February 16, 2022

Kisinger Campo & Associates
201 N. Franklin Street, Suite 400
Tampa, FL 33602

Attn: Mr. Thomas J. Shaw, P.E.

RE: Final Roadway Soil Survey Report
Roadway Plans Submittal
CR 865 (Estero Boulevard) over Big Carlos Pass
Lee County, Florida
CN-160002
Tierra Project No. 6511-16-051

Mr. Shaw:

Tierra, Inc. (Tierra) has completed a Roadway Soil Survey Report for the above referenced project. This report is being provided to support the Roadway Plans Submittal. The results of our field exploration program and laboratory testing performed to date and subsequent geotechnical recommendations are presented herein.

Tierra, Inc. (Tierra) appreciates the opportunity to be of service to Kisinger Campo & Associates, (KCA) on this project. If you have any questions or comments regarding this report, please contact our office at your earliest convenience.

Sincerely,

TIERRA, INC.

This item has been digitally signed and sealed by:

Erick M Frederick
2022.02.17 10:46:31-05'00'

on the date adjacent to the seal.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Thomas E. Musgrave, P.E.
Geotechnical Engineer
Florida License No. 81669

Erick M. Frederick, P.E.
Senior Geotechnical Engineer
Florida License No. 63920

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1.0 PROJECT INFORMATION

1.1 Project Authorization

Authorization to proceed with this project was issued by KCA in accordance with the Subconsultant Agreement.

1.2 Project Description

The project consists of the proposed replacement of the Big Carlos Pass Bridge, which carries CR 865 (Estero Boulevard) over Big Carlos Pass. The existing bridge (Bridge No. 120028) over Big Carlos Pass is functionally obsolete and has exceeded its service life of 50 years. The proposed bridge replacement project includes the construction of a new bridge built to modern transportation and structural standards with associated roadway and drainage improvements. The new, high-level fixed bridge will be constructed to the south of the existing bridge. As the Big Carlos Pass Bridge is only one of two bridges leading to Lover's Key, with the Big Carlos Pass Bridge accessing Lover's Key from the north, the construction will be phased so as to allow traffic to continue over the Big Carlos Pass.

The current bridge design calls for the bridge limits to extend from approximate station 413+66 to approximate station 436+32. The roadway typical sections for the project will include the following arrangements:

- Begin Project to approximate station 410+55 – Two-way, two-lane roadway with center turning lane.
- Approximate station 410+55 to Begin Bridge - Two-way, two-lane roadway with center turning lane supported by raised embankment fill and retaining walls.
- End Bridge to approximate station 440+96 - Two-way, two-lane roadway with bike lanes supported by raised embankment fill and retaining walls. In addition, two-way, two-lane frontage roads will be constructed to the outside of the Eastbound (EB) and Westbound (WB) mainline travelways.
- Approximate station 440+96 to approximate station 446+50 - Two-way, two-lane roadway with bike lanes and two-way, two-lane frontage roads constructed to the outside of the EB and WB mainline travelways.
- Approximate station 446+50 to End Project - Two-way, two-lane roadway with bike lanes and WB turning lane.

This report concentrates on the proposed roadway and drainage improvements associated with the bridge replacement project. The purpose of this report is to provide geotechnical (i.e. soils and groundwater) input to the design team to assist in the design of the proposed roadway and drainage improvements. Reports addressing the bridge structure and retaining walls will be submitted under separate title.

1.3 General Site Description

The existing CR 865 typical section is a two-lane rural section (flush shoulders with open drainage swales). There is a 6-foot sidewalk along the WB lane of the roadway north of Big Carlos Pass. The length of the existing bridge has two approximately 5 feet wide sidewalks along both sides of the travel lanes. Land use adjacent to CR 865 in the project area generally consists of residential land, beaches and coastal wetlands.

2.0 PURPOSE AND SCOPE OF SERVICES

The geotechnical study was performed to obtain information on the existing subsurface conditions along the project alignment to assist in the design of the proposed roadway improvements. The following services were provided:

1. Reviewed soil information from the “Soil Survey of Lee County, Florida” published by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Reviewed topographic and potentiometric information obtained from the “Fort Myers Beach, Florida” Quadrangle map and the “Potentiometric Surface of the Upper Floridan Aquifer, West-Central Florida” maps published by the United States Geological Survey (USGS), respectively. Reviewed existing bridge plans and soil boring data provided by KCA.

2. Conducted a visual reconnaissance of the project site and coordinated utility clearance via Sunshine State One Call.

3. Collected four (4) bulk soil samples of the existing subgrade soils along the CR 865 alignment. Performed Limerock Bearing Ratio (LBR) testing on the soil samples.

4. Performed a geotechnical field study to evaluate the existing subsurface conditions along the project alignment consisting of borings, subsurface sampling and field-testing. We performed more than 55 hand augers and more than 20 Standard Penetration Test (SPT) borings along the project roadway alignment.

5. Performed seven (7) field permeability tests within the proposed pond areas.

6. Visually examined soil samples recovered from the borings in the laboratory. Performed laboratory tests on selected representative samples to confirm our visual classification and developed the soil legend for the project using the American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System.

7. Prepared this Roadway Soil Survey Report to support the Final Roadway Plans Submittal for the project.

3.0 REVIEW OF PUBLISHED DATA

3.1 Regional Geology of Lee County

The Lee County Soil Survey published by the USDA was reviewed for information concerning the geology in the project area. In addition, the following paragraphs were paraphrased from the Florida Geological Survey, Open-File Report 80, 2001 and other geologic references:

The near surface geologic deposits and formations from youngest to oldest in Lee County include: Holocene Sediment (Qh), Undifferentiated sediments (Qu), Shelly sediments (TQsu), the Tamiami Formation (Tt), the Peace River Formation (Thp) and the Arcadia Formation (Tha).

The Holocene sediments generally occur near the coastline and with river flood plains and includes; quartz sands, carbonate sand and muds with organics. The Undifferentiated sediments are siliciclastics that are light gray, tan, brown to black, unconsolidated to poorly consolidated, clean to clayey silty, unfossiliferous, variably organic-bearing sands to blue green to olive green, poorly to moderately consolidated, sandy, silty clays. The Shelly sediments are variably calcareous and fossiliferous quartz sands to well indurated, sandy, fossiliferous limestones with clayey sands and sandy clays present.

The Tamiami Formation is a poorly defined lithostratigraphic unit containing a wide range of mixed carbonate-siliciclastic lithologies. The lithologies include: 1) light gray to tan, unconsolidated, fine to coarse grained, fossiliferous sand; 2) light gray to green, poorly consolidated, fossiliferous sandy clay to clayey sand; 3) light gray, poorly consolidated, very fine to medium grained, calcareous, fossiliferous sand; 4) white to light gray, poorly consolidated, sandy, fossiliferous limestone; and 5) white to light gray, moderately to well indurated, sandy, fossiliferous limestone. The Tamiami Formation has from highly permeable to impermeable lithologies that form a complex aquifer and primarily outcrops in most of eastern Lee County and can reach thicknesses of greater than 100 feet.

The Peace River Formation is primarily found near sea level elevation and is approximately 50 to 150 feet thick under the county. The Peace River Formation is composed of interbedded sands, clays and carbonates. The sands are generally light gray to olive gray, poorly consolidated, clayey, variably dolomitic, very fine to medium grained and phosphatic. The clays are yellowish gray to olive gray, poorly to moderately consolidated sandy, silty, phosphatic and dolomitic. The carbonates are light gray to yellowish gray, poorly to well indurated, variably sandy and clayey, and phosphatic. The carbonates often include opaline chert.

The Arcadia Formation is predominantly a carbonate unit with variable siliciclastic component and is found about 150 to 200 feet below land surface (bls) in Lee County. The Arcadia Formation is composed of yellowish gray to light olive gray to light brown, micro to finely crystalline, variably sandy, clayey and phosphatic, fossiliferous limestones and dolostones. Thin beds of sand and clay are common. The sands are yellowish gray, very fine to medium grained, poorly to moderately indurated, clayey, dolomitic and phosphatic. The clays are yellowish gray to light olive gray, poorly to moderately indurated, sandy, silty, phosphatic and dolomitic.

3.2 USGS Quadrangle Map

Based on a review of the "Fort Myers Beach, Florida" USGS Quadrangle Map, it appears that the natural elevation at the bridge site ranges from approximately 0 to +5 feet National Geodetic Vertical Datum of 1929 (NGVD 29) as illustrated on the **USGS Quadrangle Map** in **Appendix A**.

3.3 USDA Soil Survey, Lee County, Florida

Based on a review of the Lee County Soil Survey published by the USDA, it appears that there are five (5) primary soil-mapping units noted along the project alignment. The **USDA Soil Survey Map** is illustrated in **Appendix A** and the soil mapping units are summarized in **Appendix A**.

3.4 Potentiometric Surface Information

Based on a review of the "Potentiometric Surface of the Upper Floridan Aquifer in Florida" maps published by the USGS, the potentiometric surface elevation of the upper Floridan Aquifer in the project vicinity is not available due to lack of water-level data in this area from wells open only to the Upper Floridan Aquifer. For the area generally south of Latitude 27°N, no interpretation was made because of a lack of control points and the complexity of the flow system, which includes several permeable zones.

4.0 SUBSURFACE EXPLORATION

4.1 Boring Location Plan, Utility Clearance and Traffic Control

Prior to commencing our subsurface explorations, a boring location plan was produced. The boring location plan was generated based on a review of the current design information and general guidance provided in the FDOT "Soils and Foundation Handbook" along with our engineering judgment. The test borings were located and staked in the field by a representative of Tierra using a hand-held Garmin eTrex™ non-survey grade Global Positioning System (GPS) device with a manufacturer's reported accuracy of ±10 feet. Tierra then coordinated utility clearances for the test borings through Sunshine State One Call. Generally, the borings were performed at the proposed boring locations. When not possible due to access or utility constraints, the boring locations were altered and the GPS coordinates of the offset boring locations were recorded on the boring logs. The approximate locations of the borings performed for this study are shown on the **Boring Location Plan** sheets in **Appendix A**.

Utility clearances were coordinated by Tierra and updated as required prior to performing the soil borings in order to reduce the potential for damage to the underground utilities during the boring process. Subsurface explorations were performed in general compliance with the applicable FDOT Standard Plans Maintenance of Traffic.

4.2 Soil Borings

Hand auger and SPT borings were completed in order to evaluate the subsurface conditions and groundwater table levels along the roadway alignment. The hand auger borings were performed by manually twisting and advancing a bucket auger into the ground, typically in 4 to 6 inch increments. The SPT borings were performed in general accordance with the American Society for Testing and Materials (ASTM) test designation D-1586. The initial 4 feet of the SPT borings were manually hand augered to verify utility clearance. SPT resistance N-values were taken continuously from the auger termination depth to a depth of 10 feet and on intervals of 5 feet thereafter. As each soil type was revealed, representative samples were placed in air-tight containers and returned to our laboratory for testing and visual classification.

The locations and ground elevations of some test borings were provided by the project surveyor. The locations of the remaining borings were estimated using project design files in conjunction with the GPS coordinates obtained in the field and therefore should be considered approximate. The boring locations and results of the borings performed are presented on the **Boring Location Plan** sheets, **Roadway Soil Profiles** sheets, and **Pond Soil Profiles** sheets respectively, in **Appendix A**.

4.3 Organic Soil, (A-8) Exploration

Organic materials (A-8) were encountered within several borings performed along the roadway alignment between approximate stations 432+20 to 446+50. This area was delineated with the use of auger borings and probes in order to further characterize the vertical and horizontal limits of the A-8 soils. The results of the borings performed and the delineation limits are presented on the **Soil Profiles** sheets and **Muck Delineation Sheets** in **Appendix A**. The limits of subsoil excavation are also presented on the Roadway Plans Cross-Sections.

Recommendations regarding the organic material encountered are provided in the **Engineering Evaluations and Recommendations** section of this report.

4.4 Bulk Soil Sampling and LBR Testing

Bulk samples were retrieved for Limerock Bearing Ratio (LBR) testing at four (4) locations along the proposed roadway improvements. The sample locations were selected on alternating sides of the existing alignment in areas of the proposed roadway improvements. In general, these samples were collected from the top 1 to 2 feet of the near-surface soils encountered. The results of the LBR testing are provided in **Appendix B** of this report.

5.0 LABORATORY TESTING

5.1 General

Representative soil samples collected from the borings were classified in general accordance with the AASHTO Soil Classification System. Our classification was based on visual observations, using the results from laboratory testing as confirmation. Corrosion tests were assigned on selected soil samples from the borings to provide a basis for environmental classification.

5.2 Test Designation

The following list summarizes the laboratory tests performed by Tierra and the respective test methods utilized.

- Grain-Size Analyses - The grain-size analyses were conducted in general accordance with the AASHTO test designation T-088 (ASTM test designation D-422).
- Fines Content Test - The fines content tests were conducted in general accordance with the AASHTO test designation T-088 (ASTM test designation D-422).
- Natural Moisture Content - The natural moisture content tests were performed in general accordance with AASHTO test designation T-265 (ASTM test designation D-2216).
- Organic Content – The organic content tests were performed in general accordance with AASHTO test designation T-267.
- Atterberg Limits - The liquid limit and the plastic limit tests (“Atterberg Limits”) were conducted in general accordance with the AASHTO test designations T-089 and T-090, respectively (ASTM test designation D-4318).
- Environmental Classification – The environmental classification tests were conducted in general accordance with the FDOT test designations FM 5-550, FM 5-551, FM 5-552 and FM 5-553.

A summary of the laboratory test results for each soil stratum encountered along the project alignment is presented on the **Roadway Soils Survey Sheet** in **Appendix A**. This sheet includes ranges of laboratory test results for different stratum soil samples collected from borings performed along the project alignment. Detailed summaries of the laboratory test results performed for this report are presented in **Appendix C**.

6.0 RESULTS OF SUBSURFACE EXPLORATION

6.1 General Soil Conditions

The soil types encountered during exploration have been assigned to a stratum number. The stratum descriptions and soil types associated with this project are listed in the following table.

Stratum No.	Typical Soil Description	AASHTO Classification
1	Gray to Brown Fine Sand to Sand with Silt, occasionally with Shell	A-3
2	Gray to Brown Silty Sand, occasionally with Shell	A-2-4
3	Gray to Dark Gray Clayey Sand to Clay, occasionally indurated	A-2-6, A-6, A-4, A-7-5
4	Weathered Limestone/Caprock to Calcareous Clay	---(1)
5	Dark Brown Organic Silty Sand to Peat	A-8
(1) The AASHTO classification system does not include nomenclature for Limestone.		

These soil strata are also described in the soil legend on the **Roadway Soil Survey Sheet** in **Appendix A.** The soil stratification was based on a visual review of the recovered samples, laboratory testing, and interpretation of the field boring logs. The boring stratification lines represent the approximate boundaries between soil types of significantly different engineering properties; however, the actual transition may be gradual. In some cases, small variations in properties not considered pertinent to our engineering evaluation may have been abbreviated or omitted for clarity. The boring profiles represent the conditions at the particular boring location and variations do occur among the borings. The results of the borings performed for this investigation can be seen on the **Roadway Soil Profiles** sheets and **Pond Soil Profiles** sheets in **Appendix A**.

6.2 Groundwater

The groundwater table was measured at many of the boring locations during our field exploration. The depths to the groundwater table, when encountered, were found to range from at or above the ground surface to approximately 7 feet below the existing ground surface. The groundwater table was not encountered within some of the borings performed during our field exploration. As a result, GNE (Groundwater Not Encountered) is shown adjacent to these soil profiles. The groundwater table levels measured at the boring locations are presented on the soil profiles in **Appendix A**.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences (i.e. existing water management canals, swales, drainage ponds, underdrains and areas of covered soils, such as paved parking lots and sidewalks). The test boring locations are within a region of Lee County that is in proximity to the Estero Bay waterway. The groundwater table may be influenced by tidal effects.

6.3 Seasonal High Groundwater Estimates

Seasonal High Groundwater Table (SHGWT) levels were estimated at selected boring locations along the roadway alignment and within proposed ponds. The estimated SHGWT depths at the boring locations along the roadway alignment ranged from at or above existing grades to 3 feet below the existing ground surface at the boring locations explored.

It is important to note that the test boring locations are within a region of Lee County that is in proximity to the Estero Bay waterway. The seasonal high groundwater table may be influenced by tidal effects.

The estimated SHGWT levels at the appropriate boring locations are shown adjacent to the soil boring profiles in **Appendix A**. In addition, the **Summary of Seasonal High Groundwater Table Estimates** table is presented in **Appendix B**.

6.4 Field Hydraulic Conductivity Testing

Hydraulic conductivity (permeability) tests were performed in the vicinity of proposed "dry" ponds along the roadway alignment. Seven (7) tests were performed within Strata 1 and 2 soils at depths ranging from approximately 6 inches to 3 feet below existing grades. The tests were performed and the results evaluated in accordance with the methodology presented in the FDOT *Soils and Foundations Handbook*. A summary of the field hydraulic test results is presented in **Summary of Preliminary Geotechnical Parameters for Ponds** in **Appendix B**.

It is important to note that the results provided are the measured hydraulic conductivity rates of the encountered Strata 1 and 2 soils at the time of our field activities. **No reduction, limiting value, or factors of safety have been applied to these rates**. It should be noted that embankment/fill soils can have lower permeability characteristics than the reported rates provided in this report due to the compacted nature of the embankment soils.

7.0 ENGINEERING EVALUATIONS AND RECOMMENDATIONS

7.1 General

All earthwork activities including the site preparation, clearing and grubbing, removal and utilization/placement of soils, compaction of subgrade soils and selection of backfill materials should be accomplished in accordance with the current FDOT Standard Plans and Specifications.

Stratum 5 (A-8) material was encountered at variable depths below existing grades between approximate stations 432+20 to 446+50. According to laboratory testing, this material has organic contents that range from approximately 8 to 55 percent. It is recommended that this material be treated as "muck" and removed as "muck" in accordance with the FDOT Standard Plans and Specifications. The approximate limits of the proposed organic soil removal are identified on the **Muck Delineation Sheets** in **Appendix A** and are shown on the cross-sections within the Roadway Plans.

7.2 Groundwater Control

Depending upon groundwater levels at the time of construction, some form of dewatering will be required to achieve the required compaction. The groundwater levels presented in this report are the levels that were measured at the time of our field activities. Fluctuation should be anticipated. The contractor shall determine groundwater levels prior to construction and evaluate these levels with regards to the anticipated construction.

7.3 Pavement Design Considerations

As previously mentioned, LBR testing was performed on soil samples obtained along the existing roadway alignment. As addressed in the Summary LBR Test Results shown in **Appendix B**, a design M_R value of 12,000 psi is recommended for use in the pavement design based on the Design LBR calculated and correlations to Resilient Modulus values provided in the FDOT Flexible Pavement Design Manual. It should be noted that the design M_R value obtained from the tests performed may not be representative of borrow materials which may support some of the proposed roadway. Stabilizing material may be required depending on the embankment fill borrow sources.

Grades for this type of roadway should be ideally set to provide a minimum separation per Lee County Guidelines and/or FDOT Plans and Preparation Manual (PPM) between the bottom of the base and the estimated seasonal high groundwater levels. Correspondingly, the base should remain equally above sustained water treatment levels in roadside ditches, making positive drainage of the ditches important. The choice of base material would depend upon the relationship of final roadway improvement grades and the bottom of the base to the estimated seasonal high groundwater table levels.

