Final Trail Report
Proposed Trail Alignment
Geotechnical Engineering Services
St. Johns River to Sea Loop from Lake Beresford to Grand Avenue, Volusia County, Florida
FDOT Contract No. C-9140, FDOT TWO 18
FPID No. 439874-1-22-01
PSI Project No. 07571816

Project Number: 07571816
February 27, 2020

Professional Service Industries, Inc.
1748 33rd Street, Orlando, FL 32839
Phone: (407) 304-5560
Fax: (407) 304-5561

Mr. Bob Finck
AIM Engineering, Inc.
3802 Corporex Park Drive, Suite 225
Tampa, Florida 33619

RE: Final Trail Report
Proposed Trail Alignment
Geotechnical Engineering Services
St. Johns River to Sea Loop from Lake Beresford to Grand Avenue, Volusia County, Florida
FDOT Contract No. C-9140, FDOT TWO 18
FPID No. 439874-1-22-01

Dear Mr. Finck:

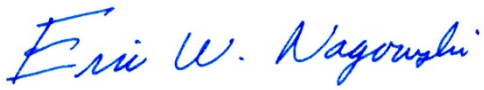
Professional Service Industries, Inc. (PSI) an **Intertek Company** has performed a subsurface exploration for the proposed trail system. This final report summarizes the field and laboratory services performed and includes PSI's geotechnical recommendations to assist with design and construction of the proposed trail way. Our services were performed in accordance with the existing subconsultant contract between Inwood Consulting Engineers and PSI dated June 16, 2017.

PSI appreciates the opportunity to provide our services to you on this project. If you have any questions regarding the information provided in this report, or if we may be of further service, please contact the undersigned.

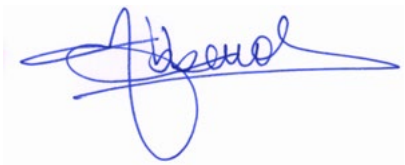
Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Certificate of Authorization No. 3684

Venkata Prashanth Muppana, M.S., E.I.
Staff Engineer



Eric W. Nagowski, E.I.
Senior Project Engineer



Mustapha A. Abboud, M.S., P.E.
Senior Geotechnical Engineer/Principal Consultant
Florida License No. 56112

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PROJECT INFORMATION

The project site under consideration herein is an approximately 3.1± mile long right of way area located along existing roads and undeveloped areas in West Deland, Volusia County, Florida. The majority of the project lies along the right-of-way areas of Grand Avenue and Beresford Road in West Deland.

Based on the preliminary project plans and information provided to PSI, the project is the expansion of the existing trail, between the northwestern corner Beresford Park to the southern terminus of the existing trail located along Grand Avenue. The proposed trail alignment will be approximately 3.1± miles long and is aligned east-west from the north trail terminus along County Road 4053 to West Minnesota Avenue and then aligned north-south to the south trail terminus. The proposed trail will traverse along the right-of-way areas of Grand Avenue and Beresford Road.

The project is currently at the Project Development and Environment Study (PD&E) phase, and the final trail alignment has not been finalized at the time of writing this report. We understand that the preliminary geotechnical information will be utilized to assess the site characteristics and to assist with selection of the trail alignment and trail design. Based on the information provided, it is PSI's understanding there will be no new stormwater treatment systems associated with the proposed trail.

The noted information/assumptions have been used for the purpose of preparing this report. If any of the stated information/assumptions are incorrect or have been changed, PSI should be notified so appropriate changes to our recommendations can be incorporated in this report.

REVIEW OF PUBLISHED DATA

USGS Topographic Map

The topographic survey map published by the USGS entitled "Deland, Florida" and "Orange City, Florida" were reviewed for ground surface elevations in the area of the proposed trail alignment. Based on this review, the natural ground surface elevation varies between +60 and +35 feet NGVD from the north trail terminus to West Beresford Road. Elevations then decrease from approximately +35 feet NGVD to +10 feet NGVD at the south trail terminus.

No site-specific topographic data was provided to PSI for review. **Figure 1** of **Appendix B** contains an excerpt of the USGS map for the site including the proposed trail alignment.

USDA SCS Soil Survey

The "Soil Survey of Volusia County, Florida," published by the USDA SCS, was reviewed for general near-surface soil information within the general project vicinity. This information indicates that there are nine soil groups within the vicinity of the proposed project. The general information provided by the SCS for the mapped soil units are summarized in the following table.

Soil Series	Depth (inches)	AASHTO Classification	USDA Seasonal High Groundwater Table Depth (feet)
1 - Apopka fine sand, 0 to 5 percent slopes	0 to 80	A-3, A-2-4, A-2-6, A-4, A-6	> 6
4 - Astatula fine sand, 0 to 8 percent slopes	0 to 95	A-3	> 6
17 - Daytona sand, 0 to 5 percent slopes	0 to 80	A-3, A-2-4	3.5 to 5
22 - Electra fine sand, 0 to 5 percent slopes	0 to 70	A-3, A-2-4, A-2-6, A-4, A-6	2 to 3.5
37 - Orsino fine sand, 0 to 5 percent slopes	0 to 80	A-3	3.5 to 5
47 - Pits	-	-	-
48 - Placid fine sand, frequently ponded, 0 to 1 percent slopes	0 to 75	A-3, A-2-4	+2 to 1
49 - Pomona fine sand	0 to 60	A-3, A-2-4, A-2, A-4, A-6	0 to 1
63 - Tavares fine sand, 0 to 5 percent slopes	0 to 80	A-3	3.5 to 6

The majority of the planned trail alignment is located within Soil Mapping Series 1. **Figure 2** of **Appendix B** contains an excerpt of the USDA SCS Soils map for the site including the proposed trail alignment.

