

# SPECIFIC PURPOSE SURVEY C-24FAS GW WELL CLUSTER REFERENCE ELEVATION

December 2016



**SOUTH FLORIDA WATER MANAGEMENT DISTRICT  
SURVEY SECTION**

3301 Gun Club Road West Palm Beach, Florida 33406

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# Surveyor's Report

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Report Date: 12/29/16

Submittal: Final

Prepared for: Hydrogeology

## South Florida Water Management District



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**SURVEY SECTION**

3301 Gun Club Road West Palm Beach, Florida 33406

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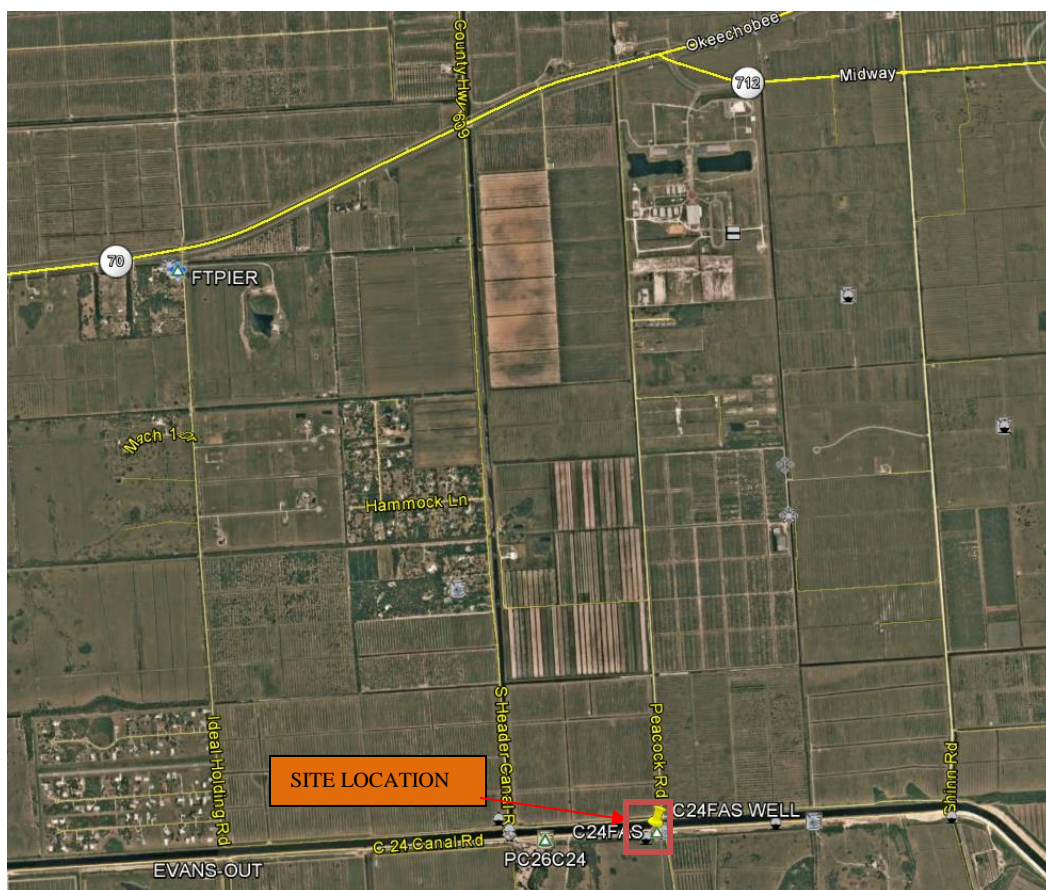
## OVERVIEW OF THE PROJECT

### **PURPOSE**

The purpose of this Survey is to establish Reference Elevation for Groundwater wells monitored by the USGS and South Florida Water Management District (SFWMD). Third order elevations referring to both the North American Vertical Datum of 1988 (NAVD88) and the National Geodetic Vertical Datum of 1929 (NGVD29). NGVD 29 elevation shall be based on offset from NAVD 88 using USACE Corpscon 6.0.1.

### **Location of Project**

The project is located in St. Lucie County, Florida. Following is a map of Location.



