

2

Field Activities

Field Activities

- 2.1 Recording of Field Data
- 2.2 Sample Numbering System
- 2.3 Installation of Groundwater Monitoring Wells and Collection of Geologic Data
- 2.4 Groundwater and Surface Water Automated Data Collection Stations
- 2.5 Manual Field Measurements
- 2.6 Sample Collection for Laboratory Analysis
- 2.7 Automated Flow Data Collection
- 2.8 Automated Meteorological Data Collection
- 2.9 Ecological Monitoring
- 2.10 Biscayne Bay Geophysical Survey
- 2.11 Bathymetric Survey

The following sections outline the QA/QC procedures to be followed during field activities to ensure that project DQOs are met. For this project, there are two general types of field work to be performed:

- Automated data collection: chemical, hydrologic, and meteorological data recorded by dedicated probes and uploaded to a data base predominately via telemetry; and
- Manual data collection: ecological, geological, and chemical data collected by field teams.

Setup of automated systems will comply with manufacturer protocols, industry standards, and regulations by state and local governments as described in this QAPP. The automated equipment will be installed by an entity with at least 10 years of experience in the setup of automated monitoring systems. The method of installation, instrumentation, system layout, and design will be reviewed and approved by FPL prior to installation. All installation work will be overseen by FPL or their designee who is familiar with the monitoring requirements of this project. All systems, including each specific piece of equipment, will be operated and maintained in accordance with the manufacturer's recommendations and any procedures set forth by or referenced within this QAPP.

Automated equipment will include instruments to measure water temperature, specific conductance, water level, CCS flow rates, rainfall, and other meteorological parameters including air temperature, wind speed and direction, solar radiation, barometric pressure, and relative humidity.

Routine manual sampling and evaluation of groundwater and surface water shall be planned and conducted in accordance with DEP-SOP-001/01 procedures. Other manual data collection efforts, such as the boat-based geophysical survey, the bathymetric survey, geologic logging during well installation, station location and elevation survey, rainwater, and porewater sampling and ecological monitoring, will follow protocols set forth in this QAPP. Methodology and QA/QC guidelines for each of these are presented below. General guidelines for recording field data that apply to all data collection efforts are presented first as Section 2.1.

2.1 Recording of Field Data

Before starting field activities, daily logs, field notebooks, and data forms shall be set up to ensure organized data collection. Daily logs and data forms are necessary to provide sufficient data to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel. Documentation of field sampling procedures and testing data will be recorded as applicable in accordance with DEP-SOP-FD1000. All daily logs will be kept in a bound, waterproof notebook containing numbered pages. All entries will be made in waterproof ink, and the time of the entry will be recorded. Per FDEP Rule 62-160.240, F.A.C., at the beginning of each day, the project name and number, the date that the entries were recorded and weather conditions will be recorded at the top of each page of the logbook. No pages will be removed for any reason. If corrections are necessary, they must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside or below. The correction must be initialed and dated. To prevent entries being added at a later date, unused portions of the notebook pages for each day will be struck through and include the statement "no further entries this date" or words similar.

2.1.1 Logbooks

The daily logs shall include, but not be limited to, the following:

- Name of person making the entry;
- Name of team members, subcontractors, and visitors on site;
- Weather conditions;
- Drilling information when applicable, including:
 - Method employed,
 - Diameter of borehole and well casing,
 - Materials used,
 - Depth of borehole, and
 - Well construction;
- Documentation on samples taken, including:
 - Sampling location,

- Sample matrix,
- Sampling depth for subsurface and surface water samples,
- Sample identification number,
- Sampling date, time, and personnel,
- Sample sequence,
- Equipment used,
- Type of sample (e.g., grab, composite, QC),
- Quantity of each aliquot (if sample is a composite),
- Required analyses, and
- Sample preservation and verification of preservation;
- Types of field QC samples, including when and where they were collected;
- Information regarding well purging when required:
 - Depth to water and total well depth,
 - Calculations used for volume purged,
 - Flow rate of water from well,
 - Volume purged,
 - Equipment used,
 - Field measurements (temperature, DO, specific conductance, turbidity and pH),
 - Length of purge time, and
 - Date and time well was purged; and
- Calibration and maintenance of automated equipment and instrumentation.

2.1.2 Data Sheets

In some cases, it will be advantageous to record field data on data sheets rather than in field logbooks. In some cases, field data sheets shall be numbered and referred to in the logbooks.

2.1.2.1 Well Purge and Sample Records

Well purging and sampling data sheets shall be created for each sample location for ease of inclusion in the semi-annual/annual reports and posted on the FPL web database. Minimal guidelines for these sheets are found in DEP-SOP-001/01 FS 2200. The records should include at a minimum:

- Project name;
- Date and time of measurement or test (including time zone, if applicable);
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number, or other description);
- Latitude and longitude of sampling source location (if required);
- Analyte or parameter measured;
- Measurement or test sample value;
- Reporting units;

- Initials or name of analyst performing the measurement; and
- Unique identification of the specific instrument unit(s) used for the test(s).

2.1.2.2 Calibration Log

A calibration log will be maintained for each instrument to be calibrated for purpose of validating the data from the field. A calibration log will also be maintained for each of the probes at the automated stations. The documentation will include, but is not limited to, the documentation of standards, reagents, and field instrument calibration documentation as described in DEP-SOP-001/01 FD 4000. The calibration log will also include a summary indicating the acceptable calibration criteria and acceptable ranges for each parameter.

The following information shall be recorded in the log concerning standards and reagents:

- Date opened and expiration date;
- Manufacturer;
- Standard description;
- Lot number;
- Concentrations; and
- Result of calibration (pass or fail).

Calibration documentation shall include:

- Vendor certifications;
- The instrument identification (make, model, serial numbers);
- Time and date of calibration;
- Instrument reading; and
- Person(s) performing the calibration.

2.1.2.3 Maintenance Log

All inspection, cleaning, and maintenance activities will be recorded in a maintenance log for the purpose of validating field data. Each log shall include, at a minimum, the applicable items specified in DEP-SOP-001/01 FD 3000:

- Inspection notes;
- Cleaning activities;
- Date(s) problem was fixed;
- Date(s) instrument was not functioning;
- Description of the problem;

- Description of the solution;
- Names of personnel involved;
- Name of specific instrument;
- Vendor service records, if applicable, and
- Date of instrument calibration including a description of all issues encountered, as applicable.

2.1.2.4 Benchmark and Station Location Forms

In addition to recording survey information in log books, forms will be used which summarize the location and relevant information benchmarks and station locations which are surveyed by a Florida licensed surveyor. Information shall include, as applicable, but not be limited to:

- County;
- Section, Township, and Range;
- State Planar coordinates (northing and easting);
- Geographic coordinates (latitude and longitude);
- Vertical data elevations (feet) in North American Vertical Datum of 1988 (NAVD) or National Geodetic Vertical Datum of 1929 (NGVD);
- Survey class/order;
- Condition of existing monument;
- New monument information (by year, type, party chief, field book, page number); and
- Directions to monument or station.

2.1.3 Photographs

Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information will be noted in the daily logbook concerning photographs:

- Date, time, location, and direction photograph was taken;
- Description of photograph taken;
- Reason photograph was taken; and
- Sequential number of the photograph.

2.2 Sample Numbering System

The sample numbering system will be used to track data collected at the site from the time of collection through the reporting process. The system will adhere to the guidelines

specified in DEP-SOP-001/01 FD5000, Section 1, for all sampling point identifications being generated. All sampling points will be identified in such a way that the station name, date, and parameter collected will be correlated to one another.

Sampling points will be identified based on their station of origin as defined in the Monitoring Plan (e.g., TPGW-1, TPSWCCS-7). If a sample is taken at depth, then the identification will include the depth (i.e., surface [T] or bottom [B] for canal and bay samples; and shallow [S], intermediate [M], or deep [D] for groundwater wells) or the actual depth at which the sample was collected.

The parameter is the type of sample being taken. If a sample is a duplicate (DUP), an equipment blank (EB), a field blank (FB), or a field cleaned equipment blank (FCEB), the applicable acronym will be used in the sample identification along with a discrete sequential number for that day.

2.2.1 Automated Sample Nomenclature

Samples uploaded via telemetry will be clearly marked with information indicating date, time, station, depth (if applicable), and parameter. Each row containing data acquired from the instruments out in the field will contain this information, either collated or each in their own column, so that if a question arises in the data, it can be traced back to the source, when it occurred, and for how long.

Dates will be recorded using the month-day-year format (i.e., MMDDYY). Time will be recorded in the 24-hour format (i.e., military format) for hours:minutes:seconds (e.g., 18:06:15) based on Eastern Standard Time (EST). To remain consistent with SFWMD data collection efforts, the data loggers will not account for Daylight Savings Time.