FIELD EXPLORATION

General

To evaluate subsurface conditions at the site, PSI performed thirty-three (33) manual auger borings along the proposed trail alignment. The auger borings were extended to depths of 7 to 10 feet below the existing grades, and samples were collected from each of the soil stratum. Upon completion of the field exploration, the boreholes were backfilled with soil cuttings. The approximate boring locations are presented on the boring location plan, **Sheet 1** of **Appendix B**.

The samples recovered from the borings were returned to our Orlando laboratory for stratification and testing. The soil samples were visually stratified following the guidelines contained in the AASHTO Classification System. A limited laboratory testing program was conducted to confirm soil classification and pertinent engineering properties. Records of the materials encountered in the borings are presented as soil profiles on **Sheet 3** of **Appendix B**. Included with the soil profiles is a legend describing the subsoils in AASHTO format. The results of laboratory testing are provided adjacent to the soil profiles at the depth interval from which the sample was obtained.

The stratification presented is based on visual observation of the recovered soil samples, laboratory testing and interpretation of field logs by a geotechnical engineer. It should be noted that variations in the subsurface conditions are expected and may be encountered between and away from PSI's borings. Also, whereas the individual boring logs indicate distinct strata breaks, the actual transition between the soil layers may be more gradual than shown on the soil profiles.

Soil Conditions

The soil types encountered at the specific boring locations are presented in the form of soil profiles on the attached **Sheet 3** of **Appendix B**. The following soil types were encountered in the trail borings performed.

Stratum	Soil Description	AASHTO Soil Classification	Standard Plan 120-001 Classification
1	Light gray to gray fine sand	A-3	Select (S)
2	Light brown to red-brown silty fine sand	A-2-4	Select (S)
3	Orange-brown clay with sand	A-7-6	Plastic (P)

Groundwater Conditions

At the time of our fieldwork (December 11, 2019), groundwater was not encounterted in the borings to a depth of 7 to 10 feet below the existing grade. The estimated normal seasonal high groundwater levels presented herein are based on the observed soil stratigraphy, conditions observed in the borings, USDA Soil Survey information, and our past experience in the project vicinity. In this regard, the estimated normal seasonal high groundwater is presented on **Sheet 3** of **Appendix B** adjacent to the soil boring profiles. More detailed groundwater information can be provided once site-specific topographic information is provided to PSI.

In general, the estimated normal seasonal high groundwater level is not intended to define a limit or ensure that future seasonal fluctuations in groundwater levels will not exceed the estimated levels. Groundwater conditions will vary with environmental changes and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as swales, ponds, drainage systems, underdrains and areas of covered soil (buildings, paved parking lots, sidewalks, etc.).

LABORATORY TESTING

Representative soil samples were retained from the soil strata observed in each boring and returned to PSI's laboratory for visual classification and stratification. Sieve analysis and moisture content were performed on selected samples for verification of the visual classification. The results of the laboratory testing are presented in **Table 1** on **Appendix A** and summarized on the Roadway Soil Survey Sheet (**Sheet 2** of **Appendix B**). The types of tests performed with the associated test designation are presented in the following table.

Test Type	ASTM	FDOT
Sieve Analysis	D-422	FM 1-T 088
Moisture Content	D-2216	FM 1-T 265
Liquid and Plastic Limits	D-4318	FM 1-T 089 and FM 1-T 090

GEOTECHNICAL RECOMMENDATIONS

Based on the results of PSI's borings, it is our opinion that subsurface conditions are generally suitable for the construction of the proposed trail from a geotechnical engineering perspective. Site preparation and trail embankment construction can proceed in accordance with the latest version of the FDOT Standard Specifications for Road and Bridge Construction. Strata 1 and 2 (A-3 and A-2-4 materials) encountered in the borings are considered Select (S) material per FDOT Standard Plans 120-001 and can be utilized as embankment soils to construct the proposed trail. Stratum 3 (A-7-6 material) encountered in the borings is considered Plastic (P) material per FDOT Standard Plans 120-001 and 120-002. Stratum 3 can be utilized as embankment soils to construct the proposed trail provided it is placed above the prevailing water table at the time of construction and to within 4 feet of the proposed base. PSI recommends placing Stratum 3 in the lower portion of the embankment utilizing thin lifts for a long distance instead of full depth placement for short distances. Organic Soils (Muck (M)) were not encountered in the borings. However, if this material is encountered within the trail alignment during construction it should be removed in accordance with FDOT Standard Plans Index 120-002.

PAVEMENT DESIGN CONSIDERATIONS

Flexible and rigid pavement design should be performed in accordance with the FDOT Flexible Pavement Design Manual and FDOT Rigid Pavement Design Manual. Trail plans and cross-sections are not available at this time. As a minimum, PSI recommends at least 24 inches of separation between the estimated normal seasonal high groundwater level and the bottom of the flexible pavement base or bottom of the rigid pavement section.

If trail grades provide less than the recommended minimum separation above the estimated normal seasonal high groundwater level, underdrains or asphaltic base may be required. Once plans and cross-sections are available, PSI should be given the opportunity to review the plans and verify the minimum separation between the trail base/pavement section and estimated normal seasonal high groundwater level.

Resilient Modulus (Mr) testing was performed by the FDOT State Materials Office (SMO) on 9 bulk soil samples obtained by PSI from along the proposed trail corridor. Based on the report, a recommended Mr design value of 9,400 psi should be used for embankment and pavement design. The recommended Mr value is based on the FDOT 90 Percent Method. A copy of the **Resilient Modulous Report** is included in **Appendix C**.

