St. Johns River
Water Management District
Ann B. Shortelle, Ph.D., Executive Director

525 Community College Parkway S.E. • Palm Bay, FL 32909 • 321-984-4940
On the internet at www.sjrwmd.com.

DATE: February 1, 2019

TO: Prospective Respondents

FROM: Amy Lucey, Procurement Specialist

SUBJECT: Addendum #2 to IFB # 34093, C40 Plugs Enhancements

As a result of inquiries, the following clarifications/changes are provided for your information. Please make all appropriate changes to your bid documents.

Q1: Is there a looping route that can be used?

A1: No, due to gaps in the levee, a looping route is not possible. Please see attached map of turnaround locations and table of approximate distances.

Q2: What is the anticipated award date?

A2: It is anticipated that award will be made at the April 9th Governing Board meeting - not at the March meeting that was stated at the pre-bid meeting.

Q3: Is there a weight restriction for the dikes?

A3: There is no weight restriction for the levees themselves, however, due to the narrow dimensions of the levee top, off road dumps will not be allowed. The District has imposed a H20 loading over the S-96 structure.

Q4: What are the compaction requirements over the pipe?

A4: As referenced in Item 4 under Earthwork on Sheet C3, specifications for compaction are located in Section 125 of the FDOT Standard Specification.

Q5: What are the specific specifications for the 36" CAP?

A5: Culvert specification are found on Sheet S3, Culvert and Slide Gate Details.

Q6: Could we have a copy of the geotechnical report?

A6: Geotechnical reports for E-3, E-4 and E-6 dated 9/20/17 are attached.

Q7: Could we get a copy of all permits?

A7: The District did have to submit new permits applications for this project to FDEP and USACE and expect to have those permits in hand by the end of February.

Q8: Will a computerized critical path scheduling plan be required for this project?

A8: An electronic work schedule will be required that shows how the work will be prosecuted. The format or software used to produce the schedule is up to the individual contractor.

Q9: Are there any other specifications for the walk ways available, other than the sheets in the bid plans?

A9: All specifications for the walkways are included in the bid set on Sheet S3.

Q10: I understand in the pre-bid it was announced the project will start after the March Board meeting, which appears to be March 12th. The by the time the contract is signed by all it will likely be close to April if not in April. That gives us less than 90 days to finish the project if we have to be substantially complete by June 30th. The temporary steel sheet pile coffer dam engineering and submittal process through approval will take some time, likely a few weeks. With the most cost effective way to build the job and to try to come close to your engineers estimate would be to install the cofferdam at one location at a time. This obviously allows it to be reused on the other two locations. With the budget restrictions we don't think 90 days is enough time to complete the project. Is the June 30th completion date a fixed milestone?

A10: The deadline for items going to the March Governing Board is before the scheduled bid opening of February 20 for this contract. Subsequently, and contrary to what was said at the pre-bid meeting, this contract will be going to the April Governing Board for approval. The June 30, 2019 finish date was set as part of the funding agreement between SJRWMD and FFWCC but is not "set in "stone". The contract expiration date can be adjusted beyond the June 30 date accordingly.

Q11: Would the District consider extending the completion date a couple of months or increasing the budget to accommodate the additional cost of working on multiple structures at one time?

A11: The contract timeframe can be extended as late as September 30, if needed.

Q12: The end of the project will be happening during the start of the rainy season. I understand the site was not accessible at the time of the pre-bid, which occurred during the dry season. Granted we had near record rain several days before the pre-bid but it had been very dry for quite some time before that. It appears access to this site is a problem when it rains. Even if we can access the site high water may also impact our ability to complete the project on time. Will there be consideration for time extensions due to these issues?

A12: The contract timeframe can be extended as late as September 30 to accommodate rain delays, if needed.

Q13: Who will pay for contractor indirect impacts if the project is delayed due to weather?

A13: Weather delays is a risk factor all contractors must take into account when preparing bids. That said, the District does have processes in place to make accommodations for weather and other delays which are considered on a case by case basis.

NOTE: The Bid Due Date remains 2:00 p.m., Wednesday, February 20, 2019

Attachments:
Table of approximate distances and turnaround locations
Geotechnical Report E-3 Dated 9/20/17
Geotechnical Report E-4 dated 9/20/17
Geotechnical Report E-6 Dated 9/20/17
Pre-bid Meeting Recording – Separate Cover

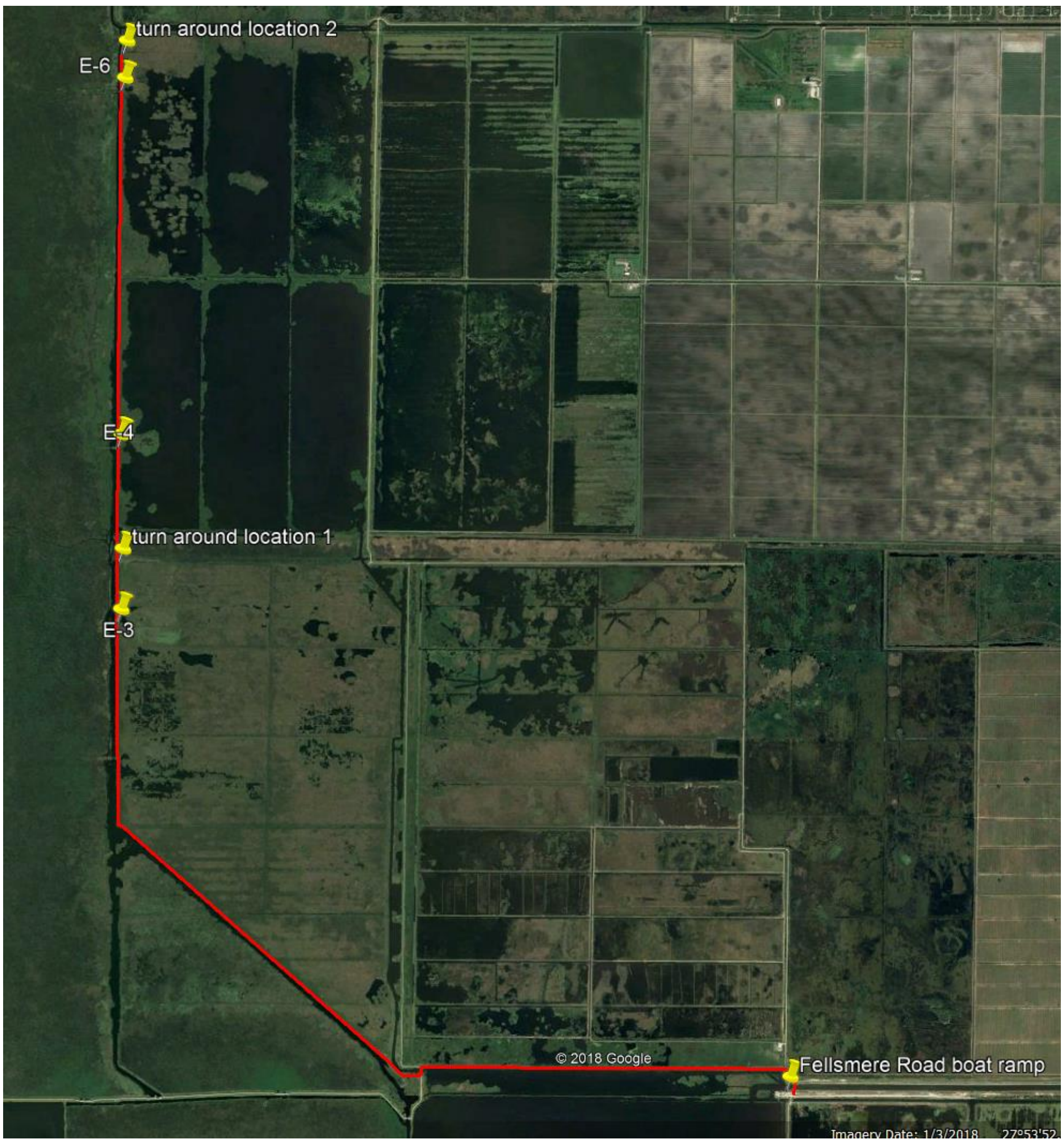
Please acknowledge receipt of this Addendum on the BID FORM provided in the bid package.

If you have any questions, please e-mail me at alucey@sjrwmd.com.

TABLE OF APPROXIMATE DISTANCES

(miles)

	E-3	turn around 1	E-4	E-6	turn around 2
Fellsmere boat ramp	5.8	6.1	6.8	8.8	9.0
E-3		0.3	1.0	3.0	3.2
turn around 1			0.7	2.7	2.9
E-4				2.0	2.2
E-6					0.2



Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-3 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

Ardaman & Associates, Inc.

OFFICES

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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

September 20, 2017
File No. 17-6401

St. Johns River Water Management District
4049 Reid Street
Palatka, Florida 32718-1429

Attention: Mr. Wayne Dempsey, P.E.

Subject: Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-3 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

Dear Mr. Dempsey:

As requested and authorized, we have completed a shallow subsurface soil exploration for the subject project. The purpose of performing this exploration was to explore general subsurface conditions at the location of the proposed canal plug restoration location designated E-3 adjacent to the Corps levee in the St. Johns Marsh Conservation Area (SJMCA). We understand that the data gathered will be used by SJRWMD in the design and construction process to install a culvert pipe at the canal plug location. This report documents our findings.

We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

Virginia A. Goff, E.I.
Assistant Project Engineer

Charles H. Cunningham, P.E.
Orlando Branch Manager
Florida License No. 38189

CHARLES H. CUNNINGHAM
LICENSE
No. 38189
STATE OF FLORIDA
PROFESSIONAL ENGINEER
9-20-17

VAG/CHC/nfm/jj
17-6401 E-3 Canal Plug.docx (Geo 2017)

8008 S. Orange Avenue (32809), Post Office Box 593003, Orlando, Florida 32859-3003 Phone (407) 855-3860 FAX (407) 859-8121

Florida: Bartow, Cocoa, Fort Myers, Miami, Orlando, Port St. Lucie, Sarasota, Tallahassee, Tampa, West Palm Beach
Louisiana: Alexandria, Baton Rouge, Monroe, New Orleans, Shreveport

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1.0 SITE LOCATION AND DESCRIPTION

The site for the proposed improvements is located in Brevard County, Florida (Township 30 South, Range 35 East). The general site location is shown superimposed on the Kenansville NE, Florida U.S.G.S. quadrangle map presented on Figure 1.

The site is currently developed with a partial canal plug adjacent to the Corps levee.

Land adjacent to the canal plug and levee is mainly wet marsh and/or canals.

