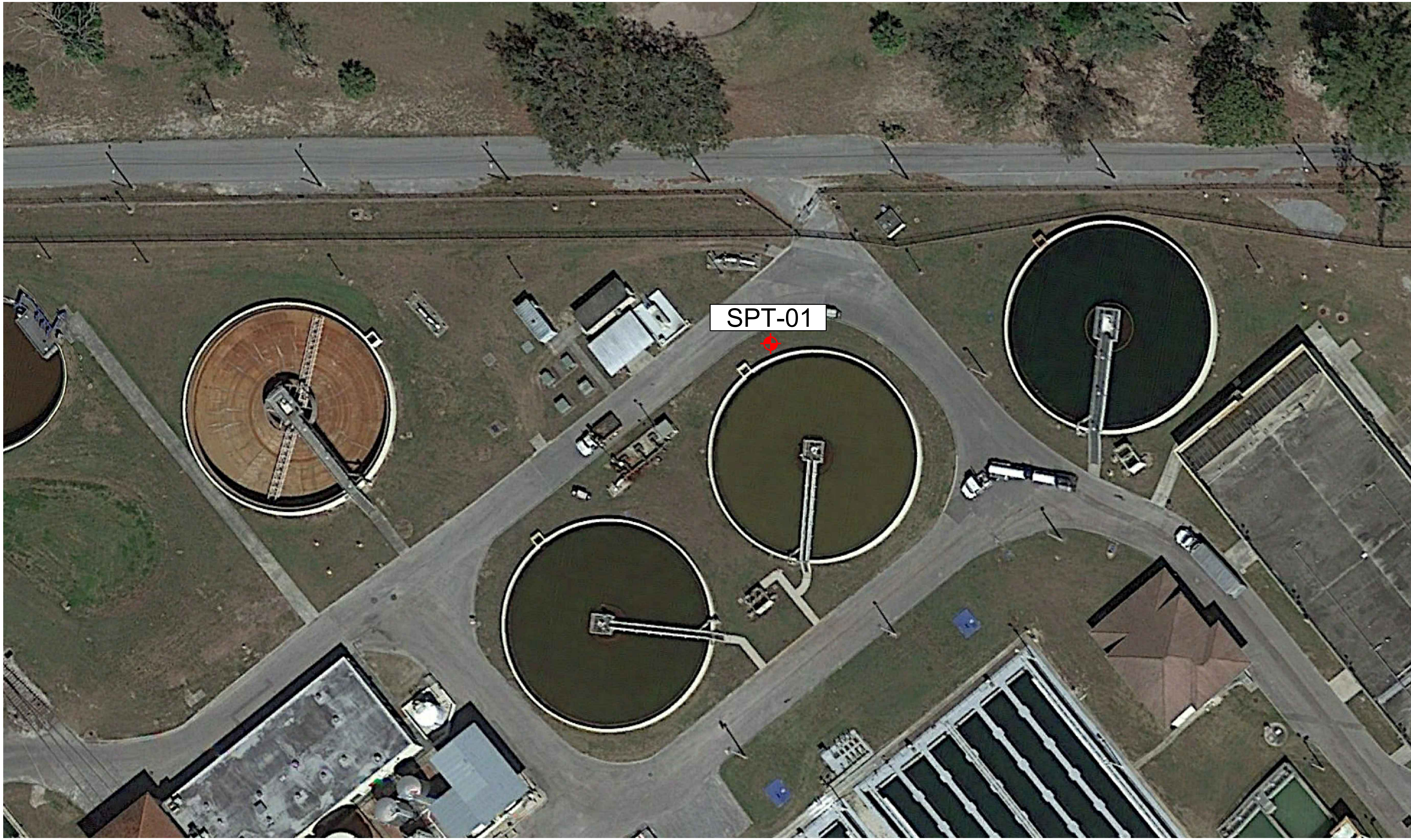
FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
Jeffery L. Hooks, P.E.
FLORIDA LICENSE No. 67882