LIMITATIONS

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This company is not responsible for the conclusions, opinions or recommendations made by others based on these data.

The scope of our exploration was intended to evaluate soil conditions within the influence of the proposed trail and does not include an evaluation of potential deep soil problems such as sinkholes. The analysis and recommendations submitted in this report are based on the data obtained from the soil borings performed at the locations indicated. If any subsoil variations become evident during the course of this project, a re-evaluation of the recommendations contained in this report will be necessary after we have had an opportunity to observe the characteristics of the conditions encountered. The applicability of the report should also be reviewed in the event significant changes occur in the design, nature or location of the proposed trail system.

The scope of our geotechnical services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

APPENDIX A

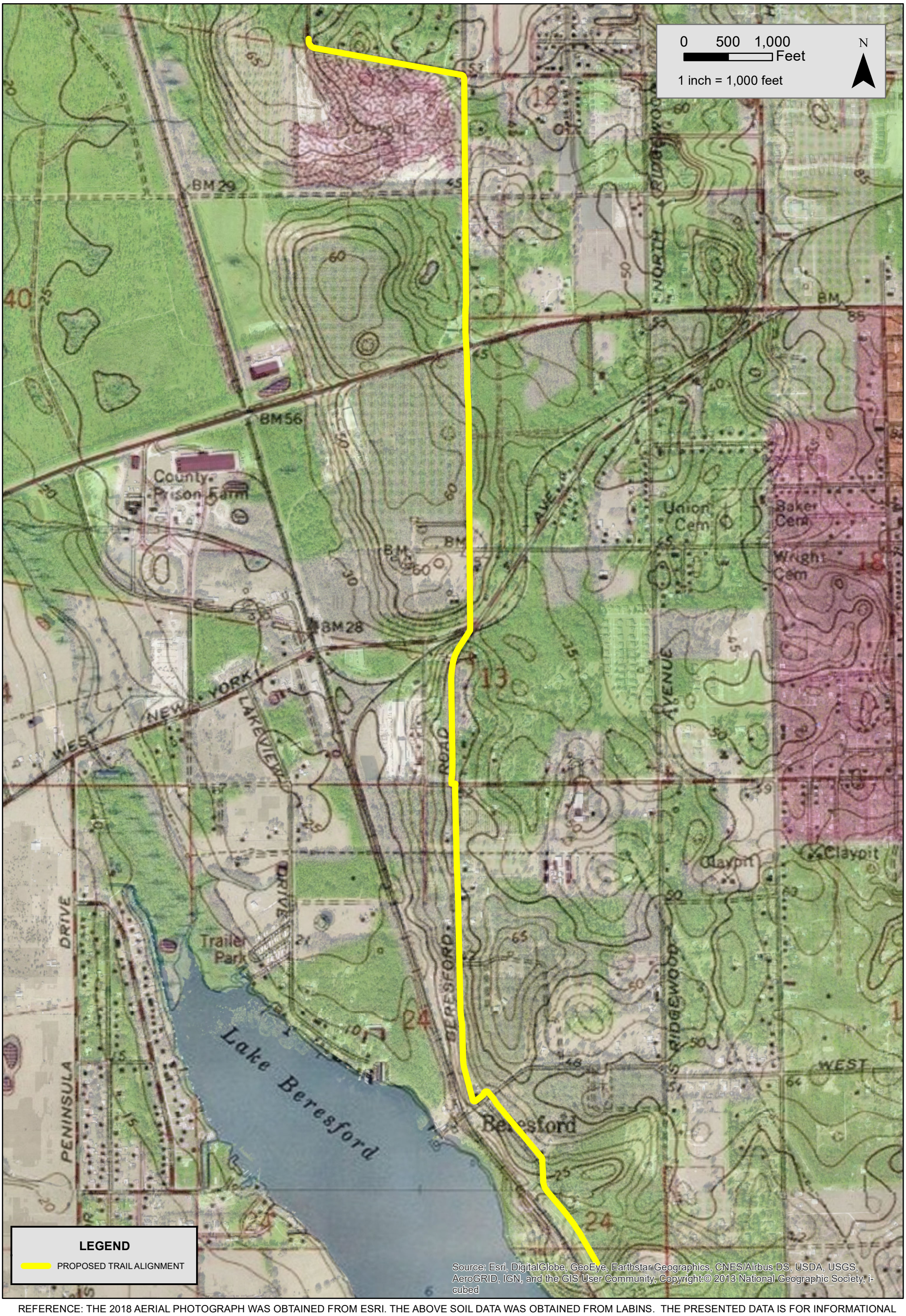
TABLE

TABLE 1
RESULTS OF LABORATORY CLASSIFICATION TESTING FOR TRAIL BORINGS
St. Johns River to Sea Loop from Lake Beresford to Grand Avenue
FPN: 439874-1-22-01
FDOT Contract No. C-9140
PSI PROJECT NO. 7571816