2.2.2 Non-Automated Samples

The nomenclature for manual samples collected for laboratory analysis and associated field measurements will follow one of the formats below, as applicable:

- MMDDYY – Sample Location;
- MMDDYY – Sample Location – Depth;
- MMDDYY – Sample Location – Split ;
- MMDDYY – Sample Location – Depth – Split.
- MMDDYY – Field QA/QC Designation (DUP, EB, FB, FCEB) Discrete Number

2.2.3 Non-Laboratory Parameters

Nomenclature for the field parameters with no corresponding laboratory analyses will be in a format that allows for the date, time, site/station, depth (if applicable), and parameter to be clearly marked on the page. The exact format will be determined by the field team prior to the start of fieldwork and consistently applied for the duration of the project.

2.2.4 Transect Nomenclature

Transects will be set up in each of the wetlands. Freshwater wetland transects will have a prefix of “F,” while mangrove transects will have “M,” and the Biscayne Bay transects will be named “BB.” Following the alphabetic naming, these transects will be numbered starting from the north. Each set of Biscayne Bay transects (i.e. region) will be named from 1-4, starting from the north (Figure 2.2-1); each of the five transects (“a” to “e”) within a region will be named alphabetically with distance from shore. Subsequent transects established after the first year will be named with lower-case letters (e.g., F2-a, M1-b), depending on their location relative to the two nearest transect numbers or the next number in sequence if not between existing transects.



Figure 2.2-1. Transect Nomenclature for Ecological Monitoring
(transects are named starting from the north to south)

2.2.5 Plot and Subplot Nomenclature

Marsh and mangrove plots along each transect will be numbered in ascending order with increasing distance from the CCS (see representative Figure 2.2-2). All plots and subplots will be named using a three-digit system (Figure 2.2-2) which follows after the transect number. The first digit denotes the plot number while the second digit indicates plot size. The third digit will indicate where it is located within each quadrant. Subplots will be named in ascending order starting clock-wise from the north.

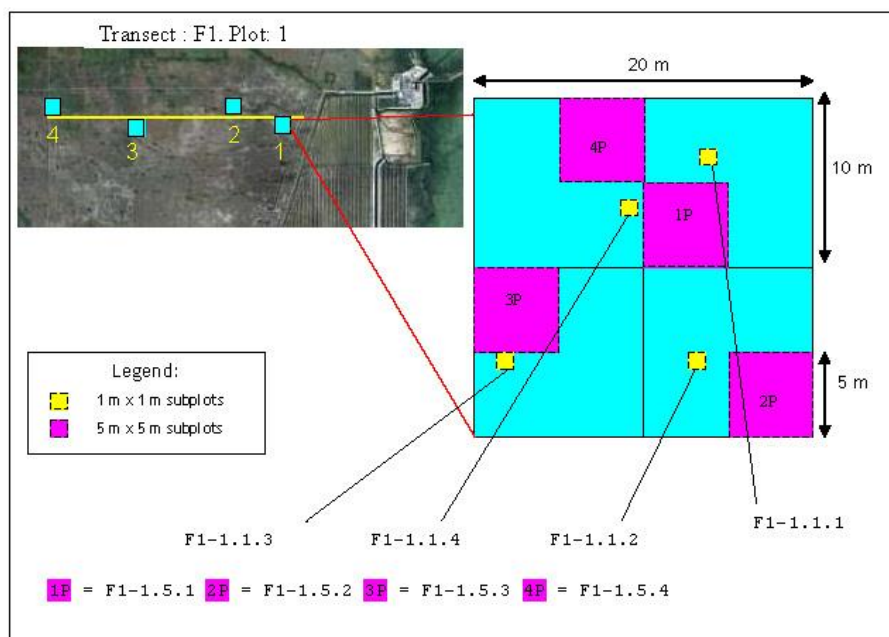


Figure 2.2-2. Transect and Subplot Nomenclature for the Ecological Monitoring Plots

For each Biscayne Bay transect, there will be eight randomly generated sites (seagrass, macroalgae, and sessile fauna such as corals and sponges) where monitoring will occur. These sites will be numbered 1 to 8 from north to south with the GPS coordinates of each site recorded to allow repeated bi-annual re-measurement at that location. Four quadrats (0.25 square meter [m²]) will be surveyed for benthic biota at each site; each quadrat will be identified based on its region (BB1 to BB4), transect (a to e), site (1 to 8), and quadrat number (1 to 4) (e.g., BB1a3-4).

2.2.6 Porewater Survey Nomenclature

Porewater sampling will occur throughout the wetlands and in Biscayne Bay at three depths per location (at 20-centimeter [cm] intervals to 60 cm deep). Although some of the samples will be collected from areas of ecological interest, other samples will be collected in a grid across the landscape, as shown in Figure 2.2-3. Samples will be collected from the midpoint of each grid. Samples will be named with a letter to denote the east-west location, a number to denote north-south location within the grid, and with a number to indicate the depth (e.g., G5 20). In areas of ecological concern where several points of interest will be measured within a grid, samples will be labeled with an additional number after the grid number (e.g., G5A-20).



Figure 2.2-3. Grid Design for Porewater Surveys in Biscayne Bay and Card Sound

2.2.7 Bathymetric Survey Transect Nomenclature

The transect number will be designated by its position in the canal. The name of the canal will coincide with the labeling that has already been created by FPL. Canals are defined as being either east or west of the Grand Canal and numbered in ascending order accordingly from this canal. There are six canals east of the Grand Canal and 32 canals to the west (Figure 2.2-4). Transverse canals are labeled based on their mileage from the Turkey Point Nuclear Power Plant (Figure 2.2-4). Specific locations within the CCS system will be noted by canal name (1 to 32, or E1-E6) followed by a specific mile number (0.0 to 4.9) from north to south (e.g., 5-0.8 for the 5th canal west of the Grand Canal, 0.8 mile south; or E1-3.2 for the canal immediately east of the Grand Canal, 3.2 miles south in the CCS). Any deviations in the nomenclature described above may be allowed subject to concurrence by the FPL PM (or their designee).

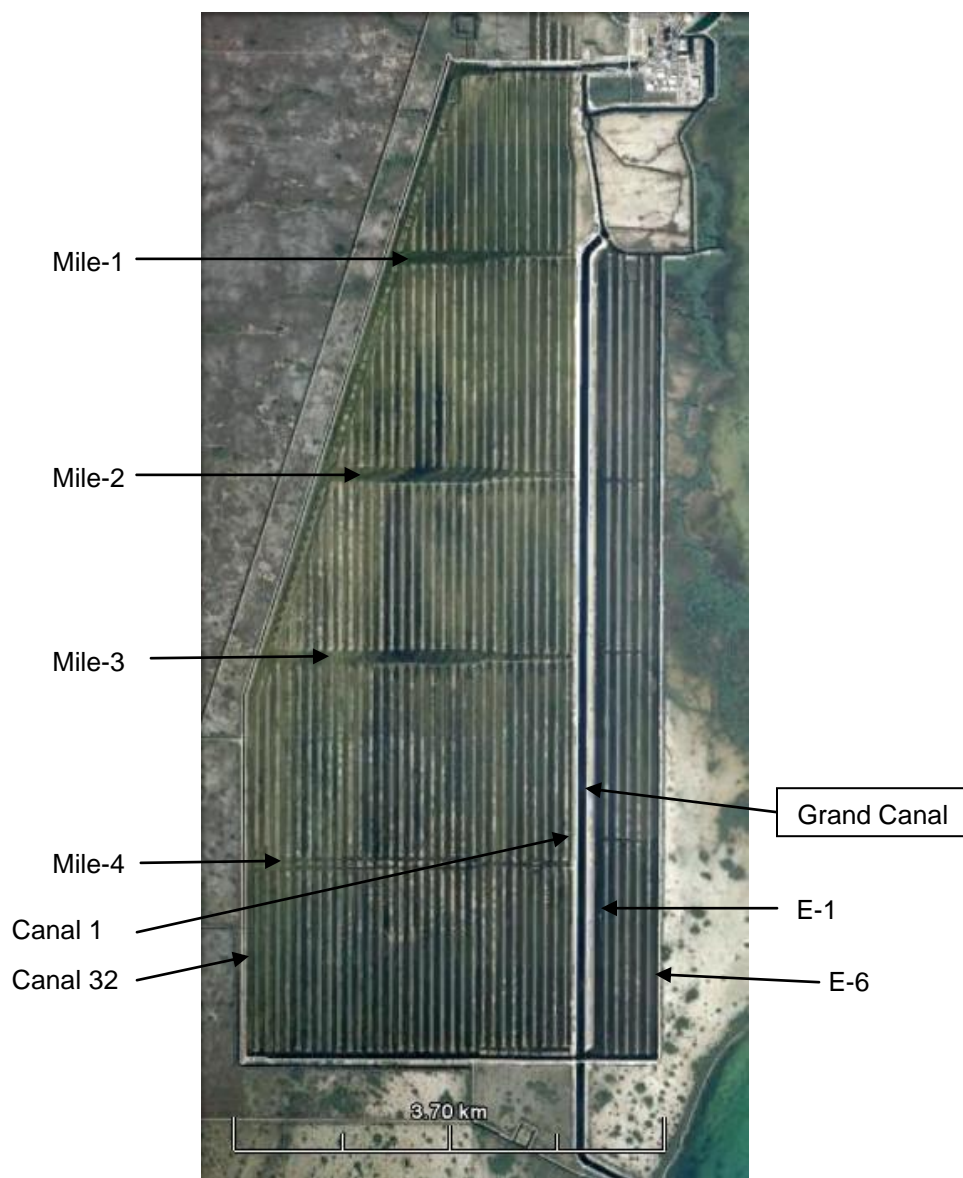


Figure 2.2-4. Names for each CCS Canal to be used in Bathymetric Survey Transect Nomenclature