	NAME	DATE
DESIGNED BY:	TC	9/20/2018
DRAWN BY:	OM	9/20/2018
CHECKED BY:	JH	9/24/2018
SUPERVISED BY:	WS	

Project Location Map

Tippin WTP Sludge Piping Replacement,
Hillsbrough County, Florida

MC² PROJ. NO.	SHEET NO.
T021808.026	1



LEGEND:

Approximate Boring Location

Source: Google Earth
Image Date: 3/15/2018

0′ 50′ 100′

Graphic Scale (feet)

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
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Tampa, FL 33610
Ph:813-623-3399 Fax:813-623-6636

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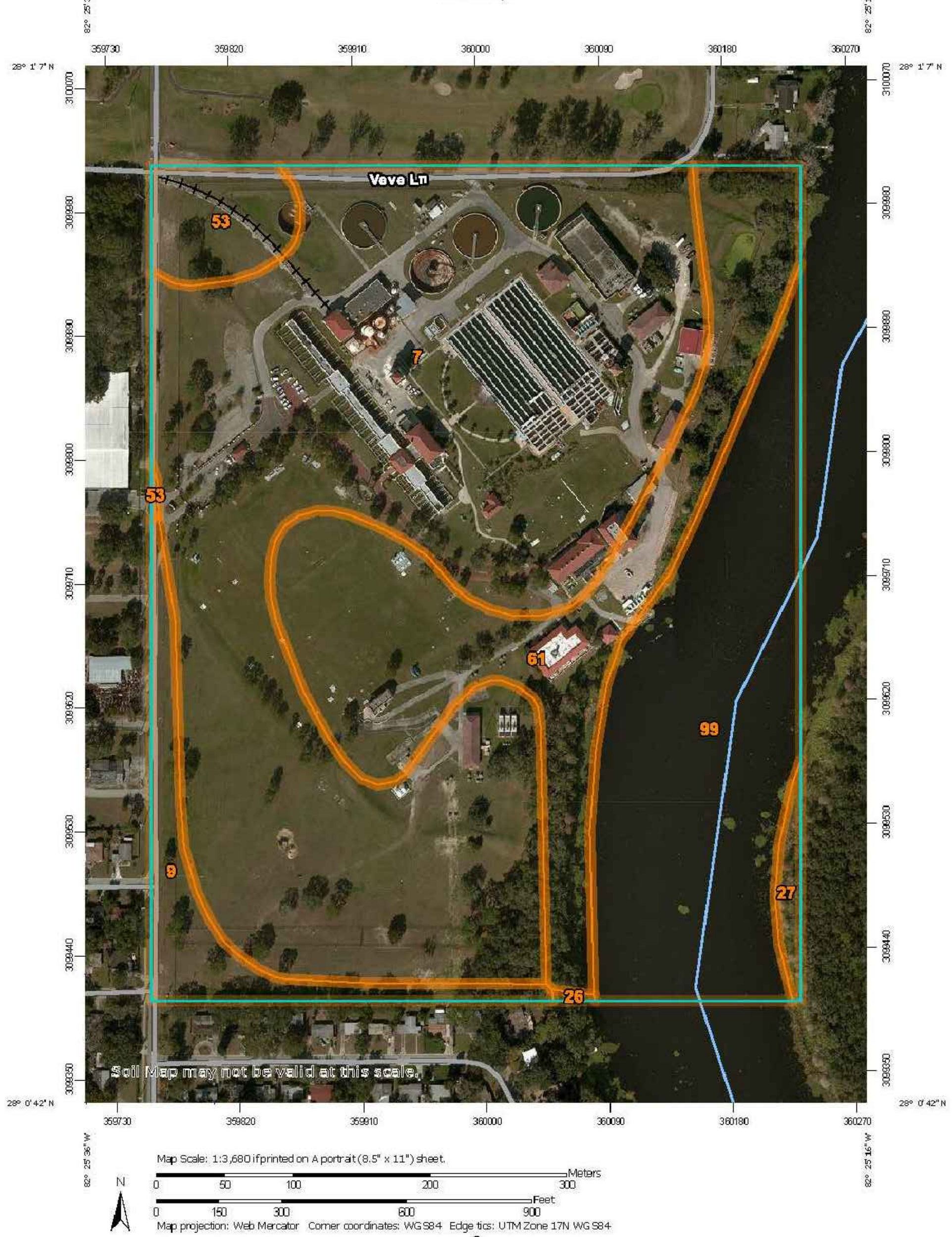
SUPERVISED BY:	WS	