Boring No.	Sample Depth (feet)	Stratum No.	Approx. Station (feet)	Approx. Offset (feet)	Baseline of Survey	AASHTO Class.	W%	OC%	Sieve Analysis (% Finer)					Atterberg Limits	
									#10	#40	#60	#100	#200	LL	PI
HA-1	3	1	---	---	---	A-3	---	---	---	---	---	---	4	---	---
HA-4	2	1	---	---	---	A-3	---	---	---	---	---	---	5	---	---
HA-10	5	1	---	---	---	A-3	---	---	---	---	---	---	5	---	---
HA-13	3	1	---	---	---	A-3	---	---	---	---	---	---	6	---	---
HA-14	1	1	---	---	---	A-3	---	---	---	---	---	---	7	---	---
HA-17	2	1	---	---	---	A-3	---	---	---	---	---	---	7	---	---
HA-21	2	1	---	---	---	A-3	---	---	---	---	---	---	6	---	---
HA-26	2	1	---	---	---	A-3	---	---	---	---	---	---	5	---	---
HA-32	5	1	---	---	---	A-3	---	---	---	---	---	---	4	---	---
HA-7	2 to 7	1	---	---	---	A-3	---	---	100	100	96	52	7	---	---
HA-31	1 to 5	1	---	---	---	A-3	---	---	100	99	93	42	9	---	---
HA-1	6.5	2	---	---	---	A-2-4	17	---	---	---	---	---	34	---	---
HA-6	8.5	2	---	---	---	A-2-4	11	---	---	---	---	---	23	---	---
HA-11	6	2	---	---	---	A-2-4	11	---	---	---	---	---	24	---	---
HA-18	6	2	---	---	---	A-2-4	10	---	---	---	---	---	25	---	---
HA-19	6	2	---	---	---	A-2-4	11	---	---	---	---	---	27	---	---
HA-31	6	2	---	---	---	A-2-4	---	---	---	---	---	---	25	---	---
HA-1	5 to 7	2	---	---	---	A-2-4	---	---	100	100	98	63	32	---	---
HA-13	5 to 7	2	---	---	---	A-2-4	---	---	100	100	97	65	27	---	---
HA-33	4 to 7	3	---	---	---	A-7-6	17	---	---	---	---	---	41	33	19

APPENDIX B

FIGURES AND SHEETS



REFERENCE: THE 2018 AERIAL PHOTOGRAPH WAS OBTAINED FROM ESRI. THE ABOVE SOIL DATA WAS OBTAINED FROM LABINS. THE PRESENTED DATA IS FOR INFORMATIONAL PURPOSES ONLY. IT IS NOT MEANT FOR DESIGN, LEGAL, OR ANY OTHER USES. PSI ASSUMES NO RESPONSIBILITY FOR ANY DECISIONS MADE OR ANY actions TAKEN BY THE USER BASED UPON INFORMATION OBTAINED FROM THE ABOVE DATA.

PROJECT NO. 07571816 TWN/RNG/SEC N/A DATE CREATED 1/10/2020	intertek psi Market Access. Risk Mitigation. Total Assurance.	1748 33rd Street Orlando, FL 32839 (407)304-5560 (407)304-5561 fax	***PROPOSED TRAIL ALIGNMENT*** ***ST. JOHNS RIVER TO SEA LOOP SECTION*** FROM LAKE BERESFORD PARK TO GRAND AVENUE VOLUSIA COUNTY, FLORIDA	Figure 1 USGS Topographic Map

0 500 1,000 Feet

1 inch = 1,000 feet

N

LEGEND

- PROPOSED TRAIL ALIGNMENT
- 1 - APOPKA FINE SAND, 0 TO 5 PERCENT SLOPES
- 4 - ASTATULA FINE SAND, 0 TO 8 PERCENT SLOPES
- 17 - DAYTONA SAND, 0 TO 5 PERCENT SLOPES
- 22 - ELECTRA FINE SAND, 0 TO 5 PERCENT SLOPES
- 37 - ORSINO FINE SAND, 0 TO 5 PERCENT SLOPES
- 47 - PITS
- 48 - PLACID FINE SAND, FREQUENTLY PONDED, 0 TO 1 PERCENT SLOPES
- 49 - POMONA FINE SAND
- 63 - TAVARES FINE SAND, 0 TO 5 PERCENT SLOPES
- 99 - WATER

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

REFERENCE: THE 2018 AERIAL PHOTOGRAPH WAS OBTAINED FROM ESRI. THE ABOVE SOIL DATA WAS OBTAINED FROM LABINS. THE PRESENTED DATA IS FOR INFORMATIONAL PURPOSES ONLY. IT IS NOT MEANT FOR DESIGN, LEGAL, OR ANY OTHER USES. PSI ASSUMES NO RESPONSIBILITY FOR ANY DECISIONS MADE OR ANY ACTIONS TAKEN BY THE USER BASED UPON INFORMATION OBTAINED FROM THE ABOVE DATA.

PROJECT NO.
07571816

TWN/RNG/SEC
N/A

DATE CREATED
1/01/2020

intertek psi

Market Access.
Risk Mitigation.
Total Assurance.

