DUDA WATER STORAGE IMPROVEMENTS (WSI)
FINAL GEOTECHNICAL REPORT

Wood Project #600550X04

Date: June 2020

DUDA WATER STORAGE IMPROVEMENTS (WSI) FINAL GEOTECHNICAL REPORT

Prepared for:

St. Johns River Water Management District (SJRWMD)
Palatka, Florida

Prepared by

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Wood Project No. 600550x04

June 30, 2020

CERTIFICATION
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Engineering Certification

I hereby certify that I am a registered professional engineer in the State of Florida practicing with Wood Environment & Solutions, Inc., 1101 Channelside Drive, Suite 200, Tampa, FL 33602, a corporation authorized to operate as a business providing engineering consulting services (5392) by the State of Florida Department of Professional Regulation, Board of Engineers. I further certify that I, or others under my direct supervision, have prepared the geotechnical engineering evaluations, findings, opinions, calculations, conclusions or technical advice hereby represented in this report.

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Duda Water Storage Improvements (WSI) FINAL Geotechnical Report

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1.0 INTRODUCTION

The Duda Water Storage Improvements (WSI) Project will be located on Duda Property which has approximately 2,900 acres, and is located at the boundaries between Lake County, and Orange County, and north of Lake Apopka, as shown in **Figure 1**. In October of 2018, Wood prepared a preliminary geotechnical investigation for pumps, structure and levee improvements. According to information provided by the St. Johns River Water Management District (Owner), for this final report, Wood Environment & Infrastructure Solutions (Wood) understands that there are plans to install 15-inch to 48-inch aluminum culvert pipes (ACP), berm plugs, risers, walkways and slide gate structures on the site. The locations of these proposed structures are presented in **Figure 2**.

Wood was tasked with performing a subsurface geotechnical exploration for the proposed site development and structures. The results of this geotechnical exploration were used to develop geotechnical recommendations for the construction of the proposed culverts, berm plug, sumps and walkways.

The field works were completed on February 27th, 2020, and included the following:

- Coordinating an underground utility locate.
- Performing five (5) Standard Penetration Test (SPT) borings in general accordance with ASTM D 1586. The depth of the borings varied between 40 feet and 50 feet. At each boring the top 5 feet were sampled using hand augers, between 5 feet and 15 feet the soils were sampled continuously, and thereafter, at 5-foot intervals. These borings were labeled as "2020-SPT-X".
- Collecting piston tube samples at two locations within Lake Level Canal. These piston tubes were labeled as "2020-PT-X".
- Classifying the soil types in accordance with the United Soil Classification System (USCS) designations (ASTM D 2487).
- Preparing this report including figures, boring logs, seasonal high groundwater level determination, laboratory test results and recommendations.

2.0 PROJECT SITE CHARACTERISTICS

2.1 Lake County and Orange County Soil Survey

Soils data from the Soil Survey of the site produced by the United States Department of Agriculture Natural Resource Conservation Service (USDA-NRCS) were reviewed as part of the exploration. The soil units identified within the project area are described below:

- Gator Muck, frequently ponded, 0 to 1 percent slopes (map symbol 18), are very poorly

drained soils with depressions on marine terraces. The soil unit consists of muck on the top 18 inches, then sandy clay loams between 18 and 55 inches below surfaces and fine sands up to 80 inches below surface. The water table is between 0 and 6 inches below surface. The available water storage capacity is very high, and permeability is moderately low to moderately high, ranging from 0.06 to 0.20 in/hr.

- Everglades Muck, depressional (map symbol 27), are very poorly drained soils with depressions on marine terraces. The soil unit consists of muck on the top 11 inches, then mucky peat up to 80 inches below surface. The water table is at the ground surface. The available water storage capacity is very high, and permeability is high, ranging from 2 to 6 in/hr.
- Wauchula Sand (map symbol 49), are poorly drained soils with rises on marine terraces. The soil unit consists of sands up to a depth of 38 inches below surface, then sandy clay loams up to a depth of 80 inches below surface. The water table is between 6 and 18 inches below ground surface. The available water storage capacity is moderately, and permeability is moderately high to high, ranging from 0.6 to 2 in/hr.

The proposed structures at Duda Property will be installed on Gator muck and Everglades muck.

These USDA-NRCS classifications are based on their interpretation of aerial photographs and widely spaced hand auger borings. Borders between mapping units are approximate, and the transition between soil types may be gradual. Areas of dissimilar soils can occur within a mapped unit. However, the soil survey provides a reasonable basis for an initial evaluation of surficial soil conditions in the area and can provide an indication of changes that may have occurred due to land filling, excavation, and other activities at the site. The soil survey information for the site is presented in **Appendix A**.

2.2 Geology

The Lake Apopka site is located on the western boundary of Orange County and the eastern boundary of Lake County, west of the town of Apopka, Florida. Local geology near the project site is characterized by surface and near-surface sediments consisting of quartz sand, clay, and limestone, ranging in age from late Eocene to Holocene. The first recognizeable lithostratigraphic unit occuring below these near-surface sediments is the Cypresshead Formation, of the Pliocene age. The Cypresshead Formation can reach thicknesses of up to 200 feet, and is composed of very fine to very coarse grained clean to clayey sands.

Underlying the Cypresshead Formation is the Hawthorn Group, Coosawhatchie Formation of the Miocene age. The Coosawhatchie Formation is characterized by poorly consolidated clayey and phosphatic sand, silty clay, and occasional dolostone and limestone.

Underlying the Hawthorn Group, Coosawhatchie Formation is the Ocala Limestone of the Eocene age. The limestone formations of the Ocala Group reach thicknesses of 90-150 feet, and

primarily consist of white, to cream, to dark brown, granular to chalky, fossiliferous, poorly to well indurated limestone and dolomite, known for its very high permeability (USGS, 2018). The regional geology of both Orange County and Lake County in the general vicinity of Lake Apopka is presented below in **Table 1.** Some of the stratigraphic units can be missing in some areas.

TABLE 1 - Generalized Stratigraphic Units

Geologic Age	Stratigraphic Unit	Approximate Thickness (ft)	General Lithologic Character (starting from land surface)
Holocene (Recent)	Holocene Sediments	0-5	Quartz sands, carbonate sands and muds, and organics.
Pleistocene/ Holocene	Undifferentiated Sediments	0-100	Fine to coarse sands with silts, clay, and marl.
Pleistocene/ Holocene	Beach Ridge and Dunes	0-20	Fine to medium grained quartz sand.
Pleistocene/ Pliocene	Shelly Sediments	0-20	Quartz sands, clayey sands, sandy clays, limestone, fossiliferous.
Pleistocene/ Holocene	Reworked Cypresshead Sediments	0-20	Fine to coarse grained quartz sands with gravel and clay.
Pliocene	Cypresshead Formation	100-200	Very fine to very coarse grained clean to clayey sands.
Miocene	Hawthorn Group, Coosawhatchie Formation	0-50	Clayey sands, phosphatic sands, silty clays, dolostone, limestone.
Eocene	Ocala Limestone	100	Porous, marine limestone, soft, granular to chalky, highly fossiliferous.

3.0 SUBSURFACE EXPLORATIONS

3.1 Standard Penetration Test Borings

Five Standard Penetration Test (SPT) borings were performed in general accordance with ASTM D 1586 (Standard Test Method for Standard Penetration Test). The field work was completed on February 27, 2020. The locations of the SPT borings are shown in **Figure 2**. These 2020 borings were labeled as "2020-SPT-X" whereas the 2018 borings were labeled as "2018-SPT-X". The soils encountered in the borings were visually classified and logged in the field in accordance with ASTM D 2488. Groundwater levels, at the end of drilling each boring, were recorded. Representative portions of the samples were transported to Wood's materials testing laboratory in Jacksonville, Florida for further classification and testing. The logs were then updated based upon the results of the laboratory classification tests (see **Section 4.0**), using the Unified Soil Classification System (USCS) in accordance with ASTM D 2487.

The subsurface conditions encountered in the SPT borings are presented on the soil boring logs in **Appendix B.** At the same time, **Appendix B** includes the borings performed in 2018. The boring logs represent our interpretation of the subsurface conditions encountered in the field and the visual examination of field samples by our technical staff. The lines designating the interfaces between various strata on the boring logs represent the approximate interface locations. Actual transitions between strata may be gradual. All the water levels shown in the logs represent the conditions at the time of our exploration. On completion, the boring locations were surveyed to determine the coordinates using a handheld Garmin GPS 72H model with a horizontal accuracy of +/- 2 feet. The ground surface elevations were obtained based on the "St. Johns River Water Management District, Upper Ocklawaha River Basin, Lake Apopka Duda Water Storage Improvements, 60% drawings".

The 2020 SPT borings were performed by AmDrill, Inc., of Brooksville, Florida. The drilling was completed using a truck mounted drill rig. The SPT borings were conducted in general accordance with ASTM D 1586 using mud-rotary drilling methods and advanced to depths between 40 and 50 feet. At each location, the top 5 feet were completed using hand augers to avoid possible shallow utilities. Between 5 and 15 feet the SPT were conducted continuously and thereafter at 5 feet intervals. Soil samples were collected from the borings using a 1.5-inch inner diameter split-spoon sampler driven with an automatic 140-pound slide hammer falling a distance of 30-inches. The soils from the recovered split spoon samples were logged. Four SPT borings (2020-SPT-1 to 2020-SPT-4) were advanced to a depth of 40 feet, and 2020-SPT-5 was advanced to a depth of 50 feet. At the end of drilling each borehole was backfilled with the remaining auger cuttings and plugged with bentonite chips.

3.2 Piston Tube Sampling

Piston tube sampling was completed on Lake Level Canal at 2 locations as shown on **Figure 2**. The piston tube sampling works were performed on February 27th, 2020 by a Wood field crew. The piston tube samples were collected from a 16-foot long Jon Boat.

The piston tube sampler is comprised of a stainless steel thin-walled, 2-inch diameter by 18-inch long sampling tube with 5-foot long threaded rod extensions. The sampler is advanced by hand and typically cannot penetrate a relatively dense muck or sand layer given the diameter and length of the sampling tube. All samples were placed into sealed jars and labeled with sample identification numbers and depths.

Upon completion, the boring locations were surveyed to determine the as-built coordinates using a handheld Garmin GPS 72H model with a horizontal accuracy of +/- 2 feet. The ground surface elevations were obtained based on the "St. Johns River Water Management District, Upper Ocklawaha River Basin, Lake Apopka Duda Water Storage Improvements, 60% drawings".

Table 2 includes a list of the Standard Penetration Tests and Piston Tubes performed at the

Duda Area.

TABLE 2 - Summary of SPT Borings (2018 and 2020) and Piston Tubes at the Duda Property

Boring / Piston Tube ID	Date	Northing (ft) (1)(2)	Easting (ft) (1)(2)	Ground Elevation (ft) (3)(6)	Boring Termination Depth (ft, bgs) (5)
2018 - SPT - 1	9/24/2018	1586255.4	440013.2	+64.0	20
2018 - SPT - 2	9/24/2018	1586255.2	441985.0	+64.0	25
2018 - SPT - 3	9/24/2018	1586082.6	442291.9	+64.0	20
2018 - SPT - 4	9/24/2018	1586292.7	442427.7	+68.0	20
2018 - SPT - 5	9/24/2018	1586170.8	442763.7	+63.5	25
2018 - SPT - 6	9/24/2018	1586219.4	447804.0	+63.5	20
2018 - SPT - 7	9/24/2018	1587097.4	452900.7	+67.7	20
2018 - SPT - 8	9/24/2018	1587087.4	452721.7	+67.0	20
2020 - SPT - 1	02/25/2020	1584070.0	438097.9	+64.0	40
2020 - SPT - 2	02/25/2020	1585074.1	437990.4	+68.0	40
2020 - SPT - 3	02/26/2020	1586275.5	442248.9	+63.5	40
2020 - SPT - 4	02/27/2020	1586239.1	442241.6	+63.5	40
2020 - SPT - 5	02/27/2020	1586247.9	452626.0	+67.0	50
2020 - PT – 1	02/27/2020	1586297.9	452763.5	+56.0 (4)	2.0 (5)
2020 - PT - 2	02/27/2020	1586171.7	452766.6	+56.0 (4)	0.7 (5)

Notes:

(1) Coordinates were measured using a Garmin GPS 72H model.
(2) Coordinates are referenced to the US State Plane, Florida East Zone (901).
(3) Ground surface elevations are referenced to vertical datum NAVD88 and were estimated from "St. Johns River Water Management District, Upper Ocklawaha River Basin, Lake Apopka Duda Water Storage Improvements, 60% drawings".
(4) Refers to bottom of canal elevation.
(5) Below bottom of canal.
(6) For the 2018 borings, Ground surface elevations are referenced to vertical datum NAVD88 and were estimated using the LIDAR.

4.0 LABORATORY TESTING

The soil samples collected during the subsurface exploration program were taken to Wood's materials laboratory in Jacksonville, Florida. Selected samples were tested for natural Moisture Content (ASTM D 2216), percent of material finer than the #200 sieve (ASTM D1140), Atterberg limits (ASTM D 4318), and Organic Content (ASTM D 2974). Soils were classified in general accordance with ASTM D 2487. Laboratory test results are presented in **Appendix C**. **Appendix C** also presents the laboratory test results of the 2018 borings. The laboratory test results are generally consistent with field descriptions. Detailed discussion of the strata is presented in

Section 5.

5.0 SUBSURFACE CONDITIONS

Based on the findings of the investigation and laboratory testing, five generalized strata were identified within the project site. **Appendix B** shows the boring logs along the existing berms. The strata are distinguished by soil characteristics, typically grain size, cohesion, plasticity and organic content. These units, in descending order from ground surface, are described in the following:

Stratum 1	FILL: SAND (SP) to Clayey Sand (SC) to Silty SAND (SM) to Sandy Clay (CL) to SAND with clay (SP-SC) to SAND with silt (SP-SM) with rock fragments, dark brown to brown to light brown to light greenish gray .
Stratum 2	Organic Sandy Silt (OL) to Silty Sand (SM), dark brown to brown, spongy, fibrous, less than 30% fibers.
Stratum 3	SAND (SP) to Clayey SAND (SC) to SAND with clay (SP-SC), light gray to light greenish gray to light brown to brown.
Stratum 4	Sandy Clay (CL to CH), light greenish to greenish gray to white.
Stratum 5	Sand with Silt (SP-SM) light gray to light brown to brown.

Stratum 1 consists of variable fill material to depths of up to approximately 3 feet below ground surface. This stratum was encountered in all the SPT borings and consisted of dark brown to brown to light brown to light greenish gray sands, clayey sands, silty sands, sandy clays and sands with clays with rock fragments. This stratum presented moisture contents between 12% and 28% and fines content between 20% and 72%.

Stratum 2 consists of dark brown to brown organic sandy silts (OL) to silty sands (SM). The stratum was identified as very soft, spongy, with less than 30% fibers, varying in color from dark brown to brown. The stratum was observed between 2 and 11 feet below the ground surface. This organic stratum was typically encountered underneath stratum 1, varying in thickness from 6 to 9 feet. The organic contents ranged between 7% and 91%. This stratum is interpreted to be the top of the original natural ground surface.

Stratum 3 consists of very loose to medium dense sands light gray to light greenish gray to light brown to brown clayey sands and sands with clays. This layer varied in thickness from 2 to 14 feet, extending to depths of up to 50 feet below ground surface. The moisture content ranged from 20% to 51%, fines content ranged between 4% and 31%, and organic contents varied between 2 and 17%.

Stratum 4 is composed of soft to firm light greenish to greenish gray to white sandy clays (CL and CH), underlain typically by strata 2 and 3. This layer extends from 9 to 17 feet, below ground

surface, varying in thickness from 2 to 6 feet. Moisture content was 33%, fines content 79%, and plasticity index varied between 63 and 149.

Stratum 5 is composed of light gray to light brown to brown sand with silts (SP-SM). This stratum was encountered at 13 feet below ground surface, varying in thickness between 10 and 13 feet. The consistencies of the sands with silts varied from very loose to medium dense. The moisture content varied between 17% and 32%, and fines contents was 6%.

General Strata Observations

Some key observations on the sediment stratigraphy includes:

- All the borings encountered the organic sandy silt or silty sand (SM) layer (Stratum 2) which varied in thickness between 6 and 9 feet.
- In the bottom of the Lake Level Canal, the piston tubes did not encounter an organic sandy silt or silty sand layer (Stratum 2).

6.0 GROUNDWATER CONDITIONS

The initial portions of the borings were advanced by dry-auger methods to depths of 5 ft. Groundwater was not observed during these initial dry-auger borings. Following the hand augers, the rotary mud drilling was utilized to boring termination depth. Due to the wet method of drilling and since the boreholes were grouted after explorations were completed, the location of the phreatic line was not determined.

7.0 SEASONAL HIGH GROUNDWATER TABLE

The seasonal high groundwater table (SHGWT) is defined as the highest groundwater level sustained for a period of 2 to 4 weeks during the "wet" season, for existing site conditions, in a year with average normal rainfall amounts.

Based on historical data, the wet season in Central Florida is typically between late May and mid-October. In order to estimate the seasonal high groundwater level at the boring locations, many factors may be considered, such as the following:

- Measured groundwater table
- Drainage characteristics of existing soil types
- Season of the year (wet/dry season)
- Current & historical rainfall data (recent and year-to-date)
- Natural relief points (such as lakes, rivers, swamp areas, etc.)

- Man-made drainage systems (ditches, canals, etc.)
- Vegetative indicators
- Review of available published literature including USDA Soil Survey, Potentiometric Maps, etc.
- Stratigraphy including the presence of hydraulically restrictive layers
- Redoximorphic features (i.e. soil mottling, color, etc.)

Based on the ground conditions encountered during the field explorations, our site observations, and information in the National Resource Conservation Service (NRCS) soil survey data, the estimated SHGWT at the site is presented in **Table 3.**

TABLE 3 - Seasonal High Groundwater Table (SHGWT) Conditions based on the 2018 and 2020 borings

SPT NO.	USDA-NRCS Soil Type	USDA-NRCS Estimated SHGWT (ft, bgs) [1]	Estimated Groundwater depth During Drilling (ft, bgs)	SHGWT Indicator depth (ft, bgs)	Estimated SHGWT depth range (ft, bgs)
2018 - SPT-1	Everglades Muck, depressional	2.0	N/E [2]	N/A [3]	2.0 – 8.0
2018 - SPT-2	Everglades Muck, depressional	2.0	10.0	N/A [3]	
2018 - SPT-3	Everglades Muck, depressional	3.0	4.0	3.0 [4]	
2018 - SPT-4	Everglades Muck, depressional	4.0	4.0	4.0 [4]	
2018 - SPT-5	Everglades Muck, depressional	4.0	2.5	4.0 [4]	
2018 - SPT-6	Wauchula Sand	0.5	2.0	2.5 [4]	
2018 - SPT-7	Gator Muck, frequently ponded, 0 to 1 percent slopes	8.0	8.0	8.0 [4]	
2018 - SPT-8	Gator Muck, frequently ponded, 0 to 1 percent slopes	6.0	N/E [2]	N/A [3]	
2020 - SPT-1	Everglades muck, depressional	3.0	N/E [2]	3.0 [4]	
2020 - SPT-2	Everglades muck, depressional	2.0	N/E [2]	5.0 [4]	

SPT NO.	USDA-NRCS Soil Type	USDA-NRCS Estimated SHGWT (ft, bgs) (1)	Estimated Groundwater depth During Drilling (ft, bgs)	SHGWT Indicator depth (ft, bgs)	Estimated SHGWT depth range (ft, bgs)
2020 - SPT-3	Everglades muck, depressional	3.0	N/E (2)	3.0 (4)	
2020 - SPT-4	Everglades muck, depressional	2.0	N/E (2)	2.0 (4)	
2020 - SPT-5	Gator muck, frequently ponded, 0 to 1 percent slopes	2.0	N/E (2)	2.0 (4)	

Notes:
(1) Considers existing berm fill height. Refer to boring logs in **Appendix B**.
(2) N/E = Not Encountered. No indicators were encountered during the exploration.
(3) N/A = Not Available.
(4) Based on recovered samples.

The recovered soil samples showed visible signs of SHGWT such as the organic sandy silt (OL and silty sand (SM) layers. Based on the information in the NRCS Soil Survey data, the soil types and properties identified in the borings, Wood estimates that the typical SHGWT at this site will be approximately between 2.0 to 8.0 ft below the top of the existing berms.

8.0 ENGINEERING PROPERTY OF MATERIALS

Walkways

Engineering properties of materials for the proposed walkways were selected for evaluating the lateral loads and axial capacities of the steel pile profile proposed to support these structures. Using boring 2020-SPT-4 as the worst-case scenario and previous geotechnical experience with similar soil conditions and site characteristics, properties were assigned to the strata on which the proposed walkways will be installed. **Table 4** presents the properties assigned to each stratum.

TABLE 4 - Engineering Properties for the strata detected by 2020-SPT-4.

Stratum No.	Description	SPT-N Range	Unit Weight (pcf)	Effective Weight (pcf)	Undrained Shear Strength, S_u (psf)	Effective Internal Friction Angle (φ')	Strain Factor ε_{50}
2	Organic Sandy Silt (OL) to Silty Sand (SM)	2-5	80	17.6	200	0	0.02
3	SAND (SP) to Clayey SAND (SC) to SAND with clay (SP-SC),	5	115	52.6	0	28	-

Stratum No.	Description	SPT-N Range	Unit Weight (pcf)	Effective Weight (pcf)	Undrained Shear Strength, S_u (psf)	Effective Internal Friction Angle (φ')	Strain Factor ε_{50}
4	Sandy Clay (CL to CH)	3 - 5	120	57.6	200	0	0.02
5	Sand with Silt (SP-SM), Loose	4 – 8	115	57.6	0	28	-
	Sand with Silt (SP-SM), Medium Dense	23	115	57.6	0	30	-
	Sand with Silt (SP-SM), Very Dense	56	115	57.6	0	35	-

9.0 ENGINEERING ANALYSIS

According to information provided by the SJRWMD, the proposed walkways will be built for pedestrian use, therefore the loads are expected to be low. Any work requiring heavy equipment would be performed from the berms. The proposed lengths of the gate access walkways vary between 25 and 28 feet, as shown in **Figures 3**, **5** and **6**. These figures also show the cross sections of the North-West, South-East and South-West walkways.

The engineering analyses considered the following parameters:

- Maximum Water elevation: +64.0 ft (NAVD88)
- Platform support steel piles: HP8X36
- Yield Stress (f'_y) of steel: 50,000 psi

These proposed piles will support only the walkways. In this report, Wood considered a typical pile analysis at the junction of Marsh Rabbit Road and the North South Road using the information from 2020-SPT-4 as the worst-case scenario. 2020-SPT-4 is located on the north-west corner of this intersection.

9.1 Steel pile lateral capacity analysis

A lateral load analysis for the supports of the proposed walkways was performed in order to verify if the steel supports are adequate to withstand the design loads. The maximum water elevation considered for this analysis is at +64.0 ft (NAVD88). **Figures 5** and **6** show elevations of the proposed pile support system which will support the proposed walkways.

When the berm is raised with additional fill to its final elevation of 64.78 ft (NAVD88), there will be some additional settlement (i.e., lateral and vertical deformation) of the berm due to consolidation of the underlying organic layer. If the filling is done after the steel pile and

walkway structures are installed, this movement will induce additional stresses on the pile support systems and structures. The additional loads and stresses that would occur on the piles and walkways have not been considered for this analysis. The final design of the structure and steel pile system can be refined to account for the potential additional stresses.

A lateral load analysis was performed for the proposed steel pile profile HP8X36 using the computer program LPILE v2016, by Ensoft. The subsurface conditions from boring 2020-SPT-4 were used to develop our analysis profile. For modelling purposes, a free length of 9 ft was considered.

Also, for the lateral load analysis, our analyses considered the worst-case scenario which was for the steel piles at the edge of the proposed walkways as they are the farthest from the berm.

Boundary Conditions

The analysis was performed for a two pile-head loading condition:

1. Shear and Moment: A shear force of 1,250 lbs, 0 kips-in bending moment and an applied axial compression load of 4,000 lbs.
2. Shear and Slope: A shear force of 1,250 lbs, 0 radians slope and an applied axial compression load of 4,000 lbs.

The soil undrained shear strength, unit weight, friction angle, and coefficient of lateral subgrade reaction (k) values used in the *LPILE v2016* analyses were estimated based on our experience, published empirical correlations, and available field and laboratory test data. A summary of the results of lateral load analysis conditions for the proposed HP8X36 steel pile is presented in **Table 5**. The complete *LPILE v2016* outputs from each computer run are presented in **Appendix D**.

TABLE 5 - Summary of Pile Lateral Load Analysis. Steel Pile HPX36

Pile-Head Loading condition	Pile top elevation (NAVD88, ft)	Pile tip elevation (NAVD88 , ft)	Embedment Length (ft)	Applied Shear Load (lbs)	Applied Bending Moment (kips-in)	Slope (rad)	Applied Axial Load (Kips)	Max Bending Moment (kips-in)	Pile Head Deflection (in)
Shear and Moment	+64.3	+24.3	31.0	1,250	0	-	4,000	180	1.0
Shear and Slope					-	0	4,000	67	0.23

Table 6 presents the comparison between the lateral analysis results and the properties of the HP8X36 profile provided by the American Institute of Steel Construction (AISC).

TABLE 6 - Profile properties comparison vs computed results.

Steel Profile	Yield Stress (f'_y) (psi)	Section Modulus (in^3)	Reduction Factor, φ_{red}	M_{red} (kips-ft)	Computed M_{max} capacity (kips-ft)	Comments
HP8X36	50,000	29.80	0.6	10,728	2,160	Steel Section is Acceptable

Based on the results of lateral analysis, the lateral analysis provides the most critical pile embedment depth (30 feet minimum) in order to resist the design loads. Final recommendations are provided in the recommendation section for walkways.

9.2 Steel pile axial and uplift capacity analysis

The axial capacity of the proposed steel pile supports was estimated following the guidelines by United States Department of Transportation of Federal Highway Administration (FHWA) – Design and Construction of Driven Pile Foundations – Volume 1. For cohesive soils we used the "alpha" method approach and for cohesionless soils we based our calculations on the Nordlund Method. **Table 7** presents the estimated axial capacity and depth for the proposed steel profile HP8X36. An axial load factor of safety (FS) of 2 was considered for these calculations.

As mentioned before, the subsurface conditions from boring 2020-SPT-4 were used to develop our analysis profile.

TABLE 7 - Summary of Axial Capacity Estimates for steel pile profile HP8X36

Pile Type	Pile Top Elevation (ft, NAVD88)	Pile Tip Elevation (ft, NAVD88)	Embedment Depth (ft)	Total Pile length from Bottom of Platform (ft)	Estimated Unfactored Axial Capacity (kips)	Estimated Allowable Axial Capacity (Q_{all}) (kips) (FS =2)
Steel Pile	+64.3	+24.3	31.0	40	36.0	18.0

The uplift capacity analysis for single steel piles was based on the guidelines provided by United States Department of Transportation of Federal Highway Administration (FHWA) – Design and Construction of Driven Pile Foundations – Volume 1. For cohesive soils and using the "alpha" method approach, this manual recommends an uplift reduction factor φ_{up} of 0.25. On the other hand, for cohesionless soils, using the Nordlund Method, this manual recommends an uplift reduction factor φ_{up} of 0.35 of the ultimate friction resistance. **Table 8** presents the summary table of the estimated uplift capacity for the proposed steel pile. **Appendix E** includes the axial and uplift resistance calculations.