2.3 Installation of Groundwater Monitoring Wells and Collection of Geologic Data

Fourteen monitoring well clusters, each comprised of three wells, will be installed in the vicinity of the CCS and the surrounding area at locations identified in the Monitoring Plan (Figure 2.3-1).

All geologic data collected from the boreholes and wells will be conducted under the supervision of a state-licensed/registered, professional geologist with at least five years' overall geologic experience. In addition, the senior well driller will be licensed in the State of Florida.

2.3.1 Well Locations and Depths

The well clusters are spatially distributed to facilitate groundwater monitoring and are generally aligned along transects to aid in determining salinity and ionic concentration gradients on a sub-regional scale. As some of the locations of these wells have been modified from the Monitoring Plan, the proposed locations as of April 2010 are provided (Figure 2.3-1). The exact locations may be adjusted in the field by FPL with Agency concurrence based on site-specific conditions or permitting constraints. Changes to sampling locations will be provided in the relevant reports.

The wells in each cluster will be completed with a discrete screen interval with one well in the upper (approximate depth of 30 feet), one well in the middle (approximate depth of 60 feet), and one well in the lower portion (approximate depth of 100 feet) of the Biscayne aquifer. The base of the Biscayne aquifer will vary from location to location, but is expected to be between 80 to 120 feet below land surface.

2.3.2 Borehole Drilling and Well Installation

Rotary drilling will be used for the installation of the wells. Bentonite drilling mud will not be used during any of the drilling. Potable water with moderate use of a drilling polymer, such as Tiger Mud[®] for recovery of soft quartz sand, can be used if needed. Drill cuttings will be disposed on site in upland areas on FPL property; airlifted development water will either be released into the CCS or the surrounding area in coordination with the appropriate regulating agencies. The method of disposal will be documented in the Geologic and Hydrogeologic Report or the Annual/Semi Annual Report. Prior to drilling activity, FPL or contractor representatives will obtain the following permits, as applicable:

- DERM Class 1 Coastal Permit or Class IV Freshwater Wetland;
- BNP Research Permit;
- FDEP/U.S. Army Corps of Engineers (USACE) Environmental Resource Permit;
- State Consent of Use or Easement for Submerged Lands;
- Rights-of-way permits on county lands;
- Well constructions permits for the wells (well driller); and
- United States Coast Guard (USCG) Aid to Navigation.

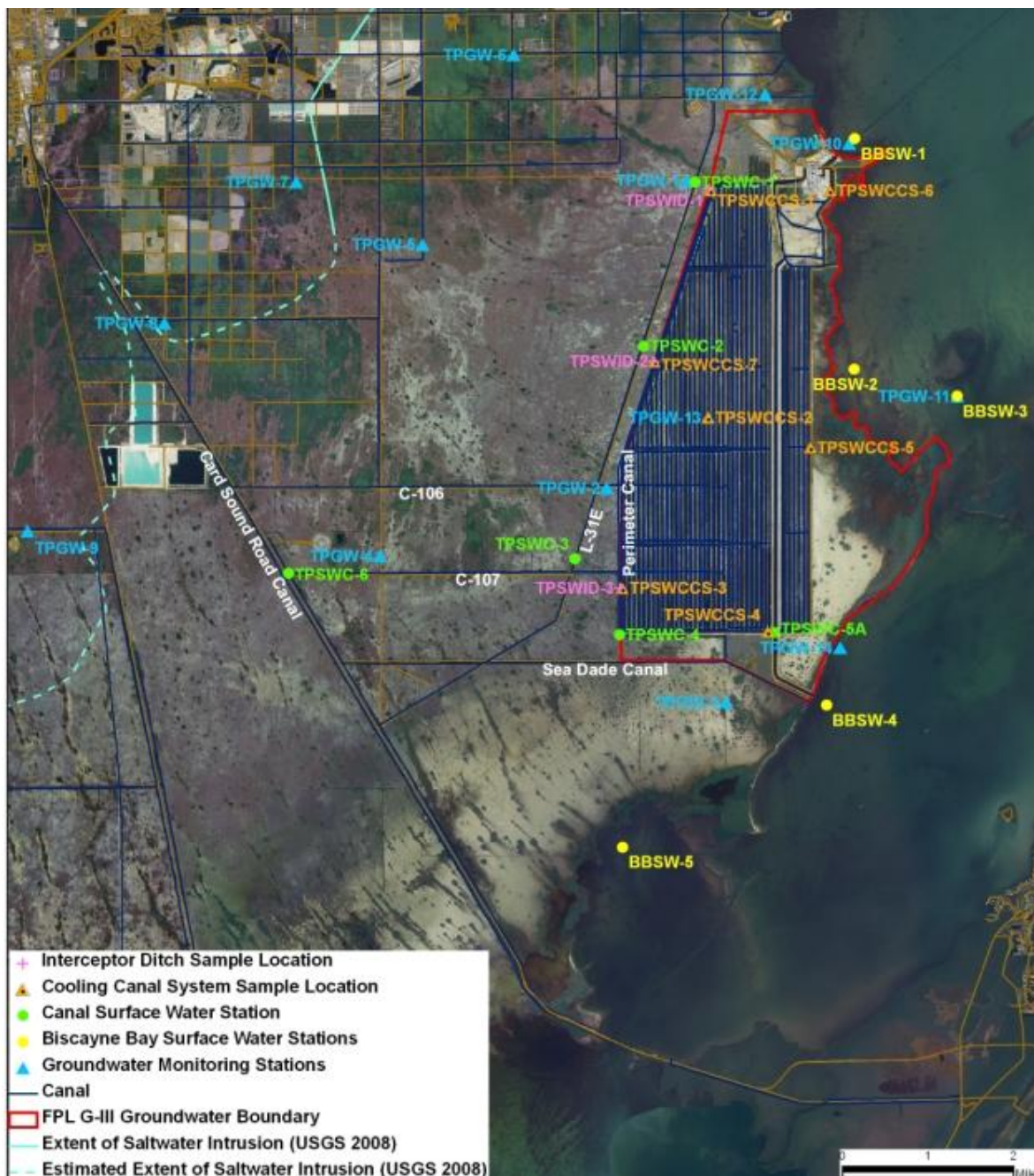


Figure 2.3-1. Locations of all proposed surface and groundwater sampling locations (08/03/10).

Also, approvals from property owners to install wells on their property or allow access to wells through their property will be obtained by FPL in advance of drilling activities.

The following text describes, in more detail, procedures to be used for drilling and logging boreholes and installing wells. Deviations from the methods outlined below may be allowed as long as the methods achieve the same objectives and are approved by FPL's PM (or their designee) and technical consultants.

2.3.2.1 Surface Casing

To prevent the migration of surface water and unconsolidated material into the borehole during coring, either 8 or 10-inch-diameter schedule polyvinyl chloride (PVC) surface casings will be installed at each deep boring location. For those locations where the casing extends above the ground surface, grey schedule 80 PVC pipe will be used. These surface casings will be installed using rotary drilling techniques.

An 8 to 10-inch-diameter auger will be advanced to the top of bedrock and the casing inserted in the hole. The casing will be grouted in place with neat cement that conforms to ASTM C150, Type II or API Class B standards using the tremie method prior to drilling the boreholes.

2.3.2.2 Pilot Boreholes

Following the completion of the surface casing, a pilot borehole will be advanced to delineate the base of the Biscayne aquifer and characterize the aquifer's characteristics. This information will help determine the placement and the monitoring well screens. Each pilot borehole will be advanced below the 8-inch surface casing. Core samples will be collected inside the surface casing using 4-inch-diameter wireline coring equipment using appropriate soft-hard-rock core catchers or soft-sediment retainer baskets. Soft or unconsolidated geologic samples will be collected from land surface (seafloor) to the total borehole depth. Recovery of at least 60% of all rock or sediment is required for this project.