The design of the pavement section should be in accordance with the Lee County Guidelines and/or FDOT Flexible Pavement Design Manual and the FDOT Plans Preparation Manual.

7.4 Embankment Settlement

Based on a review of the cross-sections, proposed maximum new embankment heights are on the order of less than 5 feet. Based on the anticipated embankment heights and the soil conditions encountered in our borings, we do not anticipate conditions that would pose limitations to the construction of the proposed CR 865 embankments after proper subgrade preparation. We expect total settlements to be less than one (1) inch for embankments of 5 feet in height that are supported on compacted sand fill and natural soils, and approximately half that amount differential settlements. These settlements are expected to occur predominantly during construction as loads are placed. Once final cross sections are available, settlement calculations will be performed for the proposed roadway embankment fill areas.

All embankment fill soils should be utilized, placed and compacted in accordance with the Lee County and FDOT Specifications.

7.5 Slope Stability

Based on a review of the cross-sections provided by KCA, the proposed roadway embankments appear to have maximum side slopes of 4 horizontal to 1 vertical (4H:1V). Based on the results of the borings and that roadway embankments are constructed in accordance with Lee County and FDOT Specifications, Tierra does not anticipate performance limitations to the proposed roadway with embankment slopes of 4H:1V or flatter. Once final cross sections are available, calculations to evaluate slope stability will be performed for the proposed roadway embankments.

7.6 Temporary Side Slopes and Excavations

Temporary side slopes and excavations should comply with the Occupational Safety and Health Administration's (OSHA) trench safety standards, 29 C.F.R., s. 1926.650, Subpart P, all subsequent revisions or updates of OSHA's referenced standard adopted by the Department of Labor and Employment Security and Florida's Trench Safety Act, Section 553.62, Florida Statutes. Excavated materials should not be stockpiled at the top of the slope within a horizontal distance equal to the excavation depth.

7.7 On-Site Soil Suitability

The general suitability of the soils encountered during our geotechnical exploration is presented on the **Roadway Soils Survey Sheet** in **Appendix A**. FDOT Specifications and Standard Plans should be consulted to determine the specific use/suitability of the soil types encountered during our geotechnical explorations performed to date.

7.8 Linear Swale and Pond Design Considerations

We understand that linear swales and two stormwater ponds are proposed along the roadway alignment. The linear swales are proposed to be on the outside of the roadway embankment. It is our understanding that the swales and ponds will be "dry retention" as indicated by KCA. Field permeability tests were performed to support the drainage design. The results are provided in the **Summary of Preliminary Geotechnical Parameters for Ponds** table in **Appendix B**. It should be noted that the field permeability test results provided are <u>not factored</u>. The drainage design engineer should apply an appropriate factor of safety.

In general, the existing embankment soils consist of compacted A-3/A-2-4 sands with shell, with the exception of the muck area as previously indicated in this report. These compacted soils can impede groundwater flow infiltration and compromise the function of "dry" linear swales/ponds.

8.0 FHWA REVIEW CHECKLIST

Conformance to the FHWA Report "Checklist and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specifications" prepared by the Geotechnical and Materials Branch, FHWA, Washington, D.C., dated October 1985 is required when preparing geotechnical reports. The FHWA checklist for this report is enclosed in **Appendix D** of this report.

9.0 REPORT LIMITATIONS

Our services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices at the time of this report. Our geotechnical engineering evaluation of the site and subsurface conditions with respect to the planned roadway improvements, and our recommendations for site preparation and roadway construction are based upon the following: (1) site observations, (2) the field exploratory test data obtained during the geotechnical study, and (3) our understanding of the project information and anticipated grades as presented in this report. This company is not responsible for the conclusions, opinions or recommendations made by others based on these data.

The scope of the exploration was intended to evaluate soil conditions within the influence of the proposed roadway improvements. The analyses and recommendations submitted in this report are based upon the anticipated location and type of construction and data obtained from the soil borings performed at the locations indicated and does not reflect any variations which may occur among these borings. If any variations become evident during the course of construction, 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 scope of services, included herein, did not include any environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water and groundwater, air, on the site, below and around the site. Any statements in this report or on the boring logs regarding odors, colors, unusual or suspicious items and conditions are strictly for the information of KCA and Lee County.

APPENDIX A

USDA Soil Survey & USGS Quadrangle Maps

Summary of USDA Soil Survey

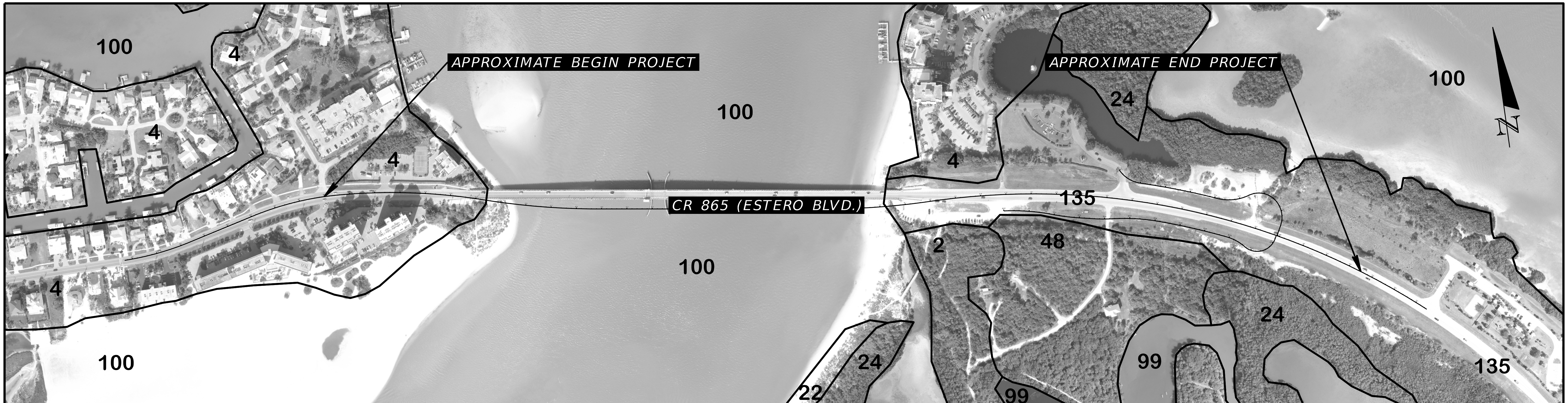
Roadway Soils Survey Sheet

Boring Location Plan Sheets

Roadway Soil Profiles Sheets

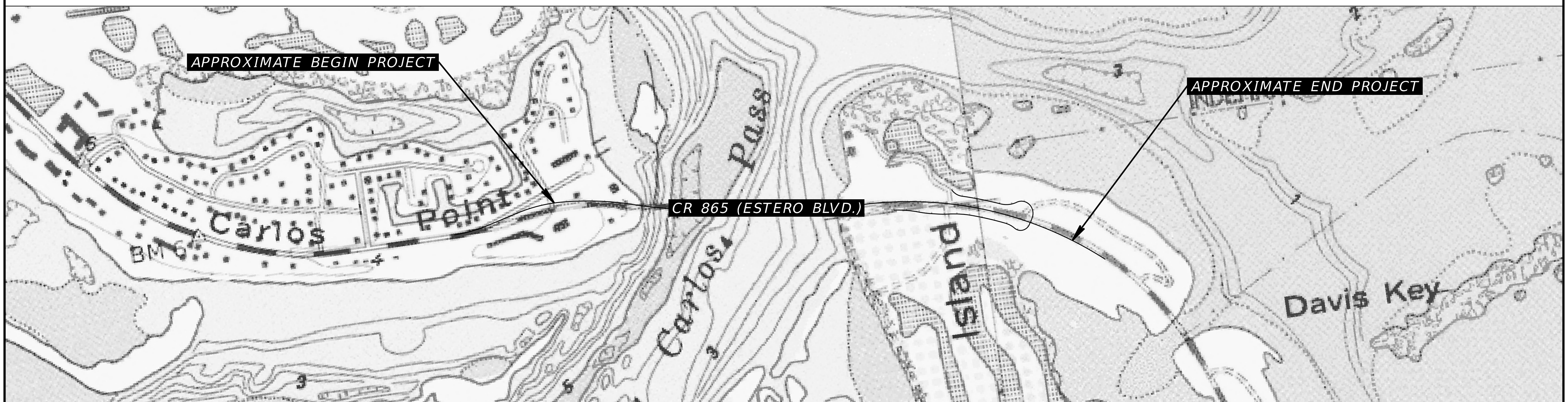
Pond Soil Profiles Sheets

Muck Delineation Sheets



REFERENCE: USDA SOIL SURVEY OF LEE COUNTY, FLORIDA

0 100 400
Feet



REFERENCE: USGS QUADRANGLE MAP OF "FORT MYERS BEACH, FLORIDA"

0 200 800
Feet

TOWNSHIP: 47S
RANGE: 24E
SECTION: 3 & 11

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY: BJS
CHECKED BY: TM
DESIGNED BY: BJS
CHECKED BY: EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT ID
CR 865	LEE	CN160002

SHEET TITLE: USDA SOIL SURVEY & USGS QUADRANGLE MAPS

PROJECT NAME: BIG CARLOS PASS BRIDGE PD&E STUDY

REF. DWG. NO.

SHEET NO.

Summary of USDA Soil Survey

CR 865 (Estero Boulevard) over Big Carlos Pass

Lee County, Florida

Lee County Project No. CN160002

Tierra Project No. 6511-16-051

USDA Map Symbol and Soil Name	Depth (in)	Soil Classification		Permeability (in/hr)	pH	Seasonal High Water Table	
		USCS	AASHTO			Depth (feet)	Months
(2) Canaveral	0-7	SP-SM, SM	A-2-4, A-3	20.0 - 40.0	6.6-8.4	1.5 - 3.5	June-Nov
	7-15	SP-SM	A-3, A-2-4	20.0 - 40.0	6.6-8.4		
	15-80	SP-SM	A-2-4, A-3	20.0 - 40.0	6.6-8.4		
(4) Canaveral-Urban land	0-7	SP-SM, SM	A-2-4, A-3	20.0 - 40.0	6.6-8.4	1.5 - 3.5	June-Nov
	7-15	SP-SM	A-2-4, A-3	20.0 - 40.0	6.6-8.4		
	15-80	SP-SM	A-3, A-2-4	20.0 - 40.0	6.6-8.4		
(24) Kesson, tidal	0-6	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	7.4-8.4	At or Above Grade	Jan-Dec
	6-23	SM, SP-SM	A-3, A-2-4	2.0 - 20.0	7.4-8.4		
	23-38	SP-SM, SM	A-2-4, A-3	2.0 - 20.0	7.4-8.4		
	38-80	SP-SM, SM	A-2-4, A-3	2.0 - 20.0	7.4-8.4		
(48) St.Augustine	0-30	SP-SM	A-3, A-2-4	6.0 - 20.0	6.6-8.4	1.5 - 3.5	June-Nov
	30-40	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	6.6-8.4		
	40-80	SM, SP-SM	A-3, A-2-4	6.0 - 20.0	6.6-8.4		
(135) St. Augustine Sand - Urban Land Complex	0-30	SP-SM	A-3, A-2-4	6.0 - 20.0	6.6-8.4	1.5 - 3.5	June - Nov
	30-40	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	6.6-8.4		
	40-80	SM, SP-SM	A-3, A-2-4	6.0 - 20.0	6.6-8.4		

DATE OF SURVEY: OCTOBER 2016 TO FEBRUARY 2022
SURVEY MADE BY: TIERRA, INC.
SUBMITTED BY: ERICK M. FREDERICK, P.E.

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.: CR 865 (ESTERO BOULEVARD)
COUNTY: LEE

LEE COUNTY PROJECT NUMBER : CN-160002
PROJECT NAME: BIG CARLOS PASS BRIDGE

CROSS SECTION SOIL SURVEY FOR THE DESIGN OF ROADS

SURVEY BEGINS STA. : 408+48.02 SURVEY ENDS STA. : 449+54.13 REFERENCE: CENTERLINE CONSTRUCTION CR 865 (ESTERO BOULEVARD)

	ORGANIC CONTENT		MOISTURE CONTENT		SIEVE ANALYSIS RESULTS PERCENT PASS (%)						ATTERBERG LIMITS (%)					CORROSION TEST RESULTS				
STRATUM NO.	NO. OF TESTS	% ORGANIC	NO. OF TESTS	MOISTURE CONTENT	NO. OF TESTS	10 MESH	40 MESH	60 MESH	100 MESH	200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTIC INDEX	AASHTO GROUP	DESCRIPTION	NO. OF TESTS	RESISTIVITY ohm-cm	CHLORIDE ppm	SULFATES ppm	pH
1	8	1-4	8	17-69	17	63-100	60-99	57-95	42-66	4-10	--	--	--	A-3	GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL	5	1,800-5,400	12-150	45-228	7.4-8.4
2	1	1	5	30-48	20	78-100	67-100	64-98	51-82	11-34	4	NP	NP	A-2-4	GRAY TO BROWN SILTY SAND, OCCASIONALLY WITH SHELL	--	--	--	--	--
3	--	--	1	23	1	--	--	--	--	33	1	25	11	A-2-6/A-6/ A-4/A-7-5	GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	WEATHERED LIMESTONE/CAPROCK TO CALCAREOUS CLAY	--	--	--	--	--
5	19	8-55	19	52-456	19	--	--	--	--	5-26	--	--	--	A-8	DARK BROWN ORGANIC SILTY SAND TO PEAT	--	--	--	--	--

EMBANKMENT AND SUBGRADE MATERIAL

STRATA BOUNDARIES ARE APPROXIMATE. MAKE FINAL CHECK AFTER GRADING.

▼ - WATER TABLE ENCOUNTERED
▽ - ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
GNE - GROUNDWATER NOT ENCOUNTERED
GNA - GROUNDWATER NOT APPARENT DUE TO THE INTRODUCTION OF DRILLING FLUID
NP - NON-PLASTIC

NOTES:

1. THE MATERIAL FROM STRATUM 1 (A-3) APPEARS SATISFACTORY FOR USE IN THE EMBANKMENT WHEN UTILIZED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-001.
2. THE MATERIAL FROM STRATUM 2 (A-2-4) APPEARS SATISFACTORY FOR USE IN THE EMBANKMENT WHEN UTILIZED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-001. HOWEVER, THIS MATERIAL IS LIKELY TO RETAIN EXCESS MOISTURE AND MAY BE DIFFICULT TO DRY AND COMPACT. IT SHOULD BE USED IN THE EMBANKMENT ABOVE THE WATER LEVEL EXISTING AT THE TIME OF CONSTRUCTION.
3. THE MATERIAL FROM STRATUM 3 (A-2-6/A-6/A-4/A-7-5) IS PLASTIC MATERIAL AND SHALL BE REMOVED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-002 AND UTILIZED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-001.
4. THE MATERIAL FROM STRATUM NUMBER 4 IS A NATURAL LIMESTONE FORMATION. SPECIAL TOOLS AND EQUIPMENT WILL BE REQUIRED TO EXCAVATE AND/OR DEWATER THIS MATERIAL.
5. WEATHERED LIMESTONE/CAPROCK WAS ENCOUNTERED WITHIN THE BORINGS. THIS MATERIAL IS ROCK AND IS LOCATED AT SHALLOW DEPTHS. EXCAVATIONS INTO AND/OR THROUGH LIMESTONE/CAPROCK WILL BE DIFFICULT AND WILL REQUIRE NON CONVENTIONAL CONSTRUCTION TECHNIQUES AND SPECIALIZED EQUIPMENT. LIMESTONE/CAPROCK IS POROUS AND WILL BE DIFFICULT TO DEWATER.
6. THE MATERIAL FROM STRATUM 5 (A-8) IS MUCK MATERIAL AND SHALL BE REMOVED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-002 AND UTILIZED IN ACCORDANCE WITH FDOT STANDARD PLANS, INDEX 120-001.

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY: BJS
CHECKED BY: TM
DESIGNED BY: BJS
CHECKED BY: EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

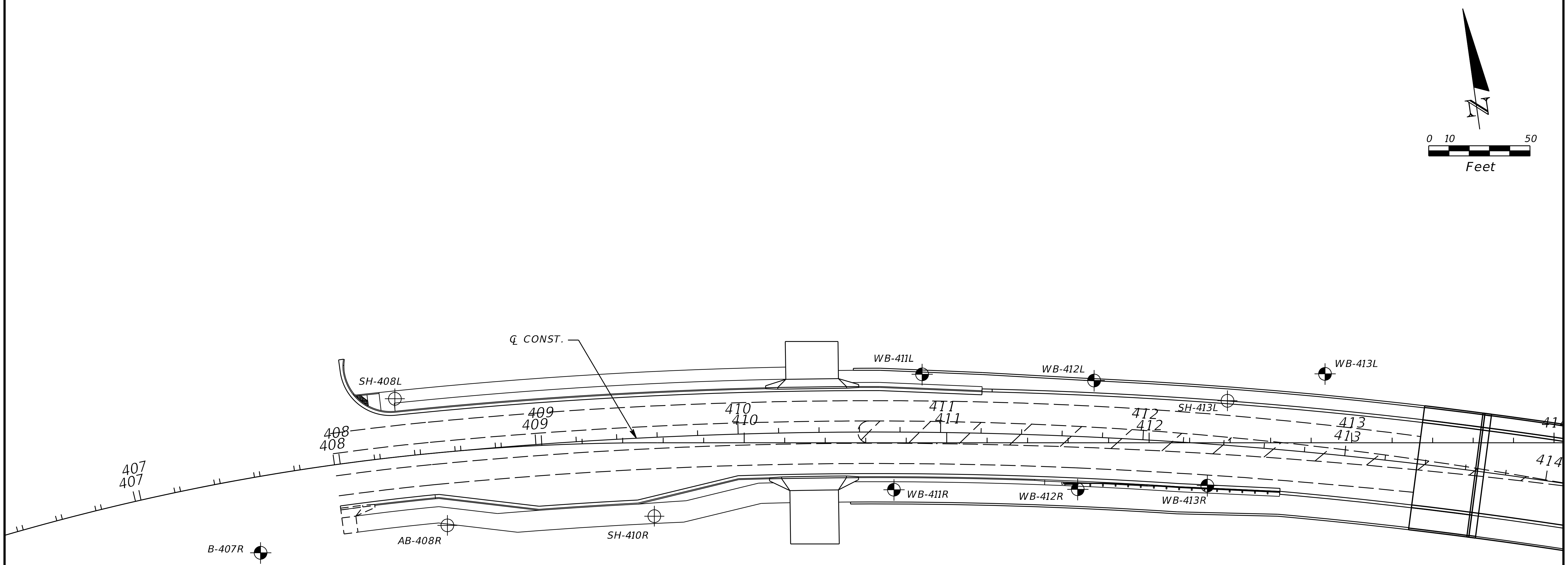
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: ROADWAY SOIL SURVEY