TABLE 8 - Summary of Uplift Capacity for steel pile profile HP8X36

Pile top elevation (ft, NAVD88)	Pile Tip Elevation (ft, NAVD88)	Embedment Depth (ft)	Total pile Length from bottom of platform (ft)	Estimated Factored Uplift Resistance (R_{up}) (kips)
+64.3	+24.3	31	40	11.5

10.0 CONSTRUCTION RECOMMENDATIONS

10.1 Proposed Aluminum Culvert Pipes (ACP)

Table 9 presents a summary of the bearing strata (as described in section 5) at which the average invert elevations of these culverts will be located. **Figures 4** and **5** indicate the proposed ACP average invert elevations.

TABLE 9 - Current bearing strata on proposed ACPs

ACP No.	Proposed ACP Location	Proposed ACP Diameter (in)	Figure No. (1)	Proposed Average Invert Elevation (ft) (NAVD88) (2)	Associated Boring	Bearing Strata (3)	Description
1	Duda West Road, STA 22+04	15	4	+58.8	2020-SPT-1	2	Organic Sandy Silt (OL) to Silty Sand (SM)
2	Duda West Road, STA 31+22	15	4	+59.3	2020-SPT-2	3	SAND (SP) to Clayey SAND (SC) to SAND with clay (SP-SC)
3	Marsh Rabbit Road, STA 44+51.49 (South End)	48	5	+57.0	2020-SPT-3	2	Organic Sandy Silt (OL) to Silty Sand (SM)
	Marsh Rabbit Road, STA 44+51.49 (North End)	48	5	+57.0	2020-SPT-4	2	Organic Sandy Silt (OL) to Silty Sand (SM)

Notes:

(1) From the "St. Johns River Water Management District, Upper Ocklawaha River Basin, Lake Apopka Duda Water Storage Improvements, 60% drawings".

(2) Average invert elevation between inlet and outlet.

(3) Refer to boring logs in Appendix B and Section 5.

As described in section 5, the organic sandy silts (OL) and silty sands (SM) encountered in strata 2 have organic contents between 7% and 91%. Soils with organic content in excess of 5%, by weight, are considered non-adequate as bearing strata.

Table 10 presents recommendations of bottom of ground improvement elevations for the proposed ACPs at Duda Property.

TABLE 10 - Recommended Bottom of Ground Improvement Elevations for the Proposed ACPs at Duda Property

ACP No.	Location of Proposed ACP	Associated Boring	Figure No.	Proposed Average Invert Elevation (ft, NAVD88)	Recommended Bottom Elevation of Removal and replacement (ft, NAVD88)
1	Duda West Road, STA 22+04	2020-SPT-1	4	+58.8	+55.0
2	Duda West Road, STA 31+22	2020-SPT-2	4	+59.3	+57.0
3	Marsh Rabbit Road, STA 44+51.49 (South End)	2020-SPT-3	5	+57.0	+54.5
	Marsh Rabbit Road, STA 44+51.49 (North End)	2020-SPT-4	5	+57.0	+55.0

Wood's recommendations are as follows:

- Install a stable trench support system down to the bottom of excavation depth.
- Dewater at least 2 feet below the bedding layer in order to facilitate proper placement and compaction of this layer and to provide adequate bedding for the pipes.
- The contractor is responsible for the design of the trench shoring. The design should be performed under the direction of a licensed professional engineer. Signed and sealed design documents and plans should be submitted to the engineer for review and approval prior to beginning construction.
- For the proposed ACPs 1 and 3, Wood recommends ground improvement works by removing the organic soils (Stratum 2) underneath the proposed culverts and replacement by a competent bearing material. Refer to **Table 10**.
- Material to be used as replacement of the organic soils will be a compacted quality fill. The compacted fill will likely consist of fine-grained quartz sands with variable silty to clayey fines generated from site excavations or imported. A minimum fines content (percent by dry weight of soil passing No. 200 Sieve) of 7% and a maximum 3-inch

particle size should be specified. The Compacted Fill should be mechanically placed in a controlled manner and compacted to a minimum of 95% of its Standard Proctor maximum dry density. This compacted fill should be placed in loose lifts of 6-inch-thick maximum

- For the proposed ACP No. 2, Wood recommends removing the existing clayey sands and compacting the existing material to be used as bearing soil for the proposed ACP.
- In areas where there is not enough room for the compaction equipment, the backfill material should be compacted using proper means.
- The Contractor should notify the Owner when fill operations associated with these works are to commence 24 hours prior to the start of fill placement for inspection and verification. Since ground conditions vary throughout the site, it is also recommended to have a qualified inspector on site at the time of performing these activities as organic soil depths might vary and excavation elevation targets might be different from the ones proposed in Table 12.

10.2 Proposed Corrugated Metal Pipe (CMP) Risers

There are 2 proposed CMP risers: the NW Riser and the SW Riser, both north and south of Marsh Rabbit Road, as shown in **Figures 2 and 3**. The CMP risers are going to have a metal bottom.

Wood's recommendations are as follows:

- The foundation of CMP risers should be dry and firm, and dewatered if necessary (at least 2 feet below grade). The foundations should be free of organic materials and debris. The fill will likely consist of fine-grained quartz sands with variable silty to clayey fines generated from site excavations or imported. A minimum fines content (percent by dry weight of soil passing No. 200 Sieve) of 7% and a maximum 3-inch particle size should be specified. The fill should be mechanically placed in a controlled manner in loose lifts of 6-inch-thick maximum and compacted to a minimum of 95% of Standard Proctor maximum dry density.

10.3 Proposed Walkways

Four walkways will be constructed for pedestrian access purposes. These proposed walkways will vary in length between 25 and 28 feet, as shown in **Figures 3, 5** and **6**. According to the SJRWMD, the walkways will be only used for pedestrian purposes, therefore the expected loads are small. SJRWMD plans to use steel profiles HP8X36. As mentioned in section 9, the pile recommendations were based on the boring that provided the worst-case scenario (2020-SPT-4) at the intersection between Marsh Rabbit Road and North South Road. **Table 11** summarizes our recommendations related to using HP8X36 for these walkways:

TABLE 11 – Recommendations for proposed HP8X36 profiles for Walkways.

Pile Profile	Proposed top elevation (ft, (NAVD88)	Proposed tip elevation (ft, NAVD88)	Proposed Pile Length (ft)	Pile Embedment depth (ft)	Yield Stress (f'_y) (psi)
HP8X36	+64.3	+24.3	40.0	31	50,000

Wood's recommendations are as follows:

Proposed steel piles:

- During production steel pile driving, a Saximeter pile driving analyzer (PDA) shall be used to record the blow counts and corresponding hammer stroke (drop) heights on the pile driving logs.
- The Contractor shall notify the Inspector 24 hours prior to the start of operations associated with these works for inspection and verification.

10.4 Proposed 48-inch ACP in Berm Plug

The proposed berm plug details are shown in **Figures 7** and **8**. The proposed berm plug will be built at the intersection between Marsh Rabbit Road and Lake Level Canal Road, at the Lake Level Canal. Underneath the berm, there will be a proposed 48-inch ACP, 70 feet long, that will connect the water bodies of Lake Level Canal from north and south of the proposed berm.

Boring 2020-SPT-5 and Piston Tubes 2020-PT-1 and 2020-PT-2, below the existing canal bottom elevation (+56.0 ft), did not encounter organic sandy silts (OL) and silty sands (SM) (Stratum 2).

Wood's recommendations are as follows:

- Dewater at least 2 feet below the bedding layer in order to facilitate proper placement and compaction of this layer and to provide a solid bedding for the 48-inch pipe.
- Remove the existing clayey sands and sands with clays to a depth of 2 feet below bottom of ditch and compact the existing material to be used as bearing soil for the proposed 48-inch ACP.
- Material to be used as replacement of the organic soils will be a compacted quality fill. The compacted fill should consist of medium to fine-grained quartz sands with variable silty to clayey fines generated from site excavations or imported. A minimum fines content (percent by dry weight of soil passing No. 200 Sieve) of 7% and a maximum 3-

inch particle size should be specified. The Compacted Fill should be mechanically placed in a controlled manner and compacted to a minimum of 95% of its Standard Proctor maximum dry density. This compacted fill should be placed in loose lifts 6-inch-thick maximum.

- In areas where there is not enough space for compaction equipment, the backfill material should be compacted using proper means.
- The Contractor should notify the Owner when fill operations associated with these works are to commence 24 hours prior to the start of fill placement for inspection and verification. Since ground conditions vary throughout the site, it is also recommended to have a qualified inspector on site at the time of performing these activities as soil conditions may vary from the ones reported in **Appendix B**.

10.5 Proposed Berm Plug

Boring 2020-SPT-5, between 2 and 11 feet below ground surface, encountered organic sandy silts (OL) (Stratum 2), between elevations +65 feet and +56 feet. There was no boring performed on the East side of Lake Level Canal, therefore Wood cannot conclude if this organic layer could be encountered on that side of the canal. A section of the proposed berm plug is presented in **Figure 8**.

Wood's recommendations are as follows:

- Clear and grub the footprint of the proposed berm plug as shown in **Figure 7**.
- Remove the organic silt (OL) or silty sand (SM) layer of the footprint where the berm plug will be built (**Figure 7**).
- The bottom of the proposed berm plug should be dry and firm, and dewatered if necessary. The foundations of this berm plug should be free of organic materials and debris. The compacted fill should consist of medium to fine-grained quartz sands with variable silty to clayey fines generated from site excavations or imported. A minimum fines content (percent by dry weight of soil passing No. 200 Sieve) of 7% and a maximum 3-inch particle size is recommended. The compacted fill should be mechanically placed in a controlled manner and compacted to a minimum of 95% of its Standard Proctor maximum dry density. This compacted fill should be placed in loose lifts 6-inch-thick maximum.
- In order to provide adequate bond between the existing berm and the new berm material, the new fill will be keyed into the existing slope. Details of the key should be provided by the contractor during the construction phase.
- The Contractor should notify the Owner 24 hours prior to the start of fill placement for inspection and verification. Since ground conditions vary throughout the site, it is also

recommended to have a qualified inspector on site at the time of performing these activities as the soil conditions may vary from the ones reported in **Appendix B**.

- The earthwork activities associated with the proposed berm plug and the 48-inch ACP should be performed simultaneously.
- The stability design of the proposed berm is beyond the scope of work of this project.

11.0 REPORT LIMITATIONS

The conclusions and recommendations presented in this report assume that site conditions are not substantially different than those exposed by the explorations. If during construction, subsurface conditions are observed or appear to be different from those encountered in the explorations, Wood should be advised promptly so that those conditions can be reviewed, and recommendations reevaluated, where necessary.

The boring log represents the subsurface conditions at the specific location at the time of the exploration. The subsurface conditions at other locations or at different times may differ, and no warranty as to the subsurface conditions elsewhere or at different times is expressed or implied by the data presented herein. Furthermore, the depths on the boring log designating the interface between the various soils and rocks may only be approximate boundaries where the transition is gradual or could not be detected by the boring operations. In addition, the depth of the groundwater table, if encountered, is only indicative of the conditions at the time of the borings as groundwater level may fluctuate significantly because of various factors.

The recommendations provided in this report are based on the scope of the exploration and testing program. In addition, this report does not reflect the subsurface conditions below the tested depths.

The evaluation of conditions that may be encountered in construction requires engineering judgment and interpretation. For this reason, we recommend that Wood remain involved with this project during the construction process, particularly during foundation construction and general earthwork operations. If we are not retained during construction, we cannot assume responsibility for misinterpretation of our recommendations, or for unfavorable foundation and pavement performance as a result of judgments rendered by others.

12.0 REFERENCES

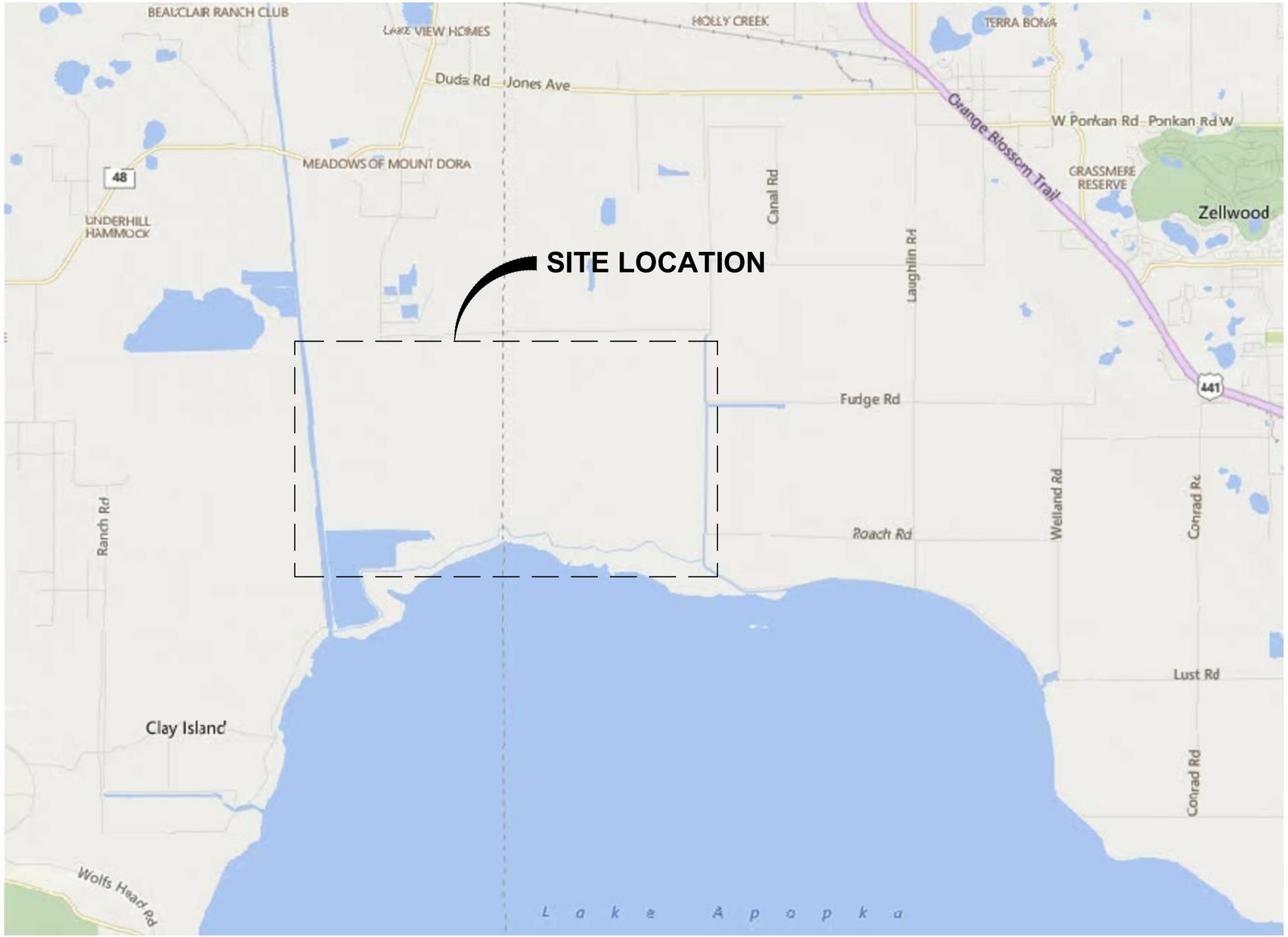
United States Geological Survey (USGS), *Geologic Units in Lake County, Florida,* March 15, 2020; USGS Website: https://www.usgs.gov/

United States Geological Survey (USGS), *Geologic Units in Orange County, Florida,* March 15, 2020; USGS Website: https://www.usgs.gov/

St. Johns River Water Management District, Upper Ocklawaha River Basin, Lake Apopka Duda Water Storage Improvements, 60% drawings". May 4, 2020.

Lake Apopka Duda Area Pumps, Structure and Levee Improvements Preliminary Geotechnical Report, October 2018.

FIGURES



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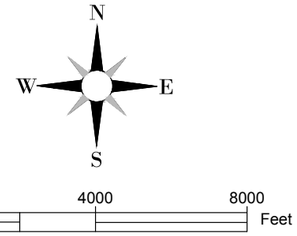

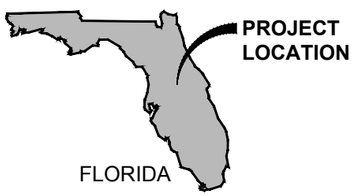

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DRAWN BY:	M. VIVES	DATE:	5/21/2020
CHECKED BY:	L. GARCIA	PROJECT NO.	600550x4
APPROVED BY:	L. LUMBARD		

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

FIGURE 1
SITE LOCATION MAP
DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION
LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550x4 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020\May, 2020\600550x4_Lake Apopka_SLM.dwg LAYOUT: FIGURE 1 SAVED: 5/21/2020 10:26 AM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 5/21/2020 10:26 AM DRAWN BY: VIVES, MARTIN

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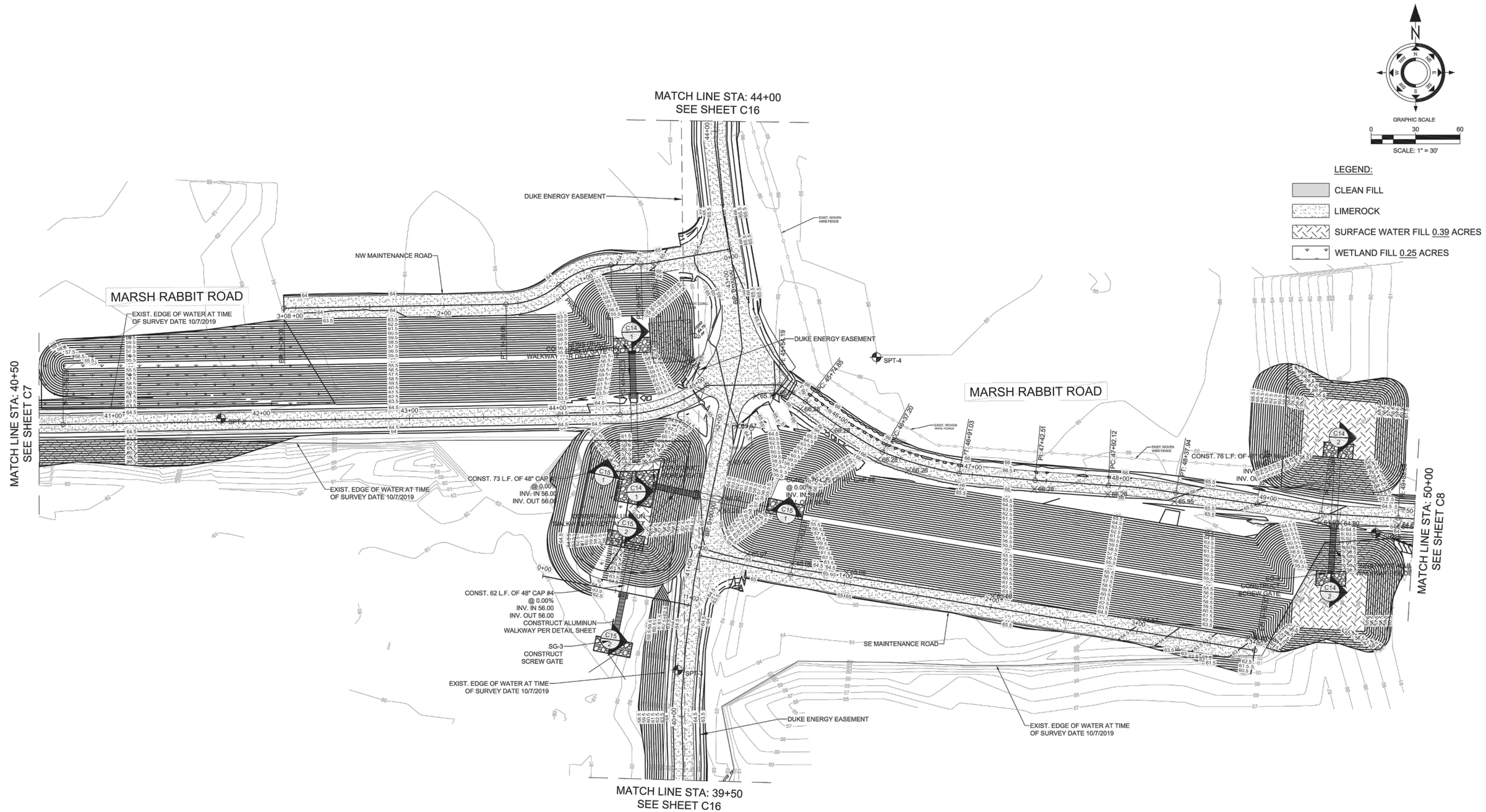
DRAWN BY:	M. VIVES	DATE:	6/16/2020
CHECKED BY:	L. GARCIA	PROJECT NO.	600550x4
APPROVED BY:	L. LUMBARD		

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

FIGURE 2
BORING LOCATIONS
DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION
LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020\May_2020\600550x4_Lake Apopka_Boring Loc.dwg LAYOUT: FIGURE 2 SAVED: 6/16/2020 10:55 AM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 6/16/2020 10:55 AM DRAWN BY: VIVES, MARTIN



SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C13.

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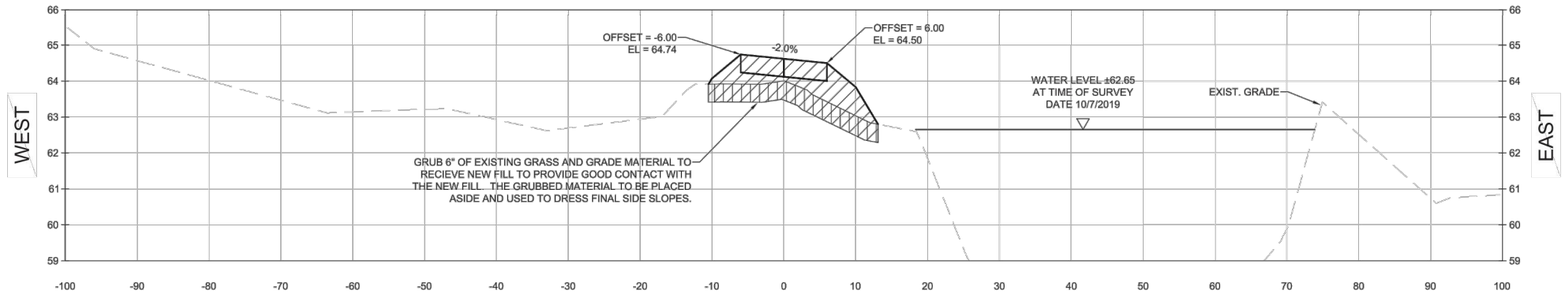
CHECKED BY:	L. GARCIA	PROJECT NO.	600550x4
APPROVED BY:	L. LUMBARD		

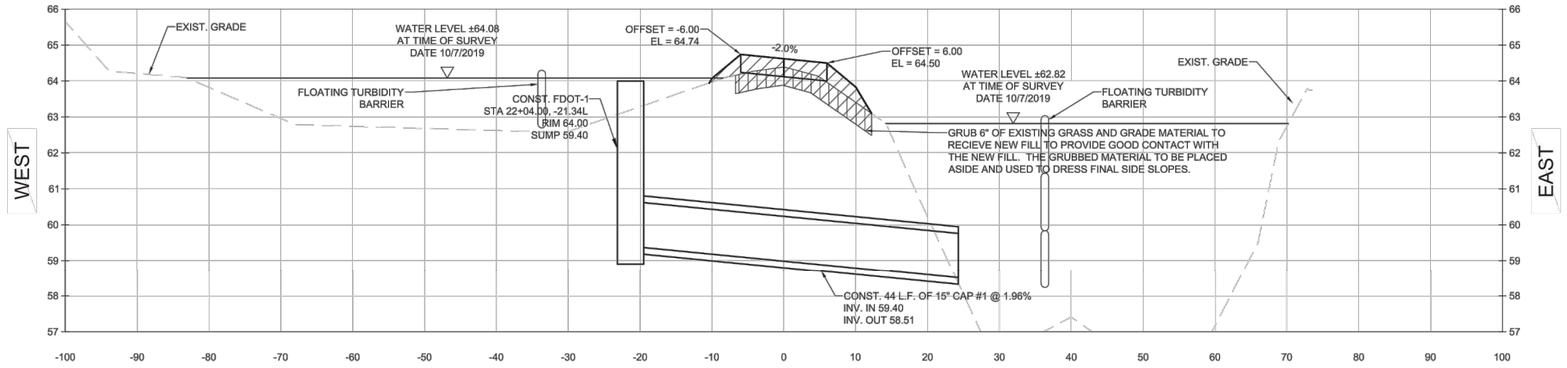
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

FIGURE 3
CENTRAL INTERSECTION
DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION
LAKE & ORANGE COUNTY, FLORIDA

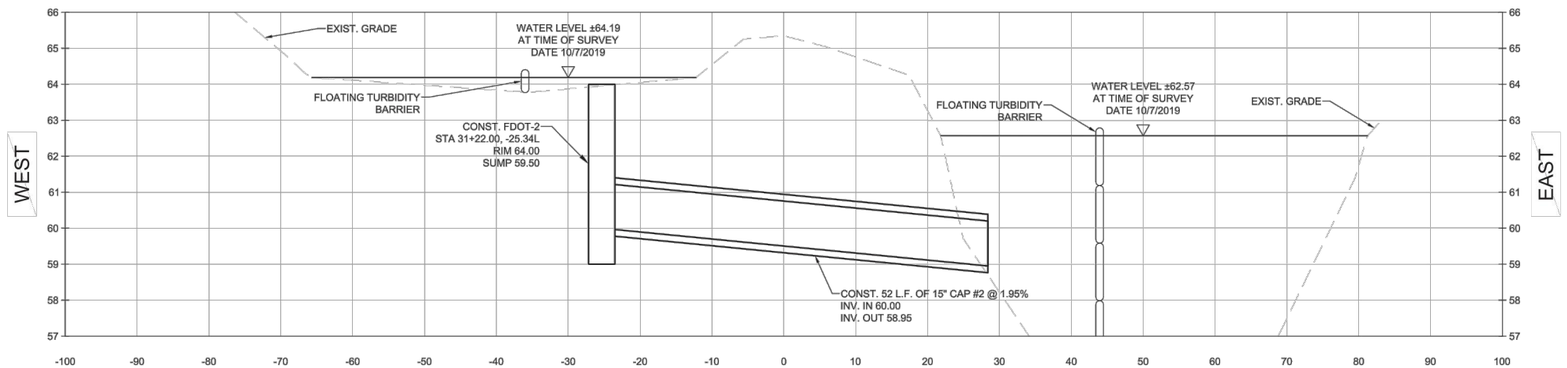
PROJECT NUMBER: 600550X3 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020\May_2020\600550x4_Lake Apopka_X-sect.dwg LAYOUT: FIGURE 3 SAVED: 6/16/2020 10:57 AM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 6/16/2020 10:57 AM DRAWN BY: VIVES, MARTIN



C6/1 DUDA WEST ROAD CROSS SECTION STA 17+00.00



C6/2 DUDA WEST ROAD CROSS SECTION STA 22+04.00



C6/3 DUDA WEST ROAD CROSS SECTION STA 31+22.00

LEGEND:

CLEAN FILL

GRUB OF GRASS

GRAPHIC SCALE IN FEET

0 5 10 20

HORIZONTAL

0 1 2 4

VERTICAL

SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C6.

