Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 1 of 48



SALT WATER ORIENTATION IN THE BISCAYNE AQUIFER IN THE TURKEY POINT PLANT VICINITY PRIOR TO INSTALLATION OF THE COOLING CANAL SYSTEM

Florida Power & Light Company Turkey Point Plant Miami-Dade County, Florida

Submitted To: Florida Power & Light Company 700 Universe Boulevard Juno Beach, Florida 33408

and

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Submitted By: Golder Associates Inc. 3730 Chamblee Tucker Road Atlanta, Georgia 30341 Certificate of Authorization Number: 1670

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Distribution:

6 Copies – Florida Power & Light Company 3 Copies – Golder Associates Inc.

August 16, 2011



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 2 of 48

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Table of Contents

COVER LETTER

1.0	INTRODUCTION	1
2.0	ISO-CONDUCTIVITY AND ISOCHLOR LOCATION ESTIMATION TECHNIQUE	3
3.0	DISCUSSION	4
4.0	CONCLUSIONS	5

List of Tables

Table 1	Relevant Reference Documents
Table 2	Average Conductivity (Micro-Mhos per cm) in E-Series Wells
Table 3	Average Conductivity (Micro-Mhos per cm) in G-Series Wells
Table 4	Average Chloride Values (mg/L) in E-Series and F-Series Wells

List of Figures

Figure 1	Turkey Point Cooling Canal System
Figure 2	E Well Locations
Figure 3	F Well Locations
Figure 4	G Well Locations
Figure 5	Color-Coded Conductivity Values at Depth of 20 Feet below Top of Casing
Figure 6	Color-Coded Conductivity Values at Depth of 40 Feet below Top of Casing
Figure 7	Color-Coded Conductivity Values at Depth of 60 Feet below Top of Casing
Figure 8	Color-Coded Conductivity Values at Depth of 50 Feet below Top of Casing
Figure 9	Color-Coded Chloride Values at Depth of 20 Feet below Top of Casing
Figure 10	Iso-Conductivity Lines at 20 Feet below Top of Casing
Figure 11	Iso-Conductivity Lines at 40 Feet below Top of Casing
Figure 12	Iso-Conductivity Lines at 60 Feet below Top of Casing
Figure 13	Isochlors at 20 Feet below Top of Casing
Figure 14	Pre-CCS Isochlor at 20 Feet below Top of Casing vs. Estimated Range of Isochlors, 1972 to 1975
Figure 15	Saltwater Intrusion Lines

List of Appendices

Appendix A Calculations

List of Attachments

CD/ROM of References



1. A.

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 3 of 48

August 2011	1	10390308

1.0 INTRODUCTION

Florida Power & Light Company (FPL) and South Florida Water Management District (SFWMD) agreed to each review existing literature and to determine the orientation of the salt water within the Biscayne Aquifer in the vicinity of the Turkey Point Plant prior to installation of the Cooling Canal System (CCS, Figure 1). The purpose of these activities is to establish a baseline of the salt water orientation before installation of the CCS. This Final Report represents the culmination of that research by FPL and SFWMD. FPL and SFMWD find that this report represents, to their best scientific knowledge based on available data, the orientation of salt water prior to the installation of the CCS.

The CCS was installed according to the terms of a Consent Final Judgment dated September 10, 1971, which settled a lawsuit brought by the U.S. Department of Justice against FPL in March, 1970, and a counter-suit brought by FPL. In July, 1972, an Operating License was obtained for Turkey Point Unit 3, and cooling water for Units 1 and 2 was diverted to the 6.5-mile long canal to Card Sound during construction of the CCS. Unit 3 was placed into operation in December, 1972. By February 18, 1973, the CCS was 40% complete and was closed off from Biscayne Bay and Card Sound, i.e. the CCS commenced operating as a closed loop cooling system for Units 1, 2, and 3. In May, 1973, Unit 4 was placed into operation, also utilizing the closed loop CCS. By August, 1973, the construction of the CCS and Interceptor Ditch (ID) was complete. By December, 1973, the ID pumping system was operational.

FPL installed several sets of monitoring wells and measured conductivity levels over time at various depths in the Biscayne Aquifer. The G-Series wells and the E-Series wells were installed in compliance with the Consent Decree. FPL installed the F-Series wells under their own volition. Although conductivity was measured as a surrogate for chloride, multiple chemical analyses were performed on ground water samples taken at various depths in order to develop mathematical relationships between chloride and conductivity

The E-Series Wells Monitoring Program was initiated in April, 1972. Twenty-three monitoring wells were installed to the north, south, and east of the CCS (Figure 2). First data from the E-series wells was obtained between April and July, 1972, and were taken at depths of 20, 40, and 60 feet below the top of each well casing (TOC).

The G-Series Wells Monitoring Program was initiated in April, 1972. Thirty-eight monitoring wells were installed at twenty-three separate locations west of the CCS (Figure 3). Three existing USGS composite wells (cased with perforated PVC pipe to allow for the free flow of ground water through the well) were also incorporated into the G-wells monitoring system. Pairs of piezometers, at depths of 20 and 50 feet TOC were installed at fifteen of the twenty-three locations (G-2, G-3, G-5, G-9, G-10, G-12, G-16, G-17, G-19, G-23, G-24, G-26, G-30, G-31, and G-33). The remaining eight new wells (G-6, G-13, G-14, G-20,

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 4 of 48

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G-27, G-34, G-34X, and G-35) were constructed as 70-foot deep composite wells. The three existing USGS composite wells incorporated into the monitoring plan (G-7, G-21, and G-28) are located along Tallahassee Road. Conductivities were measured at depths of 20, 40, and 60 feet TOC in the composite G-series wells, and at 20 and 50 feet TOC in the G-series piezometers. Data are available for the G-series wells starting in April, 1972.

The F-Series Wells Ground Water Monitoring Program was also initiated in April of 1972. FPL installed nine F-series wells in the area south of the CCS (Figure 4). The F-series wells are composite wells about 70 feet deep. Chloride data from five of the F-series wells are available starting from July –December, 1972, at depths of 20, 40, and 60 feet TOC.

FPL and SFWMD have reviewed the available literature, determined which of the documents contain relevant information to this study, and compiled a list of those references (see Table 1). Based on that review, data from 23 E-series wells, 26 G-series wells, and 5 F-series wells, for a total of 54 wells, have been utilized to estimate the locations of relevant iso-conductivity lines and isochlors in the aquifer. The estimation technique and iso-contour line locations are presented in the remainder of this report.

The CCS was utilized in closed cycle mode beginning on February 18, 1973, prior to its completion in August, 1973. The well monitoring programs described above all began in 1972. In order to estimate conductivity values prior to operation of the CCS, all available conductivity data values for each well and depth between January 1, 1972, and February 1, 1973, have been averaged. Similarly, all available chloride data over the same period of record have also been averaged. Calculations describing exact details of the data analysis are presented in Appendix A Calculations.

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 5 of 48

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2.0 ISO-CONDUCTIVITY AND ISOCHLOR LOCATION ESTIMATION TECHNIQUE

The references include limited tabulations of the actual data in references 18 through 23; however, References 3 and 4 include scaled time-history plots of the well water levels, conductivities, and temperatures, and Reference 16 includes time-history plots of well water levels, temperature, and chlorinity. The averaged conductivity data are shown in Table 2 for the E-Series wells and Table 3 for the G-Series wells. Table 4 shows the averaged chloride data which were available for the F-Series wells, and the limited chloride data which were directly available for the E-Series wells.

The values were inserted into GIS shape files, and plotted using color codes to differentiate between different ranges of conductivity levels, at depths of 20, 40, 60, and 50 feet (Figures 5, 6, 7 and 8 respectively). Conductivity values at 20, 40, and 60 feet were available for all wells; values at 50 feet were only available at the fifteen piezometer locations in the G-Series wells. Similarly, chloride values were inserted into GIS shape files, and plotted using color codes to differentiate between different ranges of chloride levels, at a depth of 20 feet (Figure 9). The resultant maps were used to draw iso-contours (isochlors for chloride and iso-conductivity for specific conductance) for each depth. Iso-contour line positions are estimated by the following methodology:

- 1. Beginning with the point with the highest value, draw a line to a nearby point
- 2. Use linear interpolation to estimate the point (or points) on the line that correspond to the selected lines to be shown
- 3. Repeat the process for other points around the highest point
- 4. Sketch a smooth curve that connects all points estimated to have the same value. Each curve must pass through any points that have its value, and must divide the map so that all points on one side have higher values and all points on the other side have lower values.
- Sketch a curve for the next value. The second curve should be similar in shape to the first curve and must not cross it.
- 6. Continue drawing lines until the entire area has been covered

The resultant iso-contour lines are shown on Figures 10, 11, and 12 for conductivity at depths of 20, 40, and 60 feet TOC, respectively, and on Figure 13 for chloride at a depth of 20 feet.

The piezometer conductivity levels at the 50-foot depth TOC are not numerous enough to develop contours.

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 6 of 48

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3.0 DISCUSSION

Figure 10 shows the iso-conductivity lines at the 20-foot depth. The 20,000 micro-mho per cm isoconductivity line on figure 10 is approximately at the location of the Levee 31E. Virtually all of the area in which the CCS is built is above 30,000 micro-mho per cm, and the eastern half of that area is above 40,000 micro-mho per cm. The eastern-most portion of the area in which the CCS is built is above 45,000 micro-mho per cm, with an isolated point exceeding 50,000 micro-mho per cm. There is also another isolated point exceeding 50,000 micro-mho per cm south of the CCS.

Figure 11 shows the iso-conductivity lines at the 40-foot TOC depth. The 35,000 micro-mho per cm isoconductivity line is west of the CCS. Conductivity levels drop off to the west, until the 1,000 micro-mho per cm line is reached near Tallahassee Road. All of the area in which the CCS is built is above 35,000 micro-mho per cm, with values exceeding 50,000 micro-mho per cm. South of the CCS, iso-conductivity levels exceed 55,000 micro-mho per cm.

Figure 12 shows the iso-conductivity lines at the 60-foot TOC depth. The distribution of the isoconductivity lines at the 60-foot depth is similar to that shown at the 40-foot depth in Figure 11. Conductivity levels in virtually all of the area in which the CCS was built are above 35,000 micro-mho per cm, and most of that area is above 45,000 micro-mho per cm. Again, the conductivity levels drop off to the west, until the 1,000 micro-mho per cm level is reached near Tallahassee Road.

Figure 13 shows chloride values at the 20-foot depth TOC. The chloride values in Figure 13 range between 10,000 and 19,000 mg/L within the footprint of the CCS, and up to about 22,000 mg/L southwest of the CCS, in well F-4.

Figure 8 shows the conductivity values found in the 50-foot deep piezometers. The values shown in Figure 8 range between 29,500 and 43,900 micro-mho per cm.

References 2 and 15 include figures that depict what was estimated to be the measured ranges of the 1,000, 10,000, and 20,000 mg/L isochlors at the 20, 40, and 60 foot depths during the period between April, 1972, and January, 1975. This period does include time when the CCS was complete and all four units were operating; therefore, the areas shown in these figures are not directly comparable to the isochlors shown in Figure 13. However, it is of interest to compare them, as is done for the 20-foot isochlors in Figure 14. The isochlors from Figure 14 are consistent with the ranges depicted in Reference 2.