All core samples will be logged by the on-site geologist and will be boxed and marked with red and black permanent markers to ensure proper orientation of the cores if they are removed from the box. The top and bottom of each core will be designated following U.S. Geological Survey (USGS) protocol to ensure that cores are properly oriented during further inspections. Following extraction, each core will be marked along its length with a red line on the right and black line on the left. Each box will be labeled with the well designation and depth interval.

The pilot boreholes will be developed using the compressed airlift method by injecting air via a flexible hose up through the bottom of a 3-inch drill pipe allowing sand and cuttings to be lifted out of the borehole through the inner diameter of the drill pipe. A right-angle elbow will be provided at the top of the drill string for extrusions of borehole fluids, rock cuttings, and sediment. Airlift will continue until the borehole remains open and the fluid is clear of particulate. The air compressor for this effort will be rated at a minimum of 180 cubic feet per minute (cfm) and no more than 320 cfm.

2.3.2.3 Decontamination of Well Drilling Equipment

Before the mobilization of the drill rig to the site, the contractor will thoroughly clean the rig and all associated equipment to remove any oil, grease, mud, etc. The decontamination of all drilling equipment, including the drill rig, and all down-hole equipment (drill pipe, tools, core barrels, etc.) will be performed before arrival at the site. This includes scrubbing the equipment with a non-phosphorus detergent (Liquinox[®] or equivalent) and using a high-pressure steam cleaner followed by a rinse with fresh water. Groundwater from an on-site supply well may be used if specific conductance is less than 1274 micro Siemens per centimeter ($\mu\text{S}/\text{cm}$). The site

geologist will confirm that proper decontamination has been completed prior to beginning drilling activities and will confirm proper decontamination between locations.

2.3.2.4 Well Installation

After the geophysics on each deep pilot borehole is completed, the results will be reviewed by FPL and a recommendation will be made to the SFWMD regarding screen intervals, screen lengths, and sand pack. Following concurrence by the SFWMD, the deep boreholes will be converted into the deep Biscayne aquifer wells. Corresponding shallow and intermediate monitoring wells will be installed adjacent to each deep well using rotary drilling techniques with a 6-inch-diameter drill bit. Tailpipes will be installed in the deep wells.

Each well will be constructed of 2.0-inch-diameter, schedule 40 flush threaded PVC casing below ground with 0.020-inch, factory-slotted, PVC well screen for matrix zones and 0.060-inch, factory slotted, PVC well screen for secondary porosity zones. The length of the well screens will be based on field conditions and will typically be between 2 to 5 feet in length. All well components (including centralizers, if used) must be non-metallic. A commercially-graded clean silica material will be installed around the well screen using the tremie method. For the 0.060-inch slot screens, pea gravel (1/4- to 1/8-inch) will be used, and for the 0.020-inch screens, 6/20 silica sand will be used unless agreed to otherwise by the SFWMD.

The sand filter pack will extend to a height of approximately 1 foot above the top of the well screen. A 0.5- to 1-foot fine sand layer will be placed above the sand filter pack followed by a 0.5 to 2-foot-thick seal of bentonite using bentonite pellets. The remainder of the borehole will be pressure grouted to just below land surface with neat cement grout using the tremie method. The cement used will conform to ASTM C150, Type II, or API Class B standards. If large cavities are present in the borehole, they may be filled with quartz sand, gravel and/or bentonite pellets. Once the cavities are filled, grouting with cement will continue. If more than one lift is required, the grout will be allowed to set up for a minimum of 12 hours between lifts. To ensure well plumbness, all wells will be constructed under tension. In the deep wells, USGS will utilize a 1.5-inch-diameter logging tool to confirm adequate plumbness.

2.3.2.5 Wellhead Completion

The on-site geologist will direct the well completion. The type of well completion (flush mounted or “stick up”) will be based on site conditions. Wells that can be completed as flush mounts are preferred, particularly in areas where vandalism is high. Above-ground (stick up) completions are required at locations that are in Biscayne Bay, are prone to regular inundation such as in wetlands, or may be difficult to find during subsequent monitoring. Each well will be fitted with a vented, locking cap and all well locks will be keyed alike. The well completions will be constructed in a manner that facilitates the long-term use of permanent sensors in the wells while preventing the introduction of surface water or other surface material into the wells.

2.3.2.6 Well Identification

Upon completion of the well installation, stainless steel labels will be made and placed on all wells (or platforms) and will include the following information:

- Well location identification name and number;

- Elevation to top of casing (NGVD);
- Depth of well;
- Screen interval of well; and
- Owner of well: FPL.

2.3.2.7 Well Development

Each well will be developed after grouting has set by pumping until clear, sediment-free water is obtained and field water quality parameters stabilize in accordance with the DEP-SOP-001/01 FS 2200. Additionally, the following parameters will also be recorded:

- Duration of pumping
- Quantity of water pumped
- Static water level
- pH
- Temperature
- Specific Conductance
- DO
- Turbidity
- Color
- Order

2.3.2.8 Plugging and Abandonment

If the on-site geologist determines that a borehole or monitoring well is not satisfactory, or the project team determines that the pilot boreholes should be abandoned after logging, the casing and screen or other material used will be removed and the hole backfilled with neat cement grout from bottom to top. A suitable replacement location will be identified and the well will be reinstalled unless FPL and the SFWMD agree on a different solution.

2.3.3 Hydrogeologic Testing of the Flow Intervals

Hydraulic conductance can be calculated using data collected during single well tests. Typically, either slug tests or pump tests are performed to collect the appropriate data. Given the expense of managing water that would be generated during a pump test, slug tests will be the most appropriate method of collecting the data needed to determine hydraulic conductance.

Slug tests are single-well tests that may be used to determine the horizontal hydraulic conductance of distinct geologic horizons under in-situ conditions. Slug tests are performed by suddenly adding or removing an object of known volume from a well and observing recovery of the water surface to its original level. Only the hydraulic properties of the formation immediately surrounding the well screen can be estimated; therefore, lateral spacing between wells and the vertical extent of the screen must be considered.

The slug may be constructed of stainless steel or sand-filled PVC of a known volume. The slug will be decontaminated prior to use using the procedures outlined in Section 2.6.2 of this QAPP. Slug tests will be performed on relatively undisturbed wells. If a test is conducted on a well that has recently been pumped for development or sampling, the measured water level must be within 0.1 foot of the initial water level measured prior to disturbing the well.

Water level measurements will be conducted in accordance with Section 2.5.6 of this QAPP or by using an appropriate pressure transducer and data logger. The datum will reference the top of casing of the well. The slug will be added or removed from the well as quickly as possible after measurements indicate that the water level has stabilized. With the moment of volume addition or removal assigned time zero, the depth to water will be measured and recorded to a minimum of 0.1 foot. The number of depth-time measurements necessary to complete the test will depend upon formation transmissivity and will be determined using previous aquifer tests and evaluations. Water level measurements will continue until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semi-log plot of time versus depth.

Based on hydrogeologic information gained during the monitoring effort, pump tests may be required at a later date. If additional testing is deemed needed by FPL or requested by the Agencies pursuant to the provisions contained in the Monitoring Plan or Agreement information will be provided as an appendix to the Geology and Hydrogeology Report required in the Monitoring Plan

2.3.4 Geological Imaging and Logging

Imaging and geophysical logging of boreholes (optical borehole imaging [OBI], electromagnetic induction, caliper, temperature, gamma ray, full waveform sonic, flow) must be conducted by an entity experienced in the use of the associated field instruments and interpretation of their results. All work must be overseen by a geologist registered in the state of Florida and who has experience conducting geophysical analysis and has working knowledge of south Florida geologic and hydrogeologic conditions. Induction logging of the deepest well within each cluster will be conducted annually during the dry season.

To ensure the collection of high-quality data, bentonite drilling muds, saline water, or other materials which can interfere with the geophysical instrumentation will not be allowed during the drilling of the deep pilot boreholes. All deep pilot holes used for geophysical logging must be first developed by the drilling contractor using an airlift to remove fines from the well.

All logging will be conducted in accordance with the following ASTM standards:

- D5737-95e1 Standard Guide for Planning and Conducting Borehole Geophysical Logging;
- D6167-97 (2004) Standard Guide for Conducting Borehole Geophysical Logging: Mechanical Caliper;
- D6274-98 (2004) Standard Guide for Conducting Borehole Geophysical Logging: Gamma; and

- D6726-01 Standard Guide for Conducting Borehole Geophysical Logging: Electromagnetic Induction.