General Location (Not to Scale)

### **VERTICAL DATUM FOR THE PROJECT**

The vertical datum for the project is the North American Vertical Datum of 1988. For correlation with older data sets, the elevations of the benchmarks are also shown in the National Geodetic Vertical Datum (NGVD) of 1929. The NGVD 29 elevations were derived using data from published NGS superseded values when applicable, otherwise values provided by the South Florida Water Management District in a file named "NGVD29.txt" were used. The linear unit for all elevations is the U.S. survey feet unless otherwise stated.

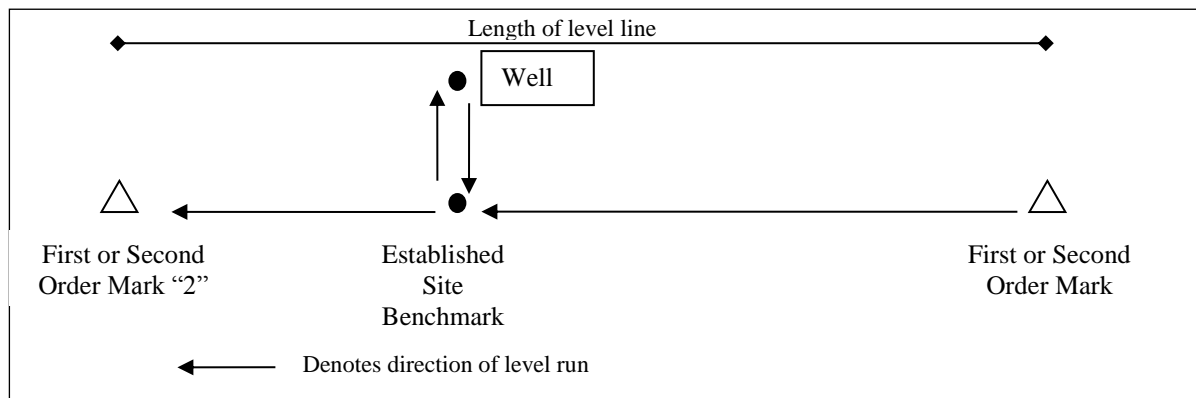
## **LEVELING METHODS**

### **CONFIGURATION OF LEVEL RUNS**

The leveling for the project was performed in accordance with the Federal Geodetic Control Subcommittee standard for Second-Order, Class II geodetic leveling. A brief description of the procedures used is as follows. The run was started at one of the First or Second Order marks and continued through the Site Benchmark (Found or Established) at the well and closed on the original or additional First or Second Order NGS vertical mark. (See Figure 1. below).

For each well site, a closed loop was run from an established Third Order vertical mark (Site Benchmark).

**Figure 1 Typical Level Run Pattern**



The FGCS maximum allowable misclosure for this type of run is 0.03' multiplied by the square root of the length of the line in miles.

### **EQUIPMENT USED**

All leveling was performed with a Topcon Digital Level.

## **BENCHMARKS USED**

### **INTRODUCTION**

The following instrument was used for GPS observations:

- (1) Garmin GPS Map 78.

<b>Description</b>	<b>X, (Easting) 83/86 Coordinates</b>	<b>Y, (Northing) 83/86 Coordinates</b>	<b>Latitude</b>	<b>Longitude</b>
<b>BM HAWK</b>	827090.730	1092521.449	27 20 18	80 28 24.6
<b>BM S-544</b>	818217.449	1092383.991	27 20 17	80 30 03.0
<b>BM C-24FAS</b>	821748.20	1092269.39	27 20 15.72	80 29 23.85

