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Turkey Point Plant

Annual Post-Uprate Monitoring Report
Units 3 & 4 Uprate Project

August 2014

Prepared for:

FPL

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ACRONYMS AND ABBREVIATIONS

%	percent
≥	greater than or equal to
°C	degrees Celsius
µg/L	micrograms per liter
µm	micrometer
µmho/cm	micromhos per centimeter
µmols/m^2/sec	micromole per square meter per second
µS/cm	micro Siemens per centimeter
‰	parts per mille
1x1	1-meter by 1-meter (subplot)
20x20	20-meter by 20-meter (plot)
5x5	5-meter by 5-meter (subplot)
ADaPT	Automated Data Processing Tool
ADVM	Acoustic Doppler velocity meter
Agencies	South Florida Water Management District, the Florida Department of Environmental Protection, and Miami-Dade County Department of Environmental Resources Management
ANPP	Annual Net Primary Productivity
ANOVA	analysis of variance
Annual Monitoring Report	Florida Power & Light Company Turkey Point Plant Annual Monitoring Report for the Units 3 and 4 Uprate Project
AO	Administrative Order
AT100	Aqua TROLL® 100 (probe)
AT200	Aqua TROLL® 200 (probe)
B	bottom
Ba	Barium

BBCA	Braun-Blanquet Cover Abundance
BBSW	Biscayne Bay Surface Water
BDL	below detection limit
BNP	Biscayne National Park
BRL	Brooks Rand Labs
C	carbon
$CaCO_3$	calcium carbonate
cc	cubic centimeter
CCS	cooling canal system
CCV	continuing calibration verification
cdb	culm diameter at the plant base
cm	centimeter(s)
CO_2	carbon dioxide
CRM	certified reference material
CWP	circulating water pump
D	deep
DERM	(Miami-Dade County) Department of Environmental Resources Management
df	degrees of freedom
DIC	dissolved inorganic carbon
DO	dissolved oxygen
DQO	data quality objective
DUS	Data Usability Summary
E & E	Ecology and Environment, Inc.
EB	equipment blank
EDMS	Electronic Data Management System
e.g.	for example
EPA	(United States) Environmental Protection Agency
f/s	foot/feet per second
F.A.C.	Florida Administrative Code
FCEB	field cleaned equipment blank
FD	field duplicate

FDEP	Florida Department of Environmental Protection
Fe	Iron
FPL	Florida Power & Light Company
FPL database	Florida Power and Light, Electronic Data Management System database
ft	foot/feet
ft/d	foot/feet per day
ft^3/s	cubic foot/feet per second
gal	gallon
g/cm^3	grams per cubic centimeter
g/m^2	grams per square meter
GIS	geographic information system
g/L	grams per liter
gpm	gallon(s) per minute
GPS	Global Positioning System
GW	groundwater
^3H	tritium
HCl	hydrocholoric acid
i.e.	that is
IC	initial calibration
ICV	initial calibration verification
ID	Interceptor Ditch
K	potassium
km	kilometer
km/hr	kilometer(s) per hour
lb	pound
LCS	laboratory control sample
Li	Lithium
LNWR	Loxahatchee National Wildlife Refuge
LT500	Level TROLL® 500 (probe)
m	meter(s)
M	Intermediate

MDL	method detection limit
MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligram(s) per liter
mL	milliliter(s)
Monitoring Plan	Groundwater, Surface Water, and Ecological Monitoring Plan for the Florida Power & Light Company Turkey Point Nuclear Power Plant (2009)
mph	miles per hour
m/s	meters per second
MS	Matrix Spike
MS	Microsoft
mS/cm	milliSiemens per centimeter
µS/cm	Milli Siemens per centimeter
mV	millivolt(s)
MW	megawatt(s)
NA	Not Applicable
NAVD 88	North American Vertical Datum of 1988
ND	Not Detected
NE	Northeast
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NEXRAD	next generation weather radar
NH_3	Ammonia
NIST	National Institute of Standards and Technology
NO_x	nitrate/nitrite
NRC	Nuclear Regulatory Commission
NTU	nephelometric turbidity unit(s)
NW	Northwest
OP	orthophosphate
ORP	oxidation reduction potential

PAR	photosynthetically active radiation
pCi/L	picocuries per liter
PDS	post digestion spike
PERA	(Miami-Dade County) Permitting, Environment and Regulatory Affairs (formerly DERM; now RER)
ppt	parts per thousand
PQL	practical quantitation limits
PSS-78	Practical Salinity Scale of 1978
PSU	practical salinity unit(s)
PushPoint Sampler	PushPoint Sampler PPX36 (M.H.E. Products, East Tawas, Michigan)
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RER	(Miami-Dade County) Department of Regulatory and Economic Resources (formerly PERA)
RPD	relative percent difference
S	shallow (well)
SAV	submerged aquatic vegetation
S.C.	specific conductance
SD	serial dilution
SDG	sample delivery group
SE	southeast
SFWMD	South Florida Water Management District
SG	specific gravity
SOP	standard operating procedure
Std Dev	Standard Deviation
SW	surface water; *also* southwest
SWI	Shannon-Wiener Index (of Diversity)
T	top
TDS	total dissolved solids
TestAmerica	TestAmerica Laboratories, Inc.

TKN	total Kjeldahl nitrogen
TN	total nitrogen
TP	total phosphorus
TPGW	Turkey Point Groundwater
TPM-1	Turkey Point Meteorological Station
TPRF	Turkey Point Rain Fall
TPSWC	Turkey Point Surface Water Canal
TPSWCCS	Turkey Point Surface Water Cooling Canal System
TPSWID	Turkey Point Surface Water Interceptor Ditch
Turkey Point	Florida Power & Light Company Turkey Point Power Plant
USGS	United States Geological Survey
W_L	water level (feet NAVD 88)

EXECUTIVE SUMMARY

Florida Power & Light Company (FPL) has prepared this Annual Post-Uprate Monitoring Report pursuant to Conditions of Certification IX and X of its Power Plant Site Certification for the FPL Turkey Point Units 3 and 4 Nuclear Power Plant and Unit 5 Combined Cycle Plant (PA 03-45A2). In 2009, a Monitoring Plan was developed with input from the Florida Department of Environmental Protection (FDEP), the South Florida Water Management District (SFWMD), and Miami-Dade County's Regulatory and Economic Resources (RER), (collectively, the Agencies), and FPL. The Monitoring Plan requires the collection of groundwater, surface water, meteorological, flow, and ecological data in and around the plant to assess Pre-Uprate and Post-Uprate conditions and to identify changes associated with the Uprate project. A minimum of two years of monitoring was required prior to the completion of the Uprate.

FPL notified the FDEP of commencement of the Uprate of nuclear Units 3 and 4 on September 24, 2010. Uprate modifications were performed at both Unit 3 and Unit 4 over a period of time. One unit was uprated at a time. The final modifications for Unit 3 took place during February 26, 2012 to September 5, 2012 and the unit reached full uprate power on October 31, 2012. The final modifications for Unit 4 took place during November 5, 2012 to April 17, 2013 and the unit reached full uprated power on May 8, 2013. Both units were operating together within their uprated capacities starting May 27, 2013. Data collected prior to February 26, 2012 are part of the Pre-Uprate period, while data collected between February 26, 2012 and May 27, 2013 are referred to as part of the Interim Operating Period. Data collected after May 27, 2013 are referred to as part of the Post-Uprate period.

FPL previously prepared a Semi-Annual Report (FPL 2011b), an Annual Report (FPL 2011c), and the Comprehensive Pre-Uprate Report (FPL 2012) which provided details on Pre-Uprate conditions. FPL subsequently prepared this Annual Post-Uprate Monitoring Report to document findings from June 2013 through May 2014 and to identify any notable changes as they relate to the Uprate. This report also incorporates information presented from the most recent FPL semi-annual data deliveries (FPL 2013a; FPL 2014a) and the Comprehensive Pre-Uprate Report (FPL 2012), where applicable, for comparisons with the Post-Uprate period.

For the Post-Uprate monitoring period from June 2013 through May 2014, automated water quality and water level data were recorded at 1-hour intervals at 14 well clusters (42 wells) and 20 surface water stations; meteorological data were collected at one automated meteorological station. Water samples were collected quarterly at 47 groundwater wells and 21 surface water stations. To continue assessing the contributions of tritium via rainfall and vapor exchange, water samples were collected from seven rainfall collectors and five evaporation pans located at varying distances from the cooling canal system (CCS). Ecological monitoring was conducted semi-annually in Biscayne Bay and quarterly in the marsh and mangrove areas. While there were some reductions in monitoring requirements from the Pre-Uprate to Post-Uprate period (e.g., eliminated probes at some surface water stations, more focused listing of parameters analyzed, reduced number of Biscayne Bay ecological transects), the sampling is still comprehensive and covers a broad area.

As required by the Monitoring Plan, components of water and salt inflow and outflow from the CCS were calculated on a daily basis. The water budget helps explain the dynamics of CCS hydraulics and may be used to assess the effect of climatic or operational changes on the CCS water levels and salinities.

Tritium was identified by the Agencies as a tracer of the CCS water and samples were collected in accordance with the Monitoring Plan. For this reporting period however, the USGS is back-logged on samples so there are no results available for the Post-Uprate period. Thus, there are some limitations in assessing the extent or influence of CCS water. Regardless, based on the Pre-Uprate and Interim Operating period findings and Post-Uprate specific conductance, temperature and chloride data, a reasonable insight can be derived about potential influences from the CCS. The results of the one year of Post-Uprate data analyses and comparisons with Pre-Uprate data are summarized briefly below.

Biscayne Bay groundwater results indicate a presence of CCS water not previously detected in the area fronting the northern half of the CCS at depth (more than 100 feet below Bay bottom). This presence is noted by increases in specific conductance, chloride, sodium, and tritium which were first observed in the Interim Operating period. There is still evidence of CCS water under Biscayne Bay at depth (>100 feet) in proximity to the southern half of the CCS. No increases have been observed for specific conductance, chloride, or sodium values in the shallow and intermediate zones, which indicates there is no upward movement of the CCS into shallow groundwater intervals, and thus no connectivity to Biscayne Bay at these locations.

Groundwater immediately adjacent to the CCS still indicates the presence of some CCS water. Farther west of the CCS, there remains influence of CCS water in decreasing concentrations at depth out approximately 3 miles. Two of the three wells farthest from the CCS, approximately 6 miles to the west, are fresh at all depths; the third well was fresh at all depths during the Pre-Uprate period but is now slightly brackish at the deep interval. It is not clear if the increase in specific conductance is the result of the long-term operation of the CCS, lag effects of the 2011 drought, or some other factor. Further assessment and confirmation of the extent of CCS water can be performed once Post-Uprate tritium data is available. FPL will be preparing an addendum to this report of all the tritium data from June 2013 to March 2014. Surface and groundwater data through March 2014 is anticipated to be available to the Agencies upon receipt by FPL. An addendum report focused on these results is expected to be available in April 2015.

A shallow, fresher water lens still exists west of the CCS and is supported by the induction logging conducted for this project and the continuous specific conductance profiling done in several historical wells for the interceptor ditch (ID) monitoring. This lens is 10 to 20 feet deep from the surface and generally thickens towards the west.

For most surface water stations around the CCS, there was no readily apparent influence of CCS water via the groundwater pathway. The only exceptions were two locations in the surface water canal stations immediately adjacent to the south end of the CCS where there appeared to be some CCS water present during the Pre-Uprate monitoring period. However, during the Post-Uprate monitoring period, those effects were not as evident based on specific conductance and temperature. There were also increases in specific conductance in the L-31E Canal during the dry season similar to what was observed during the Pre-Uprate period. Previous Pre-Uprate tritium samples in the L-31E did not show any corresponding increases in tritium, so the increase in specific conductance was not CCS water. While FPL suspects that this may still be the case, it cannot be confirmed without the tritium results for the Post-Uprate period.

Ecological findings for Biscayne Bay and the marsh and mangrove areas surrounding Turkey Point are generally similar between the Pre- and Post-Uprate periods and any differences appear to be predominately a function of site-specific conditions (i.e., low nutrients, lack of substrate for seagrass) and seasonal and meteorological effects. FPL still concludes the CCS does not have any ecological impact on the surrounding areas and evidence of CCS water in the surrounding ecosystems from a groundwater pathway. Therefore, FPL recommends the elimination of ecological monitoring.

The lack of significant rain at the site along with the increase in CCS temperature during the Post-Uprate period have led to higher specific conductance levels. Since the Post-Uprate period, the specific conductance in the CCS has increased, with values exceeding 120,000 µS/cm by the end of May 2014. This equates to salinity greater than 90 practical salinity units (PSU). The average specific conductance in the CCS is over 20% higher than the average specific conductance value during the Pre-Uprate period and the maximum CCS Post-Uprate value is over 30% higher than the maximum CCS Pre-Uprate value.

The increase in CCS surface water temperatures during the Post-Uprate period cannot be explained by the Uprate since the total heat rejection rate to the CCS from Turkey Point Units 1, 2, 3, and 4, operating at full capacity prior to the Uprate would have been higher than the Post-Uprate heat rejection rate to the CCS for Units 1, 3, and 4, operating at full capacity. Unit 2 has been dedicated to operate in a synchronous generator mode (i.e. not producing steam heat).