2.0 PROPOSED CONSTRUCTION AND GRADING

It is our understanding that the proposed development includes the restoration of the existing canal plug and the installation of a culvert pipe. At the time of this report, the culvert size and invert elevation are not known.

3.0 REVIEW OF SOIL SURVEY MAPS

Based on the Web Soil Survey for Brevard County, Florida, as prepared by the U.S. Department of Agriculture Soil Conservation Service, the canal plug location is located in an area mapped as the "Everglades mucky peat, frequently flooded" soil series. The “Everglades mucky peat, frequently flooded" soil series consists of nearly level, mucky peat underlain by sand and sandy clay loam found on flood plains and marshes on marine terraces. The internal drainage of the "Everglades mucky peat, frequently flooded" is very poor and the soil permeability is rapid to very rapid. According to the Soil Survey, the seasonal high water table for the "Everglades mucky peat, frequently flooded" soil series is typically at or above the natural ground surface.

4.0 FIELD EXPLORATION PROGRAM

4.1 SPT Boring

The field exploration program included performing one Standard Penetration Test (SPT) boring. The SPT boring was advanced to a depth of 30 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I. Split-spoon soil samples recovered during performance of the boring were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level at the boring location was measured during drilling. The boring was grouted with cement-bentonite slurry upon completion.

4.2 Test Location

The approximate location of the boring is schematically illustrated on the Boring Location Plan on Figure 2. The boring location was staked in the field by representatives of Ardaman & Associates and subsequently surveyed by SJRWMD.

Coordinates and the existing ground surface elevation for the boring were provided to us by SJRWMD. These coordinates and elevation are referenced on the boring profile presented on Figure 3.

5.0 LABORATORY TESTING PROGRAM

5.1 Visual Examination and Classification Testing

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profile presented on Figure 3.

In addition, we conducted one organic content test (ASTM D2974-87), one natural moisture content test (ASTM D2216), two percent fines analyses (ASTM D1140), and one Atterberg limits test (ASTM D4318) on selected soil samples obtained from the borings. The results of these tests are presented adjacent to the sample depth on the boring profiles on Figure 3.

5.2 Corrosion Property Testing

One composite soil sample was tested for corrosion properties. Properties tested included pH, resistivity, chloride and sulfate content. Results of the soil corrosivity test are presented in the following table.

Boring No.	Composite Sample Elevation (feet NAVD88)	Chloride Content (mg/L)	Sulfate Content (mg/L)	pH	Resistivity (ohm-cm)
E-3	+16.7 to +6.7	105	348	6.7	1,116

The results of these tests were used to evaluate the environmental classification of the structure classification in accordance with the Florida Department of Transportation (FDOT) Criteria for Substructure Environmental Classifications in Structure Design Guidelines Section 1.3.1. According to the criteria, the results of the tests indicate that the soils tested are Moderately Aggressive to steel construction materials and Moderately Aggressive to concrete construction materials.

6.0 GENERAL SUBSURFACE CONDITIONS

6.1 General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profile presented on Figure 3. The stratification of the boring profile represents our interpretation of the field boring log and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of the boring indicate the following general soil profile:

Elevation (Feet, NAVD88)		**General Description**
From	**To**	
+21.7	+19.7	Organic topsoil underlain by soft clay (CL/CH)
+19.7	+18.2	Medium stiff organic muck and/or peat (OH, Pt)
+18.2	+16.7	Medium stiff sandy clay to clay (CL/CH)
+16.7	+9.2	Very soft to medium stiff organic muck and/or peat (OH, Pt)
+9.2	-5.8	Very soft to soft sandy clay to clay (CL/CH)
-5.8	-8.3	Medium dense clayey fine sand (SC)

We note that the organic content and moisture content of the organic soils (OH, Pt) encountered in the Elevation +16.5 to +9 feet depth range were significantly greater than the organic content and moisture content of the organic soil (OH, Pt) encountered in the Elevation +19.7 feet to +18 feet depth range.

6.2 Groundwater Level

The groundwater level was measured in the borehole during drilling. As shown on Figure 3, groundwater was encountered at a depth of 3½ feet below the existing ground surface on the date indicated. Fluctuation in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted.

7.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

7.1 General

The results of our exploration indicate that, with proper site preparation as recommended in this report, the existing soils, with the exception of the deleterious organic muck/peat as encountered in the boring, are suitable for supporting the proposed canal plug culvert pipe.

Deleterious organic muck/peat (Stratum 8 on Figure 3) was encountered between approximate Elevation +19.7 feet and Elevation +9.7 feet. Organic muck/peat may be present at different depths and thicknesses at unexplored locations. Because of the potential for large total and differential settlements, deleterious organic muck/peat should not be used as a foundation soil and should be completely removed (i.e.; "demucked") in accordance with the recommendations presented in this report.

In addition, clayey sand and sandy clay were encountered in the boring. These clayey soils will be very difficult to moisture condition and compact. Because of potential for seepage and plug instability, any soils proposed by the contractor to replace in-situ soils that are difficult to compact must be pre-approved by the design engineer.

The following are our recommendations for overall site preparation which we feel are best suited for the proposed construction and existing soil conditions. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project's specifications.

7.2 Excavation

Based on the conditions encountered during the field exploration, we anticipate that the majority of the soils as encountered in the boring can be excavated with standard earth moving equipment (i.e.; front-end loaders and backhoes).

The soils below the bottom of the excavation should not be disturbed by the excavation process. If soils become disturbed and difficult to compact, they should be overexcavated to a depth necessary to remove all disturbed soils. Overexcavated areas should be replaced with compacted backfill meeting the "Backfill Requirements" presented in the following report section.

Excavation should be safely braced to prevent injury to personnel or damage to equipment. Temporary safe slopes should be cut in accordance with OSHA, 29 CFR Part 1926 Final Rule, Excavation Requirements or successor regulations. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations. Spoil banks adjacent to excavations should be sloped no steeper than 2.0H(horizontal):1.0V(vertical). Provisions for maintaining worker's safety within excavations is the sole responsibility of the Contractor.

7.3 Demucking

The deleterious organic muck/peat (Stratum 8 as shown on the boring profile) should be removed (demucked) to its entire vertical limits and to a minimum horizontal margin equivalent to the depth of muck/peat underneath the culvert pipe. A minimum horizontal margin of 5 feet should be used if the depth to the bottom of the muck/peat is less than 5 feet.

The excavated organic muck/peat must not be used as fill material and should be disposed of as directed by the owner. Demucking and backfilling operations should be monitored continuously by a representative of Ardaman & Associates to verify that all unsuitable material is removed and that backfill soils are suitable and well compacted.

Excavation slopes and/or bracing are the responsibility of the contractor. However, at a minimum, all excavations should be sloped and/or braced to meet the requirements of the Occupational Health and Safety Administration (OSHA) latest Standards.

The control of the groundwater and surface water will be required. De-mucking should be conducted “in-the-dry”. The use of well points, rim ditches, sheet piles, etc. may be required to help control groundwater during excavation and backfilling. Regardless of the dewatering method used, we recommend that the groundwater table be maintained at least 24 inches below earthwork and compaction surfaces.

Actual limits of muck/peat removal will be determined based on visual observation during construction. The final quantity of muck/peat removal should be determined after demucking has been completed using methods such as truck volume and/or survey conducted during removal of the muck/peat.

7.4 Backfill Requirements for Excavated Deleterious Organic Soil

For backfill required as needed to replace any organic muck/peat and/or excavated disturbed soils, we recommend using clayey fine sand (SC) having a fines content between 15 and 35 percent passing the U.S. Standard No. 200 sieve. Backfill should be placed in lifts not exceeding 8 inches in thickness. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Depending on the characteristics of the backfill soil, kneading type compaction equipment may be required.

The backfill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths that could cause stability problems.

7.5 Fill Compaction Requirements for the Culvert Pipe

The soil types allowed for use as fill for the water control plug will need to be specified by the design engineer. We recommend considering using soils with some cohesion such as the soils recommended for the backfill in Section 7.4 because soils with cohesion are more resistant to erosion than cohesionless soil such as fine sand (SP) and fine sand with silt (SP-SM).

The fill below, alongside and above the pipe should be placed in level lifts not exceeding 8 inches. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Care should be taken not to damage the pipe or defect it by compacting directly above the pipe where there is insufficient cover material present.

The fill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths through the plug that could cause stability problems.

We recommend constructing the plug in the vicinity of the culvert to a height where the plug will not be overtopped by water. If water can flow around the plug a sufficient distance from the culvert rather than over the plug near the culvert location, the culvert pipe will be less likely to fail as a result of plug erosion in the event of high water/flow in the marsh.

7.6 Seep Shields and Concrete Cradle for the Culvert Pipe

We recommend installing seep shields sized and spaced in accordance with good engineering practices pertinent to the material used for the fill around the culvert pipe. The seep shields should be continuously welded to the pipe.

Because it is difficult to achieve adequate compaction below the haunches of culvert pipes, it is recommended that a high slump concrete (or “flowable fill” of similar strength) cradle be constructed below the pipe. It will be necessary to anchor the pipe while the high slump concrete is being placed to prevent the pipe from floating on the concrete.

7.7 Dewatering

The control of the groundwater and surface water will be required to achieve the necessary depths of excavation, demucking, and subsequent construction and backfilling and compaction requirements presented in the following sections. The actual method(s) of dewatering should be determined by the Contractor, however, regardless of the method(s) used, we suggest drawing down the water table sufficiently; say 2 to 3 feet, below the bottom of the excavation(s) to preclude "pumping" and/or compaction-related problems with the foundation soils.

The contractor should also be aware that cuts may expose or get close to confined aquifers where relatively permeable sandy soils underlie less permeable zones of clayey soils. These relatively permeable zones may require dewatering efforts to include relatively deep full aquifer penetrating wells, airlift of water from wells, trench drains, seepage barriers, etc. Typical vacuum-type well points may not be appropriate for dewatering on this project.

8.0 QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation, excavation, demucking, backfilling and compaction of fill soils is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

As a minimum, an on-site engineering technician should monitor all demucking to verify that all deleterious materials have been removed. In-situ density tests should be conducted during filling activities to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the structural components.