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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 7 of 48

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4.0 CONCLUSIONS

Based on the iso-conductivity lines developed, the entire area in the vicinity of the present location of the CCS between the coast and Tallahassee Road contained salt water prior to construction of the CCS. Florida Class I standards, and Class III fresh water standards include a numerical limit of 1275 micro-mho per cm for specific conductance. Based on Figures 11 and 12, the 1275 micro-mho per cm value is exceeded well west of the footprint of the CCS at the 40 and 60-foot depths below TOC. Based on Figure 10, the 1275 micro-mho per cm level is exceeded at the 20-foot depth below TOC well west of Levee 31E.

Based on the isochlors developed, the entire area in the present location of the CCS contained salt water prior to construction of the CCS. Although the USGS sometimes defines a "salt line" as the location where the 1,000 mg/L chloride concentration is at the bottom of the aquifer, the Drinking Water Standards provide a limit of 250 mg/L for chloride. In either case, salt water had extended in-shore to at least the 10,000 mg/L line shown on Figure 13. There were insufficient data to develop the lower value isochlors.

Based on Figure 14, it can also be concluded that the entire area between the coast and Tallahassee Road contained salt water prior to construction of the CCS. The locations of the isochlor lines developed within this report are completely consistent with the isochlor ranges published by Dames & Moore in 1975; this fact leads to the conclusion that the 1,000 mg/L range shown on Figure 14 is also accurate for the pre-CCS condition. It can further be concluded that if the Dames & Moore ranges are accurate at the 20-foot depth, they are most likely also accurate at the 40- and 60-fot depths.

Figure 15 shows the 1,000 mg/L range at a depth of 60 feet as published by Dames & Moore in 1975. The same figure includes two "salt water intrusion lines" published by the USGS, and generally described as the location of the 1,000 mg/L isochlor at the base of the aquifer. Two observations can be made:

- 1. The 1971 line is seaward of the 1951 line, and
- The 1,000 mg/L line at the 60-foot depth as reported by Dames & Moore is consistent with the 1971 line.

With respect to the first observation, it should be noted that the salt line can move considerable distances because of changes in the local ground water hydraulic gradients. Likely causes of such changes include evaporation, precipitation, ground water withdrawals, and changes in ocean/Biscayne Bay water levels. Thus, while the 1971 line is seaward of the 1951 line, they are likely both located within the normal range within which the salt water intrusion line normally moved prior to installation of the CCS.



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 8 of 48

TABLES

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 9 of 48

	File Name	Document Title	Relevant Section	Relevance
1	1-77 semi annual report evy mon.proe2.pdf	January 1977 Semi-Annual Report GWMP	Firster 1	lanations of T T and C mult-
1-	1-77 semi annual report ew mon. proe2 odf		Fioure 2	Incentions of L. C. and D. Weits
47	1.77 termi manual senere are more area? adf		rigue a	locations of L, G. S, and IU wells
44	TT and minut report gw mon projectur		Section 2	history of monitoring wells installation and purpose
11	10/1 Scill annual report gw mon, prog., pd1		Figures 25 - 45	Chlormity Profiles-1976-ID, L. & G-6.7,21,27,28,35, and X wells
-1	1-// Semi annual report gw mon.prog2.pdf	GWMP	Figures 44 - 48	10 PPT CI Cross Sections Lines A-E
-11	4-75 quart.rep.ground.pdf	April 1975 Quarterly Report GWMP	GROUNDWATER SALINITIES	description of groundwater salinities 1975
14	4-75 quart.rep.ground.pdf	April 1975 Quarterly Report GWMP	Plates 5, 6, and 7	Isochlor lines - 1, 10, 20 PPT - 4/72 to 1/75
-4	4-75 quart.rep.ground.pdf	April 1975 Quarterly Report GWMP	Plates 8 and 9	5 PPT @ 20 ft and 15 PPT @ 50 ft loachlose near Line D - 7/72 to 6/72
-	Dames and Moore 3-final.pdf	Summary Report GWMP F-Series Wells	Finure 4 S and 6.	13.77 - AA BDT Looklan (2 an 6 an 6 an 20 an control burk J - 11 an 10 W 10
1200	Dames and Moore 3-final ndf		Times in Annuality A	
1.84	Dames and Moars & Gasl add		A A A A A A A A A A A A A A A A A A A	11mmerfilstory Flots for the wells, starting May 1972, 20, 40, and 60 ft depth
1.0	Participant Manuel Carl alf		Appendix	1 ime/History Plots for S-1 and G wells, starting 9/1/73 - 20, 40, and 60 ft depth
-11	James and Moore S tinal par		Plates 5.3.4.R through 3.3.4.Y	Isochlor maps - Figures missing from pdf file
~	data summary f-series wells.pdf		Figures 4, 5, and 6	Isochlor maps - 1. 10. and 20 PPT @ depths of 20, 40, and 60 feet
~	engineering design reservoir.pdf	The Engineering Design of the Turkey Point Cooling Reservoir	VII., page VII-1 thru VII-5	Narrative discussion of salt water intrusion
	engineering design reservoir.pdf	The Engineering Design of the Turkey Point Cooling Reservoir VIII., page VIII-1 thru VIII-3	VIII., page VIII-1 thru VIII-3	Narrative discussion of surface water usage
	fpl reservior sect 2. pdf	Florida Power & Light Company, Reservoir Concept - Appendix A:Geohydrological Conditions Related to the Construction of Cooling Ponds	Plate 1	Plate 1 shows 1,000 ppm isochior at base of aquifer
	fpl reservior sect 2.pdf	Florida Power & Light Company, Reservoir Concept - Appendix A:Geohydrological Conditions Related to the Construction of Cooling Ponds	Table 1	Table 1 shows chloride in L-31E borrow eanal ranged from 520 to 650 ppm during. November, 1970.
100	intensive mon.progpdf	Turkey Point Site	Table 3	Table 3 shows ehloride values in some E- and G- wells, including G-28, at 20, 40, and 60
(#	letter to der ndf	Tattar from CDCD to M.T. Damons Jatad 0(000		
			rigures 5 + /	1 imme-Hitstory Plots of Cl in ID wells. (@ depth of 20, 40, and 60 feet below top of casing- 11/73 through 5/82 (pp. 12-16 of 96)
-1	letter to der.pdf		Figure 1	Location of wells X-1 and X-2 (p. 10 of 96)
-	letter to der.pdf	Letter from FDER to W.J. Barrow, dated 9/6/83	Figure 8	Estimated Levels of CI in wells G-21, G-13, E-8, and E-9 with cooling canals(p. 17 of 96)
-	letter to der.pdf	Letter from FDER to W.J. Barrow, dated 9/6/83	Table 1	Weekly Salinity in cooling canale, 1981 (n. 20 of 96)
-	letter to der.pdf		un-numbered table	Salinity in cooline canals Sept-Nov 1982 (n 23 of 96)
	NPDES DIS. MON. REP 95-98.pdf		1995.1996, 1997, & 1998 sampling reports	Salinity in cooling canals, 1995-1998
V	REPORT JULY 1978 SEMI ANNUAL REPORT GROUND WATER MONITORING PROGRAM TURKEY PONT FLORIDA PROGRAM TURKEY PONT FLORIDA CONTANY Pdf CONTANY Pdf	Report, July 1978. Semi-Annual Report, GWMP	0/1 pur 691 saged	Time-History Plots Wells X-1 and X-2. April. 1974–June. 1978
	summary report of cool syspdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter VII Salinity and Table VII-1	Salinities in CCS and Biscayne Bay/Card Sound 5/73 - 11/73
	summary report of cool syspdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter X	Narrative description of Salinity in E wells
-11	summary report of cool syspdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter XI	Bisecyne Aquifer under CCS was normally saline prior to construction of CCS:1D design was to "intercept any cooling canal seepage and prevent is frem flowing to the west."
27	summary report of cool syspdf	1	Chapter XI	G-wells consist of 11 composite wells and 30 piczometers at 26 locations. Piezometers are co-located two to a location
P4	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY.pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figures 2 - 4	Cl values for pairs of wells east, west, and south of CCS at 40 ft depth
	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY off	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	page 2	Natural sea water intrusion has occurred throughout the area

Table 1 References xisx Sheet1

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1 of 2

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 10 of 48

No.	File Name	Document Title	Relevant Section	Relevance
2	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY,pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figure 6	Fresh Water - Salt Water Interface Under Original Ground Water Conditions
2	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY _P df	SUMMARY SALNITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figure 7	Fresh Water - Salt Water Interface Under Projected Ground Water Conditions - shows brackish water in L-31E Canal
	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Техt of report	Discussion of causes of salt water intrusion in this area.
2	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Last page entitled "Figures"	Mentions that this summary is based on a more detailed report dated 12/15/77
17	therm perf cool sys 1988,pdf	Thermal Performance of the Turkey Point Cooling Canal System In 1988	Figure 4	Infrared Photograph of CCS
1	therm perf cool sys 1988.pdf	Thermal Performance of the Turkey Point Cooling Canal System In 1988	Figure 5	Flow rates in individual Canals
15	1-75 quart. rep.pdf	January 1975 Quarterly Report . GWMP	Ground Water Salinity pp 12-14 of 122	description of groundwater salimities 1974
15	1-75 quart. rep.pdf	January 1975 Quarterly Report, GWMP	Plates 5. 6. and 7 pp 24 - 26	Isochlor lines = 1. 10. 20 PPT - 4/72 to 10/74
15	1-75 quart. rcp.pdf	January 1975 Quarterly Report , GWMP	Plates 8 and 9 pp 27 - 28	5 PPT @ 20 ft and 15 PPT @ 50 ft isochlors near I inc D - 7/72 to 6/73
16	1-79 semi annual report yw mon, prog.pdf	January, 1979 Semi-Annual Report GWMP	pages 173-177	Time-History Plots Wells F-3, F-4, F-6, F-7, and F-8
17	Ibd.	DMRs for 1/91 through 6/94	monthly DMR salinity tables	max, average, and min monthly salinities in CCS 1/91 through 6/94
18	EPA Turkey Point Wells.pdf	Storet LDC-Detailed Data Report	lla	Specific conductance for E-Wells for 7/31/72 at 20' 40' and 60' douths
61	E-Series Wells-Dec-11-1972.pdf	Groundwater Monitoring Data-Report Sequence #6	all	Specific conductance for E-Wells for 12/5/72 and 12/6/72 at 20' 40' and 60' denths
50	E-Series Wells-Jan-8-1973.pdf	Groundwater Monitoring Data-Report Sequence #7	lle	Specific conductance for E-Wells for 1/2/73 and 1/4/73 at 20' 40' and 60' denths
51	E-Series WQ-Oet-18 1972, pdf	Groundwater Monitoring Data-Water Sample Analyses	lle	TDS and Chlorides for E-Wells for 10/72 at 20' and 40' (E-1 only) denth
55	E-Series WQ-Nov-14-1972.pdf	Groundwater Monitoring Data-Water Sample Analyses	lle	TDS and Chlorides for E-Wells for 11/72 at 20' depth
3	E-Series WQ-Dec-18-1972.pdf	Groundwater Monitorine Data-Water Sample Analyses	la	TDS and Chloridee for E-Walle for 12/22 at 20' doubh