FPL is in consultation with the Agencies in assessing a remedy for freshening the CCS. This remedy may include a variety of options such as the water from the Floridan aquifer and excess water from the L-31E. Upon agreement of a remedy, a new monitoring plan will be developed and implemented.

1. INTRODUCTION

Florida Power & Light Company (FPL) submits this Post-Uprate Monitoring Report, dated August 2014, for the Units 3 and 4 Uprate Project. This monitoring report has been prepared in accordance with the FPL Turkey Point Power Plant (Turkey Point) Groundwater, Surface Water, and Ecological Monitoring Plan, referred to herein as the Monitoring Plan (South Florida Water Management District [SFWMD] 2009a) and modifications per SFWMD letters dated June 3, 2013 (SFWMD 2013a), and July 17, 2013 (SFWMD 2013b), followed by an email clarification dated July 23, 2013 (SFWMD 2013c). The Monitoring Plan requires the continued collection of groundwater, surface water, meteorological, and ecological data in and around the plant to establish Post-Uprate conditions and determine the horizontal and vertical effects and extent of the cooling canal system (CCS) water and compare to Pre-Uprate Conditions. For further details, refer to the Monitoring Plan (SFWMD 2009a) and the Fifth Supplemental Agreement (SFWMD 2009b).

The purpose of this Post-Uprate Monitoring Report is to summarize the Post-Uprate monitoring efforts from June 1, 2013, through May 31, 2014, to present and summarize the data, and to discuss results. This report also incorporates information presented from the most recent FPL semi-annual data deliveries (FPL 2013a; FPL 2014a) and the Comprehensive Pre-Uprate Report (FPL 2012), where applicable, for comparisons with the Post-Uprate period. Table 1.1-1 provides a summary of the Post-Uprate monitoring conducted from June 2013 through May 2014. Plant operational and outage capacity is shown in Appendix A.

FPL notified the FDEP of commencement of the Uprate of nuclear Units 3 and 4 on September 24, 2010. Uprate modifications were performed on both Unit 3 and Unit 4 over a period of time. One unit was uprated at a time. The final modifications for Unit 3 took place during February 26, 2012 to September 5, 2012 and the unit reached full uprate power on October 31, 2012. The final modifications for Unit 4 took place during November 5, 2012 to April 17, 2013 and the unit reached full uprated power on May 8, 2013. Both units were operating together within their uprated capacities starting May 27, 2013. Data collected prior to February 26, 2012 are part of the Pre-Uprate period, while data collected between February 26, 2012 and May 27, 2013 are part of the Interim Operating Period. Data collected after May 27, 2013 are part of the Post-Uprate period.

Data were collected in accordance with the FPL Quality Assurance Project Plan (QAPP) (FPL 2011a; FPL 2013b). Any notable modifications to field protocols not incorporated in the 2013 revision of the QAPP are discussed in the December 2013 field audit (FPL 2014b).

1.1 Brief Overview of Automated Monitoring Network

FPL installed an extensive automated monitoring network to collect groundwater, surface water, meteorological, and hydrologic data over a broad area surrounding Turkey Point. A brief overview of each component of the monitoring network is provided below, and further discussion regarding the results for the network is included in Section 2 of this report. Time series graphs for the entire monitoring period (Pre-Uprate, Interim Operating Period, and Post-Uprate) are incorporated in Section 2 to allow review of trends and any differences between the Pre- and Post-Uprate periods.

1.1.1 Groundwater

From February through June 2010, FPL installed 42 wells in 14 well clusters (TPGW-1 to TPGW-14) at and around Turkey Point (Figure 1.1-1). Coordinates of each station were provided in Appendix A of the Comprehensive Pre-Uprate Report (FPL 2012). The locations were determined based on site conditions and extensive coordination among FPL and the Agencies. The placement of station locations in Biscayne Bay was also coordinated with Biscayne National Park (BNP).

Three separate wells were installed at each location: a shallow well (S); an intermediate depth well (M); and a deep well (D). The borehole for the deep well was drilled first, and down-hole geophysical methods were used to help determine high flow zones and other subsurface characteristics. Based on a collaborative effort among FPL, JLA Geoscience, Inc., and the SFWMD, screen depths were established with screen lengths varying from 2 to 5 feet (ft) based on site conditions. Table 1.1-2 provides a brief summary of the well construction information, and further details are provided in the JLA Geosciences, Inc. (2010) geology and hydrogeology report.

Following well completion, the top of each well casing was surveyed and infrastructure (probes, telemetry, solar panels, and other elements) was installed to facilitate the collection of automated groundwater quality and stage data at 15-minute intervals. The measured water quality parameters are actual conductance and temperature. Specific conductance, salinity, density, and total dissolved solids (TDS) are calculated by the instrumentation based on the measured parameters. Groundwater data are remotely transmitted via telemetry each day and are uploaded to FPL's Electronic Data Management System (EDMS).

Data collection methods at these groundwater stations have remain unchanged from the Pre-Uprate to Post-Uprate monitoring period other than adjusting the stations to record data at 1-hour intervals instead of 15-minute intervals. This change was implemented system-wide in February 2013.

1.1.2 Surface Water

Per the Monitoring Plan and as shown on Figure 1.1-2, automated surface water stations were installed at the following locations:

- Seven stations in the CCS;
- Five stations in adjacent canals;
- Three stations in the Interceptor Ditch (ID); and
- Five stations in Biscayne Bay.

In addition, a non-automated station was set up at the Card Sound Road Canal (TPSWC-6).

The locations of the monitoring stations were jointly determined with the Agencies and provide broad coverage of the key water bodies in the project area. Two additional stations (TPBBSW-10 and TPBBSW-14) were added at a later date to record conditions in Biscayne Bay; these stations are co-located with TPGW-10 and TPGW-14.

The automated surface water stations record the same water quality data parameters as the groundwater stations. Stage data are recorded at all locations except stations TPBBSW-1, TPBBSW-2, TPBBSW-4, and TPBBSW-5 in Biscayne Bay, which do not have the infrastructure to support stage recorders or a telemetry system; data at these Biscayne Bay locations are retrieved manually at approximately six-week intervals and downloaded into the FPL EDMS. Data from the other stations are transmitted via telemetry daily onto a secure server system and are automatically uploaded into the FPL database.

Following submission of the Comprehensive Pre-Uprate Report and at FPL's request, the SFWMD provided a letter to FPL on June 3, 2013 (SFWMD 2013a), allowing several modifications, including:

- Discontinuation of monitoring at TPBBSW-1 and TPBBSW-2,
- Discontinuation of monitoring at the bottom of stations TPSWCCS-4, TPSWCCS-5, and TPSWCCS-6.

Similar to the automated groundwater stations, the frequency of data recorded was changed from 15-minute intervals to hourly intervals.

1.1.3 Meteorological

One meteorological station that includes instrumentation to measure solar radiation, wind speed, wind direction, air temperature, relative humidity, and rainfall was installed near the center of the CCS (TPM-1). Data were collected at 15-minute intervals from the inception (July 2010) to April 2013 where the frequency was changed to hourly to be consistent with the other automated stations. Data from the meteorological station are uploaded daily into the FPL database.

Four additional rainfall gauges were installed around the CCS and were initially used during the Pre-Uprate monitoring period. However it was determined that the SFWMD Next Generation Weather Radar (NEXRAD) data provided better information for FPL needs for the water budget analysis, so these four rainfall gauges were eliminated in June 2013.

To help assess the contributions of tritium via rainfall and vapor exchange, seven rainfall collectors were installed around the CCS and five evaporation pans were installed at various locations. The monitoring of these stations has remained the same since they were installed during the Pre-Uprate monitoring period. Figure 1.1-3 illustrates the locations of the above-mentioned stations (excluding the rainfall gauges).

1.1.4 Hydrological

Three acoustic Doppler velocity meters (ADVMs), otherwise known as index-velocity meters or flow meters, were originally set up to determine flow in the CCS primarily to help with the water budget analysis. However, as discussed in the Comprehensive Pre-Uprate Report, all three units failed within the first two years of deployment due to the harsh conditions within the CCS. Furthermore, the data was not being used for the water budget calculations. As part of the SFWMD letter on June 3, 2013 (SFWMD 2013a), the flow monitoring was discontinued. No flow data are included in this Post-Uprate report.

1.2 Quarterly Water Quality Sampling

The monitoring network for groundwater and surface water supports the collection of water samples for laboratory analysis. During the Pre-Uprate monitoring period and the Interim Operating period, samples were collected from the 42 new groundwater wells and the 21 surface water stations previously discussed. Samples were also collected at five existing historical wells (L-3, L-5, G-21, G-28, and G-35) as part of FPL's routine sampling for the ID operation. The samples were analyzed for a variety of parameters including CCS Tracer Suite constituents, ions, trace elements, nutrients, and TDS, along with field parameters, depending on the locations and whether the effort was a quarterly or semi-annual event.

Following review of the Comprehensive Pre-Uprate Report, the SFWMD (SFWMD 2013a) in consultation with the other Agencies agreed to reduce some of the monitoring requirements which included:

- Elimination of Biscayne Bay surface water quality monitoring stations TPBBSW-1 and TPBBSW-2; and
- Reduction of the number of parameters to be analyzed (Table 1.2-1).

All other monitoring remained the same. Results for the Post-Uprate monitoring efforts conducted in June 2013, September 2013, December 2013, and March 2014 are included in Section 3 of this report. Analytical results prior to June 2013 can be found in the semi-annual data deliverables (FPL 2013a; FPL 2014a) and the Comprehensive Pre-Uprate Report (FPL 2012).

1.3 Ecological Monitoring

The Monitoring Plan and QAPP outline an ecological monitoring program. Biotic components include marsh vegetation in adjacent wetlands, mangroves, submerged aquatic vegetation, and benthic fauna in and adjacent to Biscayne Bay. This report presents the results of the Post-Uprate monitoring conducted from June 2013 through May 2014 and includes data from two Biscayne Bay semi-annual monitoring events and four marsh/mangrove quarterly events. Where appropriate, discussions are provided comparing the Pre- and Post-Uprate findings. Further details on the Pre-Uprate results and conclusions, as well as more details on the transect plot setups, sampling methods and materials, can be found in the Comprehensive Pre-Uprate Report (FPL 2012). Results during the Interim Operating period can found in the semi-annual data deliverables (FPL 2013a; FPL 2014a).

1.3.1 Marsh and Mangroves

Plant community characteristics (composition, cover, canopy, height, productivity), leaf characteristics, nutrient content in the leaves, and soil/sediment, and porewater quality are being assessed in 12 transects in marsh and mangrove areas around the CCS (Figure 1.3-1). Two (one each in the marsh and mangrove) of these transects are in reference areas. This monitoring is conducted quarterly to annually, depending on the parameter. Based on information in the Comprehensive Pre-Uprate Report and per FPL's request, the SFWMD approved several reductions in the ecological monitoring for the Post-Uprate monitoring period (SFWMD 2013b). These reductions were initiated for the Post-Uprate Period and include the following:

- Reduction in frequency of vegetation sampling in the saline wetlands (mangroves) from semi-annual to annual with sampling to be conducted at the end of wet/growing season (November).
- Reduction of porewater sampling in mangroves and tree islands from quarterly to semi-annually.
- Reduction of parameters to be analyzed in porewater, which initially included a broad suite of physical parameters, cations, anions, tracer suite constituents, and nutrients. The Post-Uprate monitoring includes physical parameters (specific conductance and temperature) and chemical parameters (nutrients, tritium, sodium, and chloride).

This report presents the results of the marsh and mangrove monitoring efforts conducted in August 2013, November 2013, February 2014, and May 2014 during the Post-Uprate monitoring period. Where appropriate, comparisons with Pre-Uprate findings are included.

1.3.2 Biscayne Bay

Submerged aquatic vegetation (SAV), coral and sponge community composition and cover, fish and invertebrate species composition and abundance, nutrient content in seagrass leaves and sediment, light attenuation, and porewater quality were assessed in 20 transects that paralleled the shoreline (Figure 1.3-1) during the Pre-Uprate and Interim Operating period. This monitoring was conducted twice a year. Based on the lack of findings summarized in the Comprehensive Pre-Uprate Report, the SFWMD approved revisions to the Biscayne Bay monitoring (SFWMD 2013b; SFWMD 2013c), which included the following:

- Elimination of faunal sampling during the Post-Uprate monitoring period;
- Reduction of submerged aquatic vegetation (SAV) and semi-annual pore water sampling from five transects to two at each of the four existing Bay sites (to be collected at 'a' and 'b' transects); and
- Reduction of the number of parameters to be analyzed similar to the marsh mangrove monitoring which now includes physical parameters (specific conductance and temperature) and chemical parameters (nutrients, tritium, sodium and chloride).

This report presents the results of the Biscayne monitoring efforts conducted in September 2013 and April 2014 during the Post-Uprate monitoring period. Where appropriate, comparisons with Pre-Uprate findings are included.

1.4 Hydrogeologic Assessment

1.4.1 Post-Uprate Hydrogeological Observations and Extent of CCS Water

With the aid of data collected as part of the well installation efforts, automated data and analytical results, the United States Geological Survey (USGS) induction logs, and other supporting documentation, FPL conducted an initial assessment of the hydrogeologic conditions in the area surrounding Turkey Point and the CCS in the Comprehensive Pre-Uprate Report. Additional information is provided in this Post-Uprate; however, discussion on the extent of CCS water is not included at this time because tritium results are still pending from the USGS for the Post-Uprate period.

1.4.2 CCS Water and Salt Budget

FPL has worked closely with the Agencies to develop an acceptable methodology for the CCS water and salt budget. This methodology was presented in the Comprehensive Pre-Uprate Report and that same methodology has been used to assess the Post-Uprate water and salt budget. Estimated monthly water budgets and salt loads from June 2013 through May 2014 are included in Section 5.

1.5 Interceptor Ditch Operation

The ID is located immediately west of the CCS and is designed to prevent seasonal inland movement of saltwater from the CCS into the potable portion of the Biscayne aquifer. Shallow saline groundwater is intercepted by the ID and pumped back to the CCS during the dry season or other times when the natural gradients are low and the potential for saltwater intrusion exists. Details of the ID operation are found in the 1983 Agreement (the Agreement) between the SFWMD and FPL. On October 14, 2009, the Agreement was modified to expand the monitoring program as part of the Turkey Point Units 3 and 4 Uprate Project and added well G-35 as part of the historical monitoring network. FPL submitted a revised operations plan to the SFWMD in 2011 that included consideration of water densities and has been following that plan since December 2011.

FPL has been collecting groundwater data west of the CCS and recording ID pumping as part of the ID operation since 1972. Results of these efforts have been included in reports that are submitted on a quarterly and an annual basis. Based on discussions between FPL and the SFWMD, reporting of the ID operations for the last year (June 2013 through May 2014) is integrated into Section 6 of this report.

1.6 Data Quality Objectives and Acceptance Criteria

Data quality objectives (DQOs), along with acceptance criteria, are identified in the project QAPP (FPL 2013b). The DQOs include the following:

- Precision
- Accuracy
- Analytical Sensitivity
- Completeness
- Representativeness
- Comparability
- Availability
- Reliability
- Maintainability
- Timeliness

Quality guidelines have been established for some of the DQOs which reflect quantifiable goals. A summary of performance in meeting the DQOs is described below.

Precision

Precision is a measure of mutual agreement between duplicate or co-located measurements of the same analyte. The closer the numerical values of the measurements are to each other, the more precise the measurement.

To assess precision of the automated probes being used to collect time series water quality and water level data, field measurements are taken during sampling events and/or during cleaning and calibration events to compare the results with the automated probe. Temperature readings on the automated probe are checked against the reading of a National Institute of Standards and Technology (NIST) thermometer during cleaning and calibration events. During sampling events, specific conductance values are recorded with a second probe and compared to the automated values for informational purposes. Any major discrepancies between probes are reviewed; however, the values are sometimes different since the second probe readings for specific conductance are in the flow-through cell and not the well.

For verification of water level precision of the automated probes, water level measurements are recorded with a water level indicator at different times during the cleaning and calibration event and are compared to the probe reading. Water levels are recorded on the water level indicator and probe before pulling the probes for cleaning and after replacement of the probes following cleaning. This helps verify that the automated water level probes have recorded data with good precision prior to cleaning and confirms that the reference levels are set correctly after cleaning. If the difference between the verification water level reading (before the probe is pulled for cleaning) is greater than 0.1 ft from the automated probe reading, the data are qualified as estimated (E) back to the previous cleaning and calibration event or, at minimum, back to an interim point where there is an unexplained shift in the data. The precision continues to improve over time; however, the biggest challenge has been associated with the surface water stations in Biscayne Bay and the CCS. Sometimes wave action at these larger surface water body locations affect the water level indicator readings, making verification of the automated reading difficult. However, only a limited amount of water level data is qualified as questionable due to verification readings.

Precision for laboratory samples is established by the evaluation of field and laboratory duplicate samples. If the relative percent difference (RPD) between the sample and the duplicate result differ by more than 20%, the results for that analyte in both samples are qualified as questionable. While a small percentage of sample data has been qualified due to high duplicate RPDs, overall, the analytical results are comparable to duplicate samples for those samples using the same method. These precision results indicate the sampling and analytical procedures are consistently performed and repeatable. Details are provided in the Data Usability Summary (DUS) Reports issued for each event.

The precision for ecological samples is determined by a 5% check on all field vegetation measurements. In the marsh and mangrove, plots are randomly selected for each event to be re-measured to determine precision. Individuals conducting the first set of measurements on the plot are not allowed to re-measure the same plants. Biscayne Bay SAV plots are reassessed by a second diver following behind the first person to conduct an independent Braun-Blanquet. Scientists involved in the SAV measurements also participate in the annual inter-Agency calibration exercise (conducted 5/27/14) together with the USGS, SFWMD, and Miami-Dade Regulatory and Economic Resources (RER) as an additional level of precision determination.

Accuracy

Accuracy is the measure of bias in a measurement system. The closer the value of a measurement agrees with the true value, the more accurate the measurement.

The instrumentation for all the automated station instruments and field equipment meets the requirements for accuracy per the QAPP. All stations were surveyed with vertical control established to second order closure (accuracy within hundredths of a foot) with the exception of three groundwater cluster stations in Biscayne Bay. The top of the groundwater wells and surface water stilling wells at these Biscayne Bay stations were surveyed with GPS instruments to an accuracy of 0.1 ft.

To assess accuracy of the automated stations being used to collect time series water quality data, each probe is checked against standards of known specific conductance values (verification) and then recalibrated as necessary during each cleaning and calibration event. Approximately 98% of the probes during cleaning and calibration events have passed verification by being within 5% of the known standards. When values differ by more than 5%, the probe data are qualified as estimated (5% to 30%) or questionable (>30%) back to the previous cleaning and calibration event or, at minimum, back to an interim point where there is an unexplained shift in the data. Specific data have been qualified as unusable for this reason in only a few instances.

Similarly, probe temperature readings are compared to a highly accurate NIST-certified thermometer during each cleaning and calibration event. If a temperature verification measurement on the NIST thermometer is more than 0.5 degrees Celsius (°C) different than the automated probe reading, the data are qualified in the same manner as specific conductance. Rarely has the water quality data been qualified for not meeting a field instrument verification reading.

For the analytical results, accuracy is evaluated using percent recoveries of analytes added, termed "spiked," to samples (matrix spikes [MSs]) or reagents (laboratory control samples [LCSs]) and carried through the extraction and analysis procedure. Laboratory-established acceptance criteria (within method requirements) are used for LCS and MS percent recoveries. LCS percent recoveries have consistently passed acceptance criteria for all analyses indicating the laboratories' extraction and analytical procedures and materials met method requirements.

In addition to recoveries, accuracy is evaluated using technical comparison checks, including cation and anion charge balance; cations, anions, and TDS compared to the specific conductance; total ammonia less than total Kjeldahl nitrogen (TKN); and ortho-phosphate (OP) less than total phosphorus (TP). Many cation and anion results, particularly in the high salinity samples, have been qualified as estimated (J) due to ion charge and conductance comparisons. TDS/specific conductance and ammonia/TKN comparisons were acceptable.

TP and OP were first sampled in events from June 2010 to February 2011 and the OP had higher results than the TP; this is not possible as OP is a subset of TP. In March 2011, the OP analytical method was modified based on an FDEP Laboratory Standard Operating Procedure (SOP [NU-070-1.8]). The sample is analyzed without the color reagent to establish a background concentration. The sample is then analyzed per the method and the background concentration is subtracted from the analytical result (i.e. a blank subtraction). Since the method modification, the OP/TP comparisons have been mostly within the criteria. In some instances, the OP results were reported as not detected but with method detection limits (MDLs) above the TP results due to sample dilutions by the lab. The lab has agreed to only use dilutions when necessary in future events to reduce these occurrences. In cases where OP > TP and laboratory review has confirmed the results, both data points are then qualified as "J".

A comprehensive review of the analytical data acquired to date was performed by the SFWMD in February 2013 (SFWMD 2013d). Two issues noted in the review were related particularly to accuracy i.e. elevated MDLs and matrix spiking concentrations. Due to the high concentrations of some ions in saline samples, the laboratory routinely had to dilute certain samples, causing certain analytes to be reported as not-detected with elevated MDLs. The laboratory had also been using standard spiking concentrations for the wide range of sample types encountered at Turkey Point, which led to many instances in which the spike results were not effectively usable.

Through the course of the project, it became apparent that certain samples consistently fell into standard sample types (freshwater, saline waters, and hypersaline surface waters). As part of the corrective action plan proposed by the laboratory to limit dilutions and achieve more usable MS data, starting with the September 2013 sampling event, similar sample types were batched and the calibration curves and matrix spiking concentrations were then tailored to the expected concentrations in the samples, thus providing more accurate and usable data. During the Post-Uprate monitoring period, the number of data reported as not-detected with MDLs elevated above the QAPP requirement due to dilution have dramatically decreased.

The associated MS/MSD data validation procedures were also modified in the June 2013 QAPP revision (FPL 2013b). Since the samples were now to be batched, SFMWD required similar samples run in the same analytical batch to be qualified as the spiked sample is when there is an MS/MSD failure. The effect of the more accurate spiking concentrations was that there are fewer MS/MSD failures. However, with the new batching/qualification requirement, any failures that were experienced ended up qualifying additional samples. The net difference in MS/MSD qualified data is essentially the same as before the modifications although the MS/MSD data are more representative of actual sample conditions and matrix effects.

To further evaluate laboratory accuracy, FPL requested that TestAmerica Laboratories, Inc. (TestAmerica) analyze certified reference material (CRM) samples for nutrients in saline waters. In June 2012, the laboratory purchased the seawater CRM from Ocean Scientific International Ltd. (OSIL) in the United Kingdom and the MOOS-2 seawater CRM for nutrients from the National Research Council (NRC) in Canada. The CRMs were analyzed for ammonia, TP, OP, nitrate/nitrite, and TKN and reported acceptable recoveries for the nutrients tested using the methods and procedures employed on the project. The laboratory will continue analyzing CRMs on an annual basis to comply with the June 2013 QAPP revision (FPL 2013b).

Analytical Sensitivity

For data validation, qualification and reporting purposes, analytical sensitivity is expressed by MDLs. An MDL is set so that the minimum concentration of an analyte reported is within 99% confidence that the analyte is greater than zero.

Project-required MDLs are listed in Table 3.2-1 of the QAPP (FPL 2013b). The MDLs are based on applicable criteria, MDLs listed in the Automated Data Processing Tool (ADaPT), Florida Administrative Code (F.A.C.) 62-4.246(3), and stated laboratory capabilities. While the majority of analytical detection limits have met the QAPP requirements, a few have been difficult to achieve due to the saline nature of the samples. This is particularly an issue with the trace metals and a few other analytes. The laboratory has had to dilute the saline samples to keep instruments from being overloaded with the major ion constituents (i.e., chloride, sodium). This has resulted in some data reported as Not Detected (U) but with detection limits above the QAPP requirements. In addition, these dilutions increase the uncertainty, or error, associated with a result.

To achieve the required MDLs, TestAmerica has made several changes to protocols/methods over the course of the project. As noted in the previous section, the laboratory has started batching samples and tailoring calibration ranges, within method requirements, to fit project samples and reduce the frequency of dilutions needed.

After the Comprehensive Pre-Uprate Report (FPL 2012), the laboratory performed a new MDL study for hexavalent chromium to achieve the QAPP MDL; however, this parameter is now not required for the Post-Uprate monitoring. For bromide, nitrate/nitrite, sodium, strontium, and OP, the required MDL in the original QAPP was set unnecessarily low due to stated laboratory capabilities when the associated criteria were well above the required MDL. The June 2013 QAPP revisions included modifying the MDLs for those analytes to levels that were both below potential criteria and above typical laboratory detection limits. The MDL for total ammonia, which was intended to be modified as well, was not updated in the June 2013 QAPP due to an oversight. Future revisions of the QAPP should include this modification.

To achieve the trace metal MDLs, TestAmerica subcontracted the analysis to Brooks Rand Labs (BRL) in Seattle, Washington. BRL performed the trace metal analysis using U.S. Environmental Protection Agency (EPA) Method 1638 (Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma Mass Spectrometry) for manganese and molybdenum and EPA Method 1640 (Determination of Trace Metals by Pre-Concentration and Inductively Coupled Plasma-Mass Spectrometry) for the other trace metals in the September 2012 and the March 2013 semiannual events. The resulting MDLs were all below the QAPP requirements using the new methods. Trace metals were still collected through the Interim Operating period, but are not required for the Post-Uprate monitoring.

A SFWMD audit of TestAmerica noted concerns about the accuracy of the fluoride data by EPA Method 300 due to the high dilutions that were routinely performed by the laboratory to account for the high ion content (particularly chloride) samples. The dilutions had the effect of reporting fluoride as Not Detected with a detection limit elevated above QAPP requirements. As part of a corrective action and after several events (September 2012 to March 2013) during which the alternative method was performed in concert with the QAPP stated method for comparison purposes, the analytical method for fluoride was officially changed to Standard Methods 4500 F starting in the September 2013 event. Where fluoride was routinely reported as Not Detected with Method 300, the new method has shown improved sensitivity (detection reported at levels below former non-detect limits), even in high ion content samples.

The TestAmerica MDL for sulfide using Method 4500 S2 has consistently reported non-detect results with MDLs above the QAPP requirement. As with fluoride, alternative methods have been explored. In conjunction with the fluoride method alternative analysis, Method 376.2 was performed along with the QAPP stated method 4500 S2 for comparison purposes. Method 376.2 was approved for use by the SFWMD in the June 2013 QAPP revision. However, the laboratory has yet to receive National Environmental Laboratory Accreditation Program (NELAP) certification and, therefore, the original method is still being reported. The laboratory will subcontract the analysis if the certification cannot be achieved by the September 2014 event.

Completeness

Completeness is expressed as the percentage of valid or usable measurement to planned measurements. The higher the percentage, the more complete the measurement process. The number of planned measurements is based on when the infrastructure is in place and functional. Per the QAPP, the completeness goal for water quality measurements is 95% and is 90% for all other data.

All planned groundwater, surface water, and porewater stations were sampled during the Post-Uprate monitoring period from June 2013 through May 2014. No analytical data have been qualified as unusable during the Post-Uprate period with the exception of one OP data point from the March 2014 surface water. This results in a completion rate of almost 100% (over 99% for the entire monitoring period). It should be noted that some tritium results have not been received at the time of this assessment and as such, the percentages reported above are based on available data.

All the planned ecological measurements have been made. Field data and samples are checked prior to leaving the field so no field measurements were missing and no analytical data have been qualified as unusable during the Post-Uprate period. This results in a completion rate of 100% in meeting the project objectives (over 99% for the entire monitoring period).

The automated water quality data are calculated to be 95% complete for the entire monitoring period from June 2010 (or when stations came online) through May 2014. The percent completeness is higher in the Post-Uprate monitoring period as the percent reported in the Comprehensive Pre-Uprate Report (FPL 2012) was 89% for the period from June 2010 through June 2012. There are still issues with specific conductance oscillations resulting in bad data related to probe or cable malfunctions or radio frequency wave interferences but to a lesser extent than previously reported. Also, a small percentage of data is qualified as unusable due to overtopping of several wells from seasonally high tide events (TPGW-3 and TPGW-12) and excessive rain events (TPGW-7); data recorded during and affected by a cleaning and calibration or sampling event; clogging of stilling well; sensors blocked by sediment or other obstruction; probe malfunction; or, to an even lesser extent, failure of calibration.

Meteorological data at TPM-1 are more than 99% complete. The unit has been reporting consistently with the exception of a few weeks in May and June 2013 when the anemometer failed and the unit was taken offline for repair.

Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represent the environmental condition. The sampling locations and techniques, as outlined in the Monitoring Plan and the QAPP, provide data that are representative of conditions in the CCS and the surrounding environment.

Groundwater wells are placed in discrete high flow zones and are spatially distributed to reflect changes in groundwater levels and quality across the landscape. Automated data are collected at 15-minute to 1-hour intervals, an adequate duration to reflect temporal changes in water levels, water quality, and various meteorological parameters.

During quarterly sampling events, specific conductance is recorded when samples are pumped. These values are later compared to data from the automated probes for each location. There have been a few instances in which the sampling and automated values have differed by 30% or greater. In some cases, such as with surface water sites, probes are often inside stilling wells and samples are taken from outside of the stilling wells. The difference in values may be attributable to variance caused by the stilling well, such as algae growth in the well. If this is the case, the sample taken outside the well would be more representative of the environment than the water within the stilling well.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one set of data can be compared to another. Nearly all the data, unless qualified as "?" or unusable for other reasons, are comparable. Methods of data collection and analysis have remained primarily consistent over the entire monitoring effort including the Post-Uprate monitoring period. Some refinements in data collection have helped improve efficiency or verify precision, but have not necessarily improved precision. Since the Pre-and Post-Uprate data will be compared in some instances, comparability of data between both time periods is important.

The most notable data that may not be directly comparable are some of the nutrient results. As noted in the "Accuracy" section above, the method of analysis for OP was modified beginning with the collection of data in the March 2011 sampling event; OP data collected prior to March 2011 using the original method are not directly comparable to data collected during and after the March 2011 event. The data prior to the March 2011 event are believed to be biased high due to background fluorescence levels interfering with the analysis.

Nitrate/nitrite samples collected in March 2012, and in subsequent events, were filtered in the field. Previously, the samples were distilled in the lab and not filtered in the field. It is expected that the results are similar. Rarely does one find insoluble forms unless they are large particulates which would not be analyzed in any case; they would have to be removed as they would interfere with the analysis. This was further demonstrated by the March 2012 RER split samples. The samples were analyzed as filtered and unfiltered for ammonia and nitrate/nitrite with essentially identical results. Therefore, the ammonia and nitrate/nitrite results from both method variations are considered comparable.

The most recent data that may not be directly comparable are the fluoride results. As noted in the "Accuracy" section above, the original analytical method (EPA Method 300) was changed to an alternative method (SM 4500 F) in the September 2013 sampling event. The high concentration of other cations in some samples had been causing the lab to perform dilutions that would result in non-detect results with MDLs elevated above the QAPP required MDL. The alternative method had lower detection limits and little interference from other sample components. The data prior to the September 2013 event are believed to be usable and not biased either way; however, the elevated MDLs limit the usefulness of the data in some cases.

The frequency of automated reporting in the groundwater and surface water stations was reduced from 15-minute intervals in the Pre-Uprate monitoring period to 1-hour intervals in the Post-Uprate monitoring period. This change in frequency does not impact the comparability in data between the two periods since both time intervals adequately capture site conditions.

Availability

Availability is the percentage of time that a system or function is available for service according to established criteria and the probability that the system is operating satisfactorily at any point in time, excluding times when the system is under repair. This DQO applies primarily to the automated systems.

While FPL has not calculated percentages, the stations that report automated water level and water quality collectively still have a high degree of availability. These systems operate round the clock, the probes have been reliable, and spare probes and cables are on-hand to fix a problem station. The meteorological station has been reliable with little down time, thus has a high degree of available data for solar radiation, wind speed and direction, air temperature, relative humidity, and rainfall.

Reliability

Reliability is the probability of a system performing a specified function without failure for a specified period of time. A "failure" occurs when a measurement or control action does not comply with established accuracy, completeness, or timeliness standards. This DQO applies primarily to the automated systems.

Collectively, the stations that report automated water level and water quality are still reliable in the context of data usability. The associated probes that measure and record the data meet the accuracy requirements and exhibit high percent completeness. As previously indicated, some stations have reoccurring issues with oscillating specific conductance data; however, only a small percentage of the data are qualified "?". Reporting of the automated data from the stations on telemetry has typically been on a daily basis. However, a number of transmission/signal issues have occurred when the data have not been consistently reported within 24 hours for all stations. Still, in most instances, the data are stored internally on the probe and are eventually downloaded when a phone connection is made or the data are manually downloaded into the system. The quality guideline for reliability, as stated in the QAPP, is difficult to judge since it reflects a mean time between failures of 18 to 24 months depending on the system. While there have been "failures" in less than 18 months, the majority of the data are usable and the Agencies are not making any decisions based on the raw data that are being transmitted via telemetry.

The meteorological station at TPM-1 has been reliable with only one outage, and loss of data associated with the anemometer (April 30 to June 26, 2013) and one for several sensors (relative humidity, pressure and air temperature, June 11 to June 26, 2013). No other failures for this station occurred during the entire Uprate monitoring effort.

Maintainability

Maintainability is the ease with which a component or equipment can be modified to correct faults. The quality guideline per the QAPP for completion of repairs to components or equipment is 7 days for 95% of all incidents, with the exception of remote stations accessible only by boat or airboat. Given the size of the system, remote locations of some stations, and the occasional need for extended troubleshooting efforts, strict compliance with the guideline is still not always possible or even appropriate. The automated groundwater and surface water stations (inshore) are easier to maintain than some of the other systems. However, some of the oscillation and daily reporting issues have required extensive troubleshooting.

On an approximate weekly basis, FPL checks for any automated groundwater and surface water stations that are on telemetry but are not reporting. Often the lack of reporting is related to low signal strength or loss of modem connection the previous day and not to an equipment malfunction. Usually, the system will eventually report. On a regular basis, FPL looks at time series plots of the data to see if there are any unusual data trends or oscillations requiring troubleshooting and repair efforts.

Timeliness

Timeliness is the promptness of reporting a measurement after it is made, reporting deficiencies, submission of reports or other project documentation, addressing corrective actions, and reporting deviations within the timeframes specified in the QAPP or within the Monitoring Plan or Agreement.

Per the QAPP, the analytical data have been consistently provided to the Agencies within 48 hours following FPL's receipt of the data from the laboratory. While much of the data from the primary laboratory is in ADaPT format, such data have not undergone a full quality assurance (QA)/quality control (QC) review at the time it is submitted to the Agencies. Since the samples are analyzed by various laboratories, the results are received at different times with tritium taking the longest to obtain. Once sample results are obtained for a sampling event, a full QA/QC check of the data is conducted and FPL generates DUS Reports. The data are further assessed during the preparation of semi-annual and annual reports; occasionally, suspect results are found and subsequently qualified.

The automated systems are now set to report values at 1-hour intervals (15-minute intervals for meteorological stations) and, for those systems on telemetry, to upload the results daily. As previously discussed, low signal strength or other issues have prevented various telemetry units from consistently reporting every day. While the raw data can be viewed by the Agencies in FPL's electronic database, the data are not official until FPL has conducted a full QA/QC review. If additional errors are noted in the data following the QA/QC process, the results are updated in the database or DUS, as applicable, and are included in an errata or the subsequent annual report.

Reports have been submitted to the Agencies per the timeframes outlined in the QAPP or in accordance with revised schedules agreed to by the Agencies. Once there is concurrence that corrective actions from field and laboratory audits are needed, corrective action is typically implemented immediately or by the next sampling event.

TABLES

Table 1.1-1. Summary of Monitoring Efforts (June 2013 – May 2014)

Monitoring Effort	2013							2014				
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Automated Data Collection	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Groundwater and Surface Water Sampling (New Stations)	Field parameters, TDS (GW only), sodium, chloride and tritium			Field parameters, TDS (GW only), anions, cations, silica (SW only), tritium and nutrients[1]			Field parameters, TDS (GW only), sodium, chloride, and tritium			Field parameters, TDS (GW only), anions, cations, silica (SW only), tritium and nutrients[1]		
Historic Groundwater Well Sampling	Field parameters, TDS (GW only), sodium, chloride and tritium			Field parameters, TDS (GW only), anions, cations, silica (SW only), tritium and nutrients[1]			Field parameters, TDS (GW only), sodium, chloride, and tritium			Field parameters, TDS (GW only), anions, cations, silica (SW only), tritium and nutrients[1]		
Ecological Marsh and Mangrove Monitoring			Marsh measurements Marsh Porewater (field parameters, sodium, chloride and tritium)			Marsh and mangrove measurements Marsh & Mangrove Porewater (field parameters, sodium, chloride, tritium, and nutrients) Marsh & Mangrove vegetation (nutrients)			Marsh measurements Marsh Porewater (field parameters, sodium, chloride and tritium)			Marsh measurements Marsh & Mangrove Porewater (field parameters, sodium, chloride, tritium, and nutrients) Marsh Vegetation (nutrients)
Ecological Biscayne Bay Monitoring				Seagrass measurements Porewater (field parameters, sodium, chloride, tritium, and nutrients) Vegetation (nutrients)							Seagrass measurements Porewater (field and Tracer Suite parameters, and nutrients)	
Meteorological Station	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Rainfall Collector Sampling	Tritium			Tritium			Tritium			Tritium		
Evaporation Pan Sampling	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium	Tritium

Notes:
Automated Data Collection includes groundwater and surface water quality and stage.
[1]Nutrients sampled at all surface water stations, but in groundwater at select well clusters.

Table 1.1-2. Well Construction Summary

Monitoring Well	Top of Casing Elevation (ft NAVD 88)	Depth to Top of Screen from TOC (ft)	Depth to Bottom of Screen from TOC (ft)	Screen Length (ft)	Top of Screen Elevation (ft NAVD 88)	Bottom of Screen Elevation (ft NAVD 88)	Elevation Screen Midpoint (ft NAVD 88)
TPGW-1S	3.82	32.0	34.0	2	-28.18	-30.18	-29.18
TPGW-1M	3.92	52.1	54.1	2	-48.18	-50.18	-49.18
TPGW-1D	4.20	85.3	89.3	4	-81.10	-85.10	-83.10
TPGW-2S	1.36	24.7	28.7	4	-23.34	-27.34	-25.34
TPGW-2M	1.18	50.5	52.5	2	-49.32	-51.32	-50.32
TPGW-2D	1.14	85.5	87.5	2	-84.36	-86.36	-85.36
TPGW-3S	1.44	27.1	31.1	4	-25.66	-29.66	-27.66
TPGW-3M	1.22	54.7	58.7	4	-53.48	-57.48	-55.48
TPGW-3D	1.10	86.6	88.6	2	-85.50	-87.50	-86.5
TPGW-4S	2.24	23.2	25.2	2	-20.96	-22.96	-21.96
TPGW-4M	1.82	38.1	43.1	5	-36.28	-41.28	-38.78
TPGW-4D	1.92	61.6	65.6	4	-59.68	-63.68	-61.68
TPGW-5S	5.35	28.6	32.6	4	-23.25	-27.25	-25.25
TPGW-5M	5.07	49.3	54.3	5	-44.23	-49.23	-46.73
TPGW-5D	5.22	67.0	72.0	5	-61.78	-66.78	-64.28
TPGW-6S	1.56	22.3	24.3	2	-20.74	-22.74	-21.74
TPGW-6M	1.52	48.7	52.7	4	-47.18	-51.18	-49.18
TPGW-6D	1.59	81.9	85.9	4	-80.31	-84.31	-82.31
TPGW-7S	1.36	21.8	25.8	4	-20.44	-24.44	-22.44
TPGW-7M	1.25	47.7	51.7	4	-46.45	-50.45	-48.45
TPGW-7D	1.19	79.7	83.7	4	-78.51	-82.51	-80.51
TPGW-8S	1.98	16.8	20.8	4	-14.82	-18.82	-16.82
TPGW-8M	2.12	34.9	36.9	2	-32.78	-34.78	-33.78
TPGW-8D	2.01	49.2	53.2	4	-47.19	-51.19	-49.19
TPGW-9S	3.63	14.9	18.9	4	-11.27	-15.27	-13.27

Table 1.1-2. Well Construction Summary

Monitoring Well	Top of Casing Elevation (ft NAVD 88)	Depth to Top of Screen from TOC (ft)	Depth to Bottom of Screen from TOC (ft)	Screen Length (ft)	Top of Screen Elevation (ft NAVD 88)	Bottom of Screen Elevation (ft NAVD 88)	Elevation Screen Midpoint (ft NAVD 88)
TPGW-9M	3.53	34.3	36.3	2	-30.77	-32.77	-31.77
TPGW-9D	3.52	47.9	49.9	2	-44.38	-46.38	-45.38
TPGW-10S*	8.3	36.4	38.4	2	-28.10	-30.10	-29.10
TPGW-10M*	8.3	60.4	64.4	4	-52.10	-56.10	-54.10
TPGW-10D*	8.3	126.5	130.5	4	-118.20	-122.20	-120.10
TPGW-11S*	8.7	39.4	43.4	4	-30.70	-34.70	-32.70
TPGW-11M*	8.7	90.4	94.4	4	-81.70	-85.70	-83.70
TPGW-11D*	8.7	122.4	126.4	4	-113.70	-117.70	-115.70
TPGW-12S	0.52	21.6	23.6	2	-21.08	-23.08	-22.08
TPGW-12M	0.73	55.8	59.8	4	-55.07	-59.07	-57.07
TPGW-12D	0.76	89.8	93.8	4	-89.04	-93.04	-91.04
TPGW-13S	2.19	29.8	33.8	4	-27.61	-31.61	-29.61
TPGW-13M	2.13	56.7	60.7	4	-54.57	-58.57	-56.57
TPGW-13D	2.18	84.9	88.9	4	-82.72	-86.72	-84.72
TPGW-14S*	8.8	32.5	36.5	4	-23.70	-27.70	-25.70
TPGW-14M*	8.8	56.3	60.3	4	-47.50	-51.50	-49.50
TPGW-14D*	8.6	102.2	106.2	4	-93.60	-97.60	-95.60

Note:
* Offshore wells surveyed using GPS are only accurate to 0.1 foot.

Key:
D = Deep. NAVD 88 = North American Vertical Datum of 1988.
ft = Feet. S = Shallow.
M = Intermediate. TOC = Top of casing.

Table 1.2-1. Analytical Changes in Post-Uprate Monitoring

Pre-Uprate and Interim Operating Period (June 2010-May 2013)		Post-Uprate (June 2013 onwards)	
Quarterly Event Analytes	**Semi-Annual Analytes**	**Quarterly Event Analytes**	**Semi-Annual Analytes**
Barium, Iron	Barium, Iron [Arsenic, Beryllium, Cadmium, Copper, Lead, Manganese, Molybdenum, Nickel, Selenium, Thallium, Vanadium, Zinc] [1], Silica [2]	-	Silica [2]
-	Mercury	-	-
-	Hexavalent Chromium	-	-
Calcium, Magnesium, Potassium, Sodium, Boron, Strontium	Calcium, Magnesium, Potassium, Sodium, Boron, Strontium	Sodium only	Calcium, Magnesium, Potassium, Sodium, Boron, Strontium
Bromide, Chloride, Fluoride, Sulfate	Bromide, Chloride, Fluoride, Sulfate	Chloride only	Bromide, Chloride, Fluoride, Sulfate
Sulfide	Sulfide	-	Sulfide
Alkalinity/Bicarbonate	Alkalinity/Bicarbonate	-	Alkalinity/Bicarbonate
TDS (groundwater only)	TDS (groundwater only)	TDS (groundwater only)	TDS (groundwater only)
-	DIC	-	-
-	TKN [3]	-	TKN [3]
-	Nitrate/Nitrite [3]	-	Nitrate/Nitrite [3]
-	Total Phosphorous [3]	-	Total Phosphorous [3]
-	Ortho-Phosphate [3]	-	Ortho-Phosphate [3]
-	Total Ammonia [3]	-	Total Ammonia [3]
-	Gross Alpha [2]	-	-
-	Ammonium [3,4]	-	Ammonium [3,4]
-	Un-Ionized Ammonia [3,4]	-	Un-Ionized Ammonia [3,4]

Table 1.2-1. Analytical Changes in Post-Uprate Monitoring

Pre-Uprate and Interim Operating Period (June 2010-May 2013)		Post-Uprate (June 2013 onwards)	
Quarterly Event Analytes	Semi-Annual Analytes	Quarterly Event Analytes	Semi-Annual Analytes
-	Total Nitrogen [3,4]	-	Total Nitrogen [3,4]
δ^2H	δ^2H	-	-
$\delta^{18}O$	$\delta^{18}O$	-	-
$\delta^{13}C$	$\delta^{13}C$	-	-
$^{87}Sr/^{86}Sr$	$^{87}Sr/^{86}Sr$	-	-
δ^3H	δ^3H	δ^3H	δ^3H

Notes:
Quarterly events occur in June and December; Semi-Annual events occur in March and September.
- Parameters not sampled.
[1] Trace elements (besides Ba and Fe) were analyzed semi-annually at TPGW-1, 2, 3, 10, 13, and 14 by Method 200.7 prior to September 2012, then by 1640 for September 2012 and March 2013.
[2] Silica and Gross Alpha analyzed in the Cooling Canal (TPSWCCS) samples only. Gross alpha sampled only for 1 year (2010-2011).
[3] Nutrients sampled semi-annually at TPGW-1, 2, 3, 10, 13, 14 and all Surface Water (SW) stations. One time only sampling for June 2013 quarterly event in clusters TPGW-4, 5, 6, 7, 8, and 9.
[4] Total Nitrogen = TKN + Nitrate/Nitrite; Ammonium, and Un-ionized Ammonia are calculated using total ammonia values.

Key:
$\delta^{18}O$ = Oxygen isotope.
$^{87}Sr/^{86}Sr$ = Strontium isotope.
DIC = Dissolved Inorganic Carbon.
NH_3 = Total ammonia.
TDS = Total Dissolved Solids.
TKN = Total Kjeldahl Nitrogen.
.

FIGURES

Figure 1.1-1. Locations of Groundwater Monitoring Stations.

Note: Stations in parentheses (TPBBSW-1 and -2) and bottom stations with asterisks in the CCS (i.e. TPSWCCS-4B, -5B, -6B) were eliminated in June 2013 per SFWMD letter dated 6/3/13. 7-2014

Figure 1.1-2. Locations of Surface Water Monitoring Stations.

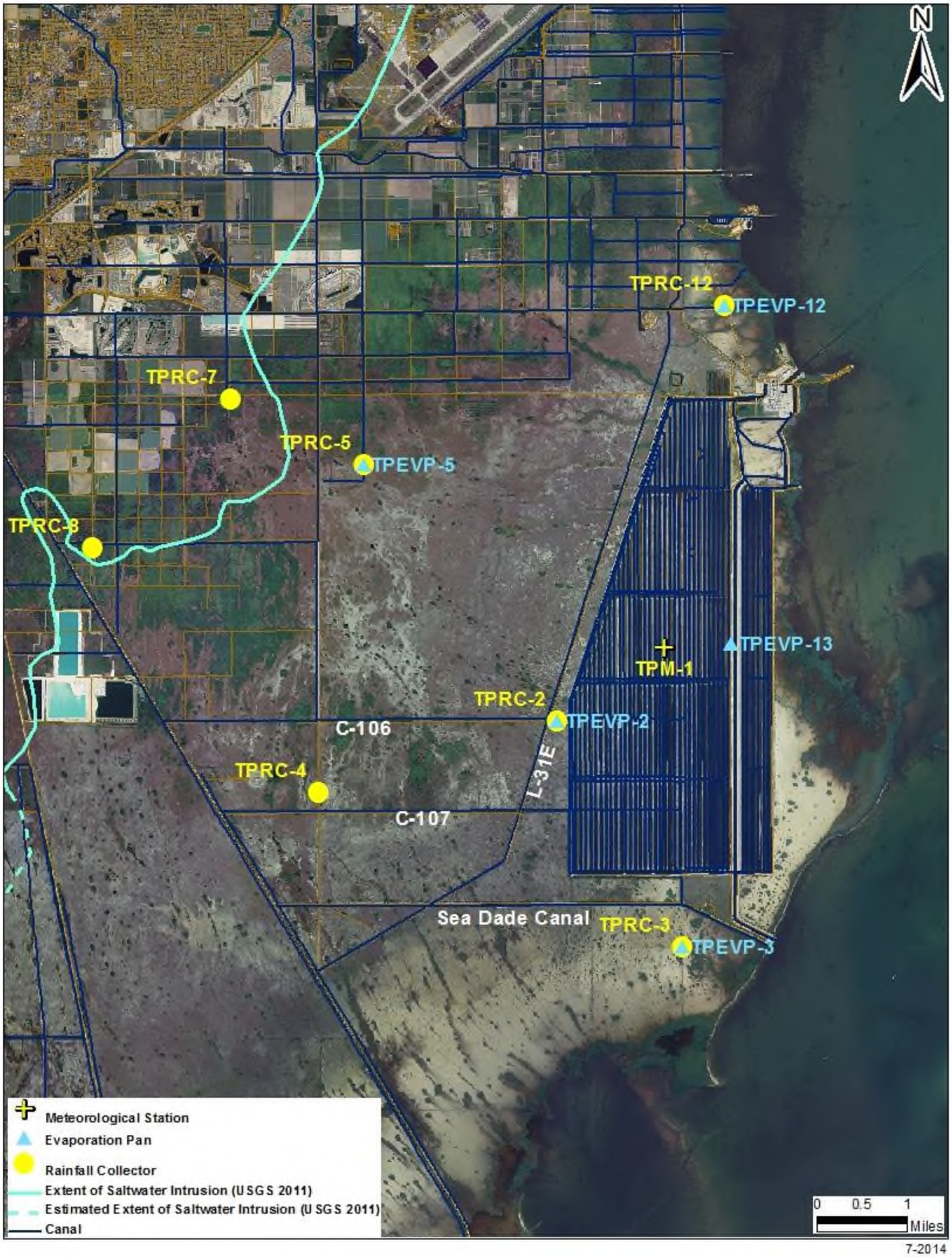

Figure 1.1-3. Locations of the Meteorological Station, Rainfall Gauges, Rainfall Collectors, and Evaporation Pans.

Note: Stations in parentheses (BB1 to BB4, lines c to e) were eliminated in September 2013 per SFWMD letter dated 6/17/13. 7-2014

Figure 1.3-1. Ecological Transect Locations.

2. AUTOMATED DATA COLLECTION

2.1 Groundwater Quality

2.1.1 Instrumentation and Data Collection Methods

Automated groundwater monitoring stations were installed at 14 well clusters in a total of 42 wells (three wells per cluster) from February to August 2010. In each well, two probes manufactured by In-Situ, Inc. (an Aqua TROLL® 100 [AT100] and a Level TROLL® 500 [LT500]) were deployed primarily between June and September 2010 and were set to record water quality parameters and water levels, respectively. Readings were initially set to record data at 15-minute intervals, which was changed in early 2013 to 1-hour intervals. The probes were connected by cable to a telemetry unit and the data at each of these sites are transmitted remotely by cellular phone service to a central database once per day. The telemetry units are powered with 12-volt batteries that are recharged by solar panels. Figure 2.1-1 shows an automated groundwater station with telemetry.

From June 2013 through May 2014, the most problematic issue with the automated stations continued to be the irregular daily reporting by the telemetry units at several stations. In nearly all cases, the data were recorded and stored in the instrument but, due to intermittent connectivity to the network, the data were not always transmitted to the FPL database on a daily basis. In a few cases, data were lost due to lightning strikes or probe electronic resets. If the system does not reconnect after these connectivity failures, FPL has to download and manually patch in the data. When connection failures occur, data are typically downloaded from probes during the cleaning and calibration events.

2.1.2 Results and Discussion

All raw data are made available to the Agencies upon receipt by FPL and are subsequently reviewed for accuracy. Depending upon the results, some of the data are qualified using the qualification codes outlined in the QAPP (FPL 2013b). While the number of measurements reviewed is substantially less now since the data are being recorded at hourly intervals instead of 15-minute intervals (four times reduction in data), the validation and qualification of data are still a substantial undertaking. For example, each groundwater well generates 144 data points each day. This results in 6,048 data points generated by the groundwater stations (42 wells) daily, or approximately 2.2 million points annually. Both the surface and the groundwater stations currently generate in excess of approximately 3 million data points per year.

Data validation and qualification of the automated data is a multi-step process and details can be found in the Comprehensive Pre-Uprate Report (FPL 2012) and the QAPP (FPL 2103b). Appendix B shows the water quality field verification/calibration logs for the Post-Uprate monitoring period. Only a small percentage of the groundwater quality data has been qualified as questionable, which has become a less frequent necessity during the Post-Uprate monitoring period. The reasons for using the "?" qualifier include erroneous data caused by overtopping of certain wells during seasonally high tide events (TPGW-3 and TPGW-12) and excessive rain events (TPGW-7); data recorded during and affected by a cleaning/calibration or sampling event; probe malfunction; or, to a lesser extent, probe failure.

Figures 2.1-2 through 2.1-15 illustrate time series graphs of specific conductance and temperature at each well. These graphs depict validated data and exclude data that have been qualified as questionable. Appendix C shows what data were qualified, while Appendix D shows time series graphs of the two parameters, but with all reported data including estimated and questionable (i.e., eliminated) data. The time series graphs show data from the beginning of station reporting in 2010 (various dates depending on station startup) through May 2014. This includes the Pre-Uprate, Interim Operating (in grey on figures) and the Post-Uprate monitoring periods. This entire time series display allows for a comparison between Pre- and Post-Uprate monitoring periods. FPL has included the raw time series data in separate Excel files with the report to facilitate closer review of the time series results by the Agencies and allow the adjustment of graphic scales presented herein and/or focus on a specific time interval.

Tables 2.1-1, 2.1-2, and 2.1-3 show statistical summaries for time series automated specific conductance, temperature, and salinity data, respectively. The tables include monthly average values for each monitoring well (specific conductance and salinity) and the minimum, maximum, average, and standard deviation for the Post-Uprate monitoring period; these summaries were calculated where at least 21 days of data were available for that month. The salinity values are presented since salinity is a more commonly displayed parameter than specific conductance. For general comparisons, the tables also include the minimum, maximum, average, and standard deviation for the Pre-Uprate monitoring period from June 2010 to February 2012 which were developed from the Comprehensive Pre-Uprate Report (FPL 2012). Figures 2.1-16, 2.1-17, and 2.1-18 show the average value and standard deviation for specific conductance, temperature, and salinity, respectively, to facilitate a spatial visualization of the average automated groundwater results for the Post-Uprate period. Statistical files have been included in separate Excel files with the report.

While Tables 2.1-1 through 2.1-3 and Figures 2.1-16 through 2.1-18 are informative, care should be used in drawing definitive conclusions when comparing these two data sets (Pre-Uprate and Post-Uprate) since the Pre-Uprate period covers a longer time span and includes an unequal number of months and seasons compared to the Post-Uprate period.

Overall, the qualified groundwater specific conductance data as shown by the time series plots and low standard deviations indicated generally consistent readings for the vast majority of wells throughout the entire monitoring period (June 2010 to May 2014). The salinity results track the specific conductance results since salinity is calculated based on specific conductance and temperature. Nearly all the specific conductance time series plots exhibit very little change over time. Groundwater wells TPGW-1S, TPGW-7D, TPGW-10D, and TPGW-11D were the notable exceptions and are further discussed below.

At TPGW-1S, the specific conductance values ranged from approximately 39,000 microSiemens per centimeter (µS/cm) to 60,000 µS/cm. Some of this variability may be seasonally driven (Figure 2.1-2) as higher specific conductance values were reported at the end of the dry season and lower specific conductance values were reported at the end of the wet season for the Interim and the Post-Uprate operating periods. This well has a lower overall specific conductance in the Post-Uprate monitoring period than the Pre-Uprate period, but this may just be a function of the differences in time periods between the two monitoring periods.

Biscayne Bay deep wells TPGW-10D and, to a lesser extent, TPGW-11D showed steady increases in specific conductance values beginning in the Interim Operating period and continuing through May 2014 in the Post-Uprate monitoring period (Figures 2.1-11 and 2.1-12). At TPGW-10D, the specific conductance value during the Pre-Uprate period was consistently around 55,000 µS/cm (average 55,352 µS/cm and standard deviation of 1,049 µS/cm), but by the end of May 2014, the value was over 66,000 µS/cm. At TPGW-11D, the specific conductance value during the Pre-Uprate period was consistently around 58,000 µS/cm (average of 58,217 µS/cm and standard deviation of 696 µS/cm), but by the end of May 2014 the value was around 62,500 µS/cm. The increases in specific conductance in the Interim Operating period appear to be influenced by the CCS based on tritium results reported prior to June 2013. Per the Comprehensive Pre-Uprate Report (FPL 2012), tritium is being used as a tracer of the CCS water. The continued increase in specific conductance into the Post-Uprate period is suspected to still be associated with the CCS; however this cannot be confirmed until tritium results are received from the USGS for the Post-Uprate period.

At TPGW-7D, the specific conductance was consistently around 500 µS/cm during the Pre-Uprate and Interim Operating periods, but the values increased during the Post-Uprate monitoring period (Figure 2.1-8). Specific conductance in the deep well at the end of May 2014 was approximately 4,300 µS/cm. It is not clear if the increase in specific conductance at TPGW-7D is the result of the lag effects of the 2011 drought, or some other factor. No changes in specific conductance were noted in the shallow and intermediate depth wells.

Similar to what has been previously observed, the wells closest to the CCS and Biscayne Bay had higher specific conductance than the wells located farther away. Outer well clusters TPGW-7 (now excluding TPGW-7D), TPGW-8 (excluding TPGW-8S), and TPGW-9 have groundwater that can be characterized as freshwater and do not appear to be affected by salt water intrusion. At TPGW-8, specific conductance values are still consistently above 2,000 µS/cm, but the values have been declining gradually since the start of monitoring in 2010. Also as reported in the Comprehensive Pre-Uprate Report, ionic data indicate non-marine influences. Monitoring wells TPGW-1M, TPGW-1D, TPGW-2S, TPGW-2M, TPGW-2D, TPGW-3S, TPGW-3M, TPGW-3D, TPGW-12M, TPGW-12D, TPGW-13S, TPGW-13M, and TPGW-13D still consistently have the higher salinity water, with specific conductance values consistently in excess of 60,000 µS/cm similar to the Pre-Uprate monitoring period. The specific conductance values in well cluster TPGW-13 were the highest with average values in the Post-Uprate period near 80,000 µS/cm; this is consistent with the Pre-Uprate monitoring period, although the Pre-Uprate averages were about 2% higher than the Post-Uprate averages.

The majority of the wells that appear to be influenced by marine water consistently had higher specific conductance values with depth, although the intermediate and deep zones often had similar values. Well cluster TPGW-13 remains one of the exceptions where the average specific conductance values over the monitoring period were slightly higher in the shallow zone, but the values between all zones were within 5% of each other. This is not unexpected at TPGW-13 given the hypersaline conditions in the CCS.

As seen in the Pre-Uprate monitoring period, the groundwater temperatures in the intermediate and deep zones still exhibited little to no change over the monitoring period and most appear flat-lined on the time series plots. The temperatures in the shallow zone wells were steady, but reflected minor seasonal influences; groundwater temperatures were typically higher near the end/beginning of the year and decreased to their lowest levels when air temperatures were warmer, which is the opposite of what would be expected if there was an immediate response in groundwater temperature to air temperature. This trend may be reflective of a lag in the response of the shallow groundwater (20 to 40 ft below ground surface) to winter and summer air and surface water temperatures. The highest groundwater temperatures still occurred in well cluster TPGW-13 with values over 29°C, however, there has been a gradual downward trend in temperature in all three wells since the beginning of monitoring in 2010 (Figure 2.1-14). During the Post-Uprate monitoring period, the average temperature in the TPGW-13S was 29.4°C (30.0°C in the Pre-Uprate monitoring period). By comparison, the average groundwater temperatures during the Post-Uprate monitoring period in TPGW-10S (Biscayne Bay well), TPGW-1S (near CCS), and TPGW-9S (westernmost well) were 25.9°C, 25.7°C, and 24.6°C, respectively. In the Pre-Uprate monitoring period, the temperatures were similar to the values of 25.8°C, 25.6°C, and 24.7°C, at TPGW-10S, TPGW-1S and TPGW-9S respectively.

TPGW-13 still exhibits the highest groundwater temperature while wells TPGW-2M and TPGW-2D continue to have the next highest temperatures. Well cluster TPGW-2 did not follow the same general groundwater temperature trends exhibited by the other well clusters, indicating an external influence. Since groundwater in TPGW-2M and TPGW-2D are warmer than other sources such as Biscayne Bay groundwater or freshwater groundwater, it appears the CCC may be influencing the groundwater temperatures in those wells. Similar to the findings for TPGW-13, there has been a gradual decline in the groundwater temperature at all the TPGW-2 wells since the beginning of monitoring.

To assess differences between wells over time, Figures 2.1-19 through 2.1-25 show comparisons of specific conductance and temperature in shallow and deep interval wells. Figure 2.1-19 shows that, for the wells in Biscayne Bay, TPGW-14 has the highest specific conductance values and the highest temperatures at depth. Figures 2.1-20 through 2.1-23 show changes across the landscape and include wells in Biscayne Bay and in the CCS, and wells farther inland. The figures illustrate how much higher the specific conductance and the temperatures are in CCS well cluster, TPGW-13, than in the other wells. The figures also show how the values generally decrease in wells with distance from the coast. Figure 2.1-24 shows plots of wells in proximity to the CCS. Figure 2.1-25 compares Biscayne Bay surface water specific conductance values and temperatures with the same parameters from Biscayne Bay groundwater. The plots show how much less the groundwater specific conductance values and temperatures fluctuate compared to surface water values. This indicates the buffering effects that groundwater has on surface water changes. The automated data observed between the Pre- and the Post-Uprate monitoring periods based on Figures 2.1-19 and 2.1-25 is similar.

2.2 SURFACE WATER QUALITY

2.2.1 Instrumentation and Data Collection Methods

Automated surface water quality stations were located throughout the Turkey Point landscape as determined jointly with the Agencies. Currently, all stations record water quality and stage data with the exception of Biscayne Bay stations TPBBSW-4 and TPBBSW-5, which record only water quality parameters, and TPSWCCS-6, which records water level. As previously stated, water quality parameter stations TPBBSW-1 and TPBBSW-2 have been eliminated for the Post-Uprate monitoring period. While a number of the sites that record surface water data have two probes (top and bottom), some have only one probe, depending on surface water depth and other considerations. When two probes are used at one location, one probe is placed near the surface and typically measures water quality parameters and pressure/water level (In-situ, Inc. Aqua TROLL® AT200 [AT200]) and the second probe is placed 1 ft from the bottom and measures water quality parameters (AT100). When only one probe is deployed at a location, it is generally placed approximately1 ft from the bottom. Table 2.2-1 summarizes the probes currently used at each surface water station and the parameters measured.

Similar to the groundwater sites, probe cables are attached to a telemetry system that uploads once a day for most sites (Figure 2.2-1). Currently, 28 probes (AT100s and AT200s) are deployed throughout the monitoring area, generating over 1 million data points each year.

Two of the current automated surface water quality sites in Biscayne Bay (TPBBSW-4 and TPBBSW-5) are not connected to a telemetry system for logistical reasons. Per the QAPP Plan (FPL 2013b), these probes are set up similar to the BNP salinity monitoring network stations (Biscayne National Park 2007) equipped with probes that record specific conductance and temperature just above the sediment surface. Rather than installing platforms or pilings, the probes are firmly attached to a cement paver/pad and are placed at pre-determined locations on the Bay bottom. The probes are swapped out approximately every six weeks and returned to the field office where they are cleaned and calibrated, and the data are manually uploaded into the online database.

2.2.2 Results and Discussion

The automated surface water data are qualified and validated in the same manner as the automated groundwater data. Appendix B shows the water quality field verification/calibration logs. Figures 2.2-2 to 2.2-23 show time series graphs of specific conductance and temperature at each surface water station. These graphs depict validated data and exclude data that have been qualified as questionable (?). Appendix C shows what data were qualified, while Appendix D shows time series graphs of the three parameters, but with all reported data. The time series graphs show data from the beginning of station reporting in 2010 (various dates depending on station startup) through May 2014. This shows the Pre-Uprate, the Interim Operating (in grey on figures), and the Post-Uprate monitoring periods. This entire time series display allows for a comparison between Pre- and Post-Uprate monitoring periods. Note that the salinity results for all surface water stations track the specific conductance results since salinity is calculated based on specific conductance and temperature. Thus, most of the discussion focuses on specific conductance and temperature. Similar to the groundwater data, FPL has included the raw time series data in separate Excel files with the report to facilitate closer review of the time series results by the Agencies and allow the adjustment of graphic scales to focus on a specific time interval.

Tables 2.2-2 through 2.2-4 show statistical summaries of the time series data for specific conductance, temperature, and salinity, respectively. Tables 2.2-2 and 2.2-3 include monthly average values for each monitoring station and all three tables include the minimum, maximum, average and standard deviations for the entire monitoring period. The salinity values are presented since readers often relate more directly to salinity than to specific conductance. For general comparisons, the tables also include the minimum, maximum, average and standard deviation for the Pre-Uprate monitoring period from June 2010 to February 2012, which were developed from the Comprehensive Pre-Uprate Report (FPL 2012). Figures 2.2-24 through 2.2-26 show the average value and standard deviation for specific conductance, temperature, and salinity, respectively, for the Post-Uprate period to facilitate a spatial visualization of the average automated surface water results. As previously discussed in the groundwater sections, care should be used when comparing the information in these tables and figures and when drawing conclusions between the Pre-and Post-Uprate periods. Statistical data have been included in separate Excel files with the report.

Compared to the groundwater time series graphs, the surface water time series graphs show greater variability in the data, most of which is related to seasonal and meteorological conditions. For example, in Biscayne Bay, the highest specific conductance values are near the end of the dry season and the lowest values are near the end of the wet season, with minimum and maximum values during the Post-Uprate monitoring period ranging from 23,315 µS/cm to 63,186 µS/cm. The specific conductance values have been increasing during this most current dry season (November 2013 to May 2014) and, by the end of May 2014, values were close to those observed at the end of the very dry season in June 2011 during the Pre-Uprate monitoring period. These May 2014 values equate to salinities throughout the project area in excess of 40 units on the practical salinity units (PSS-78) scale. Figure 2.2-27 compares surface water specific conductance values at Biscayne Bay stations. Station TPBBSW-10B (measured near the surface) continues to have the greatest variability as it is affected the most by surface water discharges from canals north of the area. TPBBSW-14 has at times exhibited fresher water compared to the Biscayne Bay surface water stations, but the specific conductance was similar to the other Biscayne Bay stations during the Post-Uprate monitoring. Figure 2.2-28 compares Biscayne Bay specific conductance values with CCS specific conductance values.

The most significant finding for surface water in the Post-Uprate period is the increase in specific conductance in the CCS compared to the Pre-Uprate and Interim Operating periods. Since June 2013, there has been a steady increase in specific conductance at the majority of the CCS stations with values by the end of May 2014 in excess of 120,000 µS/cm; the highest value of 123,743 µS/cm was recorded at TPSWCCS-3, which is located in the southwest of the CCS. The average specific conductance for the Post-Uprate monitoring period for all stations combined was 92,575 µS/cm. During the Pre-Uprate monitoring period, the minimum and maximum CCS specific conductance values ranged from 50,528 µS/cm (TPSWCCS-4B) to 93,594 µS/cm (TPSWCCS-6B), with the average specific conductance value for all sites combined being 76,727 µS/cm. The specific conductance at TPSWCCS-5 in the Post-Uprate period is sometimes lower than the other stations and while some of that might be attributed to influences from Biscayne Bay, duplicate readings from a probe in the stilling well and outside the stilling well do not always match (the measurements inside the stilling well are lower). Therefore, it is suspected that fouling of the openings in the stilling well may impact the readings and a higher percentage of the data in TPSWCCS-5 are qualified as estimated (E). While the specific conductance has increased in the CCS in comparison to the Pre-Uprate period, the specific conductance in Biscayne Bay is almost the same in the Pre- and the Post-Uprate periods (Figure 2.2-29). This figure shows specific conductance in the CCS and Biscayne Bay for equivalent time periods (January through May) during the dry seasons in 2011 (Pre-Uprate period) and 2014 (Post-Uprate period).

In the L-31E Canal stations (TPSWC-1, TPSWC-2, and TPSWC-3), the specific conductance values were predominantly reflective of freshwater; however, slightly more saline to brackish conditions, particularly at the bottom of the canal, were noted during several periods. This is the same regardless of whether the data are from the Pre-Uprate, the interim, or the Post-Uprate period. Figure 2.2-30 compares time series specific conductance and temperature values for the different surface water stations in the L-31E Canal. At the end of the dry season in April/May 2014, the specific conductance values spiked to 1,649 µS/cm at TPSWC-1B, 11,585 µS/cm at TPSWC-2B, and 18,295 µS/cm at TPSWC-3B. These levels at TPSWC-1 and TPSWC-3 are not as high as the levels recorded near the end of the very dry season in June 2011 during the Pre-Uprate period when maximum specific conductance values were 3,158 µS/cm (TPSWC-1B) and 22,776 µS/cm (TPSWC-3B). As discussed in the Comprehensive Pre-Uprate Report (FPL 2012), tritium concentrations were reviewed to help determine if the source of the higher specific conductance water in June 2011 was from the CCS or regional influences from Biscayne Bay. It was found that there was no incremental increase in tritium concentrations in any of the stations in the June 2011 data, which might indicate regional Biscayne Bay influences instead of a CCS influence. This may still be the case in the Post-Uprate period but cannot be confirmed until the tritium results are available.

The specific conductance values in the two tidal stations, TPSWC-4 and TPSWC-5, were more variable than the L-31E stations. TPSWC-4 is affected by releases from the S-20 structure and can transition quickly from saline to fresh conditions. On January 23, 2014, FPL installed a fixed weir downstream of TPSWC-4 and the site is no longer as tidally influenced. Towards the end of the dry season in 2014 (April/May 2014), the specific conductance at this station increased rapidly from around 20,000 µS/cm to values similar to those reported in Biscayne Bay during that period. TPSWC-5 reflects marine conditions and, during the Post-Uprate period, seemed to more closely follow specific conductance of nearby Biscayne Bay stations; however, values on occasion (most notably in the wet season) at the bottom are in excess of those found in Biscayne Bay. This phenomenon was most pronounced in the Pre-Uprate and Interim Operating periods. The water at TPSWC-5 is over 20 feet deep and is located at the end of this dead-end canal. The deep water depths and restrictions in flushing may contribute to the observed specific conductance values at this station.

The ID specific conductance values are affected by pumping of the ditch, which is conducted mostly in the dry season to maintain a seaward gradient between the L-31E Canal and the ID. During non-pumping periods, the water in the ID is fresh to brackish, but during periods of heavy pumping, the water becomes saline in the pumped segments. Specific conductance values in the ID were always below the values in the CCS and reflect a mixing of CCS water, freshwater, and Biscayne Bay water. Figure 2.2-31 compares time series specific conductance and temperature values for the different surface water stations in the ID. Figures 2.2-32 through 2.2-34 compare time series specific conductance and temperature values for the ID, the L-31E, and the CCS at ID operation transect A stations (TPSWID-1, TPSWC-1, and TPSWCCS-1), transect C stations (TPSWID-2, TPSWC-2, and TPSWCCS-7), and transect E stations (TPSWID-3, TPSWC-3, and TPSWCCS-3), respectively. The figures show that CCS specific conductance values are highest in the CCS and lowest in the L-31E. The figures also show the temperature difference between the water bodies as the CCS cools from transect A to transect C. Discussion of the ID operation is included Section 6 of this report.

Water temperatures at all stations are greatly affected by meteorological conditions and reflect seasonal trends as expected. In Biscayne Bay, average monthly water temperature in August 2013 was 30.1°C (based on the combined average of the Biscayne Bay Uprate monitoring stations). In January 2014, the average monthly Biscayne Bay water temperature was 20.8°C.

Comparatively, the average temperature in the CCS (based on the combined average of all the CCS Uprate monitoring stations) was 36.7°C in August 2013 and 29.2°C in January 2014. Water temperatures in the CCS are always higher than air temperatures and the other surface water station temperatures. Within the CCS, the water temperature varies based on location. The CCS water is pumped from the intake side of the plant and routed through condensers to cool the power units. As the water passes through the condensers, it is heated and eventually discharged on the west side of the plant back into the CCS. The water cools as it is routed through the CCS.

At TPSWCCS-1B (near plant discharge into CCS) and TPSWCCS-5 (on return canal to plant intake), the average Pre-Uprate temperatures were 39.2°C and 30.8°C respectively. In May 2014, these temperatures were 41.7°C (TPSWCCS-1B) and 32.3°C (TPSWCCS-5B). In comparison to the Pre-Uprate period, the average temperatures at TPSWCCS-1 and TPSWCCS-5 were 34.4°C and 27.3°C, respectively, and 35.7°C and 27.9°C, respectively, for May 2011. The range in temperatures varies monthly and CCS surface water temperatures are warmer in the summer months and cooler in the winter months. For example, in September 2013, the average monthly CCS water temperatures ranged from 41.6°C at TPSWCCS-1B to 33.6°C at TPSWCCS-5T. In January 2014, the average monthly CCS water temperatures ranged from at 34.3°C at TPSWCCS-1B to 26.0°C at TPSWCCS-5T. The increase in CCS surface water temperatures during the Post-Uprate period cannot be explained by the Uprate since the total heat rejection rate to the CCS from Turkey Point Units 1, 2, 3, and 4, operating at full capacity prior to the Uprate would have been higher than the Post-Uprate heat rejection rate to the CCS for Units 1, 3, and 4, operating at full capacity. Unit 2 has been dedicated to operate in a synchronous generator mode (i.e. not producing steam heat).

There are no temperature effects on Biscayne Bay from the warmer CCS waters; however, if there was an effect, it would most likely be evident during the cooler months. Figure 2.2-35 shows the water temperatures from December 2013 through May 2014 for representative Biscayne Bay stations used for the Uprate monitoring. Surface water temperatures from a SFWMD Biscayne Bay monitoring station several miles north of the site (BBCW-10) are included on this figure. Similar to the Pre-Uprate period, the Turkey Point Biscayne Bay monitoring stations during the Post-Uprate period track very closely with both the SFWMD station and the maximum air temperatures recorded at Homestead Air Force Base located approximately 4 miles northwest of Turkey Point. The figure also shows how much higher the CCS water temperatures are compared to the air temperatures and the Biscayne Bay water temperatures.

Figure 2.2-36 shows the information presented on Figure 2.2-35 in a different manner to enable a review of the differences in temperatures between the CCS and the Biscayne Bay stations and between the Biscayne Bay stations and the air temperatures. The maximum air temperature is used since the Biscayne Bay stations more closely follow the upper range of the daily air temperature. The figure shows that TPSWCCS-1 is consistently between 10°C and 15°C warmer than Biscayne Bay while Bay water temperatures are almost always slightly cooler than the maximum air temperatures. Air temperatures both drop and recover more quickly, and to a greater degree, than water temperatures. Thus, those cases where the Biscayne Bay temperatures are warmer than the maximum air temperatures reflect the effects of a quicker drop in air temperature in response to meteorological conditions. More importantly, however, differences between the northern "background" SFWMD surface water station (BBCW-10) and the ambient air temperatures follow the same pattern and are of a similar magnitude as the FPL Biscayne Bay station TPBBSW-3. These results, still suggest that air temperatures are driving water temperatures in Biscayne Bay and do not indicate any readily evident CCS water temperature effects in Biscayne Bay.

Water temperatures in the L-31E Canal (Figure 2.2-30) vary among stations but are collectively, on average, the same as the average of the Biscayne Bay temperatures for the Post-Uprate period. There is some temperature stratification in L-31, in part due to the canal depths and typically limited flow. The near-surface water temperatures are almost always warmer than the bottom temperatures, and the surface temperature exhibits more daily variability in response to air temperature changes. Over the past year, the lowest average bottom temperature was 25.7°C at TPSWC-1, and the highest average surface temperature was 27.2°C at TPSWC-3. There were no notable temperature differences between the Pre and Post-Uprate periods for the L-31E Canal stations.

The time series plots (Figure 2.2-31) show that there were periods when the bottom-water temperatures in the ID rose along with an increase in specific conductance in the ID. This is in response to pumping and the influence of the CCS. The findings between the Pre- and Post-Uprate period are similar. The presence of cooler and generally level water temperature was observed at the bottom of station TPSWID-2 during the wet seasons. This potentially reflects a greater groundwater influence at that time of year for this location.

The water temperatures in the two tidal canal stations (TPSWC-4 and TPSWC-5) were also affected by air temperatures, but TPSWC-4 was also affected by discharges from S-20. Generally, the surface water temperatures at TPSWC-4 were slightly higher than, or similar to, the bottom-water temperatures. The effects of the CCS, if any, were hard to differentiate due to the variables that could affect water temperature; however, the average temperature at TPSWC-4 (27.3°C) was noted during the Post-Uprate monitoring period as the highest of the non-CCS surface water stations, and the surface water temperatures are consistently higher than the nearby Biscayne Bay station TPBBSW-4. A recurring trend during the summer months shows that the water temperature at TPSWC-4 is sometimes lower than Biscayne Bay temperatures presumably due to stormwater discharges from S-20. The phenomenon reported in the Pre-Uprate period (FPL 2012) where the bottom temperature at TPSWC-5 was notably higher than the surface temperature for months at a time was not as evident in the Post-Uprate period.

2.3 WATER LEVELS

2.3.1 Instrumentation and Data Collection Methods

Water levels provide insight into groundwater hydrology and groundwater and surface water interactions; levels are collected at all groundwater and most surface water stations for the Uprate Project monitoring effort. Currently, only two water quality stations in Biscayne Bay do not have stage recorders.

Water pressures are currently measured at 1-hour intervals, and water levels are calculated from the pressure data. The results are typically transmitted on a regular basis via telemetry. LT500 and AT200 probes are used to record water pressure/levels. Further details on the probes, water level calculations, cleaning and calibration, and level setting procedures are discussed in the Comprehensive Pre-Uprate Report (FPL 2012).

2.3.2 Results and Discussion

2.3.2.1 Groundwater

Data validation and qualification of the automated water level data is a multi-step process and details can be found in the Comprehensive Pre-Uprate Report (FPL 2012) and the QAPP (FPL 2013b). Very little of the automated water level data was qualified during the Post-Uprate period and most qualifications were associated with overtopping of wells TPGW-3 and TPGW-12 during seasonally high tide events and TPGW-7 following very heavy rain/flooding events. The stage data are over 95% complete.