All instruments will be calibrated as applicable in accordance with manufacturers' instructions. Procedures used to calibrate instruments and the associated calibration results will be documented by the entity conducting the geophysical survey.

Per Appendix D of the Monitoring Plan, well components that are installed below ground such as casing, screen, and centralizers must be made of non-metallic materials to avoid interfering with electromagnetic induction logs that may be conducted on wells. Information on the USGS borehole logging program is included in Appendix H of this QAPP.

2.3.5 Drilling and Well Installation Logs

A single, continuous, drilling log will be produced for soil cores or samples obtained from each deep pilot hole location. At a minimum, the drilling logs kept by the on-site geologist will include the following information:

- Project name;
- Site location;
- Time and date of record;
- Boring/well location and identification;
- Drilling contractor and name of driller;
- Drilling equipment (size and type);
- Name of geologist;
- Drilling method, diameter, and lengths of drill rod and casing;
- Geological sampling methods;
- Drilling polymer used, if any;
- Geological materials and depths;
- Encountered depths of lost circulation zones and methods of regaining circulation;
- Drilling rate, time, and depth (1-foot drilling times, in seconds);
- Well installation date;
- Well construction details (depth from top of casing, depth to top of screen, screen length, well construction material, and screen length); and
- Well development details (flow rate, quantity, duration, and water quality).

An example of a well construction worksheet that can be used to record the majority of this information is included in Appendix C.

2.4 Groundwater and Surface Water Automated Data Collection Stations

A total of 38 automated stations (1 meteorologic, 3 flow, 14 groundwater and 20 surface water) will be established in and around the CCS, of which 29 stations will have telemetry. Each groundwater well cluster described above (i.e., three wells) will comprise a groundwater monitoring station. Every groundwater well will have two separate probes; the first probe is a pressure transducer located <15 feet below ground to measure water level (i.e., stage). The second probe will be located at the middle of the screened interval and will measure specific conductance and temperature. Fourteen groundwater well clusters (i.e., 42 wells) with a total of 84 probes will be established in the Monitoring Plan. The number of stations may be modified over time consistent with the provisions contained in the Monitoring Plan and with approval by the District.

To measure stage (water level), pressure transducers will be deployed approximately 1 ft below low water or the lowest expected water depth. The probes will measure stage at 15-minute intervals and be referenced to a surveyed control elevation.. All probes will be linked to the telemetry system and data will be uploaded daily. Equipment acceptance criteria for the automated measurements are provided in Table 2.4-1. Probes will be checked for fouling during routine maintenance, initially proposed at six-week intervals for surface water Biscayne Bay stations, and at eight-week intervals for all other surface water stations and groundwater wells. As calibration and verification of the groundwater stage probes can only be conducted by the manufacturer, the frequency of calibration will be based on manufacturer's specifications or if drift is observed.

There will be a total of 20 automated surface water stations and one manual monitoring station installed throughout the project area. Fifteen of the automated stations will be located along canals with some accessible via platform boardwalks that extend over the bottom of the canals (7 to 10 feet from canal banks). Seven stations will be located in the CCS (Figure 2.3-1), five in the surrounding canals (L-31E, S-20, and Card Sound Canal), and three in the Interceptor Ditch. Where mean water depths are in excess of 3 feet, two probes (one stage, temperature, and specific conductance probe; and a second probe with only temperature and specific conductance) will be deployed. Only one probe (stage, temperature, specific conductance) will be deployed at locations where mean water levels are <3 feet unless noted otherwise in the Monitoring Plan. The probe that includes stage measurements will be located at a surveyed location approximately 3 feet below minimum water level. The second probe (temperature and specific conductance) will be located approximately 1 foot from the bottom. The probe setup for the L-31E, S-20, Card Sound Canal and Interceptor Ditch stations (Figure 2-3 in the Monitoring Plan) will be similar to the CCS stations. All stations will have telemetry.

Five automated stations will be located in Biscayne Bay and deployed on subsurface concrete pads, similar to the setup used by Biscayne National Park (Appendix B in the Monitoring Plan). These stations will consist of one specific conductance and temperature probe that will monitor water conditions at the bottom of the water column at each station. Biscayne Bay stations will not have telemetry with the exception of BBSW-3 which is co-located to TPGW-11. Data from stations without telemetry will be collected when these instruments are calibrated and cleaned at six-week intervals; BBSW-3 data will be uploaded nightly via

telemetry. The duration between probe cleaning and calibration will depend on probe performance and fouling.

The same model and make of automated probes for specific conductance and temperature determination will be used in this project (Appendix I). The probes will be designed to tolerate conditions in the CCS and able to operate in water with salinities in excess of 70 ppt and water temperatures in excess of 105°F. Probes placed in surface waters will have copper anti-fouling guards placed at the end of the sonde housing, around the sensors, to minimize bio-fouling and ensure the effective operation of the instrument. Routine cleaning and maintenance of probes will be in accordance with manufacturers' specifications, although this schedule may be adjusted depending on probe performance at each specific location.

Monitoring equipment must be installed by representatives experienced in the installation of scientific monitoring equipment and meet the requirements specified in DEP-SOP-001/01 FT 1000. During installation, training on instrument principles for project personnel will be conducted. Training shall include methods to ensure manufacturers' specifications are being followed and applicable system diagnostics tests. All equipment will be tested prior to startup to ensure data are being properly recorded and transmitted. All testing and training done will be documented, including personnel names, training content, and date, and training records will be stored in accordance with Section 4.

Probes will be installed in accordance with the manufacturers' instructions and will have adequate battery capacity to record and/or transmit a minimum of 30 days of data. Data from each automated station will be collected at 15-minute intervals from the top of each hour and uploaded to a database unless noted otherwise in the Monitoring Plan or subsequent addendums. Data review, verification, and validation procedures are addressed in Section 4.

To the extent practical, supporting equipment such as batteries, data loggers, or embedded personal computers (PCs) will be housed in weather-proof enclosures. Some of the enclosures will need to be constructed in a manner that minimizes the loss of instrumentation and data due to vandals (including gun fire).

2.4.1 Calibration of Automated Instrumentation

All the probes should be factory-calibrated prior to being shipped from the manufacturer. All probes will also be field-verified prior to installation at each station. This initial calibration verification shall be documented by the manufacturer and a copy of the calibration will be kept on file with subsequently generated calibration logs for that probe. Field calibration of the specific parameters to be measured will be performed and then documented in the calibration log before use by doing a continuing calibration check for verification of accuracy.

Probes not calibrated by the manufacturer will undergo an initial calibration followed by calibration verification prior to installation in accordance with manufacturers' instructions and applicable FDEP SOPs. Once the instrumentation is installed, a routine maintenance and calibration schedule will be developed based on manufacturers' recommendations and refined based on the ability of the field instrument to maintain calibration. An initial schedule of two month-intervals is proposed for routine maintenance and calibration of the groundwater wells, CCS, and Interceptor Ditch Stations, while all the other surface water stations (L-31 Canal, S-20 Discharge Canal, Card Sound Canal, and Biscayne Bay) will be visited at six-week intervals

after installation. This schedule may be adjusted as the work progresses based on operation of the probes in the different environments.

The specifications for calibrations of monitoring equipment in SFWMD-FIELD-QM-001, Section 6 will be followed. The procedures specified below are essential calibration requirements that must be performed on field monitoring equipment for each field parameter:

- **Initial Calibration (IC):** The probes are adjusted (manually or automatically) to a theoretical value (e.g., dissolved oxygen [DO] saturation) or a known value of a calibration standard.
- **Initial Calibration Verification (ICV):** The probe is checked or verified directly following initial calibration by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the FDEP SOP.
- **Continuing Calibration Verification (CCV):** The probe is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.
- **Chronological Calibration Bracket:** The interval of time between verifications within which environmental sample measurements must occur. This time interval shall be consistent with manufacturers' recommendations for each type of probe used and initially set not to exceed two months. If historically generated data demonstrate that a specific instrument remains stable for longer or shorter periods of time, the time interval will be adjusted based on the shortest interval the instrument remains stable upon approval by the District.
- **Quantitative Calibration Bracket:** The probe is calibrated or verified at a minimum of two known values that encompass the range of observed environmental sample measurement(s) prior to being taken offline for routine maintenance and calibration. Samples results that are not bracketed by calibration standards, where multiple standards are used, are qualified as estimated. Confirmation will also be conducted using a second probe dropped into the same depth as the initial probe to determine the degree of drift of the initial probe.
- **Initial calibration and verification checks shall be within stated calibration acceptance criteria in Table 2.4-1. If an initial calibration or verification fails to meet the acceptance criteria during a sampling event, the probe will be immediately re-calibrated following a specific initial calibration procedure or removed from service.**

For parameters that are calibrated by the manufacturer (i.e. temperature), only verification is performed. Verification failures will be documented in the comment section of the field log with discussion of which parameter failed and corrective actions taken. Verification failures for parameters calibrated by the manufacturer require the instrument be returned to the manufacturer for re-calibration. Data prior to acceptable calibration will be reported with a 'J' qualifier.

