SCS ENGINEERS







ST. LUCIE SUBSTATION SWITCHYARD EXPANSION STORMWATER MANAGEMENT REPORT

St. Lucie Nuclear Power Plant
6501 South Ocean Drive
Jensen Beach, Florida 34957

Presented on behalf of:

Florida Power and Light
700 Universe Boulevard
Juno Beach, FL 33408

Presented by:

SCS ENGINEERS
7700 North Kendall Drive, Suite 300
Miami, FL 33156
(305) 412-8185

September 2014
File No. 09213182.00

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File No. 09213182.00
September 2014

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1.0 INTRODUCTION

A stormwater management plan was developed by SCS Engineers (SCS) on behalf of Florida Power & Light (FPL) for the expansion of the St. Lucie Substation Switchyard, located within the St. Lucie Nuclear Power Plant property in St. Lucie County. **Figure 1** (attached) provides the site location on the USGS quad map and **Figure 2** (attached) provides the site location on an aerial. The total yard expansion area is approximately 0.729 acres. The expansion will be done in one phase which consists of expanding the substation 95 feet to the south side of the yard. The stormwater management system has been designed to accommodate the expansion.

The purpose of this report is to present calculations and analysis of the proposed drainage system to support the proposed design.

2.0 DESIGN CRITERIA

The following is the design criteria for the project:

- The stormwater drainage system (swales, catch basins, piping and outfalls) for the project shall discharge to the proposed dry retention area located south of the switchyard where water quality treatment shall take place.
- The effects on dry retention area from the collected runoff shall be evaluated for the 25-year/3-day storm event.
- The storm drainage sewer system shall be designed for the 25-year/3-day storm event.

3.0 EXISTING/PRE-DEVELOPMENT CONDITIONS

Plans and reports for the existing drainage for the switchyard and the surrounding areas were not available. The following conditions have been assumed based on a review of the topographic survey and a site visit to the area:

- The existing switchyard currently drains via sheet flow to the north and south of the substation switchyard pad.
- Runoff that flows off the northern 50% of the switchyard enters a dry detention pond located directly north of the switchyard. Stormwater collected in this detention area ultimately discharges to the Big Mud Creek Basin approximately 300 feet north via control structures.
- Runoff that flows off the southern 50% of the switchyard is captured through catch basins and routed to an outfall that discharges into a grassed area south of the switchyard.

4.0 POST-DEVELOPMENT CONDITIONS

Runoff from the proposed switchyard expansion to the south is to be collected through inlet structures and piped to a dry retention area to provide water quality treatment. There is no overflow to an adjacent waterway as runoff is retained within the dry retention area. The expansion area will take up areas currently acting as banks for the existing switchyard and discharge area. Because existing drainage features in the area will be removed, valley swales

will be constructed in the expansion area routing runoff to two new catch basins located on the northern edge of the proposed paved access. The proposed catch basins will route runoff to the proposed dry retention area.

The drainage area for the proposed expansion includes the expansion area, the proposed dry retention area, and contributing areas and totals approximately 3.461 acres.

5.0 SITE DATA

The stormwater management design for the site is based on data either researched or calculated from onsite testing. The following sections summarize the data used in the design, and the methods employed to collect the data.

5.1 WATER LEVEL

Per the *Subsurface Soil Exploration and Geotechnical Engineering Evaluation* provided by Ardaman & Associates provided in **Appendix A,** the seasonal high water table at the site is approximately 1 to 1 ½ ft above the groundwater level in boreholes AB-1, AB-2 and Exfil-1in the subject area. The average water table elevation for these boreholes located in the dry retention area was 1.57 ft NAVD. Therefore, the seasonal high water table was determined to be 3.07 ft NAVD. The bottom of the existing dry detention area to the northwest of the substation switchyard pad has a bottom elevation of approximately 2.0 ft NAVD and is dry. The proposed dry retention located south of the substation switchyard pad has a bottom elevation of 7.5 ft NAVD.

5.2 RAINFALL AMOUNT

The rainfall amount used for the design was determined through the design aids presented in Volume IV of the South Florida Water Management District's (SFWMD) Environmental Resource Permit Information Manual (Volume IV). The 25-year/3-day storm event rainfall total was determined to be approximately 10.0 inches.

5.3 SOIL STORAGE

Soil storage was determined through the design aids presented in Volume IV of the South Florida Water Management District's (SFWMD) Environmental Resource Permit Information Manual (Volume IV). The total amount of water which can be stored in the soil profile is expressed as a function of the depth to the water table. The average depth from the bottom of the dry retention to the water table is greater than 4.0 ft; therefore, compacted water storage of 8.18 inches was used.

6.0 CULVERT SIZING/HYDRAULIC ANALYSIS

Culvert sizing was based on the 25-year/3-day storm event. The runoff area contributing to each drainage structure is shown on **Figure 3** (attached). The time of concentration for each subcatchment was assumed to be 5 minutes. The culvert sizes were calculated using the subcatchment areas, time of concentration and setting the proposed grade as the flood elevation. A minimum culvert size of 15" was used in accordance with FPL design standards.

7.0 STORMWATER QUANTITY

The overall stormwater management system area is 3.461 acres and the rainfall data for a 25-yr 3-day storm event is 10 inches resulting in 34.61 acre-in (125,624 ft^3) of required storage in the dry retention system. The stormwater water quantity calculations for the substation switchyard expansion are provided in **Appendix B**. The calculated peak stage for the 25-year/3-day storm event is 10.70 ft NGVD, below the proposed berm elevation of 12.5 ft NGVD. The total storage provided by the dry retention basin to elevation 12.5 ft NGVD is 207,906 ft^3.

8.0 STORMWATER QUALITY

Dry retention is proposed to provide water quality treatment. The water quality calculations and stage-storage table can be found in the stormwater quality calculations provided in **Appendix B**.

Appendix A

Subsurface Soil Exploration and Geotechnical Engineering Evaluation

Subsurface Soil Exploration
and Geotechnical Engineering Evaluation
Proposed FPL St. Lucie Switchyard Expansion
FPL St. Lucie Nuclear Power Plant
St. Lucie County, Florida

Ardaman & Associates, Inc.

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American Concrete Institute
American Society for Testing and Materials
Florida Institute of Consulting Engineers

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

AAI File No. 13-5449
October 3, 2013

Florida Power & Light Company
Switchyard and Substation Siting Group
700 Universe Boulevard TS4/JW
Juno Beach, Florida 33408-0420

Attention: Mr. Jose S. Rodriguez

Subject: Subsurface Soil Exploration and Geotechnical Engineering Evaluation St. Lucie Switchyard Expansion FPL St. Lucie Nuclear Power Plant St. Lucie County, Florida

Mr. Rodriguez:

INTRODUCTION

In accordance with your request and authorization, Ardaman & Associates, Inc. has completed a subsurface soil exploration and geotechnical engineering evaluation for the above referenced project. We explored the general subsurface conditions in order to evaluate their suitability for supporting the proposed construction, to obtain a measure of pertinent engineering properties of subsurface materials, and to provide recommendations for site preparation and foundation design. Our work included Standard Penetration Test (SPT) borings, auger borings, permeability testing and engineering analyses. This report describes our explorations and tests, reports their findings, and summarizes our conclusions and recommendations.

SITE LOCATION AND PROJECT DESCRIPTION

The existing FPL St. Lucie Switchyard is located on the western portion of the FPL St. Lucie Nuclear Power Plant in eastern St. Lucie County, Florida. The subject site is situated in Section 16, Township 36 South and Range 41 East. The site location is shown superimposed on a composite of the 1948 Fort Pierce and Eden, Florida USGS Quadrangle Maps (photorevised 1983) presented as Figure 1. It is our understanding that the switchyard facility will be expanded to the south. At the time our field explorations were performed, the area south of the switchyard was grassed with the exception of an asphalt access road that is located along the southern border of the existing switchyard facility.