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2 of 2

Table 1 References.xlsx Sheet1

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 11 of 48

Table 2

Average Conductivity¹ (micro-mhos per cm) in E-Series Wells

Well	Cond @ 20 '	Cond @ 40 '	Cond @ 60 '
E-1	39,100	46,600	47,800
E-2	42,200	46,900	47,900
E-3	30,900	48,200	49,100
E-4	37,800	50,100	52,700
E-5	43,200	47,300	49,300
E-6	41,900	48,700	51,600
E-7	47,900	49,900	52,200
E-8	44,100	48,900	51,500
E-9	48,600	54,100	54,700
E-10	48,800	51,000	52,900
E-11	48,200	51,200	52,400
E-12	50,200	50,300	51,700
E-13	49,600	49,900	50,400
E-14	46,900	48,700	49,400
E-15	45,000	49,400	50,700
E-16	41,200	49,000	50,100
E-17	45,700	50,900	51,500
E-18	43,400	50,000	51,100
E-19	32,800	45,800	46,800
E-20	35,100	44,600	46,200
E-21	44,500	53,100	54,200
E-22	50,000	55,600	56,400
E-23	49,900	55,700	56,200

Note 1: Period of Record is 4/1/1972 through 2/1/1973

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 12 of 48

Table 3

Average Conductivity¹ (micro-mhos per cm) in G-Series Wells

Well	Cond @ 20 '	Cond @ 40 '	Cl @ 50 '	Cond @ 60 '
G-2	25,300		43,100	
G-3	27,000		43,100	
G-5	14,800		42,800	
G-6	7,800	28,600		40,500
G-7	900	900		900
G-9	27,900		43,900	
G-10	18,700		45,000	
G-12	7,500		42,700	
G-13	5,900	37,800		41,300
G-14	1,000	1,100		1,000
G-16	17,500		42,800	
G-17	15,100		40,900	
G-19	6,100		37,600	
G-20	5,900	30,100		31,200
G-21	1,200	1,100		1,300
G-23	19,500		31,500	
G-24	19,800		32,600	
G-26	7,000		29,500	
G-27	3,500	26,200		26,100
G-28	3,000	16,600		26,300
G-30	30,800		40,200	
G-31	31,300		39,300	
G-33	18,600		35,800	
G-34	6,500	29,500		29,600
G-34X	4,700	17,000		22,600
G-35	1,100	4,400		27,700

Note 1: Period of Record is 4/1/1972 through 2/1/1973

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 13 of 48

Table 4

Average Chloride¹ Values (mg/L) in E-Series and F-Series Wells

Well	Cl @ 20 '	CI @ 40 '	Cl @ 60 '
E-1	15,125	17,250	
E-2	15,750		
E-3	10,667		
E-4	14,083		
E-5	15,167		
E-6	12,750		
E-7	17,417		
E-8	16,333		
E-9	17,083		
E-10	18,917		
E-11	18,500		
E-12	19,083		
E-13	19,083		
E-14	17,583		
E-15	16,667		
E-16	15,500		•
E-17	17,083		
E-18	15,750		
E-19	9,917		
E-20	12,750		
E-21	16,750		
E-22	18,750		
E-23	18,500		
F-3	19,800	20,400	21,300
F-4	21,900	21,700	22,200
F-6	13,600	17,200	17,600
F-7	1,400	13,600	15,200
F-8	800	10,100	10,900

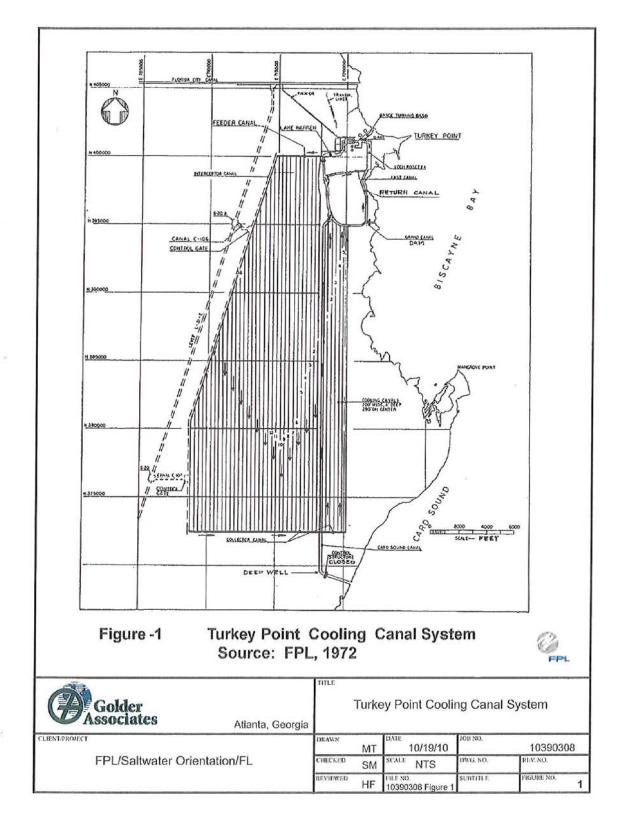
Note 1: Period of Record 4/1/1972 through 2/1/1973 as available

1

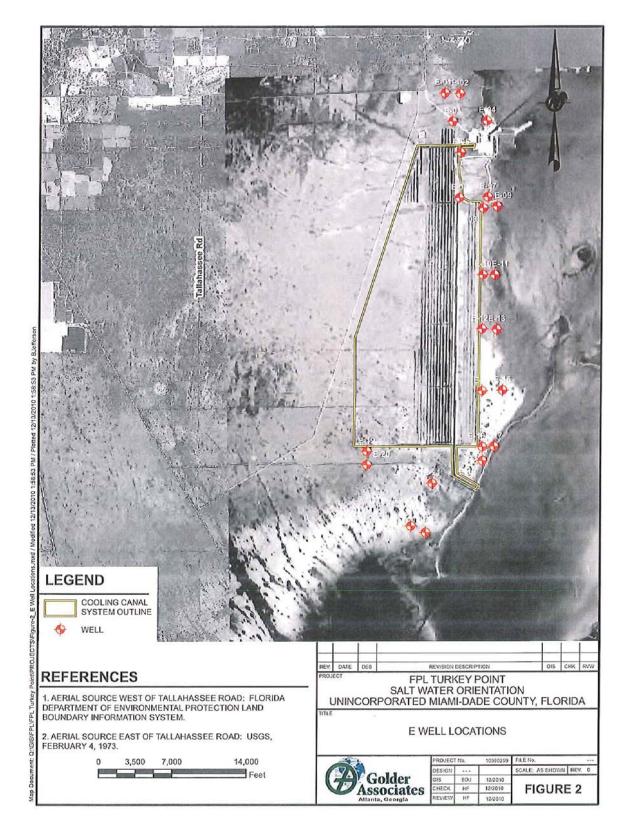
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 14 of 48

FIGURES

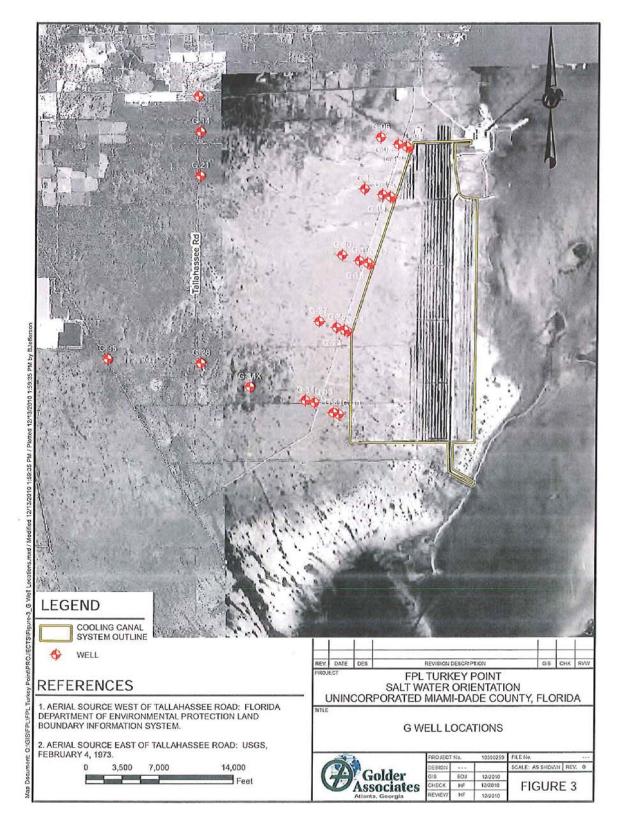
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 15 of 48



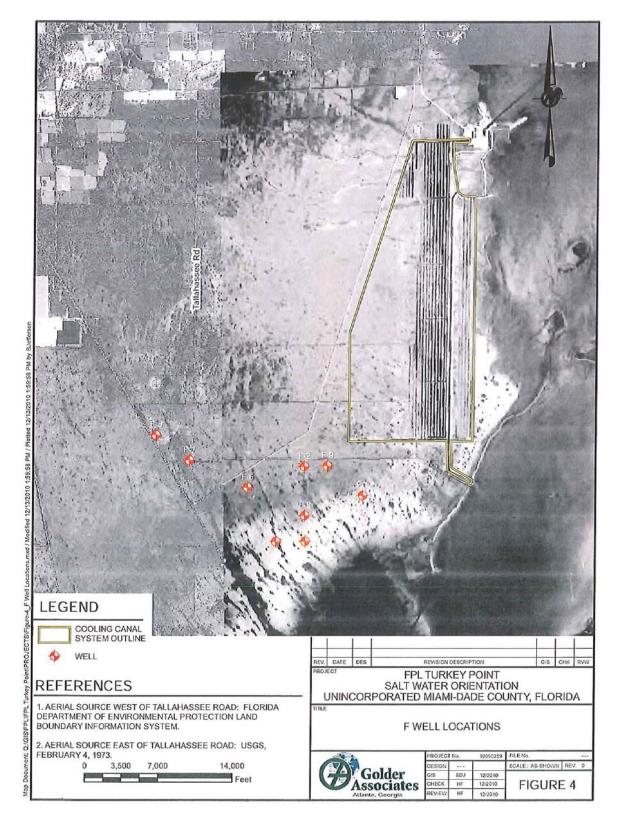
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 16 of 48