Boring Location Map	MC² PROJ. NO.	SHEET NO.
Tippin WTP Sludge Piping Replacement, Hillsbrough County, Florida	T021808.026	2

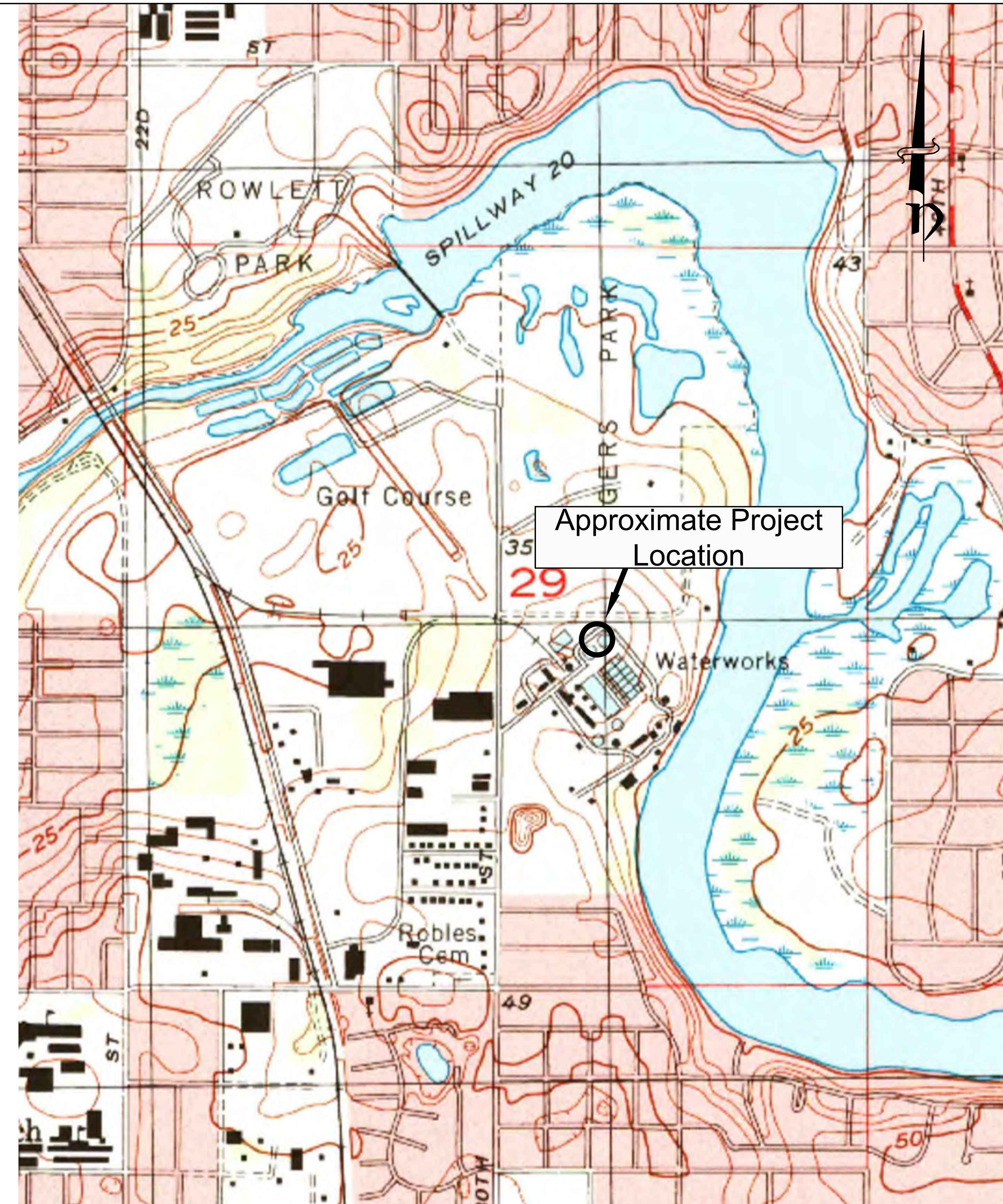
Custom Soil Resource Report

Soil Map



9

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7	Candler fine sand, 0 to 5 percent slopes	39.5	55.4%
9	Candler-Urban land complex, 0 to 5 percent slopes	3.1	4.4%
26	Lochloosa-Micanopy fine sands, 0 to 5 percent slopes	0.0	0.1%
27	Malabar fine sand, 0 to 2 percent slopes	0.6	0.8%
53	Tavares-Millhopper complex, 0 to 5 percent slopes	2.1	3.0%
61	Zolfo fine sand, 0 to 2 percent slopes	12.9	18.1%
99	Water	13.0	18.3%