## CONTROL BENCHMARKS

# The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.11
1      National Geodetic Survey,      Retrieval Date = DECEMBER 21, 2016
AJ8590 *****
AJ8590 DESIGNATION - HAWK
AJ8590 PID - AJ8590
AJ8590 STATE/COUNTY- FL/ST LUCIE
AJ8590 COUNTRY - US
AJ8590 USGS QUAD - FORT PIERCE SW (1953)
AJ8590
AJ8590 *CURRENT SURVEY CONTROL
AJ8590
AJ8590* NAD 83(1986) POSITION- 27 20 18. (N) 080 28 25. (W) SCALED
AJ8590* NAVD 88 ORTHO HEIGHT - 8.695 (meters) 28.53 (feet) ADJUSTED
AJ8590
AJ8590 GEOID HEIGHT - -27.209 (meters) GEOID12B
AJ8590 DYNAMIC HEIGHT - 8.681 (meters) 28.48 (feet) COMP
AJ8590 MODELED GRAVITY - 979,126.4 (mgal) NAVD 88
AJ8590
AJ8590 VERT ORDER - FIRST CLASS II
AJ8590
AJ8590.The horizontal coordinates were scaled from a topographic map and have
AJ8590.an estimated accuracy of +/- 6 seconds.
AJ8590.
AJ8590.The orthometric height was determined by differential leveling and
AJ8590.adjusted by the NATIONAL GEODETIC SURVEY
AJ8590.in August 2009.
AJ8590
AJ8590.Significant digits in the geoid height do not necessarily reflect accuracy.
AJ8590.GEOID12B height accuracy estimate available here.
AJ8590
AJ8590.The dynamic height is computed by dividing the NAVD 88
AJ8590.geopotential number by the normal gravity value computed on the
AJ8590.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
AJ8590.degrees latitude (g = 980.6199 gals.).
AJ8590
AJ8590.The modeled gravity was interpolated from observed gravity values.
AJ8590
AJ8590; North East Units Estimated Accuracy
AJ8590;SPC FL E - 333,000. 252,090. MT (+/- 180 meters Scaled)
AJ8590
AJ8590_U.S. NATIONAL GRID SPATIAL ADDRESS: 17RNL520240(NAD 83)
AJ8590
AJ8590 SUPERSEDED SURVEY CONTROL
AJ8590
AJ8590 NAVD 88 (05/02/02) 8.701 (m) 28.55 (f) SUPERSEDED 1 2
AJ8590
AJ8590.Superseded values are not recommended for survey control.
AJ8590
```



AJ8590'RECOVERED AS DESCRIBED.  
 AJ8590  
 AJ8590 STATION RECOVERY (2006)  
 AJ8590  
 AJ8590'RECOVERY NOTE BY FL DEPT OF ENV PRO 2006 (BPJ)  
 AJ8590'RECOVERED AS DESCRIBED.  
 AJ8590  
 AJ8590 STATION RECOVERY (2010)  
 AJ8590  
 AJ8590'RECOVERY NOTE BY CREECH ENGINEERS INC 2010  
 AJ8590'RECOVERED IN GOOD CONDITION.

## The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.11
1 National Geodetic Survey, Retrieval Date = DECEMBER 21, 2016
AJ8588 *****
AJ8588 DESIGNATION - S 544
AJ8588 PID - AJ8588
AJ8588 STATE/COUNTY- FL/ST LUCIE
AJ8588 COUNTRY - US
AJ8588 USGS QUAD - NORTH OF BLUEFIELD (1970)
AJ8588
AJ8588 *CURRENT SURVEY CONTROL
AJ8588
AJ8588* NAD 83(1986) POSITION- 27 20 17. (N) 080 30 03. (W) SCALED
AJ8588* NAVD 88 ORTHO HEIGHT - 7.352 (meters) 24.12 (feet) ADJUSTED
AJ8588
AJ8588 GEOID HEIGHT - -27.179 (meters) GEOID12B
AJ8588 DYNAMIC HEIGHT - 7.341 (meters) 24.08 (feet) COMP
AJ8588 MODELED GRAVITY - 979,124.2 (mgal) NAVD 88
AJ8588
AJ8588 VERT ORDER - FIRST CLASS II
AJ8588
AJ8588.The horizontal coordinates were scaled from a topographic map and have
AJ8588.an estimated accuracy of +/- 6 seconds.
AJ8588.
AJ8588.The orthometric height was determined by differential leveling and
AJ8588.adjusted by the NATIONAL GEODETIC SURVEY
AJ8588.in May 2002.
AJ8588
AJ8588.Significant digits in the geoid height do not necessarily reflect accuracy.
AJ8588.GEOID12B height accuracy estimate available here.
AJ8588
AJ8588.The dynamic height is computed by dividing the NAVD 88
AJ8588.geopotential number by the normal gravity value computed on the
AJ8588.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
AJ8588.degrees latitude (g = 980.6199 gals.).
AJ8588
AJ8588.The modeled gravity was interpolated from observed gravity values.
AJ8588
```







AJ8588 STATION RECOVERY (2005)  
 AJ8588  
 AJ8588'RECOVERY NOTE BY G.C.Y., INCORPORATED 2005 (JES)  
 AJ8588'RECOVERED AS DESCRIBED.