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE AUGER BORING LOCATION

REVISIONS					
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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: BORING LOCATION PLAN (1)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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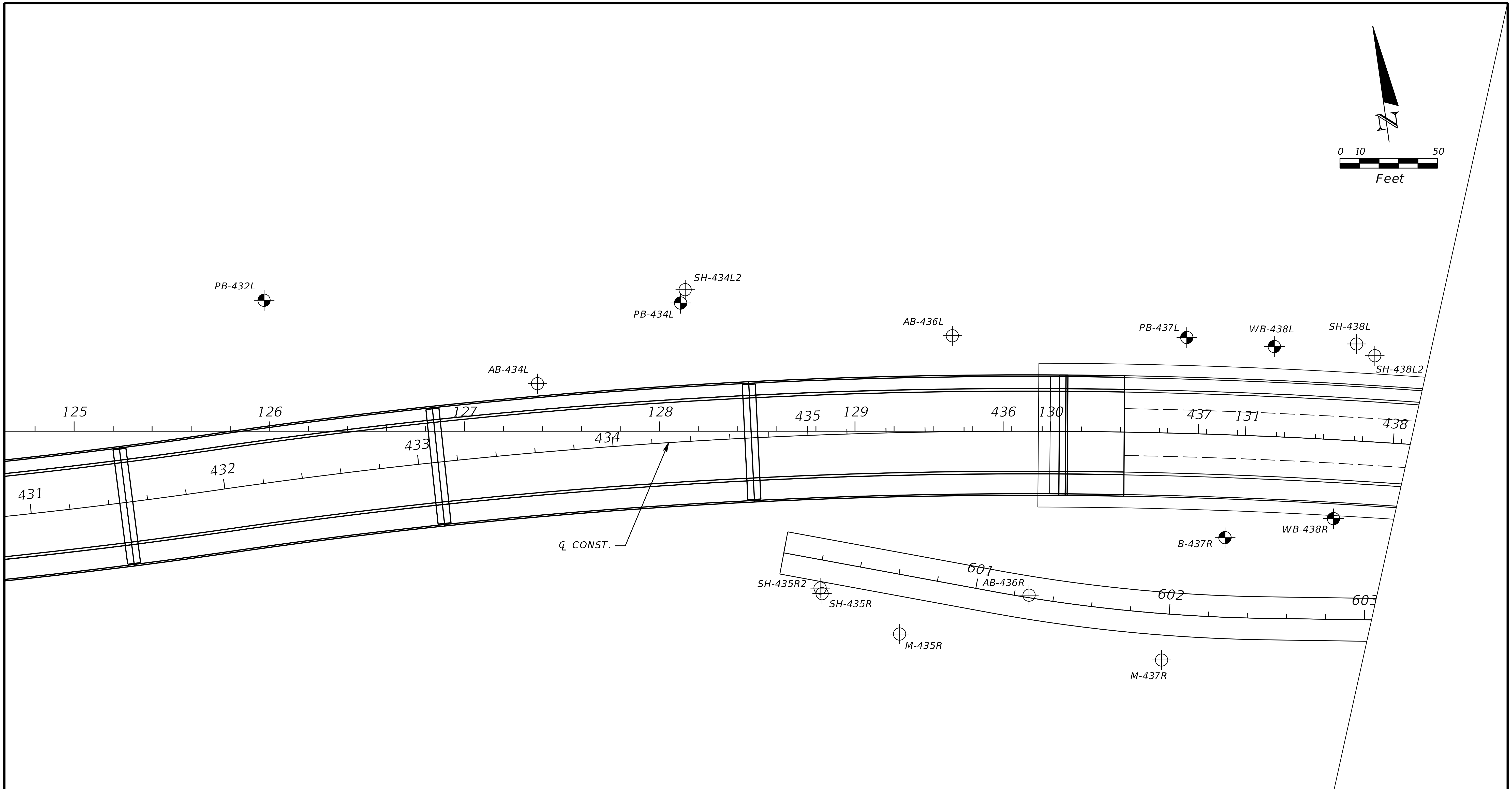

LEGEND

APPROXIMATE SPT BORING LOCATION

APPROXIMATE AUGER BORING LOCATION

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
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TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: BORING LOCATION PLAN (2)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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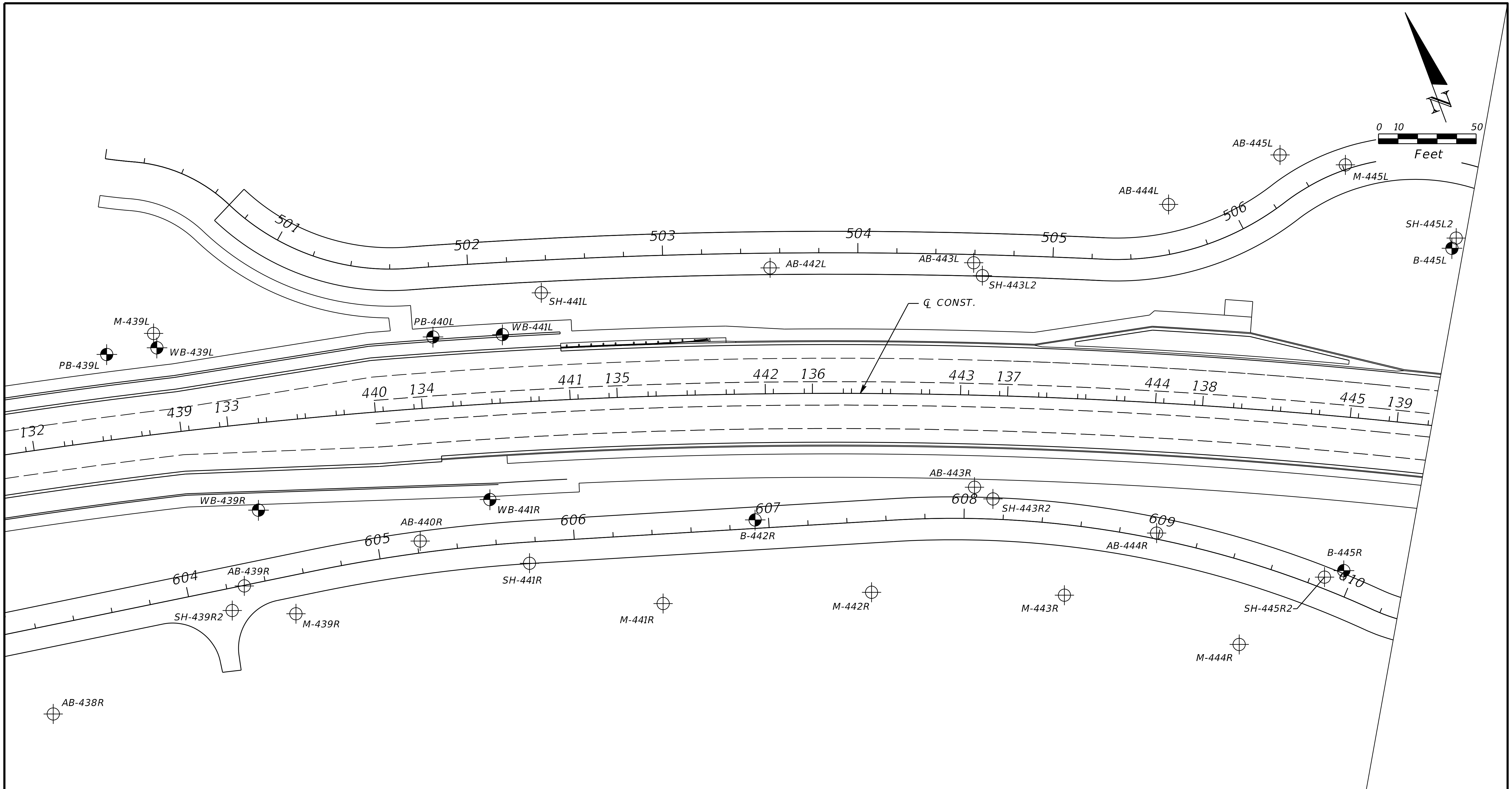

LEGEND

APPROXIMATE SPT BORING LOCATION

APPROXIMATE AUGER BORING LOCATION

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: BORING LOCATION PLAN (3)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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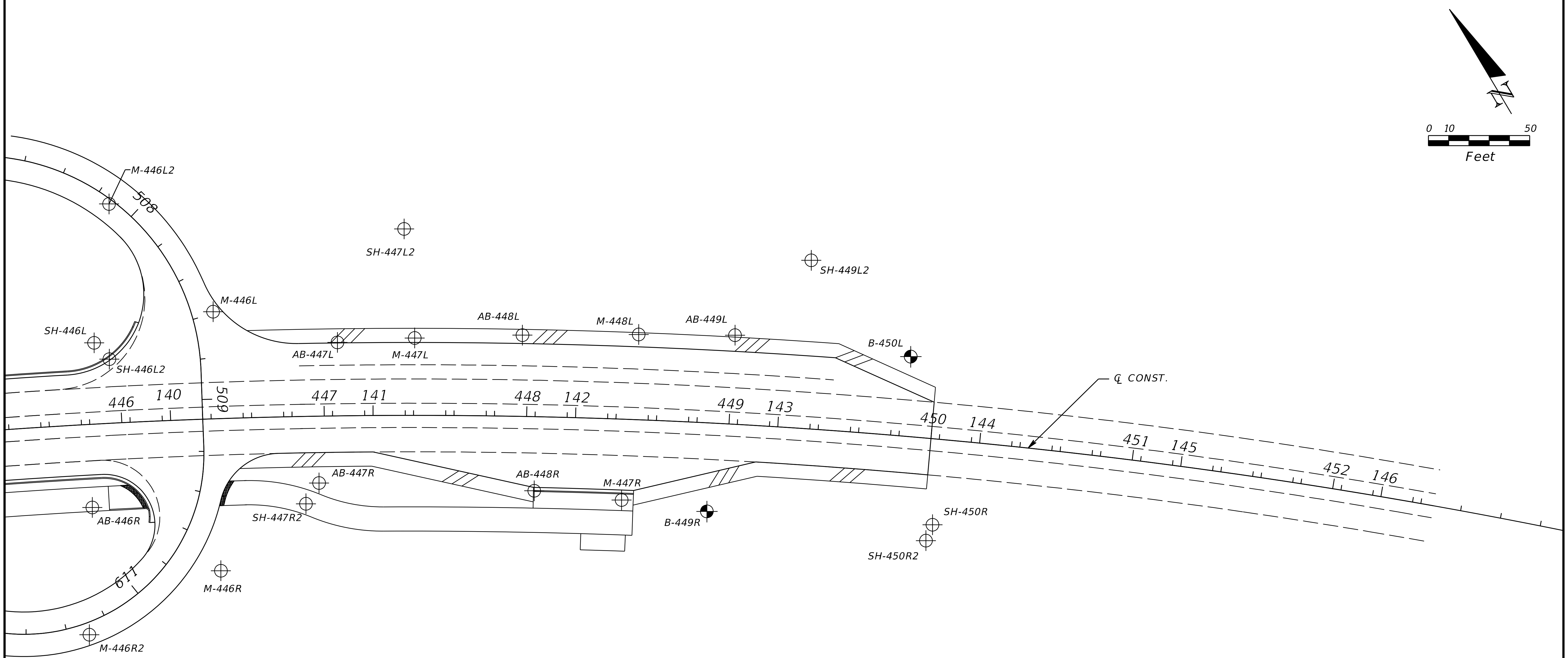

LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE AUGER BORING LOCATION

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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TAMPA, FLORIDA 33637

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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

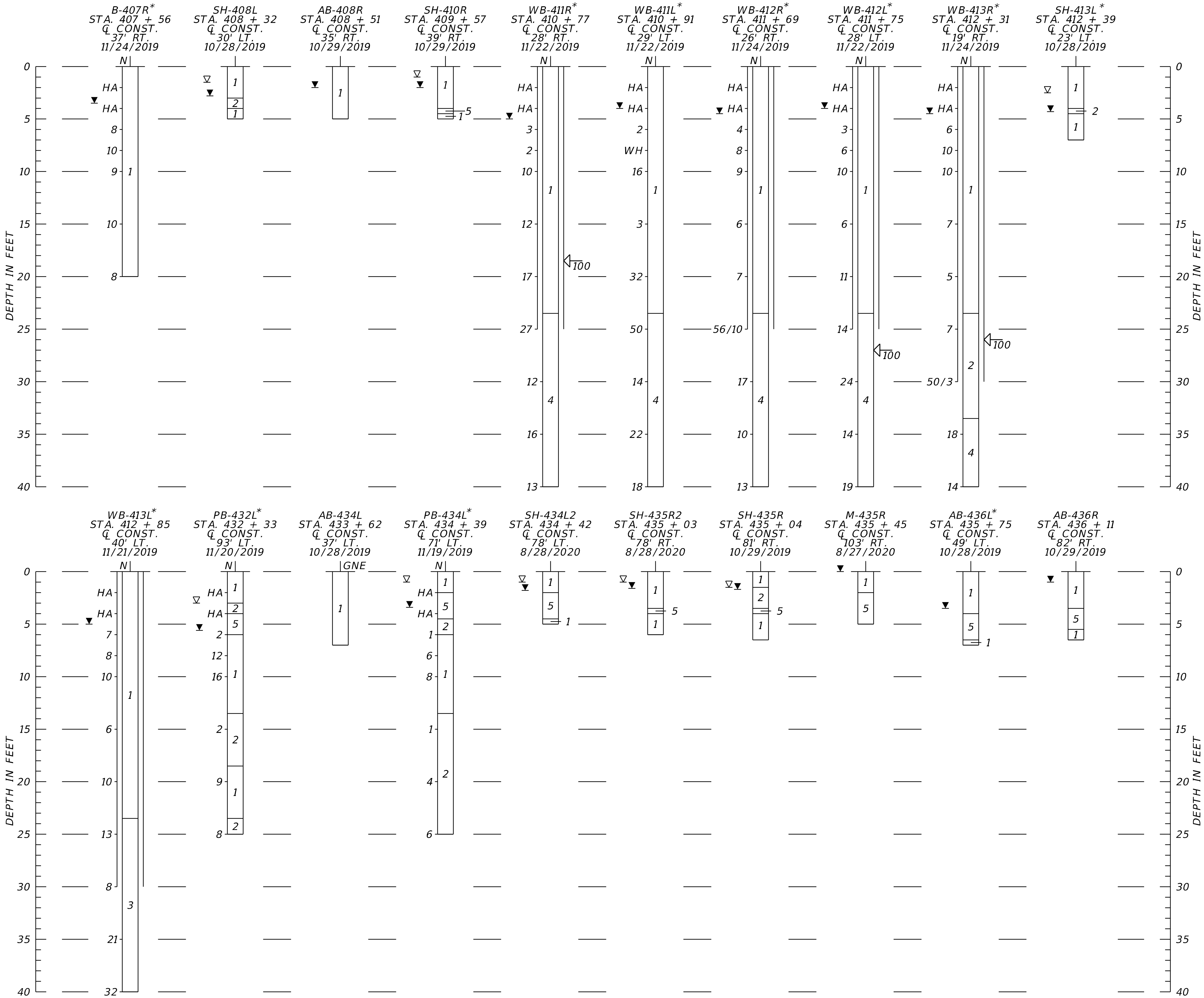
SHEET TITLE: BORING LOCATION PLAN (4)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

bgarcia 10/4/2021 4:04:14 PM J:\6511\2016 Files\6511-16-051 Big Carlos Pass\Microstation\ABORRD04.dgn



LEGEND

1. GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
2. GRAY TO BROWN SILTY SAND, OCCASIONALLY WITH SHELL (A-2-4)
3. GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED (A-2-6, A-6, A-4, A-7-5)
4. WEATHERED LIMESTONE/CAPROCK TO CALCAREOUS CLAY
5. DARK BROWN ORGANIC SILTY SAND TO PEAT (A-8)

A-3 — AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.

N — NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).

50/4 — NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION

HA — HAND AUGERED TO VERIFY UTILITY CLEARANCE

WH — SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER

▽ — ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ — GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE — GROUNDWATER NOT ENCOUNTERED

◁100 — LOSS OF CIRCULATION OF DRILLING FLUID (%)

| | — CASING

CAVE-IN — BORING TERMINATED DUE TO BOREHOLE COLLAPSE FROM GROUNDWATER INTRUSION

℄ CONST. — CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTES:

1. BORING LOCATIONS DENOTED WITH AN ASTERISK "*" WERE PROVIDED BY THE PROJECT SURVEYOR.
2. THE SPT BORINGS WERE PERFORMED UTILIZING AN AUTOMATIC HAMMER

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	LESS THAN 4 4 to 10 10 to 30 30 to 50 GREATER THAN 50	LESS THAN 3 3 to 8 8 to 24 24 to 40 GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT SOFT FIRM STIFF VERY STIFF HARD	LESS THAN 2 2 to 4 4 to 8 8 to 15 15 to 30 GREATER THAN 30	LESS THAN 1 1 to 3 3 to 6 6 to 12 12 to 24 GREATER THAN 24

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

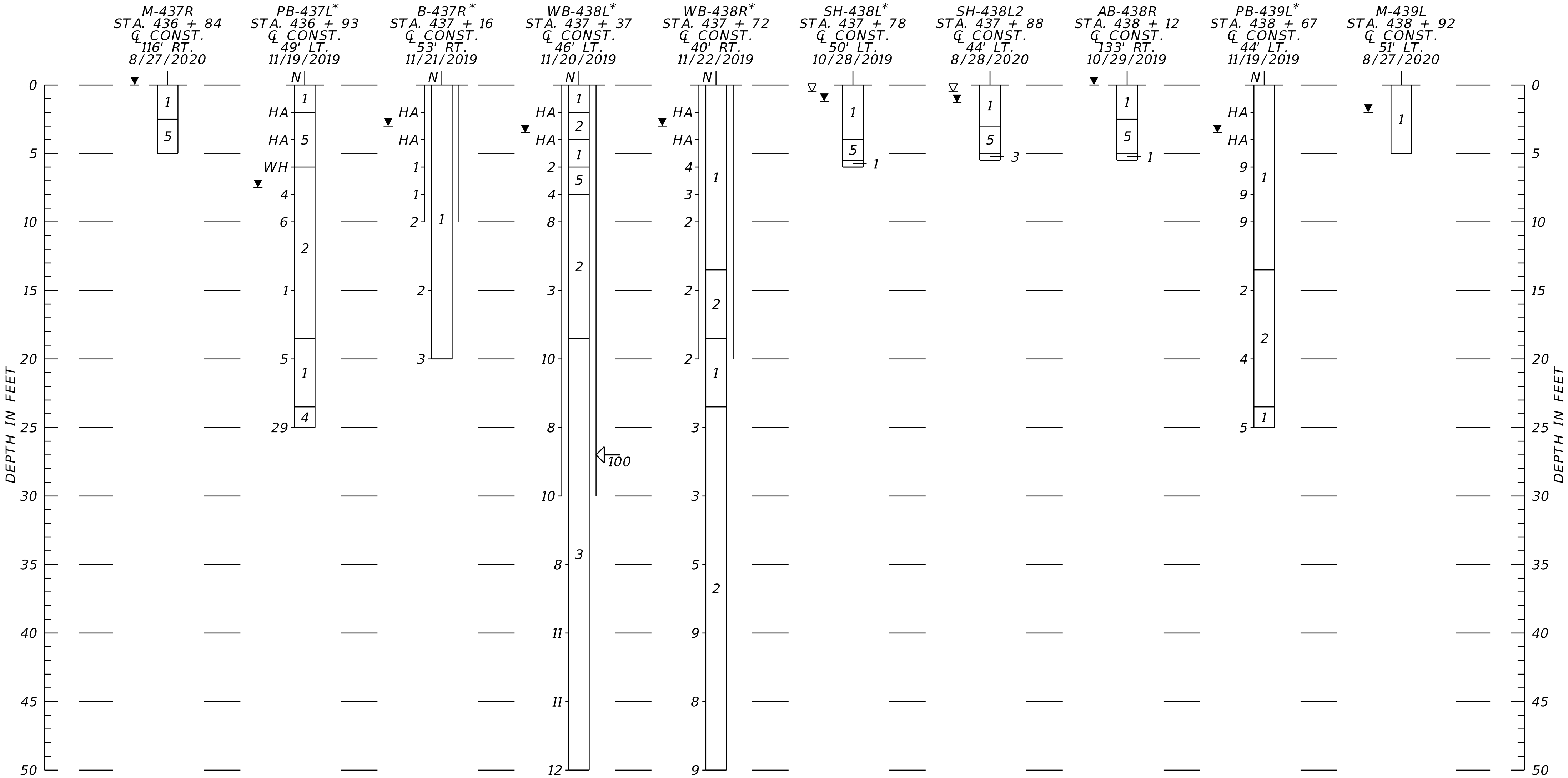
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: ROADWAY SOIL PROFILES (1)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