PROJECT DESCRIPTION

We have examined a Soil Boring Plan prepared by FPL Power Systems and dated July 23, 2013. Details of this plan have been reproduced as our Boring Location Plan, Figure 2. It is our understanding that the electrical equipment to be installed as part of the switchyard expansion will be supported on deep foundations. The expanded switchyard will be covered with a thin layer of gravel underlain by a layer of base material, and will be enclosed by a perimeter chain-link fence.

FIELD EXPLORATION

Standard Penetration Test (SPT) Borings

To explore the subsurface conditions within the proposed switchyard expansion area, three Standard Penetration Test (SPT) borings were performed at the locations shown on Figure 2. The borings were performed at the closest safely accessible locations for our truck-mounted drilling equipment that were selected based on the proximity of identified underground utilities and from discussions with representatives of FPL. The SPT borings were terminated at depths of 40 and 50 feet below the existing ground surface.

Auger Borings

Two auger borings were also performed within the existing stormwater retention area to the south of the proposed switchyard expansion area at the approximate locations shown on Figure 2. The auger borings were completed at a depth of 10 feet below the existing ground surface using a truck-mounted, 4-inch diameter continuous flight auger.

The groundwater level at each of the boring locations was measured on the date drilled. The boreholes were then backfilled with accumulated soil cuttings. The soil boring logs and a description of our drilling procedures are attached.

Field Exfiltration Test

In order to estimate the hydraulic conductivity of the shallow soils, a constant-head exfiltration test (Exfil-1) was performed at a location within the existing stormwater retention pond, as shown on Figure 2. The test was performed in general accordance with the methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV. Descriptions of the soils observed in the exfiltration test borehole and the test result are presented in the Appendix. The result of the exfiltration test indicated a hydraulic conductivity (K) value of 1.5×10^{-4} cfs/ft^2-ft head.

Double-Ring Infiltration Test

A double-ring infiltration test (DRI-1) was performed within the retention pond area in general accordance with ASTM D3385 at the approximate location shown on Figure 2. The near surface soils consisted of brown fine sand (Unified Soil Classification SP) with trace amounts of shell fragments to a depth of at least 5 feet. The groundwater table level was encountered at approximately 6.5 feet below the ground surface on the date of the test. The results of the double-ring infiltration test indicated a soil infiltration rate of 8 inches/hour.

Test Locations

The boring and test locations were laid out in the field in reference to existing site features and by referencing a hand-held GPS device using the latitude and longitude coordinates provided by FPL staff. We estimate that the actual boring locations are within approximately 10 feet of the locations shown in Figure 2. The soil samples recovered from our explorations will be kept in our laboratory for 60 days, then discarded unless you request otherwise.

LABORATORY TESTING

Our drillers examined the soil recovered from the SPT sampler or auger, placed the recovered soil samples in moisture proof containers, and maintained a log for each boring. The field soil boring logs and recovered soil samples were transported to our soils laboratory from the project site. Each soil sample was then examined by a geotechnical engineer and visually classified in general accordance with the Unified Soil Classification System (USCS). Percent fines content and moisture content tests were performed on select samples to aid in the classifications. The resulting soil classifications and other pertinent data obtained from our explorations and laboratory examinations and tests are reported on the attached soil boring logs.

GENERAL SUBSURFACE CONDITIONS

The boring logs present a detailed description of the soils encountered at the locations and the depths explored. The soil stratification shown on the boring logs is based on examination of recovered soil samples and interpretation of the driller's field logs. It indicates only the approximate boundaries between soil types. The actual transitions between adjacent soil strata may be gradual and indistinct.

As shown by the soil boring logs, the soils at the SPT boring locations consist generally of very loose to medium dense fine sand (Unified Soil Classification SP), slightly silty fine sand (SP-SM) and silty fine sand (SM) with varying amounts of shell fragments and partially cemented sand and shell extending to the termination depth of the deepest borings at 50 feet. We note that hard drilling due to intermittent layers of cemented sand and shell was noted in the drilling logs below a depth of 35 feet. The auger borings generally encountered brown and gray to greenish gray fine sand (SP), slightly silty fine sand (SP-SM) and silty fine sand (SM) to a depth of 10 feet. We note that very clayey fine sand (SC) was also encountered between depths of 4.5 and 6 feet below existing ground surface in the auger borings conducted within the existing dry retention pond area.

GROUNDWATER CONDITIONS

Our drillers observed groundwater in the boreholes at depths ranging from 6.5 to 8.1 feet below the existing ground surface, as noted on the attached boring logs. We note that the ground surface elevations at the locations of Borings B-1 and B-2 were approximately 2.5 to 3 feet higher than the rest of the borings since they were performed adjacent to the elevated access roadway on the south side of the existing switchyard. Fluctuations in groundwater levels on this site should be anticipated throughout the year due to a variety of factors, the most important of which is recharge from rainfall. Groundwater levels somewhat above the present levels should be expected after periods of heavy rains. Groundwater may also temporarily “perch” atop the shallow very clayey and silty soils encountered below depths of 4.5 and 5 feet at the auger boring locations.

NORMAL SEASONAL HIGH GROUNDWATER LEVEL

The normal seasonal high groundwater level each year is the level in the August-September period at the end of the rainy season during a year of normal (average) rainfall. The water table elevations associated with a flood would be much higher than the normal seasonal high groundwater level. The normal high water levels would more approximate the normal seasonal high groundwater levels.

The seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, the land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

Based on our interpretation of the site conditions using the soil borings and the Soil Survey, we preliminarily estimate the normal seasonal high groundwater level at the site to be approximately 1 to 1½ feet above the groundwater level measured in the boreholes at the time of our field exploration. Additional explorations including borings to deeper depths and monitoring wells could be conducted prior to final design in order to further explore the normal seasonal high groundwater table estimate.

The project drainage engineer should take into consideration that, after periods of heavy and/or prolonged rainfall, water may perch at shallower depths atop the near-surface hardpan-type and clayey soils at the site. This also indicates that the water table may temporarily rise above the ground surface at some areas on the site following periods of heavy or prolonged rainfall.

DISCUSSIONS AND RECOMMENDATIONS

General

Based on the findings of our field exploration and our evaluation of the encountered subsurface conditions, it is our opinion that the soils underlying this site are generally satisfactory to support the proposed construction on deep foundations consisting of drilled piers as presently contemplated. Following are our recommendations for site preparation procedures and for the design and construction of the foundation systems.

Please note that pending the load configurations acting upon the appurtenances and the amount of overturning moments and uplift loads; it may be possible to support the structures on shallow foundations. An allowable bearing capacity of 3,000 pounds per square foot may be feasible for such foundations. We remain available for consultations if such foundations need to be considered.

Site Preparation Procedures

The proposed switchyard expansion area should be stripped of all surface vegetation, stumps, debris, organic topsoil or other deleterious materials as encountered. We recommend proof-rolling the cleared surface to locate any unforeseen soft areas or unsuitable surface or near-surface soils, to increase the density of the upper soils, and to prepare the existing surface for the addition of fill soils (as required).

Fill material, if needed, should consist of clean sands, free of organics and other deleterious materials, with less than 12 percent by dry weight passing the U.S. No. 200 sieve and no particle larger than 3 inches in diameter. It should be placed in uniform layers, not exceeding 12 inches in loose thickness, individually compacted with a heavy (10 to 12 ton) vibratory roller so as to produce minimum dry densities of 98 percent of the Modified Proctor (ASTM D-1557) maximum dry density value of the fill material. We understand that the base course to be placed throughout the substation yard will have a thickness of 6 to 8 inches. It can be placed in a single lift, compacted with a heavy vibratory roller to the above specified minimum dry density level.

Foundation Design and Construction Recommendations

We understand that the proposed structures will be supported on a deep foundation system. We have not been provided with any specific information concerning foundation loadings and/or configuration. Following we offer a generalized subsurface profile based on the findings of our subsurface exploration, including our conservative estimate of pertinent engineering parameters of the subsurface materials, for others to use in the design of the proposed deep foundation system.