COUNTY ST LUCIE	PROJECT MISC	DESIGNATION C24FAS
SECTION 24	TOWNSHIP 36 SOUTH	RANGE 38 EAST
NAME OF QUADRANGLE FORT PIERCE SW (1953)		
Established by SFWMD STRICKLAND (Surveyor / Firm Name) <b>or</b>	Recovered by _____ (Surveyor / Firm Name)	
DATE 11/9/2016 (Established or Recovered)	FIELD BOOK MISC 7B	PAGE 12 AND 13
HORIZONTAL DATUM: 1927 <b>1983</b> ADJ _____ Other _____ (circle one)	ZONE <b>E</b> or W	
STATE PLANE COORDINATES	N 1092269.39 FT	E 821748.20 FT
LATITUDE: N 27 20 15.72	LONGITUDE: W 80 29 23.85	
VERTICAL DATUM: MSL 1929 <b>1988</b> Other _____ (circle one)	EL. 26.611 ft	
VERTICAL DATUM: MSL <b>1929</b> 1988 Other _____ (circle one)	EL. ft	
CONTROL ACCURACY: HORIZONTAL 1 2 <b>3</b> <u>SUB-METER</u> (circle one) VERTICAL 1 2 <b>3</b>		
<b>DESCRIPTION</b>		
<p>To Reach:</p> <p>FROM THE INTERSECTION OF STATE ROAD 70 AND SHINN ROAD IN FT. PIERCE. PROCEED SOUTH ON SHINN ROAD (CR 609A) 0.40 MILE TO MIDWAY ROAD. CONTINUE SOUTH ON SHINN ROAD (DIRT ROAD AT THIS POINT) 2.55 MILES CROSSING OVER THE C 24 CANAL TO THE SOUTH BANK OF CANAL AND C 24 CANAL ROAD. TURN RIGHT AND PROCEED 1.0 MILE ALONG C 24 CANAL ROAD (DIRT) TO STATION LOCATION ON THE LEFT.</p> <p>THE STATION IS LOCATED 58 FEET SOUTH OF THE CENTERLINE OF THE C 24 CANAL ROAD AND 75 WEST OF THE WEST EDGE OF CONCRETE PAD FOR SLF 75 WELL THE SW MOST WELL ( ONE OF THREE WELLS AT THIS LOCATION).</p> <p>THE STATION IS A FOUND 4" X 4" CONCRETE MONUMENT WITH A SFWMD ALUMINUM CAP STAMPED " S R/W C-24 LB 6969 BM C24FAS" 0.15 FEET BELOW GROUND.</p> <p>NOTE: THE COORDINATES ARE FROM C24 GATES.PDF</p> <p>NGS Benchmarks Used:</p>		
Notable Land marks: C24 FAS WELL SITE AKA SLF 74, 75, 76 AND C 24 PC 25		
SKETCH		

## PROJECT RESULTS

The following tables list the elevations established for each existing or new mark, the level run misclosure, “to-reach” description for each mark and a photo of the mark. All elevations and coordinates are in US Survey Feet.