Totals for Area of Interest		71.3	100.0%



Source: United States Department of Agriculture

Source: United States Department of Agriculture

SULPHUR SPRINGS QUADRANGLE
FLORIDA-HILLSBOROUGH CO.
7.5-MINUTES SERIES (TOPGRAPHIC)
NGVD: 1929 - DATE: 1995

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808-A Breckenridge Parkway
Tampa, FL 33610
Ph:813-623-3399 Fax:813-623-6636

MC²
Geotechnical • Environmental Materials Testing

FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
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	NAME	DATE
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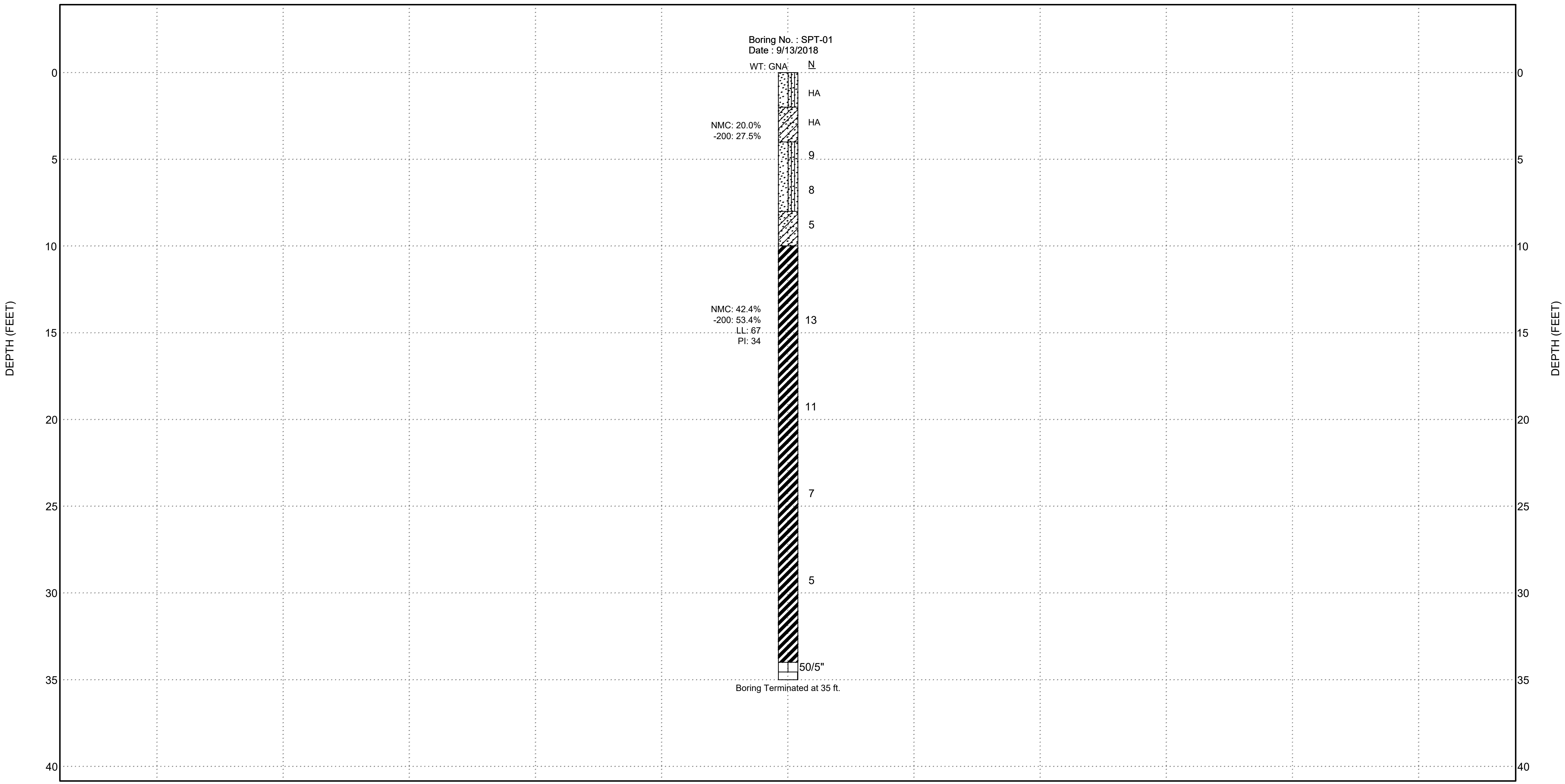
SUPERVISED BY:	WS	