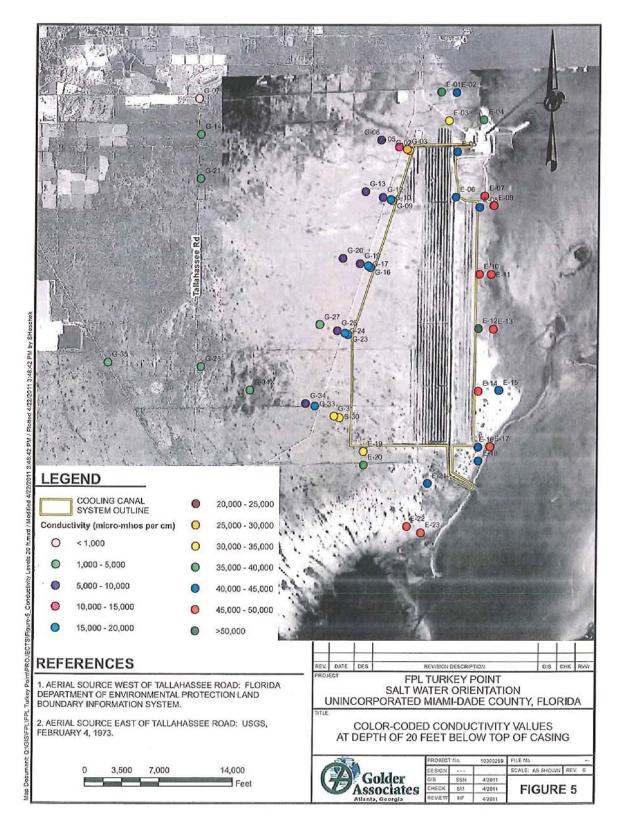
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 17 of 48



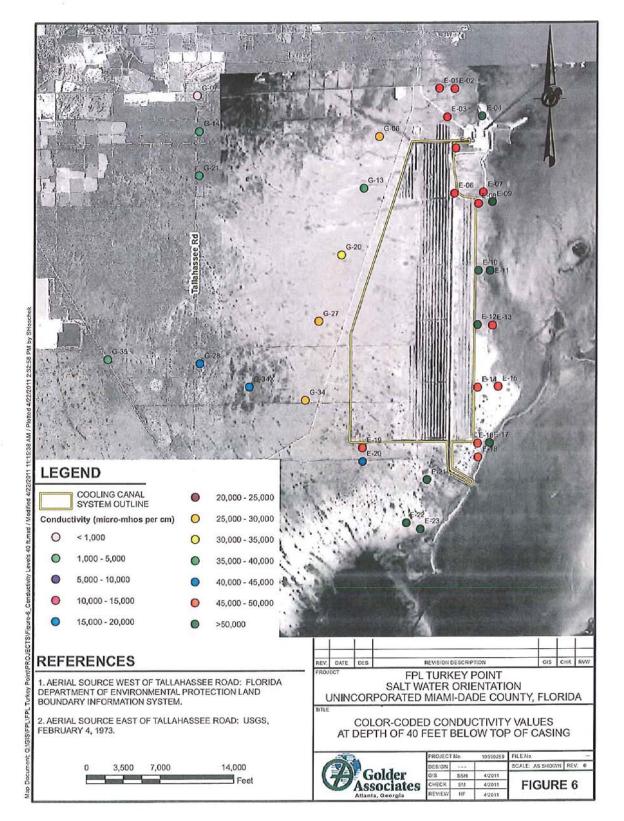
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 18 of 48



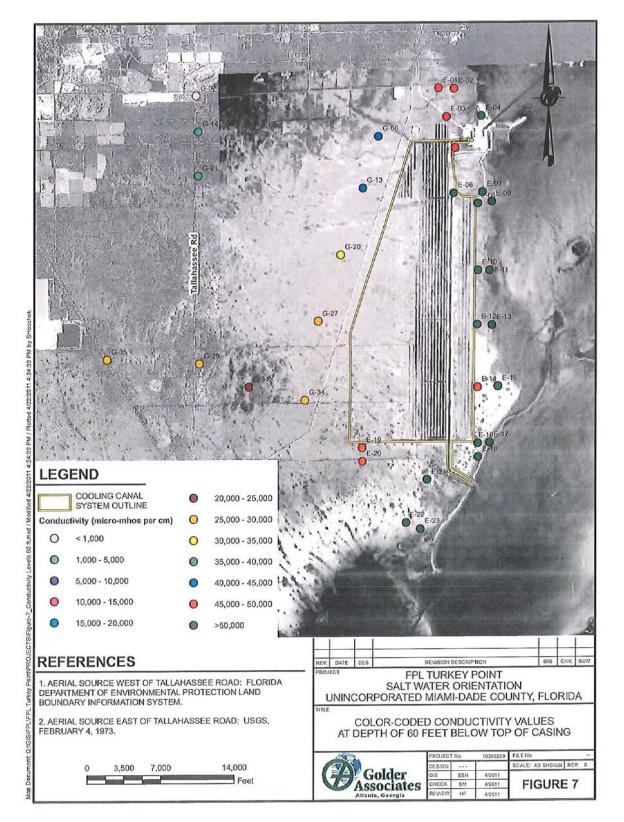
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 19 of 48



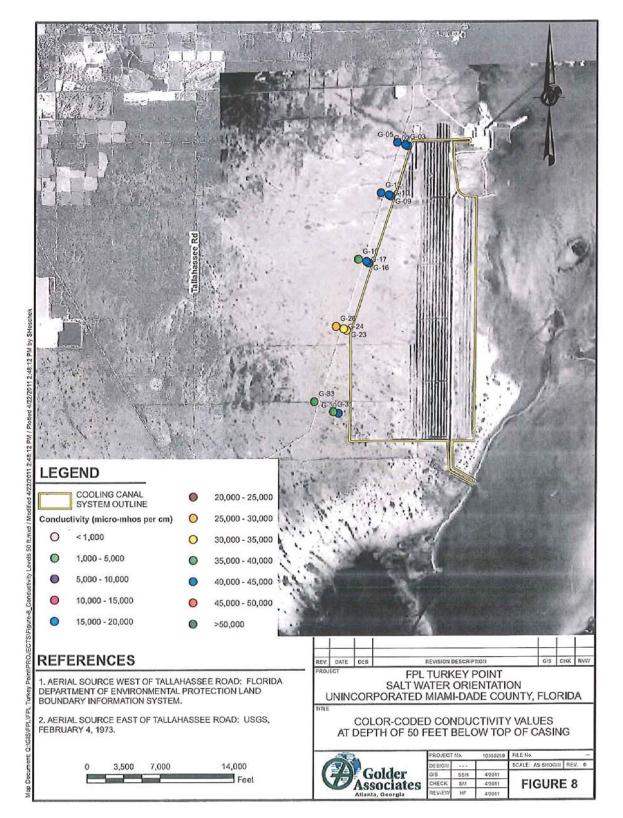
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 20 of 48



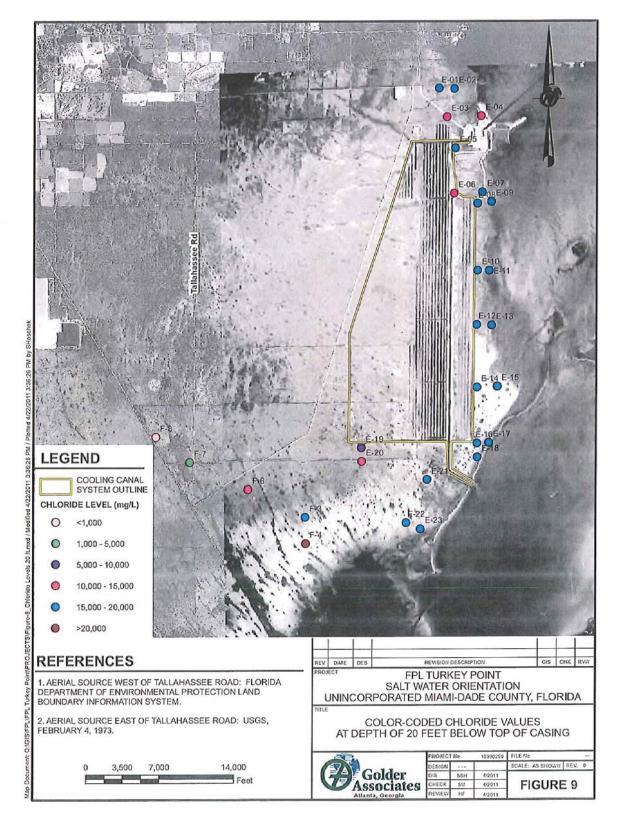
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 21 of 48



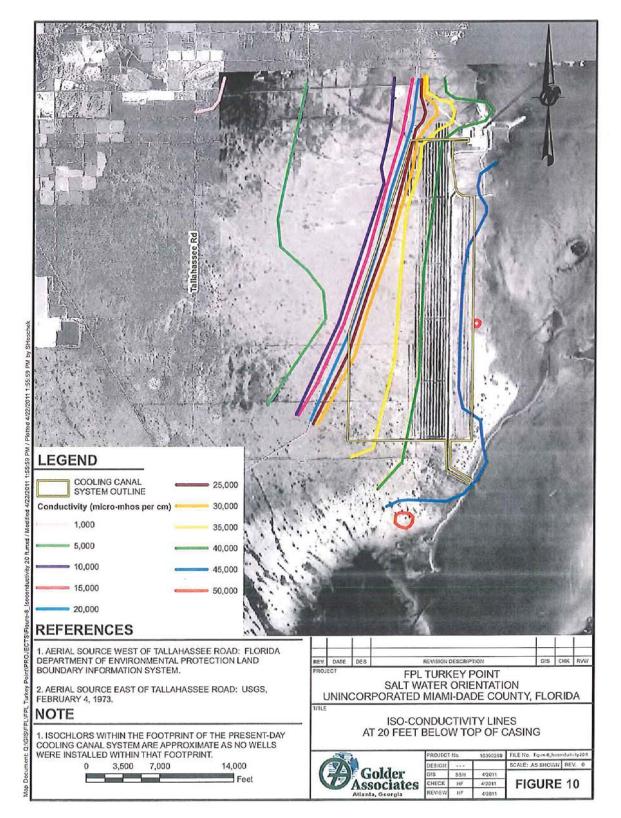
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 22 of 48



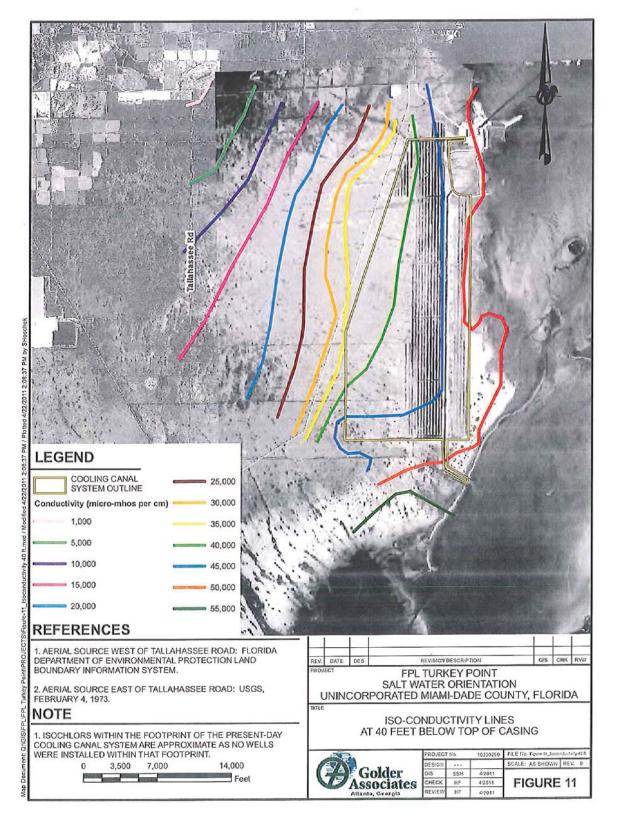
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 23 of 48