Table 2.4-1. Automated Field Parameters and Equipment Acceptance Criteria

Parameter	Matrix	Reporting Units	Resolution	Accuracy*
Stage	SW, GW	ft	0.01	0.03 ft
Specific Conductance	SW, GW	µS/cm	0.1	± 5% of the true value of KCl standard
Temperature	SW, GW	°C	0.1	± 0.5°C

Note: Accuracy for Stage and Temperature from SFWMD Task Force, Appendix B and C, Accuracy for Specific Conductance is from the FDEP SOP.

Key:

GW = groundwater

KCl = potassium chloride

SW = surface water

The continuing calibration verification of the automated sensors will be verified on a six- to eight-week schedule. If the instrument calibration is verified, as described in Table 2.4-1, then sample results (between the initial calibration and the continuing calibration verification) are considered acceptable. The criteria for the temperature and specific conductance are from the FDEP's respective SOPs. Stage accuracy is based on SFWMD Quality Assurance Task Force (QATF) – Quality Guidelines for SHDM Deliverables, Appendix B.

A second, calibrated, hand-held field instrument may be used to measure field parameters and water levels to confirm the accuracy of the automated readings in-between routine calibrations. The hand-held field instrument will be dropped into the depth of the automated probe to conduct an in-situ verification of the automated reading. The criteria listed in Table 2.4-1 also apply to the secondary confirmation instrument readings. If the criteria for the second instrument confirmation are exceeded, then the continuing calibration verification process will be initiated for the original, dedicated instrument.

Calibration must be performed each time the probe is taken off-line, after every preventative maintenance activity, and immediately after determining that the criteria verifications in the list above are not met. Records of calibration and maintenance efforts (discussed in Section 2.1) will be kept for each probe.

2.4.2 Surveying of Automated Stations

In order to ensure accuracy of water depth measurements, all groundwater wells and surface water monitoring stations will be surveyed. Horizontal coordinates and vertical elevations will be performed by a Florida licensed/registered surveyor in accordance with the Florida Minimal Technical Standards. Vertical control will be established to 3rd-order procedures with 2nd-order closure and elevations referenced to NAVD and NGVD. Horizontal control will be established to 3rd-order Class 1 standards and referenced to State Planar Coordinates North American Datum of 1983 (NAD) Florida East zone and State Planar Coordinates NAD of 1927 Florida East zone.

For surface water stations, a mark or disc will be placed on the platform where the elevation was recorded. At wells, a mark will be placed on the side of the top of casing where the elevation was recorded. To facilitate future survey efforts or to quickly reestablish an

elevation if a well is damaged, a permanent benchmark will be placed at or near all onshore well clusters. Also, the ground elevation will be recorded at stations where a stage recorder is used.

In addition to surveying in the automated stations, the existing staff gages used for the Interceptor Ditch Operation will be tied into the monitoring station survey. The staff gages will be verified and referenced to NAVD and NGVD elevations. This will ensure consistency in interpreting data, as all information will be to the same datum as part of the same survey network.

2.4.3 SFWMD Quality Guidelines

Per the SFWMD Quality Assurance Task Force (QATF) – Quality Guidelines for SHDM Deliverables, FPL will follow the SFWMD's quality guidelines listed below for the groundwater and surface water data collection stations (Table 2.4-2). The accuracy guidelines listed in the document are incorporated into Section 2.4, above. The surface water and groundwater instrumentation quality guidelines for availability (reliability and maintainability), completeness, and timeliness are described below. The definitions of these guidelines are presented in Section 1.

Table 2.4-2. Additional SFWMD Quality Guidelines – Groundwater and Surface Water Stations

Parameter	Units	Quality Guideline
Reliability	months	18 ¹
Maintainability	hours	72 ²
Completeness	%	90
Timeliness	hours	24 ³

Key:

1 = mean time between failures

2 = failure repaired within guideline timeframe for 95% of all incidents

3 = real-time delay for stations with telemetry and post-processing delay

2.5 Manual Field Measurements

Field parameter measuring equipment includes instruments used during the manual collection of surface water or groundwater samples to identify physical/chemical characteristics of the sample that are representative of field conditions as they exist at the time of sample collection. They are also used during the purging of a monitoring well prior to the collection of groundwater samples. The use of all instruments should follow a basic format to imply consistency of use. Regardless of the brand of meter used, all meters shall be properly maintained and operated in accordance with the manufacturers' instructions, and calibrations shall be checked prior to use.

The field parameters listed in Table 2.5-1 will be measured during groundwater and surface water sampling events. Table 2.5-1 describes the performance criteria for the selection of monitoring equipment. The accuracy of the instrument employed must meet or exceed the criteria specified. These criteria, as well as the other field measurement guidance below, are in accordance with FDEP-SOP-001/01 FT 1000 General Field Testing and Measurement (FSQM) and SFWMD-FIELD-QM-001 Field Sampling Quality Manual. Calibration and verification for

each instrument unit and field test must be linked with all sample measurements from that site. If any calibration verification fails to meet the acceptance criterion outlined in Table 2.5-1 in the field and it is not possible to reanalyze the sample(s), the comment “Calibration verification failed for parameter X” will be placed in the comment field of the field sampling or calibration log with discussion of which parameter failed and corrective actions taken. Verification failures for parameters calibrated by the manufacturer require the instrument be returned to the manufacturer for recalibration. Data prior to acceptable calibration verification will be qualified with a ‘J’ qualifier.

Table 2.5-1. Manual Field Parameters and Equipment Performance Criteria

Parameter	Matrix	Reporting Units	Acceptance Criteria*
pH	SW, GW	pH Units	± 0.2 pH units
DO	SW, GW	mg/L	± 0.3 mg/L of saturation chart at temp
Specific Conductance	SW, PW, GW	µS/cm	± 5% of the true value of KCl standard
Temperature	SW, PW, GW	°C	± 0.5°C
PAR	SW	µmols/m ² s	NA
ORP	SW	mV	± 20 mV

Note:

* Acceptance criteria taken from SFWMD-Field-QM-001, Section 6, with the exception of ORP which is based on YSI manufacturer specifications.

Key:

SW = surface water

GW = groundwater

PW = porewater

KCl = potassium chloride

mols = moles

Calibration and calibration verification procedures for the collection of physical parameters are similar for both grab and long-term deployment data collection (see Section 2.4). Table 2.5-2 summarizes procedures for grab samples typically associated with quarterly or semi-annual sampling. Each parameter is discussed separately below.

Table 2.5-2. Field Instrument Calibration Summary

Parameter	Initial Calibration	Initial Calibration Verification (ICV)	Continuing Calibration Verification (CCV)
pH	<ul style="list-style-type: none"> – Use at least 2 standards: pH 7 and then pH 4 and/or 10 – Standard choice other than pH 7 is dependent on station pH history – Conduct within 24-hour period prior to use for grab sample collection or if CCV fails 	<ul style="list-style-type: none"> – Read a standard as a sample – Must read within ± 0.2 standard pH units of calibration buffer TV 	<ul style="list-style-type: none"> – Read at the end of each sampling day, no later than 24 hrs after initial calibration – Read without pressing “calibrate” – Two buffers that bracket the sample value range. Preferably use the pH 7 and one other pH 4 or 10 – Must read within ± 0.2 standard pH units of calibration buffer TV
Specific Conductance	<ul style="list-style-type: none"> – Use 1 standard at the upper end of expected sample reading range but no less than 720 $\mu\text{S}/\text{cm}$ – Conduct daily prior to use for grab sample collection or if CCV fails 	<ul style="list-style-type: none"> – Read after pressing “Calibrate” – Up to 3 standards that bracket the sample range – Must be within $\pm 5\%$ of TV 	<ul style="list-style-type: none"> – Read at the end of each sample day, or within 24 hrs of initial calibration for grab sample collection. – Read only (do not press “calibrate”) – One standard used to verify calibration. Must be within $\pm 5\%$ of TV
Temperature	–		<ul style="list-style-type: none"> – Monthly verification against NIST-traceable thermometer – Must be within $\pm 0.5^\circ\text{C}$ of NIST traceable readings
DO	<ul style="list-style-type: none"> – Read under water-saturated atmosphere – Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature 	<ul style="list-style-type: none"> – Read under water-saturated atmosphere – Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature 	<ul style="list-style-type: none"> – Read under water saturated atmosphere – Reading must be within ± 0.3 mg/L of expected soluble oxygen (in water saturated air) value at that water temperature – Do CCV at the end of the event, or within 24 hrs after initial calibration, whichever is less
ORP	<ul style="list-style-type: none"> – Within 24 hours, prior to use or if CCV fails – Verify meter response against redox standard 	<ul style="list-style-type: none"> – Must be within ± 20 mV of theoretical redox value 	
PAR (Light Extinction)	<ul style="list-style-type: none"> – Verify meter at zero irradiance – Meter must not read > 0 – PAR sensors are calibrated by the manufacturer every two years 		

Source: SFWMD-FIELD-001-05 Table 6.5.A

2.5.1 Field Measurement of pH

Water pH is used to express both acidity and alkalinity on a scale which ranges from 0 to 14, with 7 representing neutrality. The measurement of pH will be performed in accordance with

FDEP-SOP-001/01 FT1100 Measurement of Hydrogen Ion Activity. A summary of the calibration procedures and acceptance criteria are provided in Table 2.5-2.