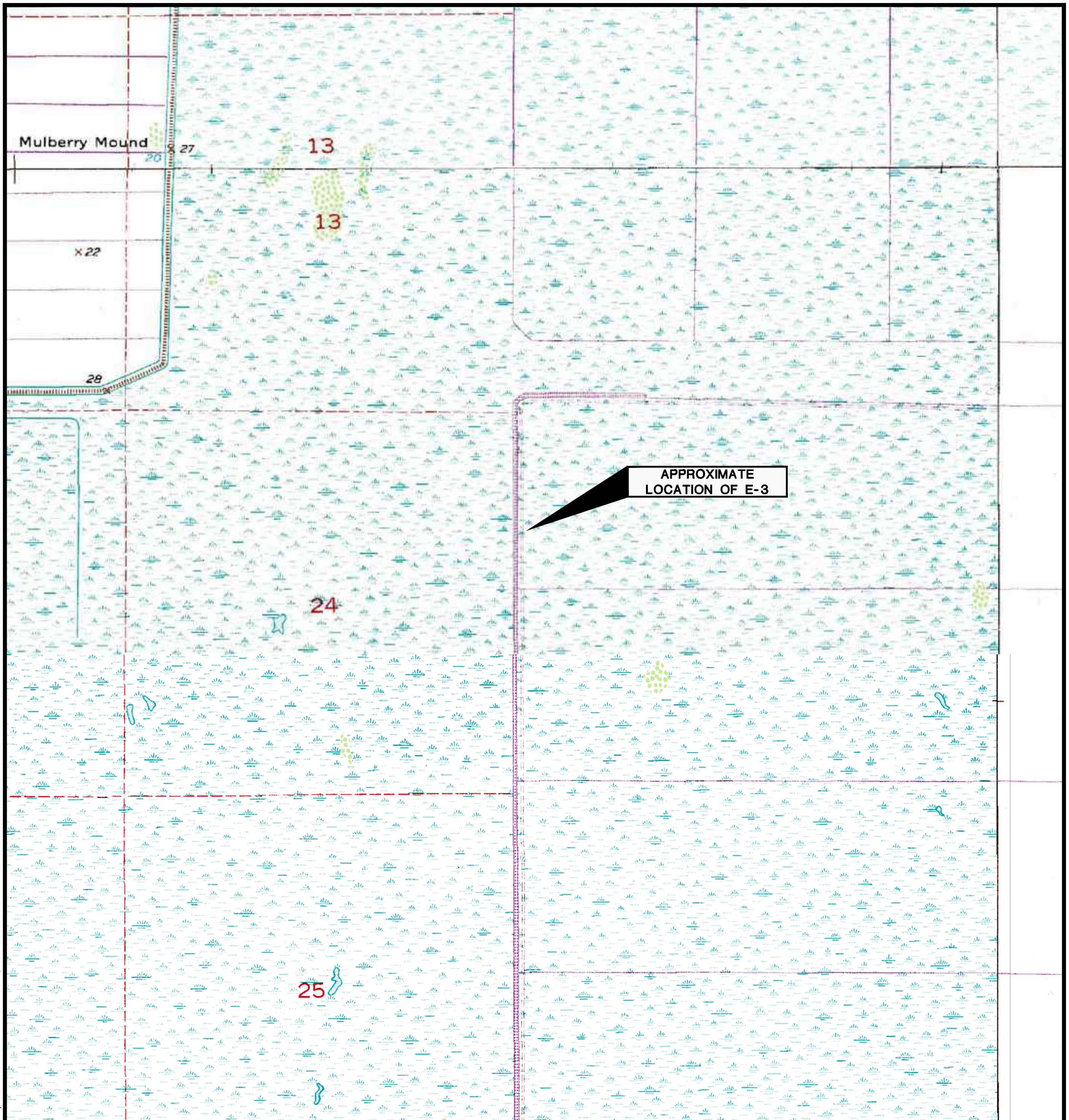
9.0 CLOSURE

The analyses and recommendations submitted herein are based on the data obtained from the soil boring presented on Figure 3. This report does not reflect any variations which may occur adjacent to the boring. The nature and extent of the variations adjacent to the boring may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

In the event any changes occur in the design, nature, or location of the proposed facility, we should review the applicability of conclusions and recommendations in this report. We recommend a general review of final design and specifications by our office to verify that earthwork and foundation recommendations are properly interpreted and implemented in the design specifications. Ardaman and Associates should attend the pre-bid and preconstruction meetings to verify that the bidders/contractor understand the recommendations contained in this report.

This study is based on a relatively shallow exploration and is not intended to be an evaluation for sinkhole potential. This study does not include an evaluation of the environmental (ecological or hazardous/toxic material related) condition of the site and subsurface.

This report has been prepared for the exclusive use of St. Johns River Water Management District in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.



TOWNSHIP 30 SOUTH
RANGE 35 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: KENANSVILLE NE, FLORIDA 1953
(PHOTOREVISED 1972)
AND KENANSVILLE SE, FLORIDA 1953
(PHOTOREVISED 1972)

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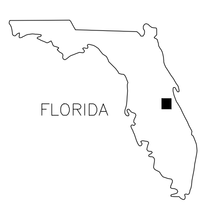

QUADRANGLE LOCATION

SITE LOCATION MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE: 08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE: 1

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LEGEND

STANDARD PENETRATION TEST (SPT) BORING LOCATION

NOTE: THE AERIAL PHOTOGRAPH FOR THE BORING LOCATION PLAN WAS OBTAINED FROM BING MAPS, DATED 03/20/17.

N

0 25 50

SCALE: (FEET)

BORING LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE: 08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE: 2

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LEGEND

SOIL DESCRIPTIONS

1. FINE SAND (SP)
2. FINE SAND WITH SILT (SP-SM)
3. FINE SAND WITH CLAY (SP-SC)
4. SILTY CLAYEY FINE SAND (SM/SC)
5. CLAYEY FINE SAND (SC)
6. SANDY CLAY TO CLAY (CL/CH)
7. ORGANIC TOPSOIL
8. ORGANIC MUCK/PEAT (OH, Pt)

COLORS

A. GRAYISH BROWN
B. LIGHT BROWN TO BROWN
C. GRAY TO GREENISH GRAY
D. DARK GRAY OR DARK BROWN
E. VERY DARK GRAY OR VERY DARK BROWN
F. LIGHT GRAY TO GRAY

TH	STANDARD PENETRATION TEST (SPT) BORING
GSE	APPROXIMATE GROUND SURFACE ELEVATION- FEET (NAVD88)
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
▼	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
NM	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D-2216)
-200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D-1140)
OC	ORGANIC CONTENT IN PERCENT (ASTM D-2974)
LL	LIQUID LIMIT (ASTM D-4318)
PI	PLASTICITY INDEX (ASTM D-4318)
SP,SP-SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

NOTES:

1) SPT BORING E-3 WAS PERFORMED USING AN AUTOMATIC HAMMER TO THE BORING TERMINATION DEPTH. AUTOMATIC HAMMER N-VALUES MAY BE CONVERTED TO EQUIVALENT SAFETY HAMMER N-VALUES BY MULTIPLYING BY 1.24.

2) UPON COMPLETION OF THE SPT BORING, THE BOREHOLE WAS GROUTED WITH CEMENT-BENTONITE SLURRY.

3) BORING NORTHING, EASTING, AND ELEVATION WERE PROVIDED BY SJRWMD.

SHELL CONTENT

TRACE: <5%
FEW: 5 TO 10%
LITTLE: 15 TO 25%
SOME: 30 TO 45%
MOSTLY: 50 TO 100%

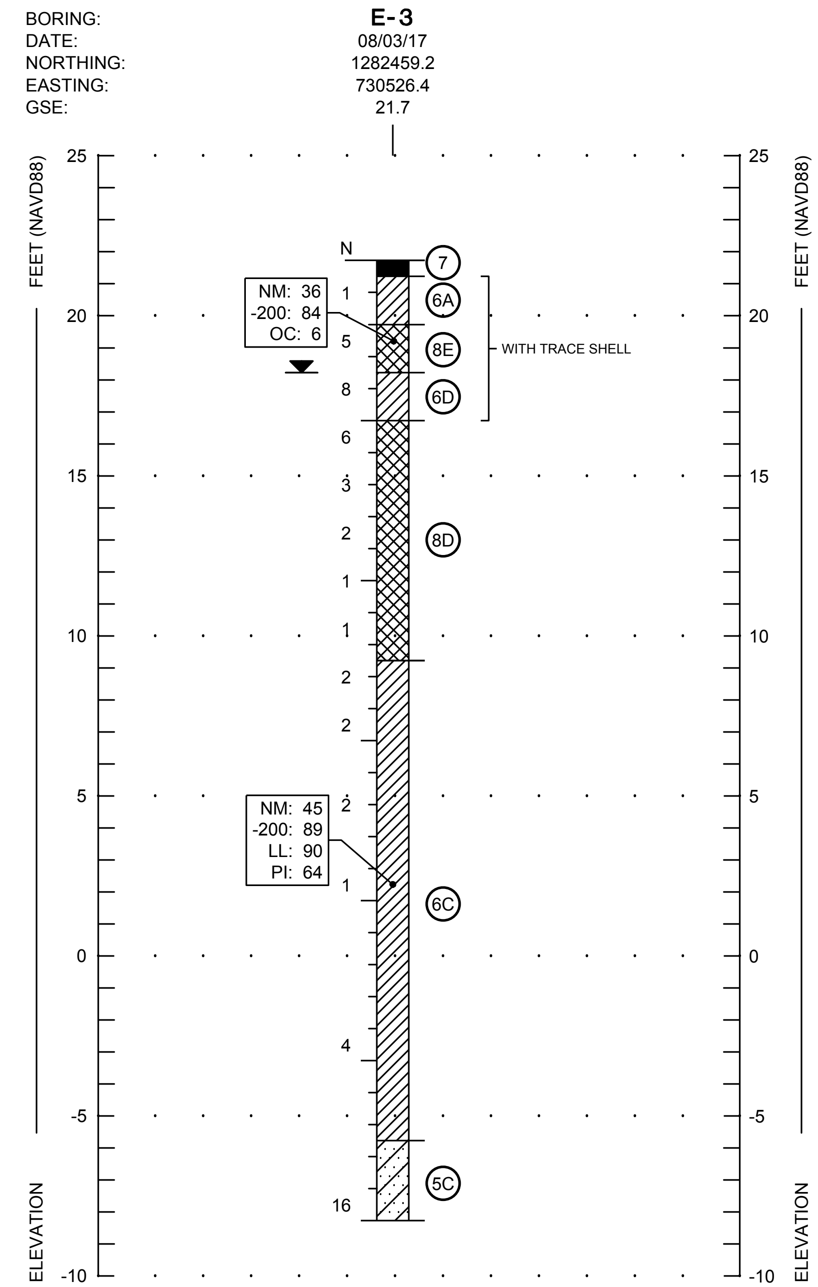
ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	<4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	<2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30



WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR.

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE: 08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE: 3

APPENDIX I

Standard Penetration Test (SPT) Boring Procedure

<u>STANDARD PENETRATION TEST</u>

The standard penetration test is a widely accepted test method of *in situ* testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, NX-size flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid.