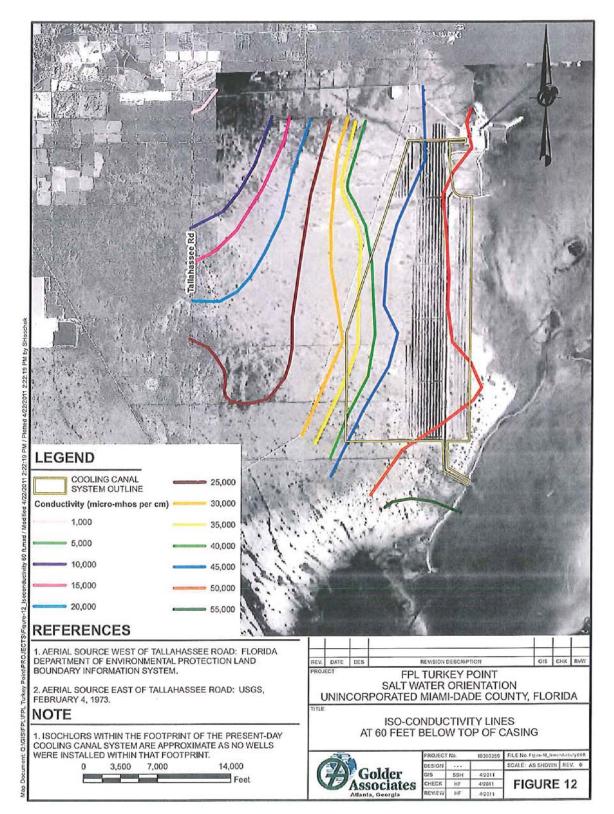
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 24 of 48



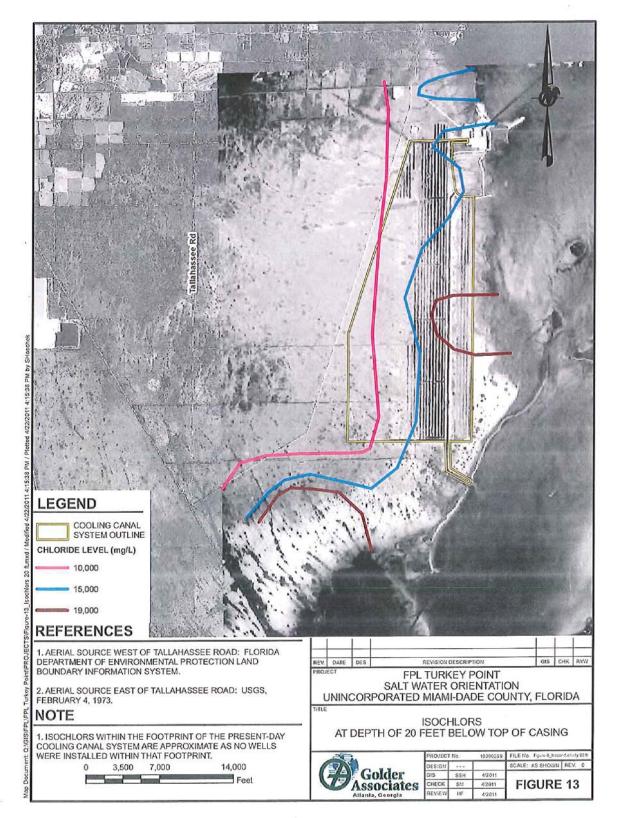
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 25 of 48



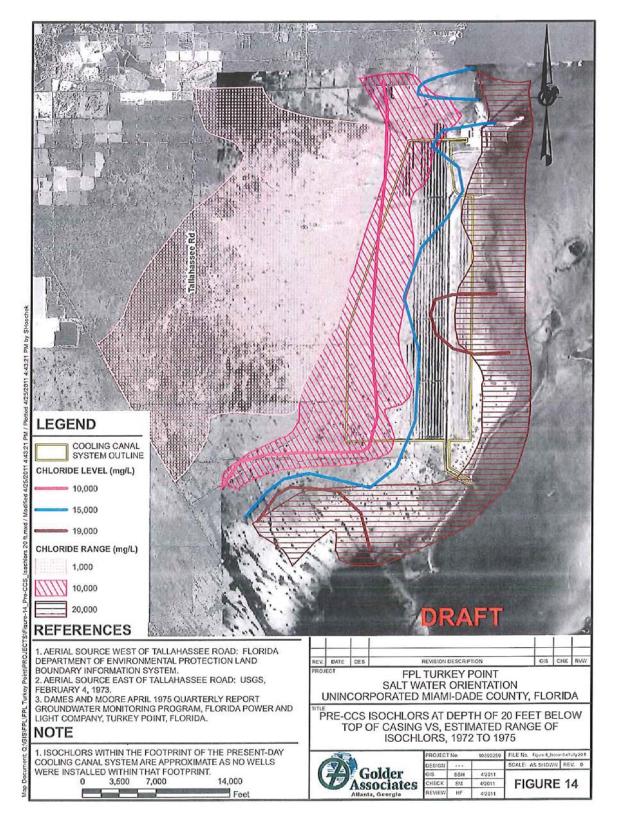
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 26 of 48



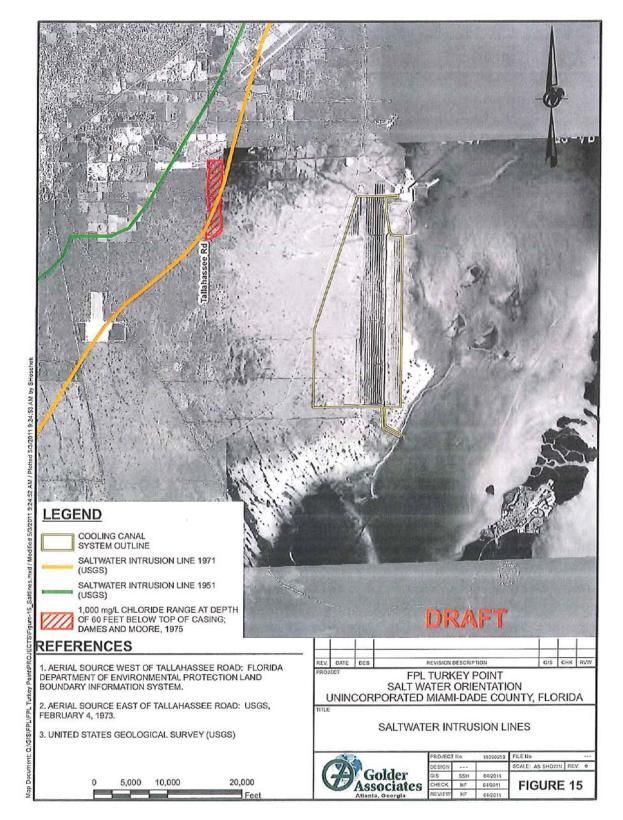
Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 27 of 48



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 28 of 48



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 29 of 48



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 30 of 48

APPENDIX A

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 31 of 48

alculation Number	Subject	Date
1	Cataloging of References	October 8, 2010
2	Chlorinity Values in Wells	Oclober 8, 2010
3	Plotting Isochlor Lines	October 21, 2010
4	Inputting Dames & Moore Ranges into GIS	May 3, 2011
5	Average Values in Wells from April 1, 1972 through January 31, 1973	April 5, 2011
6	Total Dissolved Solids and Chloride Data for E-Wells for 10/72, 11/72, and 12/72	April 7, 2011

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 32 of 48

Golder	SUBJECT Cataloging	of References	
eelaci	Job No. 10390308	Made By: H. Frediani	Date 10/8/2010
Associates	Ref. Calc 001	Checked S. Major	Sheet 1 of 1
Associates	FPL TP Salt Orientation	Reviewed	

The first task is to review the references received during the Uprate Project and distributed to the agencies during the completeness phase of that project. These are in the folder "from FPL" in the Uprate/Turkey Point folder. Start a spreadsheet called "References.xlsx" to document file name, title, and relevant sections of the document that address the extent of the salt water in the Biscayne Aquifer in the plant vicinity. As each reference is reviewed and its information added to the data base, its file is copied to a folder called "References" in the Calc 1 folder. For the purpose of this study, the date at which the salt water orientation is desired is assumed to be between Sept 10, 1971 (date of the final Consent Order ordering construction of the cooling canal system [CCS]) , and February 18, 1973 (date the CCS was closed off from Biscayne Bay and Card Sound). The reference for these dates is "<u>CASE STUDY</u>; <u>THE TURKEY POINT COOLING CANAL SYSTEM</u>", by Charles D. Henderson, FPL, May 11, 1977.