LEGEND

1. GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
2. GRAY TO BROWN SILTY SAND, OCCASIONALLY WITH SHELL (A-2-4)
3. GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED (A-2-6, A-6, A-4, A-7-5)
4. WEATHERED LIMESTONE/CAPROCK TO CALCAREOUS CLAY
5. DARK BROWN ORGANIC SILTY SAND TO PEAT (A-8)

A-3	AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
WH	SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
▽	ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
▼	GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
GNE	GROUNDWATER NOT ENCOUNTERED
◁100	LOSS OF CIRCULATION OF DRILLING FLUID (%)
│ │	CASING
CAVE-IN	BORING TERMINATED DUE TO BOREHOLE COLLAPSE FROM GROUNDWATER INTRUSION
℄ CONST.	CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTES:

1. BORING LOCATIONS DENOTED WITH AN ASTERISK "*" WERE PROVIDED BY THE PROJECT SURVEYOR.
2. THE SPT BORINGS WERE PERFORMED UTILIZING AN AUTOMATIC HAMMER

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	LESS THAN 4 4 to 10 10 to 30 30 to 50 GREATER THAN 50	LESS THAN 3 3 to 8 8 to 24 24 to 40 GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT SOFT FIRM STIFF VERY STIFF HARD	LESS THAN 2 2 to 4 4 to 8 8 to 15 15 to 30 GREATER THAN 30	LESS THAN 1 1 to 3 3 to 6 6 to 12 12 to 24 GREATER THAN 24

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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TAMPA, FLORIDA 33637

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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

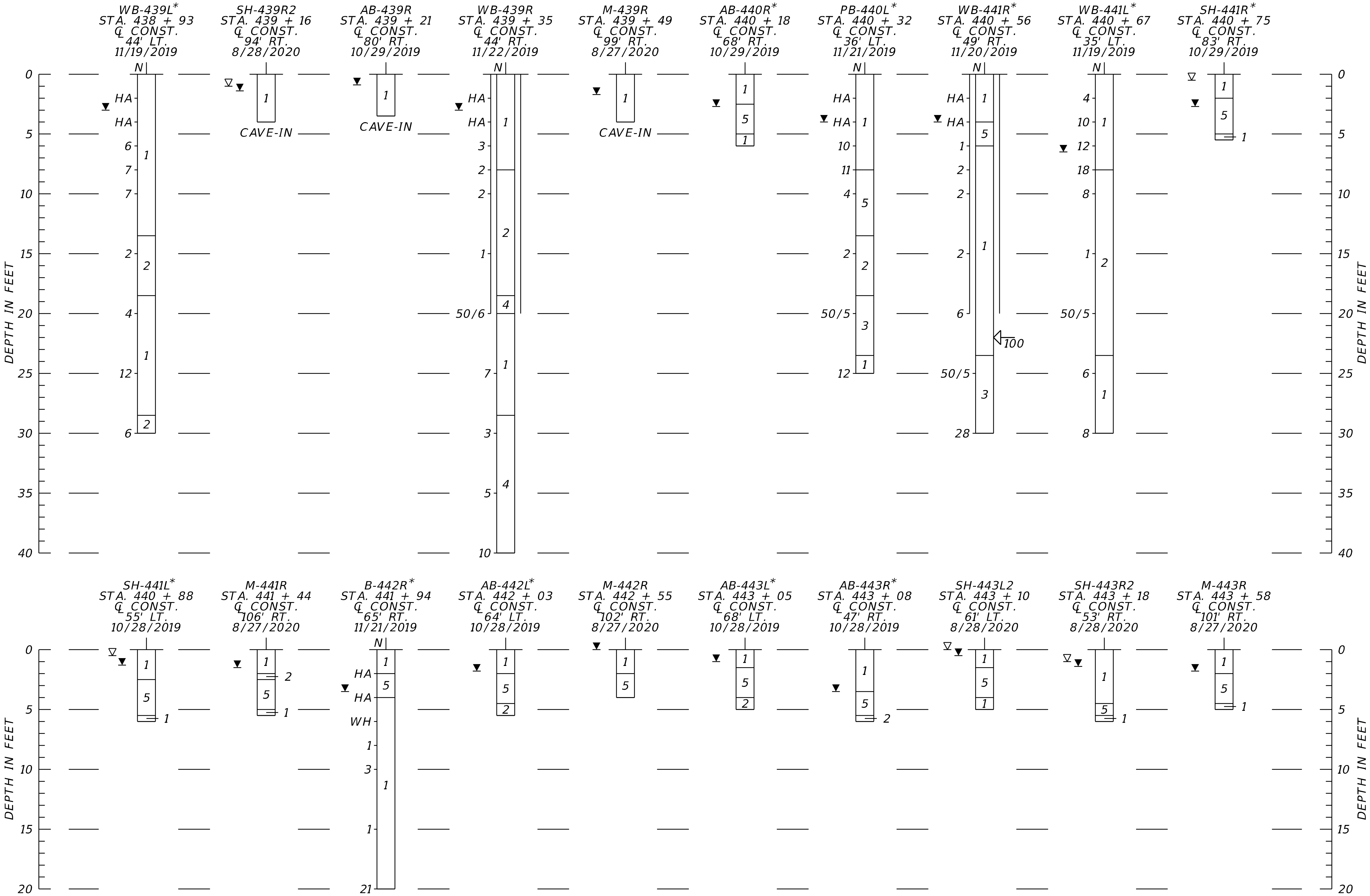
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: ROADWAY SOIL PROFILES (2)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



LEGEND

1. GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
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A-3 — AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.

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50/4 — NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION

HA — HAND AUGERED TO VERIFY UTILITY CLEARANCE

WH — SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER

▽ — ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ — GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE — GROUNDWATER NOT ENCOUNTERED

◁100 — LOSS OF CIRCULATION OF DRILLING FLUID (%)

| | — CASING

CAVE-IN — BORING TERMINATED DUE TO BOREHOLE COLLAPSE FROM GROUNDWATER INTRUSION

℄ CONST. — CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTES:

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2. THE SPT BORINGS WERE PERFORMED UTILIZING AN AUTOMATIC HAMMER

	SAFETY HAMMER	AUTOMATIC HAMMER
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REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

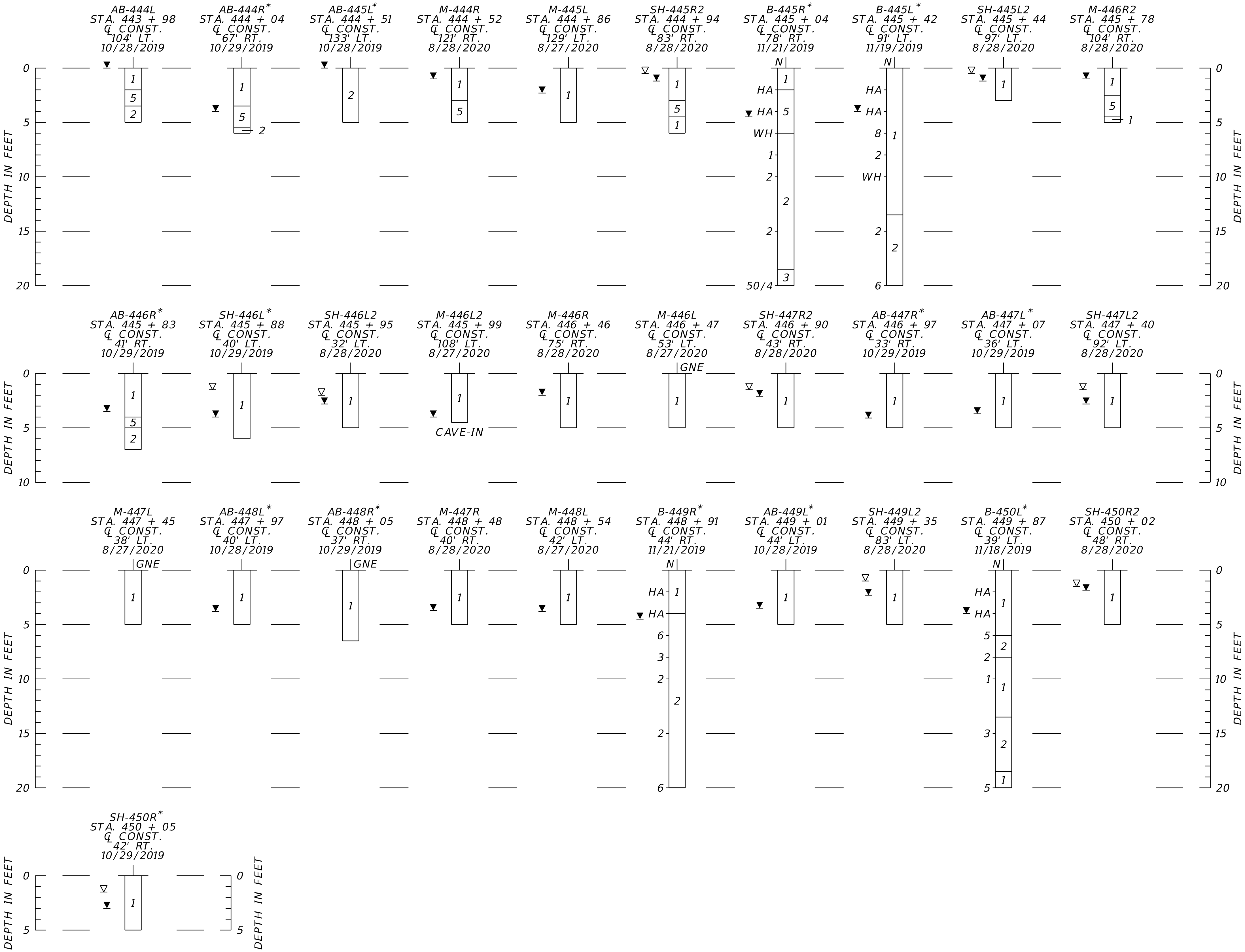
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: ROADWAY SOIL PROFILES (3)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



LEGEND

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50/4 — NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION

HA — HAND AUGERED TO VERIFY UTILITY CLEARANCE

WH — SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER

▽ — ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ — GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE — GROUNDWATER NOT ENCOUNTERED

◁100 — LOSS OF CIRCULATION OF DRILLING FLUID (%)

| | — CASING

CAVE-IN — BORING TERMINATED DUE TO BOREHOLE COLLAPSE FROM GROUNDWATER INTRUSION

℄ CONST. — CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTES:

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2. THE SPT BORINGS WERE PERFORMED UTILIZING AN AUTOMATIC HAMMER

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VERY SOFT SOFT FIRM STIFF VERY STIFF HARD	LESS THAN 2 2 to 4 4 to 8 8 to 15 15 to 30 GREATER THAN 30	LESS THAN 1 1 to 3 3 to 6 6 to 12 12 to 24 GREATER THAN 24

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
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LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

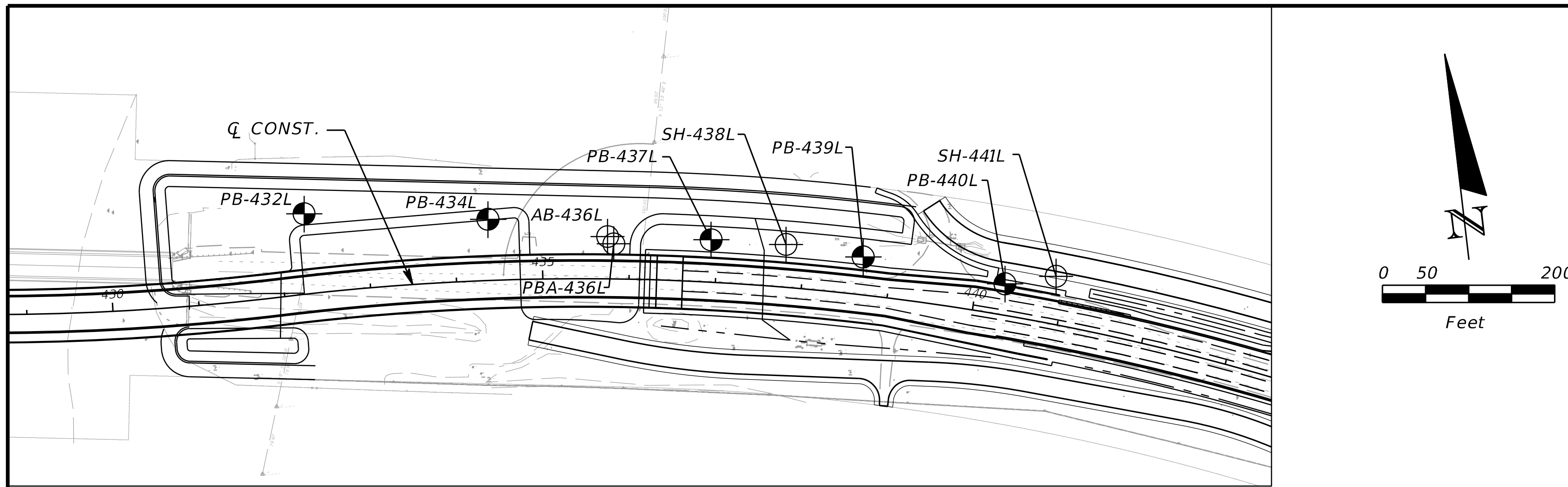
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: ROADWAY SOIL PROFILES (4)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



BORING LOCATION PLAN

LEGEND

1.	GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
2.	GRAY TO BROWN SILTY SAND OCCASIONALLY WITH SHELL (A-2-4)
3.	GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED (A-2-6, A-6, A-4, A-7-5)
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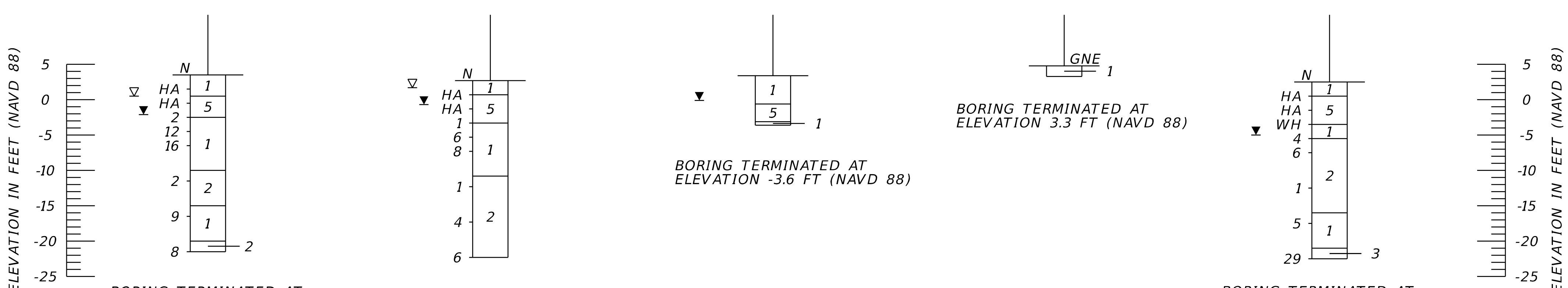
A-3	AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
WH	SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988
▽	ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
▼	GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
| |	CASING
GNA	GROUNDWATER NOT APPARENT DUE TO THE INTRODUCTION OF DRILLING FLUID.
℄ CONST.	CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTE: BORING LOCATIONS AND ELEVATIONS DENOTED WITH AN ASTERISK "*" WERE PROVIDED BY THE PROJECT SURVEYOR.

	PB-432L*	PB-434L*	AB-436L*	PBA-436L	PB-437L*
BOR #	PB-432L*	PB-434L*	AB-436L*	PBA-436L	PB-437L*
STA.	432+33	434+39	435+75	435+82	437+93
REF.	℄ CONST.	℄ CONST.	℄ CONST.	℄ CONST.	℄ CONST.
OFF.	93' LT.	71' LT.	49' LT.	41' LT.	49' LT.
ELEV.	3.5	2.7	3.4	4.8	2.5
DATE	11/20/2019	11/19/2019	10/29/2019	2/7/2020	11/19/2019
DRILLER	I. POORAN	I. POORAN			I. POORAN
HAMMER	AUTOMATIC	AUTOMATIC			AUTOMATIC
RIG	D-25	D-25			D-25



BORING TERMINATED AT ELEVATION -21.5 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -22.3 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -3.6 FT (NAVD 88)

BORING TERMINATED AT ELEVATION 3.3 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -22.5 FT (NAVD 88)

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM DENSE	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

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REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY:	CHECKED BY:	DESIGNED BY:	CHECKED BY:
BJS	TM	BJS	EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

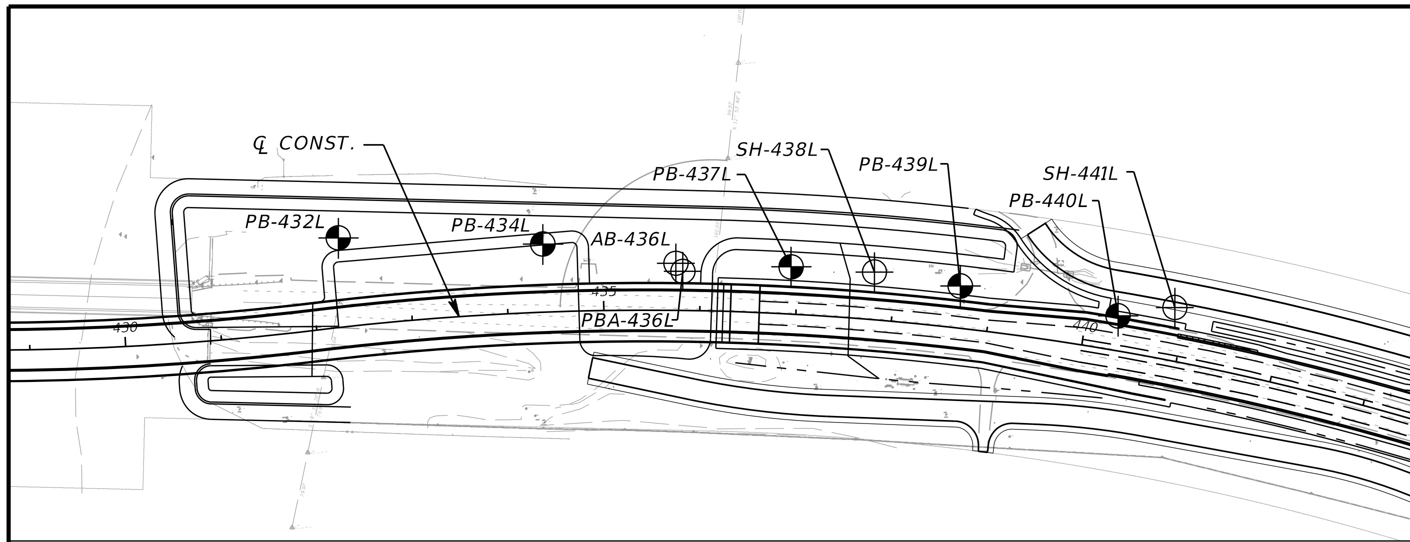
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: POND SOIL PROFILES (1)

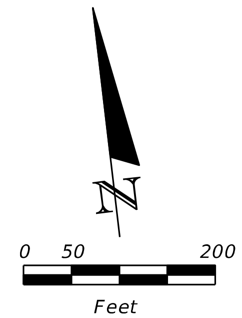
PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



BORING LOCATION PLAN



LEGEND

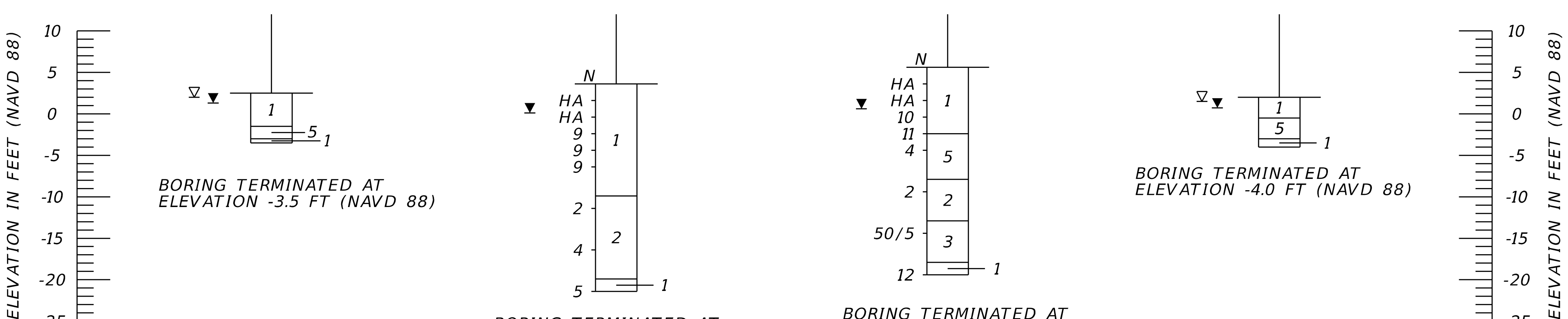
1.	GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
2.	GRAY TO BROWN SILTY SAND OCCASIONALLY WITH SHELL (A-2-4)
3.	GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED (A-2-6, A-6, A-4, A-7-5)
4.	WEATHERED LIMESTONE/CAPROCK TO CALCAREOUS CLAY
5.	DARK BROWN ORGANIC SILTY SAND TO PEAT (A-8)
A-3	AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
WH	SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988
∇	ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
▼	GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
| |	CASING
GNA	GROUNDWATER NOT APPARENT DUE TO THE INTRODUCTION OF DRILLING FLUID.
℄ CONST.	CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)
NOTE:	BORING LOCATIONS AND ELEVATIONS DENOTED WITH AN ASTERISK "*" WERE PROVIDED BY THE PROJECT SURVEYOR.

BOR #	SH-438L*	
STA.	437+78	
REF.	℄ CONST.	
OFF.	50' LT.	
ELEV.	2.5	
DATE	10/28/2019	

BOR #	PB-439L*
STA.	438+67
REF.	℄ CONST.
OFF.	44' LT.
ELEV.	3.6
DATE	11/19/2019
DRILLER	I. POORAN
HAMMER	AUTOMATIC
RIG	D-25

BOR #	PB-440L*
STA.	440+32
REF.	℄ CONST.
OFF.	36' LT.
ELEV.	5.6
DATE	11/21/2019
DRILLER	I. POORAN
HAMMER	AUTOMATIC
RIG	D-25

BOR #	SH-441L*
STA.	440+88
REF.	℄ CONST.
OFF.	55' LT.
ELEV.	2.0
DATE	10/28/2019



BORING TERMINATED AT ELEVATION -3.5 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -21.4 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -19.4 FT (NAVD 88)

BORING TERMINATED AT ELEVATION -4.0 FT (NAVD 88)

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	LESS THAN 4 4 to 10 10 to 30 30 to 50 GREATER THAN 50	LESS THAN 3 3 to 8 8 to 24 24 to 40 GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT SOFT FIRM STIFF VERY STIFF HARD	LESS THAN 2 2 to 4 4 to 8 8 to 15 15 to 30 GREATER THAN 30	LESS THAN 1 1 to 3 3 to 6 6 to 12 12 to 24 GREATER THAN 24

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REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

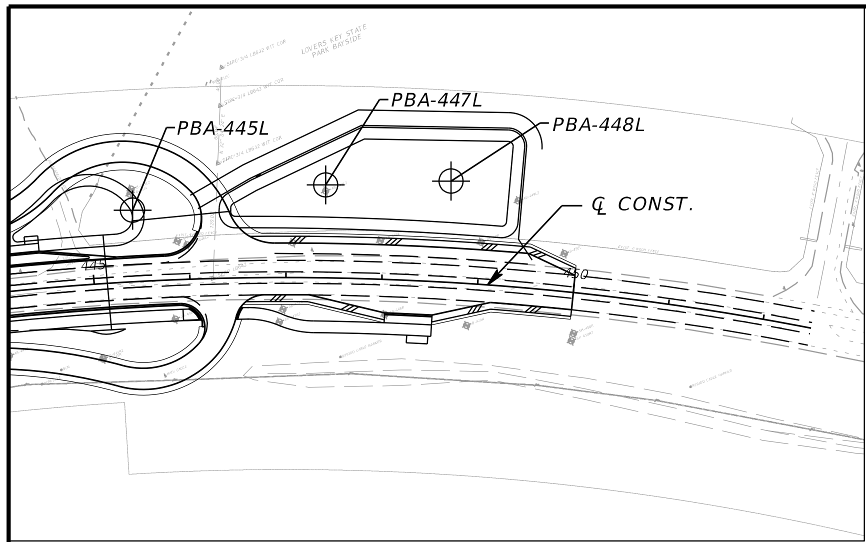
DRAWN BY: BJS	LEE COUNTY PUBLIC WORKS DEPARTMENT OF TRANSPORTATION		
CHECKED BY: TM			
DESIGNED BY: BJS	ROAD NO.	COUNTY	COUNTY PROJECT No
CHECKED BY: EMF	CR 865	LEE	CN160002

SHEET TITLE: POND SOIL PROFILES (2)

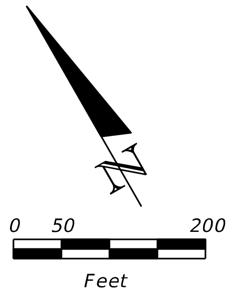
PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



BORING LOCATION PLAN

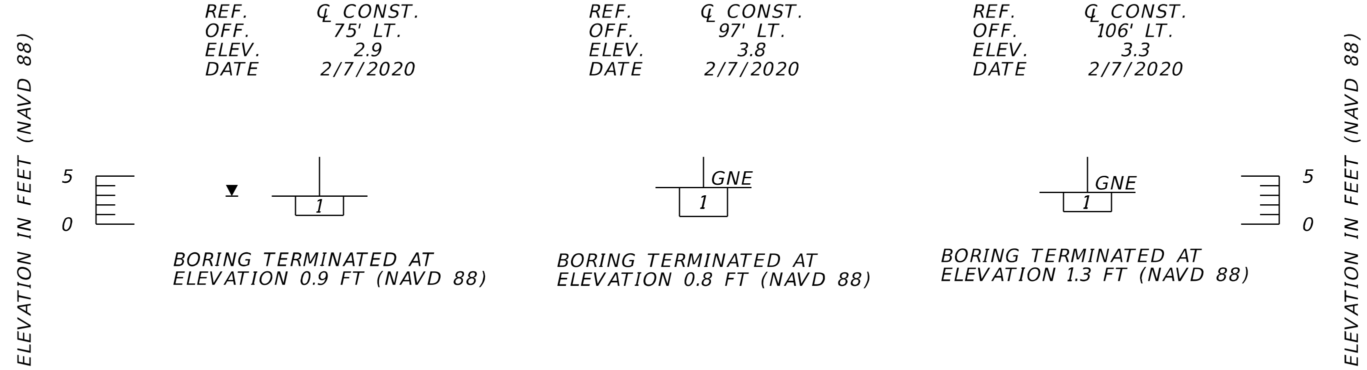


LEGEND

1.	GRAY TO BROWN FINE SAND TO SAND WITH SILT, OCCASIONALLY WITH SHELL (A-3)
2.	GRAY TO BROWN SILTY SAND OCCASIONALLY WITH SHELL (A-2-4)
3.	GRAY TO DARK GRAY CLAYEY SAND TO CLAY, OCCASIONALLY INDURATED (A-2-6, A-6, A-4, A-7-5)
4.	WEATHERED LIMESTONE/CAPROCK TO CALCAREOUS CLAY
5.	DARK BROWN ORGANIC SILTY SAND TO PEAT (A-8)
A-3	AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
WH	SPLIT-SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988
∇	ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
▼	GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
| |	CASING
GNA	GROUNDWATER NOT APPARENT DUE TO THE INTRODUCTION OF DRILLING FLUID.
℄ CONST.	CENTERLINE CONSTRUCTION OF CR 865 (ESTERO BLVD.)

NOTE: BORING LOCATIONS AND ELEVATIONS DENOTED WITH AN ASTERISK "*" WERE PROVIDED BY THE PROJECT SURVEYOR.

	PBA-445L	PBA-447L	PBA-448L
BOR #	PBA-445L	PBA-447L	PBA-448L
STA.	445+44	447+40	448+66
REF.	℄ CONST.	℄ CONST.	℄ CONST.
OFF.	75' LT.	97' LT.	106' LT.
ELEV.	2.9	3.8	3.3
DATE	2/7/2020	2/7/2020	2/7/2020



BORING TERMINATED AT ELEVATION 0.9 FT (NAVD 88)

BORING TERMINATED AT ELEVATION 0.8 FT (NAVD 88)

BORING TERMINATED AT ELEVATION 1.3 FT (NAVD 88)

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS- RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM DENSE	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

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REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY: BJS
CHECKED BY: TM
DESIGNED BY: BJS
CHECKED BY: EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

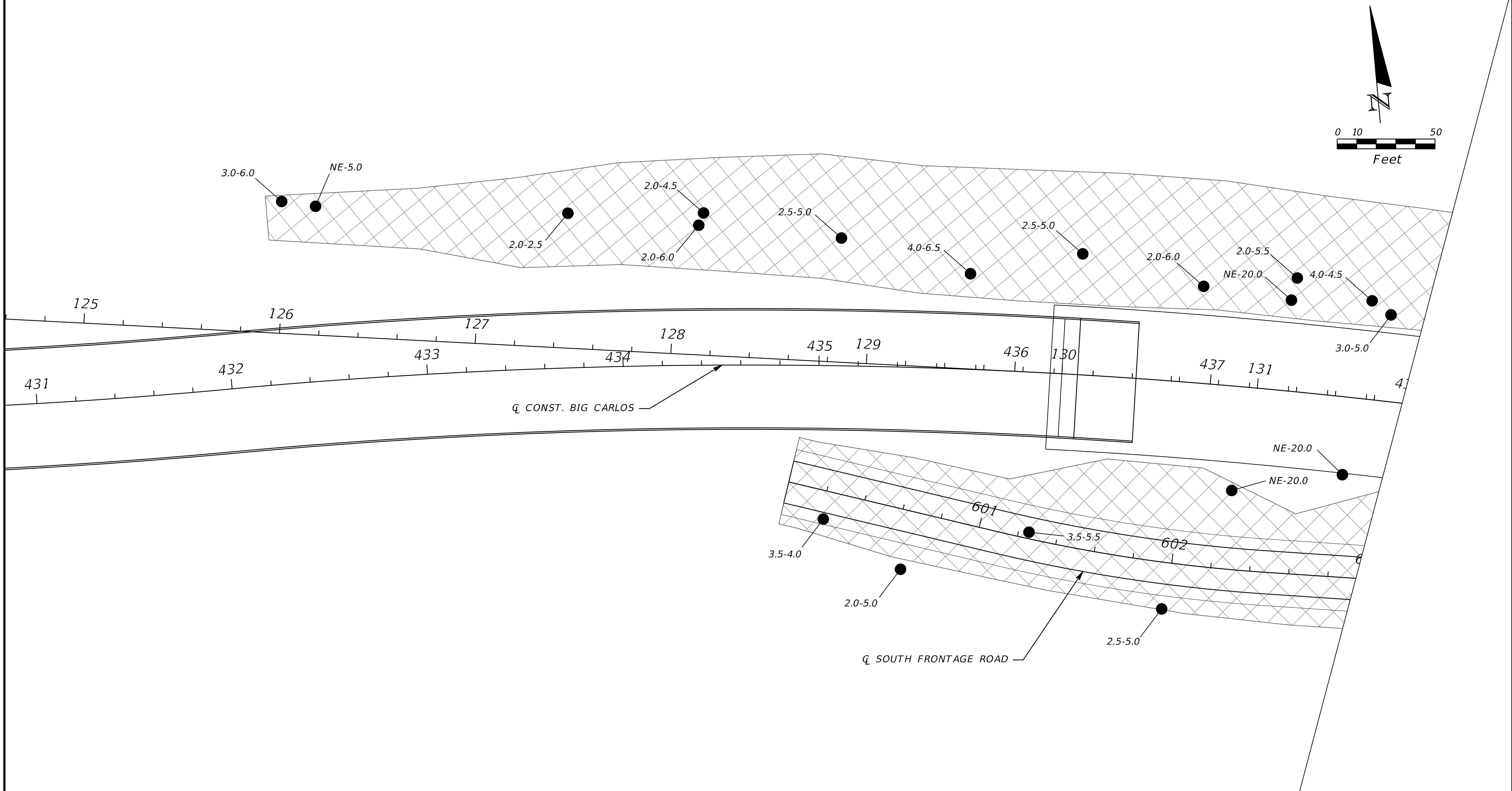
ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: POND SOIL PROFILES (3)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.



LEGEND

1.0-2.0 ● ORGANICS ENCOUNTERED 1.0 TO 2.0 FEET BELOW EXISTING GRADE

NE-5.0 ● ORGANICS NOT ENCOUNTERED TO 5.0 FEET BELOW EXISTING GRADE

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REVISIONS					
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TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY: BMG
CHECKED BY: TM
DESIGNED BY: BMG
CHECKED BY: EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: MUCK DELINEATION SHEET (1)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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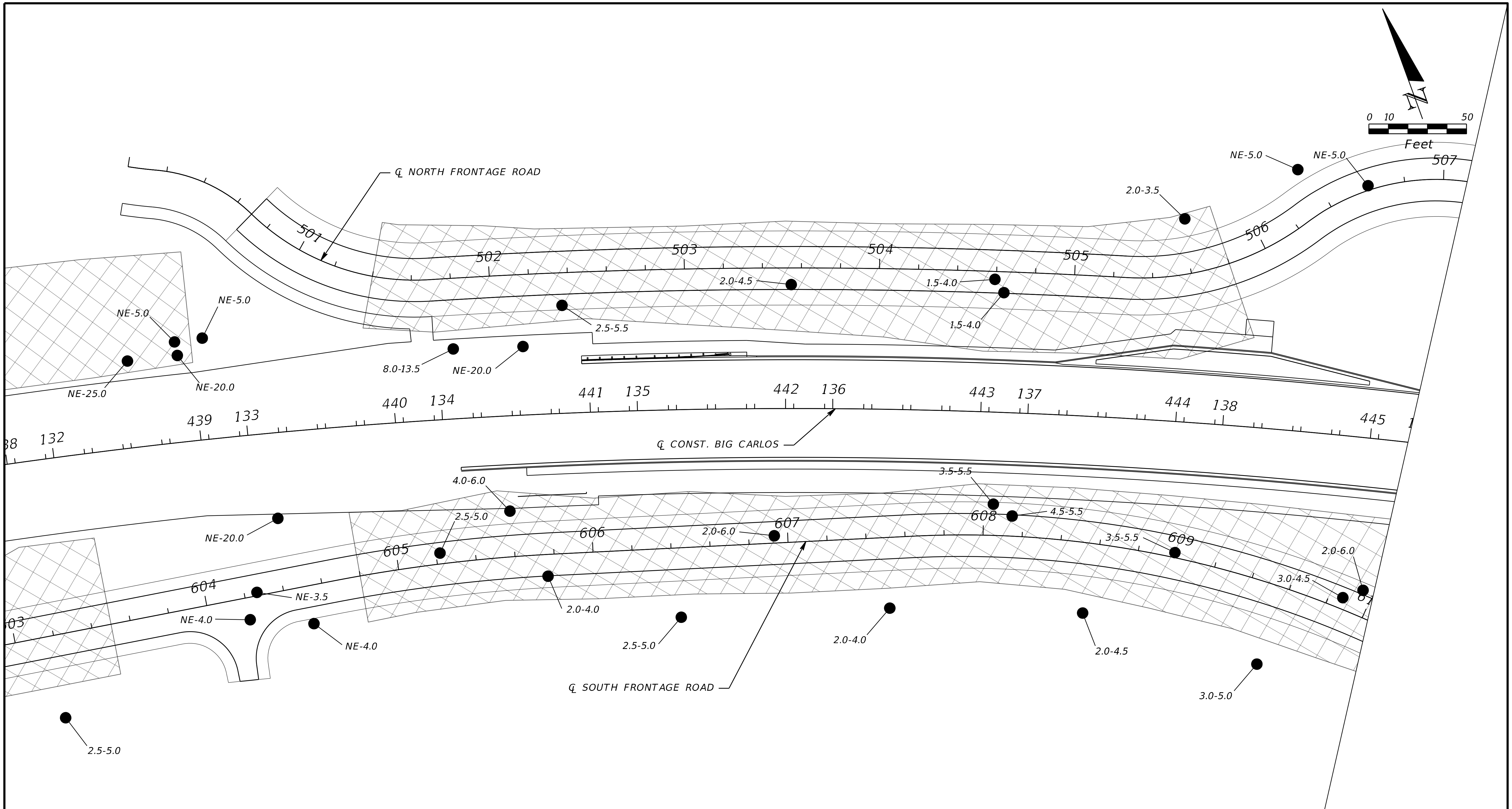

LEGEND

1.0-2.0 ● ORGANICS ENCOUNTERED 1.0 TO 2.0 FEET BELOW EXISTING GRADE

NE-5.0 ● ORGANICS NOT ENCOUNTERED TO 5.0 FEET BELOW EXISTING GRADE

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY:	BMG
CHECKED BY:	TM
DESIGNED BY:	BMG
CHECKED BY:	EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: MUCK DELINEATION SHEET (2)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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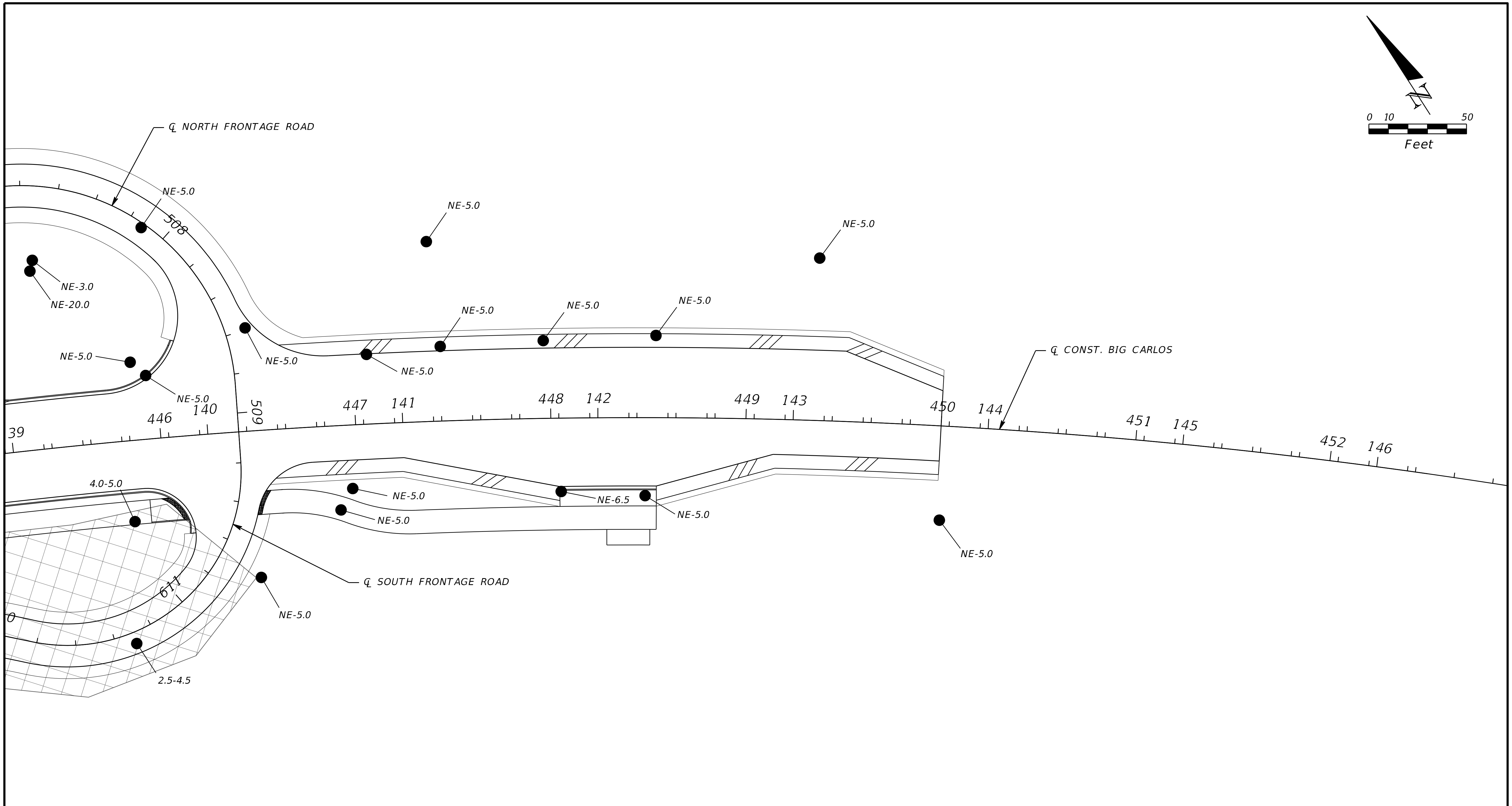

LEGEND

1.0-2.0 ●	ORGANICS ENCOUNTERED 1.0 TO 2.0 FEET BELOW EXISTING GRADE
NE-5.0 ●	ORGANICS NOT ENCOUNTERED TO 5.0 FEET BELOW EXISTING GRADE

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REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ERICK M. FREDERICK, P.E.
P.E. LICENSE NUMBER 63920
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

DRAWN BY: BMG
CHECKED BY: TM
DESIGNED BY: BMG
CHECKED BY: EMF

LEE COUNTY PUBLIC WORKS
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	COUNTY PROJECT No
CR 865	LEE	CN160002

SHEET TITLE: MUCK DELINEATION SHEET (3)

PROJECT NAME: CR 865 (ESTERO BOULEVARD) OVER BIG CARLOS PASS

REF. DWG. NO.

SHEET NO.

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APPENDIX B

Summary of Seasonal High Groundwater Table Estimates

Design LBR Calculation

Summary of Preliminary Geotechnical Parameters for Ponds

Summary of Seasonal High Groundwater Table Estimates

CR 865 (Estero Boulevard) over Big Carlos Pass

Lee County, Florida

Lee County Project No. CN160002

Tierra Project No. 6511-16-051

Boring Name	Boring Location[1] (C/L Const.)		Approximate Ground Elevation[1] (feet, NAVD 88)	Boring Depth[2] (feet)	Measured Groundwater Table			USDA Soil Survey		Estimated SHGWT[4]	
	Station (feet)	Offset (feet)			Date Recorded	Depth[2] (feet)	Elevation (feet, NAVD 88)	Map Symbol	Estimated SHGWT[3] Depth (feet)	Depth (feet)	Elevation (feet, NAVD 88)
SH - 410R	409 + 20	13 RT.	3.2	5.5	10/29/19	2.2	1.0	4	1.5 - 3.5	1.0	2.2
SH - 413L	412 + 39	23 LT.	5.5	7.0	10/28/19	4.4	1.1	4	1.5 - 3.5	3.5	2.0
PB - 432L	432 + 19	100 LT.	3.5	6.5	10/29/19	5.6	-2.1	4/135	1.5 - 3.5/1.5 - 3.5	3.0	0.5
PB - 434L	434 + 42	56 LT.	2.7	7.5	10/29/19	3.4	-0.7	4/135	1.5 - 3.5/1.5 - 3.5	1.0	1.7
SH - 434L2	434 + 42	78 LT.	2.3	5.0	08/28/20	1.8	0.5	4/135	1.5 - 3.5/1.5 - 3.5	1.0	1.3
SH - 435R	434 + 92	81 RT.	3.3	6.5	10/29/19	1.7	1.6	48/135	1.5 - 3.5/1.5 - 3.5	1.5	1.8
SH - 435R2	435 + 03	78 RT.	3.2	6.0	08/28/20	1.6	1.6	48/135	1.5 - 3.5/1.5 - 3.5	1.0	2.2
SH - 438L	437 + 70	49 LT.	2.5	6.0	10/28/19	1.3	1.3	135	1.5 - 3.5	0.5	2.0
SH - 438L2	437 + 88	44 LT.	2.4	5.5	08/28/20	1.3	1.1	135	1.5 - 3.5	0.5	1.9
SH - 439R2	439 + 16	94 RT.	2.6	4.0	08/28/20	1.4	1.2	135	1.5 - 3.5	1.0	1.6
SH - 441L	440 + 82	62 LT.	2.0	6.0	10/28/19	0.7	1.3	135	1.5 - 3.5	0.7	1.3
SH - 441R	440 + 72	89 RT.	1.6	5.5	10/29/18	2.8	-1.2	48/135	1.5 - 3.5/1.5 - 3.5	0.5	1.1
SH - 443L2	443 + 10	61 LT.	1.3	5.0	08/28/20	0.5	0.8	135	1.5 - 3.5	ABG	>1.3
SH - 443R2	443 + 18	53 RT.	2.6	6.0	08/28/20	1.4	1.2	135	1.5 - 3.5	1.0	1.6
SH - 445R2	444 + 94	83 RT.	1.9	3.0	08/28/20	1.2	0.7	135	1.5 - 3.5	0.5	1.4
SH - 445L2	445 + 44	97 LT.	2.4	3.0	08/28/20	1.2	1.2	135	1.5 - 3.5	0.5	1.9
SH - 446L2	445 + 95	32 LT.	4.2	5.0	08/28/20	2.8	1.4	135	1.5 - 3.5	2.0	2.2
SH - 447R2	446 + 90	43 RT.	3.2	5.0	08/28/20	2.1	1.1	135	1.5 - 3.5	1.5	1.7
SH - 447L2	447 + 40	92 LT.	3.6	5.0	08/28/20	2.8	0.8	135	1.5 - 3.5	1.5	2.1
SH - 449L2	449 + 35	83 LT.	3.0	5.0	08/28/20	2.3	0.7	135	1.5 - 3.5	1.0	2.0
SH - 450R2	450 + 02	48 RT.	3.1	5.0	08/28/20	1.9	1.2	135	1.5 - 3.5	1.5	1.6
SH - 450R	450 + 06	48 RT.	3.4	5.0	10/29/19	3.0	0.4	135	1.5 - 3.5	1.5	1.9

(1) Boring station, offset and elevation were provided by the Project Surveyor. The Station locations are referenced to the Centerline Construction of Estero Boulevard.

(2) Depth below existing grades at time of augering.

(3) Seasonal high groundwater table depth estimated based on the Lee County, Florida USDA Soil Survey information.

(4) Seasonal high groundwater table depth estimated based on soil stratigraphy, measured groundwater levels from the borings, and review of the Lee County, Florida USDA Soil Survey and USGS Quadrangle Map of Fort Myers Beach, Florida. The test boring locations are within a region of Lee County that is in proximity to the Estero Bay waterway. The groundwater table and seasonal high groundwater table may be influenced by tidal effects.

ABG: Seasonal High Groundwater Table Level Estimate at or Above Exisiting Grade.

Design LBR Calculation
Big Carlos Pass Bridge Replacement
Lee County, Florida
Lee County Project No. CN-160002
Tierra Project No. 6511-16-051
2% of Optimum Method

Test No.	Bulk Sample Boring Location	Maximum LBR	LBR at Moisture Contents	
			- 2%	+ 2%
LBR # 1	SH-408L	72	57	54
LBR # 2	SH-435R	36	32	32
LBR # 3	SH-441L	68	52	58
LBR # 4	SH-446L	54	46	36
Mean LBR Value		57	46	45

LBR Value Resulting from ± 2% Method = 40 [1]

Design LBR = 40

Recommended Design M_R (Resilent Modulus) [2] = 12,000 psi

[1] Per the current Flexible Pavement Design Manual, a Design LBR greater than 40 should not be recommended or used to estimate the Design M_R due to the approximate relationship of LBR to M_R.

[2] Based on current FDOT Flexible Pavement Design Manual for conversion of LBR to M_R.

Design LBR Calculation
Big Carlos Pass Bridge Replacement
Lee County, Florida
Lee County Project No. CN-160002
Tierra Project No. 6511-16-051
90% Method

Test No.	Bulk Sample Boring Location	Maximum LBR	Rank	Percent of Samples with Equal or Greater Value
LBR # 1	SH-408L	72	1	25%
LBR # 3	SH-441L	68	2	50%
LBR # 4	SH-446L	54	3	75%
LBR # 2	SH-435R	36	4	100%

LBR Value Resulting from 90% Method = 42 [1]

Design LBR = 40

Recommended Design M_R (Resilent Modulus) [2] = 12,000 psi

[1] Per the current Flexible Pavement Design Manual, a Design LBR greater than 40 should not be recommended or used to estimate the Design M_R due to the approximate relationship of LBR to M_R.

[2] Based on current FDOT Flexible Pavement Design Manual for conversion of LBR to M_R.

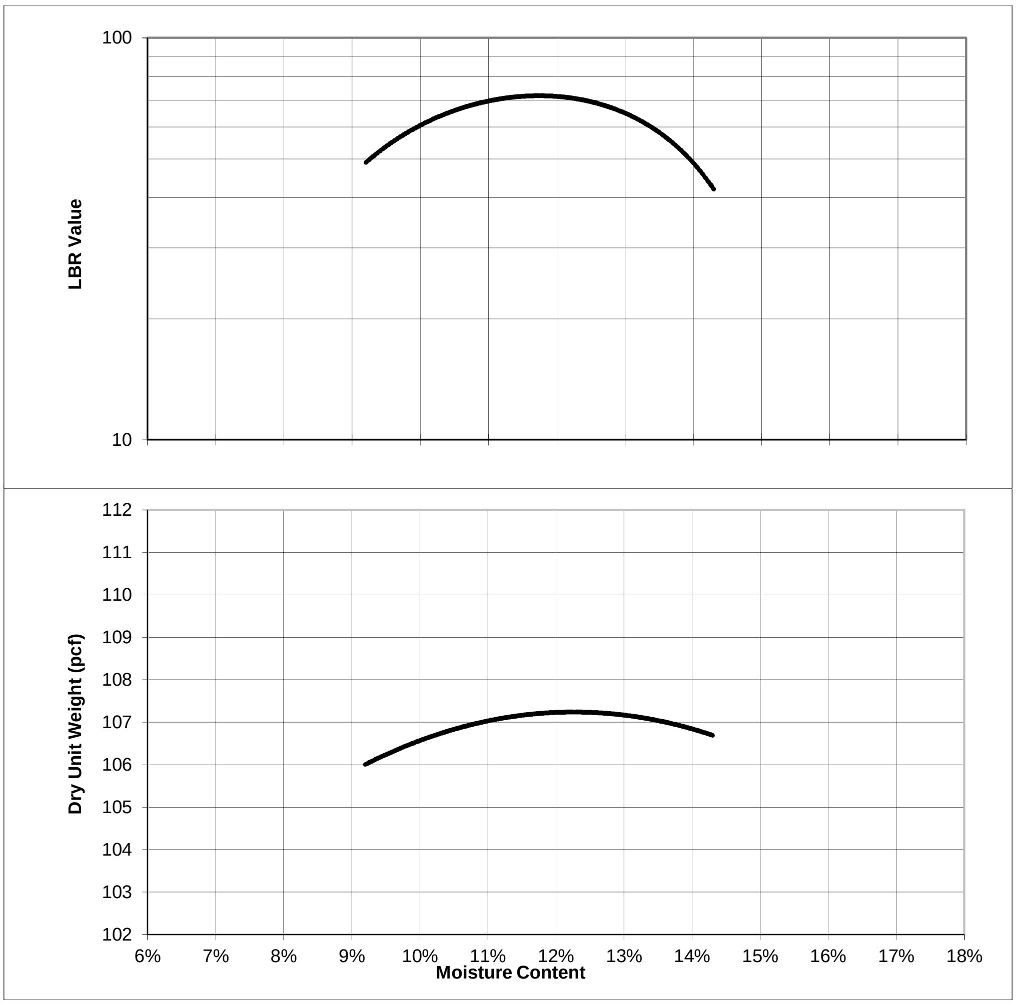
TIERRA INC.

RESULTS OF LIMEROCK BEARING RATIO TEST

Big Carlos Pass Bridge Replacement

	LCDOT Project No.:	CN-160002
	Tierra Project No.	6511-16-051
Date: 1/6/2020	Test Boring No.	SH-408L

LBR & MOISTURE-DENSITY RELATIONSHIP



LBR Value	72		
Maximum Density	107.2 pcf	Description:	Light Gray Fine Sand with Shell
Optimum Moisture	12.2 %		
Test Method:	FSTM FM 5-515		
Tested By:	Tierra, Inc.	Sample Depth:	1' - 2'

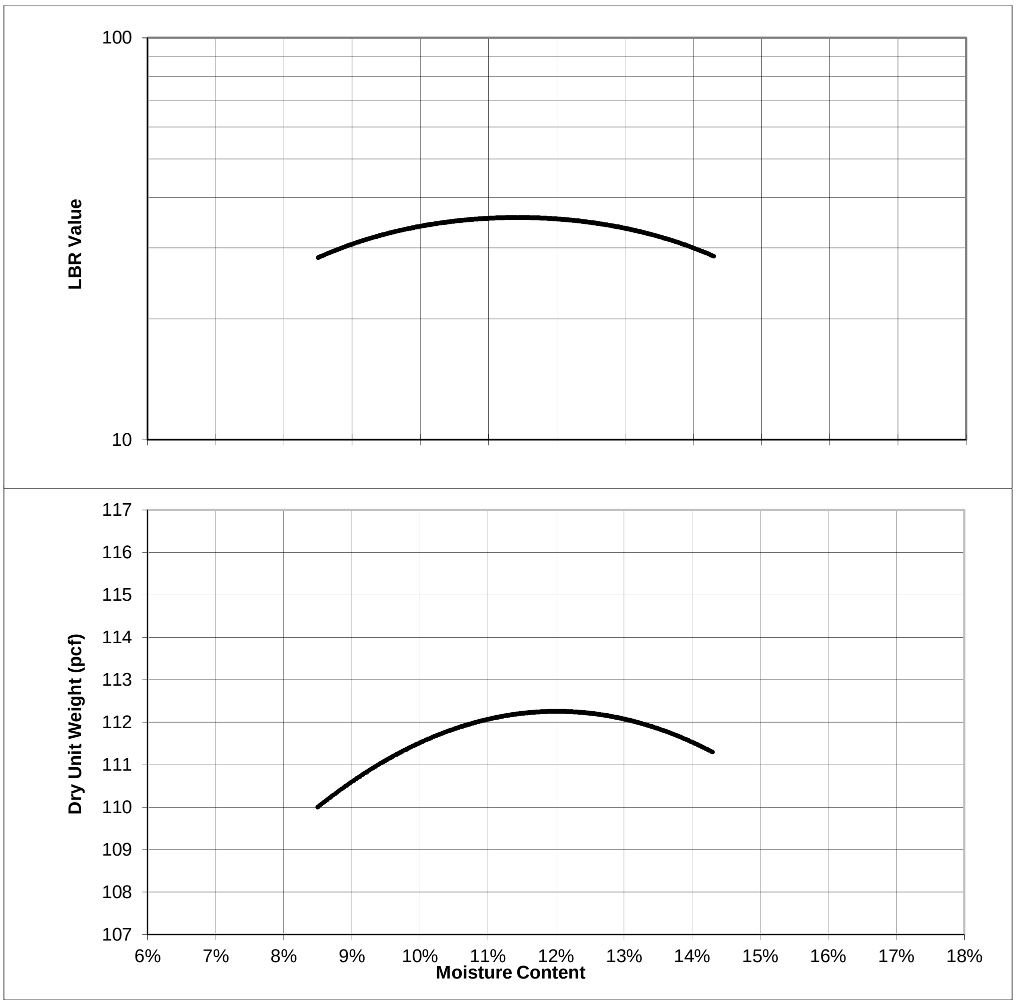
TIERRA INC.

RESULTS OF LIMEROCK BEARING RATIO TEST

Big Carlos Pass Bridge Replacement

	LCDOT Project No.:	CN-160002
	Tierra Project No.	6511-16-051
Date: 1/6/2020	Test Boring No.	SH-435R

LBR & MOISTURE-DENSITY RELATIONSHIP



LBR Value	36		
Maximum Density	112.3 pcf	Description:	Gray Fine Sand
Optimum Moisture	12.0 %		
Test Method:	FSTM FM 5-515		
Tested By:	M. Mundy	Sample Location:	1' - 2'

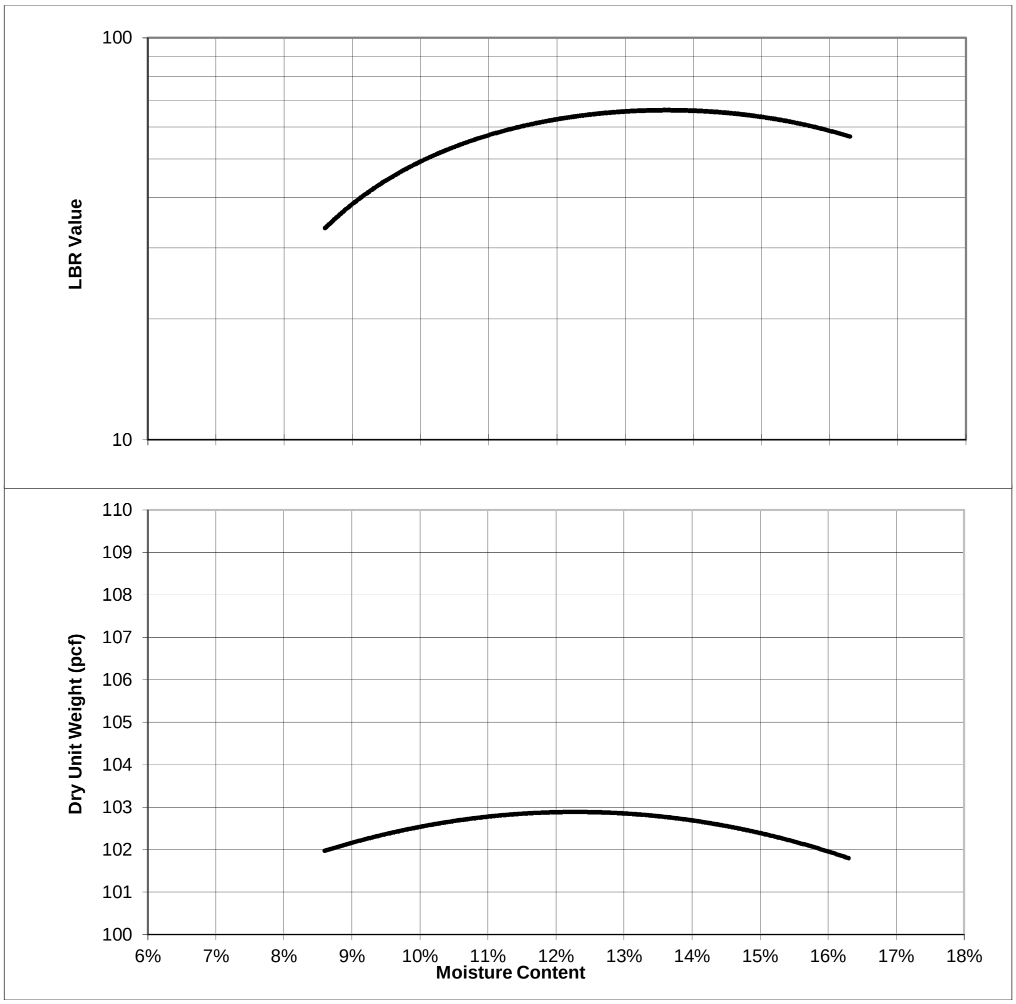
TIERRA INC.

RESULTS OF LIMEROCK BEARING RATIO TEST

Big Carlos Pass Bridge Replacement

	LCDOT Project No.:	CN-160002
	Tierra Project No.	6511-16-051
Date: 1/6/2020	Test Boring No.	SH-441L

LBR & MOISTURE-DENSITY RELATIONSHIP



LBR Value	68		
Maximum Density	102.9 pcf	Description:	Gray Fine Sand
Optimum Moisture	12.4 %		
Test Method:	FSTM FM 5-515		
Tested By:	M. Mundy	Sample Location:	1' - 2'

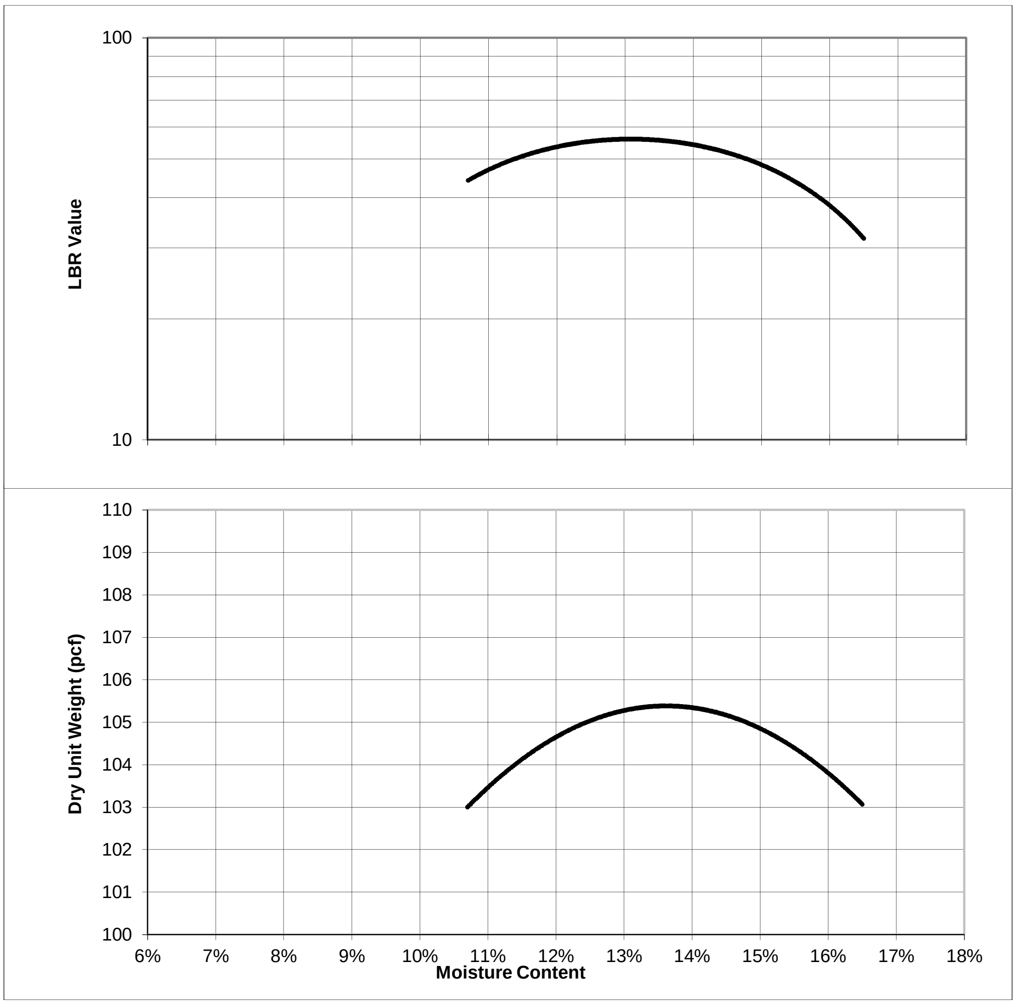
TIERRA INC.

RESULTS OF LIMEROCK BEARING RATIO TEST

Big Carlos Pass Bridge Replacement

	LCDOT Project No.:	CN-160002
	Tierra Project No.	6511-16-051
Date: 1/6/2020	Test Boring No.	SH-446L

LBR & MOISTURE-DENSITY RELATIONSHIP



LBR Value	54		
Maximum Density	105.3 pcf	Description:	Yellow-Brown Slightly Silty Fine Sand with Rock and Shell
Optimum Moisture	13.7 %		
Test Method:	FSTM FM 5-515		
Tested By:	M. Mundy	Sample Location:	1' - 2'

Summary of Preliminary Geotechnical Parameters for Ponds

CR 865 (Estero Boulevard) over Big Carlos Pass

Lee County, Florida

Lee County Project No. CN-160002

Tierra Project No. 6511-16-051

Test Number	Approximate Test Location[1] (C/L Const.)		Approximate Ground Elevation (ft., NAVD 88)	Measured Groundwater Table			Estimated Seasonal High Groundwater Table[3]		Field Test Results[4]						Sieve Analyses (Percent Passing Sieve)					
	Station	Offset		Date Recorded	Approximate Depth (feet)	Approximate Elevation (feet)	Approximate Depth (feet)	Approximate Elevation (feet)	Test Method	Approximate Test Depth (feet)	Approximate Test Elevation (ft., NAVD 88)	Soil Stratum Tested	Test Perfomed Within Emabnkment Soils	Hydraulic Conductivity (feet/day)	Sample Depth (feet)	#10	#40	#60	#100	#200
SH-438L[1]	437+78[1]	50' LT.[1]	2.5[1]	10/28/19	1.3	1.2	0.5	2.0	Field Falling Head Permeability	1.0	1.5	1	No	1.5	1.0	100	99	95	66	8
PB-432L[1]	432+33[1]	93' LT.[1]	3.5[1]	10/29/19	5.6	-2.1	1.5	2.0	Field Constant Head Permeability	3.0	0.5	2	No	17.0	3.0	89	87	85	70	20
PBA-434L[1]	434+39[1]	71' LT.[1]	2.7[1]	10/29/19	3.4	-0.7	1.0	1.7	Field Falling Head Permeability	1.0	1.7	1	No	1.6	1.0	63	60	57	42	7
PBA-436L[2]	435+82[2]	41' LT.[2]	4.8[2]	02/07/20	GNE	NA	---	---	Field Constant Head Permeability	0.5	4.3	1	No	5.2	0.5 - 1.5	100	100	98	82	11
PBA-445L[2]	445+44[2]	75' LT.[2]	2.9[2]	02/07/20	At Grade	At Grade	---	---	Field Falling Head Permeability	0.5	2.4	1	No	0.8	0.5 - 1.5	100	98	95	74	11
PBA-447L[2]	447+40[2]	97' LT.[2]	3.8[2]	02/07/20	GNE	NA	---	---	Field Constant Head Permeability	2.0	1.8	1	No	20.0	2.0 - 3.0	72	65	60	46	7
PBA-448L[2]	448+66[2]	106' LT.[2]	3.3[2]	02/07/20	GNE	NA	---	---	Field Constant Head Permeability	1.0	2.3	1	No	7.9	1.0 - 2.0	78	67	64	51	11

(1) The station, offset and elevation were provided by the Project Surveyor.

(2) The station, offset and elevation were estimated utilizing GPS coordinates obtained in the field and project design files provided by KCA. Therefore, the station, offset and elevation of the borings should be considered approximate.

(3) The test boring locations are within a region of Lee County that is in proximity to the Estero Bay waterway. The groundwater table and seasonal high groundwater table **may be influenced by tidal effects**.

(4) The test results presented above are not factored. **The design engineer should apply an appropriate factor of safety**.

GNE - Groundwater Not Encountered within the depths explored.

NA - Not Applicable

APPENDIX C

Summary of Laboratory Test Results for Soil Classification

Summary of Laboratory Test Results for Environmental Classification

Summary of Laboratory Test Results for Soil Classification CR 865 (Estero Boulevard) over Big Carlos Pass Lee County, Florida Lee County Project No. CN-160002 Tierra Project No. 6511-16-051													
Boring Name	**Depth (ft)**	**Stratum Number**	**AASHTO**	**Sieve Analysis - % Passing**					**Atterberg Limits**			**Organic Content**	**Moisture Content**
				#10	**#40**	**#60**	**#100**	**#200**	**LL**	**PL**	**PI**		
AB-408R	0.0 - 5.0	1	A-3	---	---	---	---	7	---	---	---	---	---
B-437R	13.5 - 15.0	1	A-3	---	---	---	---	10	---	---	---	1	26
B-442R	4.0 - 6.0	1	A-3	---	---	---	---	4	---	---	---	4	68
B-442R	13.5 - 15.0	1	A-3	---	---	---	---	4	---	---	---	2	41
B-445L	8.0 - 10.0	1	A-3	---	---	---	---	10	---	---	---	---	---
PB-434L	1.0 - 2.0	1	A-3	63	60	57	42	7	---	---	---	---	---
PB-434L	6.5 - 7.0	1	A-3	---	---	---	---	4	---	---	---	2	40
PBA-447L	2.0 - 3.0	1	A-3	72	65	60	46	7	---	---	---	---	---
SH-410R	3.5 - 4.0	1	A-3	---	---	---	---	10	---	---	---	4	69
SH-438L	1.0 - 2.0	1	A-3	---	---	---	---	8	---	---	---	---	---
SH-438L	1.0 - 2.0	1	A-2-4	100	99	95	66	8	---	---	---	---	---
SH-441L	5.5 - 6.0	1	A-3	---	---	---	---	8	---	---	---	1	31
SH-446L	4.5 - 5.0	1	A-3	---	---	---	---	9	---	---	---	---	---
WB-411L	6.0 - 8.0	1	A-3	---	---	---	---	5	---	---	---	3	52
WB-411L	18.5 - 20.0	1	A-3	---	---	---	---	10	---	---	---	1	17
WB-412L	13.5 - 15.0	1	A-3	---	---	---	---	7	---	---	---	---	---
WB-413L	13.5 - 15.0	1	A-3	---	---	---	---	5	---	---	---	---	---
AB-445L	0.0 - 5.0	2	A-2-4	---	---	---	---	13	---	---	---	---	---
B-445R	6.0 - 8.0	2	A-2-4	---	---	---	---	20	---	---	---	---	---
B-449R	6.0 - 8.0	2	A-2-4	---	---	---	---	24	---	---	---	---	---
PB-432L	3.0 - 4.0	2	A-2-4	89	87	85	70	20	---	---	---	---	---
PB-434L	4.0 - 4.5	2	A-2-4	---	---	---	---	17	NP	NP	NP	---	30
PB-434L	13.5 - 15.0	2	A-2-4	---	---	---	---	21	NP	NP	NP	---	46
PB-437L	6.0 - 8.0	2	A-2-4	---	---	---	---	16	---	---	---	---	---
PB-437L	13.5 - 15.0	2	A-2-4	---	---	---	---	16	---	---	---	---	---
PB-437L	13.5 - 15.0	2	A-2-4	---	---	---	---	16	---	---	---	---	---
PB-440L	13.5 - 15.0	2	A-2-4	---	---	---	---	23	---	---	---	---	---
PBA-436L	0.5 - 1.5	2	A-2-4	100	100	98	82	11	---	---	---	---	---
PBA-445L	0.5 - 1.5	2	A-2-4	100	98	95	74	11	---	---	---	---	---
PBA-448L	1.0 - 2.0	2	A-2-4	78	67	64	51	11	---	---	---	---	---
SH-408L	3.5 - 4.0	2	A-2-4	---	---	---	---	34	NP	NP	NP	---	48
SH-435R	1.5 - 2.0	2	A-2-4	---	---	---	---	11	---	---	---	---	---
WB-413R	28.5 - 30.0	2	A-2-4	---	---	---	---	28	---	---	---	---	---
WB-438R	13.5 - 15.0	2	A-2-4	---	---	---	---	16	---	---	---	---	---
WB-439L	13.5 - 15.0	2	A-2-4	---	---	---	---	18	NP	NP	NP	---	31
WB-439R	18.5 - 20.0	2	A-2-4	---	---	---	---	22	---	---	---	1	33
WB-441L	13.5 - 15.0	2	A-2-4	---	---	---	---	19	---	---	---	---	---

Summary of Laboratory Test Results for Soil Classification CR 865 (Estero Boulevard) over Big Carlos Pass Lee County, Florida Lee County Project No. CN-160002 Tierra Project No. 6511-16-051														
Boring Name	**Depth (ft)**	**Stratum Number**	**AASHTO**	**Sieve Analysis - % Passing**					**Atterberg Limits**			**Organic Content**	**Moisture Content**
				#10	**#40**	**#60**	**#100**	**#200**	**LL**	**PL**	**PI**		
B-445R	18.5 - 20.0	3	A-2-6	---	---	---	---	33	25	14	11	---	23
AB-436R	3.0 - 5.5	5	A-8	---	---	---	---	18	---	---	---	14	118
AB-438R	2.5 - 5.0	5	A-8	---	---	---	---	7	---	---	---	24	175
AB-440R	2.5 - 4.0	5	A-8	---	---	---	---	19	---	---	---	26	206
AB-442L	2.0 - 4.5	5	A-8	---	---	---	---	17	---	---	---	38	309
AB-443L	1.5 - 4.0	5	A-8	---	---	---	---	26	---	---	---	25	230
AB-443R	3.5 - 5.5	5	A-8	---	---	---	---	10	---	---	---	42	338
AB-444L	2.0 - 3.5	5	A-8	---	---	---	---	5	---	---	---	45	456
AB-444R	3.5 - 5.5	5	A-8	---	---	---	---	11	---	---	---	29	284
B-442R	2.0 - 4.0	5	A-8	---	---	---	---	20	---	---	---	55	309
PB-434L	4.5 - 5.0	5	A-8	---	---	---	---	11	---	---	---	15	105
PB-440L	8.0 - 10.0	5	A-8	---	---	---	---	11	---	---	---	35	247
SH-410R	4.0 - 4.5	5	A-8	---	---	---	---	7	---	---	---	8	61
SH-435R	3.5 - 4.0	5	A-8	---	---	---	---	6	---	---	---	8	52
SH-438L	4.0 - 4.5	5	A-8	---	---	---	---	17	---	---	---	28	241
SH-441L	3.0 - 3.5	5	A-8	---	---	---	---	19	---	---	---	45	247
SH-441R	2.0 - 2.5	5	A-8	---	---	---	---	13	---	---	---	25	188
SH-441R	3.0 - 3.5	5	A-8	---	---	---	---	20	---	---	---	36	319
WB-438L	6.0 - 8.0	5	A-8	---	---	---	---	10	---	---	---	8	121
WB-441R	4.0 - 6.0	5	A-8	---	---	---	---	8	---	---	---	17	162

Summary of Laboratory Test Results for Environmental Classification

CR 865 (Estero Boulevard) over Big Carlos Pass

Lee County, Florida

Lee County Project No. CN-160002

Tierra Project No. 6511-16-051

Sample Location[1]		Depth (feet)	Stratum No.	pH (FM 5-550)	Resistivity (ohm-cm) (FM 5-551)	Chlorides (ppm) (FM 5-552)	Sulfates (ppm) (FM 5-553)	Environmental Classification[2] (Soil)	
Station (feet)	Offset (feet)							Steel	Concrete
411 + 69	26 LT.	2.0 - 6.0	1	8.1	5,400	45	60	Slightly Aggressive	Slightly Aggressive
412 + 31	19 RT.	4.0 - 8.0	1	7.9	4,100	12	69	Moderately Aggressive	Slightly Aggressive
430 + 54	23 RT.	4.0 - 8.0	1	8.4	4,200	150	75	Moderately Aggressive	Slightly Aggressive
434 + 84	39 RT.	4.0 - 8.0	1	8.1	3,500	45	45	Moderately Aggressive	Slightly Aggressive
436 + 19	48 RT.	2.0 - 6.0	1	7.4	1,800	45	228	Moderately Aggressive	Moderately Aggressive

[2] Sample locations were determined using GPS coordinates obtained in the field by Tierra, Inc. Station, and Offset were estimated using FL State Plane coordinates and project design files and should therefore be considered approximate. Station and Offset are referenced to the Centerline Construction of CR 865.

[2] As per the current FDOT Structures Manual.

APPENDIX D

FHWA Checklist

GTR REVIEW CHECKLIST (SITE INVESTIGATION)			
A. Site Investigation Information Since the most important step in the geotechnical design process is the conduct of an adequate site investigation, presentation of the subsurface information in the geotechnical report and on the plans deserves careful attention.			
Geotechnical Report Text (Introduction) (Pages 322-325)	YES	NO	UNKNOWN OR N/A
1. Is the general location of the investigation described and/or a vicinity map included?	☒	☐	☐
2. Is scope and purpose of the investigation summarized?	☒	☐	☐
3. Is concise description given of geologic setting and topography of area?	☒	☐	☐
4. Are the field explorations and laboratory tests on which the report is based listed?	☒	☐	☐
5. Is general description of subsurface soil, rock, and groundwater conditions given?	☒	☐	☐
*6. Is the following information included with the geotechnical report (typically included in report appendices): a. Test hole logs? (Pages 25-33) b. Field test data? c. Laboratory test data? (Pages 74 - 75) d. Photographs (if pertinent)?	☒	☐	☐
Plan and Subsurface Profile (Pages 24, 47-49, 335)			
*7. Is a plan and subsurface profile of the investigation site provided?	☒	☐	☐
8. Are the field explorations located on the plan view?	☒	☐	☐
*9. Does the conducted site investigation meet minimum criteria outlined in Table 2?	☒	☐	☐

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (SITE INVESTIGATION)			
Plan and Subsurface Profile (Pages 24, 47-49, 335) Continued	YES	NO	UNKNOWN OR N/A
10. Are the explorations plotted and correctly numbered on the profile at their true elevation and location?	☒	☐	☐
11. Does the subsurface profile contain a word description and/or graphic depiction of soil and rock types?	☒	☐	☐
12. Are groundwater levels and date measured shown on the subsurface profile?	☒	☐	☐
Subsurface Profile or Field Boring Log (Pages 16-17, 25-29)			
13. Are sample types and depths noted?	☒	☐	☐
*14 Are SPT blow counts, percent core recovery, and RQD values shown?	☒	☐	☐
15. If cone penetration tests were made, are plots of cone resistance and friction ratio shown with depth?	☐	☐	☒
Laboratory Test Data (Pages 60, 74-75)			
*16 Were lab soil classification tests such as natural moisture content, gradation, Atterberg limits, performed on selected representative samples to verify field visual soil identifications?	☒	☐	☐
17. Are laboratory test results such as shear strength (Page 62), consolidation (Page 68), etc., included and/or summarized?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (CENTERLINE CUTS & EMBANKMENTS)			
B. Centerline Cuts and Embankments (Pages 6-9) In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?			
Are station to station descriptions included for:	YES	NO	UNKNOWN OR N/A
1. Existing surface and subsurface drainage?	☐	☐	☒
2. Evidence of springs and excessively wet areas?	☐	☐	☒
3. Slides, slumps, and faults noted along the alignment?	☐	☐	☒
Are station to station recommendations included for:			
General Soil Cut or Fill			
4. Specific surface/subsurface drainage recommendations?	☐	☐	☒
5. Excavation limits of unsuitable materials?	☒	☐	☐
*6. Erosion protection measures for backslopes, side slopes, and ditches, including riprap recommendations or special slope treatments?	☐	☐	☒
Soil Cuts (Pages 101-102)			
*7. Recommended cut slope design?	☒	☐	☐
8. Are clay cut slopes designed for minimum F.S. = 1.50?	☒	☐	☐
9. Special usage of excavated soils?	☒	☐	☐
10. Estimated shrink-swell factors for excavated materials?	☐	☐	☒
11. If answer to 3 is YES, are recommendations provided for design treatments?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (CENTERLINE CUTS & EMBANKMENTS)			
Fills (Pages 77-79)	YES	NO	UNKNOWN OR N/A
11. Recommended fill slope design?	☒	☐	☐
12. Will fill slope design provide minimum F.S. = 1.25?	☒	☐	☐
Rock Slopes			
*13 Are recommended slope designs and blasting specifications provided?	☐	☐	☒
*14 Is the need for special rock slope stabilization measures, e.g., rockfall catch ditch, wire mesh slope protection, shotcrete, rock bolts, addressed?	☐	☐	☒
15. Has the use of "template" designs been avoided (such as designing all rock slopes on 1/4 to 1 rather than designing based on orientation of major rock jointing)?	☐	☐	☒
*16 Have effects of blast induced vibrations on adjacent structures been evaluated?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (EMBANKMENTS OVER SOFT GROUND)			
C. Embankments over Soft Ground Where embankments must be built over soft ground (such as soft clays, organic silts, or peat), stability and settlement of the fill should be carefully evaluated. In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?			
Embankment Stability (Pages 77-79, 95-97)	YES	NO	UNKNOWN OR N/A
*1 Has the stability of the embankment been evaluated for minimum safety factors of 1.25 for side slope stability and 1.30 for end slope stability of bridge approach embankments?	☒	☐	☐
*2. Has the shear strength of the foundation soil been determined from lab testing and/or field vane shear or static cone penetrometer tests?	☐	☐	☒
*3. If the proposed embankment does not provide minimum factors of safety given above, are recommendations given for feasible treatment alternates which will increase factor of safety to minimum acceptable (such as change alignment, lower grade, use stabilizing counterberms, excavate and replace weak subsoil, fill stage construction, lightweight fill, geotextile fabric reinforcement, etc.)?	☐	☐	☒
*4. Are cost comparisons of treatment alternates given and a specific alternate recommended?	☐	☐	☒
Settlement of Subsoil (Pages 146-160)			
5. Have consolidation properties of fine grained soils been determined from laboratory consolidation tests?	☐	☐	☒
*6. Have settlement amount and settlement time been estimated?	☒	☐	☐
7. For bridge approach embankments, are recommendations made to get the settlement out before the bridge abutment is constructed (waiting period, surcharge, or wick drains)?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (EMBANKMENTS OVER SOFT GROUND)			
Settlement of Subsoil (Pages 146-160)	YES	NO	UNKNOWN OR N/A
8. If geotechnical instrumentation is proposed to monitor fill stability and settlement, are detailed recommendations provided on the number, type, and specific locations of the proposed instruments?	☐	☐	☒
9. Construction Considerations (Pages 183, 331-334)			
a. If excavation and replacement of unsuitable shallow surface deposits (peat, muck, top soil) is recommended - are vertical and lateral limits of recommended excavation provided?	☒	☐	☐
b. Where a surcharge treatment is recommended, are plan and cross-section of surcharge treatment provided in geotechnical report for benefit of the roadway designer?	☐	☐	☒
c. Are instructions or specifications provided concerning instrumentation, fill placement rates and estimated delay times for the contractor?	☐	☐	☒
d. Are recommendations provided for disposal of surcharge material after the settlement period is complete?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (LANDSLIDE CORRECTIONS)			
D. Landslide Corrections (Pages 77-80, 103-105) In addition to the basic information listed in Section A, is the following information provided in the landslide study geotechnical report? (Refer to Table 4 for guidance on the necessary technical support data for correction of slope instabilities.)			
	YES	NO	UNKNOWN OR N/A
*1. Is a site plan and scaled cross-section provided showing ground surface conditions both before and after failure?	☐	☐	☒
*2. Is the past history of the slide area summarized - including movement history, summary of maintenance work and costs, and previous corrective measures taken (if any?)	☐	☐	☒
*3. Is a summary given of results of site investigation, field and lab testing, and stability analysis, including cause(s) of the slide?	☐	☐	☒
Plan			
4. Are detailed slide features - including location of ground surface cracks, head scarp, and toe bulge - shown on the site plan?	☐	☐	☒
Cross Section			
*5. Are the cross sections used for stability analysis included with the soil profile, water table, soil unit weights, soil shear strengths, and failure plane shown as it exists?	☐	☐	☒
*6. Is slide failure plane location determined from slope indicators?	☐	☐	☒
*7. For an active slide, was soil strength along the slide failure plane backfigured using a safety factor equal to 1.0 at the time of failure?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (LANDSLIDE CORRECTIONS)	YES	NO	UNKNOWN OR N/A
Landslide Corrections (Continued)			
Text			
*8. Is the following information presented for each proposed correction alternate: (typical correction methods include buttress, shear key, rebuild slope, surface drainage, subsurface drainage-interceptor, drain trenches or horizontal drains and retaining structures)?	☐	☐	☒
a. Cross-section of proposed alternate? b. Estimated safety factor? c. Estimated cost? d. Advantages and disadvantages?			
9. Is a recommended correction alternate(s) given which provide a minimum F.S. = 1.25?	☐	☐	☒
10. If horizontal drains are proposed as part of slide correction, has subsurface investigation located definite water bearing strata that can be tapped with horizontal drains?	☐	☐	☒
11. If a toe counterberm is proposed to stabilize an active slide, has field investigation confirmed that the toe of the existing slide does <u>not</u> extend beyond the toe of the proposed counterberm?	☐	☐	☒
12. <u>Construction Considerations:</u>			
a. Where proposed correction will require excavation into the toe of an active slide (such as for buttress or shear key), has the "during construction backslope F.S." with open excavation been determined?	☐	☐	☒
b. If open excavation F.S. is near 1.0, has excavation stage construction been proposed?	☐	☐	☒
c. Has seasonal fluctuation of groundwater table been considered?	☐	☐	☒
d. Are special construction features, techniques and materials described and specified?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (RETAINING WALLS)			
E. Retaining Walls (See Section 5 of "Geotechnical Engineering Notebook") In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?			
	YES	NO	UNKNOWN OR N/A
*1. Does the geotechnical report include recommended soil strength parameters and groundwater elevation for use in computing wall design lateral earth pressures and factor of safety for overturning, sliding, and external slope stability?	☐	☐	☒
2. Is it proposed to bid alternate wall designs?	☐	☐	☒
*3. Are acceptable reasons given for the choice and/or exclusion of certain wall types (gravity, reinforced soil, tieback, cantilever, etc.)?	☐	☐	☒
*4. Is an analysis of the wall stability included with minimum acceptable factors of safety against overturning (F.S. = 2.0), sliding (F.S. = 1.5), and external slope stability (F.S. = 1.5)?	☐	☐	☒
5. If wall will be placed on compressible foundation soils, is estimated total settlement, differential settlement, and time rate of settlement given?	☐	☐	☒
6. Will wall types selected for compressible foundation soils allow differential movement without distress?	☐	☐	☒
7. Are wall drainage details including materials and compaction provided?	☐	☐	☒
8. Construction Considerations			
a. Are excavation requirements covered - safe slopes for open excavations, need for sheeting or shoring?	☐	☐	☒
b. Fluctuation of groundwater table?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (SPREAD FOOTINGS)			
F. Structure Foundations - Spread Footings (Pages 191-205) In addition to the basic information listed in Section A, is the following information provided in the project foundation report?			
	YES	NO	UNKNOWN OR N/A
*1. Are spread footings recommended for foundation support? If not, are reasons for not using them discussed?	☐	☐	☒
If spread footing supports are recommended, are conclusions/recommendations given for the following:			
*2. Is recommended bottom of footing elevation and reason for recommendation (e.g., based on frost depth, estimated scour depth, or depth to competent bearing material) given?	☐	☐	☒
*3. Is recommended allowable soil or rock bearing pressure given?	☐	☐	☒
*4. Is estimated footing settlement and time given?	☐	☐	☒
5. Where spread footings are recommended to support abutments placed in the bridge end fills, are special gradation and compaction requirements provided for select end fill and backwall drainage material? (Pages 137-141)	☐	☐	☒
6. Construction Considerations:			
a. Have the materials been adequately described on which the footing is to be placed so the project inspector can verify that material is as expected?	☐	☐	☒
b. Have excavation requirements been included for safe slopes in open excavations, need for sheeting or shoring, etc?	☐	☐	☒
c. Has fluctuation of the groundwater table been addressed?	☐	☐	☒

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GTR REVIEW CHECKLIST (PILE FOUNDATIONS)			
G. <u>Structure Foundations - Piles</u> (Pages 224-311) In addition to the basic information listed in Section A, if pile support is recommended or given as an alternate, conclusions/recommendations should be provided in the project geotechnical report for the following:			
	YES	NO	UNKNOWN OR N/A
*1. Is the recommended pile type given (displacement, nondisplacement, pipe pile, concrete pile, H-pile, etc.) with valid reasons given for choice and/or exclusions? (Pages 224-226)	☐	☐	☒
2. Do you consider the recommended pile type(s) to be the most suitable and economical?	☐	☐	☒
*3. Are estimated pile lengths and estimated tip elevations given for the recommended allowable pile design loads?	☐	☐	☒
4. Do you consider the recommended design loads to be reasonable?	☐	☐	☒
5. Has pile group settlement been estimated (only of practical significance for friction pile groups ending in cohesive soil)? (Pages 245-247)	☐	☐	☒
6. If a specified or minimum pile tip elevation is recommended, is a clear reason given for the required tip elevation, such as underlying soft layers, scour, downdrag, piles uneconomically long, etc.?	☐	☐	☒
*7. Has design analysis (wave equation analysis) verified that the recommended pile section can be driven to the estimated or specified tip elevation without damage (especially applicable where dense gravel-cobble-boulder layers or other obstructions have to be penetrated?	☐	☐	☒
8. Where scour piles are required, have pile design and driving criteria been established based on mobilizing the full pile design capacity below the scour zone?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (PILE FOUNDATIONS)			
G. Structure Foundations - Piles (Pages 224-311) - Continued	YES	NO	UNKNOWN OR N/A
9. Where lateral load capacity of large diameter piles is an important design consideration, are P-Y curves (load vs. deflection) or soil parameters given in the geotechnical report to allow the structural engineer to evaluate lateral load capacity of all piles?	☐	☐	☒
*10. For pile supported bridge abutments over soft ground:			
a. Has the abutment pile downdrag load been estimated and solutions such as bitumen coating considered in design? Not generally required if surcharging of the fill is being performed (Pages 248-251)	☐	☐	☒
b. Is bridge approach slab recommended to moderate differentials settlement between bridge ends and fill?	☐	☐	☒
c. If the majority of subsoil settlement will not be removed prior to abutment construction (by surcharging), has estimate been made of the amount of abutment rotation that can occur due to lateral squeeze of soft subsoil? (Pages 114-115)	☐	☐	☒
d. Does the geotechnical report specifically alert the structural designer to the estimated horizontal abutment movement?	☐	☐	☒
11. If bridge project is large, has pile load test program been recommended? (Pages 299-302)	☐	☐	☒
12. For a major structure in high seismic risk area, has assessment been made of liquefaction potential of foundation soil during design earthquake (note: only loose saturated sands and silts are "susceptible" to liquefaction)?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (PILE FOUNDATIONS)			
G. Structure Foundations - Piles (Pages 224-311) - Continued	YES	NO	UNKNOWN OR N/A
13. Construction Considerations: (Pages 279-311) Have the following important construction considerations been adequately addressed?	☐	☐	☒
a. Pile driving details such as: boulders or obstructions which may be encountered during driving - need for preaugering, jetting, spudding, need for pile tip reinforcement, driving shoes, etc.?	☐	☐	☒
b. Excavation requirements - safe slope for open excavations, need for sheeting or shoring? Fluctuation of groundwater table?	☐	☐	☒
c. Have effects of pile driving operation on adjacent structures been evaluated - such as protection against damage caused by footing excavations or pile driving vibrations?	☐	☐	☒
d. Is preconstruction condition survey to be made of adjacent structures to prevent unwarranted damage claims?	☐	☐	☒
e. On large pile driving projects, have other methods of pile driving control been considered such as dynamic testing or wave equation analysis?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (DRILLED SHAFTS)			
H. Structure Foundations - Drilled Shafts (Pages 252-260) In addition to the basic information listed in Section A, if drilled shaft support is recommended or given as an alternate, are conclusions/recommendations provided in the project foundation report for the following:			
	YES	NO	UNKNOWN OR N/A
*1. Are recommended shaft diameter(s) and length(s) for allowable design loads based on an analysis using soil parameters for side friction and end bearing?	☐	☐	☒
*2. Settlement estimated for recommended design load?	☐	☐	☒
*3. Where lateral load capacity of shaft is an important design consideration, are P-Y (load vs. deflection) curves or soils data provided in geotechnical report which will allow structural engineer to evaluate lateral load capacity of shaft?	☐	☐	☒
4. Is static load test (to plunging failure) recommended?	☐	☐	☒
5. Construction Considerations:			
a. Have construction methods been evaluated, (i.e., can less expensive dry method or slurry method be used or will casing be required)?	☐	☐	☒
b. If casing will be required, can casing be pulled as shaft is concreted (this can result in significant cost savings on very large diameter shafts)?	☐	☐	☒
c. If artesian water was encountered in explorations, have design provisions been included to handle it (such as by requiring casing and tremie seal)?	☐	☐	☒
d. Will boulders be encountered? (Note: If boulders will be encountered, then the use of shafts should be seriously questioned due to construction installation difficulties and resultant higher costs the boulders can cause.)	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (MATERIAL SITES)

I. Material Sites

In addition to the basic information listed in Section A, is the following information provided in the project Material Site Report?

	YES	NO	UNKNOWN OR N/A
1. Material site location, including description of existing or proposed access routes and bridge load limits (if any)?	☐	☐	☒
*2. Have soil samples representative of all materials encountered during the pit investigation been submitted and tested?	☐	☐	☒
*3. Are laboratory quality test results included in the report?	☐	☐	☒
4. For aggregate sources, do the laboratory quality test results (such as L.A. abrasion, sodium sulfate, degradation, absorption, reactive aggregate, etc.) indicate if specification materials can be obtained from the deposit using normal processing methods?	☐	☐	☒
5. If the lab quality test results indicate that specification material cannot be obtained from the pit materials as they exist naturally - has the source been rejected or are detailed recommendations provided for processing or controlling production so as to ensure a satisfactory product?	☐	☐	☒
*6. For soil borrow sources, have possible difficulties been noted - such as above optimum moisture content clay-silt soils, waste due to high PI, boulders, etc?	☐	☐	☒
*7. Where high moisture content clay-silt soils must be used, are recommendations provided on the need for aeration to allow the materials to dry out sufficiently to meet compaction requirements?	☐	☐	☒
8. Are estimated shrink-swell factors provided?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST (MATERIAL SITES)			
I. Material Site - Continued	YES	NO	UNKNOWN OR N/A
*9. Do the proven material site quantities satisfy the estimated project quantity needs?	☐	☐	☒
10. Where materials will be excavated from below the water table, has seasonal fluctuation of the water table been determined?	☐	☐	☒
11. Are special permits requirement covered?	☐	☐	☒
12. Have pit reclamation requirements been covered adequately?	☐	☐	☒
13. Has a material site sketch (plan and profile) been provided for inclusion in the plans, which contains:	☐	☐	☒
* Material site number?			
* North arrow and legal subdivision?	☐	☐	☒
* Test hole or test pit logs, locations, number and date?	☐	☐	☒
* Water table elevation and date?	☐	☐	☒
* Depth of unsuitable overburden which will have to be stripped?	☐	☐	☒
* Suggested overburden disposal area?	☐	☐	☒
* Proposed mining area and previously mined areas?	☐	☐	☒
* Existing stockpile locations?	☐	☐	☒
* Existing or suggested access roads?	☐	☐	☒
* Bridge load limits?	☐	☐	☒
* Reclamation details?	☐	☐	☒
14. Are recommended special provisions provided?	☐	☐	☒

* A response other than (Yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.