Representative split-spoon samples from the soils are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for 30 days prior to being discarded.

Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-4 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

Ardaman & Associates, Inc.

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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

September 20, 2017
File No. 17-6401

St. Johns River Water Management District
4049 Reid Street
Palatka, Florida 32718-1429

Attention: Mr. Wayne Dempsey, P.E.

Subject: Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-4 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

Dear Mr. Dempsey:

As requested and authorized, we have completed a shallow subsurface soil exploration for the subject project. The purpose of performing this exploration was to explore general subsurface conditions at the location of the proposed canal plug restoration location designated E-4 adjacent to the Corps levee in the St. Johns Marsh Conservation Area (SJMCA). We understand that the data gathered will be used by SJRWMD in the design and construction process to install a culvert pipe at the canal plug location. This report documents our findings.

We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

Virginia A. Goff, E.I.
Assistant Project Engineer

Charles H. Cunningham, P.E.
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STATE OF
FLORIDA
PROFESSIONAL ENGINEER
9-27-17

VAG/CHC/nfm/jj
17-6401 E-4 Canal Plug.docx (Geo 2017)

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Appendices

1.0 SITE LOCATION AND DESCRIPTION

The site for the proposed improvements is located in Brevard County, Florida (Township 30 South, Range 35 East). The general site location is shown superimposed on the Kenansville NE, Florida U.S.G.S. quadrangle map presented on Figure 1.

The site is currently developed with a partial canal plug adjacent to the Corps levee.

Land adjacent to the canal plug and levee is mainly wet marsh and/or canals.

2.0 PROPOSED CONSTRUCTION AND GRADING

It is our understanding that the proposed development includes the restoration of the existing canal plug and the installation of a culvert pipe. At the time of this report, the culvert size and invert elevation are not known.

3.0 REVIEW OF SOIL SURVEY MAPS

Based on the Web Soil Survey for Brevard County, Florida, as prepared by the U.S. Department of Agriculture Soil Conservation Service, the canal plug location is located in an area mapped as the "Everglades mucky peat, frequently flooded" soil series. The “Everglades mucky peat, frequently flooded" soil series consists of nearly level, mucky peat underlain by sand and sandy clay loam found on flood plains and marshes on marine terraces. The internal drainage of the "Everglades mucky peat, frequently flooded" is very poor and the soil permeability is rapid to very rapid. According to the Soil Survey, the seasonal high water table for the "Everglades mucky peat, frequently flooded" soil series is typically at or above the natural ground surface.

4.0 FIELD EXPLORATION PROGRAM

4.1 SPT Boring

The field exploration program included performing one Standard Penetration Test (SPT) boring. The SPT boring was advanced to a depth of 30 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I. Split-spoon soil samples recovered during performance of the boring were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level at the boring location was measured during drilling. The boring was grouted with cement-bentonite slurry upon completion.

4.2 Test Location

The approximate location of the boring is schematically illustrated on the Boring Location Plan on Figure 2. The boring location was staked in the field by representatives of Ardaman & Associates and subsequently surveyed by SJRWMD.

Coordinates and the existing ground surface elevation for the boring were provided to us by SJRWMD. These coordinates and elevation are referenced on the boring profile presented on Figure 3.

5.0 LABORATORY TESTING PROGRAM

5.1 Visual Examination and Classification Testing

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profile presented on Figure 3.

In addition, we conducted one organic content test (ASTM D2974-87), two natural moisture content tests (ASTM D2216), two percent fines analyses (ASTM D1140), and one Atterberg limits test (ASTM D4318) on selected soil samples obtained from the boring. The results of these tests are presented adjacent to the sample depth on the boring profiles on Figure 3.

5.2 Corrosion Property Testing

One soil sample was tested for corrosion properties. Properties tested included pH, resistivity, chloride and sulfate content. Results of the soil corrosivity test are presented in the following table.

Boring No.	Sample Elevation (feet NAVD88)	Chloride Content (mg/L)	Sulfate Content (mg/L)	pH	Resistivity (ohm-cm)
E-4	+10.3	30	97	7.8	2,320

The results of these tests were used to evaluate the environmental classification of the structure classification in accordance with the Florida Department of Transportation (FDOT) Criteria for Substructure Environmental Classifications in Structure Design Guidelines Section 1.3.1. According to the criteria, the results of the tests indicate that the soils tested are Moderately Aggressive to steel construction materials and Moderately Aggressive to concrete construction materials.

6.0 GENERAL SUBSURFACE CONDITIONS

6.1 General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profile presented on Figure 3. The stratification of the boring profile represents our interpretation of the field boring log and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of the boring indicate the following general soil profile:

Elevation (Feet, NAVD88)		General Description
From	To	
+23.8	+21.8	Organic topsoil underlain by very loose clayey fine sand (SC)
+21.8	+17.3	Soft to medium stiff clay (CL/CH)
+17.3	+14.8	Very loose to loose fine sand with silt (SP-SM) or clayey fine sand (SC)
+14.8	+11.3	Very soft organic muck/peat (OH, Pt)
+11.3	+7.8	Very loose clayey fine sand (SC)
+7.8	+1.3	Soft clay (CL/CH)
+1.3	-6.2	Loose to medium dense fine sand with silt (SP-SM) or clayey fine sand (SC)

6.2 Groundwater Level

The groundwater level was measured in the borehole during drilling. As shown on Figure 3, groundwater was encountered at a depth of 8½ feet below the existing ground surface on the date indicated. Fluctuation in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the boring was conducted.

7.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

7.1 General

The results of our exploration indicate that, with proper site preparation as recommended in this report, the existing soils, with the exception of the deleterious organic muck/peat as encountered in the boring, are suitable for supporting the proposed canal plug culvert pipe.

Deleterious organic muck/peat (Stratum 8 on Figure 3) was encountered between approximate Elevation +14.8 feet and Elevation +6.3 feet. Organic muck/peat may be present at different depths and thicknesses at unexplored locations. Because of the potential for large total and differential settlements, deleterious organic muck/peat should not be used as a foundation soil and should be completely removed (i.e.; “demucked”) in accordance with the recommendations presented in this report.

In addition, clayey sand and sandy clay were encountered in the boring. These clayey soils will be very difficult to moisture condition and compact. Because of potential for seepage and plug instability, any soils proposed by the contractor to replace in-situ soils that are difficult to compact must be pre-approved by the design engineer.

The following are our recommendations for overall site preparation which we feel are best suited for the proposed construction and existing soil conditions. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project’s specifications.

7.2 Excavation

Based on the conditions encountered during the field exploration, we anticipate that the majority of the soils as encountered in the boring can be excavated with standard earth moving equipment (i.e.; front-end loaders and backhoes).

The soils below the bottom of the excavation should not be disturbed by the excavation process. If soils become disturbed and difficult to compact, they should be overexcavated to a depth necessary to remove all disturbed soils. Overexcavated areas should be replaced with compacted backfill meeting the “Backfill Requirements” presented in the following report section.

Excavation should be safely braced to prevent injury to personnel or damage to equipment. Temporary safe slopes should be cut in accordance with OSHA, 29 CFR Part 1926 Final Rule, Excavation Requirements or successor regulations. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations. Spoil banks adjacent to excavations should be sloped no steeper than 2.0H(horizontal):1.0V(vertical). Provisions for maintaining worker’s safety within excavations is the sole responsibility of the Contractor.

7.3 Demucking

The deleterious organic muck/peat (Stratum 8 as shown on the boring profile) should be removed (demucked) to its entire vertical limits and to a minimum horizontal margin equivalent to the depth of muck/peat underneath the culvert pipe. A minimum horizontal margin of 5 feet should be used if the depth to the bottom of the muck/peat is less than 5 feet.

The excavated organic muck/peat must not be used as fill material and should be disposed of as directed by the owner. Demucking and backfilling operations should be monitored continuously by a representative of Ardaman & Associates to verify that all unsuitable material is removed and that backfill soils are suitable and well compacted.

Excavation slopes and/or bracing are the responsibility of the contractor. However, at a minimum, all excavations should be sloped and/or braced to meet the requirements of the Occupational Health and Safety Administration (OSHA) latest Standards.

The control of the groundwater and surface water will be required. De-mucking should be conducted "in-the-dry". The use of well points, rim ditches, sheet piles, etc. may be required to help control groundwater during excavation and backfilling. Regardless of the dewatering method used, we recommend that the groundwater table be maintained at least 24 inches below earthwork and compaction surfaces.

Actual limits of muck/peat removal will be determined based on visual observation during construction. The final quantity of muck/peat removal should be determined after demucking has been completed using methods such as truck volume and/or survey conducted during removal of the muck/peat.

7.4 Backfill Requirements for Excavated Deleterious Organic Soil

For backfill required as needed to replace any organic muck/peat and/or excavated disturbed soils, we recommend using clayey fine sand (SC) having a fines content between 15 and 35 percent passing the U.S. Standard No. 200 sieve. Backfill should be placed in lifts not exceeding 8 inches in thickness. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Depending on the characteristics of the backfill soil, kneading type compaction equipment may be required.

The backfill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths that could cause stability problems.

7.5 Fill Compaction Requirements for the Culvert Pipe

The soil types allowed for use as fill for the water control plug will need to be specified by the design engineer. We recommend considering using soils with some cohesion such as the soils recommended for the backfill in Section 7.4 because soils with cohesion are more resistant to erosion than cohesionless soil such as fine sand (SP) and fine sand with silt (SP-SM).

The fill below, alongside and above the pipe should be placed in level lifts not exceeding 8 inches. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Care should be taken not to damage the pipe or defect it by compacting directly above the pipe where there is insufficient cover material present.

The fill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths through the plug that could cause stability problems.

We recommend constructing the plug in the vicinity of the culvert to a height where the plug will not be overtopped by water. If water can flow around the plug a sufficient distance from the culvert rather than over the plug near the culvert location, the culvert pipe will be less likely to fail as a result of plug erosion in the event of high water/flow in the marsh.

7.6 Seep Shields and Concrete Cradle for the Culvert Pipe

We recommend installing seep shields sized and spaced in accordance with good engineering practices pertinent to the material used for the fill around the culvert pipe. The seep shields should be continuously welded to the pipe.

Because it is difficult to achieve adequate compaction below the haunches of culvert pipes, it is recommended that a high slump concrete (or “flowable fill” of similar strength) cradle be constructed below the pipe. It will be necessary to anchor the pipe while the high slump concrete is being placed to prevent the pipe from floating on the concrete.