The procedures for measuring pH in the field are as follows:

1. Calibrate the instrument in accordance with the manufacturer's specifications;
2. Calibrate with buffers of a range that bracket the expected sample pH. Buffers of 4.0, 7.0, and 10.0 are adequate for most situations. Always calibrate with the 7.0 first;
3. Collect a sample. Measure temperature prior to measuring the pH;
4. Immerse the probe in the sample or preferably measured in-situ, and keep it away from the sides and bottom of the sample container. Allow ample time for the probe to equilibrate with the sample. The same procedure applies if using a flow-through cell apparatus;
5. Record the pH. Units of pH are standard units and should be recorded in tenths (0.1);
6. Rinse the probe with analyte-free water and store it in a tap water filled container, or according to manufacturer's specifications, until the next sample is ready; and
7. Perform a calibration verification at the end of the day, verify the criteria in Table 2.5-2 is met, and record all findings.

2.5.2 Field Measurement of Temperature

The FDEP-SOP-001/01 FT1400 Field Measurement of Temperature SOP is not required when using field temperature measurement devices to monitor groundwater stabilization during the purging of groundwater monitoring wells. The measurement of temperature will be performed in accordance with SFWMD-Field-QM-001. A summary of the calibration procedures and acceptance criteria are provided in Table 2.5-2.

DO, specific conductance, and pH are dependent on temperature and, therefore, temperature must be measured each time a field measurement of DO, specific conductance, and pH is made. Temperature must be measured using a probe that is verified with a National Institute of Standards and Technology (NIST) traceable, certified, Celsius thermometer with a resolution of 0.1 degrees Celsius (°C) and a range of 0 to 100°C.

Field digital thermistors cannot be calibrated by the user but are verified according to the schedule in Table 2.5-2. If the verification fails, the thermistor is sent to the manufacturer for calibration or is removed from service. Digital thermometers shall be verified prior to use by comparison with a NIST-traceable thermometer and shall agree within $\pm 0.5^{\circ}\text{C}$. Alternatively, NIST-traceable field thermometers may be used.

The procedures for measuring temperature are as follows:

1. Insert or place the thermometer or sensor in-situ at a measuring location representative of the sampling source. Groundwater samples must be measured in-situ with a down-hole probe or in a flow-through cell container. Do not measure pumped samples in an intermediate container containing static sample.

2. Allow the thermometer or temperature sensor to equilibrate to ambient in-situ temperature.
3. Record the temperature to the nearest 0.1°C after the reading stabilizes and remains constant.

2.5.3 Field Measurement of Dissolved Oxygen

The measurement of DO will be performed in accordance with DEP-SOP-001/01 FT1500. A summary of the calibration procedures and acceptance criteria are provided in Table 2.5-2.

DO shall be measured in-situ for surface water samples. Groundwater samples must be measured in-situ in a flow-through cell container. Pumped samples will not be measured in an intermediate container containing static sample.

DO readings should not exceed the saturation limit of oxygen in water (8 to 10 milligrams per liter [mg/L]). If readings greater than 10 mg/L are observed, the water is not less than approximately 17°C, the pH is less than 8, and there is no evidence there is primary production at the sampling station that would explain an excess of oxygen, the meter should be verified by taking the probe out of the water to observe that it returns to around 8 mg/L. If the pH is greater than 8, and DO is greater than 10, the DO reading may be correct as a result of photosynthetic activity and water temperature.

Compensation for temperature dependence of DO measurements will be calculated by using instruments employing automatic temperature compensation or by manually correcting measurements in accordance with SM 4500-O G (see Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, Water Pollution Control Federation).

The procedures for measuring DO in a sample are as follows:

1. Inspect the membrane of the DO meter for air bubbles and/or holes. If air bubbles or holes exist, replace the membrane. If the membrane must be replaced, the instrument cannot be used for at least 12 hours.
2. Calibrate the DO meter in accordance with the manufacturer's specifications.
3. Measure the temperature of the sample and adjust the temperature setting of the DO meter, if so equipped.
4. Insert or place the DO probe in-situ at the measuring location.
5. Record the reading in the field log book or field sampling sheet. DO is measured in units of mg/L and % saturation. Results should be reported to the nearest tenth of a unit (0.1).
6. Rinse the probe with analyte-free water and keep the probe in the saturated atmosphere between sites and events.

If a luminescent DO (LDO) probe is used, this will minimize efforts related to sulfide interference and membrane replacement.

2.5.4 Field Measurement of Specific Conductance

Specific conductance is a measure of the ability of water to conduct an electrical current. It is highly dependent on the amount of dissolved solids (i.e. salts) in the water. The measurement of specific conductance will be performed in accordance with DEP-SOP-001/01 FT1200 Field Measurement of Specific Conductance. A summary of the calibration procedures and acceptance criteria are in Table 2.5-2.

Calibration of the conductance probes must follow manufacturers' specifications, but must also conform to specification outlined in DEP-SOP-001/01 FT1200. Conductance calibrations must be done with potassium chloride solutions that bracket the expected sample conductance range. Calibrations may not have more than $\pm 5\%$ error.

The procedures for measuring specific conductance in the field are as follows:

1. Calibrate the instrument in accordance with the manufacturer's specifications and verify calibration.
2. Collect the sample. Measure and record its temperature.
3. Correct the conductance instrument's temperature adjustment to the temperature of the sample (if required). If temperature correction of the result is required, refer to Section 3.4 of the DEP-SOP-001/01 FT1200 Field Measurement of Specific Conductance.
4. Immerse the probe in the sample keeping it away from the sides and bottom of the container. It is important that the entire portion of the probe be wetted by the sample. Preferably, measure groundwater sample conductance in-situ with a down-hole probe or in a flow-through cell apparatus.
5. Record the result in the field log book or field sampling sheet. Units of conductance are $\mu\text{S}/\text{cm}$ at 25°C . Results should be reported to the nearest 10 units.
6. Rinse the probe with analyte-free water before storage.

Specific conductance and water temperature are used to calculate the salinity of the sample. Salinity will be determined using the Practical Salinity Scale of 1978 (PSS78), an equation relating the salinity to the ratio of specific conductance of an aqueous sample to that of a potassium chloride solution. However, since the PSS78 is accurate to a salinity range of 2 to 42 practical salinity units (PSU), it will be necessary to use chloride and TDS data from laboratory measurements to validate salinity values exceeding 42 as specified in the Monitoring Plan. The In-Situ Aqua TROLLs[®] (model 100 and 200) use Standard Method 2520B to calculate specific conductance and temperature. This method adds in two additional terms beyond the PSS78 algorithm to shift the scale from 2-42 to 0-40 PSU. The Aqua TROLL algorithm uses a linear extension of this equation to calculate salinities >40 PSU.

2.5.5 Field Measurement of Oxidation-Reduction Potential

Oxidation-reduction potential (ORP) is defined as the measure of the tendency of a chemical species to acquire (become reduced) or lose (become oxidized) electrons. ORP will be measured in accordance with manufacturer's specifications. A specific FDEP SOP is not currently available that addresses ORP field measurement. A summary of the calibration procedures and acceptance criteria are provided in Table 2.5-2.

The procedures for measuring ORP in the field are as follows:

1. Calibrate the instrument in accordance with the manufacturer's specifications.
2. Collect the sample and check and record the sample temperature (ORP is temperature dependant).
3. Immerse the probe in the sample keeping it away from the sides and bottom of the container. It is important that the entire portion of the probe be wetted by the sample.
4. Record the result in the field log book or field sampling sheet. Units of ORP are millivolts (mV). Results should be reported to the nearest mV.
5. Rinse the probe with analyte-free water before storage.