### SURVEYOR’S REPORT VERTICAL CONTROL WELL SLF-74

<b>BM HAWK (AJ8590)</b>	Elevation:	<b>28.53ft</b>	(NAVD 88)	29.99 ft	(NGVD 29)
<b>BM S-544 (AJ8588)</b>	Elevation:	<b>24.12ft</b>	(NAVD 88)	25.58ft	(NGVD 29)
Site BM	<b>C-24FAS</b>	<b>26.61 ft</b>	(NAVD 88)	<b>28.07ft</b>	(NGVD 29)
Reference Elevation		29.93ft	(NAVD 88)	31.39ft	(NGVD 29)
Top of Well Pad Elevation		27.42ft	(NAVD 88)	28.88ft	(NGVD 29)
Ground Elevation		26.8ft	(NAVD 88)	28.3ft	(NGVD 29)
Length of Run:	.01 mi	<b>To Reach WELL C-24FAS:</b>			
Max Allowable Misclosure:	0.00 ft	<p><b>TO REACH</b> the Mark and Site from SR70 and SHINN RD. in FT. PIERCE. Go South on SHINN Rd. (CR609A) 0.4mils to MIDWAY Rd. Continue South on SHINN RD. (Shell Rock) for 2.55mils crossing over C-24 Canal to south bank and Shell Rock Rd. Turn Right and go 1.0ml to Station Location on Left. Located 58ft south of the centerline of the canal road and 75ft west of the west edge of the concrete pad for SLF 75 well pad. The Mark is a found 4" X 4" concrete monument with SFWMD Alum. Disk Stamped SR/W C-24 LB6969 BM C24FAS and is 0.15' below ground.</p>			
Actual Misclosure:	0.00 ft				
					
		<p>Benchmark Found at wellsite for wells SLF 74, SLF 75 and SLF 76</p>			

**SURVEYOR'S REPORT**  
**VERTICAL CONTROL**  
**WELL SLF-75**

<b>BM HAWK (AJ8590)</b>	Elevation:	<b>28.53ft</b>	(NAVD 88)	29.99 ft	(NGVD 29)
<b>BM S-544 (AJ8588)</b>	Elevation:	<b>24.12ft</b>	(NAVD 88)	25.58ft	(NGVD 29)
Site BM	<b>C-24FAS</b>	<b>26.61 ft</b>	(NAVD 88)	<b>28.07ft</b>	(NGVD 29)
Reference Elevation		29.50ft	(NAVD 88)	30.96ft	(NGVD 29)
Top of Well Pad Elevation		27.03ft	(NAVD 88)	28.49ft	(NGVD 29)
Ground Elevation		26.4ft	(NAVD 88)	27.9ft	(NGVD 29)
Length of Run:	.01 mi	<b>To Reach WELL C-24FAS:</b>			
Max Allowable Misclosure:	0.00 ft	<b>TO REACH</b> the Mark and Site from SR70 and SHINN RD. in FT. PIERCE. Go South on SHINN Rd. (CR609A) 0.4mIs to MIDWAY Rd. Continue South on SHINN RD. (Shell Rock) for 2.55mIs crossing over C-24 Canal to south bank and Shell Rock Rd. Turn Right and go 1.0ml to Station Location on Left. Located 58ft south of the centerline of the canal road and 75ft west of the west edge of the concrete pad for SLF 75 well pad. The Mark is a found 4" X 4" concrete monument with SFWMD Alum. Disk Stamped SR/W C-24 LB6969 BM C24FAS and is 0.15' below ground.			
Actual Misclosure:	0.00 ft				



Benchmark Found at wellsite for wells SLF 74, SLF 75 and SLF 76






**SURVEYOR'S REPORT**  
**VERTICAL CONTROL**  
**WELL SLF-76**

<b>BM HAWK (AJ8590)</b>	Elevation:	<b>28.53ft</b>	(NAVD 88)	29.99 ft	(NGVD 29)
<b>BM S-544 (AJ8588)</b>	Elevation:	<b>24.12ft</b>	(NAVD 88)	25.58ft	(NGVD 29)
Site BM	<b>C-24FAS</b>	<b>26.61 ft</b>	(NAVD 88)	<b>28.07ft</b>	(NGVD 29)
Reference Elevation		29.58ft	(NAVD 88)	31.04ft	(NGVD 29)
Top of Well Pad Elevation		27.18ft	(NAVD 88)	28.64ft	(NGVD 29)
Ground Elevation		26.6ft	(NAVD 88)	28.1ft	(NGVD 29)
Length of Run:	.01 mi	<b>To Reach WELL C-24FAS:</b>			
Max Allowable Misclosure:	0.00 ft	<b>TO REACH</b> the Mark and Site from SR70 and SHINN RD. in FT. PIERCE. Go South on SHINN Rd. (CR609A) 0.4mils to MIDWAY Rd. Continue South on SHINN RD. (Shell Rock) for 2.55mils crossing over C-24 Canal to south bank and Shell Rock Rd. Turn Right and go 1.0ml to Station Location on Left. Located 58ft south of the centerline of the canal road and 75ft west of the west edge of the concrete pad for SLF 75 well pad. The Mark is a found 4" X 4" concrete monument with SFWMD Alum. Disk Stamped SR/W C-24 LB6969 BM C24FAS and is 0.15' below ground.			
Actual Misclosure:	0.00 ft				