7.7 Dewatering

The control of the groundwater and surface water will be required to achieve the necessary depths of excavation, demucking, and subsequent construction and backfilling and compaction requirements presented in the following sections. The actual method(s) of dewatering should be determined by the Contractor, however, regardless of the method(s) used, we suggest drawing down the water table sufficiently; say 2 to 3 feet, below the bottom of the excavation(s) to preclude "pumping" and/or compaction-related problems with the foundation soils.

The contractor should also be aware that cuts may expose or get close to confined aquifers where relatively permeable sandy soils underlie less permeable zones of clayey soils. These relatively permeable zones may require dewatering efforts to include relatively deep full aquifer penetrating wells, airlift of water from wells, trench drains, seepage barriers, etc. Typical vacuum-type well points may not be appropriate for dewatering on this project.

8.0 QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation, excavation, demucking, backfilling and compaction of fill soils is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

As a minimum, an on-site engineering technician should monitor all demucking to verify that all deleterious materials have been removed. In-situ density tests should be conducted during filling activities to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the structural components.

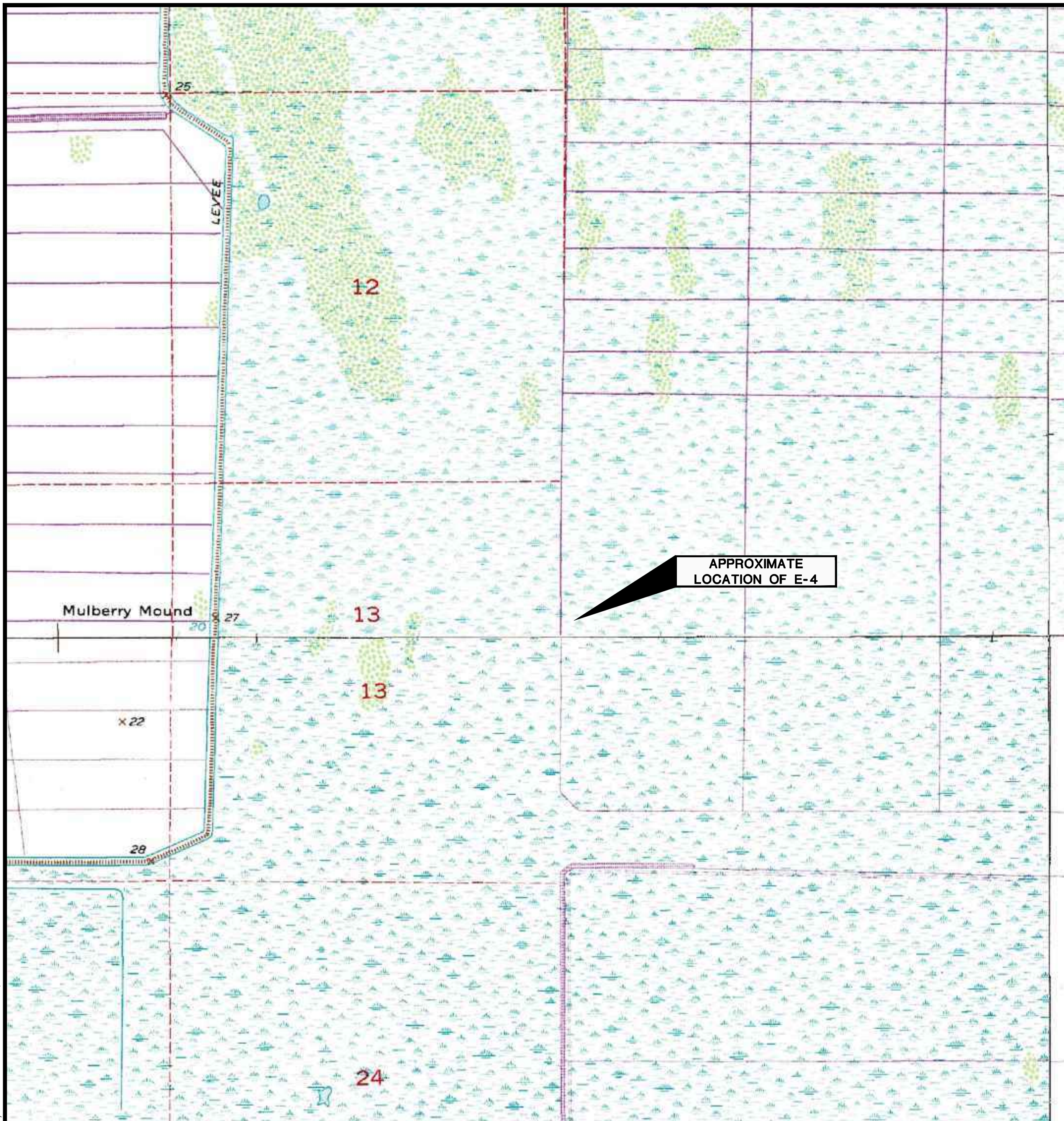
9.0 CLOSURE

The analyses and recommendations submitted herein are based on the data obtained from the soil boring presented on Figure 3. This report does not reflect any variations which may occur adjacent to the boring. The nature and extent of the variations adjacent to the boring may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

In the event any changes occur in the design, nature, or location of the proposed facility, we should review the applicability of conclusions and recommendations in this report. We recommend a general review of final design and specifications by our office to verify that earthwork and foundation recommendations are properly interpreted and implemented in the design specifications. Ardaman and Associates should attend the pre-bid and preconstruction meetings to verify that the bidders/contractor understand the recommendations contained in this report.

This study is based on a relatively shallow exploration and is not intended to be an evaluation for sinkhole potential. This study does not include an evaluation of the environmental (ecological or hazardous/toxic material related) condition of the site and subsurface.

This report has been prepared for the exclusive use of St. Johns River Water Management District in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.



TOWNSHIPS 30 SOUTH
RANGE 35 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: KENANSVILLE NE, FLORIDA 1953
(PHOTOREVISED 1972)
AND KENANSVILLE SE, FLORIDA 1953
(PHOTOREVISED 1972)

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SCALE: (FEET)

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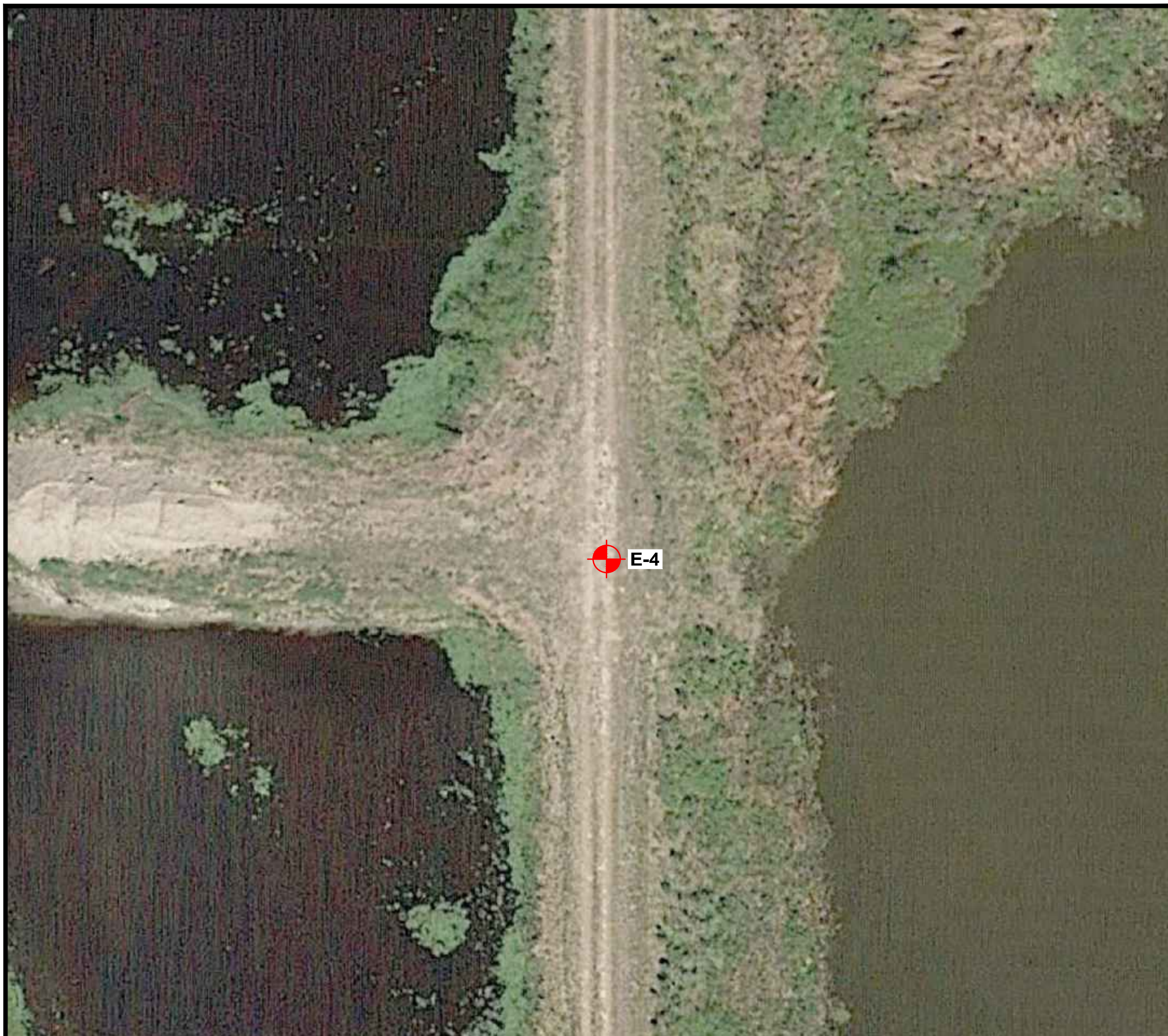
SITE LOCATION MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE: 08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE: 1



LEGEND

STANDARD PENETRATION TEST (SPT) BORING LOCATION

NOTE: THE AERIAL PHOTOGRAPH FOR THE BORING LOCATION PLAN WAS OBTAINED FROM BING MAPS, DATED 03/20/17.