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 33 of 48

	File Name	Document Title	Relevant Section	Relevance
-	1-77 semi annual report gw mon.prog2.pdf	January 1977 Semi-Annual Report , GWMP	Figure 1	locations of E. F. and G wells
-	1-77 semi annual report gw mon.prog2.pdf	January 1977 Semi-Annual Report, GWMP	Figure 2	locations of L, G, S, and ID wells
-	-77 semi annual report gw mon.proc2.pdf		Section 2	history of monitorine wells installation and mirmose
-	1-77 semi annual report gw mon.prog2.pdf		Fieures 25 - 43	Chlorinity Profiles-1976-ID 1. & G.4.7 21 27 28 35 and X wells
1 ÷	1-77 semi annual report ew mon.proc2.pdf		Figures 44 - 48	10 PDT CI Croce Sections I may A.E.
14	4-75 auart rep. cround ndf		GROUNDWATER SALINITIES	description of ground instance reliables 1076
1.5	A 75 anot the accurdent of		NOUNDER AND	uccurption of groundwater sammers 1973
111			riates 2, 9, and 7	ISOCRIOT LINES = 1, 10, 20 PPT = 4/12 to 1/15
e i	4-75 quart.rep.ground.pdf		Plates 8 and 9	5 PPT @ 20 ft, and 15 PPT @ 50 ft, isochlors near Line D - 7/72 to 6/73
<u>ا ا</u>	Dames and Moore 3-final.pdf	Summary Report GWMP E-Series Wells	Figures 4, 5, and 6	12/72 - 20 PPT Isochlor @ 20 ft. 40 ft. and 60 ft denth
100	Dames and Moore 3-final.pdf	Summary Report GWMP E-Series Wells	Figures in Appendix A	Time/History Plote for E wells starting May 1972 20 40 and 60 6 dowth
14.0	Dames and Moore S final ndf		Annouliv	There followers, Place for the strated statistic from 17 (a), 20, 70, 404 UV 11 UC/01
110	Dames and Moore S final ndf		Distances of A Boltomole 5 5 4 50	1 minut resolvy r lots for S-1 and O Wells, starting 2/1/2 - 20, 40, and 90 ft depth
111	are communed ranks will add	ANGH- CUAM	FINGS 2.2,4,6, INTOUGH 2.2,4,1	Isocator maps - rigures missing from pdt lite
n I 7	data summary 1-series wells, pol			Isochlor maps - 1, 10, and 20 PPT @ depths of 20, 40, and 60 feet
e	engmeering design reservourpdi	The Engineering Design of the Turkey Point Cooling Reservoir	VII., page VII-1 thru VII-5	Nantative discussion of salt water intrusion
1.84	engineering design reservoir.pdf	The Engineering Design of the Turkey Point Cooling Reservoir VIII. , page VIII-1 thru VIII-3	VIII., page VIII-1 thru VIII-3	Narrative discussion of surface water usage
i here	fpl reservior seet 2.pdf	Florida Power & Light Company. Reservoir Concept - Appendix A.Geohydrological Conditions Related to the Construction of Cooling Ponds	Plate 1	Plate 1 shows 1.000 ppm isochlor at base of aquifer
1944	fpl reservior sect 2.pdf	Florida Power & Light Company, Reservoir Concept - Appendix A:Geolydrological Conditions Related to the Construction of Cooling Ponds	Table 1	Table 1 shows chloride in L-31E borrow canal ranged from 520 to 650 ppm during November, 1970.
1.22	intensive mon.progpdf	Intensive Monitoring Program, Turkey Point Site	Table 3	Table 3 shows chloride values in some E- and G- wells, including G-28, at 20, 40, and 60 feet durine Nov/Dee 1972
12	letter to der ndf	I other from EDEP to W.1 Borrow dated OK/02	Disses 2 - 2	
a -			/ - c sandu	1 time-Fitsfory Fiots of CL in 1D wells. (g) depth of 20, 40, and 60 feet below top of easing- 11/73 through 5/82. (pp. 12-16 of 96)
4	letter to der.pdf	Letter from FDER to W.J. Barrow, dated 9/6/83	Figure 1	Location of wells X-1 and X-2 (p. 10 of 96)
÷ .	letter to der.pdf		Figure 8	Estimated Levels of Cl in wells G-21. G-13, E-8, and E-9 with cooling canals(p. 17 of 96)
120	letter to der.pdf	Letter from FDER to W.J. Barrow, dated 9/6/83	Table 1	Weekly Salinity in cooline canals. 1981 (n. 20 of 96)
-	etter to der.pdf	Letter from FDER to W.J. Barrow, dated 9/6/83	un-numbered table	Salinity in cooline canals. Sept-Nov. 1982 (p. 23 of 96)
1-	NPDES DIS, MON, REP 95-98.pdf	NPDES DMRs	1995.1996, 1997, & 1998 sampling reports	Salinity in cooling canals, 1995-1998
In sh the she U	REPORT JULY 1978 SEMI ANNUAL REPORT GROUND WATER MONITORING PROGRAM TURKEY POINT FLORIDA PROGRAM TURKEY POINT FLORIDA CONPANY off	Report, July 1978, Semi-Annual Report, GWMP	pages 169 and 170	Time-History Plots Wells X-1 and X-2 April, 1974–June, 1978
103	summary report of cool sys. pdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter VII Salinity and Table VII-1	Salinities in CCS and Biscoyne Bay/Card Sound 5/73 - 11/73
- 10	summary report of cool syspdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter X	Narrative description of Salinity in E wells
96	xummary report of cool sys.pdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter XI	Biseayne Aquifer under CCS was normally salue prior to construction of CCS.ID design was to "intercept any cooling canal seepage and prevent it from flowing to the west."
1.10	summary report of cool syspdf	A Summary Report of the Turkey Point Cooling Canal System	Chapter XI	G-wells consist of 11 composite wells and 30 piezometers at 26 locations. Piezometers are co-located two to a location
WY CT MAN	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY, pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figures 2 - 4	CI values for pairs of wells east, west, and south of CCS at 40 ft depth
143 2 19	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY.adf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	page 2	Natural sea water intrusion has occurred throughout the area

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1 of 2

References.xlsx Sheet1

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 34 of 48

No.	File Name	Document Title	Relevant Section	Relevance
13	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figure 6	Fresh Water - Solt Water Interface Under Original Ground Water Conditions
12	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY, pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Figure 7	Fresh Water - Salt Water Interface Under Projected Ground Water Conditions - shows brackish water in L-31E Canal
13	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY.pdf	SUMMARY SALNITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Text of report	Discussion of causes of salt water intrusion in this area.
12	SUMMARY SALINITY EVALUATIONS TURNKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY, pdf	SUMMARY SALINITY EVALUATIONS TURKEY POINT PLANT FLORIDA POWER AND LIGHT COMPANY	Last page entitled "Figures"	Mentions that this summary is based on a more detailed report dated 12/15/77
14	therm perf cool sys 1988.pdf	Thermal Performance of the Turkey Point Cooling Canal System In 1988	Figure 4	Infrared Photograph of CCS
12	therm perf cool sys 1988.pdf	Thermal Performance of the Turkey Point Cooling Canal System In 1988	Figure 5	Flow rates in individual Canals
15	1-75 quart. rep.pdf	January 1975 Quarterly Report , GWMP	Ground Water Salinity pp 12-14 of 1222	description of groundwater salinities 1974
15	1-75 quart, rep.pdf	January 1975 Quarterly Report, GWMP	Plates 5, 6, and 7 pp 24 - 26	Isochlor lines - 1, 10, 20 PPT - 4/72 of 10/74
15	1-75 quart. rep.pdf	January 1975 Quarterly Report, GWMP	Plates 8 and 9 nn 27 - 28	S PPT @ 20 ft and 15 PPT @ 60 ft involution mane f inc D - 2/73 in 6/73
16	1-79 semi annual report gw mon, prog.pdf	January, 1979 Semi-Annual Report GWMP	paces 173-177	Time-History Plots Wells F.3 F.4 F.6 F.7 and F.8
1	NPDES DISCHARGE 91-94.pdf	DMRs for 1/91 through 6/94	monthly DMR salinity tables	max average and min monthly solicities in CCS 1/01 shrough 6/04
18	EPA Turkey Point Wells.pdf	Storet LDC-Detailed Data Report	lle	Specific conductance for E-Weite for 7/31/72 at 201 at 201 and 601 danies
19	E-Series Wells-Dec-11-1972,pdf	Groundwater Monitoring Data-Report Sequence #6	lle	Specific conductance for F-Wells for 17/5/72 and 17/6/72 at 20/ 40/ 40/ America
50	E-Series Wells-Jan-8-1973,pdf	Groundwater Monitoring Data-Report Sequence #7	Ite	Specific conductance for E-Wells for 1/2/73 and 1/4/73 at 201 407 and 607 denths
5	E-Series WQ-Oct-18 1972.pdf	Groundwater Monitoring Data-Water Sample Analyses	Ile	TDS and Chlorides for E-Wells for 10/72 at 20 and 40' (E-1 only) denth
13	E-Series_WO-Nov-14-1972.pdf	Groundwater Monitoring Data-Water Sample Analyses	IE	TDS and Chlorides for E-Wells for 11/72 at 20' denth
12	E-Series WO-Dec-18-1972.pdf	Groundwater Monitoring Data-Water Sample Analyses	IIc	TDS and Chlorides for E-Wells for 12/72 at 20' death

Table .

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 35 of 48

Golder Associates

SUBJECT Inputtin	g Dames & Moore Ranges int	o GIS		
Job No. 10390308 Ref. Calc 004 FPL TP Salt Orientation	Made By: S. Hoschek Checked: H. Frediani Reviewed	Date Sheet	5/3/2011 1 of	1

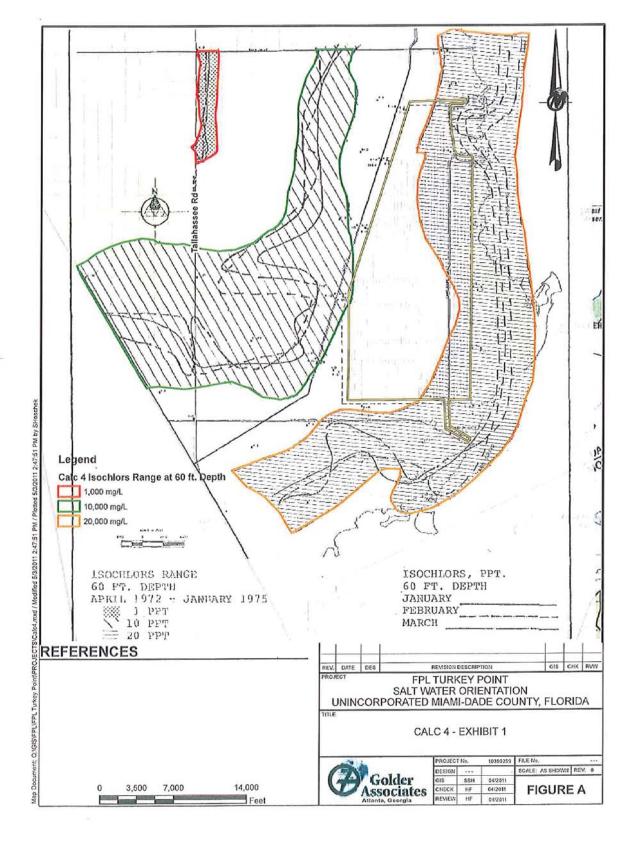
References 2 and 15 include maps prepared by Dames & Moore of the location of the 1,000; 10,000; and 20,000 mg/L isochlors in the Biscayne Aquifer, at the 20, 40, and 60-foot depths between the period April, 1972, and January, 1975. In order to compare the Dames & Moore results with our present-day results, it was decided to create a GIS shape file which would locate the areas Dames & Moore designated as containing the isochlor ranges at the 60-foot depth. It should be noted that the Dames & Moore data covers a period which extends after the Cooling Canal System (CCS) became operational. Plate 7 of the two references afore-mentioned shows the isochlor ranges at the 60-foot depth as areas, and indicates that these ranges cover the period from April, 1972, through January, 1975.

In order to do this, a scanned image of the Dames & Moore Plate 7 was added to an .mxd file in ArcMap 9.3. The Dames & Moore Plate 7 image was georeferenced to a base map using the locations of road intersections. The base map consisted of United States Geological Survey (USGS) 1:24,000 scale quad maps accessed through ESRI ArcGIS Online services. Once the image was georeferenced to an acceptable level, the isochlor ranges were digitized into a polygon shape file called isochlors_range_all.shp.

Figure A, Calc 4 - Exhibit 1 shows a transparent version of the Dames & Moore Plate 7 image, the USGS quad base map, and the shape file with the digitized 1, 10, and 20 parts per thousand (PPT) isochlor ranges corresponding to the 1,000, 10,000, and 20,000 mg/L lines. The digitized 60-foot depth isochlor range for 1,000 mg/L was used in Figure 15.

This technique was also used for Dames & Moore Plate 5 from the above references to digitize the isochlor ranges at the 20-foot depth. The digitized 20-foot depth isochlor ranges for 1,000, 10,000 and 20,000 mg/L were used in Figure 14.

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 36 of 48



Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 37 of 48

Golder	SUBJECT Average V	alues in Wells from April 1, 1	972 through January 31, 1973
Associates	Job No. 10390308 Ref. Calc 005	Made By: S. Major Checked H. Frediani	Date 4/5/2011 Sheet 1 of 1
	FPL TP Salt Orientation	Reviewed	

The purpose of this calculation is to tabulate the conductivity values of the E-Wells and G-Wells, and the chlorinity of F-Wells, from April 1, 1972 through January 31, 1973, and to obtain the average values. These values were put into a spreadsheet entitled Values By Date.xis.