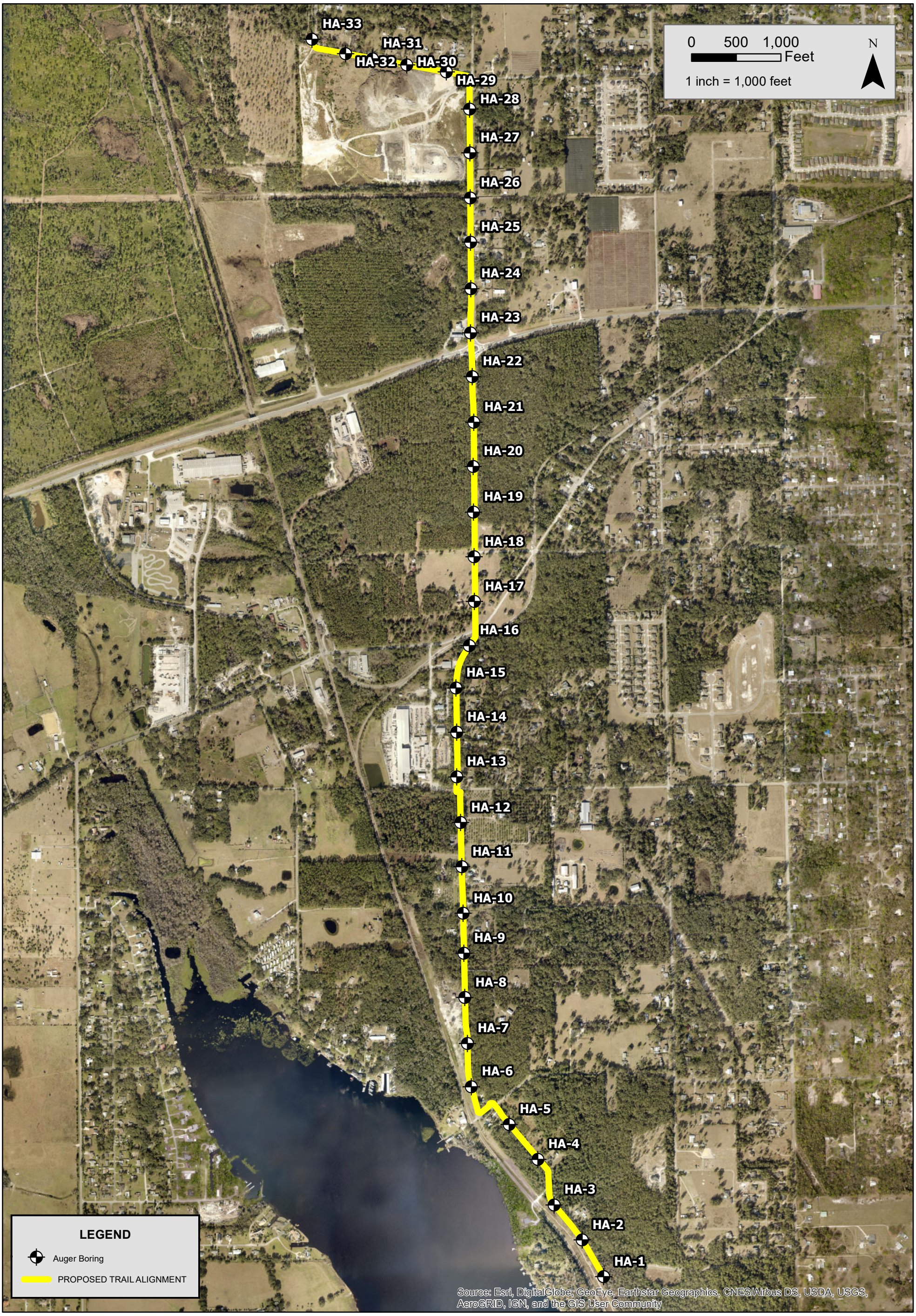
1748 33rd Street
Orlando, FL 32839
(407)304-5560
(407)304-5561 fax

PROPOSED TRAIL ALIGNMENT
ST. JOHNS RIVER TO SEA LOOP SECTION

FROM LAKE BERESFORD PARK TO GRAND AVENUE
VOLUSIA COUNTY, FLORIDA

FIGURE 2

Soils Map



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PROJECT NO. 07571816 TWN/RNG/SEC N/A DATE CREATED 1/10/2020	intertek psi Market Access. Risk Mitigation. Total Assurance.	1748 33rd Street Orlando, FL 32839 (407)304-5560 (407)304-5561 fax	***PROPOSED TRAIL ALIGNMENT*** ***ST. JOHNS RIVER TO SEA LOOP SECTION*** FROM LAKE BERESFORD PARK TO GRAND AVENUE VOLUSIA COUNTY, FLORIDA	Sheet 1 Boring Location Map

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

DATE OF SURVEY : 12/19
SURVEY MADE BY : PSI
SUBMITTED BY : MUSTAPHA A. ABBOUD, P.E.

SECTION : 39, 40, 19 AND 24
TOWNSHIP : 17 SOUTH
RANGE : 29 EAST

DISTRICT : 5
ROAD NO. : -
COUNTY : VOLUSIA

FINANCIAL PROJECT ID : 439874-1-22-01

CROSS SECTION SOIL SURVEY FOR THE DESIGN OF TRAILS

SURVEY BEGINS STA. : N/A SURVEY ENDS STA. : N/A

	ORGANIC CONTENT		MOISTURE CONTENT		SIEVE ANALYSIS RESULTS % PASS						ATTERBERG LIMITS					CORROSION TEST RESULTS					SUBSTRUCTURE ENVIRONMENTAL CLASSIFICATION	
STRATUM NO.	No. OF TESTS	% ORGANIC	No. OF TESTS	MOISTURE CONTENT	No. OF TESTS	% PASSING 10 MESH	% PASSING 40 MESH	% PASSING 60 MESH	% PASSING 100 MESH	% PASSING 200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTIC INDEX	AASHTO GROUP	DESCRIPTION	NO. OF TESTS	RESISTIVITY OHM-CM	CHLORIDES PPM	SULFATE PPM	pH	CONCRETE	STEEL
1	-	-	-	-	9(-200) 2(F.S.)	100	99-100	93-96	42-52	4-9	-	-	-	A-3	Light gray to gray fine SAND	-	-	-	-	-	-	-
2	-	-	5	10-17	6(-200) 2(F.S.)	100	100	97-98	63-65	23-34	2	NP	NP	A-2-4	Light brown to red-brown silty fine SAND	-	-	-	-	-	-	-
3	-	-	1	17	1(-200)	-	-	-	-	41	1	33	19	A-7-6	Orange-brown CLAY with sand	-	-	-	-	-	-	-

EMBANKMENT AND SUBGRADE MATERIAL

STRATA BOUNDARIES ARE APPROXIMATE, MAKE FINAL CHECK AFTER GRADING

▼ WATER TABLE ENCOUNTERED AT TIME OF SURVEY

▽ ESTIMATED NORMAL SEASONAL HIGH WATER LEVEL AT TIME OF SURVEY.