N

0 25 50

SCALE: (FEET)

BORING LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

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LEGEND

SOIL DESCRIPTIONS

1. FINE SAND (SP)
2. FINE SAND WITH SILT (SP-SM)
3. FINE SAND WITH CLAY (SP-SC)
4. SILTY CLAYEY FINE SAND (SM/SC)
5. CLAYEY FINE SAND (SC)
6. SANDY CLAY TO CLAY (CL/CH)
7. ORGANIC TOPSOIL
8. ORGANIC MUCK/PEAT (OH, Pt)

COLORS

A. GRAYISH BROWN
B. LIGHT BROWN TO BROWN
C. GRAY TO GREENISH GRAY
D. DARK GRAY OR DARK BROWN
E. VERY DARK GRAY OR VERY DARK BROWN
F. LIGHT GRAY TO GRAY

TH	STANDARD PENETRATION TEST (SPT) BORING
GSE	APPROXIMATE GROUND SURFACE ELEVATION- FEET (NAVD88)
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
▼	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
NM	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D-2216)
-200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D-1140)
OC	ORGANIC CONTENT IN PERCENT (ASTM D-2974)
LL	LIQUID LIMIT (ASTM D-4318)
PI	PLASTICITY INDEX (ASTM D-4318)
SP,SP-SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

NOTES:

1) SPT BORING E-4 WAS PERFORMED USING AN AUTOMATIC HAMMER TO THE BORING TERMINATION DEPTH. AUTOMATIC HAMMER N-VALUES MAY BE CONVERTED TO EQUIVALENT SAFETY HAMMER N-VALUES BY MULTIPLYING BY 1.24.

2) UPON COMPLETION OF THE SPT BORING, THE BOREHOLE WAS GROUTED WITH CEMENT-BENTONITE SLURRY.

3) BORING NORTHING, EASTING, AND ELEVATION WERE PROVIDED BY SJRWMD.

SHELL CONTENT

TRACE: <5%
FEW: 5 TO 10%
LITTLE: 15 TO 25%
SOME: 30 TO 45%
MOSTLY: 50 TO 100%

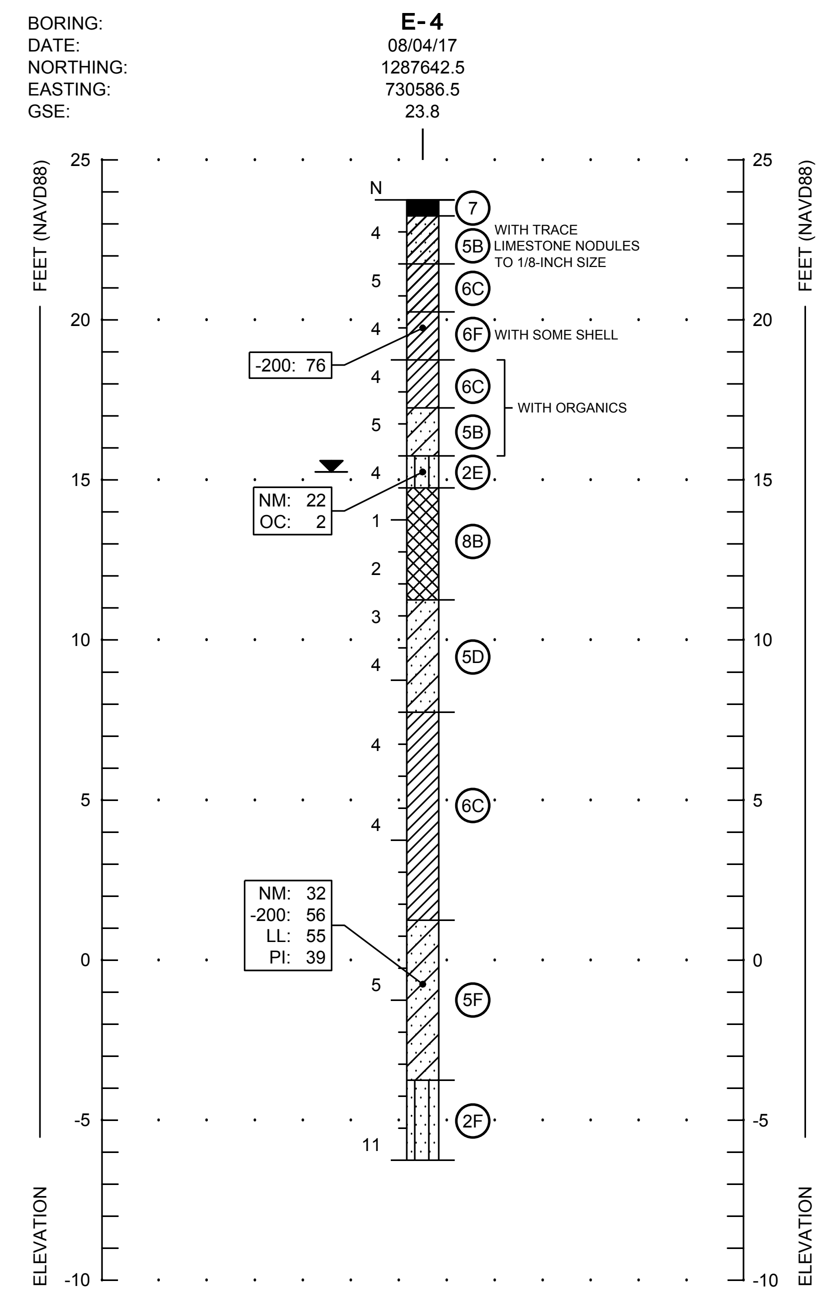
ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	<4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	<2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30



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Representative split-spoon samples from the soils are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for 30 days prior to being discarded.

Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-6 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

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Tallahassee – 3175 West Tharpe Street, Tallahassee, Florida 32303 – Phone (850) 576-6131
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West Palm Beach – 2200 North Florida Mango Road, Suite 101, West Palm Beach, Florida 33409 – Phone (561) 687-8200

Ardaman & Associates, Inc.

Geotechnical, Environmental and Materials Consultants

September 20, 2017
File No. 17-6401

St. Johns River Water Management District
4049 Reid Street
Palatka, Florida 32718-1429

Attention: Mr. Wayne Dempsey, P.E.

Subject: Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
E-6 Canal Plug
St. Johns Marsh Conservation Area
Drainage Improvements
Brevard County, Florida

Dear Mr. Dempsey:

As requested and authorized, we have completed a shallow subsurface soil exploration for the subject project. The purpose of performing this exploration was to explore general subsurface conditions at the location of the proposed canal plug restoration location designated E-6 adjacent to the Corps levee in the St. Johns Marsh Conservation Area (SJMCA). We understand that the data gathered will be used by SJRWMD in the design and construction process to install a culvert pipe at the canal plug location. This report documents our findings.

We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

Virginia A. Goff, E.I.
Assistant Project Engineer

CHARLES H. CUNNINGHAM LICENSE No. 38189 STATE OF FLORIDA PROFESSIONAL ENGINEER

Charles H. Cunningham, P.E.
Orlando Branch Manager
Florida License No. 38189

VAG/CHC/nfm/jj
17-6401 E-6 Canal Plug.docx (Geo 2017)

TABLE OF CONTENTS

1.0 SITE LOCATION AND DESCRIPTION

The site for the proposed improvements is located in Brevard County, Florida (Township 30 South, Range 35 East). The general site location is shown superimposed on the Kenansville NE, Florida U.S.G.S. quadrangle map presented on Figure 1.

The site is currently developed with a partial canal plug adjacent to the Corps levee.

Land adjacent to the canal plug and levee is mainly wet marsh and/or canals.

2.0 PROPOSED CONSTRUCTION AND GRADING

It is our understanding that the proposed development includes the restoration of the existing canal plug and the installation of a culvert pipe. At the time of this report, the culvert size and invert elevation are not known.

3.0 REVIEW OF SOIL SURVEY MAPS

Based on the Web Soil Survey for Brevard County, Florida, as prepared by the U.S. Department of Agriculture Soil Conservation Service, the canal plug location is located in an area mapped as the "Everglades mucky peat, frequently flooded" soil series. The “Everglades mucky peat, frequently flooded" soil series consists of nearly level, mucky peat underlain by sand and sandy clay loam found on flood plains and marshes on marine terraces. The internal drainage of the "Everglades mucky peat, frequently flooded" is very poor and the soil permeability is rapid to very rapid. According to the Soil Survey, the seasonal high water table for the "Everglades mucky peat, frequently flooded" soil series is typically at or above the natural ground surface.

4.0 FIELD EXPLORATION PROGRAM

4.1 SPT Boring

The field exploration program included performing one Standard Penetration Test (SPT) boring. The SPT boring was advanced to a depth of 30 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I. Split-spoon soil samples recovered during performance of the boring were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level at the boring location was measured during drilling. The boring was grouted with cement-bentonite slurry upon completion.

4.2 Test Location

The approximate location of the boring is schematically illustrated on the Boring Location Plan on Figure 2. The boring location was staked in the field by representatives of Ardaman & Associates and subsequently surveyed by SJRWMD.

Coordinates and the existing ground surface elevation for the boring were provided to us by SJRWMD. These coordinates and elevation are referenced on the boring profile presented on Figure 3.

5.0 LABORATORY TESTING PROGRAM

5.1 Visual Examination and Classification Testing

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profile presented on Figure 3.

In addition, we conducted one organic content test (ASTM D2974-87), two natural moisture content tests (ASTM D2216), two percent fines analyses (ASTM D1140), and one Atterberg limits test (ASTM D4318) on selected soil samples obtained from the boring. The results of these tests are presented adjacent to the sample depth on the boring profiles on Figure 3.

5.2 Corrosion Property Testing

One soil sample was tested for corrosion properties. Properties tested included pH, resistivity, chloride and sulfate content. Results of the soil corrosivity test are presented in the following table.

Boring No.	Sample Elevation (feet NAVD88)	Chloride Content (mg/L)	Sulfate Content (mg/L)	pH	Resistivity (ohm-cm)
E-6	+7.3	15	167	8.1	1,898

The results of these tests were used to evaluate the environmental classification of the structure classification in accordance with the Florida Department of Transportation (FDOT) Criteria for Substructure Environmental Classifications in Structure Design Guidelines Section 1.3.1. According to the criteria, the results of the tests indicate that the soils tested are Moderately Aggressive to steel construction materials and Moderately Aggressive to concrete construction materials.

6.0 GENERAL SUBSURFACE CONDITIONS

6.1 General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profile presented on Figure 3. The stratification of the boring profile represents our interpretation of the field boring log and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of the boring indicate the following general soil profile:

Elevation (Feet, NAVD88)		General Description
From	**To**	
+22.3	+20.3	Organic topsoil underlain by loose clayey fine sand (SC)
+20.3	+15.8	Soft to medium stiff clay (CL/CH)
+15.8	+8.3	Very soft to soft organic muck/peat (OH, Pt)
+8.3	-5.2	Soft to medium stiff clay (CL/CH)
-5.2	-7.7	Loose clayey fine sand (SC)

6.2 Groundwater Level

The groundwater level was measured in the borehole during drilling. As shown on Figure 3, groundwater was encountered at a depth of 4½ feet below the existing ground surface on the date indicated. Fluctuation in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the boring was conducted.

7.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

7.1 General

The results of our exploration indicate that, with proper site preparation as recommended in this report, the existing soils, with the exception of the deleterious organic muck/peat as encountered in the boring, are suitable for supporting the proposed canal plug culvert pipe.

Deleterious organic muck/peat (Stratum 8 on Figure 3) was encountered between approximate Elevation +15.8 feet and Elevation +8.3 feet. Organic muck/peat may be present at different depths and thicknesses at unexplored locations. Because of the potential for large total and differential settlements, deleterious organic muck/peat should not be used as a foundation soil and should be completely removed (i.e.; “demucked”) in accordance with the recommendations presented in this report.

In addition, clayey sand and sandy clay were encountered in the boring. These clayey soils will be very difficult to moisture condition and compact. Because of potential for seepage and plug instability, any soils proposed by the contractor to replace in-situ soils that are difficult to compact must be pre-approved by the design engineer.

The following are our recommendations for overall site preparation which we feel are best suited for the proposed construction and existing soil conditions. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project’s specifications.

7.2 Excavation

Based on the conditions encountered during the field exploration, we anticipate that the majority of the soils as encountered in the boring can be excavated with standard earth moving equipment (i.e.; front-end loaders and backhoes).

The soils below the bottom of the excavation should not be disturbed by the excavation process. If soils become disturbed and difficult to compact, they should be overexcavated to a depth necessary to remove all disturbed soils. Overexcavated areas should be replaced with compacted backfill meeting the “Backfill Requirements” presented in the following report section.

Excavation should be safely braced to prevent injury to personnel or damage to equipment. Temporary safe slopes should be cut in accordance with OSHA, 29 CFR Part 1926 Final Rule, Excavation Requirements or successor regulations. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations. Spoil banks adjacent to excavations should be sloped no steeper than 2.0H(horizontal):1.0V(vertical). Provisions for maintaining worker’s safety within excavations is the sole responsibility of the Contractor.

7.3 Demucking

The deleterious organic muck/peat (Stratum 8 as shown on the boring profile) should be removed (demucked) to its entire vertical limits and to a minimum horizontal margin equivalent to the depth of muck/peat underneath the culvert pipe. A minimum horizontal margin of 5 feet should be used if the depth to the bottom of the muck/peat is less than 5 feet.

The excavated organic muck/peat must not be used as fill material and should be disposed of as directed by the owner. Demucking and backfilling operations should be monitored continuously by a representative of Ardaman & Associates to verify that all unsuitable material is removed and that backfill soils are suitable and well compacted.

Excavation slopes and/or bracing are the responsibility of the contractor. However, at a minimum, all excavations should be sloped and/or braced to meet the requirements of the Occupational Health and Safety Administration (OSHA) latest Standards.

The control of the groundwater and surface water will be required. De-mucking should be conducted “in-the-dry”. The use of well points, rim ditches, sheet piles, etc. may be required to help control groundwater during excavation and backfilling. Regardless of the dewatering method used, we recommend that the groundwater table be maintained at least 24 inches below earthwork and compaction surfaces.

Actual limits of muck/peat removal will be determined based on visual observation during construction. The final quantity of muck/peat removal should be determined after demucking has been completed using methods such as truck volume and/or survey conducted during removal of the muck/peat.

7.4 Backfill Requirements for Excavated Deleterious Organic Soil

For backfill required as needed to replace any organic muck/peat and/or excavated disturbed soils, we recommend using clayey fine sand (SC) having a fines content between 15 and 35 percent passing the U.S. Standard No. 200 sieve. Backfill should be placed in lifts not exceeding 8 inches in thickness. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Depending on the characteristics of the backfill soil, kneading type compaction equipment may be required.

The backfill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths that could cause stability problems.

7.5 Fill Compaction Requirements for the Culvert Pipe

The soil types allowed for use as fill for the water control plug will need to be specified by the design engineer. We recommend considering using soils with some cohesion such as the soils recommended for the backfill in Section 7.4 because soils with cohesion are more resistant to erosion than cohesionless soil such as fine sand (SP) and fine sand with silt (SP-SM).

The fill below, alongside and above the pipe should be placed in level lifts not exceeding 8 inches. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor (ASTM D-698). Care should be taken not to damage the pipe or defect it by compacting directly above the pipe where there is insufficient cover material present.

The fill soil should be of a homogenous nature such that a layer(s) of relatively permeable soil is not placed beneath relatively low permeable soils. This could create undesirable preferential seepage paths through the plug that could cause stability problems.

We recommend constructing the plug in the vicinity of the culvert to a height where the plug will not be overtopped by water. If water can flow around the plug a sufficient distance from the culvert rather than over the plug near the culvert location, the culvert pipe will be less likely to fail as a result of plug erosion in the event of high water/flow in the marsh.

7.6 Seep Shields and Concrete Cradle for the Culvert Pipe

We recommend installing seep shields sized and spaced in accordance with good engineering practices pertinent to the material used for the fill around the culvert pipe. The seep shields should be continuously welded to the pipe.

Because it is difficult to achieve adequate compaction below the haunches of culvert pipes, it is recommended that a high slump concrete (or “flowable fill” of similar strength) cradle be constructed below the pipe. It will be necessary to anchor the pipe while the high slump concrete is being placed to prevent the pipe from floating on the concrete.

7.7 Dewatering

The control of the groundwater and surface water will be required to achieve the necessary depths of excavation, demucking, and subsequent construction and backfilling and compaction requirements presented in the following sections. The actual method(s) of dewatering should be determined by the Contractor, however, regardless of the method(s) used, we suggest drawing down the water table sufficiently; say 2 to 3 feet, below the bottom of the excavation(s) to preclude "pumping" and/or compaction-related problems with the foundation soils.

The contractor should also be aware that cuts may expose or get close to confined aquifers where relatively permeable sandy soils underlie less permeable zones of clayey soils. These relatively permeable zones may require dewatering efforts to include relatively deep full aquifer penetrating wells, airlift of water from wells, trench drains, seepage barriers, etc. Typical vacuum-type well points may not be appropriate for dewatering on this project.

8.0 QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation, excavation, demucking, backfilling and compaction of fill soils is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

As a minimum, an on-site engineering technician should monitor all demucking to verify that all deleterious materials have been removed. In-situ density tests should be conducted during filling activities to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the structural components.

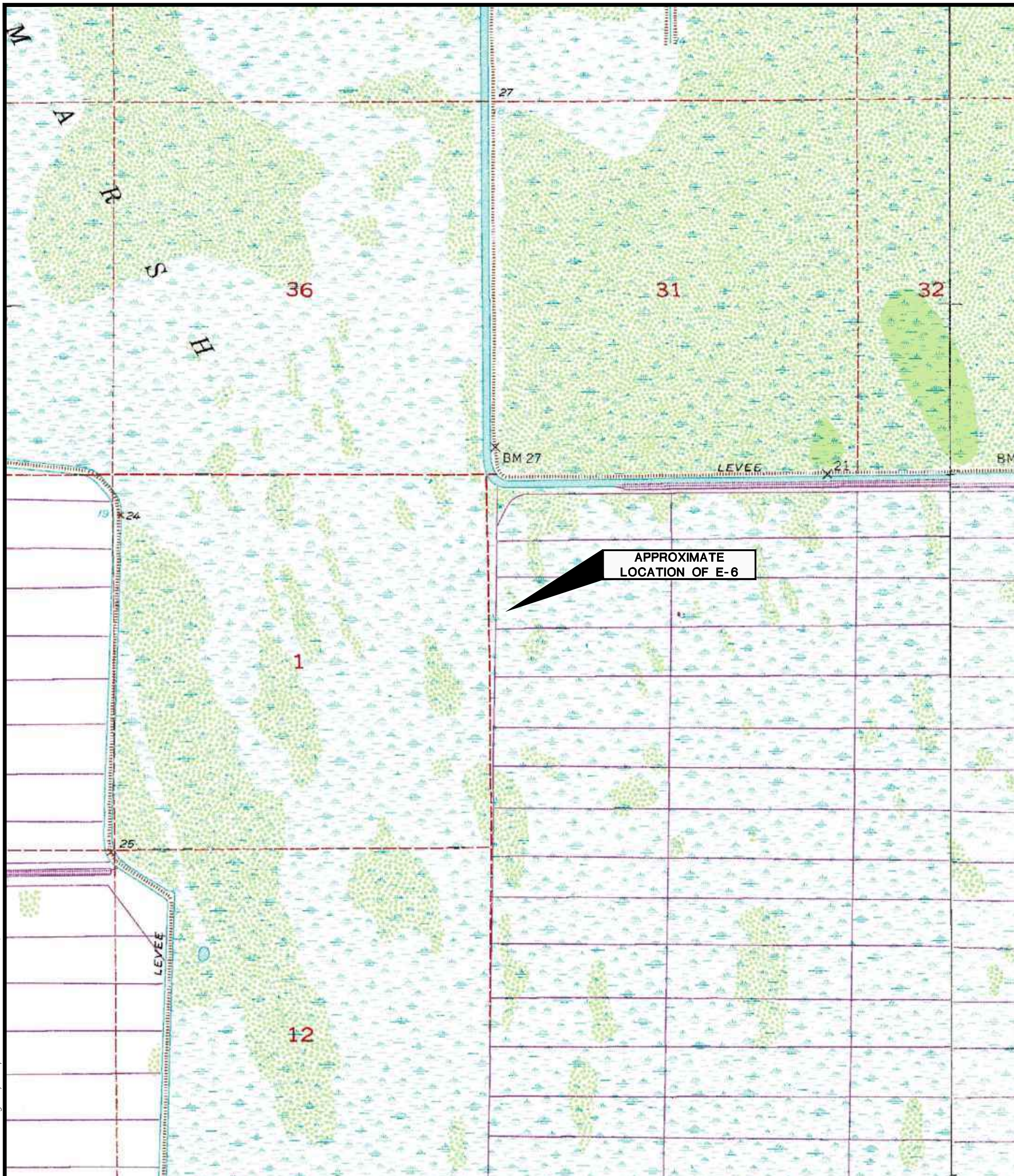
9.0 CLOSURE

The analyses and recommendations submitted herein are based on the data obtained from the soil boring presented on Figure 3. This report does not reflect any variations which may occur adjacent to the boring. The nature and extent of the variations adjacent to the boring may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

In the event any changes occur in the design, nature, or location of the proposed facility, we should review the applicability of conclusions and recommendations in this report. We recommend a general review of final design and specifications by our office to verify that earthwork and foundation recommendations are properly interpreted and implemented in the design specifications. Ardaman and Associates should attend the pre-bid and preconstruction meetings to verify that the bidders/contractor understand the recommendations contained in this report.