The References identified in Calc 1 were used, as follows:

For the E-Wells, Reference 3-Dames and Moore 3-final.pdf-Appendix A-Plates 1 through 69.

For the G-Wells, Reference 4—Dames and Moore 5 final.pdf—Appendix—Plates 2 through 62 (with the exception of Plates 6, 13, 18, 25, 30, 37, 42, 49, and 54, which are Surface Water monitoring locations). For the F-Wells, Reference 16—1-79 semi annual report gw mon. prog.pdf—pp. 173-177.

Note that some of the G-Wells are designated as A and B. These are a set of piezometers, one 50 feet and one 20 feet deep. At each location, the two piezometers are approximately 10 feet apart in a north-south direction, with the 20-foot piezometer being the northernmost in each case. The 50-ft. piezometer is designated as "A" and the 20-ft as "B". (Ref. 4, p. 2.0-1)

Units for conductivity for the E- and G-Wells are micromhos/cm X1000, and units for chlorinity for the F-Wells are in ppt.

Note that on the plot for Well F-3, at 60' depth, the scale jumps from 21 to 26. This appears to be an error, and the 26 should actually read "22". Values above 21 reflect the corrected scale.

Next, compare this spreadsheet with information obtained in an email from FPL.

The email from Stacy Foster, dated April 5, 2011, (E-Series Well Data.msg) had several attachments containing additional conductivity data.

These are:

EPA Turkey Point Wells.pdf

E-Series_Wells-Dec-11-1972.pdf

E-Series_Wells-Jan-8-1973.pdf

These documents were added to Calculation 1, file "references.xls" as Reference Numbers 18, 19, and 20 respectively. The values from these documents were copied into the spreadsheet and compared to the data readings from the plots for the nearest date, i.e. the values from E-Series_Wells-Dec-11-1972.pdf were compared to the points from 12/1/72, E-Series_Wells-Jan-8-1973.pdf were compared to points from 1/1/73, and EPA Turkey Point Wells.pdf, which were taken on 7/31/72, were compared to 8/1/72.

Where discrepancies occurred, the values from References 18, 19, and 20, took precedence over the plots, and the plot readings were replaced. The resultant spreadsheet is called "Corrected Values.xls".

The values were averaged over time for each well, and tabulated in Corrected Values.xls.

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 38 of 48

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	0.0			Ī	ł	14			2	-	32	10	40		4	14		40	m	Conductivity	micromhos/cm (x1000
	20	00		T	I	1 5	3 .	3 .	10		54	75	42		47	42	1	43.5	m	Conductivity	micromhos/cm (x1000
	24	an a	I	t	t	30	10	40	31	10	20	2	2		15	16		31	8	Conductivity	micromhos/cm (x1000
2		22		t		ACC	AC.	AC AC	0.74	7 4		2/2	10		55	22	1	37.5	-	Conductivity	micromhos/cm (x100
9-3	41	38				45	245	44	25	20	24	1	-		30	5	t	3		Conductivity	micromhos/cm (x100
E-7				36.5		15	40 5	40		22			,		-		-	3		Conductivity	micromhos/cm (x100
8.3			40	34		52.5	38.5	38	46	192	45	44			42		47	45	8 0	Conductivity	micromhos/cm (x100
6-3						23	67	49	05	47	15	45	Ī	24	47	t	-	27	0	Conditatiutur	
E-10				32		51	49.5	49.5	525	20	15	S		3	525		525	505		Conductionity	micromhor/sem (x100
E-11				34		51.5	49	49	50	48	51	20		95	15		15	205		Conditioning	mireomboologiam (vent
E-12				36.5	-	23	50.5	50.5	55	20	S1	51		52	53	ľ	5	52		Conductivity	micromboclem (vtn)
E-13				34	-	22	515	51.5	53	50	47	S		S	3		3	15		Conductivity	micromhos/cm (v10
E-14				28.5	-	SO	48.5	48.5	53	49	49	47		12	47		47	50		Conductivity	micromhos/cm (v100
C-15				29.5		45	45.5	46	49	48	47	46		46	47		47	45		Conductivity	micromhos/cm (x100)
-16				IE		44	46	46	37	39	47	42		42	42		4	43		Conductivity	micromhos/cm (x100
E-17				29		48	51	46	51	65	49	46		46	47		47	46.5	-	Conductivity	micromhos/cm (x100
E-13			39	28		46.5	46	46	50	52	45	42		42	42		42	43	~	Conductivity	micromhos/cm (x100
E-19	-			-		37.5	35.5	35.5	38	40	31	28		28	22		27	22		Conductivity	micromhos/cm [x100
6-20				27		41	43	43	39	36	36	32		32	32		32	30	3	Conductivity	micromhos/cm (x10
12-			39	34	-	50.5	48	48	50	42	47	45		45	44		4	45	-	Conductivity	micromhos/cm (x1000
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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 39 of 48

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 40 of 48

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Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 41 of 48

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Values by Date.xdsx 60 ft.

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 42 of 48

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	32		-	202	202	41	15	42	47	47	48.6	n	Conductivity	micromhos/cm (x1000)
	24		515	90	0.00	00	To	00	57.5	50.5	46.6	m	Conductivity	micromhos/cm (x1000)
	20.5		53	500	200	9	10	20	15	49.5	48.2	m	Conductivity	micromhos/cm (x1000)
	2.00		20	20.0	2 2	2	51	SI	23	52	50.2	ŝ	Conductivity	micromhos/cm (x1000)
	20 5		3	2.45	00	00	14	53	53	51	49.6	2	Conductivity	micromhos/cm (x1000)
	100		2	10.0	22	64	49	47	47	20	46.9	3	Conductivity	micromhos/cm (x1000)
			ę :	10.04	46	8 2	47	46	47	45	45.0	m	Conductivity	micromhos/cm (x1000)
	10		44	46	37	- 68	47	42	42	43	41.2	m	Conductivity	micromhos/cm (x1000)
	67		89	46	51	67	49	46	47	46.5	45.7	m	Conductivity	micromhos/cm (x1000)
59	28		46.5	46	So	52	45	42	42	43	43,4	m	Conductivity	micromhos/em (x1000)
			37.5	35.5	30	40	31	23	27	25	32.8		Conductivity	micromhes/em (x1000)
	27		41	43	39	36	36	32	32	30	35.1	m	Conductivity	micromhos/em (x1000)
39	34		50.5	48	50	42	47	45	44	45	44.5	en	Conductivity	mirromhor /em (v1000)
42	ŝ		SS	54.5	56	53	49	SO	47	50.S	50.0	-	Conductivity	micromhoc/cm (v1000)
40	39		55	53.5	56	55	51	50	49	50	49.9	m	Conductivity	micromhos/cm (v1000)
25		27	25	23	30	25	26	25	25	25	25.3	4	Conductivity	micrombac/em (v1000)
			28	31	27	38	25	27	25	24	27.0	4	Conductivity	micrombec/em (v1000)
24	-	25	21.5	17	19	14	14	9.5	9.5	11.5	14.8	4	Conductivity	micromhos/cm (x1000)
10.5			7.5	14	6	9	6.5	7.8	7.8	7.8	7.8	4	Conductivity	micromhos/cm (x1000)
			0.5		-1	0.8	-	1	1.2	1.2	6.0	4	Conductivity	micromhos/cm (x1000)
3 2		20	29.5	22	25	26	31	28	28	30	27.9	4	Conductivity	micromhos/cm (x1000)
10		20	70	07	57	18	21	9.5	13	9	18.7	4	Conductivity	micromhos/cm (x1000)
		00	0	0.0	\$.5	6.5	8.5	7.5	6	9.5	7.5	4	Conductivity	micromhos/cm (x1000)
				2	0.0		4.5	5.5	9	5.8	5.9	4	Conductivity	micromhos/cm (x1000)
15			50	1	6.0	-	0.9	-		-1	1.0	4	Conductivity	micromhos/cm (x1000)
0			10	277	20	16	17	17	11	17.5	17.5	4	Conductivity	micromhos/cm (x1000)
				14	,	11	16	17	20	15	15.1	4	Conductivity	micromhos/cm (x1000)
	+		C.4	9	-	9	9	6.8	7.2	7.5	6.1	4	Conductivity	micromhos/cm (x1000)
ac				~.		4	4.8	S	5.7	5.8	5.9	4	Conductivity	micromhos/cm (x1000)
				21	2.3	-	0.8	-	1.2	1.2	1.2	4	Conductivity	micromhos/cm (x1000)
22			67	1	2	14	18	16	23	24	19.5	4	Conductivity	micromhos/cm (x1000)
			2 .	27	17	12	17	16	24	22	19.8	4	Conductivity	micromhos/cm (x1000)
			1	C'0	00	· ·		4	4	4.5	7.0	4	Conductivity	micromhos/cm (x1000)
				3.5	A		0.	2,5	0.0		3	4	Conductivity	micromhos/cm (x1000)
25			215	3.45	36	30		0.7	0.7	2.2	5.0	4	Conductivity	micromhos/cm (x1000)
			31	30	37	29	34	00	10	2010	20.2	4 .	Conductivity	micromhos/cm (x1000)
20			15	27	23	14	15	17	20	3.65	2010	4 .	Conductivity	micromhos/cm (x1000)
			-	11	02	5	55	4	-	541.0	10'0		Conductivity	micromhos/cm (x1000)
3.4			s	5.2	5.6	4.5	4.1	4.5	25		5.7		Conductivity	micromhos/cm (x1000)
				-1	-	0.8	0.8	11	1.6	-			Conductivity	micromnos/cm (x1000)
			23		13	19.8	20.4	20.6	18.3	18.25	19.0	16	Chlorinity and	(nontx) us/soumoment
			23.6						21.8	20.2	21.9	16	Chlorinity out	
							15	13.1	13.1	13.1	13.6	16	Chloriolau ant	
								1.4	1.3	1.6	1.4	16	Chlorinity, pot	
					-			0.7	0.75	-1	0.8	16	Chlorinity, ppt	