GNE GROUNDWATER LEVEL NOT ENCOUNTERED AT TIME OF SURVEY.

NOTES:

(1) STRATA BOUNDARIES ARE APPROXIMATE AND REPRESENT SOIL STRATA AT EACH TEST HOLE LOCATION ONLY. ANY STRATUM CONNECTING LINES SHOWN ARE FOR ESTIMATING EARTHWORK ONLY AND DO NOT INDICATE ACTUAL STRATUM LIMITS. SUBSURFACE VARIATIONS BETWEEN BORINGS SHOULD BE ANTICIPATED AS INDICATED IN SECTION 2-4. FOR FURTHER DETAILS SEE SECTION 120-3.

(2) IF THE SYMBOL "-" IS PRESENT, IT REPRESENTS UNMEASURED SOIL PARAMETERS.

(3) SOIL ANALYSIS INCLUDES DATA FROM TRAIL AUGER BORINGS.

(4) THE MATERIAL FROM STRATA NOS. 1 AND 2 IS SELECT (S) MATERIAL AND APPEARS SATISFACTORY FOR USE IN THE EMBANKMENT WHEN UTILIZED IN ACCORDANCE WITH INDEX NO. 120-001. HOWEVER, STRATUM NO. 2 MATERIAL WILL RETAIN EXCESS MOISTURE AND BE DIFFICULT TO DRY AND COMPACT.

(5) STRATUM 2 SHOULD BE USED IN THE EMBANKMENT ABOVE THE PREVAILING WATER LEVEL AT THE TIME OF CONSTRUCTION. STRATUM 2 SHOULD NOT BE USED IN THE SUBGRADE PORTION OF THE TRAIL BED.

(6) THE MATERIAL FROM STRATUM NO. 3 SHOULD BE CONSIDERED AS HIGHLY PLASTIC (HP) MATERIAL AND SHALL BE REMOVED IN ACCORDANCE WITH INDEX NO. 120-002. STRATUM NO. 3 MAY BE USED WITHIN THE PROJECT LIMITS AS INDICATED IN THE STANDARD PLANS, INDEX NO. 120-001 ONLY WHEN EXCAVATED WITHIN THE PROJECT LIMITS AND IT IS NOT TO BE USED WHEN OBTAINED FROM OUTSIDE THE PROJECT LIMITS.

REVISIONS					
Date	By	Description	Date	By	Description

MUSTAPHA A. ABBOUD, P.E.
P.E. NO.: 56112
PROFESSIONAL SERVICE IND., INC.
1748 33RD STREET
ORLANDO, FL. 32839
CERTIFICATE OF AUTHORIZATION No. 00003684

intertek psi

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
-	VOLUSIA	439874-1-22-01

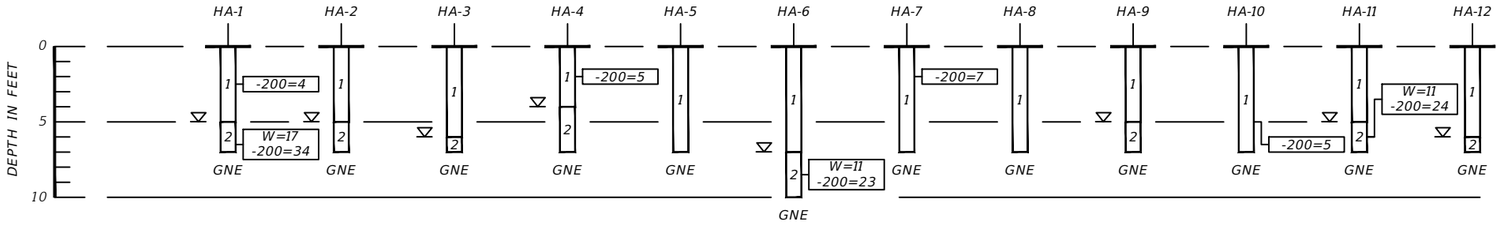
TRAIL SOIL SURVEY

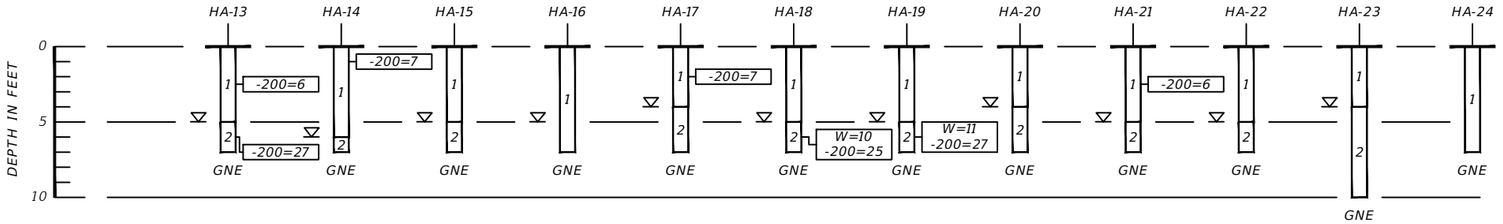
ST. JOHNS RIVER TO SEA LOOP FROM LAKE BERESFORD PARK TO GRAND AVENUE