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APPROVED BY:	L. LUMBARD		

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

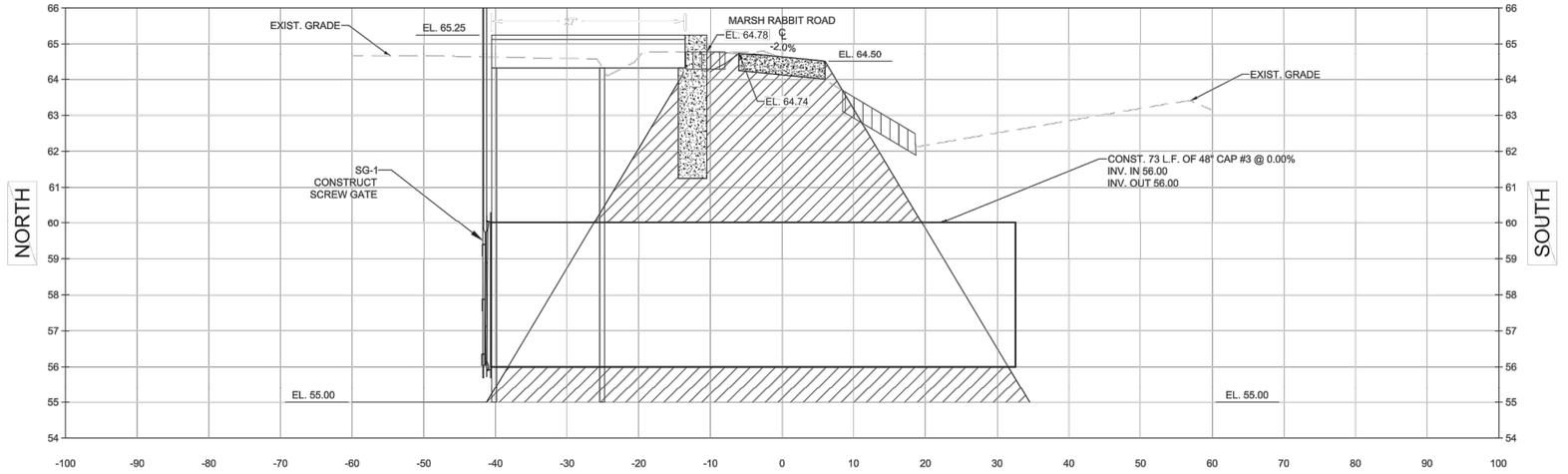
FIGURE 4

DUDA ROAD CROSS SECTIONS

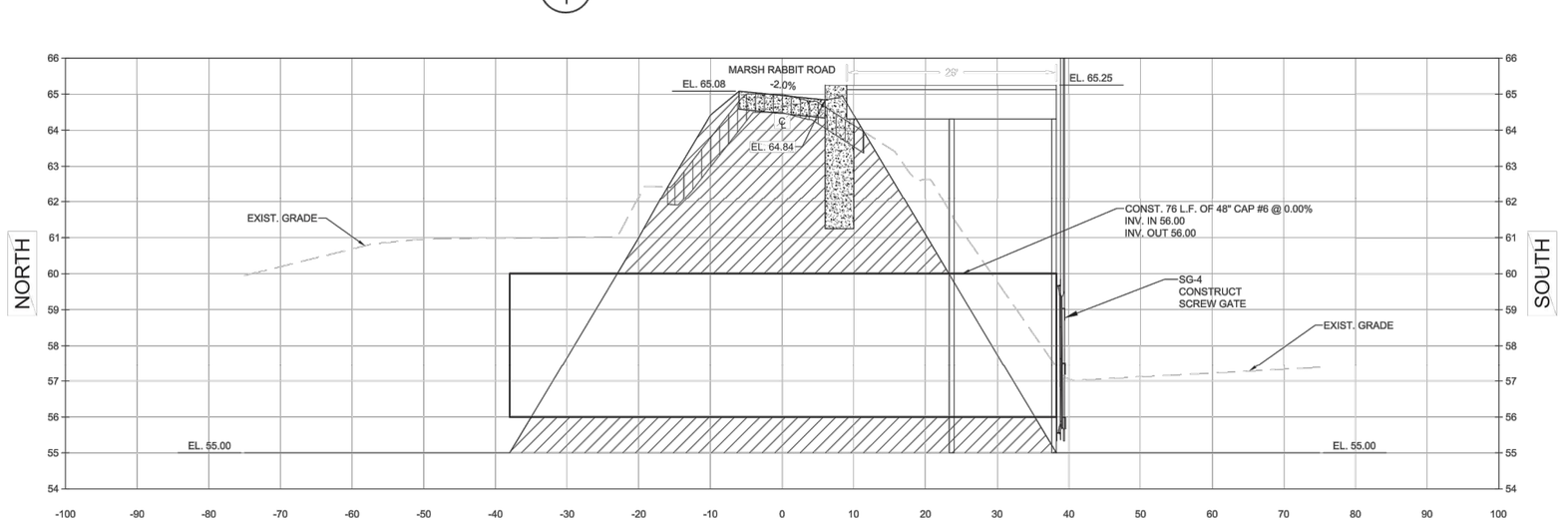
DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION

LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020\May_2020\600550x4_Lake Apopka_X-sect.dwg LAYOUT: FIGURE 4 SAVED: 6/16/2020 10:57 AM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 6/16/2020 10:57 AM DRAWN BY: VIVES, MARTIN



C14/1 NW SUMP CROSS SECTION STA 44+51.49



C14/2 SE SUMP CROSS SECTION STA 49+45.93

LEGEND:
- CLEAN FILL
- LIMEROCK
- GRUB OF GRASS

GRAPHIC SCALE IN FEET
0 5 10 20
HORIZONTAL

0 1 2 4
VERTICAL

SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C14.

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DRAWN BY:	M. VIVES	DATE:	5/21/2020
CHECKED BY:	L. GARCIA	PROJECT NO.	600550x4
APPROVED BY:	L. LUMBARD		

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FIGURE 5

CENTRAL INTERSECTION CROSS SECTIONS

DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION

LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
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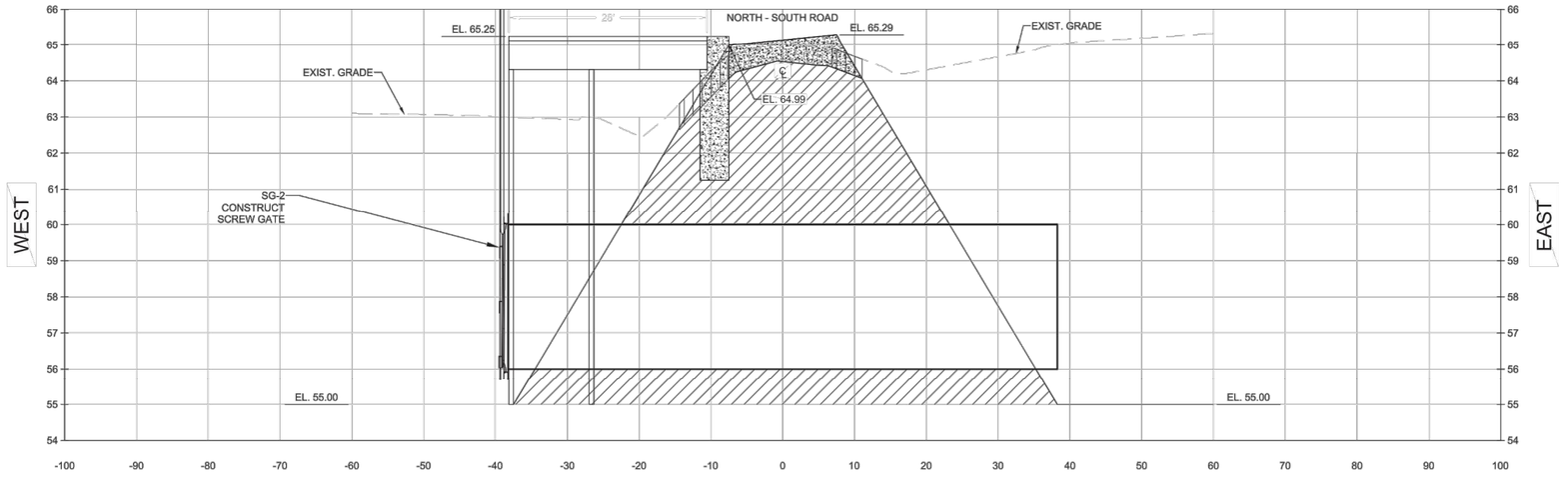
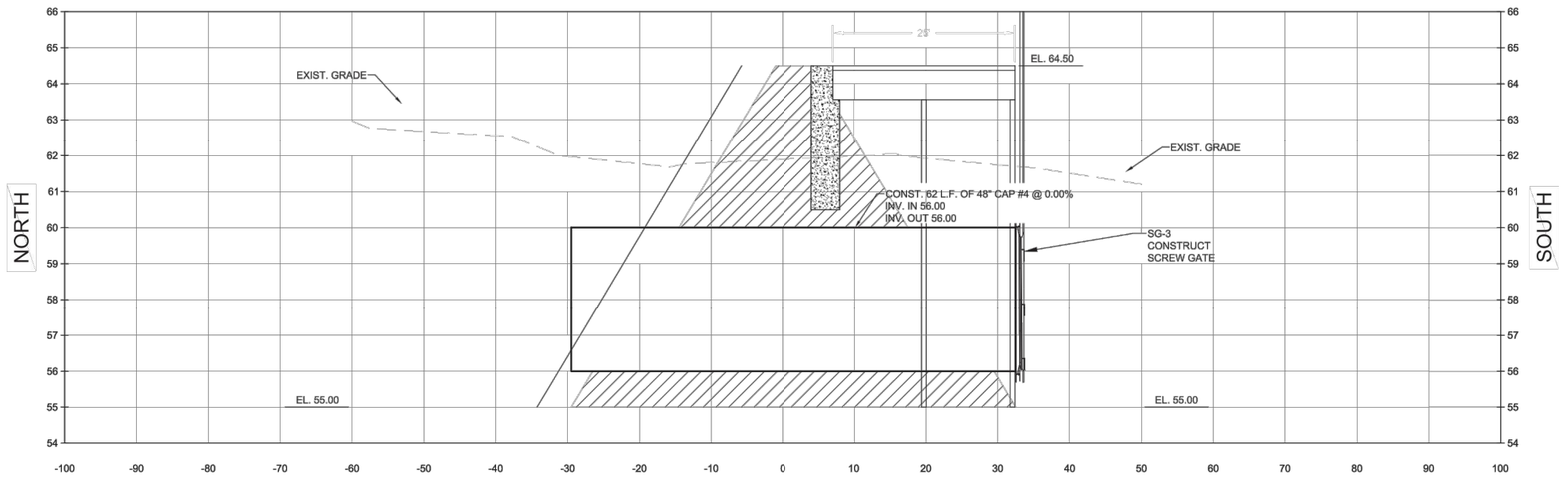


C15/1 SW SUMP NO. 1 CROSS SECTION 41+38.61



C15/2 SW SUMP NO. 2 CROSS SECTION STA 49+45.93

LEGEND:

- CLEAN FILL
- LIMEROCK
- GRUB OF GRASS

GRAPHIC SCALE IN FEET

0 5 10 20

HORIZONTAL

0 1 2 4

VERTICAL

SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C15.

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APPROVED BY:	L. LUMBARD		

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FIGURE 6

CENTRAL INTERSECTION CROSS SECTIONS

DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION

LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
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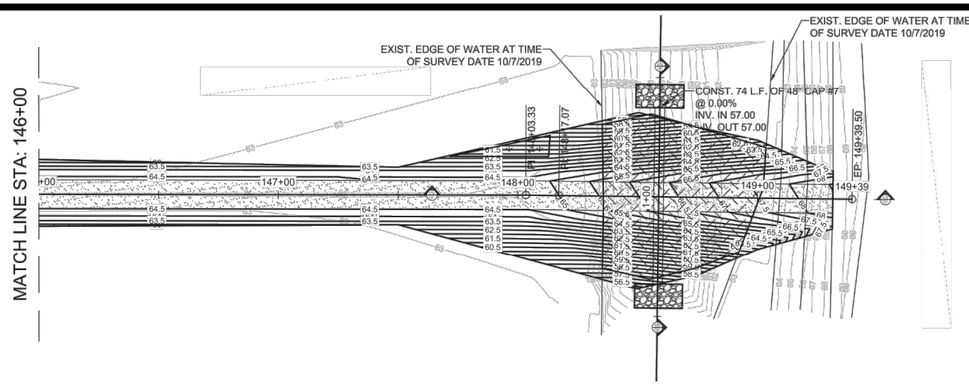
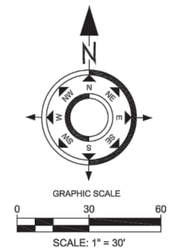
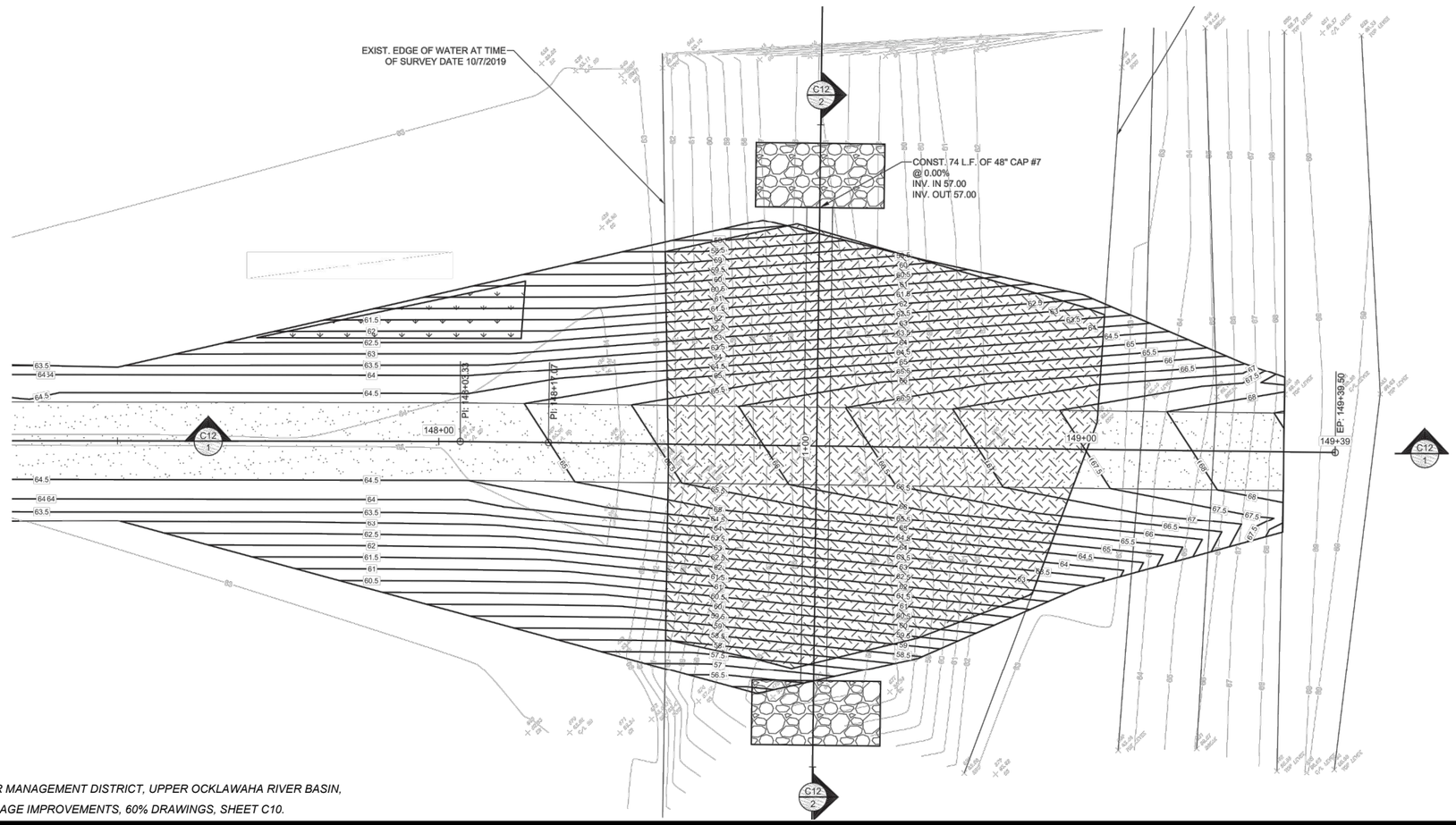
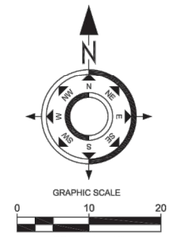




LEGEND:

- 6" ROCK
- CLEAN FILL
- LIMEROCK
- SURFACE WATER FILL 0.09 ACRES
- WETLAND FILL 0.01 ACRES





SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C10.

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CHECKED BY:	L. GARCIA
APPROVED BY:	L. LUMBARD

SCALE:	AS SHOWN
DATE:	5/21/2020
PROJECT NO.	600550x4

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

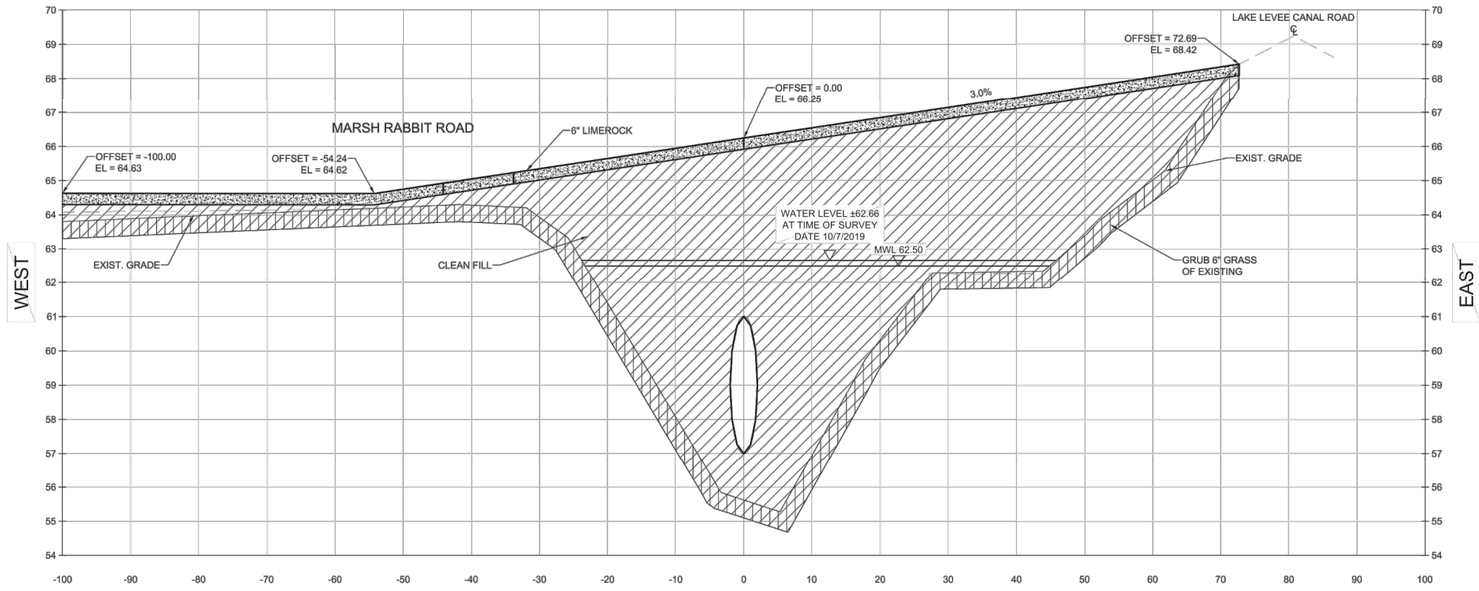
FIGURE 7

MARSH RABBIT ROAD PLAN

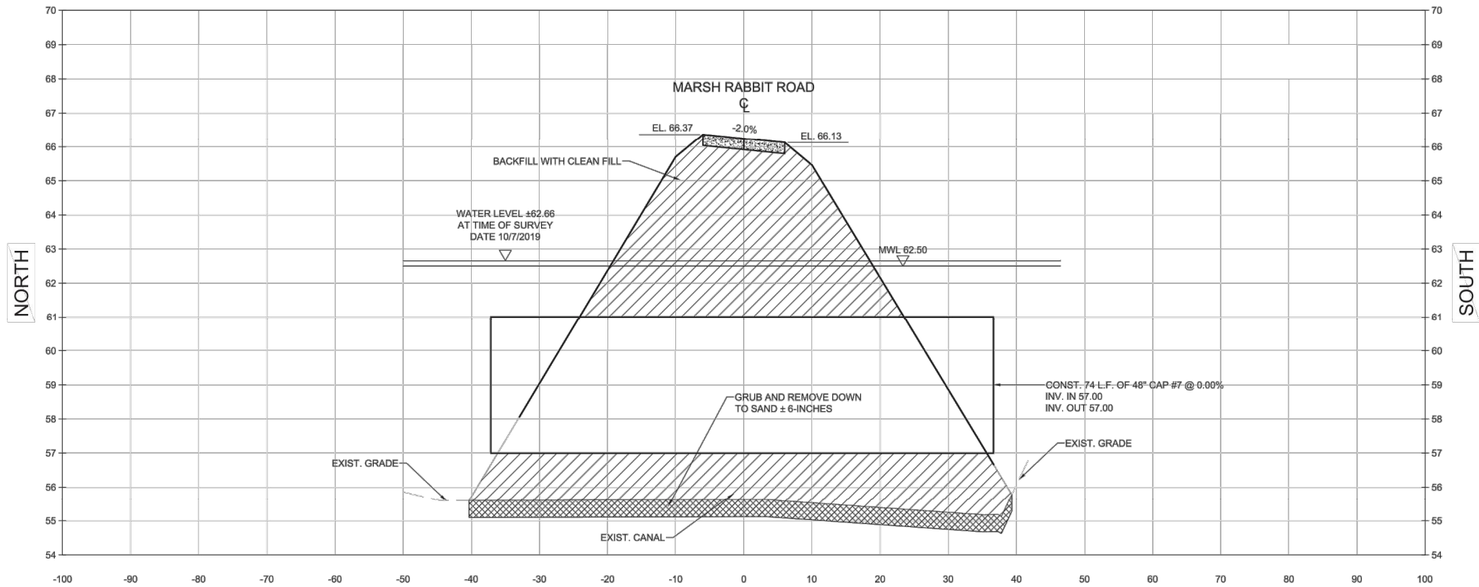
DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION

LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020\May_2020\600550x4_Lake Apopka_X-sect.dwg LAYOUT: FIGURE 7 SAVED: 5/21/2020 1:39 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 5/21/2020 1:42 PM DRAWN BY: VIVES, MARTIN



C12/1 LAKE LEVEL CANAL ROAD PROFILE



C12/2 LAKE LEVEL CANAL ROAD CROSS SECTION

LEGEND:
- 6" ROCK
- LIMEROCK
- CLEAN FILL
- GRUB AND REMOVE
- GRUB OF GRASS

GRAPHIC SCALE IN FEET
0 5 10 20
HORIZONTAL

0 1 2 4
VERTICAL

SOURCE: ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, UPPER OCKLAWAHA RIVER BASIN, LAKE APOPKA DUDA WATER STORAGE IMPROVEMENTS, 60% DRAWINGS, SHEET C12.

DATE	REVISIONS

wood.
Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Suite 200, Tampa, FL 33602
Phone: 1.813.289.0750 Fax: 1.813.289.5474
www.woodplc.com CA-5392

DESIGNED BY:	L. GARCIA	SCALE:	AS SHOWN
DRAWN BY:	M. VIVES	DATE:	5/21/2020
CHECKED BY:	L. GARCIA	PROJECT NO.	600550x4
APPROVED BY:	L. LUMBARD		

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

FIGURE 8

PROPOSED 48" ACP AND BERM PLUG SECTION

DUDA WATER STORAGE IMPROVEMENTS (WSI) PROJECT GEOTECHNICAL INVESTIGATION

LAKE & ORANGE COUNTY, FLORIDA

PROJECT NUMBER: 600550X3 CITY: TAMPA
F:\PROJECTS-C3D\600550x3 Lake Apopka\2020 May. 2020\600550x4_Lake Apopka_X-sect.dwg LAYOUT: FIGURE 8 SAVED: 5/21/2020 1:39 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 5/21/2020 1:42 PM DRAWN BY: VIVES, MARTIN

APPENDIX A

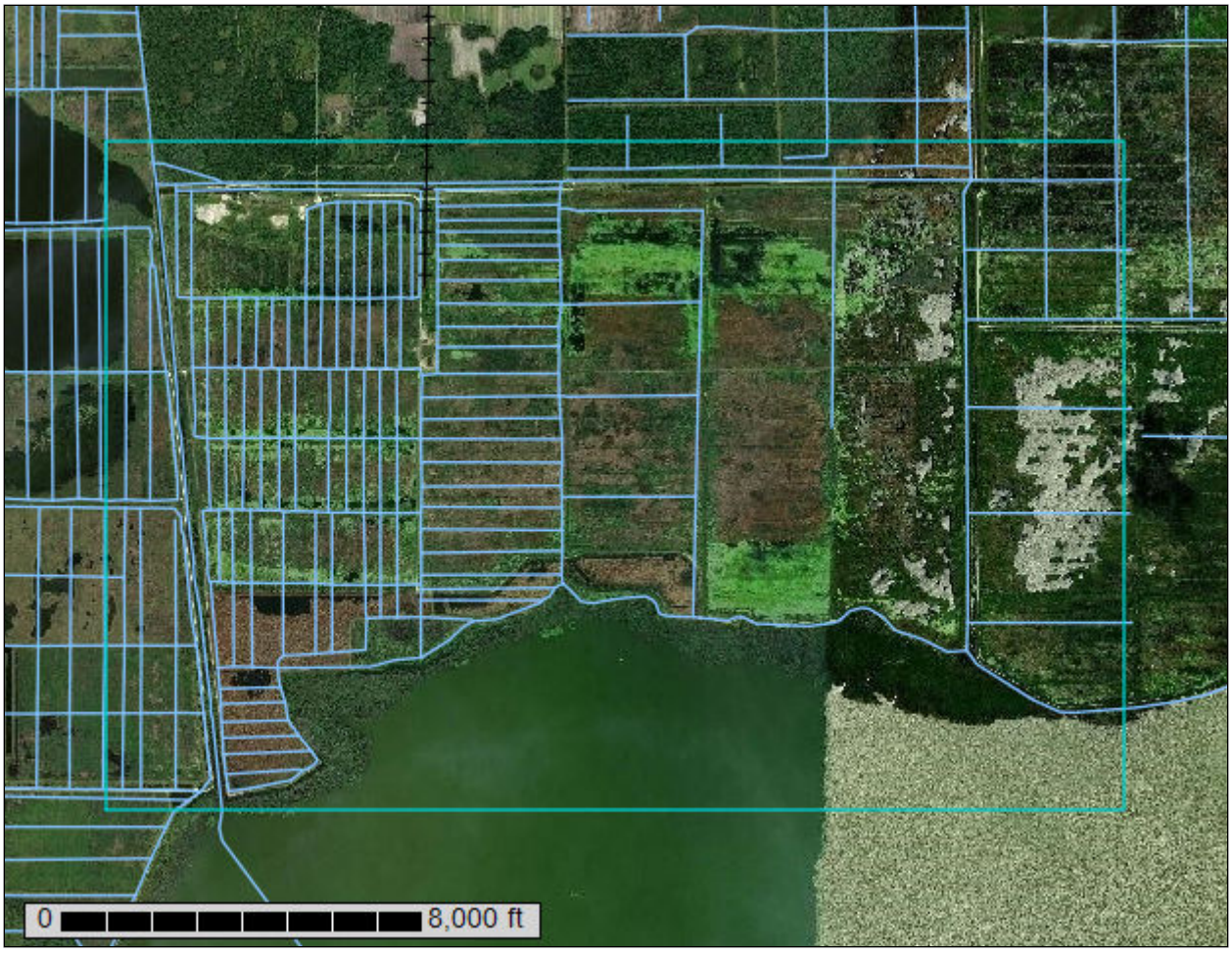
United States Department of Agriculture

NRCS

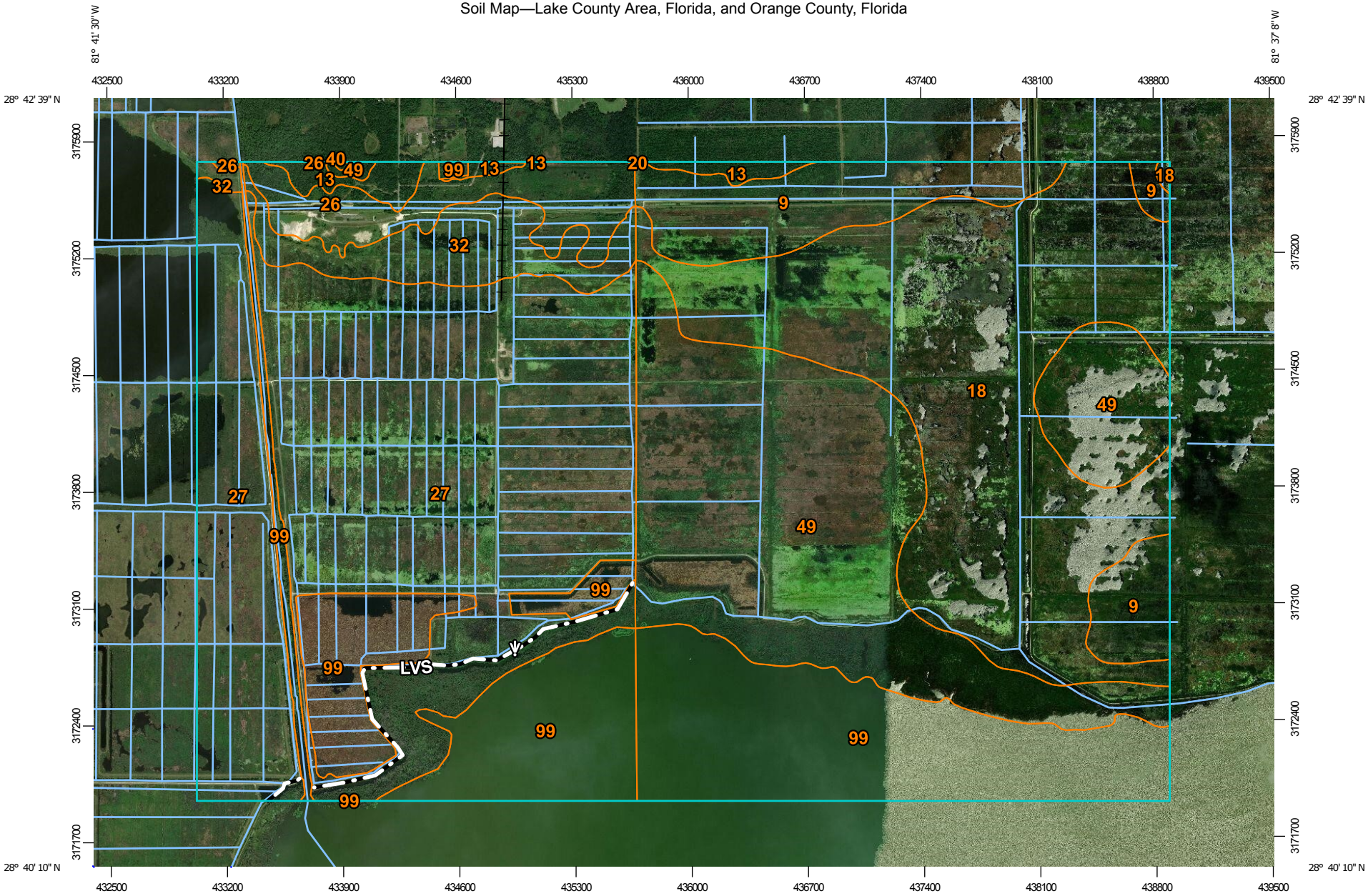
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Lake County Area, Florida, and Orange County, Florida



September 27, 2018


81° 41' 30" W
81° 37' 8" W
28° 42' 39" N
28° 40' 10" N
432500
433200
433900
434600
435300
436000
436700
437400
438100
438800
439500
3175900
3175200
3174500
3173800
3173100
3172400
3171700
26
32
40
49
99
13
20
18
9
27
LVS
Map Scale: 1:32,500 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
450
900
1800
2700
Feet
0
1500
3000
6000
9000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lake County Area, Florida
Survey Area Data: Version 18, Sep 13, 2018

Soil Survey Area: Orange County, Florida
Survey Area Data: Version 15, Sep 13, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 19, 2013—Nov 26, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
13	Emeralda fine sand	38.9	0.7%
20	Immokalee sand	0.1	0.0%
26	Manatee fine sand, depressional	177.4	3.2%
27	Everglades muck, depressional	1,625.6	29.2%
32	Oklawaha muck	182.1	3.3%
40	Placid and Myakka sands, depressional	0.8	0.0%
49	Wauchula sand	5.3	0.1%
99	Water	483.8	8.7%
Subtotals for Soil Survey Area		**2,514.0**	**45.1%**
Totals for Area of Interest		**5,569.7**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Canova muck	327.0	5.9%
13	Felda fine sand, 0 to 2 percent slopes	18.4	0.3%
18	Gator muck, frequently ponded, 0 to 1 percent slopes	1,125.3	20.2%
20	Immokalee fine sand	0.1	0.0%
49	Terra Ceia muck, frequently ponded, 0 to 1 percent slopes	1,038.7	18.6%
99	Water	546.2	9.8%
Subtotals for Soil Survey Area		**3,055.7**	**54.9%**
Totals for Area of Interest		**5,569.7**	**100.0%**

Lake County Area, Florida

13—Emeralda fine sand

Map Unit Setting

National map unit symbol: 1qt66
Elevation: 30 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Emeralda and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Emeralda

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Clayey marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 11 inches: fine sand
Btg - 11 to 56 inches: sandy clay
BCkg - 56 to 66 inches: sandy clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G154XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)

Hydric soil rating: Yes

Minor Components

Felda

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Slough (R154XY011FL)
Hydric soil rating: Yes

Martel

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

26—Manatee fine sand, depressional

Map Unit Setting

National map unit symbol: 1nrvz
Elevation: 30 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Manatee, depressional, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manatee, Depressional

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 10 inches: fine sand
Btg - 10 to 40 inches: fine sandy loam
BCg - 40 to 48 inches: loamy fine sand
Cg - 48 to 60 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G154XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

Minor Components

Martel

Percent of map unit: 10 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

27—Everglades muck, depressional

Map Unit Setting

National map unit symbol: 1qt6n
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Everglades, depressional, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everglades, Depressional

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Typical profile

Oa - 0 to 11 inches: muck
Oe - 11 to 80 inches: mucky peat

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very high (about 27.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G154XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

Minor Components

Oklawaha, freq. flooded

Percent of map unit: 10 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

32—Oklawaha muck

Map Unit Setting

National map unit symbol: 1nrw5
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Oklawaha, freq. flooded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oklawaha, Freq. Flooded

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material over loamy and clayey marine deposits

Typical profile

Oa - 0 to 9 inches: muck
Oe - 9 to 25 inches: mucky peat
Cg1 - 25 to 31 inches: sandy loam
Cg2 - 31 to 54 inches: sandy clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D

Forage suitability group: Organic soils in depressions and on flood plains (G154XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

Minor Components

Brighton, depressional
Percent of map unit: 10 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R154XY010FL)
Hydric soil rating: Yes

40—Placid and Myakka sands, depressional

Map Unit Setting
National map unit symbol: 1nrwf
Elevation: 10 to 60 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition
Placid and similar soils: 55 percent
Myakka and similar soils: 35 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Placid

Setting
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile
A - 0 to 18 inches: sand
C - 18 to 80 inches: sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on stream terraces, flood plains, or in depressions (G154XB145FL)
Other vegetative classification: Slough (R154XY011FL)
Hydric soil rating: Yes

Description of Myakka

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile

A - 0 to 6 inches: sand
E - 6 to 20 inches: sand
Bh - 20 to 36 inches: sand
C - 36 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on stream terraces, flood plains, or in depressions (G154XB145FL)
Other vegetative classification: Slough (R154XY011FL)
Hydric soil rating: Yes

Minor Components

Wabasso, hydric

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R154XY003FL)
Hydric soil rating: Yes

Ellzey, hydric

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R154XY003FL)
Hydric soil rating: Yes

49—Wauchula sand

Map Unit Setting

National map unit symbol: 1nrwq
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 340 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Wauchula, non-hydric, and similar soils: 70 percent
Wauchula, hydric, and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wauchula, Non-hydric

Setting

Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: sand
E - 6 to 22 inches: sand
Bh - 22 to 35 inches: sand
E' - 35 to 38 inches: sand

Btg - 38 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G154XB241FL)
Other vegetative classification: South Florida Flatwoods (R154XY003FL)
Hydric soil rating: No

Description of Wauchula, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: sand
E - 6 to 22 inches: sand
Bh - 22 to 35 inches: sand
E' - 35 to 38 inches: sand
Btg - 38 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G154XB241FL)
Other vegetative classification: South Florida Flatwoods (R154XY003FL)
Hydric soil rating: Yes

Minor Components

Immokalee, non-hydric

Percent of map unit: 10 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R154XY003FL)
Hydric soil rating: No

99—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Orange County, Florida

9—Canova muck

Map Unit Setting

National map unit symbol: bv90
Mean annual precipitation: 45 to 53 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Canova, drained, and similar soils: 56 percent
Canova, undrained, and similar soils: 30 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canova, Drained

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy marine deposits

Typical profile

Oa - 0 to 6 inches: muck
A - 6 to 16 inches: fine sand
B - 16 to 37 inches: sandy clay loam
C - 37 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 0 to 36 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Hydric soil rating: Yes

Description of Canova, Undrained

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy marine deposits

Typical profile

Oa - 0 to 6 inches: muck
A - 6 to 16 inches: fine sand
B - 16 to 37 inches: sandy clay loam
C - 37 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Hydric soil rating: Yes

Minor Components

Gator

Percent of map unit: 7 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Okeelanta, undrained

Percent of map unit: 7 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

13—Felda fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2tzvy
Elevation: 0 to 180 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Felda and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Felda

Setting

Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 4 inches: fine sand
Eg - 4 to 35 inches: fine sand
Btg - 35 to 43 inches: fine sandy loam
Cg - 43 to 80 inches: extremely paragravelly fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: A/D
Ecological site: Slough (R155XY011FL)
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Wabasso
Percent of map unit: 6 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear, convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Oldsmar
Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Valkaria
Percent of map unit: 4 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

18—Gator muck, frequently ponded, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: 2tzwz
Elevation: 0 to 100 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition
Gator and similar soils: 83 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gator

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over sandy and loamy marine deposits

Typical profile

Oa - 0 to 18 inches: muck
Cg1 - 18 to 36 inches: sandy clay loam
Cg2 - 36 to 55 inches: fine sandy loam
Cg3 - 55 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very high (about 13.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Terra ceia

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Chobee

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave

Across-slope shape: Concave
Ecological site: Freshwater Marshes and Ponds (R155XY010FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Tequesta

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156BY010FL)
Hydric soil rating: Yes

Felda

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pompano

Percent of map unit: 1 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

49—Terra Ceia muck, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2svzl
Elevation: 0 to 130 feet
Mean annual precipitation: 45 to 62 inches
Mean annual air temperature: 68 to 79 degrees F
Frost-free period: 335 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Terra ceia and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Terra Ceia

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear
Parent material: Herbaceous organic material

Typical profile

Oa1 - 0 to 15 inches: muck
Oa2 - 15 to 44 inches: muck
Oa3 - 44 to 80 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Okeelanta

Percent of map unit: 6 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)

Hydric soil rating: Yes

Tomoka

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Okeechobee

Percent of map unit: 2 percent
Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Anclote

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Chobee

Percent of map unit: 1 percent
Landform: Depressions on flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Placid

Percent of map unit: 1 percent
Landform: Depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Pompano

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

99—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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APPENDIX B

BORING NUMBER 2018-SPT-1

wood.

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 64 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR AmDrill, Inc.
LOCATION N1586255.35 , E440013.24
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	5-4-6-3 (10)		SM		Light Brownish Gray to Grayish Brown, moist, fine-grained Quartz Silty SAND with trace roots. (Munsell 10YR6/2 to Munsell 10YR5/2) (Fill)	
						2.0	62.0
	SS 2	3-3-3-5 (6)	MC = 85% LL = NP PL = NP PI = NP OC = 25%	SM		Very Dark Brown, moist Silty SAND with little organics. (Munsell 10YR2/2)	
5	SS 3	3-4-9-8 (13)				5.0	59.0
				SM		Very Dark Brown, moist, fine-grained Silty SAND. (Musell 10YR2/2)	
						6.0	58.0
	SS 4	6-9-9-6 (18)	MC = 19% #200 = 4%	SP		Dark Brown, moist, fine-grained SAND. (Munsell 10YR3/3)	
	SS 5	5-5-5-8 (10)					
10						10.0	54.0
				SP			
15	SS 6	4-5-6 (11)				Light Gray, moist, fine-grained Quartz SAND. (Munsell 10YR 7/1)	
						15.0	49.0
				SM			
20	SS 7	8-8-7 (15)	MC = 25% #200 = 21%			Light Gray, fine-grained Silty SAND. (Munsell 10YR7/1)	
						20.0	44.0

Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2018-SPT-2

wood.

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 64 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR AmDrill, Inc.
LOCATION N1586255.17 , E441985.03
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 10.00 ft / Elev 54.00 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES Culvert 1: NW Cell to SW Duda Property Canal

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0						0.1 Topsoil	63.9
	SS 1	8-5-3-3 (8)		SP		Light Gray, fine-grained Quartz SAND with cemented sand particles. (Munsell 10YR7/2) (Fill)	
						2.5	61.5
	SS 2	6-4-3-4 (7)		SM		Very Dark Brown fine-grained Silty SAND (SM) with trace roots (<5%). (Munsell 10YR2/2)	
						4.0 Proposed Culvert Invert Elevation: 60 feet	
5	SS 3	4-4-3-4 (7)		SM		Very Dark Brown,moist, fine-grained Silty SAND. (Munsell 10YR2/2)	
						6.0	58.0
	SS 4	3-5-4-6 (9)		SP-SM		Very Dark Gray, moist, fine-grained Quartz SAND with SILT. (Munsell 10YR3/1)	
						8.0	56.0
10	SS 5	3-4-5-11 (9)		SP-SM		Light Gray to Dark Gray, fine-grained Quartz SAND with SILT. (Munsell 10YR7/2 to Munsell 10YR4/1)	
						10.0 ▽	54.0
				SC			
15	SS 6	14-12-13 (25)	MC = 14% #200 = 19%			Light Gray, wet, fine-grained Clayey SAND. (Munsell 10YR7/1)	
						15.0	49.0
				SP			
20	SS 7	7-6-4 (10)				Light Gray, moist, fine-grained Quartz SAND. (Munsell 10YR7/2)	
						20.0	44.0
				SM			
25	SS 8	9-5-8 (13)	LL = NP PL = NP PI = NP			Light Gray, moist fine-grained Silty SAND. (Munsell 10YR7/2)	
						25.0	39.0

Bottom of borehole at 25.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-3

wood.

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 64 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR AmDrill, Inc.
LOCATION N1586082.56 , E442291.86
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 4.00 ft / Elev 60.00 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES Culvert 2: SW Cell to SE Duda Property Canal, Culvert 3: SW Duda Cell to Duda Property Canal, Culvert 4: SE Duda Cell to Duda Proprty Canal

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	7-5-6-8 (11)		SM		Grayish Brown to Very Dark Grayish Brown, fine-grained Silty SAND with trace gravel (<3/8"). (Munsell 10YR5/2 to Munsell 10YR3/2) (Fill)	
						2.0	62.0
	SS 2	8-6-9-9 (15)		SP-SM		Light Brownish Gray, fine-grained Quartz SAND with Silt. (Munsell 10YR6/2) (Fill)	
						3.0	61.0
						Dark Brown, wet, woody, spongy, mostly organic (< 30% fibers) Silty SAND. (Munsell 10YR3/3)	
5	SS 3	6-6-5-5 (11)	MC = 538% LL = NP PL = NP PI = NP OC = 91%	SM		Proposed Culvert Invert Elevation: 60 feet	
	SS 4	6-4-8-8 (12)				7.0	57.0
				SM		Dark Gray, wet, fine-grained Silty SAND. (Munsell 10YR4/1)	
						8.0	56.0
	SS 5	3-4-8-7 (12)		SP		Light Brown, wet, fine-grained Quartz SAND with trace Silt. (Munsell 10YR4/3)	
10						10.0	54.0
	SS 6	8-12-14 (26)	MC = 20% #200 = 2%			Light Gray, wet, fine-grained Quartz SAND. (Munsell 10YR7/2)	
15				SP			
	SS 7	12-16-19 (35)					
20						20.0	44.0

Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-4

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 68 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586292.7 , E442427.69
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 4.00 ft / Elev 64.00 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	30-40-34-23 (74)		SP-SM		Light Brownish Gray, fine-grained Quartz SAND with Silt. (Munsell 10YR6/2) (Fill)	
						2.0	66.0
	SS 2	15-14-10-13 (24)		SP-SM		Dark Gray fine-grained Quartz SAND with Silt. (Munsell 10YR4/1) (Fill)	
						4.0 ▽	64.0
5	SS 3	2-2-3-5 (5)	MC = 606% LL = NP PL = NP PI = NP OC = 90%	SM		Very Dark Grayish Brown, wet, spongy, woody, mostly organic (~30% fibers) Silty SAND. (Munsell 10YR3/2)	
	SS 4	2-2-1-2 (3)					
	SS 5	5-8-4-6 (12)					
						9.0	59.0
10				CL		Brown , wet, CLAY with fine-grained SAND. (Munsell 10YR4/3)	
						10.0	58.0
				CH			
	SS 6	3-3-4 (7)	LL = 74 PL = 20 PI = 54			Light Gray CLAY with fine grained Sand. (Munsell 10YR7/2)	
15						15.0	53.0
				SC			
	SS 7	12-19-33 (52)	MC = 14% #200 = 19%			Light Gray, fine-grained Quartz SAND with Clay. (Munsell 10YR7/2)	
20						20.0	48.0

Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-5

wood.

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 63.5 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586170.83 , E442763.65
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 2.50 ft / Elev 61.00 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES Duda Pump Station/ Culvert 5: SE Duda Property Cell to NE Duda Property Canal

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	3-2-3-3 (5)		OH		Grayish Brown to Dark Brown, wet, ORGANIC SILT with cemented sand particles. (Munsell 10YR5/2 to Munsell 10YR3/3)	
						2.0	61.5
	SS 2	3-2-2-3 (4)		OH		▽ Light Brown, woody ORGANIC SILT with buried debris. (Munsell 10YR6/4)	61.0
				SM		2.5 Light Gray, Very Dark Brown, wet, fine-grained Silty SAND. (Munsell 10YR2/2)	
						4.0 Proposed Culvert Invert Elevation: 60 feet	59.5
5	SS 3	3-2-2-3 (4)	MC = 669% LL = NP PL = NP PI = NP OC = 92%	SM		Dark Brown, wet, woody, spongy, mostly organic Silty SAND. (Munsell 10YR3/3)	
						6.0	57.5
	SS 4	2-4-4-4 (8)		SP-SM		Dark Gray to Dark Brown fine-grained SAND with Silt. (Munsell 10YR 4/1 to Munsell 10YR3/3)	
						8.0	55.5
	SS 5	3-4-4-6 (8)		SM		9.0 Light Brown,moist, fine-grained Silty SAND. (Munsell 10YR5/3)	54.5
10						Light Gray fine-grained Silty SAND. (Munsell 10YR7/2)	
				SM			
15	SS 6	3-8-19 (27)	LL = NP PL = NP PI = NP			15.0	48.5
						Light Brownish Gray, moist, fine-grained Quartz SAND. (Munsell 10YR6/2)	
20	SS 7	10-11-18 (29)	MC = 23% #200 = 5%	SP			
25	SS 8	11-12-14 (26)				25.0	38.5

Bottom of borehole at 25.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-6

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 63.5 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586219.4 , E447803.99
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 2.00 ft / Elev 61.50 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	5-4-3-3 (7)		SM		Dark Grayish Brown, moist, fine-grained Silty SAND with trace roots. (Munsell 10YR4/2) (Fill)	
						2.0 ▽	61.5
	SS 2	2-2-2-2 (4)	MC = 594% LL = NP PL = NP PI = NP OC = 93%	SM		Very Dark Brown, wet, woody, spongy, mostly organic Silty SAND with buried debris. (Munsell 10YR2/2)	
5	SS 3	2-2-2-2 (4)					
						6.5	57.0
	SS 4	2-6-5-3 (11)		SP		Dark Gray fine-grained Quartz SAND with trace Silt. (Munsell 10YR4/1)	
						8.0	55.5
10	SS 5	3-2-2-5 (4)	MC = 22% #200 = 15%	SM		Gray, moist, fine-grained Silty SAND. (Munsell 10YR5/1)	
						10.0	53.5
15	SS 6	8-6-9 (15)		SP		Light Gray, wet, fine-grained Quartz SAND. (Munsell 10YR6/1)	
20	SS 7	6-7-8 (15)				20.0	43.5

Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-7

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 67.7 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1587097.39 , E452900.65
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 8.00 ft / Elev 59.70 ft
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES Culvert 7: Canal Rd. to Phase 7

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	SS 1	4-4-5-5 (9)		SC		Yellowish Brown, moist, fine-grained Clayey SAND. (Munsell 10YR5/4) (Fill)	
						2.0	65.7
	SS 2	3-7-6-9 (13)		SP-SC		Yellowish Brown to Gray fine-grained SAND with Clay. (Munsell 10YR5/4 to Munsell 10YR5/1) (Fill)	
						4.0	63.7
5	SS 3	5-5-7-6 (12)	MC = 29% #200 = 55%	CL		Yellowish Brown fine-grained Sandy CLAY. (Munsell 10YR5/4) (Fill)	
						6.0	61.7
	SS 4	12-3-4-3 (7)		SP-SM		Dark Brown, moist, fine-grained SAND with Silt. (Munsell 10YR3/3) (Fill)	
						Proposed Culvert Invert Elevation: 60 feet	
						8.0 ▽	59.7
10	SS 5	4-4-5-5 (9)	MC = 459% LL = NP PL = NP PI = NP OC = 91%	SM		Very Dark Brown, wet, woody (<30% fibers), spongy, mostly organic Silty SAND. (Munsell 10YR2/2)	
15	SS 6	2-6-6 (12)				15.0	52.7
				SM			
20	SS 7	3-6-8 (14)	MC = 36% #200 = 14%			Light Brownish Gray, moist, fine-grained Silty SAND. (Munsell 10YR6/2)	
						20.0	47.7

Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve
▽ = Apparent Water Table

BORING NUMBER 2018-SPT-8

CLIENT St. Johns River Water Management District (SJRWMD)
PROJECT NAME Prel. Design - Duda Pumps, Structures, and Levee Imp
PROJECT NUMBER 600550X3
PROJECT LOCATION Lake County and Orange County, FL
DATE STARTED 9/24/18 **COMPLETED** 9/24/18
GROUND ELEVATION 67 ft **HOLE SIZE** 2.75 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1587087.43 , E452721.69
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY EG **CHECKED BY** AC
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES Culvert 6: Duda Property Cell to Canal Rd.

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	SS 1	2-3-4-5 (7)		CL		Brown, moist fine-grained Sandy CLAY. (Munsell 10YR5/3) (Fill)
	SS 2	5-4-5-5 (9)				3.0 64.0
5	SS 3	4-4-4-4 (8)	MC = 45% #200 = 29%	SC		Light Yellowish Brown fine-grained Clayey SAND. (Munsell 10YR6/4) (Fill)
	SS 4	5-2-3-3 (5)				6.0 61.0
						Very Dark Brown, woody (<30% fibers), spongy, mostly organic Silty SAND. (Munsell 10YR2/2)
						Proposed Culvert Invert Elevation: 60 feet
10	SS 5	4-2-2-3 (4)	MC = 494% LL = NP PL = NP PI = NP OC = 75%	SM		
15	SS 6	3-2-2 (4)				15.0 52.0
				SM		
20	SS 7	3-5-14 (19)	LL = NP PL = NP PI = NP			Light Gray, chalky, moist, fine-grained Silty SAND. (Munsell 10YR7/1)
						20.0 47.0
						Bottom of borehole at 20.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-SPT-1

wood.

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/26/20 **COMPLETED** 2/27/20
GROUND ELEVATION 64 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1584070.002 , E438097.856
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	AU 1			SP		Dark brown, poorly graded fine grained quartz SAND, with organics, trace silt, trace rock fragments, moist (Munsell 10YR 2/2)
1.0						63.0
	AU 2		MC = 17%	SC		Light greenish gray, CLAYEY SAND, fine grained quartz, with rock fragments, moist (Munsell 10YR 5/2)
	AU 3		#200 = 20%			
3.0						61.0
	AU 4					Dark brown to brown, very loose, SANDY ORGANIC SILT (PEAT), fine grained quartz, spongy, moist (Munsell 10YR 2/1)
5	AU 5					Drilling fluid used below 5 feet — Average Bottom Elevation of Proposed Culvert (EL. 58.8)
	SS 6	0-1-1-1 (2)		OL		weight of hammer for 6-inches, 1,1,1 (WOH/6", 1,1,1)
	SS 7	0-0-1-1 (1)				fiberous, less than 30% fibers, from 5 to 9 feet weight of hammer for 12-inches, 1,1 (WOH/12",1,1)
9.0						55.0
10	SS 8	1-1-2-2 (3)		CL		Greenish gray, soft, SANDY CLAY, fine grained quartz (Munsell 10YR 5/2)
11.0						53.0
	SS 9	4-7-12-14 (19)		SP		Light gray, medium dense, poorly graded fine grained quartz SAND (Munsell 10YR 4/2)
13.0						51.0
15	SS 10	2-3-3-6 (6)	LL = 83 PL = 20 PI = 63	CH		Greenish gray, firm, SANDY CLAY, fine grained quartz (Munsell 10YR 5/2)
16.8						47.3
20	SS 11	6-10-7 (17)		SP-SM		Light brown, medium dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1)
25	SS 12	9-13-14 (27)				dense from 21.75 to 26.75 feet
26.8						37.3
30	SS 13	7-13-14 (27)	#200 = 4%	SP		Light brown, dense, poorly graded fine grained quartz SAND, trace silt (Munsell 10YR 5/1 to 10YR 4/1)

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BORING NUMBER 2020-SPT-1

CLIENT St Johns River Water Management District **PROJECT NAME** Duda Water Storage Improvements

PROJECT NUMBER 600550x4 **PROJECT LOCATION** Apopka, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30						Light brown, dense, poorly graded fine grained quartz SAND, trace silt (Munsell 10YR 5/1 to 10YR 4/1) *(continued)*
35	SS 14	7-14-10 (24)		SP		medium dense from 31.75 to 36.75 feet
40	SS 15	6-4-5 (9)	MC = 25%			loose from 36.75 to 40 feet
40.0						24.0

Bottom of borehole at 40.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-SPT-2

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/27/20 **COMPLETED** 2/27/20
GROUND ELEVATION 68 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1585074.1 , E437990.364
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	AU 1		MC = 12%	SP		2-inches of topsoil and vegetation Brown, poorly graded fine grained quartz SAND, trace silt, trace organics, trace rock fragments, moist (Munsell 10YR 2/2)	
	AU 2				2.0		66.0
	AU 3		OC = 7%	SM		Dark brown, SILTY SAND, fine grained quartz, with organics, spongy (Munsell 10YR 2/1)	
	AU 4						
5	AU 5					Drilling fluid used below 5 feet very loose from 5 to 7 feet weight of hammer for 12-inches, 1,1 (WOH/12", 1,1) fiberous, less than 30% fibers, from 5 to 7 feet	
	SS 6	0-0-1-1 (1)			7.0		61.0
	SS 7	1-2-2-2 (4)		SC		Greenish gray, loose, CLAYEY SAND, fine grained quartz (Munsell 10YR 5/2)	
						Bottom Elevation of Proposed Culvert (EL. 59.3)	
10	SS 8	3-4-5-6 (9)	#200 = 31%		11.0	trace rock fragments from 7 to 11 feet	57.0
	SS 9	2-3-4-5 (7)	LL = 218 PL = 69 PI = 149	CH		Greenish gray, firm, SANDY CLAY, fine grained quartz (Munsell 10YR 5/2)	
15	SS 10	1-2-2-2 (4)			16.8		51.3
				SC		Light brown, medium dense, CLAYEY SAND, fine grained quartz, trace silt (Munsell 10YR 5/1)	
20	SS 11	3-5-7 (12)			21.8		46.3
				SP-SM		Light gray to light brown, medium dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1)	
25	SS 12	6-10-7 (17)	MC = 20%				
30	SS 13	7-6-5 (11)					

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BORING NUMBER 2020-SPT-2

CLIENT St Johns River Water Management District **PROJECT NAME** Duda Water Storage Improvements

PROJECT NUMBER 600550x4 **PROJECT LOCATION** Apopka, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30						Light gray to light brown, medium dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1) *(continued)*
35	SS 14	6-11-12 (23)		SP-SM		
40	SS 15	12-13-11 (24)				dense from 36.75 to 40 feet
					40.0	28.0

Bottom of borehole at 40.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-SPT-3

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/25/20 **COMPLETED** 2/25/20
GROUND ELEVATION 63.5 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586275.453 , E442248.9374
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	AU 1			SC		Light greenish gray, CLAYEY SAND, fine grained quartz, with rock fragments, trace silt, trace organics, moist (Munsell 10YR 5/2) 62.5
	AU 2		#200 = 42%	SM		1.0 Brown, SILTY SAND, fine grained quartz, with rock fragments, with organics, moist (Munsell 10YR 2/1)
	AU 3					3.0 60.5
	AU 4			OL		Dark brown, SANDY ORGANIC SILT (PEAT), fine grained quartz, spongy, moist (Munsell 10YR 2/1)
5	AU 5		OC = 61%			Fiberous, less than 30% fibers, from 4 to 9 feet
	SS 6	1-0-1-1 (1)				1 blow for 12-inches, 1,1 (1/12", 1,1)
						Bottom Elevation of Proposed Culvert (EL. 57.0)
	SS 7	2-0-1-1 (1)				very loose from 5 to 9 feet 2 blows for 12-inches, 1,1 (2/12", 1,1)
						9.0 54.5
10	SS 8	1-2-3-3 (5)		CH		Light greenish gray to white, firm, SANDY CLAY, fine grained quartz (Munsell 10YR 5/2) trace shell fragments from 9 to 11 feet
	SS 9	2-3-3-2 (6)	#200 = 79%			13.0 50.5
	SS 10	14-33-32-34 (65)		SP		Light brown to light gray, very dense, poorly graded fine grained quartz SAND (Munsell 10YR 5/1)
15						16.8 46.8
				SP-SM		Light gray to light brown to brown, medium dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 4/1)
	SS 11	7-9-7 (16)	MC = 17%			
20						loose from 21.75 to 40 feet
	SS 12	5-4-4 (8)				
25						
	SS 13	2-2-2 (4)				
30						

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BORING NUMBER 2020-SPT-3

CLIENT St Johns River Water Management District

PROJECT NAME Duda Water Storage Improvements

PROJECT NUMBER 600550x4

PROJECT LOCATION Apopka, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30						Light gray to light brown to brown, medium dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 4/1) *(continued)*
35	SS 14	3-3-2 (5)	MC = 25%	SP-SM		
40	SS 15	2-2-2 (4)				40.0 23.5

Bottom of borehole at 40.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-SPT-4

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/26/20 **COMPLETED** 2/26/20
GROUND ELEVATION 63.5 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586239.132 , E442241.6095
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	AU 1			SP-SC		2-inches of topsoil and vegetation
						1.0
	AU 2		MC = 28%	SP-SM		Light greenish gray, poorly graded fine grained quartz SAND with CLAY, with rock fragments, trace silt, moist (Munsell 10YR 5/2) 62.5
						2.0
	AU 3					Brown, poorly graded fine grained quartz SAND with SILT, with organics, trace rock fragments, moist (Munsell 10YR 2/2) 61.5
	AU 4					Dark brown, SANDY ORGANIC SILT (PEAT), fine grained quartz, spongy, moist (Munsell 10YR 2/1)
						fiberous, less than 30% fibers, from 3 to 7 feet
5	AU 5			OL		Drilling fluid used below 5 feet
	SS 6	1-1-1-1 (2)	OC = 91%			very loose from 5 to 8 feet
						Bottom Elevation of Proposed Culvert (EL. 57.0)
	SS 7	0-2-3-2 (5)				weight of hammer for 6-inches, 2,3,2 (WOH/6", 2, 3, 2)
						8.0 55.5
				SP		Brown, loose, poorly graded fine grained quartz SAND, trace silt (Munsell 10YR 5/1)
						9.0 54.5
10	SS 8	1-1-2-2 (3)	MC = 33%	CH		Light greenish gray to white, firm, SANDY CLAY, fine grained quartz, trace roots, trace rock fragments (Munsell 10YR 5/2)
	SS 9	1-2-3-2 (5)				
						13.0 50.5
15	SS 10	10-28-28-35 (56)	#200 = 6%	SP-SM		Light brown, very dense, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1)
						16.8 46.8
						Light gray to brown, medium dense, poorly graded fine grained quartz SAND with SILT, trace clay (Munsell 10YR 4/1)
20	SS 11	5-10-13 (23)				
						loose from 21.75 to 40 feet
25	SS 12	4-4-4 (8)		SP-SM		
30	SS 13	2-2-2 (4)				

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BORING NUMBER 2020-SPT-4

CLIENT St Johns River Water Management District **PROJECT NAME** Duda Water Storage Improvements

PROJECT NUMBER 600550x4 **PROJECT LOCATION** Apopka, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30						Light gray to brown, medium dense, poorly graded fine grained quartz SAND with SILT, trace clay (Munsell 10YR 4/1) *(continued)*
35	SS 14	3-2-2 (4)		SP-SM		
40	SS 15	4-3-3 (6)				40.0 23.5

Bottom of borehole at 40.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-SPT-5

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/25/20 **COMPLETED** 2/25/20
GROUND ELEVATION 67 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Amdrill, Inc.
LOCATION N1586247.921 , E452625.998
DRILLING METHOD Standard Penetration / Mud Rotary
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION backfilled with cuttings and bentonite chips
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	AU 1			SP-SC		1-inch of topsoil and vegetation
					1.0	Light brown, poorly graded fine grained quartz SAND with CLAY, trace silt, loamy, moist (Munsell 10YR 2/2) 66.0
	AU 2		#200 = 72%	CL		
					2.0	Light brown, SANDY CLAY, fine grained quartz, trace silt, moist (Munsell 10YR 5/1) 65.0
	AU 3			OL		Dark brown to brown, SANDY ORGANIC SILT (PEAT), fine grained quartz, spongy, moist (Munsell 10YR 2/1)
	AU 4		OC = 85%			fiberous, less than 30% fibers, from 3 to 9 feet
5	AU 5					Drilling fluid used below 5 feet
	SS 6	1-1-1-1 (2)				very loose from 5 to 11 feet
	SS 7	0-1-1-1 (2)				weight of hammer for 6-inches, 1, 1, 1 (WOH/6", 1, 1, 1)
10	SS 8	2-2-1-1 (3)				Bottom Elevation of Proposed Culvert (EL. 57.0)
					11.0	trace rock fragments from 9 to 11 feet 56.0
	SS 9	1-2-1-1 (3)	MC = 51%	SP-SC		Light brown to light greenish gray, very loose, poorly graded fine grained quartz SAND with CLAY, loamy, with shell fragments (Munsell 10YR 5/1)
	SS 10	2-2-5-9 (7)	MC = 20%			loose from 13 to 15 feet
15					16.8	50.3
				SC		Light gray to light greenish gray, dense, CLAYEY SAND, fine grained quartz (Munsell 10YR 5/2)
	SS 11	7-12-14 (26)				
20					21.8	45.3
				SP-SM		Light gray, loose, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1)
	SS 12	3-3-2 (5)				
25						
	SS 13	2-2-4 (6)	MC = 32%			
30						

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BORING NUMBER 2020-SPT-5

CLIENT St Johns River Water Management District **PROJECT NAME** Duda Water Storage Improvements

PROJECT NUMBER 600550x4 **PROJECT LOCATION** Apopka, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30				SP-SM		Light gray, loose, poorly graded fine grained quartz SAND with SILT (Munsell 10YR 5/1) *(continued)*
						31.8 — 35.3
				SC		Light gray, loose, CLAYEY SAND, fine grained quartz (Munsell 10YR 5/1)
35	SS 14	4-4-3 (7)				
40	SS 15	4-4-4 (8)				
45	SS 16	4-6-7 (13)	#200 = 16%			shell fragments from 43.5 to 45 feet medium dense from 41.75 to 50 feet
50	SS 17	5-6-7 (13)				50.0 — 17.0

Bottom of borehole at 50.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-PT-1

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/27/20 **COMPLETED** 2/27/20
WATER ELEVATION 62 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Wood
LOCATION N1586297.88 , E452763.4683
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					6 feet of water
5					Bottom Elevation of Proposed Culvert (EL. 57.0)
					6.0 / 56.0
	UD 1	OC = 17%	SC		6.5 / 55.5 NO RECOVERY
	UD 2				Dark brown to light brown, CLAYEY SAND, fine grained quartz, with organics, wet (Munsell 10YR 2/2)
	UD 3				8.0 / 54.0 Bottom of borehole at 8.0 feet.

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

BORING NUMBER 2020-PT-2

CLIENT St Johns River Water Management District
PROJECT NAME Duda Water Storage Improvements
PROJECT NUMBER 600550x4
PROJECT LOCATION Apopka, FL
DATE STARTED 2/27/20 **COMPLETED** 2/27/20
WATER ELEVATION 62 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Wood
LOCATION N1586171.658 , E452766.5586
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING ---
LOGGED BY BA **CHECKED BY** CS
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					6 feet of water	
5					Bottom Elevation of Proposed Culvert (EL. 57.0)	
					6.0	56.0
	UD 1	OC = 2%	SC		6.8 Light brown, CLAYEY SAND, fine grained quartz, wet (Munsell 10YR 2/2)	55.3
	UD 2				Bottom of borehole at 6.8 feet.	

LEGEND:
MC=Moisture Content
LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index
OC= Organic Content
NP= Not Plastic
#200= Percent passing #200 sieve

APPENDIX C

wood.

Laboratory Test Result Summary

SPT / PT No.	Depth Range (ft)	Moisture Content (%)	% Finer #200 Sieve (%)	Atterberg Limits			Organic Content (%)
				LL	PL	PI	
2018-SPT-1	2 - 4	84.7	-	-	-	NP	25
2018-SPT-1	6 - 8	18.8	3.7	-	-	-	-
2018-SPT-1	18.5 - 20	25.1	20.5	-	-	-	-
2018-SPT-2	13.5 -15	14.1	18.8	-	-	-	-
2018-SPT-2	23.5 - 25	-	-	-	-	NP	-
2018-SPT-3	4 - 6	537.9	-	-	-	NP	91.4
2018-SPT-3	13.5 - 15	19.7	1.8	-	-	-	-
2018-SPT-4	4 - 6	605.7	-	-	-	NP	89.8
2018-SPT-4	13.5 - 15	-	-	74	20	54	-
2018-SPT-4	18.5 - 20	14	18.6	-	-	-	-
2018-SPT-5	4 - 6	669.1	-	-	-	NP	92.3
2018-SPT-5	13.5 - 15	-	-	-	-	NP	-
2018-SPT-5	18.5 - 20	23	4.6	-	-	-	-
2018-SPT-6	2 - 4	593.9	-	-	-	NP	92.6
2018-SPT-6	8 - 10	21.6	15.3	-	-	-	-
2018-SPT-7	4 - 6	29.3	54.5	-	-	-	-
2018-SPT-7	8 - 10	458.9	-	-	-	NP	91.3
2018-SPT-7	18.5 - 20	36.1	14.3	-	-	-	-
2018-SPT-8	4 - 6	45	29	-	-	-	-
2018-SPT-8	8 - 10	494.2	-	-	-	NP	74.9
2018-SPT-8	18.5 - 20	-	-	-	-	NP	-
2020-SPT-1	1 - 2	17	-	-	-	-	-
2020-SPT-1	2 - 3	-	20	-	-	-	-
2020-SPT-1	13 - 15	-	-	83	20	63	-
2020-SPT-1	28.5 - 30	-	4	-	-	-	-
2020-SPT-1	38.5 - 40	25	-	-	-	-	-
2020-SPT-2	0 - 1	12	-	-	-	-	-
2020-SPT-2	2 - 3	-	-	-	-	-	7
2020-SPT-2	9 - 11	-	31	-	-	-	-
2020-SPT-2	11 - 13	-	-	218	69	149	-
2020-SPT-2	23.5 - 25	20	-	-	-	-	-
2020-SPT-3	1 - 2		42	-	-	-	-
2020-SPT-3	4 - 5	-	-	-	-	-	61
2020-SPT-3	11 - 13	-	79	-	-	-	-
2020-SPT-3	18.5 - 20	17	-	-	-	-	-

Laboratory Test Result Summary

SPT / PT No.	Depth Range (ft)	Moisture Content (%)	% Finer #200 Sieve (%)	Atterberg Limits			Organic Content (%)
				LL	PL	PI	
2020-SPT-3	33.5 - 35	25	-	-	-	-	-
2020-SPT-4	1 - 2	28	-	-	-	-	-
2020-SPT-4	5 - 7	-	-	-	-	-	91
2020-SPT-4	9 - 11	33	-	-	-	-	-
2020-SPT-4	13 - 15	-	6	-	-	-	-
2020-SPT-5	1 - 2	-	72	-	-	-	-
2020-SPT-5	3 - 4	-	-	-	-	-	85
2020-SPT-5	11 - 13	51	-	-	-	-	-
2020-SPT-5	13 -15	20	-	-	-	-	-
2020-SPT-5	28.5 - 30	32	-	-	-	-	-
2020-SPT-5	43.5 - 45	-	16	-	-	-	-
2020-PT-1	6.5 - 7	-	-	-	-	-	17
2020-PT2	6 - 6.8	-	-	-	-	-	2

TOTAL ORGANIC CONTENT ANALYSIS (ASTM D 2974)

CLIENT: **St. John River Water Management District (SJRWMD)**
PROJECT: Prel. Design - Duda Pumps, Structures, and Levee Improvements
LOCATION: Lake County and Orange County, FL

Test Date: October 4, 2018
Project #: 600550x3.****.04
Requested By: L.Garcia
Tested By: M. Hall
Checked By: A. Chordia

Sample No. and Depth	Weight of Container + Wet Soil (grams)	Weight of Container + Dry Soil (grams)	Weight of Container (grams)	Weight of Container + Furnace Ash (grams)	Organic Loss (grams)	Moisture Content (%)	Organic Content (%)
2018-SPT-1 2-4	20.59	15.77	10.08	14.35	1.42	84.7	25.0
2018-SPT-3 4-6	20.37	12.84	11.44	11.56	1.28	537.9	91.4
2018-SPT-4 4-6	20.82	11.31	9.74	9.90	1.41	605.7	89.8
2018-SPT-5 4-6	26.62	13.64	11.70	11.85	1.79	669.1	92.3
2018-SPT-6 2-4	20.17	11.38	9.90	10.01	1.37	593.9	92.6
2018-SPT-7 8-10	23.42	12.82	10.51	10.71	2.11	458.9	91.3
2018-SPT-8 8-10	23.89	12.87	10.64	11.20	1.67	494.2	74.9

MOISTURE CONTENT and WET SIEVE ANALYSIS

CLIENT: St. John River Water Management District (SJRWMD)
PROJECT: Prel. Design - Duda Pumps, Structures, and Levee Improvements
LOCATION: Lake County and Orange County, FL

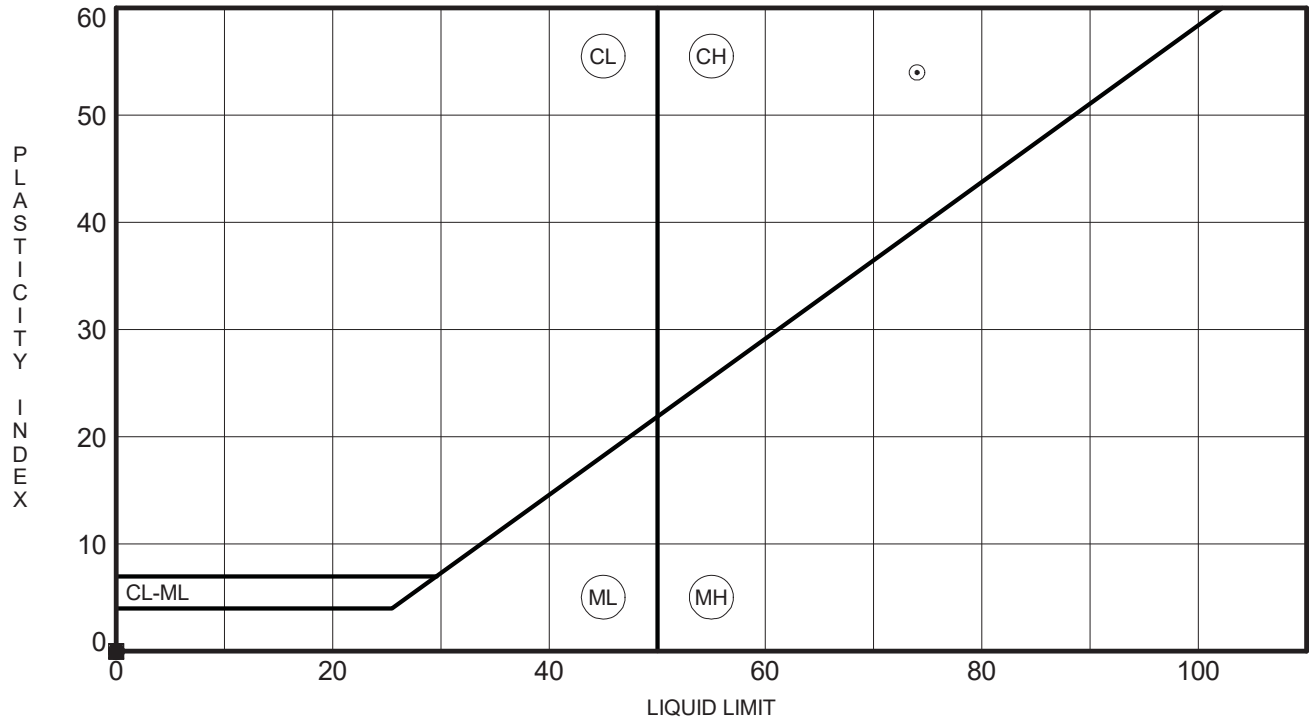
Test Date: October 4, 2018
Project #: 600550x3.****.04
Requested By: L.Garcia
Tested By: M. Hall
Checked By: A. Chordia

% Solids, Moisture Content							Wet Sieve Test		
Sample No. and Depth	Tare ID	Weight of Container (g)	Weight of Container + Wet Soil (g)	Weight of Container + Dry Soil (g)	Solids Content (%)	Moisture Content (%)	Weight of Container + Dry Soil (g)	Weight of Container + Dry washed Soil (g)	% Finer than #200 Sieve (%)
2018-SPT-1 6-8	1010	85.25	333.57	294.26	84.17	18.8	294.26	286.45	3.7
2018-SPT-1 18.5-20	1012	84.18	382.62	322.76	79.94	25.1	322.76	273.91	20.5
2018-SPT-2 13.5-15	89A	84.21	377.99	341.60	87.61	14.1	341.6	293.15	18.8
2018-SPT-3 13.5-15	B	87.45	391.08	341.18	83.57	19.7	341.18	336.60	1.8
2018-SPT-4 18.5-20	Q	87.06	418.05	377.34	87.70	14.0	377.34	323.33	18.6
2018-SPT-5 18.5-20	4	85.29	401.41	342.24	81.28	23.0	342.24	330.53	4.6
2018-SPT-6 8-10	1961	86.13	380.92	328.46	82.20	21.6	328.46	291.47	15.3
2018-SPT-7 4-6	89C	84.16	256.65	217.60	77.36	29.3	217.6	144.90	54.5
2018-SPT-7 18.5-20	P	85.65	345.73	276.75	73.48	36.1	276.75	249.47	14.3
2018-SPT-8 4-6	0	89.48	243.55	195.75	68.98	45.0	195.75	164.94	29.0

ATTERBERG LIMITS' RESULTS

CLIENT St. Johns River Water Management District (SJRWMD) **PROJECT NAME** Prel. Design - Duda Pumps, Structures, and Levee Imp

PROJECT NUMBER 600550X3 **PROJECT LOCATION** Lake County and Orange County, FL



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**2018-SPT-1**	**2.0**	**NP**	**NP**	**NP**		
⊠	**2018-SPT-2**	**23.5**	**NP**	**NP**	**NP**		
▲	**2018-SPT-3**	**4.0**	**NP**	**NP**	**NP**		
★	**2018-SPT-4**	**4.0**	**NP**	**NP**	**NP**		
⊙	**2018-SPT-4**	**13.5**	**74**	**20**	**54**		
✿	**2018-SPT-5**	**4.0**	**NP**	**NP**	**NP**		
○	**2018-SPT-5**	**13.5**	**NP**	**NP**	**NP**		
△	**2018-SPT-6**	**2.0**	**NP**	**NP**	**NP**		
⊗	**2018-SPT-7**	**8.0**	**NP**	**NP**	**NP**		
⊕	**2018-SPT-8**	**8.0**	**NP**	**NP**	**NP**		
□	**2018-SPT-8**	**18.5**	**NP**	**NP**	**NP**		

wood.

SOIL TESTING REPORT

Project: Duda Water Storage Improvements
Client: SJRWMD

Project Number: 600550x4.****.02
Date Tested: March 4, 2020
Date Reported: March 18, 2020

Wood Environment & Infrastructure Solutions, Inc. performed soil testing on the soil samples delivered to our Jacksonville laboratory on March 4, 2020. The samples were tested in general accordance with ASTM standards. The results are outlined below.

Boring No	Sample No.	Depth (ft)	Percent Moisture (ASTM D2216)	Percent Organic (ASTM D2974)	Percent Passing #200 (ASTM D1140)
2020-SPT-1	2	1.0-2.0	17.1%	-	-
2020- SPT-1	3	2.0-3.0	-	-	20.4%
2020-SPT-1	13	28.5-30.0	-	-	4.3%
2020-SPT-1	15	38.5-40.0	24.6%	-	-
2020-SPT-2	1	0.0-1.0	12.3%	-	-
2020-SPT-2	3	2.0-3.0	-	31.0%	-
2020-SPT-2	8	9.0-11.0	-	-	31.0%
2020-SPT-2	12	23.5-25.0	19.9%	-	-
2020-SPT-3	1	1.0-2.0	-	-	42.4%
2020-SPT-3	5	4.0-5.0	-	78.0%	-
2020-SPT-3	9	11.0-13.0	-	-	78.6%
2020-SPT-3	11	18.5-20.0	16.5%	-	-
2020-SPT-3	14	33.5-35.0	24.6%	-	-
2020-SPT-4	2	1.0-2.0	27.5%	-	-
2020-SPT-4	6	5.0-7.0	-	38.0%	-
2020-SPT-4	8	9.0-11.0	33.4%	-	-
2020-SPT-4	10	13.0-15.0	-	-	6.0%
2020-SPT-5	2	1.0-2.0	-	-	71.8%
2020-SPT-5	4	3.0-4.0	-	18.0%	-
2020-SPT-5	9	11.0-13.0	51.3%	-	-
2020-SPT-5	10	13.0-15.0	20.3%	-	-
2020-SPT-5	13	28.5-30.0	31.5%	-	-
2020-SPT-5	16	43.5-45.0	-	-	16.4%
2020-PT-1	1	0.5-1.0	-	64.0%	-
2020-PT-2	2	0.3-0.8	-	48.0%	-

"-" Test not performed.

Performed By:

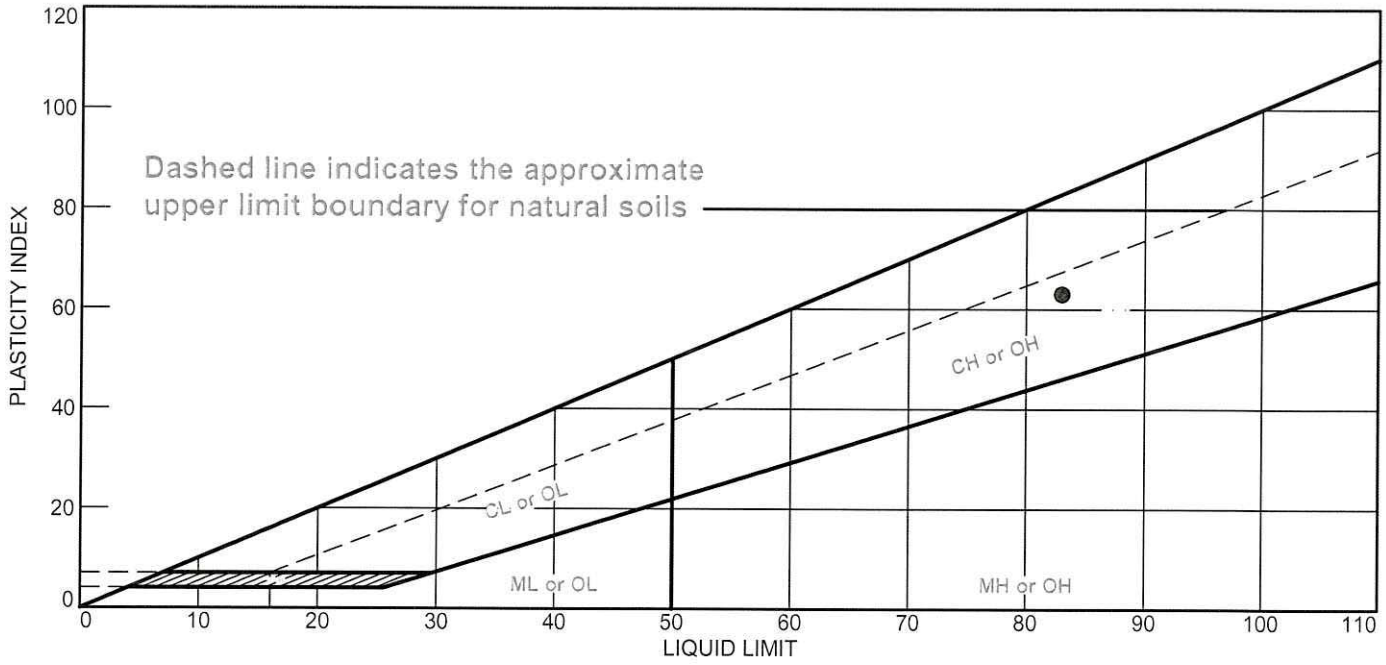
C. Martin

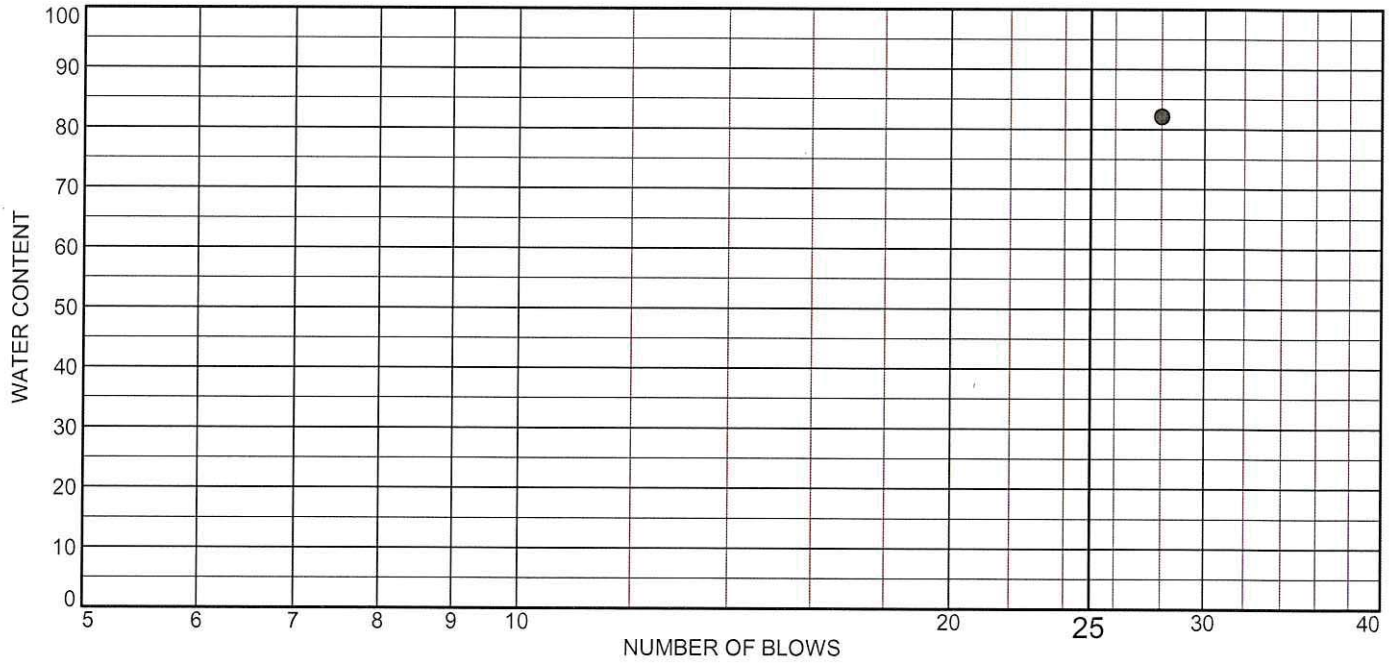
Reviewed By:

Corey Chascin 3/31/20

Corey T. Chascin, E.I.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		83	20	63			

Project No. 600550x4 **Client:** SJRWMD

Project: Duda Water Storage Improvements

Location: SPT-1(2020)
Sample Number: 10 **Depth:** 13.0'- 15.0'

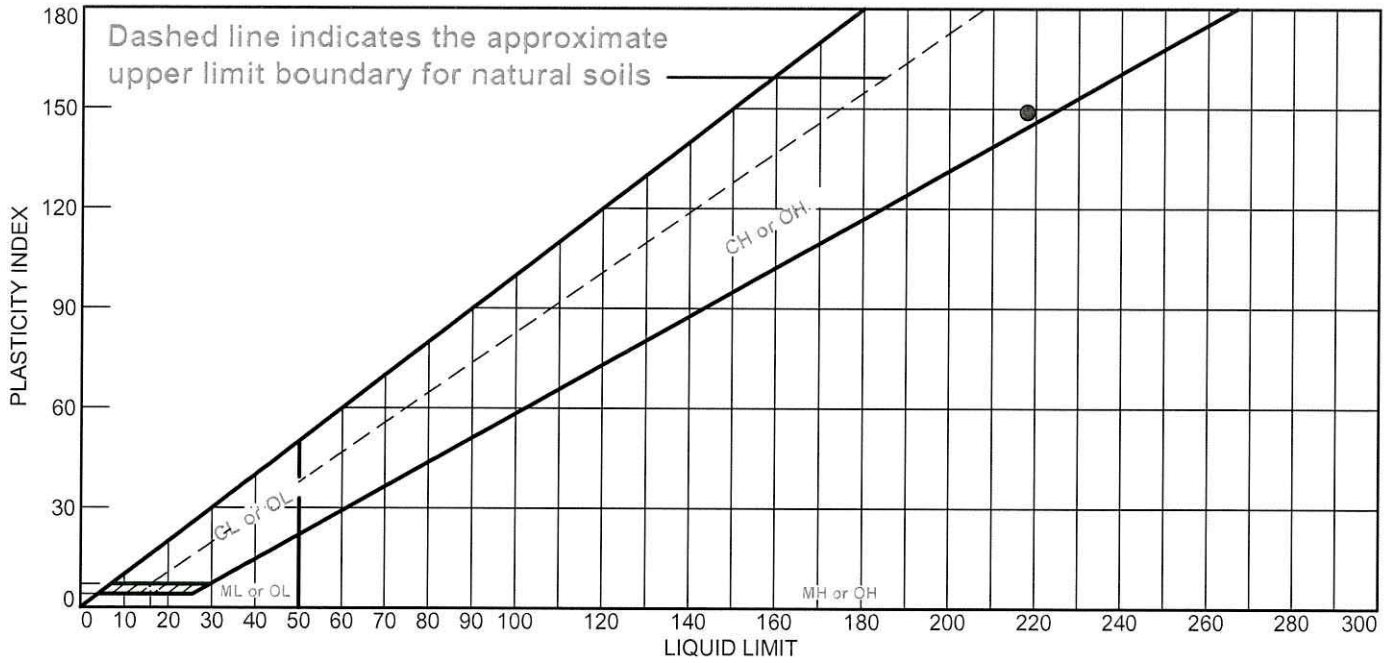
Wood E&I

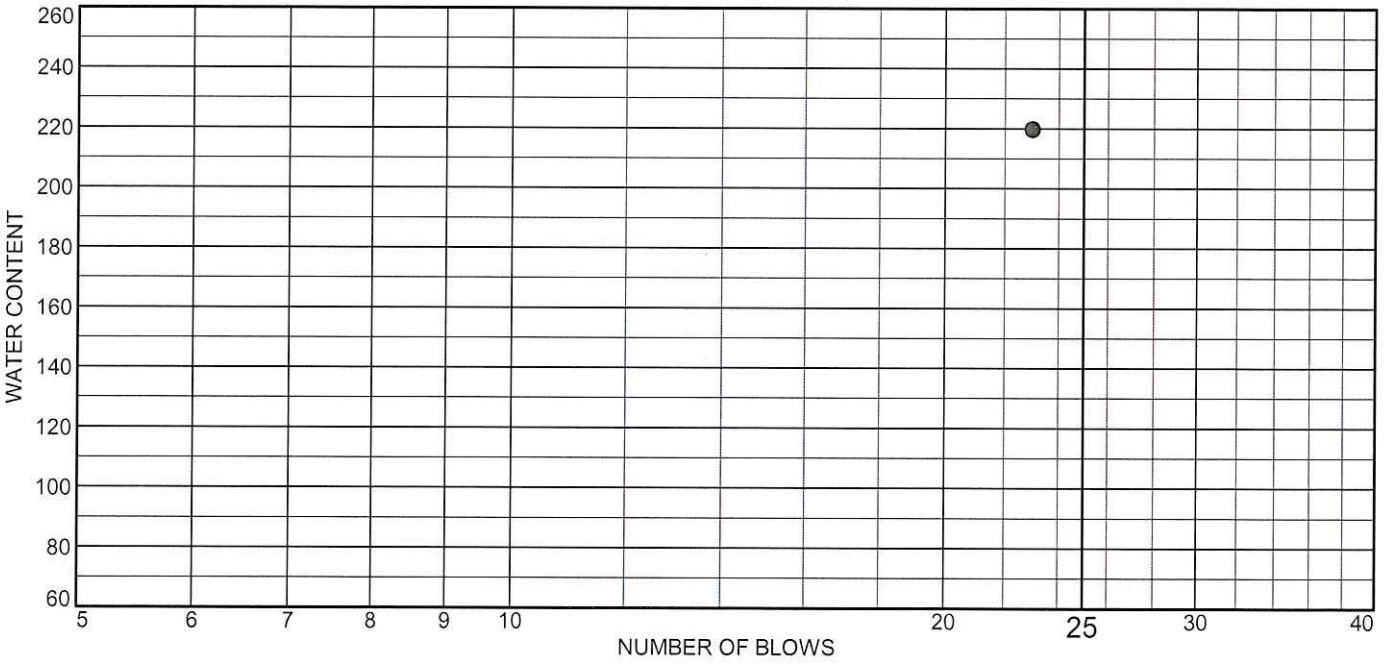
Jacksonville, Florida

Remarks:

Tested By: C. Martin **Checked By:** Corey T. Chascin, E.I. CTC 3/31/20

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		218	69	149			

Project No. 600550x4 **Client:** SJRWMD

Project: Duda Water Storage Improvements

Location: SPT-2 (2020)
Sample Number: 9 **Depth:** 11.0'- 13.0'

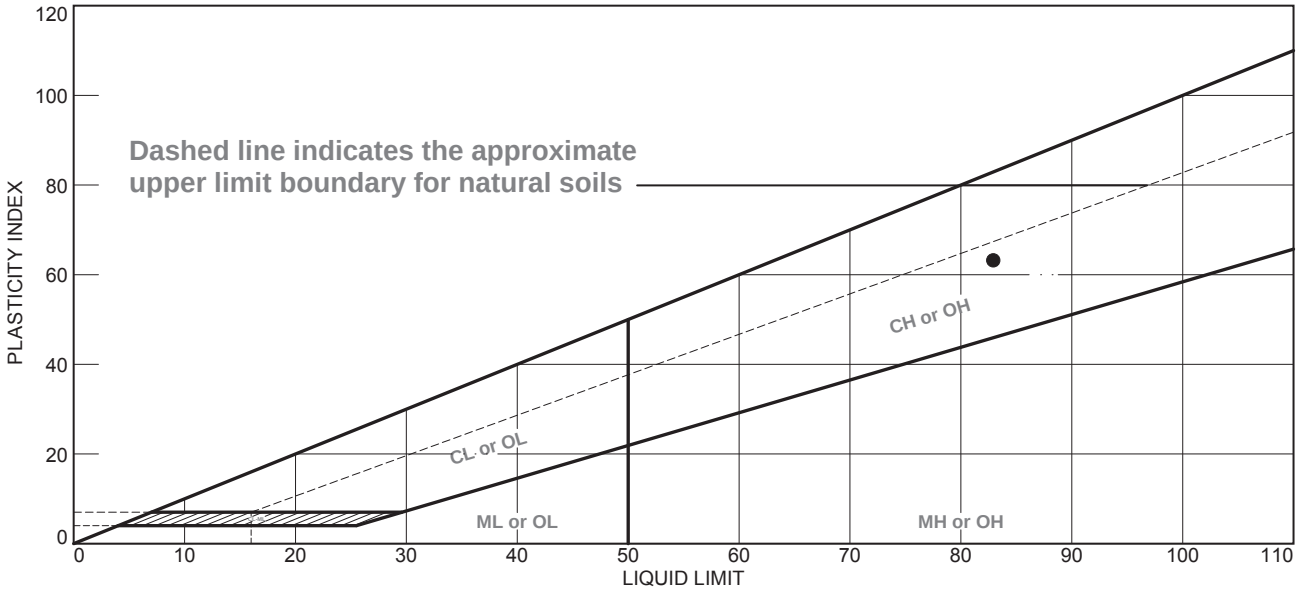
Wood E&I

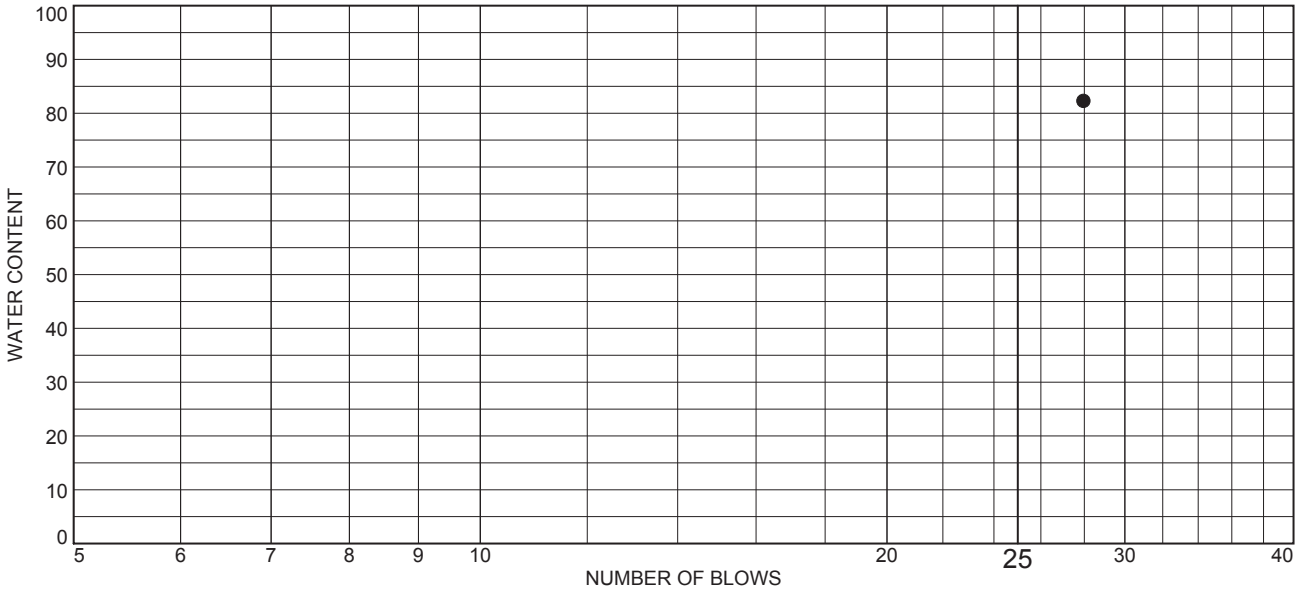
Jacksonville, Florida

Remarks:

Tested By: C. Martin **Checked By:** Corey T. Chascin, E.I. CTC 3/31/20

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		83	20	63			

Project No. 600550x4.****.02 **Client:** Wood Tampa

Project: Duda Water Storage Improvments

Source of Sample: SPT-1(2020) **Depth:** 13.0'- 15.0'
Sample Number: 10

Remarks:

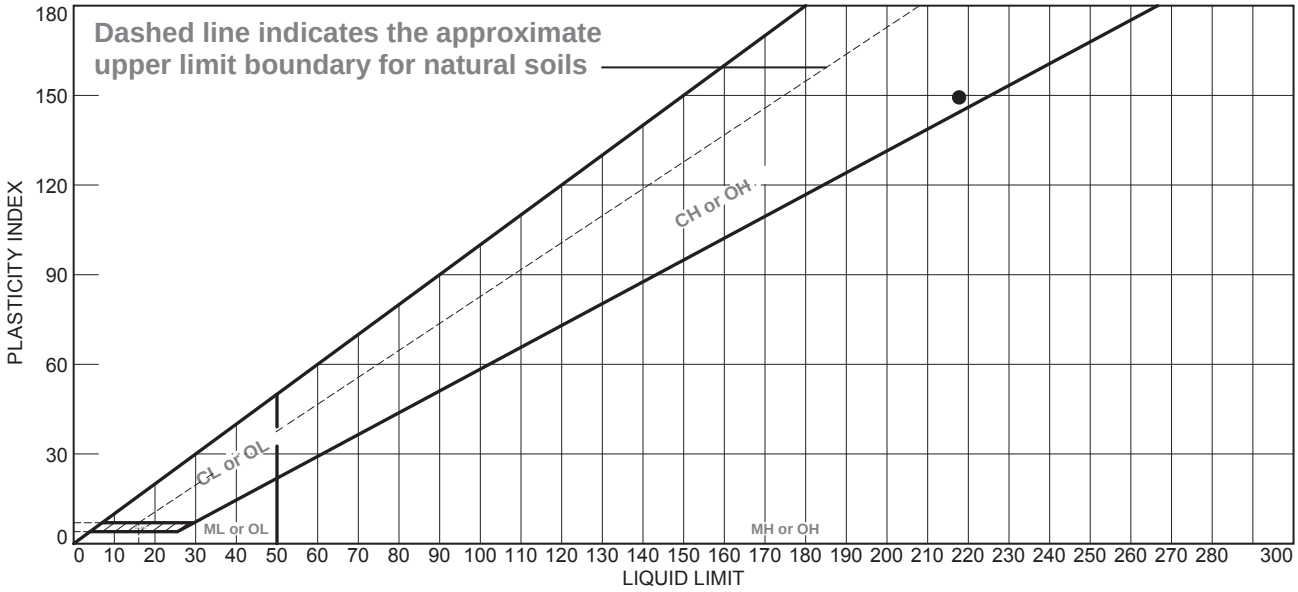
Wood E&I

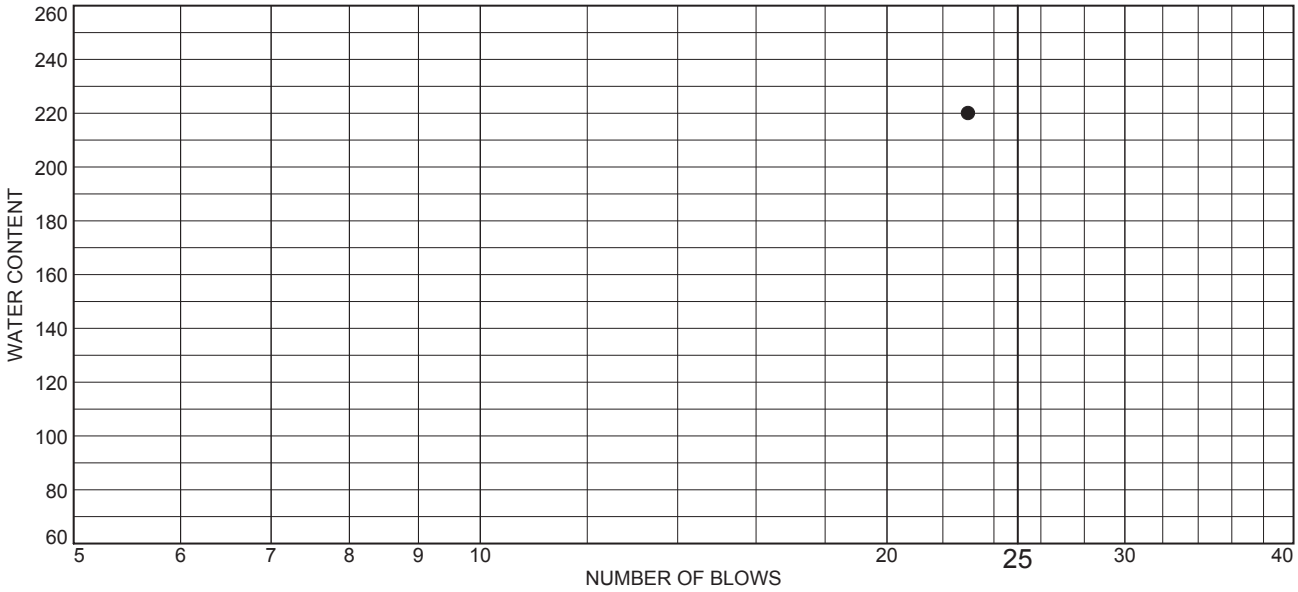
Jacksonville, Florida

Figure

Tested By: C. Martin **Checked By:** Corey T. Chascin, E.I.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		218	69	149			

Project No. 600550x4.****.02 **Client:** Wood Tampa

Project: Duda Water Storage Improvments

Source of Sample: SPT-2 (2020) **Depth:** 11.0'- 13.0'
Sample Number: 9

Remarks:

Wood E&I

Jacksonville, Florida

Figure

Tested By: C. Martin **Checked By:** Corey T. Chascin, E.I.

APPENDIX D

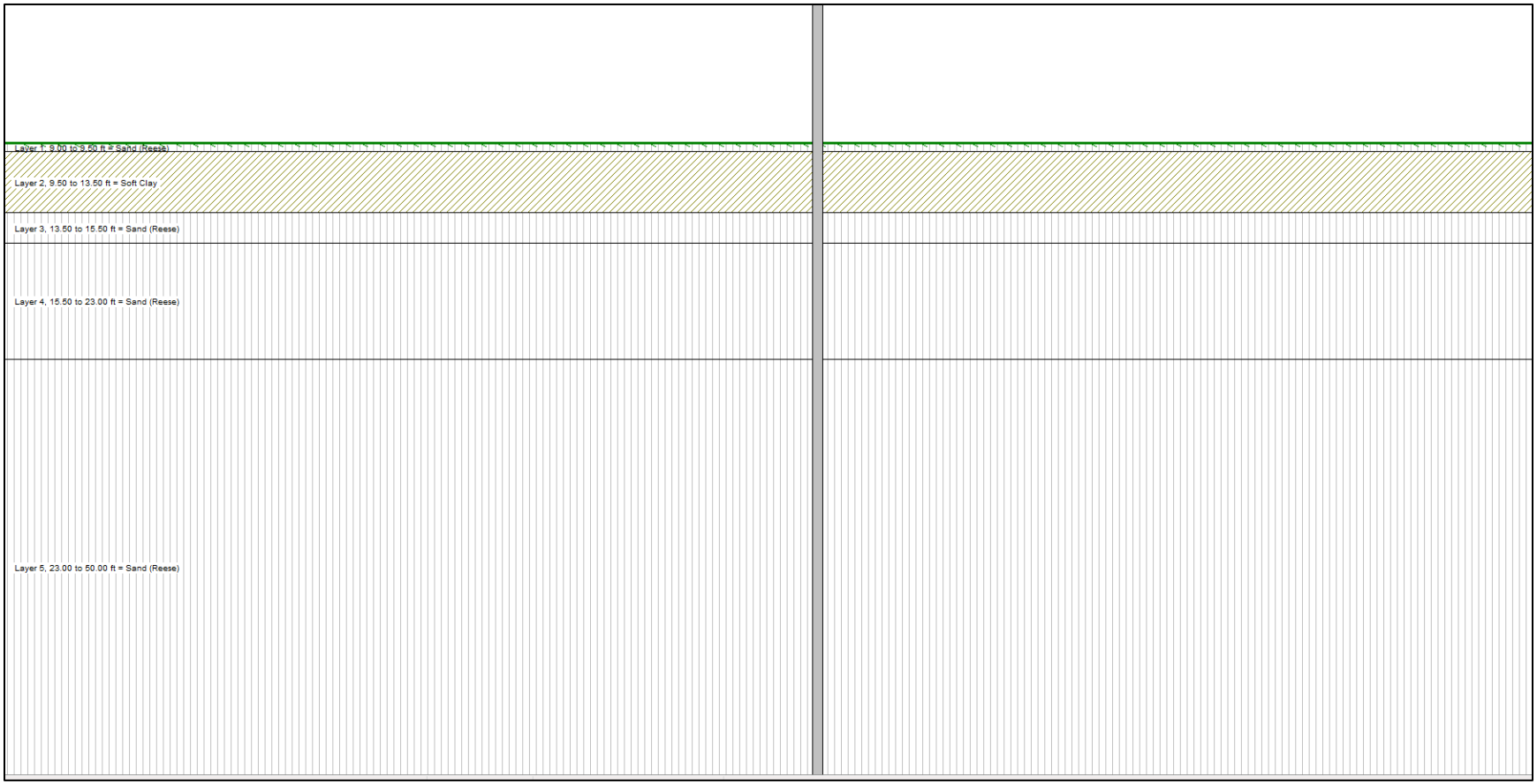


Figure 1. Stratigraphy used for Lateral Soil Analysis

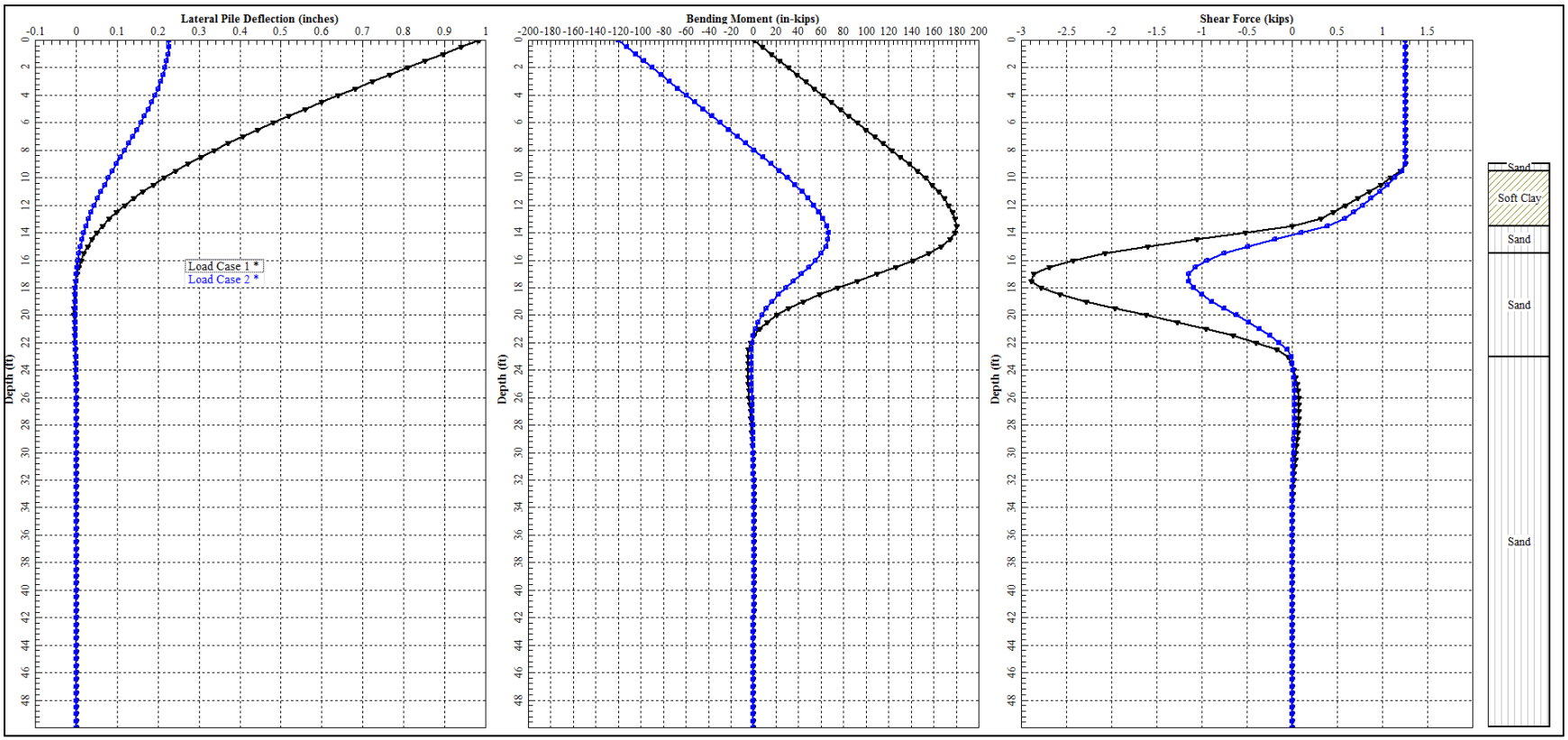


Figure 2. Lateral Deflection, Bending Moment and Shear Force Results

APPENDIX E

Axial Capacity Analysis on Steel piles

Ref: United States Department of Transportation of Federal Highway Administration (FHWA) – Design and Construction of Driven Pile Foundations – Volume 1

Project: Duda Water Storage Improvements (WSI) FINAL Geotechnical Report
Project No: 60055OX4
Prepared by: Luis Garcia

Boring Reference:	2020-SPT-4	
Water depth:	0.3 ft	from top of pile
Design Water Elevation:	64.0 ft	NAVD88
Pile Top Elevation:	64.3 ft	NAVD88
Pile Ground Elevation:	55.0 ft	NAVD88
Depth from Water to Existing Ground =	9.0 ft	
Design Pile Tip Elevation =	24.3 ft	NAVD88
Design Embedment Depth =	30.7 ft	
D/b Ratio =	45	
Proposed Steel Pile:	HP8X36	
Cross Sectional Area =	10.6 in2 0.1 ft2	
Flange Width, b_f =	8.2 in	
Flange Thickness, t_f = Depth, d =	0.45 in 8.0 in	
Web Thickness, t_w=	0.45 in	
Perimeter =	47.8 in 4.0 ft	
"Box Perimeter" =	32.3 in 2.7 ft	
"Box Area" =	65.4 in2 0.5 ft2	
Critical Depth (D_s) =	13.6 ft	(20 B)
Factor of Safety (FS) =	2.0	
ω =	0.0 deg	

																Side Friction Resistance											
Soil Stratum No.	**Description**	**SPT-N**	**N**	**Top Embedment Depth from Ground Surface (Elev +55 ft, NAVD88)**	**Bottom Embedment Depth from Ground Surface (Elev +55 ft, NAVD88)**	**Thickness (ft)**	**Top Ground Elevation (ft, NAVD88)**	**Bottom Ground Elevation (ft, NAVD88)**	**Depth from Water Surface to Top Layer (ft)**	**Depth from Water Surface to Mid Layer (ft)**	**Total Depth from Ground Surface to mid layer (ft)**	**γ (pcf)**	**γ' (pcf)**	**Undrained Shear Strength, S_u (psf)**	**Pile Embedded Length, D, (ft)**	**Adhesion factor, α**	**Adhesion, C_{ai}, (ksf)**	**Vol of soil displaced, V (ft^3/ft)**	**phi, ϕ (deg)**	**δ / ϕ**	**Pile Interface Friction Angle, δ**	**Coefficient of Lateral Earth Pressure at Depth, D, K_s**	**Correction Factor, C_F**	**σ_v @ Mid depth (psf)**	**PWP @ Mid depth (psf)**	**σ'_v @ Mid depth (psf)**	**Unit Skin Friction Resistance, f_{si}, (ksf)**	**Ult. Skin Friction Resistance, Q_{si}, (kips)**	**Accumulated Ult. Skin Friction Resistance, Q_{si}, (kips)**	**Accumulated Allowable Skin Friction Resistance, Q_{si}, (kips) (FS = 2)**
3	SP / SC / SP-SC	5	5	0.0	0.5	0.5	55.0	54.5	0.0	0.3	115	53	-	0.0	-	-	0.91	28	1.00	28	1.00	1.00	590	577	13	0	0	0.0	0.0
4	CH	3	3	0.5	1.0	0.5	54.5	54.0	9.5	9.8	0.8	120	58	200	0.5	0.55	0.11	0.91	-	-	-	-	-	649	608	41	0.1	0.1	0.1	0.1
4	CH	3	3	1.0	1.5	0.5	54.0	53.5	10.0	10.3	1.3	120	58	200	1.0	0.55	0.11	0.91	-	-	-	-	-	709	640	70	0.1	0.1	0.3	0.1
4	CH	3	3	1.5	2.0	0.5	53.5	53.0	10.5	10.8	1.8	120	58	200	1.5	0.55	0.11	0.91	-	-	-	-	-	769	671	98	0.1	0.1	0.4	0.2
4	CH	3	3	2.0	2.5	0.5	53.0	52.5	11.0	11.3	2.3	120	58	200	2.0	0.55	0.11	0.91	-	-	-	-	-	829	702	127	0.1	0.1	0.6	0.3
4	CH	5	5	2.5	3.0	0.5	52.5	52.0	11.5	11.8	2.8	120	58	200	2.5	0.55	0.11	0.91	-	-	-	-	-	889	733	156	0.1	0.1	0.7	0.4
4	CH	5	5	3.0	3.5	0.5	52.0	51.5	12.0	12.3	3.3	120	58	200	3.0	0.55	0.11	0.91	-	-	-	-	-	949	764	185	0.1	0.1	0.9	0.4
4	CH	5	5	3.5	4.0	0.5	51.5	51.0	12.5	12.8	3.8	120	58	200	3.5	0.55	0.11	0.91	-	-	-	-	-	1009	796	214	0.1	0.1	1.0	0.5
4	CH	5	5	4.0	4.5	0.5	51.0	50.5	13.0	13.3	4.3	120	58	200	4.0	0.55	0.11	0.91	-	-	-	-	-	1069	827	242	0.1	0.1	1.2	0.6
5	SP-SM	56	56	4.5	5.0	0.5	50.5	50.0	13.5	13.8	4.8	115	53	-	4.5	-	-	0.91	35	1.00	35	1.75	1.00	1128	858	270	0.27	0.4	1.6	0.8
5	SP-SM	56	56	5.0	5.5	0.5	50.0	49.5	14.0	14.3	5.3	115	53	-	5.0	-	-	0.91	35	1.00	35	1.75	1.00	1185	889	296	0.30	0.4	2.0	1.0
5	SP-SM	56	56	5.5	6.0	0.5	49.5	49.0	14.5	14.8	5.8	115	53	-	5.5	-	-	0.91	35	1.00	35	1.75	1.00	1243	920	322	0.32	0.4	2.4	1.2
5	SP-SM	56	56	6.0	6.5	0.5	49.0	48.5	15.0	15.3	6.3	115	53	-	6.0	-	-	0.91	35	1.00	35	1.75	1.00	1300	952	349	0.35	0.5	2.9	1.4
5	SP-SM	23	23	6.5	7.0	0.5	48.5	48.0	15.5	15.8	6.8	115	53	-	6.5	-	-	0.91	30	1.00	30	1.15	1.00	1358	983	375	0.22	0.3	3.1	1.6
5	SP-SM	23	23	7.0	7.5	0.5	48.0	47.5	16.0	16.3	7.3	115	53	-	7.0	-	-	0.91	30	1.00	30	1.15	1.00	1415	1014	401	0.23	0.3	3.5	1.7
5	SP-SM	23	23	7.5	8.0	0.5	47.5	47.0	16.5	16.8	7.8	115	53	-	7.5	-	-	0.91	30	1.00	30	1.15	1.00	1473	1045	428	0.25	0.3	3.8	1.9
5	SP-SM	23	23	8.0	8.5	0.5	47.0	46.5	17.0	17.3	8.3	115	53	-	8.0	-	-	0.91	30	1.00	30	1.15	1.00	1530	1076	454	0.26	0.4	4.1	2.1
5	SP-SM	23	23	8.5	9.0	0.5	46.5	46.0	17.5	17.8	8.8	115	53	-	8.5	-	-	0.91	30	1.00	30	1.15	1.00	1588	1108	480	0.28	0.4	4.5	2.3
5	SP-SM	23	23	9.0	9.5	0.5	46.0	45.5	18.0	18.3	9.3	115	53	-	9.0	-	-	0.91	30	1.00	30	1.15	1.00	1645	1139	507	0.29	0.4	4.9	2.5
5	SP-SM	23	23	9.5	10.0	0.5	45.5	45.0	18.5	18.8	9.8	115	53	-	9.5	-	-	0.91	30	1.00	30	1.15	1.00	1703	1170	533	0.31	0.4	5.3	2.7
5	SP-SM	23	23	10.0	10.5	0.5	45.0	44.5	19.0	19.3	10.3	115	53	-	10.0	-	-	0.91	30	1.00	30	1.15	1.00	1760	1201	559	0.32	0.4	5.8	2.9
5	SP-SM	23	23	10.5	11.0	0.5	44.5	44.0	19.5	19.8	10.8	115	53	-	10.5	-	-	0.91	30	1.00	30	1.15	1.00	1818	1232	585	0.34	0.5	6.2	3.1
5	SP-SM	23	23	11.0	11.5	0.5	44.0	43.5	20.0	20.3	11.3	115	53	-	11.0	-	-	0.91	30	1.00	30	1.15	1.00	1875	1264	612	0.35	0.5	6.7	3.3
5	SP-SM	23	23	11.5	12.0	0.5	43.5	43.0	20.5	20.8	11.8	115	53	-	11.5	-	-	0.91	30	1.00	30	1.15	1.00	1933	1295	638	0.37	0.5	7.2	3.6
5	SP-SM	23	23	12.0	12.5	0.5	43.0	42.5	21.0	21.3	12.3	115	53	-	12.0	-	-	0.91	30	1.00	30	1.15	1.00	1990	1326	664	0.38	0.5	7.7	3.8
5	SP-SM	23	23	12.5	13.0	0.5	42.5	42.0	21.5	21.8	12.8	115	53	-	12.5	-	-	0.91	30	1.00	30	1.15	1.00	2048	1357	691	0.40	0.5	8.2	4.1
5	SP-SM	23	23	13.0	13.5	0.5	42.0	41.5	22.0	22.3	13.3	115	53	-	13.0	-	-	0.91	30	1.00	30	1.15	1.00	2105	1388	717	0.41	0.6	8.8	4.4
5	SP-SM	23	23	13.5	14.0	0.5	41.5	41.0	22.5	22.8	13.8	115	53	-	13.5	-	-	0.91	30	1.00	30	1.15	1.00	2163	1420	743	0.43	0.6	9.4	4.7
5	SP-SM	23	23	14.0	14.5	0.5	41.0	40.5	23.0	23.3	14.3	115	53	-	14.0	-	-	0.91	30	1.00	30	1.15	1.00	2220	1451	770	0.44	0.6	10.0	5.0
5	SP-SM	6	6	14.5	15.0	0.5	40.5	40.0	23.5	23.8	14.8	115	53	-	14.5	-	-	0.91	28	1.00	28	1.00	1.00	2278	1482	796	0.37	0.5	10.5	5.2
5	SP-SM	6	6	15.0	15.5	0.5	40.0	39.5	24.0	24.3	15.3	115	53	-	15.0	-	-	0.91	28	1.00	28	1.00	1.00	2335	1513	822	0.39	0.5	11.0	5.5
5	SP-SM	6	6	15.5	16.0	0.5	39.5	39.0	24.5	24.8	15.8	115	53	-	15.5	-	-	0.91	28	1.00	28	1.00	1.00	2393	1544	848	0.40	0.5	11.5	5.8
5	SP-SM	6	6	16.0	16.5	0.5	39.0	38.5	25.0	25.3	16.3	115	53	-	16.0	-	-	0.91	28	1.00	28	1.00	1.00	2450	1576	875	0.41	0.6	12.1	6.0
5	SP-SM	6	6	16.5	17.0	0.5	38.5	38.0	25.5	25.8	16.8	115	53	-	16.5	-	-	0.91	28	1.00	28	1.00	1.00	2508	1607	901	0.42	0.6	12.6	6.3
5	SP-SM	6	6	17.0	17.5	0.5	38.0	37.5	26.0	26.3	17.3	115	53	-	17.0	-	-	0.91	28	1.00	28	1.00	1.00	2565	1638	927	0.44	0.6	13.2	6.6
5	SP-SM	6	6	17.5	18.0	0.5	37.5	37.0	26.5	26.8	17.8	115	53	-	17.5	-	-	0.91	28	1.00	28	1.00	1.00	2623	1669	954	0.45	0.6	13.8	6.9
5	SP-SM	6	6	18.0	18.5	0.5	37.0	36.5	27.0	27.3	18.3	115	53	-	18.0	-	-	0.91	28	1.00	28	1.00	1.00	2680	1700	980	0.46	0.6	14.4	7.2
5	SP-SM	6	6	18.5	19.0	0.5	36.5	36.0	27.5	27.8	18.8	115	53	-	18.5	-	-	0.91	28	1.00	28	1.00	1.00	2738	1732	1006	0.47	0.6	15.1	7.5
5	SP-SM	6	6	19.0	19.5	0.5	36.0	35.5	28.0	28.3	19.3	115	53	-	19.0	-	-	0.91	28	1.00	28	1.00	1.00	2795	1763	1033	0.48	0.7	15.7	7.9
5	SP-SM	6	6	19.5	20.0	0.5	35.5	35.0	28.5	28.8	19.8	115	53	-	19.5	-	-	0.91	28	1.00	28	1.00	1.00	2853	1794	1059	0.50	0.7	16.4	8.2
5	SP-SM	6	6	20.0	20.5	0.5	35.0	34.5	29.0	29.3	20.3	115	53	-	20.0	-	-	0.91	28	1.00	28	1.00	1.00	2910	1825	1085	0.51	0.7	17.1	8.5
5	SP-SM	6	6	20.5	21.0	0.5	34.5	34.0	29.5	29.8	20.8	115	53	-	20.5	-	-	0.91	28	1.00	28	1.00	1.00	2968	1856	1111	0.52	0.7	17.8	8.9
5	SP-SM	6	6	21.0	21.5	0.5	34.0	33.5	30.0	30.3	21.3	115	53	-	21.0	-	-	0.91	28	1.00	28	1.00	1.00	3025	1888	1138	0.53	0.7	18.5	9.3
5	SP-SM	6	6	21.5	22.0	0.5	33.5	33.0	30.5	30.8	21.8	115	53	-	21.5	-	-	0.91	28	1.00	28	1.00	1.00	3083	1919	1164	0.55	0.7	19.3	9.6
5	SP-SM	6	6	22.0	22.5	0.5	33.0	32.5	31.0	31.3	22.3	115	53	-	22.0	-	-	0.91	28	1.00	28	1.00	1.00	3140	1950	1190	0.56	0.8	20.0	10.0
5	SP-SM	6	6	22.5	23.0	0.5	32.5	32.0	31.5	31.8	22.8	115	53	-	22.5	-	-	0.91	28	1.00	28	1.00	1.00	3198	1981	1217	0.57	0.8	20.8	10.4
5	SP-SM	6	6	23.0	23.5	0.5	32.0	31.5	32.0	32.3	23.3	115	53	-	23.0	-	-	0.91	28	1.00	28	1.00	1.00	3255	2012	1243	0.58	0.8	21.6	10.8
5	SP-SM	6	6	23.5	24.0	0.5	31.5	31.0	32.5	32.8	23.8	115	53	-	23.5	-	-	0.91	28	1.00	28	1.00	1.00	3313	2044	1269	0.60	0.8	22.4	11.2
5	SP-SM	6	6	24.0	24.5	0.5	31.0	30.5	33.0	33.3	24.3	115	53	-	24.0	-	-	0.91	28	1.00	28	1.00	1.00	3370	2075	1296	0.61	0.8	23.2	11.6
5	SP-SM	6	6	24.5	25.0	0.5	30.5	30.0	33.5	33.8	24.8	115	53	-	24.5	-	-	0.91	28	1.00	28	1.00	1.00	3428	2106	1322	0.62	0.8	24.0	12.0
5	SP-SM	6	6	25.0	25.5	0.5	30.0	29.5	34.0	34.3	25.3	115	53	-	25.0	-	-	0.91	28	1.00	28	1.00	1.00	3485	2137	1348	0.63	0.9	24.9	12.4
5	SP-SM	6	6	25.5	26.0	0.5	29.5	29.0	34.5	34.8	25.8	115	53	-	25.5	-	-	0.91	28	1.00	28	1.00	1.00	3543	2168	1374	0.65	0.9	25.7	12.9
5	SP-SM	6	6	26.0	26.5	0.5	29.0	28.5	35.0	35.3	26.3	115	53	-	26.0	-	-	0.91	28	1.00	28	1.00	1.00	3600	2200	1401	0.66	0.9	26.6	13.3
5	SP-SM	6	6	26.5	27.0	0.5	28.5	28.0	35.5	35.8	26.8	115	53	-	26.5	-	-	0.91	28	1.00	28	1.00	1.00	3658	2231	1427	0.67	0.9	27.5	13.8
5	SP-SM	6	6	27.0	27.5	0.5	28.0	27.5	36.0	36.3	27.3	115	53	-	27.0	-	-	0.91	28	1.00	28	1.00	1.00	3715	2262	1453	0.68	0.9	28.5	14.2
5	SP-SM	6	6	27.5	28.0	0.5	27.5	27.0	36.5	36.8	27.8	115	53	-	27.5	-	-	0.91	28	1.00	28	1.00	1.00	3773	2293	1480	0.69	0.9	29.4	14.7
5	SP-SM	6	6	28.0	28.5	0.5	27.0	26.5	37.0	37.3	28.3	115	53	-	28.0	-	-	0.91	28	1.00	28	1.00	1.00	3830	2324	1506	0.71	1.0	30.3	15.2
5	SP-SM	6	6	28.5	29.0	0.5	26.5	26.0	37.5	37.8	28.8	115	53	-	28.5	-	-	0.91	28	1.00	28	1.00	1.00	3888	2356	1532	0.72	1.0	31.3	15.7
5	SP-SM	6	6	29.0	29.5	0.5	26.0	25.5	38.0	38.3	29.3	115	53	-	29.0	-	-	0.91	28	1.00	28	1.00	1.00	3945	2387	1559	0.73	1.0	32.3	16.1
5	SP-SM	6	6	29.5	30.0	0.5	25.5	25.0	38.5	38.8	29.8	115	53	-	29.5	-	-	0.91	28	1.00	28	1.00	1.00	4003	2418	1585	0.74	1.0	33.3	16.6
5	SP-SM	6	6	30.0	30.5	0.5	25.0	24.5	39.0	39.3	30.3	115	53	-	30.0	-	-	0.91	28	1.00	28	1.00	1.00	4060	2449	1611	0.76	1.0	34.3	17.2
5	SP-SM	6	6	30.5	31.0	0.5	24.5	24.0	39.5	39.8	30.8	115	53	-	30.5	-	-	0.91	28	1.00	28	1.00	1.00	4118	2480	1637	0.77	1.0	35.4	17.7
5	SP-SM	6	6	31.0	31.5	0.5	24.0	23.5	40.0	40.3	31.3	115	53	-	31.0	-	-	0.91	28	1.00	28	1.00	1.00	4175	2512	1664	0.78	1.1	36.4	18.2
5	SP-SM	6	6	31.5	32.0	0.5	23.5	23.0	40.5	40.8	31.8	115	53	-	31.5	-	-	0.91	28	1.00	28	1.00	1.00	4233	2543	1690	0.79	1.1	37.5	18.7
5	SP-SM	6	6	32.0	32.5	0.5	23.0	22.5	41.0	41.3	32.3	115	53	-	32.0	-	-	0.91	28	1.00	28	1.00	1.00	4290	2574	1716	0.81	1.1	38.6	19.3
5	SP-SM	6	6	32.5	33.0	0.5	22.5	22.0	41.5	41.8	32.8	115	53	-	32.5	-	-	0.91	28	1.00	28	1.00	1.00	4348	2605	1743	0.82	1.1	39.7	19.8
5	SP-SM	6	6	33.0	33.5	0.5	22.0	21.5	42.0	42.3	33.3	115	53	-	33.0	-	-	0.91	28	1.00	28	1.00	1.00	4405	2636	1769	0.83	1.1	40.8	20.4
5	SP-SM	6	6	33.5	34.0	0.5	21.5	21.0	42.5	42.8	33.8	115	53	-	33.5	-	-	0.91	28	1.00	28	1.00	1.00	4463	2668	1795	0.84	1.1	41.9	21.0
5	SP-SM	6	6	34.0	34.5	0.5	21.0	20.5	43.0	43.3	34.3	115	53	-	34.0	-	-	0.91	28	1.00	28	1.00	1.00	4520	2699	1822	0.86	1.2	43.1	21.5
5	SP-SM	6	6	34.5	35.0	0.5	20.5	20.0	43.5	43.8	34.8	115	53	-	34.5	-	-	0.91	28	1.00	28	1.00	1.00	4578	2730	1848	0.87	1.2	44.2	22.1
5	SP-SM	6	6	35.0	35.5	0.5	20.0	19.5	44.0	44.3	35.3	115	53	-	35.0	-	-	0.91	28	1.00	28	1.00	1.00	4635	2761	1874	0.88	1.2	45.4	22.7
5	SP-SM	6	6	35.5	36.0	0.5	19.5	19.0	44.5	44.8	35.8	115	53	-	35.5	-	-	0.91	28	1.00	28	1.00	1.00	4693	2792	1900	0.89	1.2	46.6	23.3
5	SP-SM	6	6	36.0	36.5	0.5	19.0	18.5	45.0	45.3	36.3	115	53	-	36.0	-	-	0.91	28	1.00	28	1.00	1.00	4750	2824	1927	0.90	1.2	47.8	23.9
5	SP-SM	6	6	36.5	37.0	0.5	18.5	18.0	45.5	45.8	36.8	115	53	-	36.5	-	-	0.91	28	1.00	28	1.00	1.00	4808	2855	1953	0.92	1.2	49.1	24.5
5	SP-SM	6	6	37.0	37.5	0.5	18.0	17.5	46.0	46.3	37.3	115	53	-	37.0	-	-	0.91	28	1.00	28	1.00	1.00	4865	2886	1979	0.93	1.3	50.3	25.2
5	SP-SM	6	6	37.5	38.0	0.5	17.5	17.0	46.5	46.8	37.8	115	53	-	37.5	-	-	0.91	28	1.00	28	1.00	1.00	4923	2917	2006	0.94	1.3	51.6	25.8
5	SP-SM	6	6	38.0	38.5	0.5	17.0	16.5	47.0	47.3	38.3	115	53	-	38.0	-	-	0.91	28	1.00	28	1.00	1.00	4980	2948	2032	0.95	1.3	52.9	26.4
5	SP-SM	6	6	38.5	39.0	0.5	16.5	16.0	47.5	47.8	38.8	115	53	-	38.5	-	-	0.91	28	1.00	28	1.00	1.00	5038	2980	2058	0.97	1.3	54.2	27.1
5	SP-SM	6	6	39.0	39.5	0.5	16.0	15.5	48.0	48.3	39.3	115	53	-	39.0	-	-	0.91	28	1.00	28	1.00	1.00	5095	3011	2085	0.98	1.3	55.5	27.8
5	SP-SM	6	6	39.5	40.0	0.5	15.5	15.0	48.5	48.8	39.8	115	53	-	39.5	-	-	0.91	28	1.00	28	1.00	1.00	5153	3042	2111	0.99	1.3	56.8	28.4

40 ft

Axial Capacity Analysis on Steel piles

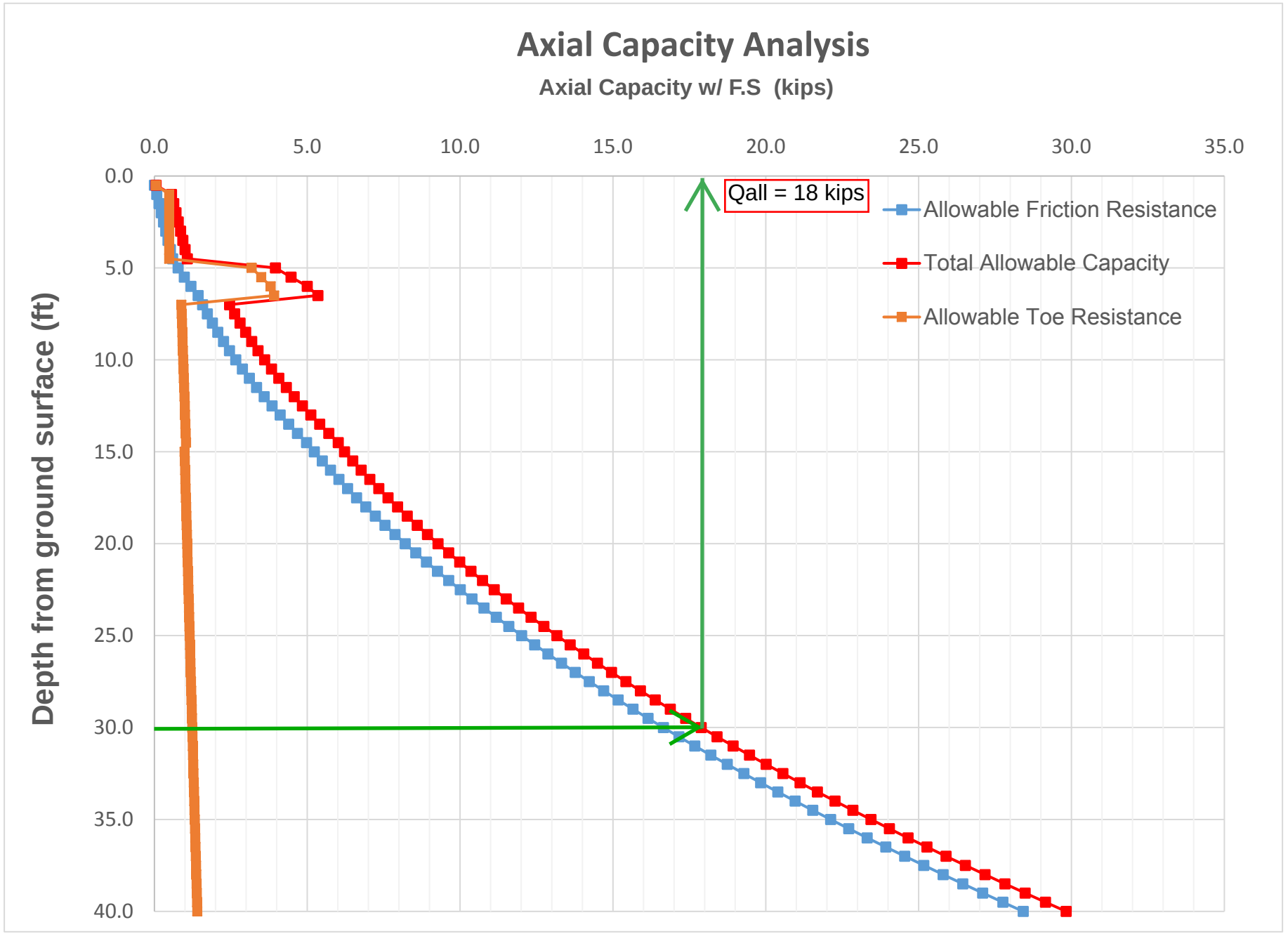
Ref: United States Department of Transportation of Federal Highway Administration (FHWA) – Design and Construction of Driven Pile Foundations – Volume 1

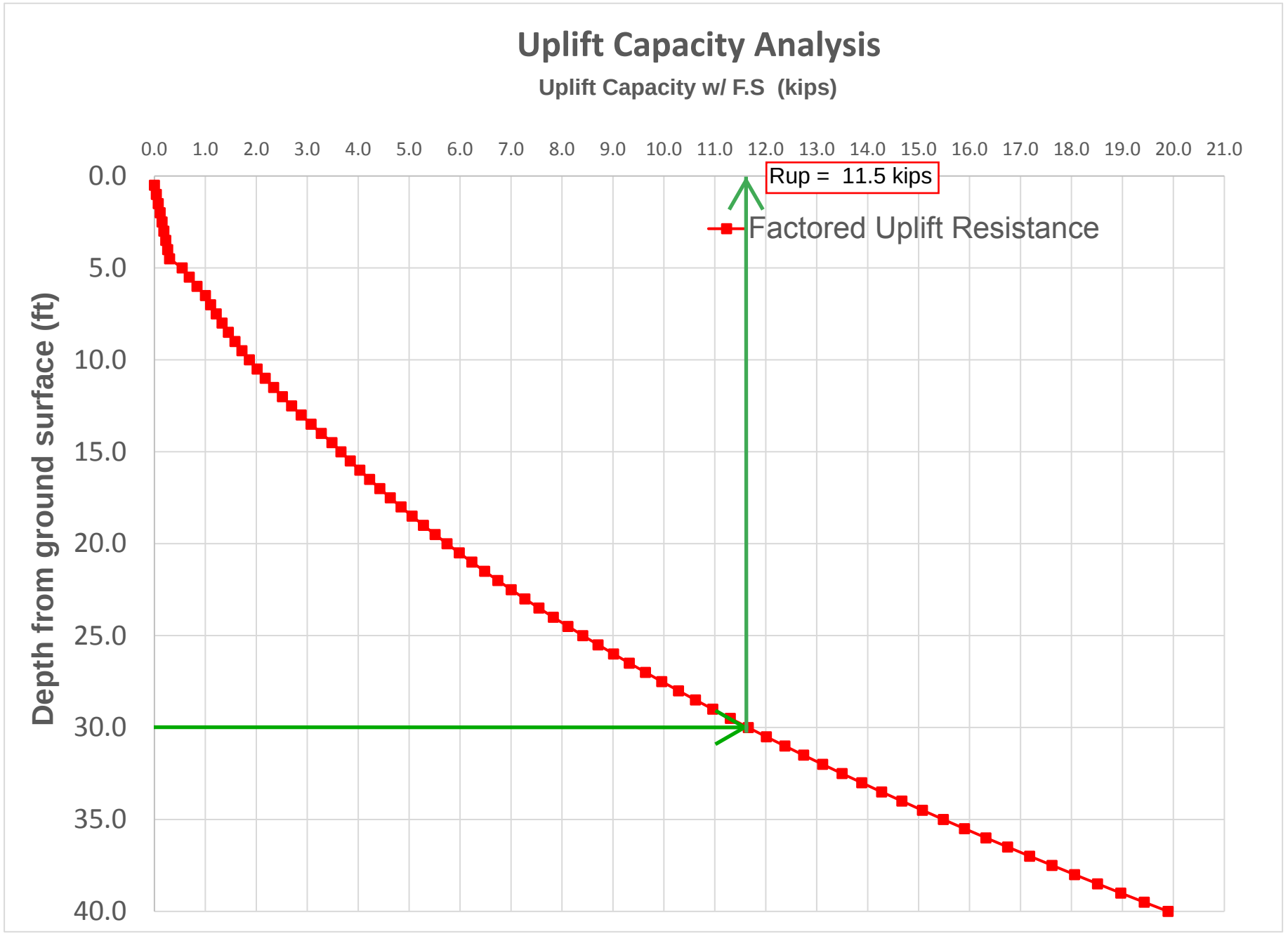
Project: Duda Water Storage Improvements (WSI) FINAL Geotechnical Report
Project No: 600550X4
Prepared by: Luis Garcia

Boring Reference:	2020-SPT-4	
Water depth:	0.3 ft	from top of pile
Design Water Elevation:	64.0 ft	NAVD88
Pile Top Elevation:	64.3 ft	NAVD88
Pile Ground Elevation:	55.0 ft	NAVD88
Depth from Water to Existing Ground =	9.0 ft	
Design Pile Tip Elevation =	24.3 ft	NAVD88
Design Embedment Depth =	30.7 ft	
D/b Ratio =	45	
Proposed Steel Pile:	HP8X36	
Cross Sectional Area =	10.6 in2 0.1 ft2	
Flange Width, b_f =	8.2 in	
Flange Thickness, t_f =	0.45 in	
Depth, d =	8.0 in	
Web Thickness, t_w=	0.45 in	
Perimeter =	47.8 in 4.0 ft	
"Box Perimeter" =	32.3 in 2.7 ft	
"Box Area" =	65.4 in2 0.5 ft2	
Critical Depth (D_c) =	13.6 ft	(20 B)
Factor of Safety (FS) =	2.0	
ω =	0.0 deg	

														End Bearing Resistance											**Uplift Resistance**	
												Alpha method (cohesive soils)				*Nurlond method (cohesionless soils)*										
Soil Stratum No.	**Description**	**SPT-N (field)**	**Top Embedment Depth from Ground Surface (Elev +55 ft, NAVD88)**	**Bottom Embedment Depth from Ground Surface (Elev +55 ft, NAVD88)**	**Thickness (ft)**	**Depth from Water Surface to Top Layer (ft)**	**Depth from Water Surface to Mid Layer (ft)**	**Total Depth from Ground Surface to mid layer (ft)**	**γ (pcf)**	**γ' (pcf)**	**Undrained Shear Strength, S_u (psf)**	**N_c**	**Unit Toe Resistance, q_p (ksf)**	**Nominal toe Resistance (R_p) (kips)**	**α_t Coefficient**	**N'_q**	**σ_v at Pile toe at this depth (psf)**	**σ'_v at Pile toe at this depth (psf)**	**Nominal toe Resistance (R_p) (kips)**	**Limiting Unit Toe Resistance (q_L) (ksf)**	**Limited Toe Resistance, R_L (kips)**	**Governing Nominal toe Resistance (R_p) (kips)**	**Q_{ult} (kips)**	**Allowable Toe Resistance (Q_{toe}) (kips) (FS = 2)**	**Total Allowable Capacity (Q_{all}) (kips) (FS = 2)**	**ϕ_{up}**	**Accumulated R_{uplift} (kips)**
3	SP / SC / SP-SC	5	0	0.5	0.5	9.0	9.25	0.25	115	52.6	-	-	-	-	0.6	30	590	13	0.1	100	7.4	0.1	0.1	0.1	0.1	0.35	0.0
4	CH	3	0.5	1.0	0.5	9.5	9.75	0.75	120	57.6	200	9	1.8	0.82	-	-	649	41	-	-	-	0.8	1.0	0.5	0.6	0.25	0.0
4	CH	3	1.0	1.5	0.5	10.0	10.25	1.25	120	57.6	200	9	1.8	0.82	-	-	709	70	-	-	-	0.8	1.0	0.5	0.6	0.25	0.1
4	CH	3	1.5	2.0	0.5	10.5	10.75	1.75	120	57.6	200	9	1.8	0.82	-	-	769	98	-	-	-	0.8	1.0	0.5	0.7	0.25	0.1
4	CH	3	2.0	2.5	0.5	11.0	11.25	2.25	120	57.6	200	9	1.8	0.82	-	-	829	127	-	-	-	0.8	1.0	0.5	0.8	0.25	0.1
4	CH	5	2.5	3.0	0.5	11.5	11.75	2.75	120	57.6	200	9	1.8	0.82	-	-	889	156	-	-	-	0.8	1.0	0.5	0.9	0.25	0.2
4	CH	5	3.0	3.5	0.5	12.0	12.25	3.25	120	57.6	200	9	1.8	0.82	-	-	949	185	-	-	-	0.8	1.0	0.5	0.9	0.25	0.2
4	CH	5	3.5	4.0	0.5	12.5	12.75	3.75	120	57.6	200	9	1.8	0.82	-	-	1009	214	-	-	-	0.8	1.0	0.5	1.0	0.25	0.3
4	CH	5	4.0	4.5	0.5	13.0	13.25	4.25	120	57.6	200	9	1.8	0.82	-	-	1069	242	-	-	-	0.8	1.0	0.5	1.1	0.25	0.3
5	SP-SM	56	4.5	5.0	0.5	13.5	13.75	4.75	115	52.6	-	-	-	-	0.7	70	1128	270	6.0	100	7.4	6.0	6.4	3.2	4.0	0.35	0.5
5	SP-SM	56	5.0	5.5	0.5	14.0	14.25	5.25	115	52.6	-	-	-	-	0.7	70	1185	296	6.6	100	7.4	6.6	7.0	3.5	4.5	0.35	0.7
5	SP-SM	56	5.5	6.0	0.5	14.5	14.75	5.75	115	52.6	-	-	-	-	0.7	70	1243	322	7.2	100	7.4	7.2	7.6	3.8	5.0	0.35	0.8
5	SP-SM	56	6.0	6.5	0.5	15.0	15.25	6.25	115	52.6	-	-	-	-	0.7	70	1300	349	7.8	100	7.4	7.4	7.8	3.9	5.3	0.35	1.0
5	SP-SM	23	6.5	7.0	0.5	15.5	15.75	6.75	115	52.6	-	-	-	-	0.6	30	1358	375	3.1	20	1.5	1.5	1.8	0.9	2.5	0.35	1.1
5	SP-SM	23	7.0	7.5	0.5	16.0	16.25	7.25	115	52.6	-	-	-	-	0.6	30	1415	401	3.3	20	1.5	1.5	1.8	0.9	2.6	0.35	1.2
5	SP-SM	23	7.5	8.0	0.5	16.5	16.75	7.75	115	52.6	-	-	-	-	0.6	30	1473	428	3.5	20	1.5	1.5	1.8	0.9	2.8	0.35	1.3
5	SP-SM	23	8.0	8.5	0.5	17.0	17.25	8.25	115	52.6	-	-	-	-	0.6	30	1530	454	3.7	20	1.5	1.5	1.8	0.9	3.0	0.35	1.5
5	SP-SM	23	8.5	9.0	0.5	17.5	17.75	8.75	115	52.6	-	-	-	-	0.6	30	1588	480	3.9	20	1.5	1.5	1.8	0.9	3.2	0.35	1.6
5	SP-SM	23	9.0	9.5	0.5	18.0	18.25	9.25	115	52.6	-	-	-	-	0.6	30	1645	507	4.1	20	1.5	1.5	1.9	0.9	3.4	0.35	1.7
5	SP-SM	23	9.5	10.0	0.5	18.5	18.75	9.75	115	52.6	-	-	-	-	0.6	30	1703	533	4.4	20	1.5	1.5	1.9	0.9	3.6	0.35	1.9
5	SP-SM	23	10.0	10.5	0.5	19.0	19.25	10.25	115	52.6	-	-	-	-	0.6	30	1760	559	4.6	20	1.5	1.5	1.9	1.0	3.8	0.35	2.0
5	SP-SM	23	10.5	11.0	0.5	19.5	19.75	10.75	115	52.6	-	-	-	-	0.6	30	1818	585	4.8	20	1.5	1.5	1.9	1.0	4.1	0.35	2.2
5	SP-SM	23	11.0	11.5	0.5	20.0	20.25	11.25	115	52.6	-	-	-	-	0.6	30	1875	612	5.0	20	1.5	1.5	1.9	1.0	4.3	0.35	2.3
5	SP-SM	23	11.5	12.0	0.5	20.5	20.75	11.75	115	52.6	-	-	-	-	0.6	30	1933	638	5.2	20	1.5	1.5	2.0	1.0	4.6	0.35	2.5
5	SP-SM	23	12.0	12.5	0.5	21.0	21.25	12.25	115	52.6	-	-	-	-	0.6	30	1990	664	5.4	20	1.5	1.5	2.0	1.0	4.8	0.35	2.7
5	SP-SM	23	12.5	13.0	0.5	21.5	21.75	12.75	115	52.6	-	-	-	-	0.6	30	2048	691	5.6	20	1.5	1.5	2.0	1.0	5.1	0.35	2.9
5	SP-SM	23	13.0	13.5	0.5	22.0	22.25	13.25	115	52.6	-	-	-	-	0.6	30	2105	717	5.9	20	1.5	1.5	2.0	1.0	5.4	0.35	3.1
5	SP-SM	23	13.5	14.0	0.5	22.5	22.75	13.75	115	52.6	-	-	-	-	0.6	30	2163	743	6.1	20	1.5	1.5	2.0	1.0	5.7	0.35	3.3
5	SP-SM	23	14.0	14.5	0.5	23.0	23.25	14.25	115	52.6	-	-	-	-	0.6	30	2220	770	6.3	20	1.5	1.5	2.1	1.0	6.0	0.35	3.5
5	SP-SM	6	14.5	15.0	0.5	23.5	23.75	14.75	115	52.6	-	-	-	-	0.6	30	2278	796	6.5	20	1.5	1.5	2.0	1.0	6.2	0.35	3.7
5	SP-SM	6	15.0	15.5	0.5	24.0	24.25	15.25	115	52.6	-	-	-	-	0.6	30	2335	822	6.7	20	1.5	1.5	2.0	1.0	6.5	0.35	3.8
5	SP-SM	6	15.5	16.0	0.5	24.5	24.75	15.75	115	52.6	-	-	-	-	0.6	30	2393	848	6.9	20	1.5	1.5	2.0	1.0	6.8	0.35	4.0
5	SP-SM	6	16.0	16.5	0.5	25.0	25.25	16.25	115	52.6	-	-	-	-	0.6	30	2450	875	7.1	20	1.5	1.5	2.0	1.0	7.0	0.35	4.2
5	SP-SM	6	16.5	17.0	0.5	25.5	25.75	16.75	115	52.6	-	-	-	-	0.6	30	2508	901	7.4	20	1.5	1.5	2.0	1.0	7.3	0.35	4.4
5	SP-SM	6	17.0	17.5	0.5	26.0	26.25	17.25	115	52.6	-	-	-	-	0.6	30	2565	927	7.6	20	1.5	1.5	2.1	1.0	7.6	0.35	4.6
5	SP-SM	6	17.5	18.0	0.5	26.5	26.75	17.75	115	52.6	-	-	-	-	0.6	30	2623	954	7.8	20	1.5	1.5	2.1	1.0	8.0	0.35	4.8
5	SP-SM	6	18.0	18.5	0.5	27.0	27.25	18.25	115	52.6	-	-	-	-	0.6	30	2680	980	8.0	20	1.5	1.5	2.1	1.0	8.3	0.35	5.1
5	SP-SM	6	18.5	19.0	0.5	27.5	27.75	18.75	115	52.6	-	-	-	-	0.6	30	2738	1006	8.2	20	1.5	1.5	2.1	1.1	8.6	0.35	5.3
5	SP-SM	6	19.0	19.5	0.5	28.0	28.25	19.25	115	52.6	-	-	-	-	0.6	30	2795	1033	8.4	20	1.5	1.5	2.1	1.1	8.9	0.35	5.5
5	SP-SM	6	19.5	20.0	0.5	28.5	28.75	19.75	115	52.6	-	-	-	-	0.6	30	2853	1059	8.7	20	1.5	1.5	2.1	1.1	9.3	0.35	5.7
5	SP-SM	6	20.0	20.5	0.5	29.0	29.25	20.25	115	52.6	-	-	-	-	0.6	30	2910	1085	8.9	20	1.5	1.5	2.2	1.1	9.6	0.35	6.0
5	SP-SM	6	20.5	21.0	0.5	29.5	29.75	20.75	115	52.6	-	-	-	-	0.6	30	2968	1111	9.1	20	1.5	1.5	2.2	1.1	10.0	0.35	6.2
5	SP-SM	6	21.0	21.5	0.5	30.0	30.25	21.25	115	52.6	-	-	-	-	0.6	30	3025	1138	9.3	20	1.5	1.5	2.2	1.1	10.4	0.35	6.5
5	SP-SM	6	21.5	22.0	0.5	30.5	30.75	21.75	115	52.6	-	-	-	-	0.6	30	3083	1164	9.5	20	1.5	1.5	2.2	1.1	10.7	0.35	6.7
5	SP-SM	6	22.0	22.5	0.5	31.0	31.25	22.25	115	52.6	-	-	-	-	0.6	30	3140	1190	9.7	20	1.5	1.5	2.2	1.1	11.1	0.35	7.0
5	SP-SM	6	22.5	23.0	0.5	31.5	31.75	22.75	115	52.6	-	-	-	-	0.6	30	3198	1217	9.9	20	1.5	1.5	2.2	1.1	11.5	0.35	7.3
5	SP-SM	6	23.0	23.5	0.5	32.0	32.25	23.25	115	52.6	-	-	-	-	0.6	30	3255	1243	10.2	20	1.5	1.5	2.3	1.1	11.9	0.35	7.5
5	SP-SM	6	23.5	24.0	0.5	32.5	32.75	23.75	115	52.6	-	-	-	-	0.6	30	3313	1269	10.4	20	1.5	1.5	2.3	1.1	12.3	0.35	7.8
5	SP-SM	6	24.0	24.5	0.5	33.0	33.25	24.25	115	52.6	-	-	-	-	0.6	30	3370	1296	10.6	20	1.5	1.5	2.3	1.1	12.7	0.35	8.1
5	SP-SM	6	24.5	25.0	0.5	33.5	33.75	24.75	115	52.6	-	-	-	-	0.6	30	3428	1322	10.8	20	1.5	1.5	2.3	1.2	13.2	0.35	8.4
5	SP-SM	6	25.0	25.5	0.5	34.0	34.25	25.25	115	52.6	-	-	-	-	0.6	30	3485	1348	11.0	20	1.5	1.5	2.3	1.2	13.6	0.35	8.7
5	SP-SM	6	25.5	26.0	0.5	34.5	34.75	25.75	115	52.6	-	-	-	-	0.6	30	3543	1374	11.2	20	1.5	1.5	2.3	1.2	14.0	0.35	9.0
5	SP-SM	6	26.0	26.5	0.5	35.0	35.25	26.25	115	52.6	-	-	-	-	0.6	30	3600	1401	11.4	20	1.5	1.5	2.4	1.2	14.5	0.35	9.3
5	SP-SM	6	26.5	27.0	0.5	35.5	35.75	26.75	115	52.6	-	-	-	-	0.6	30	3658	1427	11.7	20	1.5	1.5	2.4	1.2	15.0	0.35	9.6
5	SP-SM	6	27.0	27.5	0.5	36.0	36.25	27.25	115	52.6	-	-	-	-	0.6	30	3715	1453	11.9	20	1.5	1.5	2.4	1.2	15.4	0.35	10.0
5	SP-SM	6	27.5	28.0	0.5	36.5	36.75	27.75	115	52.6	-	-	-	-	0.6	30	3773	1480	12.1	20	1.5	1.5	2.4	1.2	15.9	0.35	10.3
5	SP-SM	6	28.0	28.5	0.5	37.0	37.25	28.25	115	52.6	-	-	-	-	0.6	30	3830	1506	12.3	20	1.5	1.5	2.4	1.2	16.4	0.35	10.6
5	SP-SM	6	28.5	29.0	0.5	37.5	37.75	28.75	115	52.6	-	-	-	-	0.6	30	3888	1532	12.5	20	1.5	1.5	2.4	1.2	16.9	0.35	11.0
5	SP-SM	6	29.0	29.5	0.5	38.0	38.25	29.25	115	52.6	-	-	-	-	0.6	30	3945	1559	12.7	20	1.5	1.5	2.5	1.2	17.4	0.35	11.3
5	SP-SM	6	29.5	30.0	0.5	38.5	38.75	29.75	115	52.6	-	-	-	-	0.6	30	4003	1585	12.9	20	1.5	1.5	2.5	1.2	17.9	0.35	11.7
5	SP-SM	6	30.0	30.5	0.5	39.0	39.25	30.25	115	52.6	-	-	-	-	0.6	30	4060	1611	13.2	20	1.5	1.5	2.5	1.2	18.4	0.35	12.0
5	SP-SM	6	30.5	31.0	0.5	39.5	39.75	30.75	115	52.6	-	-	-	-	0.6	30	4118	1637	13.4	20	1.5	1.5	2.5	1.3	18.9	0.35	12.4
5	SP-SM	6	31.0	31.5	0.5	40.0	40.25	31.25	115	52.6	-	-	-	-	0.6	30	4175	1664	13.6	20	1.5	1.5	2.5	1.3	19.5	0.35	12.7
5	SP-SM	6	31.5	32.0	0.5	40.5	40.75	31.75	115	52.6	-	-	-	-	0.6	30	4233	1690	13.8	20	1.5	1.5	2.5	1.3	20.0	0.35	13.1
5	SP-SM	6	32.0	32.5	0.5	41.0	41.25	32.25	115	52.6	-	-	-	-	0.6	30	4290	1716	14.0	20	1.5	1.5	2.6	1.3	20.6	0.35	13.5
5	SP-SM	6	32.5	33.0	0.5	41.5	41.75	32.75	115	52.6	-	-	-	-	0.6	30	4348	1743	14.2	20	1.5	1.5	2.6	1.3	21.1	0.35	13.9
5	SP-SM	6	33.0	33.5	0.5	42.0	42.25	33.25	115	52.6	-	-	-	-	0.6	30	4405	1769	14.5	20	1.5	1.5	2.6	1.3	21.7	0.35	14.3
5	SP-SM	6	33.5	34.0	0.5	42.5	42.75	33.75	115	52.6	-	-	-	-	0.6	30	4463	1795	14.7	20	1.5	1.5	2.6	1.3	22.3	0.35	14.7
5	SP-SM	6	34.0	34.5	0.5	43.0	43.25	34.25	115	52.6	-	-	-	-	0.6	30	4520	1822	14.9	20	1.5	1.5	2.6	1.3	22.8	0.35	15.1
5	SP-SM	6	34.5	35.0	0.5	43.5	43.75	34.75	115	52.6	-	-	-	-	0.6	30	4578	1848	15.1	20	1.5	1.5	2.6	1.3	23.4	0.35	15.5
5	SP-SM	6	35.0	35.5	0.5	44.0	44.25	35.25	115	52.6	-	-	-	-	0.6	30	4635	1874	15.3	20	1.5	1.5	2.7	1.3	24.0	0.35	15.9
5	SP-SM	6	35.5	36.0	0.5	44.5	44.75	35.75	115	52.6	-	-	-	-	0.6	30	4693	1900	15.5	20	1.5	1.5	2.7	1.3	24.7	0.35	16.3
5	SP-SM	6	36.0	36.5	0.5	45.0	45.25	36.25	115	52.6	-	-	-	-	0.6	30	4750	1927	15.7	20	1.5	1.5	2.7	1.3	25.3	0.35	16.7
5	SP-SM	6	36.5	37.0	0.5	45.5	45.75	36.75	115	52.6	-	-	-	-	0.6	30	4808	1953	16.0	20	1.5	1.5	2.7	1.4	25.9	0.35	17.2
5	SP-SM	6	37.0	37.5	0.5	46.0	46.25	37.25	115	52.6	-	-	-	-	0.6	30	4865	1979	16.2	20	1.5	1.5	2.7	1.4	26.5	0.35	17.6
5	SP-SM	6	37.5	38.0	0.5	46.5	46.75	37.75	115	52.6	-	-	-	-	0.6	30	4923	2006	16.4	20	1.5	1.5	2.7	1.4	27.2	0.35	18.1
5	SP-SM	6	38.0	38.5	0.5	47.0	47.25	38.25	115	52.6	-	-	-	-	0.6	30	4980	2032	16.6	20	1.5	1.5	2.8	1.4	27.8	0.35	18.5
5	SP-SM	6	38.5	39.0	0.5	47.5	47.75	38.75	115	52.6	-	-	-	-	0.6	30	5038	2058	16.8	20	1.5	1.5	2.8	1.4	28.5	0.35	19.0
5	SP-SM	6	39.0	39.5	0.5	48.0	48.25	39.25	115	52.6	-	-	-	-	0.6	30	5095	2085	17.0	20	1.5	1.5	2.8	1.4	29.1	0.35	19.4
5	SP-SM	6	39.5	40.0	0.5	48.5	48.75	39.75	115	52.6	-	-	-	-	0.6	30	5153	2111	17.2	20	1.5	1.5	2.8	1.4	29.8	0.35	19.9

40 ft


Axial Capacity Analysis
Axial Capacity w/ F.S (kips)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Depth from ground surface (ft)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Qall = 18 kips
Allowable Friction Resistance
Total Allowable Capacity
Allowable Toe Resistance


Uplift Capacity Analysis
Uplift Capacity w/ F.S (kips)
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0
Depth from ground surface (ft)
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0
Rup = 11.5 kips
Factored Uplift Resistance

Wood

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