USDA Soil Survey and USGS Topographic Map

Tippin WTP Sludge Piping Replacement,
Hillsbrough County, Florida

MC² PROJ. NO.: T021808.026

SHEET NO.: 3



*N Values Drawn At Middle Of Interval

DATE	NAME	REVISION	APPROVED BY:

MC²
GEOTECHNICAL • ENVIRONMENTAL
MATERIALS TESTING

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DESIGNED BY:	TC	9/20/2018
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CHECKED BY:	JH	9/24/2018
SUPERVISED BY:	WS	

Subsurface Boring Profiles

Tippin WTP Sludge Piping Replacement,
Hillsbrough County, Florida

MC² PROJ. NO.	SHEET NO.
T021808.026	4

LEGEND

- Top Soil
- Asphalt
- Concrete
- (GAB) Graded Aggregate Base
- Limerock Base
- No. 57 Stone
- Soil Cement
- (SP) Poorly Graded Sand
- (SP-SM) Poorly Graded Sand With Silt
- (SP-SC) Poorly Graded Sand With Clay
- (SM) Silty Sand
- (SC) Clayey Sand
- (MH) Elastic Silt
- (ML) Silt
- (CL-ML) Silty Clay
- (CH) Fat Clay
- (CL) Lean Clay
- (OH) Organic Clay
- (OL) Organic Silt
- Peat
- Fill
- Bedrock
- Limestone
- (WLS) Weathered Limestone
- (PWR) Partially Weathered Rock
- Granite
- Gneiss
- Schist

NOTES:

▽	Water Table At Time Of Drilling
▼	Water Table After 24 Hours
GNE	Groundwater Not Encountered
GNA	Groundwater Not Apparent
GNM	Groundwater Not Measured
CL	Center Line
RT	Right Of Center Line
LT	Left of Center Line
BGS	Below Ground Surface
HA	Hand Auger
PA	Power Auger
NMC	Natural Moisture Content (%)
-200	Fines Passing A No. 200 Sieve (%)
PI	Plasticity Index
NP	Non Plastic
LL	Liquid Limit
OC	Organic Content (%)
N	SPT N-Value
WOH	Weight-Of-Hammer
WOR	Weight-Of-Rod
CPT	Cone Penetrometer Test
SPT	Standard Penetration Test
DT	Dilatometer Test
LOC	Loss Of Circulation
ROC	Regain Of Circulation
REC	Rock Core Recovery(%)
RQD	Rock Quality Designation
ST	Shelby Tube Sample
q_u	Unconfined Compressive Strength From Pocket Penetrometer In tsf

GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT)
VERY LOOSE	≤ 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50
SILTS AND CLAYS CONSISTENCY	**SPT (BLOWS/FT)**
VERY SOFT	≤ 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	30-50
VERY HARD	GREATER THAN 50
SPT Spoon Inside Diameter 1 3/8" SPT Spoon Outside Diameter 2"	ASTM Standard Drop Safety Hammer Average Hammer Drop Height 30" Hammer Weight 140 lbs