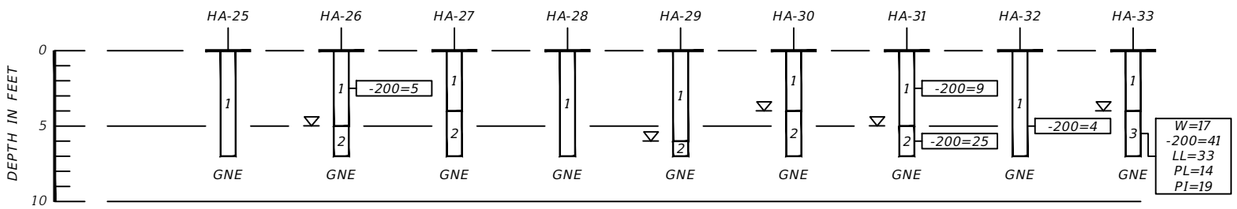
VOLUSIA COUNTY, FLORIDA

SHEET NO.

PSI PROJECT No. 07571816
SHEET: 2







LEGEND

1	Light gray to gray fine SAND, (A-3)
2	Light brown to red-brown silty fine SAND, (A-2-4)
3	Orange-brown CLAY with sand, (A-7-6)
(A-3)	A.A.S.H.T.O soils classification group symbol
GNE	Groundwater not encountered to the boring termination depth
▽	Estimate normal seasonal high water level
W	Natural moisture content in percent
-200	Fines passing #200 sieve in percent
LL	Liquid limit in percent
PL	Plastic limit in percent
PI	Plasticity index

REVISIONS

Date	By	Description	Date	By	Description

MUSTAPHA A. ABBOUD, P.E.
P.E. NO.: 56112
PROFESSIONAL SERVICE IND., INC.
1748 33RD STREET
ORLANDO, FL. 32839
CERTIFICATE OF AUTHORIZATION No. 00003684

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
-	VOLUSIA	439874-1-22-01

TRAIL AUGER BORING PROFILES

ST. JOHNS RIVER TO SEA LOOP FROM LAKE BERESFORD PARK TO GRAND AVENUE

VOLUSIA COUNTY, FLORIDA

SHEET NO.

PSI PROJECT No. 07571816
SHEET: 3

APPENDIX C

FDOT RESILIENT MODULUS TEST REPORT

Florida Department of Transportation
605 Suwannee Street
Tallahassee, FL 32399-0450

RON DESANTIS
GOVERNOR

KEVIN J. THIBAULT
SECRETARY

MEMORANDUM

DATE: February 20, 2020

TO: Michael Byerly, District Geotechnical Materials Engineer

FROM: David Horhota, State Geotechnical Materials Engineer

SUBJECT: Embankment Resilient Modulus Pavement Design
District 5, Volusia County
FPN 439874-1: St Johns River to Sea Loop Trail from Lake Beresford Park to Grand Ave

Nine (9), 2-bag samples were received by the State Materials Office (SMO) for determination of an embankment (roadbed) resilient modulus for pavement design. After visual observation of the nine samples, it was determined that the material from each 2-bag sample looked visually similar and the material from each of the bags were combined to form one sample from each location. After combining materials from the bags, samples from each location were obtained for classification tests (Atterberg limits, particle size analysis, and organic content), Proctor density, and resilient modulus. The classification test results are reported in Tables 1 and 2. Information provided for this project by Intertek PSI, Inc. did not include sample depth.

Table 1. Summary of Initial Soil Gradation Results

Sample ID	Passing 3/4" (%)	Passing 1/2" (%)	Passing 3/8" (%)	Passing No. 4 (%)	Passing No. 10 (%)	Passing No. 40 (%)	Passing No. 60 (%)	Passing No. 100 (%)	Passing No. 200 (%)
LBR 1	100.0	100.0	100.0	99.9	99.8	99.3	93.0	47.6	6.7
LBR 2	100.0	100.0	100.0	100.0	99.9	99.4	93.0	47.1	6.8
LBR 3	100.0	99.9	99.9	99.9	99.9	99.3	93.0	55.0	6.8
LBR 4	100.0	99.9	99.9	99.9	99.9	99.3	93.0	48.5	6.4
LBR 5	99.9	99.9	99.9	99.8	99.7	99.1	93.0	48.3	7.1
LBR 6	100.0	100.0	100.0	100.0	99.9	99.5	94.2	53.7	10.6
LBR 7	100.0	100.0	100.0	100.0	99.9	99.6	95.1	59.4	12.1
LBR 8	100.0	100.0	100.0	100.0	100.0	99.5	94.5	53.5	9.8
LBR 9	100.0	100.0	100.0	100.0	100.0	99.5	94.6	55.1	9.1

Table 2. Summary of Soil Classification and Organic Content Results

Sample ID	Latitude	Longitude	Soil Class.	Organic Content (%)	LL/PI
LBR 1	28.997955°	-81.342628°	A-3	0.7	N.P.
LBR 2	29.002629°	-81.345938°	A-3	0.8	N.P.
LBR 3	29.007907°	-81.347535°	A-3	0.7	N.P.
LBR 4	29.013335°	-81.347652°	A-3	0.8	N.P.
LBR 5	29.018734°	-81.347180°	A-3	1.1	N.P.
LBR 6	29.024251°	-81.347238°	A-2-4	0.9	N.P.
LBR 7	29.029795°	-81.347355°	A-2-4	0.5	N.P.
LBR 8	29.035029°	-81.348239°	A-3	0.6	N.P.
LBR 9	29.036043°	-81.352941°	A-3	0.3	N.P.