Benchmark Found at wellsite for wells SLF 74, SLF 75 and SLF 76






**SURVEYOR'S REPORT**  
**PROJECT RESULTS**  
**WELL SLF-74**

<b>Site SLF-74 GW</b>		<b>Date of Field Work</b> 11/9&14/16
<b>Party Chief</b> Strickland/Demonstranti	<b>Field Book Name/Number</b> Misc FB #7B	<b>Page Number(s)</b> Pg. 12&13
<b>Site Benchmark Name</b> C24FAS	<b>Benchmark Elevation (NAVD88)</b> 26.61ft	<b>Datum Offset to NGVD29</b> +1.46
<b>Reference Elevation (NAVD 88)</b> 29.93ft		<b>Existing Tag Elevation (Datum)</b> NA
<b>Latitude</b> 27° 20' 15.9"		<b>Longitude</b> 80° 29' 22.8"
<b>Photographs</b>		
<b>Overall Site</b>	<b>Benchmark Location</b>	<b>Benchmark Close Up</b>
		
<b>Brass Tag Close Up</b>	<b>Brass Tag + Reference Mark</b>	
		

**SURVEYOR'S REPORT**  
**PROJECT RESULTS**  
**WELL SLF-75**

<b>Site SLF-75 GW</b>		<b>Date of Field Work</b> 11/9&14/16
<b>Party Chief</b> Strickland/Demonstranti	<b>Field Book Name/Number</b> Misc FB #7B	<b>Page Number(s)</b> Pg. 12&13
<b>Site Benchmark Name</b> C24FAS	<b>Benchmark Elevation (NAVD88)</b> 26.61ft	<b>Datum Offset to NGVD29</b> +1.46
<b>Reference Elevation (NAVD 88)</b> 29.50ft		<b>Existing Tag Elevation (Datum)</b> NA
<b>Latitude</b> 27° 20' 15.8"		<b>Longitude</b> 80° 29' 22.9"
<b>Photographs</b>		
<b>Overall Site</b>	<b>Benchmark Location</b>	<b>Benchmark Close Up</b>
		
<b>Brass Tag Close Up</b>		<b>Brass Tag + Reference Mark</b>
		

**SURVEYOR'S REPORT**  
**PROJECT RESULTS**  
**WELL SLF-76**

<b>Site SLF-76 GW</b>		<b>Date of Field Work</b> 11/9&14/16
<b>Party Chief</b> Strickland/Demonstranti	<b>Field Book Name/Number</b> Misc FB #7B	<b>Page Number(s)</b> Pg. 12&13
<b>Site Benchmark Name</b> C24FAS	<b>Benchmark Elevation (NAVD88)</b> 26.61ft	<b>Datum Offset to NGVD29</b> +1.46
<b>Reference Elevation (NAVD 88)</b> 29.58ft		<b>Existing Tag Elevation (Datum)</b> NA
<b>Latitude</b> 27° 20' 15.9"		<b>Longitude</b> 80° 29' 22.9"
<b>Photographs</b>		
<b>Overall Site</b>	<b>Benchmark Location</b>	<b>Benchmark Close Up</b>
		
<b>Brass Tag Close Up</b>	<b>Brass Tag + Reference Mark</b>	
		



**SURVEYOR'S REPORT**  
**PROJECT RESULTS**  
**Field Notes**

16		MISC FID 78		11-9-16	
SEC	BY	TIME	SW	ESC	SR
CHECK BATTERY FOR BANS Q1 & Q2					
FOR C24 FAS SIZE REF 74.753 76 WINDS 300%					
STA 176			64		B15 64
B1	1				28.99 MUSK
C24 FAS	2		26.611		
B1	5		28.429		28.94
(CHECK BATT)					
LINER					
B1	5				28.94
C24 FAS	6		26.806		
B1	7		28.942		28.94
(CHECK BATT)					