DATE	NAME	REVISION	APPROVED BY:

MC² Geotechnical • Environmental Materials Testing

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FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
Jeffery L. Hooks, P.E.
FLORIDA LICENSE No. 67882

	NAME	DATE
DESIGNED BY:	TC	9/20/2018
DRAWN BY:	OM	9/20/2018
CHECKED BY:	JH	9/24/2018
SUPERVISED BY:	WS	

Legend

Tippin WTP Sludge Piping Replacement, Hillsbrough County, Florida

MC² PROJ. NO.	SHEET NO.
T021808.026	5

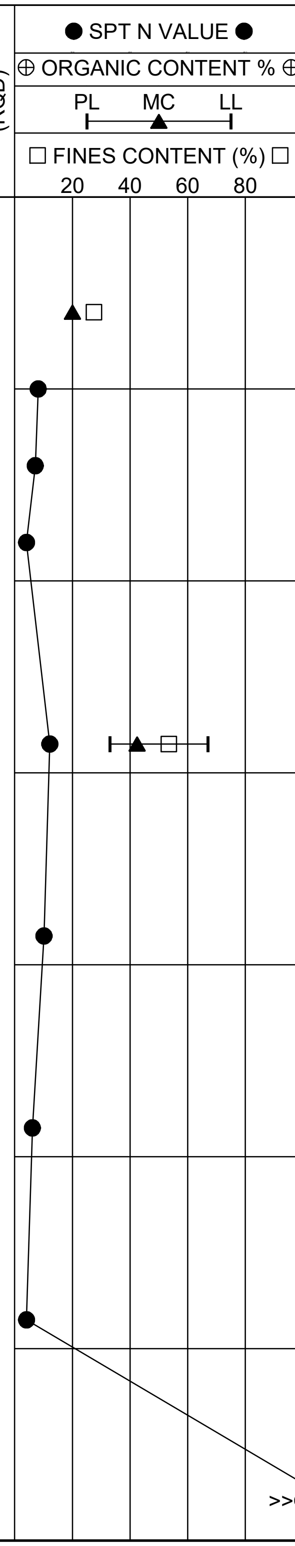
Soil Profile

BORING ID: SPT-01

GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

CLIENT Arcadis U.S., Inc.
PROJECT NAME Tippin WTP Sludge Piping Replacement
PROJECT NUMBER T021808.026
PROJECT LOCATION Hillsborough County, Florida
DATE STARTED 9/13/18 **COMPLETED** 9/13/18
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Standard Drilling
GROUND WATER LEVELS:
DRILLING METHOD Wet Rotary
AT TIME OF DRILLING GNA
LOGGED BY S. Gomez **CHECKED BY** J. Hooks
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
0		SP-SM	Brown, poorly-graded fine SAND with silt and clay nodules	HA		
		SC	Grayish brown, clayey fine SAND			
5		SP-SM	Loose, grayish brown, poorly-graded fine SAND with silt and clay nodules	SS 1	5-5-4-6 (9)	
				SS 2	4-4-4-4 (8)	
		SC	Loose, brown, clayey fine SAND	SS 3	2-3-2-2 (5)	
10		CH	Firm to stiff, light greenish gray, sandy fat CLAY			
15				SS 4	3-5-8 (13)	
20				SS 5	3-4-7 (11)	
25				SS 6	2-3-4 (7)	
30				SS 7	2-2-3 (5)	
35		LS	LIMESTONE	SS 8	2-50/5"	



Bottom of hole at 35.0 feet.

TEST PROCEDURES

The general field procedures employed by MC Squared, Inc. (**MC²**) are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as boring.

Standard Drilling Techniques
To obtain subsurface samples, boring are drilled using one of several alternate techniques depending upon the subsurface conditions. Some of these techniques are:

In Soils:

a) Continuous hollow stem augers.
b) Rotary boring using roller cone bits or drag bits, and water or drilling mud to flush the hole.
c) "Hand" augers.