In addition to the classification testing, the following test program was conducted:

(1) Standard Proctor, AASHTO T 99
(2) Resilient Modulus (M_R), AASHTO T 307.

A summary of laboratory test results is included in Table 3. The resilient modulus values listed in this table were obtained using the relationship developed from each individual test (resilient modulus versus bulk stress - with bulk stress, **Θ,** defined as $\Theta = \sigma_1 + \sigma_2 + \sigma_3$), and using a bulk stress of 11 psi, which is the recommendation from Dr. Ping's research work in modeling the embankment in-situ stresses for Florida pavement conditions. Two results are listed for each location because two samples were prepared for each location and they represent the individual test result from each sample tested. The resilient modulus samples were compacted to within 1 pound per cubic foot (pcf) of the maximum density and 0.5 percent of the optimum moisture content as determined by AASHTO T99.

Table 3. Summary of T-99 and M_R Test Results

Sample ID	Passing No. 200, %	Standard Proctor Density, pcf	Optimum Moisture Content, %	Resilient Modulus @ Θ=11psi (psi)
LBR 1	7	102.2	15.8	10,942
				10,287
LBR 2	7	102.9	15.0	9,718
				9,294
LBR 3	7	102.4	15.7	9,967
				9,221
LBR 4	6	102.3	15.3	10,547
				10,733
LBR 5	7	102.2	15.2	11,748
				11,271

LBR 6	11	103.3	15.0	10,380
				10,546
LBR 7	12	104.6	14.4	10,077
				9,394
LBR 8	10	103.4	15.5	10,054
				9,596
LBR 9	9	103.9	14.7	10,625
				11,002

To obtain a design embankment resilient modulus, a 90 percent method was used as outlined in both the Flexible Pavement Design Manual and Soils and Foundations Handbook. The resilient modulus values were ranked in ascending order and the percentage of values which were greater than or equal to the individual value were determined. The results of this analysis are recorded in Table 4 and the corresponding graph of these results is included as Figure 1.

Table 4. Ranked M_R Test Results for 90 Percent Method

Rank	Sample ID	% ≥	M_R (psi)
1	LBR 3 (2)	100	9,221
2	LBR 2 (2)	94	9,294
3	LBR 7 (2)	89	9,394
4	LBR 8 (2)	83	9,596
5	LBR 2 (1)	78	9,718
6	LBR 3 (1)	72	9,967
7	LBR 8 (1)	67	10,054
8	LBR 7 (1)	61	10,077
9	LBR 1 (2)	56	10,287
10	LBR 6 (1)	50	10,380
11	LBR 6 (2)	44	10,546
12	LBR 4 (1)	39	10,547
13	LBR 9 (1)	33	10,625
14	LBR 4 (2)	28	10,733
15	LBR 1 (1)	22	10,942
16	LBR 9 (2)	17	11,002
17	LBR 5 (2)	11	11,271
18	LBR 5 (1)	6	11,748

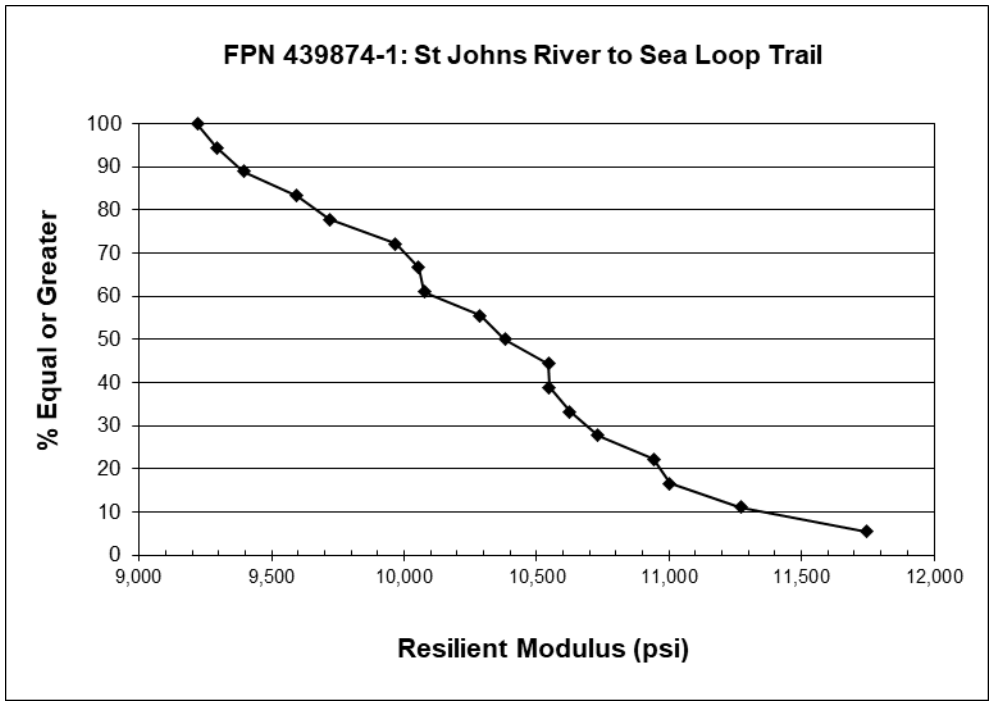


Figure 1. Ranked M_R Test Results for 90% Method

Based on the results shown in Table 4 and Figure 1, the resilient modulus corresponding to a 90th percentile is **9,400 psi**, which would represent the design embankment M_R value.