Table 1: Generalized Profile and Estimated Soils Parameters for the Design of Deep Foundations

Depth (ft)	Description	Unit Weight* γ (lb/ft^3)		Internal Friction Angle ϕ (degrees)	Cohesion C (lb/ft^2)	Lateral Soil Reaction Modulus K_H (lb/in^3)
		Moist	Saturated			
0-13	Very loose to medium dense fine sand with trace rock and shell	105	115	30	0	20
13-28	Very loose to medium dense slightly silty to silty fine sand	105	115	30	0	20
28-50	Loose to medium dense fine sand with varying amounts of shell and partially cemented sand and shell	110	120	33	0	35

* The effective unit weight can be obtained using the following equations:

Above groundwater level: $\gamma_{EFFECTIVE} = \gamma_{MOIST}$

Below groundwater level: $\gamma_{EFFECTIVE} = \gamma_{SATURATED} - \gamma_{WATER}$

Stormwater Pond

Based on the results of the auger borings performed in the existing retention pond area, the near surface fine sand (SP) soils encountered in the upper 4 to 5 feet are considered to be relatively permeable. The underlying very clayey fine sand (SC) and silty fine sand (SM) soils are significantly less permeable and should be considered aquitards with lower permeabilities for retention pond analysis.

For dry bottom ponds, pond performance will be significantly influenced by the soil permeability, the presence of aquitards or confining layers and the vertical separation between the pond bottom and the seasonal high groundwater level. Depending on the final design elevations and staging levels, underdrains may be necessary to prevent growth of aquatic vegetation and for pond volume recovery. An outfall (i.e., stormwater drain, ditch, canal, natural low areas, etc.) will be necessary to utilize underdrains.

Ardaman & Associates, Inc. would be pleased to assist in evaluating the design exfiltration rates, underdrains and/or groundwater baseflow as final pond geometry and stormwater volume requirements become available.

CLOSURE

Our report has been prepared specifically for this project. It is intended for the exclusive use of Florida Power & Light Company and its representatives. Our work has used methods and procedures consistent with local foundation engineering practices. No other warranty, expressed or implied, is made. We do not guarantee project performance in any respect, only that our work meets normal standards of professional care. The recommendations submitted in this report are based on the data obtained from our field exploration and our understanding of the proposed construction as described herein. This report may not account for all the possible variations that may exist between conditions observed in the borings and conditions at locations that were not explored. The nature and extent of any such variations may not become evident until construction is underway. If variations are then observed, we recommend that Ardaman & Associates, Inc. be requested to inspect the actual site conditions and, if necessary, re-evaluate the recommendations of this report.

It has been a pleasure to assist you on this phase of your project. Please contact us whenever we may be of service to you, and please call if you have any questions concerning this report.

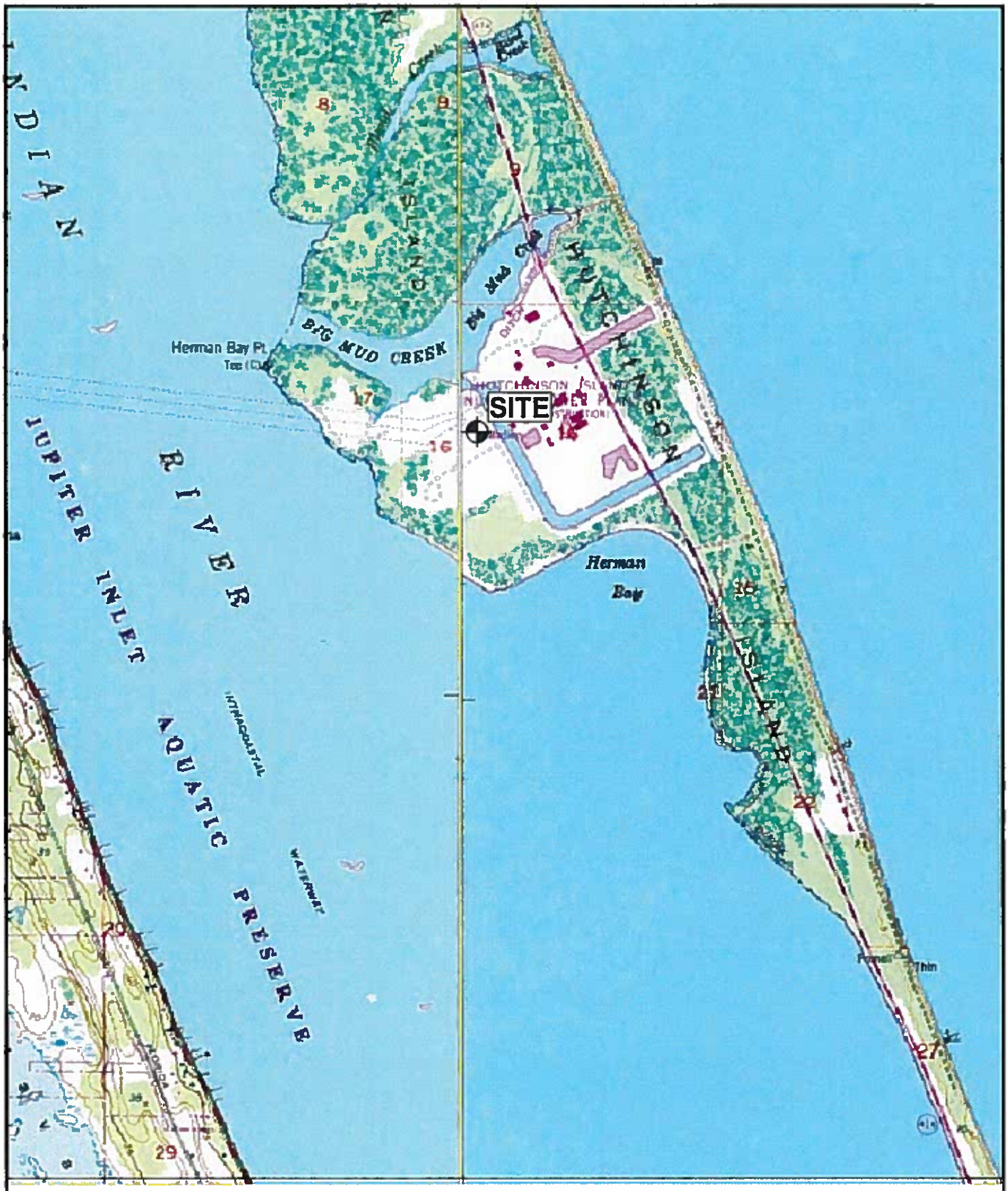
Best regards,

ARDAMAN & ASSOCIATES, INC.
Florida Certificate of Authorization No. 5950

Dan J. Zrallack, P.E.
Branch Manager
Florida License no. 63911

Roberto E. Balbis, P.E.
Principal Engineer
Florida License No. 15832

Attachments: Figure 1 - Site Vicinity Map
Figure 2 - Boring Location Plan
Subsurface Exploration Information
Soil Boring Logs



SECTION 16
TOWNSHIP 36 SOUTH
RANGE 41 EAST

1948 USGS QUADRANGLE MAPS
FORT PIERCE, FLORIDA
EDEN, FLORIDA
(PHOTOREVISED 1983)

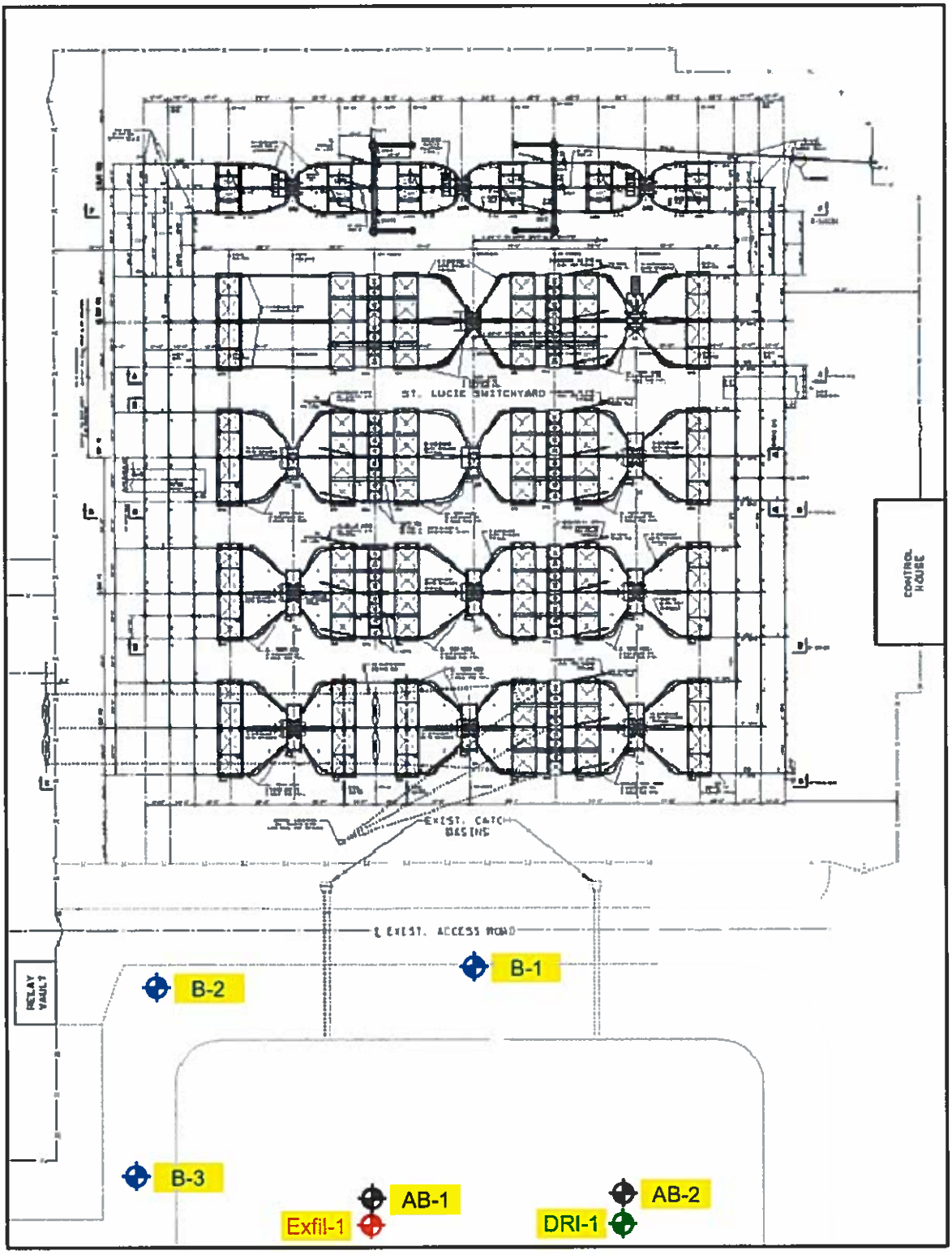
N.T.S

SITE LOCATION MAP

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

Subsurface Soil Exploration
St. Lucie Switchyard Expansion
FPL St. Lucie Nuclear Power Plant
St. Lucie County, Florida

FILE NO.	APPROVED BY:	FIGURE:
13-5449	DJZ	1



N.T.S.

- B-1 — Indicates SPT Boring Location
- AB-1 — Indicates Auger Boring Location
- Exfil-1 — Indicates Field Exfiltration Test Location
- DRI-1 — Indicates DRI Test Location

BORING LOCATION PLAN

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

Subsurface Soil Exploration
St. Lucie Switchyard Expansion
FPL St. Lucie Nuclear Power Plant
St. Lucie County, Florida

FILE NO.	APPROVED BY:	FIGURE:
13-5449	DJZ	2

Subsurface Exploration Information

Ardaman & Associates, Inc.

Our borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level requires long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that no groundwater will be encountered at that boring location.

STANDARD PENETRATION TEST BORINGS

The Standard Penetration Test is a widely accepted method of testing foundation soils in place. The N-Value obtained from the test has been correlated empirically with various soil properties. These empirical correlations allow satisfactory estimates to be made of how the soil is likely to behave when subjected to foundation loads. Tests are usually performed in the boreholes at intervals of five feet. In addition, our Firm performs tests continuously in the interval directly below the expected foundation bearing grade where the soil will be most highly stressed.

Boreholes where Standard Penetration Tests will be performed are drilled with a truck-mounted CME 45 drill rig or a CME 55 drill rig. The boreholes are advanced by rotary drilling with a winged bit that makes a hole about three inches in diameter. A bentonitic drilling mud is recirculated in order to remove the cuttings and support the walls of the borehole. The drag bit is specially modified to direct the mud upward and reduce disturbance of the soil ahead of the bit. If access is not available for our truck-mounted drilling equipment, portable tripod drilling equipment can be used instead.

Occasionally, running or squeezing ground is encountered that cannot be stabilized by the drilling mud alone. In addition, drilling mud may be lost into the soil or rock strata that are unusually pervious. In such cases, flush-coupled steel casing with an outside diameter of about 3.5 inches is driven as a liner for the borehole.

After the borehole has been advanced to the depth where a Standard Penetration Test will be performed, the soil sampler used to run the test is attached to the end of the drill rods and lowered to the bottom of the borehole. The testing procedure used conforms closely to the methods recommended in ASTM D-1586. The sampler used has a split-barrel 24 inches long and an outside diameter of 2.0 inches. It is driven into the ground below the bottom of the borehole using a hammer that weighs 140 pounds and falls 30 inches. The driller records the number of hammer blows needed to advance the sampler in successive increments of six inches. The total number of blows required to advance the sampler the second and third six-inch increments constitutes the test result; that is, the N-value at the depth. The test is completed after the sampler has been

driven not more than 24 inches or when refusal is encountered, whichever occurs first. Refusal occurs when 50 hammer blows advance the sampler six inches or less. After the test is completed, the sampler is removed from the borehole and opened.

The driller examines and classifies the soil recovered by the sampler. He places representative soil specimens from each test in closed glass jars or plastic bags and takes them to our laboratory. In the laboratory, additional evaluations and tests are performed, if needed. The driller's classifications may be adjusted, if necessary, to conform more closely with the Unified Soil Classification System (USCS). Jar samples are retained in our laboratory for thirty days, then discarded unless our clients request otherwise.

After completion of a test boring, the water level in the borehole is recorded.

SOLID-STEM AUGER BORINGS

Solid-stem auger borings are used when a relatively large, continuous sampling of soil strata close to the ground surface is desired. The testing procedure used conforms closely to the methods recommended in ASTM D-1452. A 4-inch diameter continuous flight, helical auger with a cutting head at its end is screwed into the ground in 5 foot sections. It is powered by the rotary drill rig. The samples are recovered by withdrawing the auger out of the ground without rotating it. The soil samples so obtained, are described and representative samples put in jars or bags and returned to the laboratory for further classification and testing, if necessary.

ENGINEERING CLASSIFICATION OF SOILS

The following tables relate N-values to a qualitative description of the relative soil density.

	Description	N
Cohesionless Soils	Very loose	0-4
	Loose	5-9
	Medium dense	10-29
	Dense	30-49
	Very dense	50+

	Description	N
Cohesive Soils	Very soft	0-2
	Soft	3-4
	Medium stiff	5-8
	Stiff	9-15
	Very stiff	16-30
	Hard	31+

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-1

PROJECT: FPL St. Lucie Switchyard Expansion

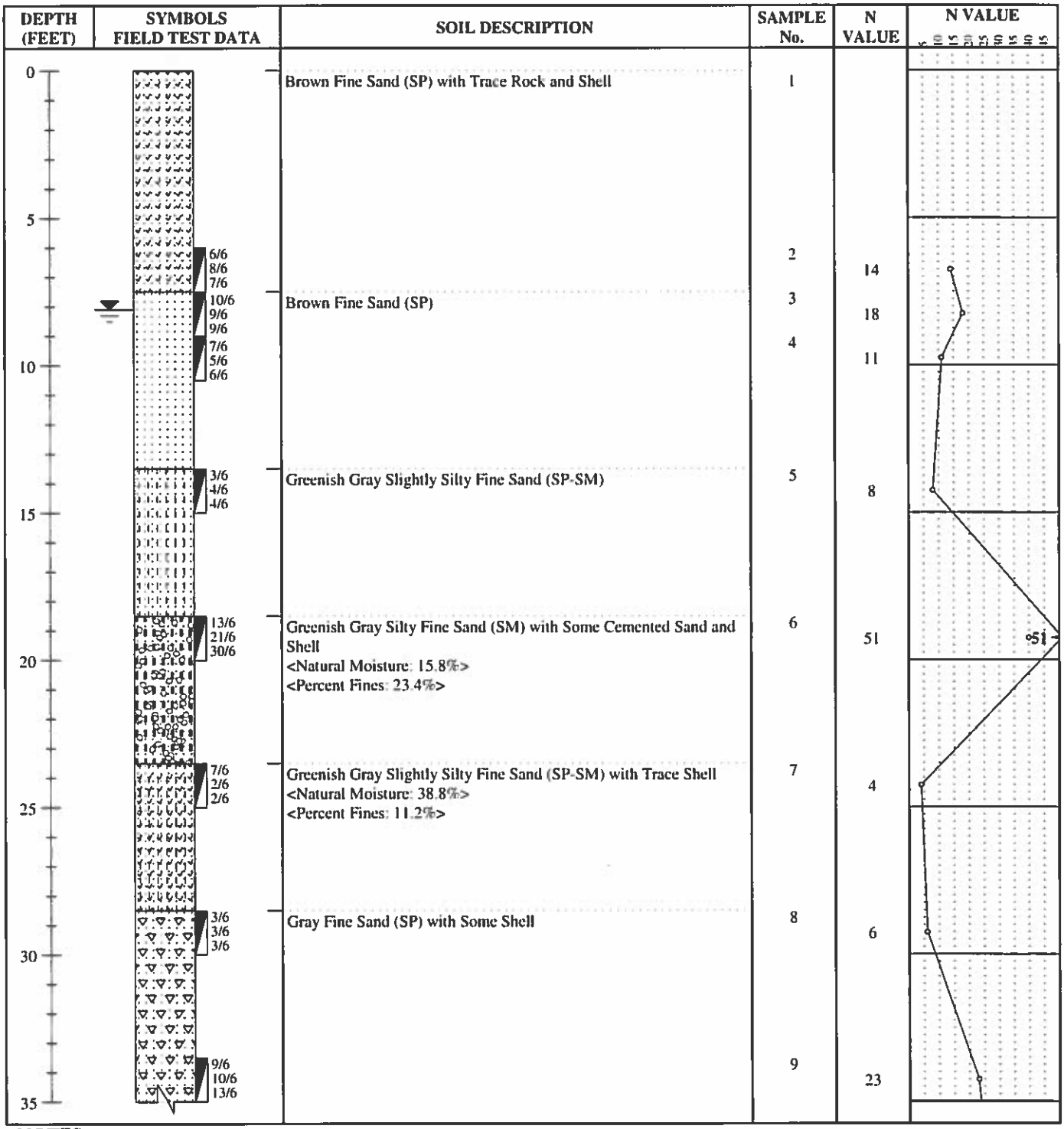
FILE No.: t3-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 8.1 Feet

DATE DRILLED: 9/25/13



NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-1

PROJECT: FPL St. Lucie Switchyard Expansion

FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 8.1 Feet

DATE DRILLED: 9/25/13

DEPTH (FEET)	SYMBOLS FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	N VALUE	N VALUE
35					
40	9/6 13/6 14/6	Greenish Gray Slightly Silty Fine Sand (SP-SM) with Some Partially Cemented Sand and Shell	10	27	
45	8/6 9/6 9/6	Greenish Gray Slightly Fine Sand (SP-SM)	11	18	
50	9/6 10/6 9/6	Greenish Gray Fine Sand (SP) with Some Partially Cemented Sand and Shell	12	19	
55		End of Boring			
60					
65					
70					

NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN", 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-2

PROJECT: FPL St. Lucie Switchyard Expansion

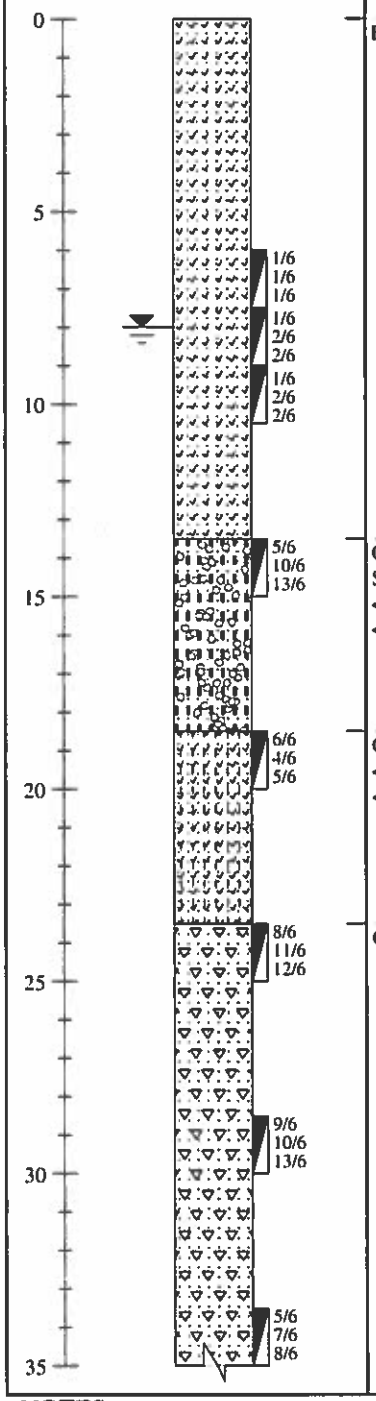
FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

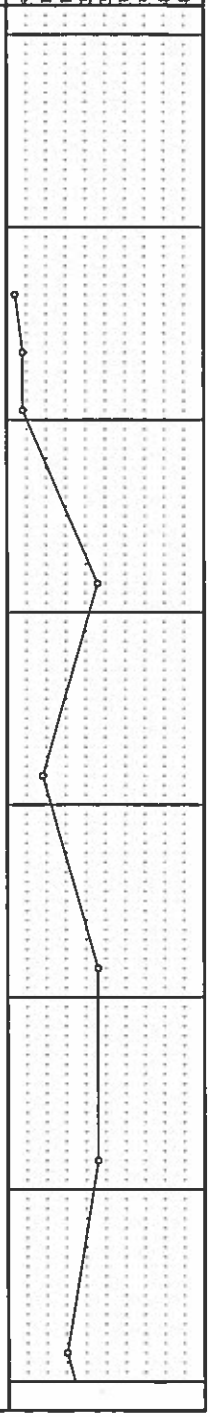
DRILL CREW: WPB

WATER OBSERVED AT DEPTH 8.0 Feet

DATE DRILLED: 9/25/13



DEPTH (FEET)	SOIL DESCRIPTION	SAMPLE No.	N VALUE
0	Brown Fine Sand (SP) with Trace Rock and Shell	1	
		2	2
		3	4
		4	4
15	Greenish Gray Silty Fine Sand (SM) with Some Partially Cemented Sand and Shell <Natural Moisture: 15.0%> <Percent Fines: 17.2%>	5	23
20	Grayish Brown Slightly Silty Fine Sand (SP-SM) with Trace Shell <Natural Moisture: 35.6%> <Percent Fines: 11.8%>	6	9
25	Gray Fine Sand (SP) with Some Shell	7	23
		8	23
35		9	15



NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-2

PROJECT: FPL St. Lucie Switchyard Expansion

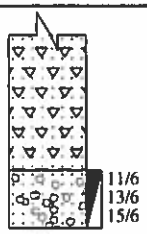
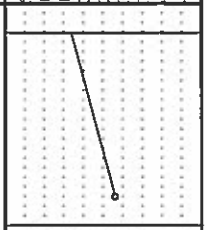
FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 8.0 Feet

DATE DRILLED: 9/25/13

DEPTH (FEET)	SYMBOLS FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	N VALUE	N VALUE
35	 11/6 13/6 15/6	Gray Fine Sand (SP) with Some Partially Cemented Sand and Shell	10	28	
40		End of Boring			
45					
50					
55					
60					
65					
70					

NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN", 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-3

PROJECT: FPL St. Lucie Switchyard Expansion

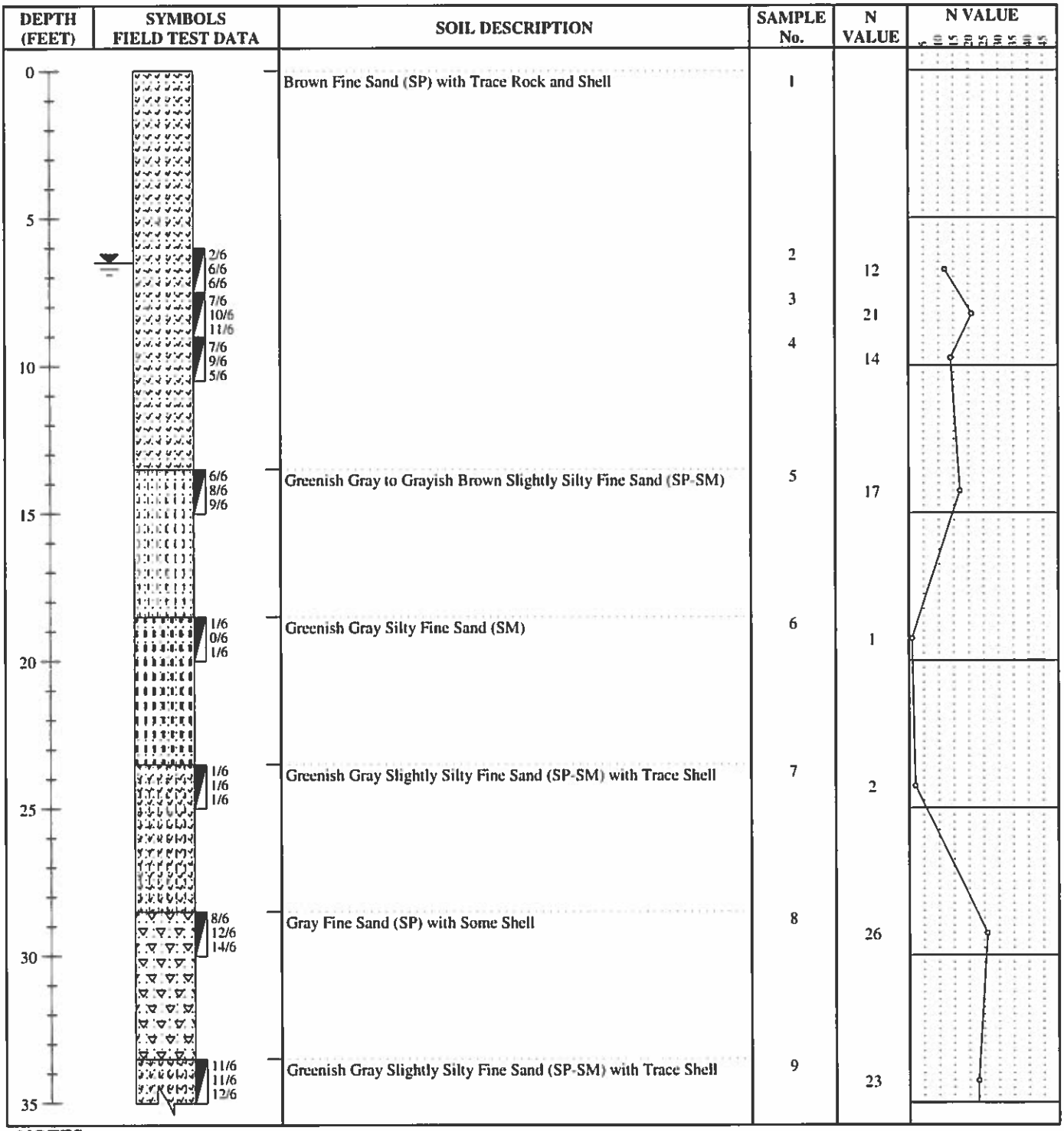
FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 6.5 Feet

DATE DRILLED: 9/25/13



NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

STANDARD PENETRATION TEST BORING LOG

BORING B-3

PROJECT: FPL St. Lucie Switchyard Expansion

FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 6.5 Feet

DATE DRILLED: 9/25/13

DEPTH (FEET)	SYMBOLS FIELD TEST DATA	SOIL DESCRIPTION	SAMPLE No.	N VALUE	N VALUE
35					
	9/6 10/6 13/6		10	23	
40					
	3/6 3/6 3/6	Greenish Gray Fine Sand (SP) with Some Partially Cemented Sand and Shell	11	6	
45					
	3/6 3/6 4/6		12	7	
50		End of Boring			
55					
60					
65					
70					

NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN". 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

Ardaman & Associates, Inc.

AUGER BORING LOG

BORING AB-1

PROJECT: FPL St. Lucie Switchyard Expansion

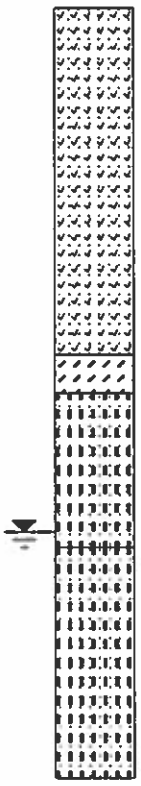
FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 6.8 Feet

DATE DRILLED: 9/25/13

DEPTH	SYMBOLS	SOIL DESCRIPTION	SAMPLE No.
0		Brown Fine Sand (SP) with Trace Rock and Shell	1
		Greenish Gray Very Clayey Fine Sand (SC)	2
5		Greenish Gray Silty Fine Sand (SM) <Natural Moisture: 30.7%> <Percent Fines: 30.2%>	3
		Greenish Gray Silty Fine Sand (SM) <Natural Moisture: 34.6%> <Percent Fines: 49.9%>	4
10		End of Boring	
15			

NOTES:

Ardaman & Associates, Inc.

AUGER BORING LOG

BORING AB-2

PROJECT: FPL St. Lucie Switchyard Expansion

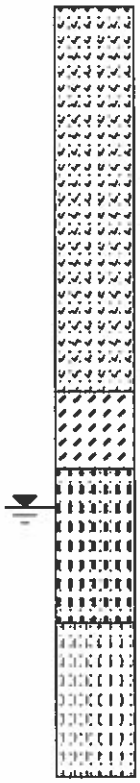
FILE No.: 13-5449

BORING LOCATION: See Boring Location Plan

DRILL CREW: WPB

WATER OBSERVED AT DEPTH 6.5 Feet

DATE DRILLED: 9/25/13

DEPTH	SYMBOLS	SOIL DESCRIPTION	SAMPLE No.
0		Brown Fine Sand (SP) with Trace Rock and Shell	1
5		Greenish Gray Very Clayey Fine Sand (SC)	2
		Brown Silty Fine Sand (SM)	3
		Brown Slightly Silty Fine Sand (SP-SM)	4
10		End of Boring	
15			

NOTES:

Ardaman & Associates, Inc.

SFWMD USUAL OPEN-HOLE TEST
Exfil-1

PROJECT: FPL St. Lucie Switchyard Expansion

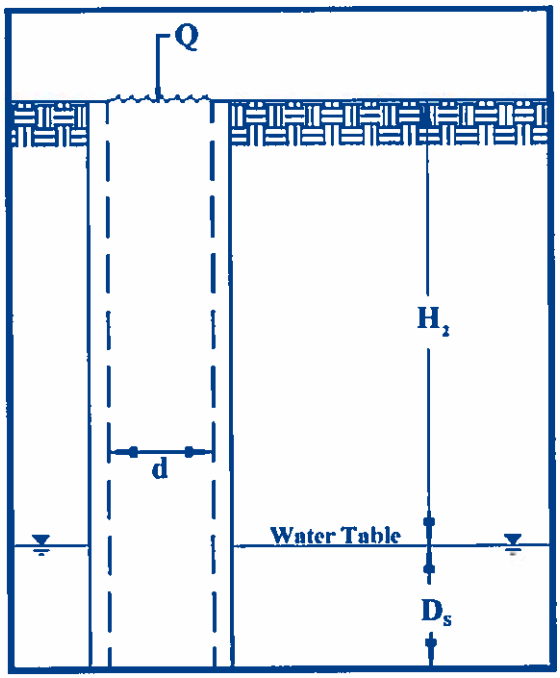
FILE No.: 13-5449

TEST LOCATION: See Boring Location Plan

DRILL CREW: WC/TC

GROUNDWATER OBSERVED AT DEPTH 6.8 Feet

TEST DATE: 9/27/13



$$K = \frac{4Q}{\pi d(2H_2^2 + 4H_2D_s + H_2d)}$$

Q ["Stabilized" Flow Rate (cfs)] = 2.7 x 10^{-3}

K [Hydraulic Conductivity (cfs/sqf - ft head)] = 1.5 x 10^{-4}

d [Diameter of Test Hole (ft)] = 0.5

H_2 [Depth to Water Table (ft)] = 6.8

* D_s [Saturated Hole Depth (ft)] = -1.8

* By Groundwater

DEPTH	SYMBOLS	SOIL DESCRIPTION	SAMPLE No.
0 1 2 3 4 5 6		Brown Fine Sand (SP) with Trace Rock and Shell	1
		End of Boring	

NOTES:

DOUBLE-RING INFILTRATION (DRI) TEST
(ASTM D 3385)

Project Name: FPL St. Lucie Switchyard Expansion **File Number:** 13-5449

Test ID: DRI-1 **Test Date:** 9/27/2013

Location: Existing Dry Retention Pond, Eastern Portion (AB-2) **Field Crew:** WC/TC

INFILTROMETER SET UP INFORMATION:

Inner Ring Diameter (in): 12 **Inner Ring Area [A_{IR}] (in^2):** 113.1

Outer Ring Diameter (in): 24 **Annular Space Area [A_A] (in^2):** 339.3

Inner Ring Height (in): 20 **Inner Ring Embedment Depth (in):** 9

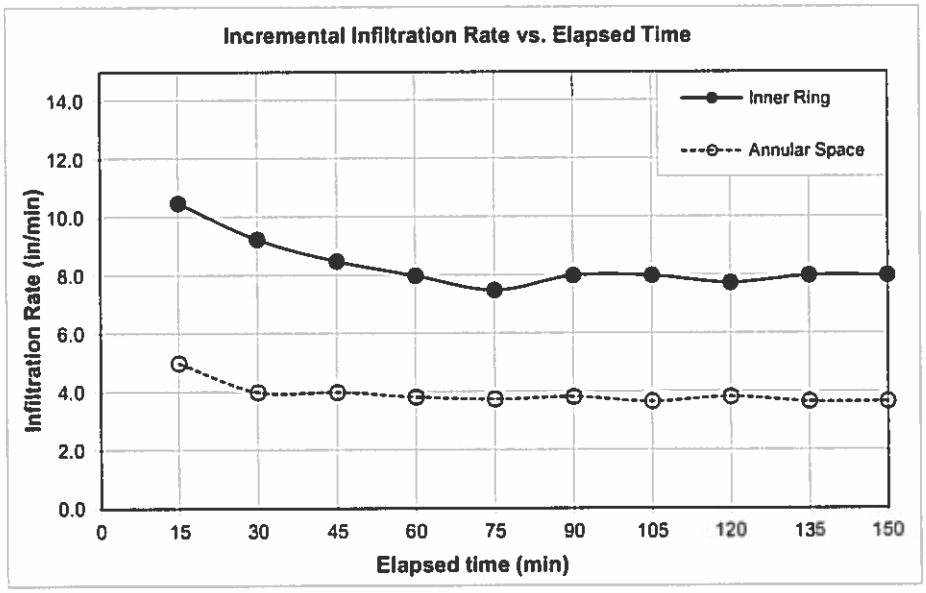
Outer Ring Height (in): 20 **Outer Ring Embedment Depth (in):** 6

Test Surface Depth (in bls): 0 **Depth of Water Inside Rings (in):** 6

Surficial Soil Description: brown fine sand (SP) with trace rock and shell

TEST DATA

Trial No.	Elapsed Time (min)	Δt (hr)	ΔV_{IR} (in^3)	ΔV_A (in^3)	V_{IR} (in/hr)	V_A (in/hr)
1	15	0.25	296.8	424.1	10.50	5.00
2	30	0.25	261.5	339.2	9.25	4.00
3	45	0.25	240.3	339.2	8.50	4.00
4	60	0.25	226.2	325.1	8.00	3.83
5	75	0.25	212.0	318.0	7.50	3.75
6	90	0.25	226.2	325.1	8.00	3.83
7	105	0.25	226.2	311.0	8.00	3.67
8	120	0.25	219.1	325.1	7.75	3.83
9	135	0.25	226.2	311.0	8.00	3.67
10	150	0.25	226.2	311.0	8.00	3.67



SOIL INFILTRATION RATE = 8 in/hr

Appendix B

Stormwater Calculations

SITE DATA

1.0 PROJECT

FPL St. Lucie Substation - Yard Expansion

Location: North Hutchinson Island
St. Lucie County, Florida

2.0 PROPOSED BASIN AREA BREAKDOWN *(REFER TO FIGURE 3)*

	ft^2	acres	Median El.
Property Area (not stated)	-	-	
Basin Area (interpolated using glass wall)	150,761	3.461	
Yard Area w/ Expansion (Impervious)	98,874	2.270	14.88
Proposed Pavement Area (Impervious)	16,120	0.370	14.34
Existing Building Area (Impervious)	4,835	0.111	15.35
Green Area (Pervious)	30,920	0.710	10.00

3.0 STORMWATER DATA

Ground Water Table: 1.57 ft (interpolated from attached Geotech Report; Appendix A)

Rainfall Data:

5-yr, 1-hr Storm event (Total Rainfall)	2.9	inches
5-yr, 1-day Storm event (Total Rainfall)	5.2	inches
10-yr, 1-day Storm event (Total Rainfall)	6.2	inches
25-yr, 3-day Storm event (Total Rainfall)	10.0	inches
100-yr, 3-day Storm event (Total Rainfall)	12.1	inches

4.0 STORMWATER BASIN DATA

4.1 BASIN 1

4.1.1 Site Data

Impervious Area	2.751	acres	
Pervious Area	0.710	acres	
Area Subtotal	3.461	acres	
% Impervious	79.5	%	
% Pervious	20.5	%	
Finished Grade:	Varies 7.50 to 15.35	ft	
Average Grade:	13.84	ft	
Retention Area Bottom:	7.50	ft	
Average Water Table Elevation:	1.57	ft	<== Per AB-1, AB-2 and Exfil-1
Seasonal High Water Table Elevation:	3.07		<== Avg. + 1.50'
Average Depth to Seasonal High Water Table:	4.43	ft	<== 7.50' - 3.07'

4.1.2 Stormwater Management System Design Criteria

Area 1 x 25-yr, 3-day rainfall:	34.61	Ac-in	=	125,624 cf
Max. water height in new retention area				5.00 ft
Retention area:	0.58	Ac	=	25125 sf

4.1.3 Soil Storage (Excerpt from SFWMD Manual)

Depth to Water Table (ft)	Compacted Water Storage (Inches)
1	0.45
2	1.88
3	4.95
4	8.18

Soil storage for 4.00+ ft: **8.18 inches**

	Area 1	
Post Dvlpmt. Soil Storage x % Perv. Area	1.68	inches
Soil Storage Provided	21,077	ft^3

4.1.4 Retention Storage

Stage	Contour	Cumulative Storage	
(ft)	Area (ft^2)	ft^3	acre-in
7.50	12,937	-	-
8	14,070	13,504	3.720
8.5	15,246	28,162	7.758
9	16,422	43,996	12.120
9.5	17,642	61,028	16.812
10	18,905	79,301	21.846
10.5	20,168	98,838	27.228
11	21,475	119,659	32.964
11.5	22,782	141,788	39.060
12	24,132	165,245	45.522
12.5	25,526	186,829	51.468

Note:

4.1.5 Total Storage

Total Soil Storage (Section 4.1.3):	21,077 ft^3		
Total Dry Storage (@12.5' stage, Sec. 4.1.4):	186,829 ft^3		
Total Storage Provided:	**207,906 ft^3**	**>**	**125,624 ft^3 of storage required**

The total storage provided exceeds the stormwater management design criteria for both water quantity and water quality.

4.1.6 Bleed Down Time For Retention Systems

$$V = \frac{L[K(2H_2D_u - D_u^2 + 2H_2D_s)]}{2}$$

Bleed down time requirements:

Total Retention Volume	28.80	ac-in	(25 yr/3 day storage less soil storage)
Water Quality Volume	6.88	ac-in	
Hydraulic Conductivity (k)	1.05E-04	cfs/ft^2-ft h	(geotech report attached)
Approx. Retention Perimeter	690	ft	
Design Volume Head ($H_2=D_u$)	9.43	ft	(Max stage of 12.5'; min. stage of 3.07')
D_s	4.43	ft	(Bottom of ret. 4.43' above the water table)

V= 6.25 Ac-in/hr, when the retention area is full
Average V= 3.12 Ac-in/hr

Time to drain retention volume,

	Hours	Days
Time (Total Retention Volume)	9.22	0.38
Time (Water Quality Volume)	2.20	0.09

Figures

SOURCE: SCANNED USGS TOPOGRAPHIC QUADRANGLES
SCANNED BY THE FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION, 1997.

0 2000 4000

SCALE IN FEET

M:\ESMASTER\FPL\09213182.00 St. Lucie Substn – Expansion\Drawings\09213182.00 F001.dwg

8/15/2014

Prepared For FLORIDA POWER AND LIGHT JUNO BEACH, FLORIDA	Project Name and Address ST. LUCIE SUBSTATION SWITCHYARD EXPANSION ST. LUCIE COUNTY, FL	Sheet Title USGS QUAD MAP	
Prepared By SCS ENGINEERS 7700 NORTH KENDALL DRIVE, SUITE 300 MIAMI, FLORIDA 33156 PH 305.412.8185 FX 305.412.8105	Project No. 09213182.00	Date SEPTEMBER 2014	Sheet FIGURE 1

M:\ESMASTER\FPL\09213182.00 St. Lucie Substn - Expansion\Drawings\09213182.00 F002.dwg

8/15/2014

Prepared For
FLORIDA POWER AND LIGHT
JUNO BEACH, FLORIDA

Prepared By
SCS ENGINEERS

7700 NORTH KENDALL DRIVE, SUITE 300
MIAMI, FLORIDA 33156
PH 305.412.8185 FX 305.412.8105

Project Name and Address
ST. LUCIE SUBSTATION
SWITCHYARD EXPANSION

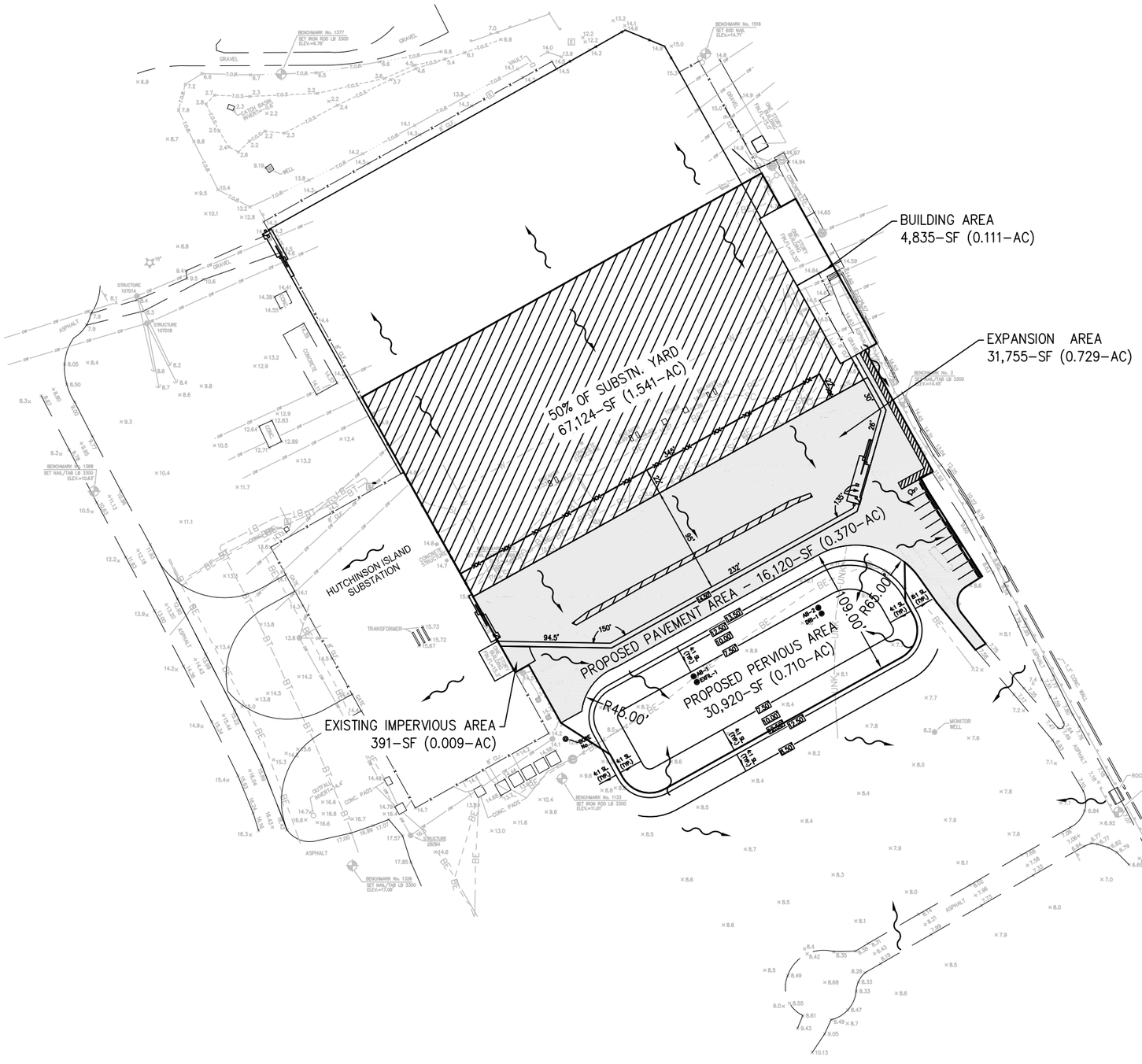
ST. LUCIE COUNTY, FL

Project No.
09213182.00

Sheet Title
SITE LOCATION MAP

Date
SEPTEMBER 2014

Sheet
FIGURE 2



LEGEND

- EXISTING IMPERVIOUS AREA
- PROPOSED IMPERVIOUS AREA
- PROPOSED FLOW ARROW
- BASIN AREA

NOTES

TOTAL BASIN AREA = 3.461 AC

0 100 200

SCALE IN FEET

Prepared For: FLORIDA POWER AND LIGHT, JUNO BEACH, FLORIDA Prepared By: SCS ENGINEERS 7700 NORTH KENDALL DRIVE, SUITE 300, MIAMI, FLORIDA 33156 PH 305.412.8185 FX 305.412.8105	Project Name and Address: ST. LUCIE SUBSTATION SWITCHYARD EXPANSION, ST. LUCIE COUNTY, FL Project No. 09213182.00	Sheet Title: DRAINAGE BASIN AREA BREAKDOWN Date SEPTEMBER 2014 | Sheet FIGURE 3

8/15/2014 M:\ESMASTER\FPL\09213182.00 St. Lucie Substn – Expansion\Drawings\09213182.00 F003.dwg