This study is based on a relatively shallow exploration and is not intended to be an evaluation for sinkhole potential. This study does not include an evaluation of the environmental (ecological or hazardous/toxic material related) condition of the site and subsurface.

This report has been prepared for the exclusive use of St. Johns River Water Management District in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.



TOWNSHIPS 30 SOUTH
RANGE 35 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: KENANSVILLE NE, FLORIDA 1953
(PHOTOREVISED 1972)
AND KENANSVILLE SE, FLORIDA 1953
(PHOTOREVISED 1972)

SITE LOCATION MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE:	08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE:	1

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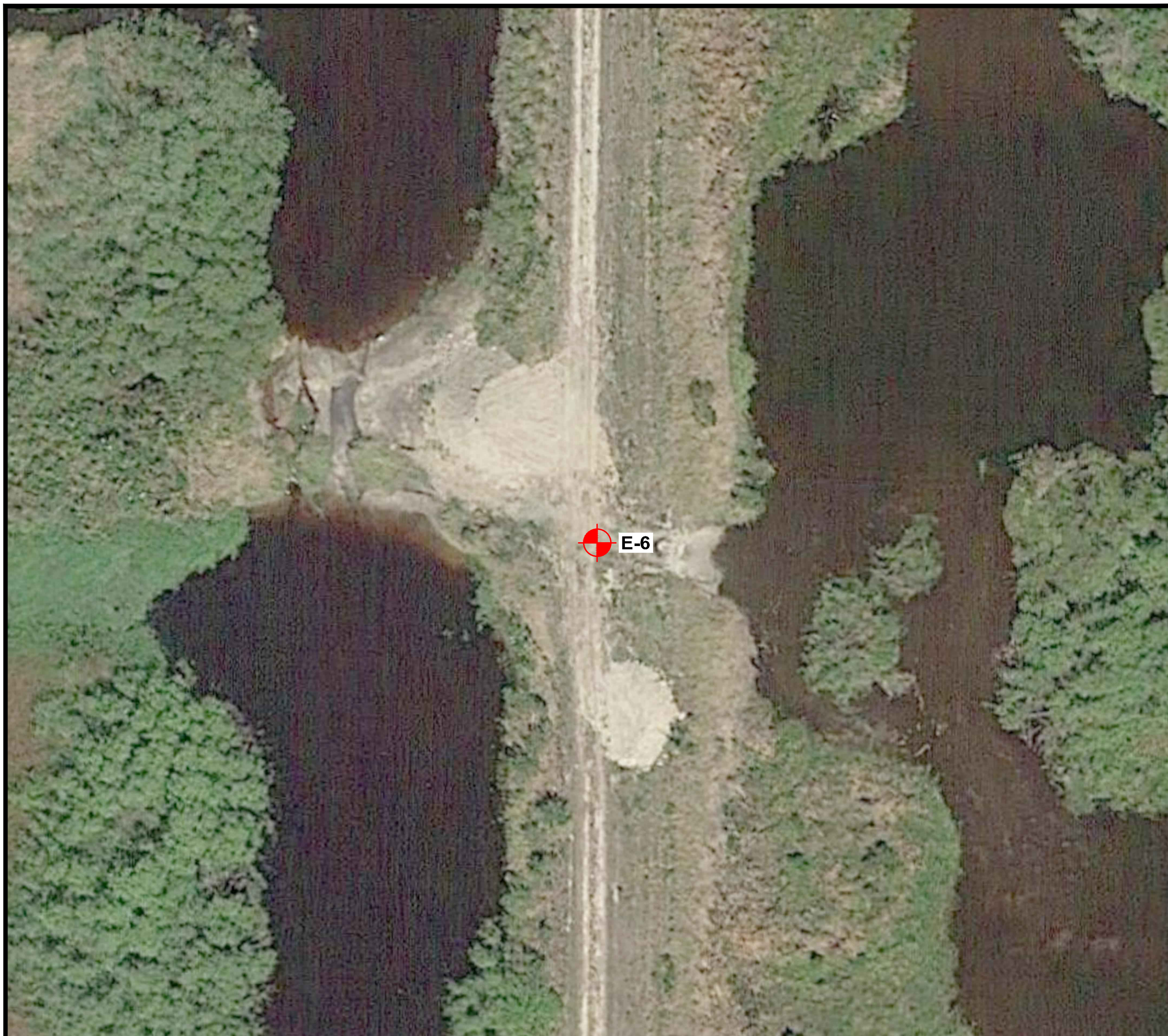

LEGEND

STANDARD PENETRATION TEST (SPT) BORING LOCATION

NOTE: THE AERIAL PHOTOGRAPH FOR THE BORING LOCATION PLAN WAS OBTAINED FROM BING MAPS, DATED 03/20/17.

N

0 25 50

SCALE: (FEET)

BORING LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

DRAWN BY: CD	CHECKED BY:	DATE: 08/18/17
FILE NO. 17-6401	APPROVED BY:	FIGURE: 2

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LEGEND

SOIL DESCRIPTIONS

1. FINE SAND (SP)
2. FINE SAND WITH SILT (SP-SM)
3. FINE SAND WITH CLAY (SP-SC)
4. SILTY CLAYEY FINE SAND (SM/SC)
5. CLAYEY FINE SAND (SC)
6. SANDY CLAY TO CLAY (CL/CH)
7. ORGANIC TOPSOIL
8. ORGANIC MUCK/PEAT (OH, Pt)

COLORS

A. GRAYISH BROWN
B. LIGHT BROWN TO BROWN
C. GRAY TO GREENISH GRAY
D. DARK GRAY OR DARK BROWN
E. VERY DARK GRAY OR VERY DARK BROWN
F. LIGHT GRAY TO GRAY

TH	STANDARD PENETRATION TEST (SPT) BORING
GSE	APPROXIMATE GROUND SURFACE ELEVATION- FEET (NAVD88)
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
▼	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
NM	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D-2216)
-200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D-1140)
OC	ORGANIC CONTENT IN PERCENT (ASTM D-2974)
LL	LIQUID LIMIT (ASTM D-4318)
PI	PLASTICITY INDEX (ASTM D-4318)
SP,SP-SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

NOTES:

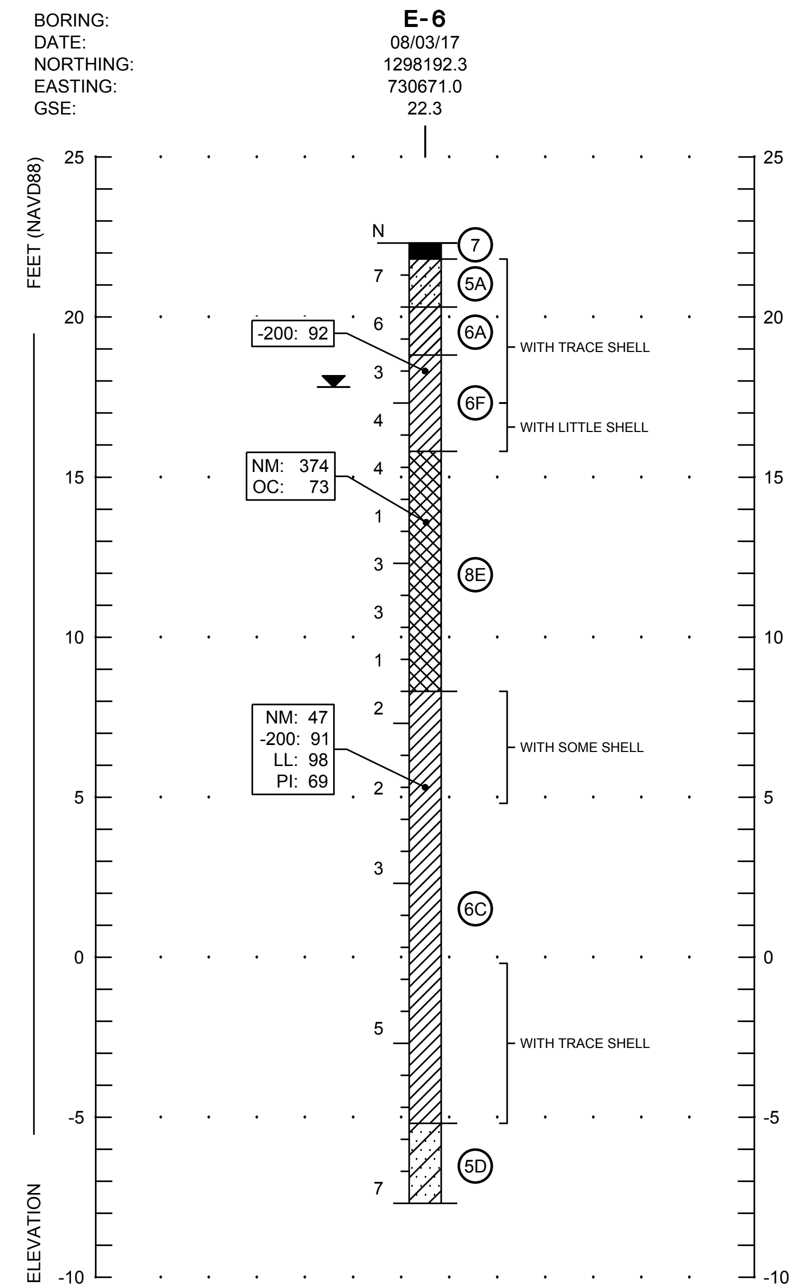
1) SPT BORING E-6 WAS PERFORMED USING AN AUTOMATIC HAMMER TO THE BORING TERMINATION DEPTH. AUTOMATIC HAMMER N-VALUES MAY BE CONVERTED TO EQUIVALENT SAFETY HAMMER N-VALUES BY MULTIPLYING BY 1.24.

2) UPON COMPLETION OF THE SPT BORING, THE BOREHOLE WAS GROUTED WITH CEMENT-BENTONITE SLURRY.

3) BORING NORTHING, EASTING, AND ELEVATION WERE PROVIDED BY SJRWMD.

SHELL CONTENT

TRACE: <5%
FEW: 5 TO 10%
LITTLE: 15 TO 25%
SOME: 30 TO 45%
MOSTLY: 50 TO 100%



ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	<4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	<2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR.

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
ST. JOHNS MARSH CONSERVATION AREA
DRAINAGE IMPROVEMENTS
BREVARD COUNTY, FLORIDA

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FILE NO. 17-6401	APPROVED BY:	FIGURE: 3

APPENDIX I

Standard Penetration Test (SPT) Boring Procedure

STANDARD PENETRATION TEST

The standard penetration test is a widely accepted test method of *in situ* testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, NX-size flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid.

Representative split-spoon samples from the soils are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for 30 days prior to being discarded.