MISC FID 78		11-9-16	
EN USED DONT LEVEL BIL CASE B49			
SERIAL# 771298			
FILE NAME = C24 FAS			
REF C-24 BATES			
COMMENTS			
B15 B1 SPWMS YELLOW PL CAP & 95' BENE IN CR TO GND CONT			
B15 C24 FAS IS A PD B1W CR 44. W/ SPWMS AL CAP STRAPER 2. R/W 3.24 68.6765" ALL SO ABOVE MOUNTAIN "B15 C24 FAS"			
B15 B1 SPWMS YELLOW PL CAP & 95' BENE TO GND CONT			
B15 B1 AS ABOVE			
CANAL C24 FAS TO SPWMS LATE AUMS DISK WITH CONT AT 2000' BANS & AT 200' IN CR TO BAY R.P. 26			
B15 B1 AS ABOVE			

13 MISC FB# 78 11-14-16

SEC	24	TWP	36	RGE	38
ESTABLISH NAVD 88 EL @ C-24 FAS WELLS					
SLF 74 75 & 76					
STA	+	HC	-	EL	BM EL
BM	6.58	32.13			25.55 NAVD 88
SLF 74 GW 3			2.20	29.98	
CONC			4.71	27.42	
GENS			5.3	26.82	
SLF 75 GW 1			2.63	29.50	
CONC			5.10	27.03	
GENS			5.7	26.43	
SLF 76 GW 2			2.55	29.58	
CONC			4.95	27.12	
GENS			5.55	26.58	
BM	6.58			25.55	25.55

MISC FB# 78 11-14-16

13

X III STEICKLAND  
of DEMONSTRATE

COMMENTS

BM GI SFWMD YELLOW PL CAP & 9/8" REBAR IN CONC  
FD GENS COND SEE PG 12 THIS BOOK

REF MARK "X" ATOP of 1/4" 90° N SIDE E. ELBOW GW 3

CONC PAD 3'x3'

GENS @ WELL

REF MARK "X" ATOP of 1/4" 90° N SIDE ESK CONCRETE GW 1

CONC PAD 3'x3'

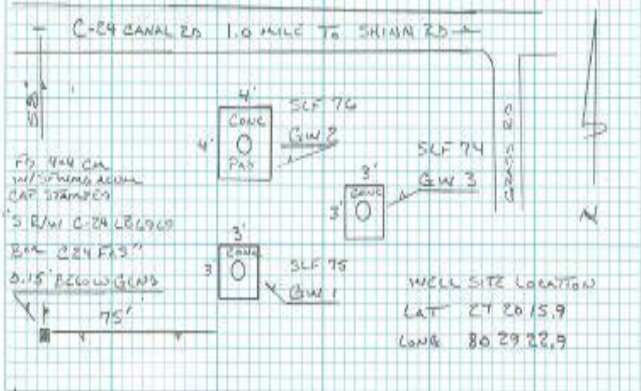
GENS @ WELL

REF MARK "X" ATOP of 1/4" 90° N SIDE E. ELBOW GW 2

CONC PAD 4'x4'

GENS @ WELL

BM GI AS ABOVE



Abbreviation:

- NAVD 88 – North American Vertical Datum of 1988
- NGVD 29 – National Geodetic Vertical Datum of 1929
- NAD 83/99- (Horizontal Datum) North American Datum
- NGS – National Geodetic Survey.
- SFWMD – South Florida Water Management District
- PSM – Professional Surveyor & Mapper

**SURVEYOR'S CERTIFICATION**

**I hereby certify that this Specific Purpose Survey was made under my responsible charge and meets applicable portions of the Standards of Practice set forth by the Florida Board of Professional Surveyors and Mappers in Chapter 5J, Florida Administrative Code, pursuant to Section 472.027, Florida State Statutes.**

**This report is prepared for the sole and specific use of the South Florida Water Management District and is not assignable.**

-----  
**Date of Survey**  
**November 14, 2016**

-----  
**Elvie D. Ebanks PSM**  
**Professional Surveyor and Mapper**  
**State of Florida**  
**Certificate No. 5765**