In Rock:

a) Core drilling with diamond-faced, double or triple tube core barrels.
b) Core boring with roller cone bits.

<u>Hollow Stem Augering:</u> A hollow stem auger consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

<u>Mud Rotary:</u> In situations where unconsolidated materials are anticipated, the direct-rotary or "mud" rotary method may be used as a more effective method for obtaining soil samples. The fluid used, which is typically stored in an aluminum tub (also known as a "mudtub"), is a mix of water and bentonite, also known as a bentonite slurry or "mud". This fluid circulates into the borehole and then returns to the mudtub using a pump system. A loss of circulation, partially or otherwise, may signify a void at that sample depth. The key advantage of using this drilling method is that it stabilizes the borehole wall while drilling in unconsolidated formations, due to the buildup of a filter cake on the wall.

<u>Core Drilling</u>: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material which cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as "refusal material". Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D-2113 using a diamond-studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

Sampling and Testing in Boreholes
Several techniques are used to obtain samples and data in soils in the field; however the most common methods in this area are:

a) Standard Penetrating Testing
b) Undisturbed Sampling
c) Dynamic Cone Penetrometer Testing
d) Water Level Readings

The procedures utilized for this project are presented below.

<u>Standard Penetration Testing:</u> At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2-inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D1586. The depths and N-values of standard penetration tests are shown on the Boring Logs. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

<u>Water Level Readings:</u> Water level readings are normally taken in the boring and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water level at the time of our field exploration. In clayey soils, the rate of water seepage into the boring is low and it is generally not possible to establish the location of the hydrostatic water level through short-term water level readings. Also, fluctuation in the water level should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Logs are determined by field crews immediately after the drilling tools are removed, and several hours after the boring are completed, if possible. The time lag is intended to permit stabilization of the groundwater level that may have been disrupted by the drilling operation.

Occasionally the boring will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone.

BORING LOGS

The subsurface conditions encountered during drilling are reported on a field boring log prepared by the Driller. The log contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of groundwater. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed a geotechnical professional classifies the soil samples and prepares the final Boring Logs, which are the basis for our evaluations and recommendations.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our Boring Logs.

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties are presented in this report.

The following table presents criteria that are typically utilized in the classification and description of soil and rock samples for preparation of the Boring Logs.

Relative Density of Cohesionless Soils From Standard Penetration Test

Very Loose	≤ 4 bpf
Loose	5 - 10 bpf
Medium Dense	11 - 30 bpf
Dense	31 - 50 bpf
Very Dense	> 50 bpf

(bpf = blows per foot, ASTM D 1586)

Consistency of Cohesive Soils

Very Soft	≤ 2 bpf
Soft	3 - 4 bpf
Firm	5 - 8 bpf
Stiff	9 - 15 bpf
Very Stiff	16 - 30 bpf
Hard	30 – 50 bpf
Very Hard	> 50 bpf

Relative Hardness of Rock

Very Soft	Very soft rock disintegrates or easily compresses to touch; can be hard to very hard soil.
Soft	May be broken with fingers.
Moderately Soft	May be scratched with a nail, corners and edges may be broken with fingers.
Moderately Hard	Light blow of hammer required to break samples.
Hard	Hard blow of hammer required to break sample.

Particle Size Identification

Boulders	Larger than 12"
Cobbles	3" - 12"
Gravel	
Coarse	3/4" - 3"
Fine	4.76mm - 3/4"
Sand	
Coarse	2.0 - 4.76 mm
Medium	0.42 - 2.00 mm
Fine	0.42 - 0.074 mm
Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity

$$\textbf{RECOVERY} = \frac{\text{Total Length of Core}}{\text{Length of Core Run}} \times 100\ \%$$

Description	Core Recovery %
Incompetent	Less than 40
Competent	40 - 70
Fairly Continuous	71 - 90
Continuous	91 - 100

Relative Quality of Rocks

$$\textbf{RQD} = \frac{\text{Total core, counting only pieces > 4" long}}{\text{Length of Core Run}} \times 100\ \%$$

Description	RQD %
Very Poor	0 - 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %