SOUTH FLORIDA WATER MANAGEMENT DISTRICT

# FPL Turkey Point Power Plant Groundwater, Surface Water, and Ecological Monitoring Plan

# EXHIBIT B

**South Florida Water Management District**
**Florida Department of Environmental Protection**
**Miami-Dade County Department of Environmental Resource Management**

**October 14, 2009**

sfwmd.gov

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# Acronyms and Abbreviations

| | |
|---|---|
| ALKA | Alkalinity |
| APT | aquifer performance test |
| BBAP | Biscayne Bay Aquatic Preserve |
| BBSW | Biscayne Bay Surface Water |
| BNP | Biscayne National Park |
| $B^{+-}$ | Boron ion |
| Ba | Barium |
| BACI | Before-After-Control-Impact |
| $Br^{-}$ | Bromide ion |
| bsl | below sea level |
| C | Carbon |
| °C | degrees Celsius |
| $^{12}C$ | Carbon isotope |
| $^{13}C$ | Carbon isotope |
| $Ca^{2+}$ | Calcium ion |
| $CaCO_3$ | Calcium carbonate |
| $Cl^{-}$ | Chloride ion |
| CCS | cooling canal system |
| CDMP | Comprehensive Development Master Plan |
| CERP | Comprehensive Everglades Restoration Plan |
| cm | Centimeter |
| COC | Conditions of Certification |
| CRP | continuous resistivity profiling |
| D | Deuterium |
| DERM | Miami-Dade County Department of Environmental Resource Management |
| DIC | dissolved inorganic carbon |
| DO | dissolved oxygen |
| DOAH | Department of Administrative Hearings |

| | |
|---|---|
| DOC | dissolved organic carbon |
| DOH | Department of Health |
| DOI | U.S. Department of Interior |
| DTS | distributed temperature sensing |
| EPA | U.S. Environmental Protection Agency |
| ESRI | Environmental Systems Research Institute |
| $F^-$ | Fluoride ion |
| F.A.C. | Florida Administrative Code |
| FDEP | Florida Department of Environmental Protection |
| FKAA | Florida Keys Aqueduct Authority |
| FPL | Florida Power and Light Company |
| fpd | feet per day |
| FWS | U.S. Fish and Wildlife Service |
| GIS | Geographic Information System |
| H | Hydrogen |
| $^3H$ | Tritium |
| $^2H$ | Deuterium |
| $HCO_3^-$ | Bicarbonate ion |
| ID | interceptor ditch |
| $K^+$ | Potassium ion |
| km | kilometer |
| LSC | liquid scintillation counting |
| M | meters |
| µm | micrometer |
| µS/cm | microsiemens/centimeter |
| MDL | maximum developable limit |
| $Mg^{2+}$ | Magnesium cation |
| mg/L | milligrams per liter |
| N | Nitrogen |
| Na | Sodium |
| NAD | North American Datum |
| NAVD | North American Vertical Datum of 1988 |
| NELAC | National Environmental Laboratory Accreditation Conference |

| | |
|---|---|
| $NH_3$ | Ammonia |
| $NH_4$ | Ammonium |
| NGVD | National Geodetic Vertical Datum of 1929 |
| NOAA | National Oceanic & Atmospheric Administration |
| $NO_x$ | Nitrate+Nitrite |
| NPS | National Park Service |
| NRC | Nuclear Regulatory Commission |
| NSF | National Science Foundation |
| O | Oxygen |
| $^{16}O$ | Oxygen isotope |
| $^{18}O$ | Oxygen isotope |
| ORP | oxidation-reduction potential |
| P | Phosphorus |
| pCi/L | Picocuries per liter |
| pH | potential of hydrogen |
| ppm | parts per million |
| PSS78 | Practical Salinity Scale of 1978 |
| psu | practical salinity units |
| PVC | Polyvinyl chloride |
| QA/QC | Quality Assurance/Quality Control |
| RECOVER | Restoration Coordination and Verification |
| RTK | Real-time Kinematic |
| $\delta^{13}C$ | stable carbon isotope |
| $\delta^{15}N$ | stable nitrogen isotope |
| SAV | submersed aquatic vegetation |
| SFWMD | South Florida Water Management District |
| $SiO_4$ | Silicate |
| $SO_4^{2-}$ | Sulfate anion |
| Spp | species (plural) |
| SPT | standard penetration test |
| $Sr^{2+}$ | Strontium |
| $SR^{86}$ | Strontium isotope |
| $SR^{87}$ | Strontium isotope |

| | |
|---|---|
| (SRP)[c] | soluble reactive phosphorus |
| TDS | total dissolved solids |
| TOC | total organic carbon |
| (TP)[c] | total phosphorus |
| TKN | Total Kjeldahl nitrogen |
| TPGW | Turkey Point groundwater |
| USACE | U.S. Army Corps of Engineers |
| USGS | U.S. Geological Survey |

# 1
# Introduction

This Monitoring Plan (Plan) has been developed pursuant to Conditions of Certification (COC) IX and X of the Power Plant Site Certification for the Florida Power & Light (FPL) Turkey Point Units 3 and 4 Nuclear Power Plant Unit Combined Cycle Plant PA 03-45A2 (Uprate Certification). COC IX and X are attached hereto as **Appendix A**. In addition, this Plan identifies monitoring required under the "Fifth Supplemental Agreement between the South Florida Water Management District and Florida Power and Light Company" (Fifth Supplemental Agreement or 2009 Agreement). The Plan is incorporated into and made a part of the 2009 Agreement as Exhibit B.

This Plan, and any resultant actions by the Agencies and FPL, is being conducted in order to satisfy the objectives of the 1983 Agreement, the Fifth Supplemental Agreement, and the COCs.

The Plan incorporates contributions from the Florida Department of Environmental Protection (FDEP), the South Florida Water Management District (SFWMD), and Miami-Dade County's Department of Environmental Resources Management (DERM), (collectively, the Agencies), and FPL. The following Federal entities are contributing to the development and implementation of the Plan: Everglades National Park (ENP) and Biscayne National Park (BNP).

The Monitoring Plan shall provide information to determine the vertical and horizontal effects and extent of the cooling canal system (CCS) water on existing and projected surface and groundwater, and ecological conditions surrounding Turkey Point (see **Figure 1-1**). The CCS is hypersaline. There shall be a minimum of two years of monitoring of surface water, groundwater, and ecological conditions prior to the first of either Unit 3 or 4 becoming operational (defined as pre-Uprate). Monitoring shall be continuous from this pre-Uprate period throughout commencement of the Uprate (defined as post-Uprate when both Units 3 and 4 operational). Monitoring under the Plan shall continue pursuant to the 2009 Agreement and the Conditions of Certification. Prior to and following the commencement of the Uprate period, data shall be collected including monitoring for ground and surface water levels, specific conductance, temperature, CCS tracer suite constituents, tidal influences, preferential groundwater flow paths, surface and groundwater quality (including CCS constituents), rainfall, any other information necessary for the water budget, and ecological conditions.

During the pre-Uprate period, FPL shall exercise due diligence, as defined below, and due care to perform its obligations under the Plan in a timely manner. If a Force Majeure Event,

as defined below, or an unforeseen permitting delay, beyond FPL's control and FPL has pursued the permit with due diligence, as explained below, occurs causing a delay in any portion of this Plan, the Turkey Point 3 and 4 Uprate will not be delayed.

If FPL anticipates a delay in implementation of any part of this Plan due to a Force Majeure Event or an unforeseen permitting delay outside FPL's control and FPL has pursued the permit with due diligence, within fourteen days of becoming aware of such event, FPL shall notify the SFWMD in writing of the anticipated length and cause of the delay, demonstrate that such delays are due to a Force Majeure Event or outside FPL's control, and identify the probable impact on FPL's performance, the measures taken or to be taken to prevent or minimize the delay and the time table by which FPL intends to implement these measures. Any portion of the Plan that is delayed shall not cause delays in any other unrelated portion of the Plan.

FPL shall exercise commercially reasonable due diligence to overcome the Force Majeure Event. To the extent it is able, FPL shall continue to perform under this Agreement and cause the suspension of its performance to be of no greater scope and no longer duration than the Force Majeure Event requires.

However, if FPL is not able to produce two years of monitoring data due to situations beyond its control despite FPL's exercise of due diligence and due care in the timely implementation of this plan, the Agencies shall reserve the right to evaluate the data collected to date and determine if it is sufficient to establish the pre-Uprate baseline condition.

When FPL is able to resume performance of its obligations under this Agreement, it shall immediately give SFWMD written notice to that effect and shall resume performance under this Agreement after the notice is delivered.

"Force Majeure Event" shall mean any event outside the control, and not the fault, of FPL that cannot be avoided or overcome by the exercise of due diligence, including but not necessarily limited to: an act of God, war, flood, lightning, fire, hurricane, tornado, explosion, civil disturbance, or the public enemy, terrorist act, military action, epidemic, work-to-rule action, go-slow or similar labor difficulty, each on an industry-wide, region-wide or nationwide basis; but does not include economic hardship, changes in market conditions, insufficiency of funds, or unavailability of equipment or supplies.

"Due diligence" in FPL's permitting applications means that: a) FPL submitted the permit application in sufficient time for the permitting agency to act on the application and for FPL to complete the project for which the permit is necessary in order to obtain a minimum of two years of pre-Uprate data for a sufficient baseline of data; b) FPL responded in a reasonable time to requests for information needed by the permitting agency to process the application or prepare any necessary environmental analysis; and c) FPL took practicable steps to ensure completion of the project as expeditiously as possible after issuance of the permit.

FPL maintains all rights it may have under Chapter 120, Florida Statutes (F.S.). However, nothing in this Plan is intended to create, modify, or expand FPL's rights it may have under Chapter 120, F.S., or under Chapter 403, Part II, F.S. FPL maintains its right to request a proceeding under Chapter 120, Florida Statutes, to challenge any proposed or final agency action taken in implementing this monitoring plan that affects FPL's substantial interests. This specifically includes the right of FPL to file a petition requesting a formal or informal administrative hearing pursuant to Section 120.569 and 120.57, Florida Statutes. The terms of the Plan do not limit any existing regulatory authority the individual Agencies have over FPL or its Turkey Point facility. The SFWMD and the FDEP have concurrent jurisdiction to determine impacts, harm or potential harm, require or allow Plan modifications, require or allow Plan termination, and require compliance as indicated in the Conditions for Certification or the Agreement.

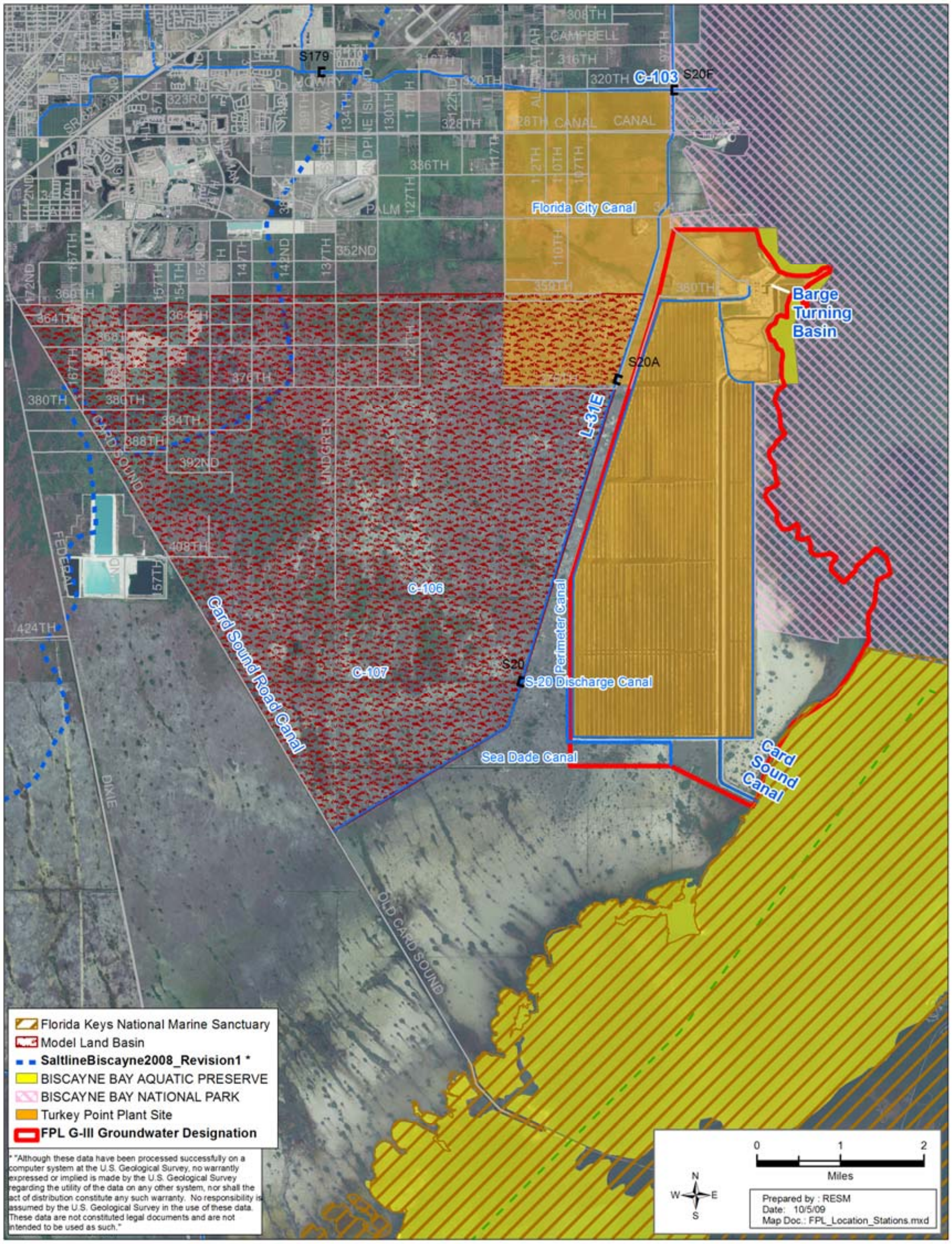


**Figure 1-1**. Turkey Point and surrounding area.

## 1.1 ADAPTIVE MONITORING APPROACH AND PLAN MODIFICATIONS

The development of this Plan was based on limited available hydrologic and ecological information. The intent of the adaptive monitoring approach is to streamline completion of the objectives related to the identification and monitoring through time of the CCS water tracers, state and county water quality constituents, water budget, and ecological effects. The adaptive monitoring approach includes the potential expansion or reduction of monitoring elements based on the findings of previous steps. Any party can propose enhancements or decreases in monitoring, however, such proposal by any party shall not be implemented without approval of the lead Agency (SFWMD).

Modification of the Plan may be proposed at any time either by the FDEP, SFWMD, DERM, or FPL. Any modification shall be approved/denied by FDEP or SFWMD, as applicable, after consultation with DERM. These procedures for Plan modification are in addition to any other regulatory enforcement authorities of the Agencies (FDEP, SFWMD, and DERM).

FPL shall implement Plan modifications within the timeframes established by the Agencies. Plan modifications during the pre-Uprate monitoring period shall be implemented expeditiously in light of the limited monitoring timeframes before the Uprate is operational.

Minor field changes, such as movement/adjustment of monitoring stations or locations over short distances, due to logistical constraints or to optimize monitoring, may be initiated after Agency approval by telephone during Plan implementation. If the adjustment is deemed more significant, SFWMD may require a written request be made prior to the modification and technical information be provided before the adjustment is made. The SFWMD shall make decisions promptly to avoid delays.

# 2
# Monitoring Plan

## 2.1 MONITORING DESIGN STRATEGY

The Plan consists of an integrated system of surface, groundwater, porewater, and ecologic sampling. New monitoring wells shall be installed and a hydrogeologic investigation and surface and groundwater monitoring shall be conducted. All stage recorders and groundwater wells (top of casing) shall be referenced as described in **Appendix C** to allow comparison of results across the landscape and at depth. Where available or possible, data collected by other entities will be used to further enhance the understanding of baseline conditions and help determine impacts or potential impacts. Ecological monitoring shall be initiated in areas of presumed stress, along transects, and for spatial characterization.

The approach for monitoring of existing conditions at the FPL Turkey Point Power Plant (plant) and adjacent environments is to determine the relationship of CCS water and: a) the underlying groundwater in all directions; b) the freshwater wetlands and nearby canals, c) the adjacent saltwater wetlands; d) the eastern mangrove shoreline; e) the Biscayne Bay littoral zone; and f) within Biscayne Bay and Card Sound. The tracking of the CCS water movement is proposed using a combination of automated monitoring, along with manual data collection of water constituents and tracers of CCS water (discussed in Section 2.4).

The exact monitoring locations, as depicted in maps in the subsequent sections, may need to be adjusted based on access, environmental considerations (i.e., wetland and estuarine impacts), or other findings that warrant placement in alternative locations. The final locations of all sampling sites shall be approved by the Agencies prior to placement.

The monitoring area shall include the CCS and surrounding areas, as shown in **Figure 1-1**. Portions of the Florida Keys National Marine Sanctuary, Biscayne Bay Aquatic Preserve (BBAP), Biscayne National Park (BNP), and the Model Land Basin are also included.

### 2.1.1 Landward Delineation of Groundwater Plume

For groundwater beneath land (defined as being landward of the mean high water line), the vertical (to the base of the Biscayne aquifer) and horizontal extent of the plume will be determined by State and County groundwater quality standards and the CCS tracer suite, as determined by the Agencies.

The plume will be delineated starting from the CCS and continue landward if State or County groundwater quality standards are exceeded and one or more of the tracer suite values are above background, unless the Agencies agree expanded landward delineation is not necessary.

However, if at a given location, one or more of the tracer suite values are above background, but groundwater quality concentrations are lower than State and County standards, but projected to increase above those standards, continued monitoring will be required and potentially expanded to determine the zone of plume movement, as determined by the Agencies.

### 2.1.2 Seaward Delineation of the Groundwater Plume

For the purpose of groundwater plume delineation within and beneath Biscayne Bay and Card Sound (seaward of the mean high water line), monitoring will be conducted as described in the Plan. Criteria for seaward delineation shall be identified by the Agencies based on an evaluation of all available data, including initial monitoring conducted for a minimum of one year.

## 2.2 PARAMETER SUITE

Required parameters are listed in **Table 2-1** and described in the following sections of this monitoring plan: Sections 2.3.4 Groundwater Sampling; 2.4 CCS Monitoring; 2.5.2 Surface Water Collection; 2.6 Water Budget and Mass Balance Calculations; and Section 2.8 Ecological Monitoring.

### 2.2.1 Tracer Suite

For the purpose of identifying the vertical and horizontal extent of the CCS plume, the delineation methodology shall be based, in part, on the finding of tracer values above those which would not be present in the environment, except for a contribution of water from the CCS. The tracer shall be used to identify water originating from the CCS and differentiate it from water from other sources. A subset of the analytical parameters is collected for purposes of identification of a tracer suite. The final tracer suite shall be identified by the Agencies based on all available data, including initial monitoring data collected during a minimum of one year. Samples shall be collected quarterly at each surface and groundwater monitoring station.

At the end of the initial monitoring period, which is a minimum of one year, FPL shall submit a report to present its findings (to include raw data) regarding potential tracer monitoring parameters (tracer suite) to be used in future tracer monitoring in accordance with the reporting requirements, as specified in Section 3. The Agencies shall identify the tracer suite, applicable detection levels, background levels, and any recommended changes (i.e., increases/decreases) in sampling sites and sampling frequency. If at the end of the first

year of monitoring the Agencies determine that additional tracer monitoring parameters are needed to better assess the adequacy of specific tracers, the Agencies may require additional monitoring.

These tracer monitoring parameters are separated into three different categories and include, but are not limited to:

1. Stable Isotopes: this group includes the oxygen isotopes of water ($^{18}O/^{16}O$), hydrogen isotopes of water (D/H), strontium ($Sr^{87}/Sr^{86}$), and stable isotopes of carbon ($^{13}C/^{12}C$) in the dissolved inorganic carbon (DIC) in water.
2. Radioactive Isotopes: tritium ($H^3$).
3. Ions: listed in **Table 2-1**, plus Barium (Ba) and Iron (Fe).

The FDEP's drinking water standard for concentrations of tritium in groundwater is 20,000 pCi/L. The Agencies and FPL recognize that the concentrations of tritium from the CCS water are expected to fall below the regulatory standard used to identify the potential for human health concerns. Accordingly it is mutually understood tritium is being monitored only as a potential tracer for identifying contributions of CCS water as a source. According to the FDEP, pursuant to Chapter 62-520 and 62-550, F.A.C., the presence of tritium below 20,000 pCi/L in water does not represent a public health and safety issue.

Sample collection and analytical methodologies for potential tracer suite monitoring parameters and interpretation of tritium results are presented in **Appendix E**.

**Table 2-1**. Required parameters for groundwater/surface water characterization.

| | |
|---|---|
| **Field Parameters[c]** | |
| Temperature (T)<br>Specific Conductance (conductivity at 25°C) in µS/cm<br>Dissolved Oxygen (DO)<br>Percent Oxygen Saturation | pH<br>Oxidation-Reduction Potential (ORP)<br>Salinity using the Practical Salinity Scale of 1978 (PSS78) |
| **Laboratory Parameters** | |
| CCS tracer suite [c]<br>Hydrogen ($^{3}H$, $^{2}H$) [Tritium, Deuterium] [d]<br>Oxygen ($^{18}O$, $^{16}O$)<br>Barium (Ba) | Strontium ($^{87}Sr/^{86}S$)<br>Carbon ($^{13}C$,$^{12}C$)<br>Dissolved Inorganic Carbon (DIC)<br>Total Iron |
| Ions[c]:<br>Calcium ($Ca^{2+}$)<br>Sodium ($Na^{+}$)<br>Magnesium ($Mg^{2+}$)<br>Potassium ($K^{+}$)<br>Strontium ($Sr^{2+}$)<br>Chloride ($Cl^{-}$)<br>Bromide ($Br^{-}$)<br>Sulfate ($SO_4^{2-}$)<br>Fluoride ($F^{-}$)<br>Bicarbonate ($HCO_3^{-}$)<br>Boron ($B^{+}$)<br>Alkalinity (ALKA) Alkalinity as $CaCO_3$<br>Sulfides | Nutrients:<br>Ammonia ($NH_3$)[c] – calculated as $NH_3$<br>Ammonium ($NH_4^{+}$) as N[c]<br>Nitrate+Nitrite ($NO_X$) as N[c]<br>Total Kjeldahl Nitrogen (TKN)[c]<br>Total Nitrogen (TN)[c] – calculated<br>Total Phosphorus (TP)[c]<br>Soluble Reactive Phosphorus (SRP)[c]<br>Silicate[a] |
| Total Dissolved Solids (TDS)[b] | Other:<br>Gross Alpha[a] |
| Trace Elements[b]:<br>Arsenic<br>Barium<br>Beryllium<br>Cadmium<br>Chromium (Hexavalent Chromium)<br>Copper<br>Iron<br>Lead | <br>Mercury<br>Manganese<br>Molybdenum<br>Nickel<br>Selenium<br>Thallium<br>Vanadium<br>Zinc |

[a] Surface water CCS only.
[b] Groundwater only.
[c] Both surface and groundwater.
[d] At this time, it is FPL's position that tritium is not a suitable tracer.

## 2.3 GROUNDWATER MONITORING

The purpose of groundwater monitoring is described in COC IX and X of the Uprate **Appendix A** and the 2009 Agreement.

### 2.3.1 Groundwater Monitoring Well Locations

Fish and Stewart (1991) showed that the base of the Biscayne aquifer was approximately 106 feet below sea level (bsl) at the G-3321 well location, adjacent to the northwestern portion of the CCS and the L-31E Canal (**Figure 2-1**). The base of the Biscayne aquifer at G-3321 is shown within a few feet of the contact between overlying limestone with relatively high hydraulic conductivity [>1,000 feet per day (fpd)] and underlying sandstone with relatively low hydraulic conductivity (10 to 100 fpd) within the Tamiami Formation. The USGS is developing the hydrostratigraphic framework of the Biscayne aquifer system for Miami-Dade County (Cunningham et al 2004, 2006a, 2006b, 2008).

Based on input with the Agencies, a series of groundwater monitoring stations shall be installed. A total of 14 well clusters are included, as shown in **Figure 2-1** and **Table 2-2**. These well clusters are spatially distributed to facilitate plume monitoring and are generally aligned along transects to aid in determining concentration gradients on a sub-regional scale. The exact installation locations may need to be adjusted based on site-specific conditions (e.g., access considerations, minimization of environmental impacts) or permitting constraints.

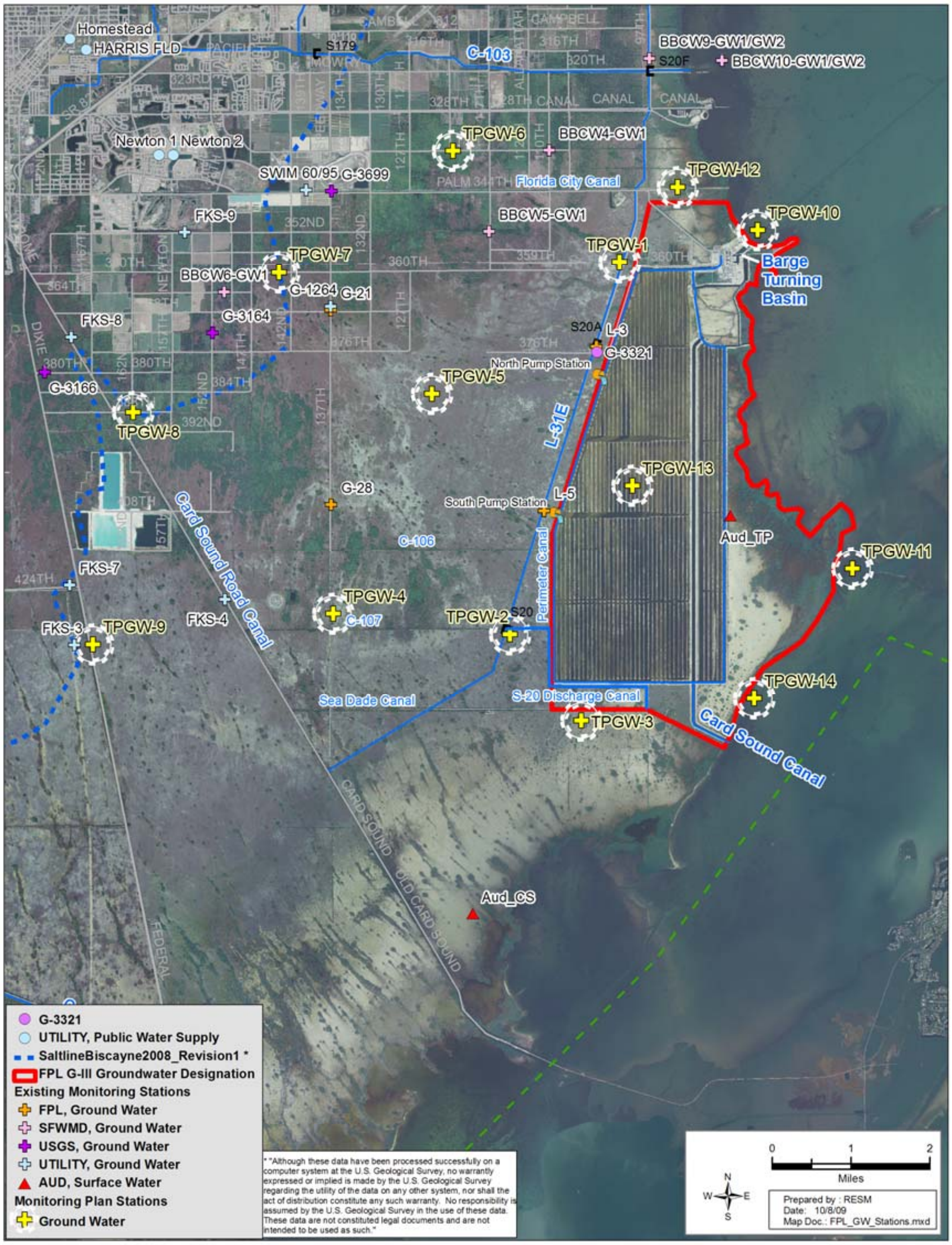


**Figure 2-1**. Groundwater well cluster locations.

**Table 2-2**. Rationale for the groundwater monitoring locations. All locations are approximate until field verification.

| Location | Rationale |
|---|---|
| Groundwater stations will establish baseline conditions and delineate limits of the CCS plume. A cluster of three groundwater monitoring wells at each location will enable sampling from macroporous-permeable zones. | |
| TPGW-1 | Monitor west/northwest of L-31E |
| TPGW-2 | Monitor west of the south-central portion of the CCS |
| TPGW-3 | Monitor south of the CCS |
| TPGW-4 | Monitor westward of the CCS |
| TPGW-5 | Monitor westward of the CCS |
| TPGW-6 | Monitor northwest of the CCS |
| TPGW-7 | Monitor west of the CCS and northwest of TPGW-5. Nearest well cluster to Newton Wellfield. |
| TPGW-8 | Monitor west of the CCS and northwest of TPGW-4 |
| TPGW-9 | Reference Well |
| TPGW-10 | Monitor offshore north of the entrance to the barge turning basin |
| TPGW-11 | Monitor offshore of the CCS in Biscayne Bay |
| TPGW-12 | Monitor north of the CCS |
| TPGW-13 | Site is located in the approximate center of the CCS to monitor below the source area of the hypersaline plume. |
| TPGW-14 | Monitor offshore of the CCS in Biscayne Bay |

### 2.3.2 Groundwater Monitoring Well Installation

Each monitoring well cluster shall be completed with discrete screen intervals in the upper, middle, and lower portions of the Biscayne aquifer. No monitoring zone shall be placed below the Biscayne aquifer system and at least one monitoring zone shall include the base of the plume within the Biscayne aquifer system. To accomplish this task, a pilot hole shall be advanced at each cluster site to delineate to the base of the Biscayne aquifer and characterize the aquifer's characteristics and water quality. FPL shall conduct detailed geological sampling in the pilot hole of each cluster. Geological sampling of each pilot hole shall include continuous split spoon samples using the standard penetration test (SPT), in accordance with ASTM standards, and/or core sample collection from surface to total depth. Core samples shall be collected when SPTs are refused. Detailed geological samples shall be correlated to the downhole borehole videos in the final geological report.

Well development shall be conducted on all pilot holes prior to optical borehole imaging and all monitoring wells until clear, sand-free water is obtained and field parameters stabilize in accordance with FDEP criteria.

Monitoring well screen intervals shall be site-specific and shall represent macroporous and relatively high-permeability zones of the upper, middle, and lower Biscayne aquifer based on the combined results from optical borehole imaging (oriented camera system),

electromagnetic induction, caliper, flow, specific conductance, temperature, gamma ray, full wave form sonic, and borehole logging of the deepest hole (**Table 2-3**). If hydrogeologic testing of the flow intervals is not conducted at the time of well construction, such testing and data shall be provided, as determined by the Agencies, to evaluate the hydraulic conductivity of each screened flow zone in conjunction with any future model efforts.

Agency representatives shall be allowed onsite to observe field activities and shall be provided copies of field generated data upon request. The SFWMD representative(s) will pre-approve well screen intervals in the field prior to well construction. FPL shall notify SFWMD representatives in writing at least 14 calendar days, or less if agreed to by the SFWMD, before initiating well construction. If the SFWMD is notified in a timely manner and determines that no SFWMD representative will be present, FPL may proceed with the subject well construction without the SFWMD attending.

In addition, the deepest well at each cluster shall be constructed to facilitate once a year induction logging across the entire vertical extent of the well. Based on initial induction log results, a subset of wells may be selected by the Agencies for semi-annual logging. This will enable the monitoring of conductivity changes within the Biscayne aquifer and potential migration of the plume, even in zones that are not screened. Once installed, the network of wells shall be horizontally and vertically surveyed to second order accuracy and referenced to both NGVD and NAVD (**Appendix C**). **Appendix D** presents well construction requirements, which will facilitate electromagnetic induction logging.

**Table 2-3**. Borehole logging methods, descriptions of the properties measured, and types of data obtained.

| Type of Log | Properties Measured | Purpose |
|---|---|---|
| Optical borehole imaging (OBI) | Imaging of borehole | Determines the 360-degree image of borehole and identifies borehole condition and macroporous zones. Provides an oriented optical image of the borehole that compensates for tool spinning. |
| Electromagnetic Induction | Formation and fluid conductivity | Provides data on specific conductance within fluid and formation around the borehole. |
| Caliper | Borehole diameter | Borehole diameter; determines presence of voids and cavities. |
| Flow | Flow rate | Identifies zones of groundwater flow within borehole. |
| Temperature | Fluid temperature | Determines temperature variations across depth within borehole. |
| Gamma Ray | Rock sediment gamma radiation | Provides information on formation characteristics, including rock types and changes in lithology. |
| Full Wave Form Sonic | Lithology and porosity of formation | Provides information on presence and location of potential preferential flow paths. |

A well construction spreadsheet supplied by the SFWMD shall be constructed and maintained. The spreadsheet shall include the following parameters: drilling method, geologic sampling method, drilling mud used, well installation date, latitude, longitude, state planar, muck (ground) elevation, ground surface elevation, measuring point at top of casing, depth from top of casing, depth at top of screen, screen length, well construction material, screen slot size, gravel pack at screen interval, elevation at top of well screen, elevation at bottom of well screen, centralizers used, project manager, and the source of well information.

Data collected during well installation, including geological sampling (i.e., coring or SPTs), detailed lithologic logs, borehole geophysics, digital optical logs, initial induction logs, temperature and flowmeter logs, field water quality data, and well construction details shall be compiled and submitted to the Agencies within 60 days of completion of each well. In addition, a summary of well drilling procedures, geophysical logging procedures, and instrumentation used shall be provided. Based on wells installed from this monitoring effort and other subsurface geologic data, scaled geologic cross-sections, including macroporosity zone and geophysical log overlays, shall be generated and included in the report. This includes information from the induction logs that reveal zones of saline water. In addition, a plan view map showing the location of significant features shall be included. The information generated from this report will enable a better understanding of the movement of groundwater in the area and will provide the basis for interpretation of tracer and water quality monitoring.

### 2.3.3 Biscayne Bay Geophysical Survey

Broad-scale estimates of specific conductance and temperature of waters potentially influenced by the CCS are needed to assess the spatial extent and magnitude of this influence (including the identification of potential groundwater upwelling zones) and provide information to improve the monitoring design within the adaptive protocols of this Plan. Electromagnetic resistivity surveys can provide such broad-scale salinity estimates for both surface water and groundwater (Fitterman and Desczcz-Pan 2001; Swarzenski et al. 2006).

A boat-based electromagnetic resistivity survey shall be made over Biscayne Bay (south of the latitude of the Mowry Canal) and over Card Sound. The geophysical investigation shall be performed using a combination of continuous resistivity profiling (CRP) and distributed temperature sensing (DTS) investigation. GPS technology shall be used to establish horizontal control of the geophysical survey locations. Since water has different degrees of resistivity, a CRP survey can provide both horizontal and vertical insight of saline versus fresh versus hypersaline water. A DTS survey can provide a continuous profile of temperature over a large distance with a high degree of resolution. Its use is based on distinguishing temperature contrasts between groundwater, surface water, and potentially warmer CCS water. Relatively fine-scale tracks (less than 1 km apart) shall be made parallel from shoreline to 4 km east of the shoreline, from Card Sound Road to the Mowry Canal. South of this area, the remaining area of Biscayne Bay and Card Sound shall be coarsely surveyed with at least three transects that cross these bays eastward to Key Largo, Old

Rhodes Key, and Elliott Key. An additional track shall be made long-shore of these Keys at the eastern boundary of Biscayne Bay and Card Sound, between the southern end of Card Sound and the latitude of the Mowry Canal. The CRP survey shall be conducted from a boat with readings collected along transects. A DTS cable shall also be deployed on a grid pattern with data collected for at least two tidal cycles along the same transects. The logs of the well boreholes will be used to calibrate the results. Thus, the survey shall be initiated within three months after the Biscayne Bay wells are installed (Section 2.3.2). All available specific conductance and salinity data from the surveyed terrestrial and estuarine areas shall be used to provide the best estimates of salinity based on resistivity values.

Additional geophysical surveys may be required over the wetlands or bays in a later phase of this monitoring program to update estimated groundwater salinity distributions.

### 2.3.4 Groundwater Sampling

Each station shall comprise a combination of three monitoring wells at each site, designed to evaluate the extent of CCS influence and to determine hydraulic gradients (i.e., vertical and horizontal) with specific focus on macroporous hydrogeologic zones. Each monitoring well shall be instrumented and automatically monitored for groundwater levels, temperature, and specific conductance. The sensors in the monitoring wells shall be placed near the midpoint of the screened section of each well. Salinities measured by sensors shall be calculated using the PSS78.

Quarterly monitoring at each groundwater cluster shall consist of field parameters, ions, TDS, and the CCS tracer suite, as listed in **Table 2-1**. Semiannual monitoring at each groundwater cluster shall consist of all of the above, plus the nutrient parameters in the groundwater clusters (1, 2, 10, 13, and 14) labeled in **Figure 2-1**. In addition, trace elements shall be monitored semiannually for one year in the groundwater clusters (1, 2, 10, 13, and 14). If trace element concentrations exceed primary and secondary drinking water standards in groundwater samples, monitoring for these parameters shall continue and may be expanded to other stations as determined by the Agencies. All applicable samples shall be analyzed in accordance with Chapter 62-160 F.A.C. at an FDEP-approved laboratory capable of analyzing samples with a wide salinity range (including hypersaline waters).

FPL shall continue to manually collect all quarterly data (from two depths) from the existing wells L-3, L-5, G-21, G-28, and G-35 to compare the information with the new wells, which are more strategically screened. Since there are over 30 years of data from these existing wells, a comparison of the information to nearby wells shall give insight into the accuracy of the historical data. Previously, these wells were monitored quarterly with field instruments. While temperature, specific conductance, and water level shall continue to be monitored with field instruments, samples shall be collected and sent to a laboratory for analysis of the same parameters that shall be the subject of monitoring in the new wells.

To further supplement the groundwater data being collected by FPL, information collected by others, including but not limited to USGS and the FKAA, may be used upon the

Agencies' pre-approval. The Agencies will review each proposed well's applicability to the Plan based on geologic data and construction details submitted. Currently, the USGS collects chloride data on a semiannual or quarterly basis and conducts induction logs once a year from a network of coastal wells throughout Miami-Dade County. In some cases, there are only a few years of data, and in other cases, over 30 years. Some of these wells are located in the project area and are screened near the base of the Biscayne aquifer.

## 2.4 CCS MONITORING

The purpose of sampling within the CCS is to characterize the water. A total of seven stations are included, six along the interior boundary of the CCS, and one in the central portion of the CCS. These stations, labeled TPSWCCS-1 to TPSWCCS-7, are located both at the edge and the middle of the CCS system, as well as in the areas that are of the highest and lowest stage. These data shall provide a clear spatial and temporal understanding of the specific conductance and temperature variability within the CCS (**Figure 2-2** and **Table 2-4**).

All stations in the perimeter canals shall have a specific conductance, temperature, and depth sensor placed approximately 1 foot below the surface level, and one approximately 1 foot above the bottom of the canal. Stations in shallow water (<3 feet) shall use one water quality sensor. The site in the center of the CCS (TPSWCCS-2) shall only have one sensor approximately 1 foot above the bottom of the canal; a second sensor is not warranted due to this center canal's shallow depth (~3 feet). Sensors shall monitor for temperature and specific conductance (salinity calculated from specific conductance and temperature), which will help determine the vertical profiles in the CCS canals. Water level shall be measured at each station with a fixed sensor that is surveyed as described in **Appendix C**.

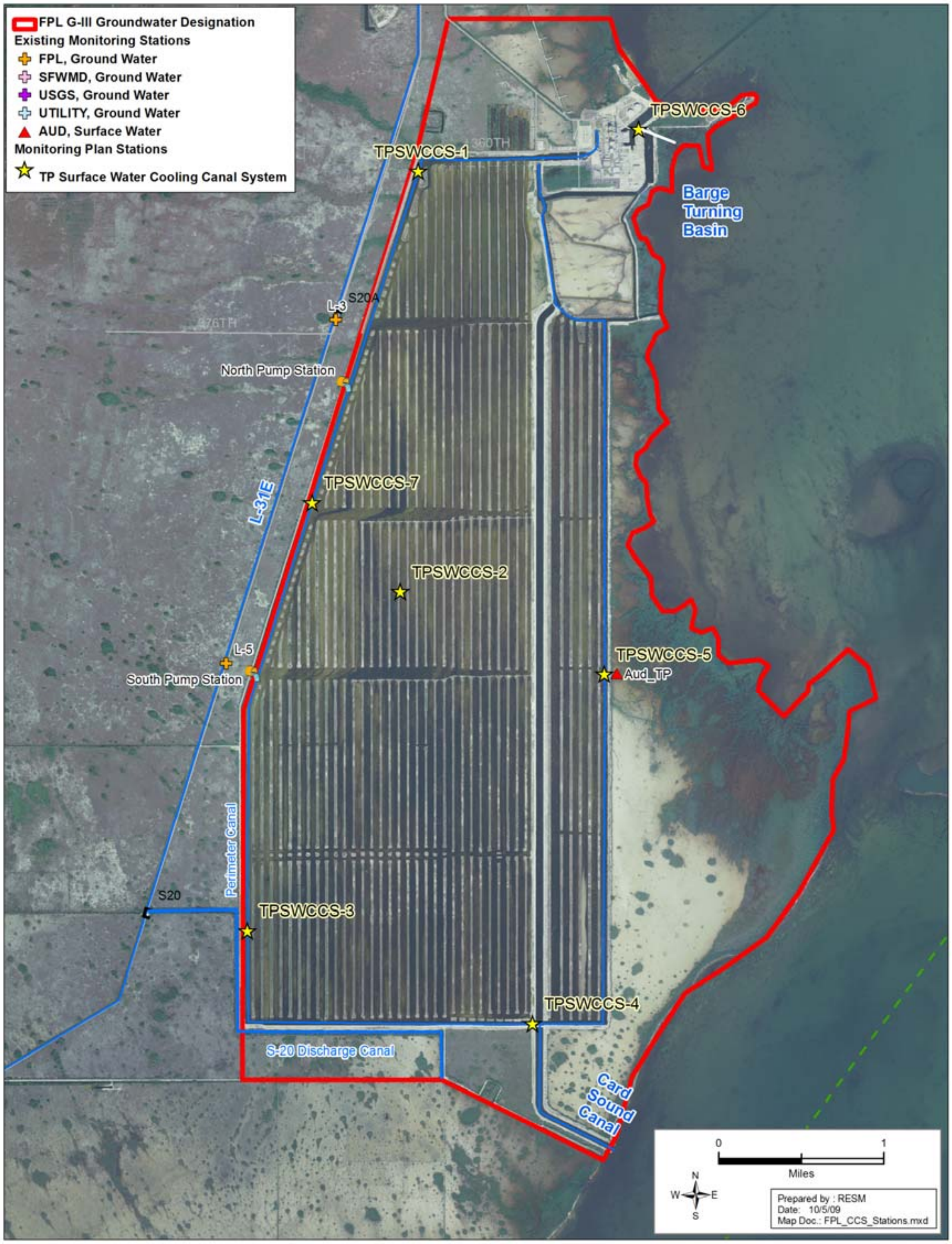


**Figure 2-2.** CCS monitoring stations.

In addition to the automated monitoring, quarterly monitoring at each surface water station shall consist of field parameters, major ions, and the CCS tracer suite, as listed in **Table 2-1**. Semiannual monitoring at each surface water station shall consist of all of the above parameters, as well as nutrients. The total count of alpha particle radioactivity (Gross Alpha)

shall be monitored semiannually for one year in all stations located within the CCS. All applicable samples shall be analyzed in accordance with Chapter 62-160 F.A.C. at an FDEP-approved laboratory capable of analyzing samples with a wide-range of specific conductance values, including hypersaline waters (salinity conditions in excess of typical marine conditions).

**Table 2-4.** Rationale for the CCS monitoring locations.

| Location | Samples | Rationale |
|---|---|---|
| Cooling canal system (CCS) stations characterize CCS water and monitor changes.<br>The monitoring of water will be just below the surface within the CCS and at bottom, unless otherwise noted. | | |
| CCS | TPSWCCS-1 | This site is located in Canal 32, which shall document the specific conductance and temperature of water leaving the plant, where the greatest hydraulic stage is observed and shall serve as a station associated with operation of the inceptor ditch (ID). |
| | TPSWCCS-2 | This site is in the middle of the CCS, co-located with TPGW-13, and documents the change in specific conductance and temperature as the water travels down the CCS. This shallow site shall only have one monitoring sensor. |
| | TPSWCCS-3 | This site is located in Canal 32 near the southwest corner of the CCS, characterizes water at this end of the CCS, and shall serve as a station associated with operation of the ID. |
| | TPSWCCS-4 | This site is located in the Collector Canal at the southeast corner of the CCS, and characterizes water at this end of the CCS by the scrub mangrove forest. |
| | TPSWCCS-5 | This site is located in the deepest portion of Canal E6 and characterizes the water on its return trajectory back to the plant, nearest the location where DERM has observed atypical mangroves. |
| | TPSWCCS-6 | This location in the East Canal measures water as it enters the plant in the area of lowest hydraulic stage; this site will provide insight into the degree of exchange between the CCS and surrounding subsurface hydrology. |
| | TPSWCCS-7 | This station is located in Canal 32, halfway down the CCS on the west side, and shall serve as a station associated with operation of the ID. |

Preliminary investigation into the thermal anomaly located within the northwest side of the CCS shall be undertaken after the detailed bathymetric survey (Section 2.6.1) has been completed. This investigation includes detailed sampling and characterization and shall include surface water sampling for parameters required under the quarterly sampling. The approximate location of the thermal anomaly is Longitude 80 21 4.79 West, Latitude 25 24 47.13 North, and Longitude 80 21 5.46 West, Latitude 25 24 11.04 North. The exact location shall be measured during the bathymetric survey and shall be compared to existing reports.

### 2.4.1 Sediment and Porewater Sampling

Sampling within the sediment and porewater may be needed to help with the interpretation of geochemical and/or ecological findings. Such sampling may be phased in after initial Plan implementation based on ecological and/or geochemical results, as recommended by the Agencies. The determination of specific measurements and locations will be made by the Agencies, and may include sediment bulk analyses in duplicate cores per site and porewater analyses. Sample depths shall include surface (0-10 cm) and subsurface (40-50 cm) samples, where possible.

## 2.5 SURFACE WATER MONITORING

The purpose of surface water monitoring is described in COC IX and X of the Uprate Certification (see **Appendix A**) and the 2009 Agreement. This appendix focuses on the proposed surface water monitoring in Biscayne Bay and the nearby freshwater and tidal canals, including the L-31E Canal, tidal canal downstream of the S-20 Structure, and the Card Sound Canal. Monitoring surface water in the Model Land Basin freshwater wetlands and nearshore mangroves shall be addressed in Section 2.8: Ecological Monitoring.

### 2.5.1 Surface Water Locations

A total of five surface water stations are proposed in Biscayne Bay, extending offshore along the length of the CCS. BBSW-3 shall be co-located with groundwater cluster TPGW-11 (**Figure 2-3**). BBSW-1 is located in the barge cut, northeast of Barge Turning Basin. **Table 2-5** shows the locations of these surface water stations and the rationale for these locations respectively. The exact installation locations may need to be adjusted based on site-specific conditions (i.e., access considerations, minimization of environmental impacts) or permitting constraints. The surface water stations shall be located as close to shore as possible, but it is recognized that the water is quite shallow immediately east for much of the CCS.

As shown in **Figure 2-3** and **Table 2-5**, surface water monitoring stations are proposed at three non-tidal surface water locations in the L-31E Canal: one tidal location at the S-20 Discharge Canal, and one tidal location at the Card Sound Canal. A sixth location in the Card Sound Road Canal, away from the influences of the CCS, shall be monitored manually with the quarterly sampling events. This is a reference station and may indicate the Card Sound Road Canal's influence on regional saltwater intrusion and the possible impact on the area between Card Sound Road and the CCS.

The L-31E Canal is the closest freshwater water body to the CCS. The L-31E Canal stations shall serve a dual purpose of providing information for the assessment of CCS influences, as well as supporting the monitoring of water levels for ID operation.

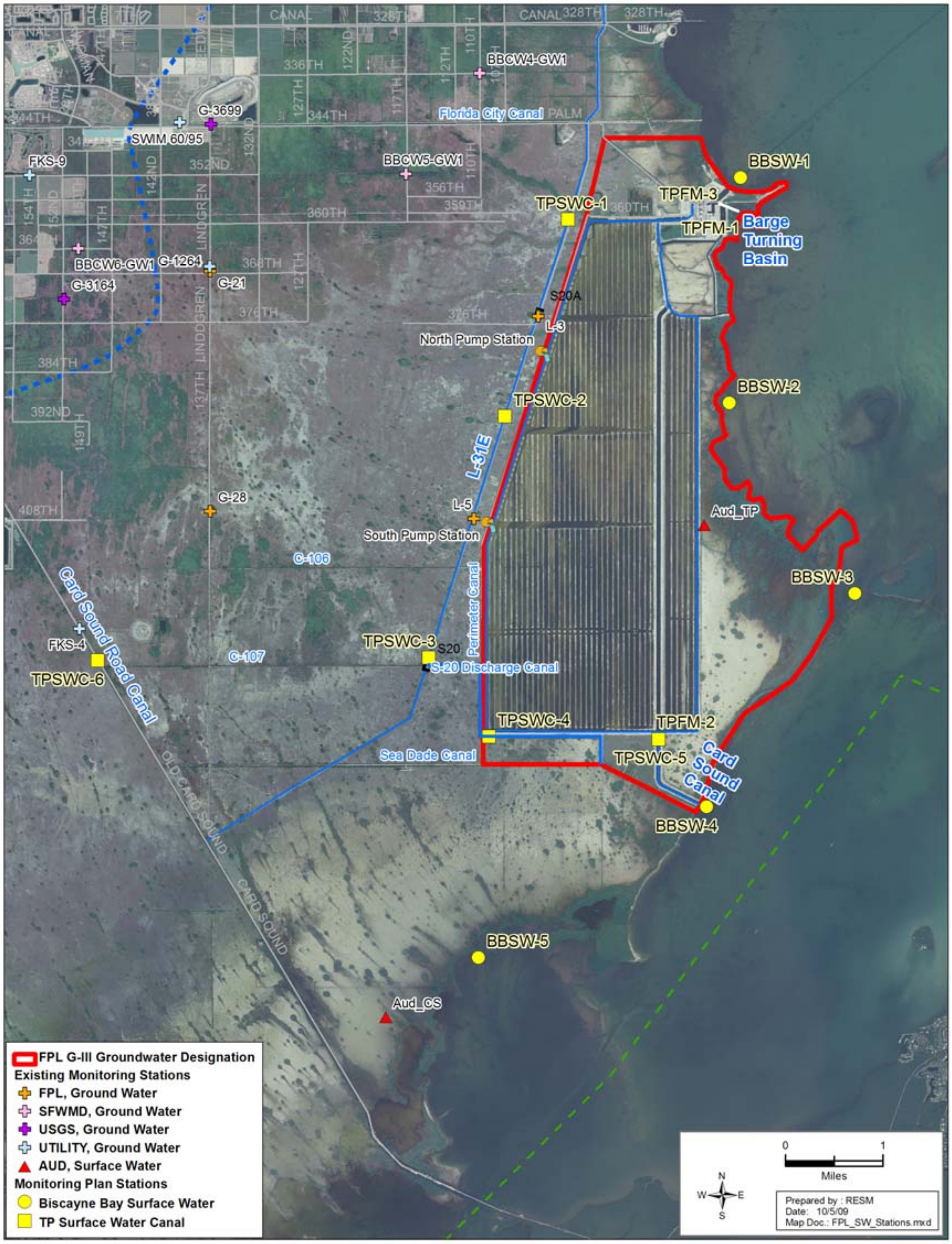


**Figure 2-3.** Surface water monitoring sites.

**Table 2-5**. Rationale for the surface water monitoring locations.

| Location | Sample | Rationale |
|---|---|---|
| Biscayne Bay | BBSW-1 | This site is in the cut and just offshore the Barge Turning Basin, northeast of the CCS. |
| | BBSW-2 | This site is located offshore from the scrub mangrove where DERM has observed atypical mangroves to monitor for seepage from the CCS. |
| | BBSW-3 | This site is located near the Arsenicker Keys, just offshore the mangrove forest and co-located with TPGW-11. |
| | BBSW-4 | This site monitors the offshore portion of the CCS south of the Arsenicker Keys and near the mouth of the Card Sound Canal/historical CCS outlet, and co-located with TPGW-14. This site is located in close proximity to a Department of Health radiological monitoring site. |
| | BBSW-5 | This site is located south of the CCS and mitigation bank. |
| L-31E Canal | TPSWC-1 | This site is located northwest of the CCS along ID Transect A to monitor for seepage from the CCS and to aid in the operation of the ID. |
| | TPSWC -2 | This site is located along the middle segment of the CCS and along ID Transect C to monitor for seepage from the CCS and to aid in the operation of the ID. |
| | TPSWC -3 | This site is located by the S-20 structure, at the intersection of the L-31E and C-107 Canals to monitor for seepage from the CCS. It is also part of the ID operations located along Transect E. |
| S-20 Discharge Canal | TPSWC 4 | This sampling station is located at the S-20 Discharge Canal. This site shall monitor the extent to which the tidal portions of the drainage canal downstream of the S-20 Structure is affected by the surface waters of the CCS, as well as the potential influence of Biscayne Bay on the canal around the CCS. |
| Card Sound Canal | TPSWC -5 | This site is located in Card Sound Canal, just below the CCS, where manatees have been increasingly observed as reported by DERM. |
| Card Sound Road Canal | TPSWC-6 | This site is located at Card Sound Road Canal, in the general proximity of FKS-4, and will serve as a reference station that will help document the influence of Card Sound Road Canal on groundwater. This station shall be manually monitored. |

### 2.5.2 Surface Water Data Collection

The surface water stations in Biscayne Bay shall measure conditions just above the sediment surface. All stations, with the exception of the Card Sound Road canal station, shall be automated with one set of temperature and conductivity sensors installed horizontally, approximately 1 foot above the sediment surface (**Appendix B**). Stations in the Biscayne Bay not co-located with groundwater stations will not have telemetry and a surface water stage recorder. Sampling stations in **Table 2-5** shall be automated and instrumented similarly to the CCS stations. This will allow for the determination of water level, temperature, and specific conductance at each site.

Data from each surface water station discussed previously shall be collected at 15-minute intervals from the top of each hour and either manually or remotely uploaded to a database. This monitoring strategy shall allow a continuous assessment of specific conductance and temperature changes in Biscayne Bay and canals in the areas surrounding the FPL Turkey Point Power Plant. The stage sensors shall be tied to an established datum (NGVD and NAVD). All sensors shall be inspected and cleaned as needed to meet QA/QC requirements.

In addition to the proposed automated monitoring, quarterly monitoring at each surface water station shall consist of field parameters, major ions, and the CCS tracer suite, as listed in **Table 2-1**. Semiannual monitoring at each surface water station shall consist of all of the above parameters, as well as nutrients. All applicable samples shall be analyzed in accordance with Chapter 62-160 F.A.C. at an FDEP-approved laboratory facility capable of analyzing samples with a wide specific conductance range (including hypersaline waters).

Additional data from other entities, such as BNP, NRC, USACE, EPA, NOAA, DOI, NPS, DOH, USGS, FWS, DERM, other local governments, and the SFWMD will be added to the information collected from this effort to form a more comprehensive understanding of this area. BNP monitors salinity at 34 sites in the area at the same 15-minute sampling frequency (Bellmund et al. 2007), and the sites around the CCS (BISC08B, BISC12B, and BISC13S) will be used to complement the monitoring efforts. Information available from the sampling network in BNP, Audubon Society's nearby sites, and the SFWMD Water Quality sampling network will be reviewed for relevance and applicability in the inclusion of data reporting. Other data that will support this monitoring effort include the SFWMD operations of the S-20 structure, since that may affect the water quality at TPSWC-4.

## 2.6 WATER BUDGET AND MASS BALANCE CALCULATIONS

Developing a periodic water budget for the CCS is essential in evaluating the exchange, if any, between the CCS and the groundwater, fresh surface waters, Biscayne Bay waters and the atmosphere. The monitoring and reporting described herein includes updated bathymetric survey work and provides supportive data and calculations of water and material mass within, entering, and leaving the CCS. The requirements of this section are necessary to implement FPL obligations under the Conditions for Certification as well as the Agreement with SFWMD.

### 2.6.1 Bathymetric Survey

A key component of recharge/discharge in the water budget is a bathymetric survey because it will enable the estimation of the volume and water surface area of the CCS. A bathymetric/volumetric survey of the CCS and each segment of the interceptor ditch (ID) shall be conducted using sonar equipment, and results shall be tied to established horizontal and vertical datums as described in **Appendix C**. The positioning (x, y, and z) requires the

use of a high-accuracy GPS navigation system (or Real-Time Kinematic GPS survey grade equipment). The GPS vertical accuracy of the system shall be decimeter GPS. Since the volume of water in the CCS will vary hourly, the water surface shall be continuously monitored during the survey and all depths shall be corrected to reflect the depth below the vertical datums as described in **Appendix C**. The survey shall take into consideration the water levels collected electronically in the CCS and Biscayne Bay.

The raw sonar results of the bathymetric survey shall be converted into rectified electronic data sets with specific point elevations and coordinates and a three-dimensional rectified surface and subsurface mesh shall be developed in AutoCAD (version 14 or higher). These two surfaces must show the mean water surface elevations and actual depths within the CCS. The volumetric calculations shall be complemented by all field water level data.

### 2.6.2 Water Budget Parameters and Monitoring

The general water budget parameters to be collected are listed below. The units of all parameters shall be converted to similar volumes and rates.

- Daily rainfall quantities from three on-site locations and two off-site locations.
- Power plant intake and outflow velocity as measured by Acoustical Doppler current meters.
- Meteorological data (solar radiation, wind speed, wind direction, air temperature, relative humidity, or other components necessary to calculate evaporation).
- Groundwater and surface water levels in and surrounding the CCS.
- Interceptor ditch operations, flows, qualities, and rates for each segment.
- Other parameters (e.g., salinity measured from specific conductance) as needed to complete an estimated water budget.

Five rainfall stations shall be set up in and or near the CCS system. These stations will be co-located at stations TPRF-12 in the north, TPGW-13 in the center of the CCS, TPRF-L3 in the south, TPRF-L5 on the west side, and TPGW-11 on the east side (**Figure E-1**). Rainfall stations shall not be placed near structures that may obstruct rain or prevent accuracy in rainfall collection. Data from the rainfall buckets shall be collected with the same frequencies as the water level data. All data shall be transmitted to the FPL main server daily.

Permanent flow stations shall be established within the CCS using acoustic Doppler velocity meters. Volumetric and velocity measurements shall be conducted at three strategic locations in the CCS perimeter canal to assist in the estimation of water inputs and losses. The stream gauging locations shall be placed near the plant discharge (TPFM-1): at the constriction between the "C" series canals and the "E" series canals on the southeast side of the CCS (TPFM-2) and near the plant intake (TPFM-3) (**Figure 2-4**). Acoustical flow and velocity data at these stations shall be taken at each location concurrently and shall be collected at 15-minute intervals. The flow stations shall be integrated with existing CCS water quality monitoring stations when applicable. Inflows (timing, duration, and frequency) from the

Interceptor ditch shall be monitored electronically and reported with the other water budget components.

Evaporative losses shall be calculated based on a wind speed sensor co-located at TPGW-13. Additional parameters needed to calculate evaporative losses can be obtained from existing FPL meteorological stations. The wind parameter from the TPGW-13 station shall be combined with water temperature collected from the CCS surface water stations (**Figure 2-4**).

### 2.6.3 Water Budget Calculations

A time series volumetric spreadsheet (or equivalent) shall be developed based on actual field data. This spreadsheet shall include all measured and calculated components of the water budget. This includes water volumes and material mass exchanges across the CCS boundaries estimated on a daily time step. A salt budget, estimated from specific conductance and concurrent flow measurements, shall be a component of this exchange estimate. If the water budget spreadsheet contains summarized variables, all data and supportive information shall be included for these variables. The water budget report shall use the daily time step to calculate the monthly averages (January through December) and data shall be summarized annually.

The water budget shall include a breakdown for each contribution. This includes but is not limited to:

- Losses/gains to the atmosphere as measured by rainfall and evaporation.
- Losses/gains to the surficial aquifer vertically.
- Losses/gains to the surficial aquifer horizontally.
- Losses/gains to Biscayne Bay (differentiated between Biscayne Bay groundwater and surface water to the extent practical).

Total estimated contributions from each area of potential losses and gains (shown previously) shall be calculated. After each quarterly sampling, the water budget spreadsheet shall be updated to include the results of the laboratory analysis. Combining the results will yield total load contributions for the CCS. This shall be done for the major cations, anions, and tracer suites parameters.

The updated water budget shall be thoroughly documented using the new information, and all estimates and assumptions shall be clearly noted. The water budget shall be calculated on a monthly frequency, summarized at the end of each year, and reported as specified in and reported in the annual report. After the second year of post-Uprate (as defined in Section 1), a review of the approach and findings will be conducted.

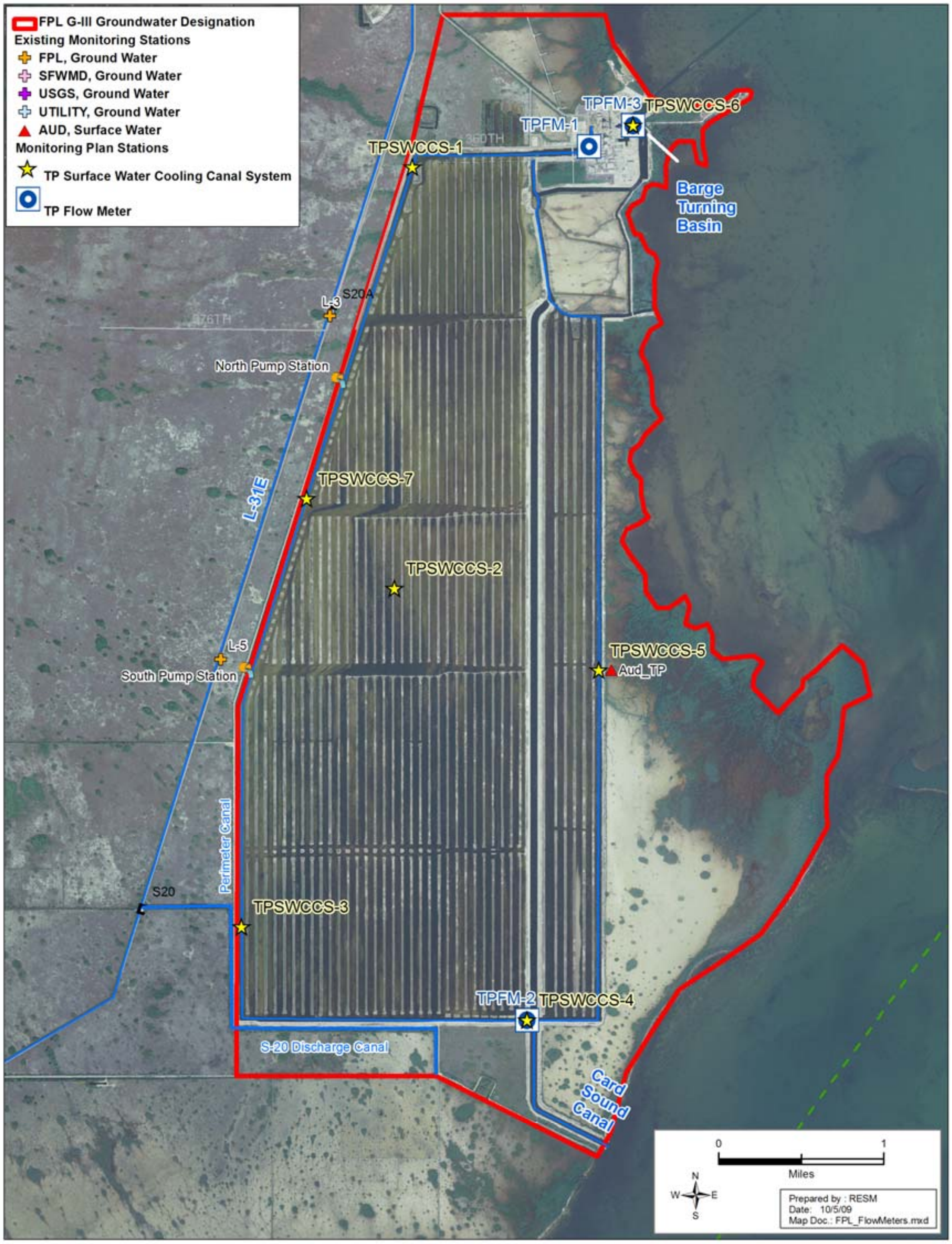


**Figure 2-4.** CCS flowmeter locations.

## 2.7 INTERCEPTOR DITCH WATER MONITORING

This Plan adds three water quality sensors at existing gauge stations in the ID coincident with Transects A, C, and E (TPSWID-1, TPSWID-2, and TPSWID-3) as shown in **Figure 2-5**. Each gauge station shall have a specific conductance, temperature, and depth sensor placed approximately 1 foot below the surface level, and one approximately 1 foot above the bottom of the ditch and be automated and instrumented similarly to the CCS stations. This will allow for the determination of water level, temperature, and specific conductance (salinity calculated) at each site. Transects B and D will still be monitored manually for stage unless automated in the future. Quarterly monitoring at each ID station shall consist of field parameters.

Data from each surface water station (Section 2.5) shall be collected at 15-minute intervals from the top of each hour and remotely uploaded to a database. This monitoring strategy shall allow a continuous assessment of stage, specific conductance, and temperature changes in the interceptor ditch. The stage sensors shall be tied to an established datum as described in **Appendix C**. All sensors shall be inspected and cleaned as needed.

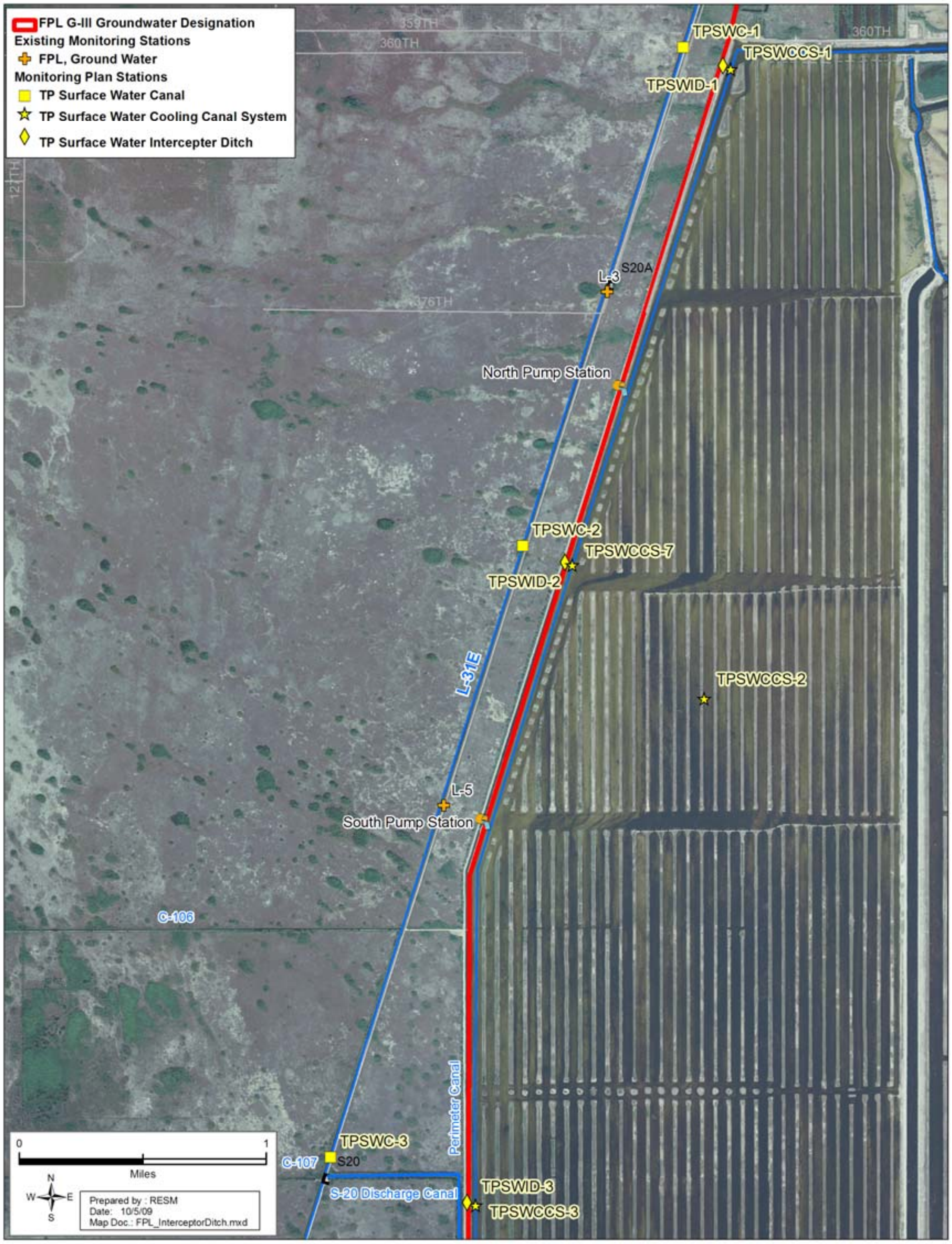


**Figure 2-5.** Proposed interceptor ditch monitoring sites.

# 2.8 ECOLOGICAL MONITORING

## 2.8.1 Overview and Strategy

The purpose of ecological monitoring design is to identify the existing baseline conditions and future impacts of CCS waters as described in the Conditions of Certification (COC) IX and X of the Uprate and in the Agreement (see **Appendix A**). Ecological monitoring is necessary to establish the current, pre-Uprate status of ecological conditions and biotic components, the extent to which CCS operations may be impacting conditions and components, and the extent to which Uprate implementation may result in further impacts and changes to these conditions and components now and into the future. Ecological conditions of primary, but not exclusive, interest related to CCS operations and ecological responses, are temperature, salinity, a CCS tracer suite, and nutrients. Biotic components of primary interest are marsh vegetation (i.e., freshwater graminoid and woody) in adjacent wetlands, mangroves, submersed aquatic vegetation (SAV), and benthic fauna in and adjacent to Biscayne Bay.

The strategy of this Plan is as follows:

- Spatially characterize ecological conditions via broad reconnaissance surveys. Wetland surveys shall be completed within six months of plan approval. Estuarine and bay surveys shall be conducted within one year of Plan approval and include a resistivity survey of Biscayne Bay and Card Sound (see Section 2.3.3), along with sampling of specific conductance (with salinity calculated) and a CCS tracer suite within the upper 60 cm of soils and sediments (porewater) in these bays and in the saline and freshwater wetlands adjacent to the CCS (Section 2.8.3 Initial Ecological Condition Characterization).
- Within three months of Plan approval, identify stressed areas in the vicinity of the CCS. This will be accomplished by synthesizing existing data relating to the distribution and density of vegetation using observations and cursory analysis of recent and historical aerial photographs. Aerial photographs of the region taken by the Comprehensive Everglades Restoration Plan (CERP) Restoration Coordination and Verification (RECOVER) team in April 2009 will be made available for this purpose. Analysis of such photographs combined with site visits will help determine the specific locations of sampling sites (Section 2.8.4 Broad Scale Vegetation Characterization).
- Establish transects and plots in freshwater and saline wetlands, including sampling of specific conductance and a CCS tracer suite, and nutrients in soils and sediments within six months of plan approval (Sections 2.8.5, 2.8.6, 2.8.7).
- Initiate Biscayne Bay benthic SAV and faunal assessment (Section 2.8.8 Biscayne Bay and Card Sound).

### 2.8.2 Design

Three zones, freshwater marshes, saline/coastal wetlands, and Biscayne Bay and Card Sound, shall be assessed for pre- and post-Uprate by establishing transects that are repeatedly measured over time. Results shall be compared with changes over this time in reference areas that are ecologically similar, with exposure to similar environmental factors other than CCS operations. The "Triangle Area," between Card Sound Road and US Highway 1 of the Model Lands, will serve as the reference area (**Figure 2-6**). It is anticipated that at least a minimum of two years of pre-Uprate monitoring (as defined Section 1) shall be performed.

Within each zone, a slightly different sampling design is recommended. A transect design is to be used within the northern, eastern, western, and southern marshes (**Figure 2-6**). Areas that have been currently identified as containing stressed or atypical vegetation patterns shall be included in the transects and subject to additional evaluation. Such stressed areas have been identified at the following locations:

1. An atypical mangrove area, east of the CCS (25.41N, 80.32W).
2. Short fringe mangroves, south of the Sea Dade Canal (25.34N, 80.33W).
3. Stunted sawgrass site, west of CCS (25.43N, 80.35W).
4. Pond area in saltwater mangrove area east of CCS (25.3799N, 80.3268W).
5. Nearshore benthic features within Card Sound (25.4072N, 80.3273W).

Additional areas that may be identified in initial site characterizations (described in Sections 2.8.3 and 2.8.4) shall also be considered in the final transect placement after consultation with the SFWMD. A transect approach shall also be used in the mangrove wetlands east of the CCS, but because of the small area involved, and the structure of existing or remnant creeks, these transects may be modified over time to spatially conform to landscape features and areas of potential impact.

Within Biscayne Bay and Card Sound, a combination of nearshore-offshore transects and nearshore areal sampling shall be used. For any of these zones, additional sites shall be added at locations where specific CCS influence is subsequently identified; concerns are noted (e.g., sites of CCS derived groundwater upwelling) and/or harm or potential harm is indicated.

### 2.8.3 Initial Ecological Condition Characterization

Assessment of biotic responses to CCS operations requires information on the spatial distribution of environmental conditions that affect biota and are potentially influenced by CCS water. A condition of primary interest is salinity, as calculated with specific conductance, especially soil and sediment specific conductance for vascular plants, but other conditions, such as temperature and nutrients, are important ecological factors (**Table 2-7**).

Measurement of a CCS tracer suite is essential to establish the extent of CCS connectivity if any in a given adjacent zone. Initial information on salinity distribution will be derived from two sources: 1) an electromagnetic resistivity survey of Biscayne Bay and Card Sound (Section 2.3.3); and 2) porewater surveys of freshwater and saline wetlands adjacent to the CCS and Biscayne Bay and Card Sound (described as follows). Porewater shall be analyzed for specific conductance within the root zone (about 30 cm deep, but limited to the top 60 cm), along with the CCS tracer suite analysis at a subset of locations. Results from these surveys shall identify potential zones of CCS water connectivity with surface sediments and soils via seepage and groundwater pathways, providing information on potential ecological influence of the CCS, as well as a basis to improve the monitoring design within the adaptive protocols of this Plan.

The resistivity survey of Biscayne Bay and Card Sound, described in Section 2.3.3, shall be used to locate potential upwelling zones containing CCS water within Biscayne Bay.

A broad-scale survey of porewater temperature, specific conductance, and the CCS tracer suite shall be made in adjacent wetlands during the first dry season (December through May) after Plan implementation and in Biscayne Bay and Card Sound during the first wet season (June through November) and dry season after Plan implementation. Specific conductance and temperature profiles (at 20 cm intervals to 60 cm or refusal) shall be measured in situ, using field meter and probes at more than 100 points in the wetlands, both freshwater and saline, and more than 100 points in Biscayne Bay and Card Sound. The boundaries of the surveyed wetlands shall be as far west as Tallahassee Road and Card Sound Road, as far north as the Florida City Canal and south to Card Point, and east to the estuarine shoreline. The boundaries of estuarine porewater surveys shall be as far east as 4 km offshore from the Biscayne Bay and Card Sound shoreline between the Mowry Canal and Card Sound Road. Sample sites shall be approximately even in distribution, but some samples may be taken in areas of special interest, such as apparently stressed areas, tree islands, remnant creeks, or sites where groundwater inputs are suspected. If such areas are found to be distinct from adjacent marsh areas, the transect design, described in Sections 2.8.6 and 2.8.7 may be modified and/or expanded to include these areas. Water level within wetlands, and water depth, within the Bay shall also be measured, and locations of all sampling shall be tracked and identified by GPS.

Following analysis of the survey results, and after consultation with the SFWMD, CCS tracer suite measurements shall be made from porewater about 30 cm deep at a subset of sites that, based on specific conductance results, indicate the strongest CCS influence. The CCS tracer suite measurements shall include at least 30 samples in each wetland zone, both freshwater and saline, yielding a total of 60 wetland samples, and 30 samples in Biscayne Bay and Card Sound. Wetland sampling shall include a subset of deeper samples (about 60 cm deep) to help distinguish groundwater and rainfall derived tracer sources. In Biscayne Bay and Card Sound, there shall be two separate samplings, each including 30 tracer suite analyses. One sampling shall be done during a neap tide period, January through March. A second sampling shall be performed in the wet season in June through August. Pending the results of this initial porewater survey and/or the resistivity survey, additional samplings may be conducted in a later phase and may include the tracer suite and/or additional parameters.

### 2.8.4 Broad Scale Vegetation Characterization

Within one month of Plan approval, a broad scale vegetation assessment shall be conducted in wetland areas adjacent to the FPL facility, by review of existing information supplemented by documented ground observation. Existing data shall be synthesized relating to the distribution and density of vegetation by cursory analysis of recent and historical aerial photographs. One set of photographs that may be used was taken by RECOVER in April 2009 and copies of these photos shall be made available to FPL upon request to the SFWMD. Additional ground observations that indicate stressed vegetation or other ecological conditions shall be made and described in field logs and recorded by photographs, including GPS locations during any initial site characterizations described in Section 2.8.3.

Vegetation mapping may be initiated at a later stage of this monitoring program if analysis of vegetation in plots along transects indicates a CCS effect on the wetlands.

### 2.8.5 Wetland Transect Locations

Ecological assessment of the wetlands shall focus primarily on patterns of plant community status and environmental conditions relevant to this community, along transects emanating from the CCS. The approximate locations are shown in **Figure 2-6** and the parameters are summarized in **Table 2-6**. Three east-west transects (approximately 6 km long) shall be established through the freshwater wetlands (shown in yellow in **Figure 2-6**) from the CCS into the Model Land Basin at least as far west as Tallahassee Road. Preliminary locations for these three western transects include an area of special concern, adjacent to the CCS western boundary, where observations of sparse and stressed vegetation have been made, as well as further areas to the west that do not indicate obvious stress. Two shorter transects shall run from the northern and southern CCS boundary through freshwater wetlands (in yellow) and saline wetlands (in pink) to the Biscayne Bay and Card Sound coastline. The southern transect traverses wetlands south of the CCS from the southwest corner of the CCS to Card Sound. The northern transect traverses wetlands from the northern CCS boundary to approximately the mouth of the Florida City Canal. Three additional short transects shall run from the eastern CCS boundary to the coastline in the saline mangrove wetlands (shown in pink in **Figure 2-6**) with an orientation dictated by the shape of this narrow coastal area and the location of previously identified atypical mangrove growth and mangrove mortality.

A reference transect (in turquoise in **Figure 2-6**), approximately 9 km long through freshwater and saline wetlands shall also be established in the Triangle Area. Water levels within wetlands and water depth within the Bay shall also be measured, and locations of all sampling shall be tracked and identified by GPS. Land based areas along the transects shall be referenced back to an established elevation as described in **Appendix C**. This effort does not require professional surveying. However, all measurements shall be tied back into an existing datum. This includes the use of existing benchmarks, LIDAR data, EDEN network elevations and/or ground surface elevation from nearby well surveys.

The specific site selection shall be made in consultation with the Agencies. The final location of these transects and the sample sites selected along them shall be subject to the review and approval by the Agencies within 30 days.

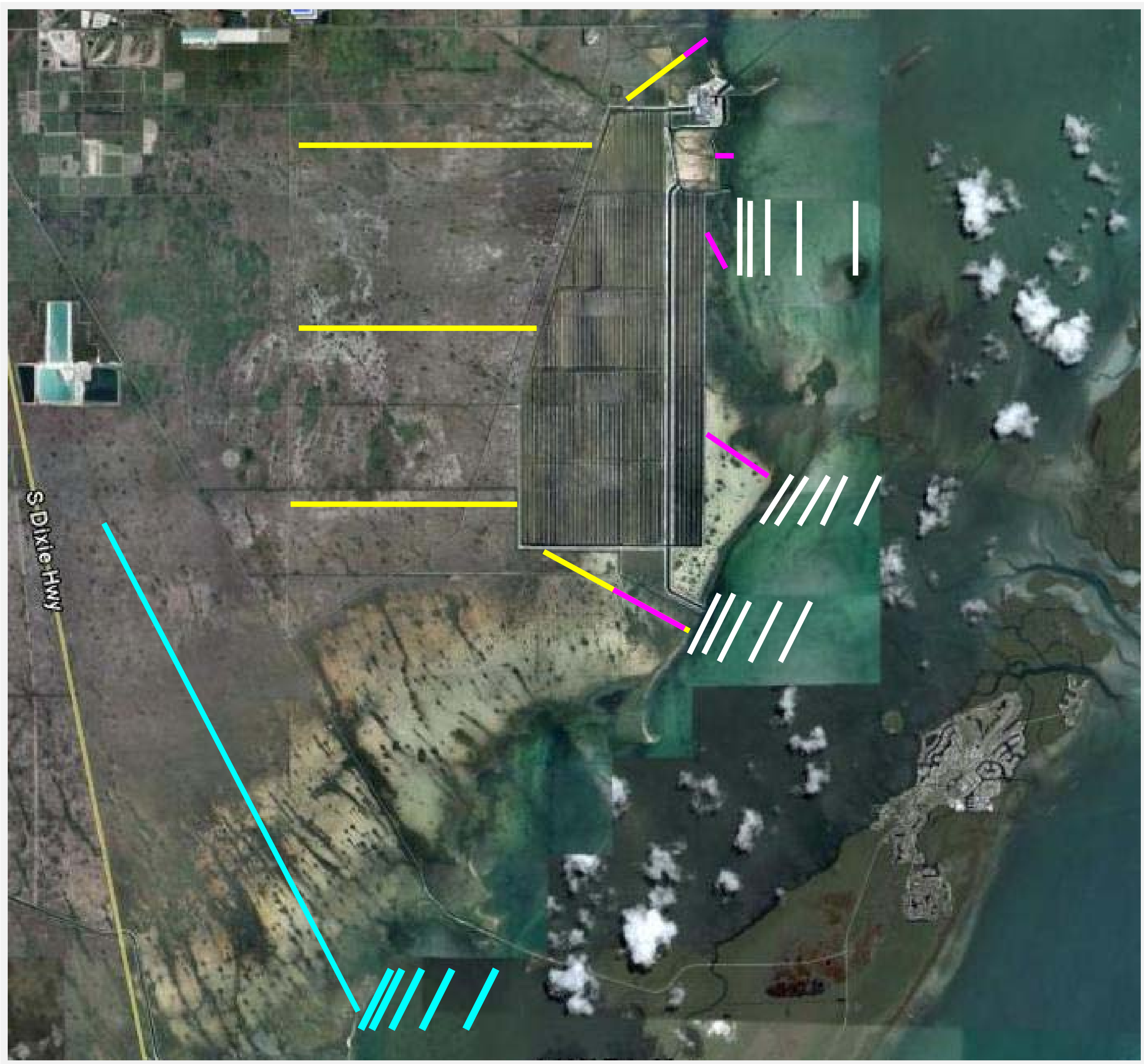


**Figure 2-6.** Ecological monitoring transects adjacent to the CCS. Freshwater wetlands are shown in yellow, saline wetlands in pink, Biscayne Bay and Card Sound benthic in white and associated reference transects in turquoise. Location of the interface of freshwater and saline wetlands shown here is conceptual.

### 2.8.6 Freshwater Wetland Transect Assessments

Sampling along all transects shall be at three spatial levels (shown in **Figure 2-6**): 20 m x 20 m major plots (turquoise squares), 5 m x 5 m subplots (pink squares), and 1 m x 1 m subplots (yellow squares). The exact locations of these plots along the transect shall be jointly determined among the Agencies after the initial dry season assessment along each transect. The measurements shall be every 500 m of field porewater specific conductance and temperature depth profiles to 60 cm depth. Each western transect shall be established with a total of four major plots, of which two are within 1.5 km of the CCS and one near the western end of the transect (**Figure 2-6**). This effort does not require professional surveying. However, all measurements shall be tied back into an existing datum. This includes the use of existing benchmarks, LIDAR data, EDEN network elevations, and/or ground surface elevation from nearby well surveys.

From each major (20m x 20m) plot, species composition and abundance, woody species cover, herbaceous species cover, and canopy height shall be measured. Percent vegetative cover shall be determined from the aerial imagery, while the other parameters shall be determined from ground assessment. Photographs for each plot shall be digitized, and classification of community types defined for each plot.

During the ground assessment, one 5 m x 5 m subplot shall be randomly established within each quadrant of the larger plot (**Figure 2-7**). Species diversity and characteristics of woody plant species (e.g., height, diameter at breast height) shall be measured within each subplot. Within the same quadrant, a 1 m x 1 m subplot shall also be randomly established in the marsh to determine the marsh species diversity and density. All sawgrass (*C. jamaicence)* culms and spikerush (*Eleocharis* spp.) stems shall be counted within each subplot. The number of leaves in ten *C. jamaicense* culms shall be counted and measured; similarly, the height of ten *Eleocharis* spp. stems shall be measured. Estimates of plant productivity shall be made in woody vegetation (5 x 5 m) plots from changes in morphology (e.g., diameter at breast height) and leaf litter production or alternative production methods, as approved by the Agencies. Plant productivity of dominant graminoid species (in 1 m x 1 m plots) shall be estimated by leaf biomass turnover measurements. The proposed methodology is consistent with methods used in Everglades National Park by the National Science Foundation (NSF) funded Long-Term Ecological Research Program based at Florida International University.

Major plot (20 m x 20 m) measurements shall be conducted once a year, while the 5 m subplot measurements shall be conducted twice a year, at the end of the wet season (June through November) and dry season (December through May). Leaf litter production shall be made quarterly or alternative production measurements made at a frequency as approved by the Agencies. The 1 m subplots shall be measured at three-month intervals.

Twice a year (i.e., once at the end of the wet and dry seasons), ten leaves per stems of each of the dominant species shall be randomly selected and collected from each subplot along each transect for morphological and physiological characterization. Leaf characteristics (i.e., leaf length, width, and thickness, water content) shall be measured prior to the leaves being dried and analyzed for C, N, and P contents, as well for $\delta^{13}C$. Changes in these plant

characteristics over time and among plants within and between transects shall be analyzed for trends and differences.

Water level and surface water (when present), temperature, and specific conductance shall be measured within one woody vegetation subplot (5 x 5 m) and one graminoid (1 x 1 m) subplot per each major plot every three months. Soil temperature and porewater, and specific conductance shall also be measured at two depths (about 30 cm and 60 cm) in these two subplots per each major plot every three months.

If specific conductance values of >725 μS/cm (derived from 250 mg/L Cl-) are observed, two subplots will be sampled and composited (within each major plot) for the tracer suite analysis from porewaters at a depth of about 30 cm. This conductance threshold is subject to revision based on the Initial Ecological Condition Characterization survey and/or other information.

Porewater nutrients (TP, SRP, $NH_4$, $NO_X$, TKN) shall be measured in one graminoid subplot (1 x 1 m) and one woody vegetation (5 x5 m) subplot of each major plot within the root zone (about 30 cm) twice per year. A composite sample may be made from the two samples. Bulk soil nutrients (TP, TN, TOC) and bulk density shall be measured initially (once) in 30 cm cores. For these measurements, composite samples shall consist of 10 cm horizons (0-10 cm, 10-20 cm, and 20-30 cm) from one 30 cm core from a graminoid subplot (1 x 1 m) and one 30 cm core from woody vegetation (5 x5 m) subplot. Additionally, specific conductance and temperature shall be measured in the L-31E Canal along the line of these transects.

As described in the Initial Ecological Condition Characterization (Section 2.8.3), the specific conductance and ecological condition of tree islands along potentially remnant streams and other sites of special interest shall be assessed in a preliminary survey. If results from this survey indicate the need for additional information, then additional transects or plots near the three established transects may be added at the discretion of the Agencies. Sampling shall be consistent with that occurring along transects, but the SFWMD will coordinate Agency review prior to initiation.

Plot site selection, plot design, and sampling along the two shorter freshwater marsh transects north and south of the CCS shall be as described previously for the western transects. However, only two major plots shall be established along each of these transects. Plot site selection, plot design, and sampling along the reference freshwater marsh transect within the Triangle Area shall be as previously described for the western transects, with a total of four plots.

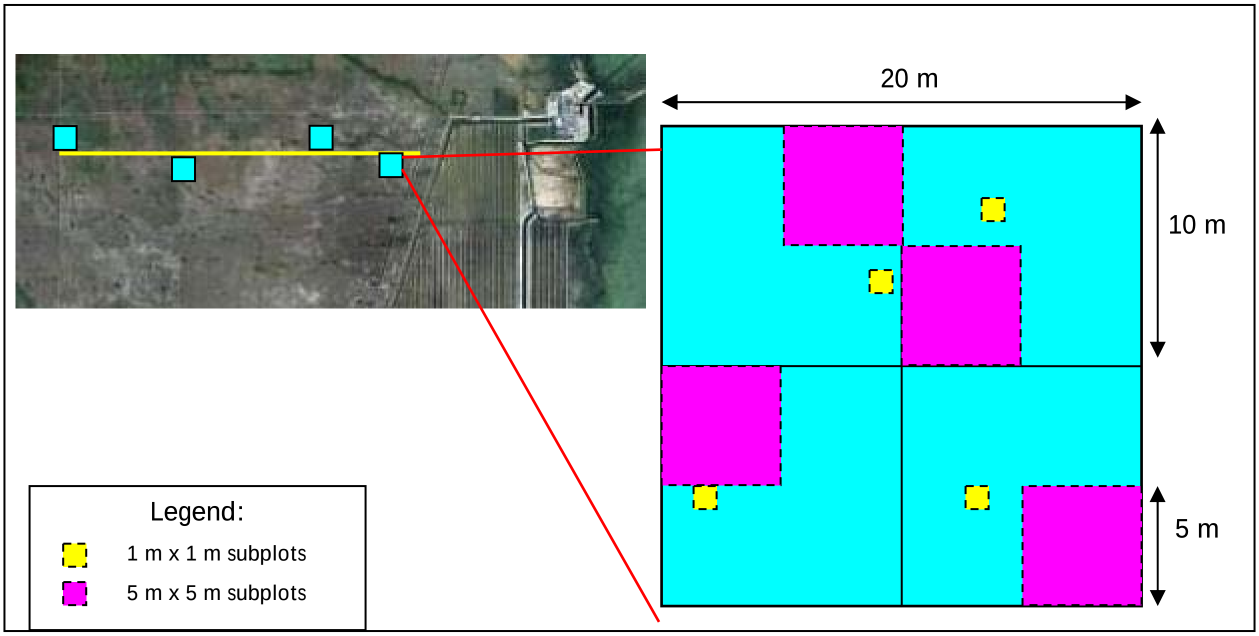


**Figure 2-7.** Example of a proposed sampling design for ecological monitoring along the transects.

### 2.8.7 Saline Wetland Transect Assessment

Assessment along the five transects containing saline wetlands (shown in pink in **Figure 2-6**) shall focus on plant community composition, morphology, productivity, and environmental conditions, similar to that described for the freshwater wetlands. The sampling design shall also be similar, with the establishment of two major (20m x 20 m) plots per transect, each with four to eight subplots, pending the presence of herbaceous vegetation. The specific location of these plots shall be determined with the approval of the Agencies after the initial site characterization survey with porewater salinity, temperature, and the tracer suite measurements as described previously. However, along the three short eastern transects, initial site survey points shall be spaced approximately 100 to 200 m apart.

The following shall be measured as previously described for freshwater wetlands: plant community composition; cover; canopy height; leaf litter production; stage; surface water temperature and specific conductance; soil temperature; porewater specific conductance; porewater nutrients; and bulk soil nutrients and density. The tracer suite shall be measured quarterly at 30 cm depth with composited samples from two subplots per each major plot. Should tracer suite results along a transect indicate potential contributions from the CCS, additional non-composited tracer suite sampling shall be conducted from two additional sites along the transect. Twice a year, at the end of the wet and dry seasons, ten leaves/stems from each of the dominant species shall be randomly selected and collected from each plot along the transect. Leaf characteristics (i.e., leaf length, width, thickness, and water content) shall be measured prior to the leaves being dried and analyzed for C, N, and P contents, as well as for δ13C. Changes in these plant characteristics over time and among plants within and among transects shall be analyzed for trends and differences.

The saline coastal portion of the reference transect within the Triangle Area (**Figure 2-6**) shall also include, at a minimum, two major plots with subplots and sampling of these subplots as described for the saline wetlands.

### 2.8.8 Biscayne Bay and Card Sound

Ecological monitoring shall document benthic biota of Biscayne Bay and Card Sound (i.e., SAV, benthic and epibenthic fauna), salinity (calculated with specific conductance), and a tracer suite to distinguish the extent of CCS connectivity to these conditions. Specific conductance and the tracer suite initially shall be surveyed as described previously (see Section 2.8.3). Benthic surveys and fish and invertebrate sampling, as specified in the Plan, shall use results from existing monitoring programs within Biscayne Bay, to the extent possible. Sample methodology for work in the Plan shall be consistent with other programs within Biscayne Bay and Card Sound, but is performed in locations near Turkey Point not sampled by the other programs. Data from these programs shall be used for assessment of reference area conditions.

Benthic surveys shall be made using a transect design to discern potential CCS effects as a function of distance from shore. A set of 15 fixed transects (white lines in **Figure 2-6**), each 2 km long, shall be sampled randomly along each transect twice per year. The transects shall be arrayed such that each set includes five transects approximately parallel to shore that are 0.25 km, 0.5 km, 1.0 km, 2.0 km, and 4.0 km offshore. If the area is inaccessible, transect locations may be re-evaluated in consultation with the Agencies. The array shall include four sets of these transects that project from the proposed saline wetland transects: one northern zone (offshore near the power plant), one central zone (offshore of the central CCS), one southern zone (offshore of the Sea Dade Canal - southeast CCS corner), and one reference set in northern Barnes Sound (starting north of Middle Key; in turquoise in **Figure 2-6**). Sampling shall be done to estimate the species composition, abundance and cover of benthic vegetation (SAV, including seagrass, and macroalgae) and large sessile fauna (e.g., corals and sponges), using the rapid Braun-Blanquet methodology currently used in Florida Bay and Biscayne Bay by RECOVER and other groups (Fourqurean et al. 2002). For each transect and sampling event, eight points shall be randomly selected, with measurements in four quadrats (0.25 $m^2$ each) per sample point. Sampling times shall be done twice per year, once during the months of March-May and once during the months of August-October.

For each benthic survey transect, light extinction shall be measured at one point per transect. Porewater specific conductance and temperature shall also be measured at each sampling point along these transects, with the tracer suite measured at a subset of points (one site per transect, selected based on the highest specific conductance and/or appearance of ecological stress). Should tracer suite results along a transect indicate potential contributions from the CCS, additional tracer suite sampling shall be conducted from two sites along each transect. Sampling depth shall reflect exposure within the seagrass root zone (upper 30 cm). Nutrients in porewater shall be measured twice per year and bulk sediments shall be measured once (initially) at two sites per transect and composited as described for the saline and freshwater wetland transects (Section 2.8.6). Seagrass leaf nutrients from the dominant species (likely

turtle grass) along each transect shall also be analyzed once per year for total nutrient content (C, N, P per dry weight), as well as $\delta^{13}C$ and $\delta^{15}N$ ratios.

Nearshore benthic fauna (i.e., small fish and epibenthic macroinvertebrates, such as pink shrimp) will be monitored using methods consistent with other sampling elsewhere in Biscayne Bay. This Monitoring Plan component shall fill a gap between Mangrove Point and Turkey Point, where no such monitoring has been done, using methods that allow quantitative spatial comparison. Sampling shall be done with 30 throw trap samples per sampling event, twice during the year in the wet season and dry season. If a contractor is used that previously has not performed such sampling, consultation with parties that use this method in other areas of the Bay shall be made to ensure sampling and reporting consistencies and allow comparison with other areas within Biscayne Bay. Supporting information, needed to interpret ecological findings, shall be collected along transects and at fish and macroinvertebrate sampling sites. Bottom water specific conductance, temperature, and water depth, along with observations regarding SAV habitat, shall be measured at each site during each sampling event.

**Table 2-6**. Ecologic monitoring: transect sampling.

| Zone | Location(s) and number | Surface Water (SW) & Porewater (PW) Parameters | Biotic Parameters | Soil/ Sediment Parameters | Frequency |
|---|---|---|---|---|---|
| Freshwater Wetland | 3 east-west transects, 2 (roughly) north-south transects, 1 reference transect (Figure 2-6). All with 3 spatial levels (20 m plots, 5 m and 1 m subplots; Figure 2-7). | SW: Water depth, temperature, and specific conductance.<br><br>PW: temperature, specific conductance, tracer suite, andnutrients. | Plant community composition, cover, canopy height, productivity, leaf characteristics, C, N, P contents, and $\delta^{13}C$. | Nutrients (TOC,TN, TP), initial bulk density. | Annual, bi-annual, and once every three months, depending on plot level (see text). |
| Saline/ Coastal Wetland | Five transects plus reference transect (Figure 2-6). 3 spatial levels (20 m plots, 5 m and 1 m subplots; Figure 2-7). | SW: Water depth, temperature, and specific conductance.<br><br>PW: temperature, specific conductance, tracer suite as indicated, nutrients. | Plant community composition, cover, canopy height, photosynthesis, leaf characteristics , C, N, P contents, and $\delta^{13}C$. | Nutrients (TOC,TN, TP), initial bulk density. | Annual, bi-annual, and once every three months, depending on plot level (see text). |
| Biscayne Bay and Card Sound | For SAV and sessile benthic fauna, 4 sets of 5 transects (each 2 km long). Eight random sample points per transect. For mobile epibenthic fauna, area between Mangrove and Turkey points, 30 stratified random points. | SW: Water depth, temperature, specific conductance, and light extinction<br><br>PW: temperature, specific conductance, tracer suite as indicated, and nutrients. | Benthic (SAV, coral, sponge) community composition and cover, seagrass leaf nutrients (C,N,P), $\delta^{13}C$, and $\delta^{15}N$, fish and invertebrate species composition, and abundance. | Nutrients (TOC, TN, TP), bulk density. | Two times per year for biota and waters (including porewater), one time for sediments. |

**Table 2-7**. Ecologic monitoring: initial characterization and survey sampling.

| Zone | Type | Location(s) and number | Parameter(s) | Frequency |
|---|---|---|---|---|
| Saline and Freshwater Wetland | Porewater Survey | Spatially distributed within freshwater wetlands; minimum of 100 conductivity samples and 30 tracer suite samples, each for saline and freshwater wetland areas. | Temperature, specific conductance, tracer suite,and water depth. | 1 time; initiate within the first dry season after Plan approval. |
| Biscayne Bay | Resistivity Survey | Biscayne Bay south of Mowry Canal, including Card Sound. | -- | Within 3 months after groundwater wells within Biscayne Bay are operational. |
| | Porewater Survey | Spatially distributed within 4 km of shore; minimum of 100 conductivity samples and 30 tracer suite samples within the Bay. | Temperature, water depth, specific conductance, and tracer suite. | 1 time in wetland and 2 times in bays (wet and dry season); initiate within 3 months after Plan approval. |

# 3

# Field Notification, Data Collection and Reporting

## 3.3 QUALITY ASSURANCE/QUALITY CONTROL PLAN

Pursuant to Chapter 62-160 F.A.C., preparation of a Quality Assurance/Quality Control (QA/QC) Plan shall be initiated immediately upon approval of the Monitoring Plan and submitted for the Agencies' approval within 60 days of this Plan's approval (effective date of the 2009 Agreement). The QA/QC Plan shall lay out the overall framework to ensure defensible monitoring results and quality reporting. The Plan shall outline procedures used in the field to install wells, manually collect samples, and conduct laboratory analysis. All data collected shall meet Chapter 62-160 F.A.C., SFWMD, and FDEP QA/QC requirements. More detailed information related to calibration and maintenance of probes and other automated instrumentation shall be provided. A major part of the QA/QC Plan shall describe data management procedures to ensure the data is properly recorded and reported. Detection limits for each parameter in the Plan shall be listed in the QA/QC Plan for Agency approval. Any request for long-term modification of sampling or analytical procedures shall be submitted in writing at least 90 days prior to the intended modification for review and approval by the Agencies. This shall include a proposed associated amendment of the QA/QC Plan.

To ensure appropriate methods are used to analyze saline and/or hypersaline samples, field measurements of salinity shall be logged and shall accompany all samples analyzed at laboratories. All contract laboratories shall be made aware of and be capable of analyzing constituents in saline and/or hypersaline waters. Field measurements for salinity shall be made in accordance with the Standard Method 2520B using the Practical Salinity Scale of 1978 (PSS78) (APHA 1998). Since the PSS78 is accurate to a salinity range of 0 to 40, it will be necessary to use chloride and TDS data from laboratory measurements to validate salinity values exceeding 40. The QA/QC plan shall include a methodology for performing these validations.

Laboratory analyses shall be performed by laboratories with NELAC certification (for analyses in this Plan that specify such certification) and methods shall be appropriate for samples with a wide range of salinities (i.e., from 0 to about 70 psu). Laboratory audits performed by the Agencies or Agency contractors shall be allowed for any facility analyzing samples from this monitoring program.

### 3.3.1 Field Sampling and Analysis Event Notifications

The lead Agency personnel or their designated contractor shall be notified of all field events no later than five days prior to initiation of field events, including but not limited to site surveys, well installation, surface and groundwater sampling, and ecological sampling and analysis. During long-term events, such as well installation, the lead Agency shall be notified for subtasks, such as well development and geophysical logging. Agency personnel shall have access onsite to observe field activities, with annual field audits by the Agencies, and FPL shall provide copies of field-generated notes and logs upon request. If field events are delayed, notification shall be provided as soon as practical and include the revised field event schedule.

### 3.3.2 Meetings

To facilitate communication and keep the Agencies apprised of the monitoring efforts and any significant findings, quarterly meetings for the first year, followed by semiannual meetings of FPL staff and contractors and the Agencies shall be held. Issues of concern or suggested improvements in the monitoring effort commensurate with focused objectives of the Conditions of Certification shall be discussed.

## 3.4 DATA COLLECTION AND REPORTING

Detailed information shall be provided to enable the Agencies to understand potential physical, chemical, and possibly ecological impacts of water movement and/or interchanges between the CCS, surface water, and groundwater. Data shall be submitted on a secure Web site and in the form of hard and electronic report copies. In accordance with the Conditions of Certification and unless stated otherwise in the Fifth Supplemental Agreement, electronic copies of all data and reports generated directly from this Monitoring Plan shall be provided to the SFWMD Director of Water Supply Management, Miami-Dade County Director of DERM, FDEP Director of the Southeast District Office, FDEP Siting Coordination Office Director, and Biscayne Bay Aquatic Preserve Manager.

**Table 3-1** provides a summary of data collection efforts and frequency of collection for designated sites with continuous recorders.

**Table 3-1.** Sampling frequency for field and laboratory parameters.

| Sample Type | Automated Field Parameters | Electronic Frequency | Field and Laboratory Parameters | Manual Frequency |
|---|---|---|---|---|
| CCS Water | Salinity[1], specific conductance, temperature, and water level | 15 minutes | Salinity, specific conductance, temperature, tracer suite and water quality parameters | Quarterly to Semiannually (Section 2.2.4) |
| Groundwater Monitoring Wells | Salinity[1], specific conductance, temperature, and water level | 15 minutes | Salinity, specific conductance, temperature, tracer suite and water quality parameters | Quarterly to Semiannually (Section 2.3.4) |
| Biscayne Bay Littoral Zone Surface Water | Salinity[1], specific conductance, temperature, and water level[3] | 15 minutes | Salinity, specific conductance, temperature, tracer suite and water quality parameters | Quarterly to Semiannually (Section 2.5.2) |
| Canal Surface Water (L-31) (3 Stations), L-31 Discharge Canal, Card Sound Canal, Card Sound Road Canal | Salinity[1], specific conductance, temperature, and water level | 15 minutes | Salinity, specific conductance, temperature, tracer suite and water quality parameters | Quarterly to Semiannually (Section 2.5.2) |
| Interceptor Ditch Control (3 Stations) | Salinity[1], specific conductance, temperature, and water level | 15 minutes | Salinity, specific conductance, temperature | Quarterly |
| Ecological Monitoring | See Tables 2-6 and 2-7. | | | |

[1] Salinity values calculated using the PSS78.
[2] All stations except for the Card Sound Road Canal Station shall be automated.
[3] Water levels recorded at stations co-located with monitoring well clusters

## 3.5 DATA COLLECTION

### 3.5.1 Automated Sample Collection

Proposed stations identified in **Figures 2-1**, **2-2**, **2-3**, **2-4**, and **2-5** of this document shall be electronically monitored by FPL. All automated time-series specific conductance, temperature, and water level data as discussed in Section 2 and provided in **Table 3-2** shall be compiled from the remote locations by telemetry. Each station as appropriate shall have a stand-alone solar power supply, onsite data loggers (with appropriate storage capacity), and the appropriate sensors needed to monitor the parameters described in **Table 3-2**. Each data logger shall initially be programmed to collect the required data at 15-minute intervals, unless otherwise noted, starting at the top of the hour based on time at the atomic clock and maintained in Eastern Standard Time. The data loggers shall also not account for Daylight Savings Time to retain consistency with SFWMD data collection efforts. Calibration of sensors shall be a function of the manufacturer's specifications. All sensors and equipment shall be maintained per the manufacturer's specifications.

**Table 3-2.** Proposed automated time-series data collection from surface and groundwater stations.

| Parameter | Units |
|---|---|
| Temperature | degrees (Celsius) |
| Level | feet (NGVD and NAVD) |
| Specific Conductance | $\mu S\ cm^{-1}$ |
| Salinity | psu |

### 3.5.2 Manual Sample Collection

Data from efforts such as borehole logging, well and stage recorder surveying, manual water quality sampling, and biological monitoring shall be recorded in field notebooks prior to entry into an electronic database. As outlined in Section 2 and per **Table 3-1**, water quality samples shall be collected from groundwater wells, surface waters, and the CCS, as part of regular monitoring on a quarterly and/or semi-annual basis.

## 3.6 DATA REPORTING

### 3.6.1 Web Database

The database shall be maintained and archived by FPL on a Web portal. This server shall be backed up and archived weekly to minimize the risk of data loss. The Agencies shall be given passwords to access the data 24 hours a day/7 days a week. A web master's contact

information shall be clearly posted on the web page. The Web-based applications shall provide the following:

- Geologic and hydrogeologic data acquired during this investigation.
- Well construction data and spreadsheets.
- Downhole geophysical logs.
- Geophysical surveys.
- Water budget and material load input values, calculations, and sums.
- Bathymetric survey.
- Equipment calibration logs and maintained records.
- Manual sampling of COCs, field data sheets, analytical laboratory results with QA/QC documentation.
- Ecological data.

Summarized data shall include but is not limited to:

- Groundwater and surface water hydrographs.
- Spreadsheet summaries and graphical representations of current and historical manual sample results.
- Automated reports such as, but not limited to, water level, temperature, specific conductance, and ID pump operations, meteorological monitoring.
- Log of any plant operations change, system shut downs or deviations that might affect parameters in this investigation.
- All results generated as a result of ecological monitoring (Section 2.8) and, Geophysical Surveys (Section 2.3.3).
- Semiannual and annual reports in PDF formats.
- All other reports that pertain to this Monitoring Plan.
- Aerial imaging results.

If determined that additional information must be added or modified to enhance the Web site, FPL shall do this within 60 days of Agency notification.

### 3.6.2 Automated Data Reporting

The data generated from continuous electronic monitoring of meteorological, surface and groundwater stations, and ID stage and pump operations shall be accessible real-time to the SFWMD; however, the raw data shall not become official until FPL has had a chance to conduct a QA/QC review. The data shall be provided in the comma delimited format for use in the SFWMD databases. The column headings and format will be specified by the SFWMD after consultation with FPL. This shall be done within 50 days of the date of collection. FPL shall provide electronic accessibility of the results to the Agencies. All data

shall be stored in a database maintained by FPL; this server shall be backed up and archived weekly to minimize the risk of data loss. The data shall be tabulated in downloadable Excel®, comma delimited format, and where appropriate, graphically presented to allow monitoring of operations by FPL staff, quick review of time-series data variations, and sensor performance.

### 3.6.3 Manual Data Reporting

Data collected from manual sampling and monitoring shall be stored in a database maintained by FPL; this server shall be backed up and archived weekly to minimize the risk of data loss. Electronic copies of analytical data shall be provided simultaneously to FPL and the SFWMD; however, the data shall not become official until it has undergone a QA/QC review by FPL. A summary of QA/QC analytical results shall be posted on a secure Web site. While the length of time between collecting the data and posting it will vary depending on what is collected, FPL shall post the data within three months of collection or at minimum provide a status as to when the data shall be posted. The manual data shall be compiled with automated data into reports as outlined as follows. Data files shall be made electronically available to the Agencies.

#### *3.6.3.1 Surveyor's Report*

FPL shall obtain a licensed Florida surveyor to conduct detailed surveys at each location where monitoring is being done, except as specified in Section 2.8 (Ecological Monitoring). The data collected from this effort shall be compiled and documented in a report that documents all data and techniques. The order of surveying shall be documented (1$^{st}$, 2$^{nd}$, or 3$^{rd}$ order).

Data collected from the survey of the groundwater monitoring wells and surface water stations shall be documented. **Appendix C** provides surveying requirements for this Monitoring Plan. An electronic copy of the field notes, an electronic copy of all computation sheets, site photographs, and benchmark sheets shall also be included.

### 3.6.4 Geology and Hydrogeology Report

Geologic and hydrogeologic data, as outlined in this Monitoring Plan, shall be collected to better understand the movement of water within the Biscayne aquifer, in the immediate vicinity of the CCS. This is relevant because subsurface conditions may influence the extent and rate of CCS water migration.

This report shall provide relevant and available information on the lithology and hydrostratigraphy of the subsurface rocks and sediments of that area.

Data collected during well installation (Section 2.3.1), including detailed lithologic logs, borehole geophysics, optical borehole logs, initial induction logs, temperature and flowmeter logs, field water quality data, and well construction details shall be compiled and submitted

to the Agencies within 60 days of completion of each well cluster. Geophysical logs shall be provided electronically in a PDF and LAS formats. In addition, a summary of well drilling procedures, geophysical logging procedures, and instrumentation used shall be provided. Based on wells installed from this monitoring effort and other subsurface geologic data, scaled geologic cross-sections, including macroporosity zone and geophysical log overlays, shall be generated and included in the report. This includes information from the induction logs, which reveal zones of saline water. Also, a plan view map showing the location of significant features shall be included. The information generated from this report will be used to enhance understanding of groundwater movement in the area and may be used to aid in the interpretation of tracer suite and water quality monitoring data. The final geology and hydrogeology report shall be signed and sealed by a Florida-licensed geologist experienced in hydrogeologic investigation.

#### *3.6.4.1 Biscayne Bay Geophysical Survey Report*

Biscayne Bay geophysical surveys shall be initiated within three months after the Biscayne Bay wells are installed. Results from these wells shall be used to estimate salinity from resistivity values. Results from resistivity survey shall be reported within six months of completion of a survey. Reports shall include a detailed description of methodology, maps showing GPS-derived survey track line locations, and figures showing depth profiles of resistivity along track lines, and any associated measurements along the track line. Best estimates of salinity or conductivity, derived from resistivity and all available salinity or conductivity data shall be made with tabular documentation of data and calculations used for this estimate (in .xls or .xlsx format). All geophysical survey data shall be supplied to the Agencies as raw tabular data, as well as processed graphical output, and all geophysical survey reports shall be signed and sealed by a Florida-licensed geologist experienced in geophysical interpretation.

### 3.6.5 Initial Ecological Condition Characterization Report

Initial information on salinity distribution shall be derived from porewater surveys of the freshwater and saline wetlands adjacent to the CCS and Biscayne Bay and Card Sound. Results from these surveys shall be detailed in a report within one year of Plan approval. The report shall provide a detailed description of all sampling and analysis methods, all data (including field and laboratory measurements, with QA/QC results, such as instrument blanks and calibrations), the GPS coordinates of all sites sampled, and a map showing site locations. Climatic data from the previous month as recorded by onsite or nearby instrumentation (rain data, air temperature, etc.) shall also be indicated in the report. Results, including any calculations generated from the data, shall be provided in a spreadsheet (.xls or .xlsx format). The details and supporting data for specific transect establishment (i.e., wetland and Biscayne Bay) shall be included in this report. Field observations shall be recorded by photographs in field logs, specifying the dates and GPS coordinates, which shall also be provided in the report. The report shall identify areas of CCS water connectivity with surface sediments and soils as indicated by the CCS tracer suite, and discuss evidence

concerning the potential ecological influence of the CCS. Timelines and status of completeness for any other elements of the ecological monitoring shall also be included.

### 3.6.6 Semiannual and Annual Comprehensive Monitoring Reports

Semiannual and annual reports shall be provided to the Agencies during the pre-Uprate and post-Uprate monitoring periods. Comprehensive semiannual monitoring reports shall be submitted for documentation of site conditions, data generated as part of Plan implementation including but not limited to, groundwater monitoring, surface water monitoring, CCS monitoring, and ecological monitoring, as described in the Plan. The ecological component shall be a subsection of the report and shall provide all data generated in the report period as indicated in the Ecological Monitoring (Section 2.8), including all field and laboratory measurements made (with QA/QC results, such as instrument blanks and calibrations), the GPS coordinates of all sites sampled, and a map showing site sampling locations. The data and any calculations generated from the data shall be provided in electronic format (.xls or .xlsx format). The column headings and format will be specified by the SFWMD.

The report(s) shall be submitted within 90 days of the completion of each monitoring period (wet season [June through November] and dry season [December through May]) and include quarterly and semiannual monitoring results of the previous periods. The report(s) shall include a brief summary of the CCS operations and operational changes that result in changes in physical or chemical characteristics of cooling water effluent or flow rates. A description of monitoring activities, station modifications and station operational summaries, graphic summaries of electronic monitoring data with electronic data archives, spreadsheet summaries of physical parameters, sample results, sampling field forms and laboratory results, L-31E salinity profile reports, monitoring well induction logging reports, and ID monitoring logs shall be included. Annual reports submitted during the post-Uprate monitoring period shall include conclusions regarding change from the pre-Uprate monitoring period.

The collected monitoring information, shall be used to provide an analysis of the following, to the extent supported by the data: 1) estimates of the spatial extent of CCS derived plume migration and the rate and direction of this migration; 2) for a given location outside of the CCS, an estimated percent contribution of waters originating from the CCS (based on a comparison of tracer suite constituent concentrations and other select chemical constituent concentrations in CCS waters, with concentrations of such constituents in surface water and groundwater outside of the CCS); and 3) estimates of the quantity of water and salt load that the CCS produced based on the updated CCS water budget. The report shall include recommendations for installation of additional monitoring points or other Plan modifications if needed to complete the monitoring objectives. The report(s) shall include a completeness evaluation of specific Plan objectives and an updated monitoring schedule.

To estimate the rate at which water is transported or dispersed from the CCS, a water budget analysis shall be performed (Section 2.6). The results of the bathymetric survey, CCS characterization, water budget, and salt and ionic loads shall be included in the Water Budget Analysis Report. This report shall be generated annually. Following collection of data during the pre- and post-Uprate period, the salt and ionic loads shall be reassessed to see if there are any significant changes from the pre-Uprate period.

The water budget report shall include a breakdown for each of the contributions as described in Section 2.6.3 (Water Budget Calculations).

### 3.6.7 Comprehensive Pre-Uprate Report

A comprehensive Pre-Uprate Final Report shall be submitted for documentation of background conditions before implementation of the Uprate project. The report shall include summaries of data presentations included in semiannual reports with trends analysis, including incorporation of seasonal or other variations over the pre-Uprate monitoring period. The data and any calculations generated from the data shall be provided in electronic format (.xls or .xlsx format). The column headings and format will be specified by the SFWMD. To meet the objectives, the report shall include a completeness evaluation of specific Plan objectives and recommendations for additional investigation, if appropriate. The comprehensive Pre-Uprate Final Report will take the place of one of the annual reports.

# 4 Schedule

Within 60 days after the approval of the Plan (effective date of the 2009 Agreement), FPL shall submit a monitoring schedule with a detailed breakdown of timelines for implementation of monitoring components and plant Uprate activity.

Permits for installing monitoring wells and instrumentation in Biscayne National Park must be obtained and entities to conduct the work selected. It is envisioned that it will take at least six months to drill all wells, purchase instrumentation, set up the monitoring network, and be fully operational.

The Uprate project is expected by FPL to come online in the spring of 2012. Two years of data collection during the pre-Uprate (as defined in Section 1) is expected. Pre-Uprate monitoring shall continue until commencement of the Uprate. Post Uprate monitoring, as may be modified, shall continue for a time period as specified by the Agencies. During this time, both automated and manual data collection shall be conducted.

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# A

# FDEP's Conditions of Certification IX and X Related to the FPL Turkey Point Power Plant Uprate

## IX. Biscayne Bay Surface Water Monitoring

As proposed, the Turkey Point Units 3 and 4 Uprate project may cause an increase in temperature and salinity in the cooling canal system. Field data is needed to determine impacts of the proposed changes in the Turkey Point cooling canal system on Biscayne Bay.

A. Within 180 days following certification of Units 3 & 4, FPL shall submit a Biscayne Bay Surface Water Monitoring Plan (Plan) pursuant to Chapter 62-302, F.A.C. to the FDEP Southeast District Office for review and approval. The Plan shall include, at a minimum, the following components:

   1. salinity and temperature monitoring within the surface waters of the Bay, including the Biscayne Bay Aquatic Preserve; (Specific parameters to be measured, including specific conductance and temperature, shall be sampled in accordance with Chapter 62-160, F.A.C.);
   2. a minimum of five monitoring stations located near shore in the vicinity of the FPL Turkey Point Power Plant; and three specific monitoring locations, sampling frequencies and methods, and specific parameters to be monitored.
   3. specific monitoring locations, sampling frequencies and methods, and specific parameters to be monitored.

B. This monitoring data shall be compared to data using compatible monitoring instrumentation already in place in Biscayne Bay.

C. FPL shall continue the monitoring of salinity and temperature in the cooling canals under its industrial wastewater facility permit.

D. If the Department determines that the pre- and post-Uprate salinity and temperature monitoring data indicate potential adverse changes in the surface water in Biscayne Bay, then the Department may propose additional measures to evaluate or to abate such impacts to Biscayne Bay.

E. The Plan, including monitoring locations, shall be approved prior to implementation. The Department shall indicate its approval or disapproval of the submitted Plan within 90 days of the originally submitted information. In the event that the Department requires additional information for the licensee to complete, and the Department to approve the Plan, the Department shall make a written request to the licensee for additional information no later than 30 days after receipt of the submitted information. Any changes to the approved Surface Water Monitoring Plan shall be approved by Coastal and Aquatic Managed Area personnel in consultation with other FDEP personnel. [62-160, 62-302, 62-302.700, 62-520.600, F.A.C.]

## X. Surface Water, Groundwater, and Ecological Monitoring

This is a consolidated condition agreed upon by three Agencies: Department of Environmental Protection (FDEP), Miami-Dade County Department of Environmental Resource Management (DERM), and the South Florida Water Management District (SFWMD). This consolidated condition sets forth the framework for new monitoring and, as may be needed, abatement or mitigation measures, for approval of FPL's Turkey Point Units 3 and 4 Uprate Application. Specific monitoring and potential modeling parameters will be identified and implemented pursuant to a monitoring plan as part of a supplemental agreement between FPL and the SFWMD as described as follows.

A. In addition to the monitoring framework set forth in this consolidated condition, within 180 days after Certification, FPL shall execute a SFWMD approved Fifth Supplemental Turkey Point Agreement ("Fifth Supplemental Agreement") to the original 1972 Agreement between FPL and the SFWMD pertaining to FPL's obligation to monitor for impacts of the Turkey Point cooling canal system on the water resources of the SFWMD in general and the facilities and operations of the SFWMD (the "Agreement"). Subject to the SFWMD's approval, FPL shall also amend the Agreement's Revised Operating Manual as referenced in Paragraph C "Monitoring Provisions" (the "Revised Plan") of the Fourth Supplemental Agreement, dated July 15, 1983. The Revised Plan shall be incorporated into the Fifth Supplemental Agreement and shall include assessment of potential impacts to surface water and groundwater, including wetlands, as needed, in the vicinity of the cooling canal system. The specific monitoring boundaries shall be determined as part of the Revised Plan.

B. The Revised Plan shall be designed to be in concurrence with other existing and ongoing monitoring efforts in the area and shall include but not necessarily be limited to, surface water, groundwater, and water quality monitoring, and ecological monitoring to:

   1. delineate the vertical and horizontal extent of the hyper-saline plume that originates from the cooling canal system and to characterize the water quality including salinity and temperature impacts of this plume for the baseline condition;

   2. determine the extent and effect of the groundwater plume on surface water quality as a baseline condition; and

   3. detect changes in the quantity and quality of surface and groundwater over time due to the cooling canal system associated with the Uprate project. The Revised Plan shall include installation and monitoring of an appropriate network of wells and surface water stations. The Revised Plan shall be approved by the SFWMD in consultation with the FDEP Office of Coastal and Aquatic Managed Areas, the FDEP Southeast District Office, and DERM.

C. FPL shall transmit electronic copies of all data and reports required under the Fifth Supplemental Agreement and the Revised Plan in accordance with timeframes as approved in the Fifth Supplemental Agreement to:

   1. SFWMD, Director, Water Supply (or alternative transmittal procedures to be described in the Fifth Supplemental Agreement);

   2. Miami-Dade County, Director, DERM; FDEP, Director, Southeast District Office;

   3. FDEP Siting Coordination Office;

   4. FDEP, Director, Biscayne Bay Aquatic Preserve Manager

D. If the FDEP in consultation with SFWMD and DERM determines that the pre- and post-Uprate monitoring data: is insufficient to evaluate changes as a result of this project; indicates harm or potential harm to the waters of the State including ecological resources; exceeds State or County water quality standards; or is inconsistent with the goals and objectives of the CERP Biscayne Bay Coastal Wetlands Project, then additional measures, including enhanced monitoring and/or modeling, shall be required to evaluate or to abate such impacts. Additional measures include, but are not limited to:

   1. the development and application of a 3-dimensional coupled surface and groundwater model (density dependent) to further assess impacts of the Uprate Project on ground and surface waters; such model shall be calibrated and verified using the data collection during the monitoring period;

2. mitigation measures to offset such impacts of the Uprate Project necessary to comply with State and local water quality standards, which may include methods and features to reduce and mitigate salinity increases in groundwater including the use of highly treated reuse water for recharge of the Biscayne aquifer or wetlands rehydration;
3. operational changes in the cooling canal system to reduce any such impacts; and/or
4. other measures to abate impacts as may be described in the Revised Plan.

[Sections 373.016, 373.223, F.S.; Rules 40E-4.011, 40E-4.301, 40E-4.302, F.A.C.; Sections 62-302 and 62-520, F.A.C.; Section 24-42, Code of Miami-Dade County, Miami-Dade County Comprehensive Development Master Plan (CDMP) Land Use Element, Conservation Element, Intergovernmental Coordination Element, Coastal Management Element.]

# B

# Near Shore Sonde Deployment Methods

The near shore sites, or mangrove sites, have sondes deployed to measure salinity using differing methods. This is due to the extremely shallow water at these locations, as well as the composition of the bottom substrate. Normally the sondes are deployed in a vertical position attached to a mooring pin, which has been cemented in place by drilling a hole in the bay floor. However, at the mangrove sites, there is insufficient water for vertical deployments, so the instruments are deployed horizontally, and the bottom is composed mainly of mud, which is unsuitable for drilling. Therefore, the instruments are deployed affixed to cement paving slabs, which have been drilled in two places at opposing corners and fitted with stainless steel eyebolts that settle into the mud, with the eyes of the eyebolts well above the bottom and in the water column. The sonde is then locked to one of the eyebolts and fastened securely to both using nylon tie-wraps. This maintains a constant horizontal position, which will remain beneath the water surface even at low tide. This positioning also provides ample space for an additional sonde to be mounted simultaneously for concurrent sampling and overlapping data at deployment and retrieval times to ensure quality control. Per instruction by YSI personnel, the instruments are oriented in a way such that the sensor's hole is not facing directly down, which could cause air bubbles to accumulate and skew the salinity data.

# C

# Survey Parameters Collected during Groundwater and Surface Water Investigations

Data collected from the survey of the groundwater monitor well, and surface water sites shall include, but not be limited to the following:

- Latitude
- Longitude
- State Planar Coordinates North American Datum of 1983 (NAD), Florida East zone
- State Planar Coordinates NAD of 1927, Florida East zone
- Natural Ground Surface Elevation
  - Elevation in North American Vertical Datum of 1988 (NAVD)
  - Elevation in National Geodetic Vertical Datum of 1929 (NGVD)
- Elevation of bottom of surface water location
  - Elevation in NAVD
  - Elevation in NGVD
- Monitor Well Top-of-Casing Elevation
  - Elevation in NAVD
  - Elevation in NGVD
- Elevation of any nearby standing surface water at the time of surveying (15 feet radius from site)

An electronic copy of the field notes, an electronic copy of all computation sheets, site photographs, a surveyor report, and benchmark sheets shall also be included.

# D

# Special Requirements for an Electromagnetic Induction Well

In general, the groundwater monitoring wells shall meet normal State or Federal Regulations for monitoring wells. The USGS publication WRIR-96-4233, located on the Web, available at (http://water.usgs.gov/owq/pubs/wri/wri964233/), provides general guidelines for the installation of monitoring wells used to evaluate water quality. In addition to these general guidelines, there are some special requirements needed for a well to be logged using an electromagnetic induction probe, including:

**Casing material PVC** - Metal casing will interfere with the log.

**Well Screen PVC** - Metal screens will interfere with the log.

**Well diameter generally 2" to 6"** - The USGS is currently logging wells 2" to 6" in diameter. For shallow wells, 2" is acceptable. For deep wells (>150 feet), the USGS suggests 3" or 4" well diameters to make sure the probe does not get stuck. The probe is most sensitive to differences in conductivity within an 8" to 40" donut-shaped radius around the well because of bends or distortions in well casing.

**Depth extending to the base of the Biscayne aquifer** - This allows evaluation of changes throughout the zone of interest. Salinity is usually but not always highest at the base of the aquifer; this is generally a good depth to set the open interval. The driller needs to be careful not overshoot the bottom of the aquifer.

If the monitoring well is to be used for detecting "upconing" directly beneath a wellfield, there are alternate strategies. If only fresh water is found when drilling, finish the well at the base of the aquifer. Future upconing would most likely begin at or near the base of the aquifer.

If salt water is found when drilling, one can: (1) Stop drilling and screen the well at this depth so that the chloride level can be monitored at this depth, or (2) Keep drilling to the base of the aquifer and complete the well at this depth to evaluate the full thickness of encroachment and maximum salinity. This would allow one to determine if seawater is encroaching preferentially through just one zone or throughout the depth of aquifer. Either

way, induction logging can help detect future upconing. Option 2 describes what is happening in the aquifer, but Option 1 provides the ability to obtain a precise chloride value in mg/l.

**Open Interval 5 to 10 feet** - The idea of a short screen length is to be able to sample a discrete interval and avoid the effects of flow within the borehole.

**Chloride Sampling** - It is generally good to collect water chloride samples during drilling to determine if encroached seawater is present.

**Annular Seal** - Neat Cement is the best type of annular seal. A seal just above the filter pack is necessary to prevent the cement from infiltrating the filter pack. A very fine sand or bentonite is proven means of isolating the well screen.

**Manhole cover** - Metal is acceptable at the top of well, but no metal should be used down the hole or on the casing.

**Well centralizers** - Well centralizers are only acceptable if they are non-metallic; metallic screws used for well centralizers can cause problems.

**Flush Mounted Finish** This is usually best because the logging requires setting a tripod over the well.

**Clustered wells** - If wells are too close together, and one has a metal object in it, this can affect the log in the other well.

**Well development** - The well should be developed to clear and consolidate the filter pack. This also needs to be done to ensure that cement did not seep into the filter pack and clog it, as well as to verify that the well is not in an impermeable zone. Well development should be performed to clear up the hole prior to well installation. If there is a lot of mud or muddy water in the hole, the first few logs might detect this. Do not use salty or electrically conductive drilling fluid.

# E

# Tritium Sample Collection and Analysis Protocols

## Introduction

The measured tritium values along with a measure of salinity (salinity, conductivity, or chlorinity) will be used in a ternary mixing model that will estimate the proportion of the three potential end members in the sample, CCS water, BBSW, and fresh groundwater. Most of the influence of the CCS on the groundwater will be through the sub-surface connection between the CCS and the Biscayne aquifer. It is possible that tritium-enriched rainfall, which originates from evaporated CCS water, could be deposited in the area immediately surrounding the CCS. Measurements of tritium in rainfall will be used to determine if tritium-enriched rainfall is occurring. If it is, the amount of this rainfall, and thus tritium, that reaches the aquifer will be estimated by taking into account the extent to which rainwater is recycled back into the atmosphere. These measurements and calculations, and other available data as applicable will be used to determine if an adjustment is needed in what is considered background levels of tritium for groundwater surrounding the CCS.

## Sample Collection and Analysis of Tritium

Samples for tritium analysis will be collected in 1-L high-density polyethylene bottles. Water can be transferred into the sample bottles using any type of sampling pump. The sample bottles do not require rinsing before filling. Sampling personnel shall not wear luminous watches because these watches can contain relatively large amounts of tritium, which would contaminate the water sample. The samples will not be filtered. Samples will be stored and transported at room temperature. Each sample will at a minimum be labeled with the sample location, collection date and time, and sampler's name. All groundwater and surface water stations (7 samples in the CCS at varying depths) identified in this Monitoring Plan will be sampled for tritium quarterly. In addition to these samples, rainfall samples will be collected from at least nine stations (discussed as follows). These rainfall samples will be used to assess whether deposition of evaporated CCS water could contribute detectable amounts of tritium via rainfall to the surface and groundwater surrounding the CCS.

The detection limit for tritium analysis shall be $\leq$10 pCi/L for groundwater and surface water samples, except as specified below. The analytical uncertainty measurement will be $\leq$10 pCi/L or $\pm$3.5 percent, whichever is larger, and the methodology used for this analysis shall be consistent with these requirements. The laboratory performing the low-level tritium

analyses will participate in the International Atomic Energy Agency's tritium inter-laboratory comparison study. This proficiency testing program is carried out every four years using standards ranging in activity from <1 pCi/L to ~2000 pCi/L. The laboratory shall maintain active participation in the proficiency testing program. FPL shall propose specific tritium analytical techniques in the QA/QC plan, including the method detection limit and the uncertainty associated with the method, for review and approval by the Agencies.

During the initial monitoring period over the first year, a test methodology with a 10-pCi/L detection level will be used for all monitoring wells and surface water outside the CCS. Detection levels for sampling within the CCS will initially be at 350 pCi/L. The adaptive monitoring approach will be used to identify appropriate changes in detection levels for specified locations.

After the first year of sampling adjustments to detection levels may be implemented if surface water samples from the CCS and wells very close to the CCS (i.e., L3 and L5) and directly underneath the CCS, have tritium levels well above the detection limits of 350 pCi/L. An acceptable alternative method would be direct liquid scintillation counting (LSC), which has a detection limit of 350 pCi/L. It is possible that some other groundwater and surface water samples will have consistent tritium values well above the lower detection limit of 10 pCi/L. If a site has been established to have a tritium concentration >700 pCi/L by four consecutive samplings over a one-year period, then future samples may be analyzed by the LSC, or equivalent, method upon the notification and approval of the Agencies.

If eight quarterly samples taken over a two-year period from a particular groundwater or surface water sampling site indicate that the tritium concentration of these samples is < 15 pCi/L or background as determined by the Agencies, then tritium sampling at that site may be discontinued. As long as the chloride concentration of the samples collected at said sampling site remains below 250 mg/L, tritium does not need to be sampled. If chloride concentrations rise above 250 mg/L, then tritium sampling shall be resumed for a time period to determine if the source of the increased chloride is attributable to the CCS.

## Tritium Measurements in Rainfall

FPL shall conduct an evaluation of the extent of influence of local rainfall on tritium levels in groundwater and surface water for purposes of providing additional data for identification of background levels of tritium. Eight rainfall collection stations will be co-located with monitoring well clusters north, east, south, and west of the CCS (shown in **Figure E-1**). One collector will be located to the north and one to the south. One collector will be located in Biscayne Bay to the east. One collector will be located adjacent to the L-31E Canal, two collectors will be located approximately two miles west of the plant, and two collectors will be located approximately four miles west of the plant. Collected rainfall data will be analyzed for a period of one year, and determination of future sampling will need to be assessed. After the testing period, based on all available information, a scientifically based level(s) of tritium in rainfall shall be identified across the area.

## Rainfall Sample Collection Protocols

The following protocols shall be used for rainfall sample protection:

- Rainfall collectors will be sampled four times per year.
- Rainfall collectors will be deployed at the sampling locations continuously, and will be designed to integrate samples collected during a three-month time period.
- At the end of every three-month sampling period, collected rainfall will be sent to the laboratory for tritium analysis. Tritium rainfall averages have been reported <10 pCi/L, therefore a laboratory detection limit of <10 pCi/L shall be used for rainfall analysis. If the concentrations of tritium in the rainfall are less than or equal to the MDL, any rainfall contributions of tritium shall be considered negligible.
- Data will be correlated with either local (temporary setups alongside rainfall collectors) or nearby micrometeorological stations.
- If tritium is observed in the shallow (<30 feet deep) monitoring wells, sampling of porewater may be conducted to determine directionality of tritium movement in the ground.

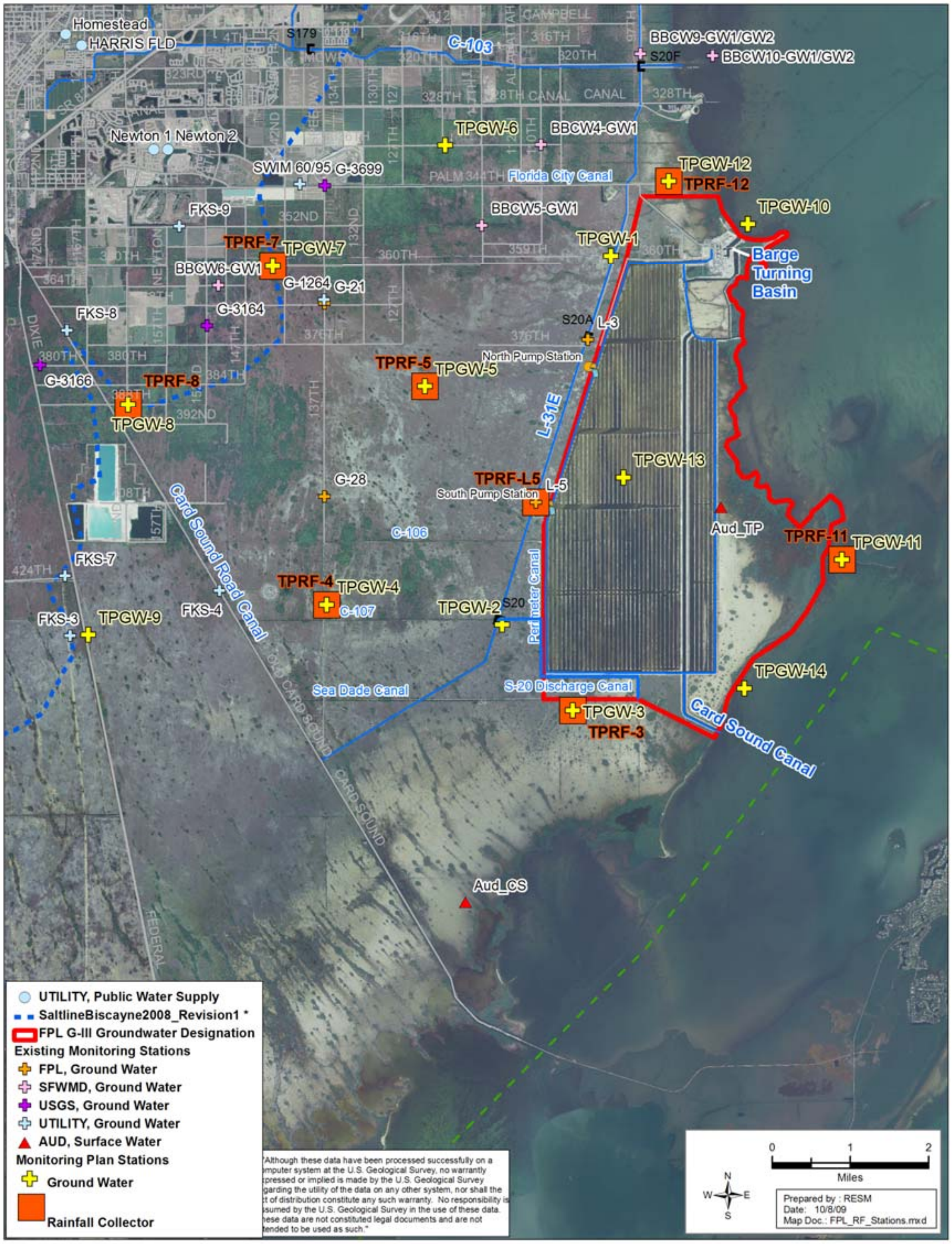


**Figure E-1** Rainfall collection stations.

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South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406
561-686-8800 • FL WATS 1-800-432-2045
www.sfwmd.gov

MAILING ADDRESS: P.O. Box 24680
West Palm Beach, FL 33416-4680