The accuracy of the land-based station survey is better than 0.1 ft and typically within hundredths of a foot. Well locations in the Bay may have a lower level of accuracy since those stations could only be surveyed with global positioning system (GPS) units. Thus, the survey accuracy limits should be considered when interpreting the results to hundredths of a foot or, in the case of the Biscayne Bay wells, to several tenths of a foot.

Figures 2.3-1 through 2.3-14 show time series graphs at all automated groundwater stations. These graphs are based on refined validated data and exclude data that are qualified as questionable or recorded during a cleaning/calibration event. Appendix C shows what data were qualified, while Appendix D shows time series graphs of the three parameters, but with all reported data. The time series graphs show data from the beginning of station reporting in 2010 (various dates depending on station startup) through May 2014. They show the Pre-Uprate, Interim Operating period (in grey on figures) and the Post-Uprate monitoring period. This entire time series display allows for a comparison between Pre- and Post-Uprate monitoring periods. To facilitate closer review of the time series results by the Agencies and to allow the adjustment of graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data in separate MSExcel files with the report.

Findings regarding groundwater levels presented in the Comprehensive Pre-Uprate Report (FPL 2012) are still valid for the Post-Uprate period. These findings include:

- Water levels change very quickly in response to rainfall events. This is most evident in stations not significantly influenced by tides (TPGW-1, TPGW-2, TPGW-4 through TPGW-9, and TPGW-13). Typically, where there is a spike in water levels on the time series graphs, there is a corresponding rainfall event.
- At each well cluster, fluctuations in stage for all three depth intervals track closely, indicating good hydrologic connection between intervals.
- Water levels at stations in or immediately adjacent to Biscayne Bay (TPGW-3, TPGW-10, TPGW-11, TPGW-12, and TPGW-14) exhibited tidal influence at all three depths (Figures 2.3-3, 2.3-10, 2.3-11, 2.3-12, and 2.3-14). The amplitude of the tidal changes decreases across the landscape from north to south. Thus, TPGW-10 has a larger range of water levels than TPGW-14.

- The stations that are freshest and located farthest from the coast (TPGW-7, TPGW-8, and TPGW-9) exhibit few water level differences among the shallow, intermediate, and deep wells (Figures 2.3-7, 2.3-8, and 2.3-9, respectively).
- Wells located between the westernmost wells and the CCS, such as TPGW-4 and TPGW-5, have brackish water in the intermediate and deep zones overlain by much fresher water in the shallow zone. The shallow zone water elevations in these wells are always higher than the deep zone (Figures 2.3-4 and 2.3-5).
- Closer to Biscayne Bay and the CCS, several well clusters have deep or intermediate zones with the highest elevation, such as TPGW-2. At this cluster, the deep and intermediate interval water levels often alternate between having the highest water level (Figure 2.3-2). During much of the Post-Uprate period, though, the water levels for these two zones were nearly the same.

One other observation made for the Post-Uprate period is as follows:

- While nearly all the wells clearly had their lowest recorded groundwater levels at the end of a very dry period in May/June 2011, TPGW-13 had the lowest water level readings of a single well in April/May 2014 during the Post-Uprate period.

To provide insight into the differences in groundwater water levels over the landscape, time series plots from select stations are illustrated on Figures 2.3-15 to 2.3-18. Each figure represents a transect of well clusters. Many of these figures are self-explanatory and support the discussion above. All the time series data that are reported reflect actual measured water levels and have not been converted to freshwater head equivalents.

To provide some initial insight into the groundwater and surface water interactions, Figures 2.3-19 through 2.3-21 illustrate the differences between surface water levels and groundwater levels in a nearby or co-located well(s) and where the densities in most wells and surface water stations are somewhat similar. Figure 2.3-19 shows a time series plot of surface water stage at TPSWCCS-2 and TPGW-13S. The results indicate that the water elevations at TPGW-13S are higher more often than at the corresponding surface water station in the CCS (TPSWCCS-2) during the Post-Uprate period except during May and June 2013 and May and April 2014 when the CCS water levels were higher. When looking over the entire time period, there appears to be a trend of the CCS water levels being higher than the groundwater at TPGW-13 during the dry season or near the end of the dry season.

Figure 2.3-20 shows surface water levels in the CCS and groundwater levels in several wells immediately to the west. Figure 2.3-21 shows daily average surface water levels in TPBBSW-3 and TPGW-11, which is in Biscayne Bay. The daily average eliminates the hourly tidal fluctuations and facilitates a visual comparison among these stations. The plot illustrates that the groundwater levels in the Bay stations are directly influenced by surface water stage and the groundwater elevation at TPGW-11S is the same as the average water level of the co-located surface water station.

2.3.2.2 Surface Water

Figures 2.3-22 through 2.3-39 show time series graphs at all surface water stations where data from automated stage recorders are available. These graphs are based on validated data and exclude data that are qualified as questionable or recorded during a calibration event when the log was running. Appendix C shows what data were qualified, while Appendix D shows time series graphs of the three parameters, but with all reported data. The time series graphs show data from the beginning of station reporting in 2010 (various dates depending on station startup) through May 2014. This shows the Pre-Uprate, Interim Operating (in grey on figures) and the Post-Uprate monitoring periods. This entire time series display allows for a comparison between Pre and Post-Uprate monitoring periods. All the time series graphs are based on actual levels and do not reflect freshwater head equivalents. In order to facilitate closer review of the time series results by the Agencies and allow the adjustment of graphic scales presented herein and/or focus on a specific time interval, FPL has included the raw time series data in separate Excel files with the report.

The precision and accuracy of the surface water levels, particularly associated with stations affected by wave activity, may be slightly lower than for groundwater stations. While wave activity is dampened in stilling wells, some oscillation occurs that can affect the ability to consistently get precise verification readings with a water level indicator. Some data end up being qualified as estimated if a verification reading is off by more than 0.1 ft when it may not need to be qualified. Also, the setting of the reference levels is affected by waves, which can cause inaccurate readings.

Findings regarding surface water levels presented in the Comprehensive Pre-Uprate Report (FPL 2012) are still valid for the Post-Uprate period. These findings include:

- Diurnal water level variations were observed at all tidally influenced stations, including those located in Biscayne Bay (north to south: TPBBSW-10, TPBBSW-3, and TPBBSW-14), as well as tidal canal stations (TPSWC-4 [until January 23, 2014 when a weir was constructed downstream] and TPSWC-5). The tidal range declines across the landscape from north to south (Figure 2.3-40). At TPBBSW-10, tide ranges during spring tide and neap tides can be over 2.0 ft and less than 0.5 ft, respectively.
- The effect of rainfall is masked in most tidal stations; however, its effect is evident at TPSWC-4 since this station is downstream of S-20 discharges. Rainfall effects are also evident on all onshore surface water stations where water level increases have been observed following significant rainfall events in L-31E, the CCS, and the ID.
- Water levels in the CCS vary spatially depending upon whether the station is located on the discharge or intake side of the canal. Water levels on the plant discharge side have lower ranges in variability (less than 1 ft at TPSWCCS-1) than stations on the intake side (up to 2 ft at TPSWCCS-6 (4 ft during Pre-Uprate)). Also, water levels on the discharge side of the CCS are typically at least 1 ft higher than those on the CCS plant intake side (Figure 2.3-41).

- Water levels in the CCS and L-31E exhibit little response to tidal influences in Biscayne Bay surface water. This suggests the hydrogeologic connection with Biscayne Bay is limited or not as direct as may have been expected.

2.4 METEOROLOGICAL DATA

One of the important parameters is the amount of precipitation in the CCS and surrounding areas. Rainfall timing, duration, and amounts provide some insight into the area's hydrology and the CCS water budget. Additionally, meteorological data such as barometric pressure, wind speed, and light levels (i.e., photosynthetically active radiation [PAR]) are useful in determining water losses and gains in the CCS and in establishing a water budget.

A meteorological station (TPM-1) was set up in the middle of the CCS, co-located with TPGW-13 and TPSWCCS-2. Four additional rainfall gauges were initially set up in the vicinity of the plant to determine the spatial and temporal variability in rainfall onshore and offshore proximate to the Turkey Point Plant; however, those gauges have been eliminated in favor of SFWMD NEXRAD rainfall data that are used for the water budget.

Additional rainfall data were also obtained from the on-site Turkey Point meteorological stations south of the CCS (LU-South), Homestead Air Force Base, SFWMD's S-20 gauge, and the NEXRAD data provided by the SFWMD. All these stations represent rainfall at the locations specified (Figure 2.4-1) with the exception of the NEXRAD data which is an integrated measure of rainfall in a radar cell that encompasses the CCS.

2.4.1 Instrumentation and Data Collection Methods

Meteorological station TPM-1 consists of a weather transmitter (WXT520, Vaisala Inc., Helsinki, Finland) and a quantum sensor (190SA, LI-COR Inc., Lincoln, Nebraska) attached to a datalogger (CR1000, Campbell Scientific Ltd., Logan, Utah) and telemetry system, mounted 15 ft above the ground surface; the range of parameters measured is listed in Table 2.4-1. Technical specifications on the instrumentation are provided in Appendix I of the QAPP (FPL 2013b).

Monitoring at TPM-1 has been nearly continuous since the station was activated on July 26, 2010. The only times that any components of the station were not operating was in 2013 when the anemometer was out from April 30 through June 26, 2013, and the relative humidity, pressure, and temperature sensors were out from June 11 through June 26, 2013. As a result, averages reported for the Post-Uprate period for most meteorological parameters do not include June 2013.

The data are now set to record at 1-hour intervals and data are uploaded via telemetry to the FPL database on a daily basis. During the Pre-Uprate period, data were uploaded at 15-minute intervals. Rainfall data from the LU-South, Homestead Air Force Base, and S-20 are also on hourly intervals while the NEXRAD data were provided by the SFWMD in monthly increments.

2.4.2 Results and Discussion

Rainfall and temperature (Figure 2.4-2), relative humidity and barometric pressure (Figure 2.4-3), wind speed and wind direction (Figure 2.4-4), wind gusts and speeds at lull (Figure 2.4-5) and PAR (Figure 2.4-6) for TPM-1 are shown for the entire period for comparative purposes.

Rainfall observed at TPM-1 during the Post-Uprate was significantly lower than the surrounding stations. During the Post-Uprate period, only 12.39 inches of rain were observed at TPM-1 (Table 2.4-2). Rainfall for June 2013 is not included since the station was not in operation the entire month. The highest rainfall was in July 2013 when 2.41 inches of monthly rainfall were recorded (Figure 2.4-2 and Table 2.4-3). In the Post-Uprate period, no rainfall days had recorded totals in excess of 1 inch in a calendar day (Table 2.4-3). The total monthly rainfall for each month from December 2013 through May 2014 was less than 1 inch. For comparison, Table 2.4-3 includes data for a portion of the Pre-Uprate period that covers an equivalent time period from June 2010 through May 2011. While the 2011 dry season (December 2010 to May 2011) was very dry and some of the lowest groundwater water levels were recorded at nearly all of the monitoring stations during this period, the rainfall in the 2014 dry season (December 2013 to May 2014) was even less. This is clearly a contributing factor to the increased salinity in the CCS in the Post-Uprate period. Additionally, during the wet season before this Post-Uprate period, there were no heavy rain events or high rainfall months to provide a source of freshwater.

To determine whether the rainfall reported at the CCS from July 2013 through May 2014 was representative of regional totals or was a localized phenomenon, rainfall that was collected at Homestead Air Force Base was checked. The results showed that 35.15 inches of rain occurred in the area from July 2013 through May 2014 (Weather Underground 2014), which is more than reported by TPM-1 for that same period (i.e., 12.39 inches). In the same time period, the NEXRAD (30.68 inches), LU-South (39.36 inches), and S-20 (35.09 inches) stations also reported more rainfall than at TPM-1.

Air temperatures (at 15 ft (5 meters) above ground) in the middle of the CCS at TPM-1 ranged from 2.8°C to 32.6°C for the period of record (Figure 2.4-2). The minimum temperature was observed on December 14, 2010, during the morning hours of a cold front passing through the area. The warmest temperature was observed on July 25, 2013, as the months of July through September are usually the warmest of the year (monthly average greater than 28°C). The average air temperature from July 2013 through May 2014 was 25.7°C, which is similar to the average air temperature reported from the Pre-Uprate period (average: 25.6°C).

Relative humidity at TPM-1 was an average of 74% during the period from July 2013 through May 2014. This is similar to the Pre-Uprate where the relative humidity was 72% (Figure 2.4-3). Humidity was generally highest after a rain event, and lowest after the passage of a cold front in the winter and early spring months.

The prevailing wind directions from July 2013 through May 2014 were from the east and east-southeast, i.e., predominantly onshore, which is similar to the Pre-Uprate period (Figure 2.4-7).

Average wind speed for this period, at 5 meters above ground, was 9.4 miles per hour (mph). The lull wind speeds averaged 4.6 mph, but several instances of strong wind gusts were observed, some in excess of 45 mph. Most of the wind was between 7-11 knots (41% of records), followed by 4-7 knots (28% of records) for the Post-Uprate duration; this was similar to the Pre-Uprate observations (7-11 knots: 44%; 4-7 knots: 26%) (Figure 2.4-8).