Corrected Values.xisx 20 ft

4/27/2011 3:37 PM

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 43 of 48

	4 4/ 48 48 48 49 49 53 53 53 53 53 53 54 54 55 53 53 53 53 53 53 53 53 53 53 54 55 55 55 55 55 55 55 55 55 55 55 55	475 475 50 50 50 50 60 48 48 48 48 48 48 48 51 51 52 51 51 51 51 51 51 51 52 51 52 51 53 52 53 53 53 53 53 53 53 53 53 53 53 53 53	46.5 46.9 43.2	10 1	Conductivity	
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37 35 34 35 40 38 40 37 35 34 35 40 38 40 38 31 1.9 0.8 1 0.9 28 28 0.8 0.8 32 32 28 28 0.8 0.8 32 32 0.8 0.8 0.8 0.8 0.7 0.7 0.8 0.8 0.8 1.9 2 0.7 28 28 0.8 0.8 0.9 32 20 0.5 0.8 1.9 2 0.7 0.8 0.8 0.8 1.9 2 0.7 24 22 27 32 26 28	1.5	1.2	6.0	4	Conductivity	micromhos/cm (x1000)
37 35 34 33 40 38 40 37 35 34 33 40 38 40 37 32 33 40 38 40 38 40 3 33 40 38 40 31 1.9 0.8 1 0.9 1 0.9 28 28 28 0.8 0.5 32 32 0.8 0.8 0.8 1.9 2 0.7 0.7 0.8 0.8 0.8 1.9 2 0.7 0.7 24 22 27 27 32 24 28						
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	27	25.5	26.2	4	Conductivity	micromhos/cm (x1000)
x1 10 11 24 28 14 10	13	13	16.6	4	Conductivity	micromhos/cm (x1000)
6-10 6-10		1				
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(15 15 17 23 24 14 17	85	16	17.0	1 4	Conducerinieu	micromnas/cm (x1000)
6	4.5	5.5	4.4	4	Conductivity	micromhos/cm (x1000)
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23.8	21.6	20.6	21.7	16	Chlorinity, ppt	
178 17	17	16.9	17.2	16	Chlorinity, ppt	
13.3	13.5	14.1	13.6	16	Chlorinity, ppt	
	6.6	10.2	10.1	16	Chlorinity, ppt	

4/27/2011 3:41 PM

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 44 of 48

				51	50.5	52 5	43	12	50	48	47.5	47.8		Conductivity	micromhos/cm (x1000)
141	5			53	52	52	51	52	49	48	47	1.04		Conductivity	micromhos/cm (x1000)
	42			57.5	55	Sa	55	57	52	Sd	53.5	52.7	m	Conductivity	micromhos/cm (x1000)
	52			53.5	49	49	52	54.5	46	49	49	49.3	m	Conductivity	micromhos/cm (x1000)
	43.5			55	53	51	52	56	52	53	53	51.6	~	Conductivity	micromhos/cm (x1000)
	+	39		25	S	IS	SS	55	23	z	52	52.2	6	Conductivity	micromhos/cm (x1000)
	+	10 00		22		X	21	3	53.5	55	23	51.5	m	Conductivity	micromhos/cm (x1000)
		36		23.5	10	8 0	2 2	20	2 2	57	22	54.7		Conductivity	micromhos/cm (x1000)
	-	35		57	53.5	20	23	20	8 5	8 33	22	676	~	Conductivity	micromhos/cm (x0000)
		32		22		24	5	00	8 3	8	0.00	570		Conductivity	micromhos/cm (x1000)
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	+	20		2	10	5	44	5	15	52	52	20.1	~	Conductivity	micromhos/cm (x1000)
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		_		49	48	46	46	SO	46	46	43	46.8	m	Conductivity	micromhos/cm (x1000)
		33.1	10	51	51	45	46	49	48	47	45	46.2	m	Conductivity	micromhos/cm (x1000)
	_	_		60	58.5	60	55	58	55	SS	55.5	54.2	m	Conductivity	micromhos/cm (x1000)
	_	46 42		62	60.5	19	65	59	56	56	56.5	56.4		Conductivity	mirromhoc/rm (v1000)
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	-														
- E S		00	-	;		-	-								
	20	20 4		44	43	15	40	41	15	15	41	40.5	4	Conductivity	micromhos/cm (x1000)
	1.0	0.8		0.8	-	-	11	0.8	-	1.5	-	6'0	4	Conductivity	micromhos/cm (x1000)
1.1			-												
. 1															
201	37		_	42.5	39.5	43	40	44	42	43	42.5	41.3	4	Conductivity	micromhos/cm (x1000)
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11	+		_												-
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	+														
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	21	27		27.5	32	24	50	25	27	25.5	26	190	4	Conditiveliation	_
	24			26.5	32.5	34	24	26	22	25	25	26.3	4	Conductivity	micromhos/cm (v1000)
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11	20		+		~	;	1								
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1.1	28		6.97		51	30	AL OC	24	19	22	22	22.6	4	Conductivity	
					10	201	20 5	07	47	47	87	1.12		Conductivity	micromhos/cm (x1000)
10	+			5		0.01	50.5	7.77	117	20.9	21.5	21.3		Chlorinity, ppt	
10	+			47					27.8	21.8	21.1	22.2		Chlorinity, ppt	
11	+							15.2	17.6	17.5	16.9	17.6		Chlorinity, ppt	
11	+								15	15.2	15.4	15.2	16	Chlorinity, ppt	
			-						11.1	10.8	10.8	10.9		Chlorinity, ppt	

Wd 19:5 1102/22/9

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 45 of 48

Units																							tv micromhos/cm (x1000)	+	-	-	\square	_	_	ty micromhos/cm (x1000)		-	ty micromnos/cm (x1000)	-	+		hu mirromhos/rm (v1000)	+	+	+		ty micromhos/cm (x1000)	-	ty micromhos/cm (x1000)	+-							
Value																							Conductivity	Conductivity	Conductivity			Conductivity	Conductivity	Conductivity		Conditioning	Conductivity	Conductivity			Conductivity	Conductivity	Conductivity			Conductivity	Conductivity	Conductivity								
Reference #																							4	4	4			4	4	4		V	,	4			4	4	4	t		4	4	4								
Average																							43.1	43.1	42.8			43.9	45.0	42.7		0 CV	0.04	37.6			31.5	32.6	29.5	2		40.2	39.3	35.8								
2/1/1973																							44.5	44.5	42			42.5	47.5	44		47	40	38.5			35	33	29			40	36	32.5								
1/1/1973																							44	43	43			44	46	44		44	40	1 000			32	33	30			42	40	35								
111121C 0/1121C 2/1121C 2011121C 17/1121C 17/1121C 1/1121S 2/11213																							44	43.5	43			55	45.5	43.5		42	41	38			30	31	28			41	39	34								
7/27/7/77																							46	42	44		-	14	49	45		44	42	39			34	33	30			44	42	37								
SICH IN INT																							42	42	37			14	43	40		30	50	33			30	30	27			39	38	33								
TICTIC			T	T							T											Γ	51	48	45.5		:	t.	23	40	T	51	49	43			38	42	38			47	48	44								
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SICTIVI																							48	44	48		37.6	2/1	4/	40.5		46	45	36			30	32.5	29.5			44.5	40.5	37.5					1			
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t	5-2	53	5-4	E-5	9-3	5-7	E-8	0.3	E-10	E-11	E-12	5.12	 111	E-15	E-16	E-17	E-18	E-19	E-20	E-21	E-22	E-23	G-2A	G-3A	G-5A	6-6	1-D	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	VOT-D	C-12	G-14	G-16A	G-17A	G-19A	G-20	G-21	G-23A	G-24A	G-26A	G-27	G-28	G-30A	G-31A	G-33A	G-34	G-34X	6-35	2	4	91	F-7	

Corrected Values.xisx 50 ft.

4/27/2011 3:42 PM

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 46 of 48

	ed mation obtained via email from FPL. nsg) had several attachments containing eference Numbers 21, 22, and 23, respectivel s_E_Wells.xlsx", with one spreadsheet for.	1
The email from Stacy Foster, dated April 5, 2011, (E-Series Well Data.n Total Dissolved Solids (TDS) and Chlorides data for the E-Wells. These are: E-Series_WQ-Oct-18_1972.pdf E-Series_WQ-Nov-14-1972.pdf These documents were added to Calculation 1, file "references.xls" as F These values were tabulated into a workbook called "TDS_and_Chloride TDS and one spreadsheet for Chlorides. All values were for 20' depth, with the exception of Well E-1 on 10/4/72,	isg) had several attachments containing eference Numbers 21, 22, and 23, respectivel s_E_Wells.xlsx", with one spreadsheet for.	ły.
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TDS and one spreadsheet for Chlorides. All values were for 20' depth, with the exception of Well E-1 on 10/4/72,		
All values were for 20' depth, with the exception of Well E-1 on 10/4/72,	where the value for 40' depth was listed.	
	where the value for 40° depth was listed.	
Average values were calculated for 20' and 40' depths.		
	. *	

		Total C	Dissolved Soli	Total Dissolved Solids (ppm) @ 20' Depth (except where noted)	0' Depth (ex	cept where	noted)		TDS (ppm)	TDS (ppm)
	10/2/1972	10/4/1972	10/6/1972	10/4/1972 10/6/1972 10/31/1972 11/1/1972 11/2/1972 12/5/1972 12/6/1972	11/1/1972	11/2/1972	12/5/1972	12/6/1972	Average at 20 feet	Average at 40 feet
H		32100		25500			28300		26,900	32.100
E-2		28500		29400			30300		29,400	
E-3			20000	20700			22400		21,033	
E-4			25500	27000			27300		26,600	
E-5			28400	28200			31000		29,200	
E-6			31740	10500			34100		25,447	
E-7	30300				33300			35000	32.867	
E-8	29700				31800			33800	31.767	
E-9	32100				31000			34800	32.633	
E-10	34100				38500			37200	36,600	
E-11	33400				32700			34300	33,467	
E-12	36000				33600			37500	35.700	
E-13	35000				35400			36100	35,500	
E-14	32500				31700			33300	32,500	
E-15	30900					30600		32400	31,300	
E-16	23700					28500		27900	26,700	
E-17	29800					31700		33300	31,600	
E-18	29700					37900		30400	32,667	
E-19	18700					18400		18500	18,533	
E-20			24400			20400		21000	21,933	
E-21			27400			31000		33000	30,467	
E-22	33300					34400		35300	34,333	
E-23	34700					33100		37000	34 933	

40' Depth

4/27/2011 3:39 PM

Calc-6.xlsx

Florida Power & Light Company Docket No. 20170007-EI Staff's Third Set of Interrogatories Interrogatory No. 54 Attachment No. 1 Page 47 of 48

		Chloride (pp	Chloride (ppm) @ 20' Depth (except where noted)	th (except w	here noted			Chloride (ppm)	Chloride (ppm)
10/2/1972	10/4/1972	10/6/1972	4/1972 10/6/1972 10/31/1972 11/1/1972 11/2/1972 12/5/1972 12/6/1972	11/1/1972	11/2/1972	12/5/1972	12/6/1972	Average at 20 feet	Average at 40 feet
_	17250		15000			15250		15.125	17.250
-	16250		15250			15750		15.750	
-		11250	10000			10750		10,667	
-		14750	13500			14000		14.083	
-		15000	14750			15750		15.167	
-		16750	5500			16000		12.750	
-				18750			17750	17.417	
				16000			17250	16 333	
17250				16500			17500	17,083	
18750				18750			19250	18.917	
18500				18250			18750	18.500	
18250				19250			19750	19.083	
18500				18750			20000	19,083	
17250				17750			17750	17,583	
15500					17000		17500	16,667	
15250					15750		15500	15,500	
16750					17000		17500	17.083	
15750					16000		15500	15,750	
					9750		9750	9 917	
-		14500			12750		11000	12.750	
-		17250			16500		16500	16.750	
					19000		18750	18,750	
18000					18250		19250	18 500	

40' Depth

Florida Power & Light Company

Staff's Third Set of Interrogatories

Docket No. 20170007-EI

Interrogatory No. 54 Attachment No. 1 Page 48 of 48

4/27/2011 3:46 PM

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