2.5.6 Field Measurement of Stage (Water Level)

Manual stage measurements will be conducted in each of the monitoring wells during quarterly water collection. At each event, water level will be measured electronically prior to sample collection from the groundwater wells. All measurements will be made using an electronic water level indicator (sounder) and recorded to the nearest 0.01 foot referencing the well top of casing. The measurements will be taken at the top of casing survey location that will be marked on the casing at the time of surveying. The water level indicator will be rinsed with de-ionized water between well locations. Calibration and verification of the electronic water level indicators can only be conducted by the manufacturer; frequency of calibration will be based on manufacturer's specifications or if drift is observed.

2.5.7 Field Measurement of Light Extinction

Light extinction will be measured at five depths at each location to determine light attenuation with depth. The five depths will be at equal distances vertically along the water column if water depth ≥ 5 feet. In areas < 5 feet, three measurements will be taken. Per methods outlined DEP-SOP-001/01 FT 1700, Li-Cor quantum sensors will be used to measure the photosynthetically active radiation (PAR; 400-700 nm), and solar irradiance (400-1100 nm). The underwater spherical quantum sensor (LI-193SA) and the on-deck pyranometer (LI-190SA) will be read simultaneously as the sensor is lowered down the water column. Both sensors will be connected to a Li-Cor Datalogger (LI-1400) The on-deck pyranometer allows for changes in light due to cloud cover to be factored out when light extinction coefficients are calculated. The LI-COR photometer measures light in units of microeinsteins per meter squared per second ($\mu\text{E}/\text{m}^2/\text{s}$) and the light extinction coefficient (k) determined using a least squares regression to determine the best fit of the data to the equation by Parsons *et al.* (1988).

where:

$$I_z = I_0 \cdot e^{-kz}$$

I_z = light intensity remaining at a distance (or depth)
 I_0 = the initial light intensity (at $z=0$)
 k = extinction coefficient
 z = distance (or depth).

2.5.8 Field Measurement of Turbidity

Turbidity will only be measured during well purging activities as one of the required parameters to measure for well stabilization. The parameter of turbidity will be performed in accordance with DEP-SOP-001/01 FT 1600 Field Measurement of Turbidity. Turbidity measures the scattering effect that suspended solids have on the propagation of light through a body of water (surface or ground waters). The higher the effect (i.e., intensity of scattered light), the higher the turbidity value. Suspended and colloidal matter such as clay, silt, and finely divided organic and inorganic matter cause turbidity in water. A turbidimeter (nephelometer) will be used to indicate the intensity of light.

The procedures for measuring turbidity are as follows:

1. Calibrate the instrument in accordance with the manufacturer's specifications and following FT1600 calibration SOP. Acceptance criteria for primary and secondary standards are provided in the FT1600 SOP.
2. Gently agitate the sample and wait until air bubbles disappear.
3. Double-rinse the sample cell or cuvette with a small amount of the sample. Discard, and pour an aliquot into the sample cell or cuvette.
4. Gently dry out its external surface with lint-free paper.
5. Insert the cell in the instrument and read the turbidity directly from the meter display. Turbidity must be less than 20 NTU (nephelometric turbidity units) before groundwater sampling can be initiated.
6. Do not use vacuum degassing, ultrasonic bath, or other devices to remove bubbles from the sample. If the sample contains visible bubbles or if it effervesces (as in groundwater, with changes in pressure and temperature), make a note of this in the field records and collect a sample for laboratory measurement.

2.6 Sample Collection for Laboratory Analysis

Groundwater and surface water samples will be collected at locations and intervals specified per the Monitoring Plan (Figure 2.6-1 and 2.6-2) and sent to a laboratory for analysis. Also, porewater and rainwater will be collected during the monitoring effort and will require laboratory analysis (Table 2.6-2). This section also discusses the methodology of sample collection and associated QC procedures.

Table 2.6-1. Locations and Frequency of Analytes Collected

Details of each analyte collected for each of the categories GW, SW, Nutrients, and CCS are defined in Table 2.6-2

Event	Locations	Analytes ¹
Quarterly	TPGW – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, L-3, L-5, G-21, G-28, G-35	GW
	BBSW – 1, 2, 3, 4, 5 TPSWC – 1, 2, 3, 4, 5, 6 TPSWID – 1, 2, 3	SW
	TPSWCCS – 1, 2, 3, 4, 5, 6, 7 and anomaly ²	CCS
Semiannual	TPGW – 3, 4, 5, 6, 7, 8, 9, 11, 12, L-3, L-5, G-21, G-28, G-35	GW
	TPGW – 1, 2, 10, 13, 14	GW - quarterly analytes plus Nutrients & Trace Elements
	BBSW – 1, 2, 3, 4, 5 TPSWC – 1, 2, 3, 4, 5, 6 TPSWID – 1, 2, 3	SW - quarterly analytes plus Nutrients
	TPSWCCS – 1, 2, 3, 4, 5, 6, 7	SW - quarterly analytes plus Nutrients and Gross Alpha ³

Key:

BBSW = Biscayne Bay Surface Water

CCS = Cooling Canal System

ID = Interceptor Ditch

SW = Surface Water

TPCSW = Canal Surface Water

TPGW = Groundwater Well

Table 2.6-2. Categories of Analytes from Groundwater (GW) with or without Nutrients, Surface Water (SW), Cooling Canal Water (CCS), and Porewater (PW)

Table 2.6-2. Categories of Analytes from Groundwater (GW) with or without Nutrients, Surface Water (SW), Cooling Canal Water (CCS), and Porewater (PW)

Analyte	Monitoring Plan (Table 2-1) Label	GW	SW	CCS	PW*	RW
Metals, Total Recoverable ¹	Elements	SA	-	-	X	-
Iron and Barium ¹	Tracer	Q	Q	Q	-	-
Chromium (VI)	Elements	SA	-	-	X	-
Mercury ¹	Elements	SA	-	-	X	-
Anions (Cl ⁻ , SO ₄ ²⁻ , F ⁻ , Br ⁻ , HCO ₃ ⁻)	Ions	Q	Q	Q	X	-
Cations (Ca ²⁺ , Na ⁺ , Mg ²⁺ , K ⁺ , Sr ²⁺ , B ⁺) ³	Ions	Q	Q	Q	X	-
Alkalinity	Ions	Q	Q	Q	X	-
Ammonia as N	Nutrients	SA	SA	SA	X	-
Unionized Ammonia as N – calculated	Nutrients	SA	SA	-	X	-
Nitrate+Nitrite as N (NO _x N)	Nutrients	SA	SA	SA	X	-
Nitrite (NO ₂ N) as N	Nutrients	SA	SA	-	X	-
Total Kjeldahl Nitrogen	Nutrients	SA	SA	SA	X	-
Total Nitrogen as N – calculated	Nutrients	SA	SA	-	X	-
Total Phosphorus	Nutrients	SA	SA	SA	X	-
Soluble Reactive Phosphorus	Nutrients	SA	SA	SA	X	-
Silica - Dissolved	Nutrients	-	-	SA	-	-
Sulfides	Ions	Q	Q	Q	X	-
TDS	Other	Q	-	-	-	-
Dissolved Inorganic Carbon	Tracer	Q	Q	Q	X	-
³ H	Tracer	Q	Q	Q	X	Q
² H/ ¹ H	Tracer	Q	Q	Q	X	-
¹⁸ O/ ¹⁶ O	Tracer	Q	Q	Q	X	-

Table 2.6-2. Categories of Analytes from Groundwater (GW) with or without Nutrients, Surface Water (SW), Cooling Canal Water (CCS), and Porewater (PW)

$^{87}\text{Sr}/^{86}\text{Sr}$	Tracer	Q	Q	Q	X	-
$^{13}\text{C}/^{12}\text{C}$	Tracer	Q	Q	Q	X	-
Gross Alpha	Other	-	-	SA	-	-

Notes:

* Porewater sampling frequency varies depending on location per Monitoring Plan sections 2.8.6, 2.8.7 and 2.8.8

Q = Quarterly sampling event

SA = Semiannual sampling event

1 = trace elements and mercury referred to by the lab as “trace metals”. Barium and Iron actually part of trace metals but broken out separately since they are included with the tracer suite.

2.6.1 Field QC

The following section outlines field QC samples to be collected in accordance with DEP-SOP-001/01 – FQ1000 Field QC Requirements

2.6.1.1 Equipment Blanks

An equipment blank is a sample of analyte-free water poured into, over, or through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be collected at a frequency of one blank per equipment type per matrix per day. Equipment blanks will be collected each day the equipment is used prior to sampling and analyzed for all laboratory analyses requested for the environmental samples collected at the site according to DEP-SOP-001/01 FQ 1000. If equipment is cleaned in the field, a field cleaned equipment blank (FCEB) is collected following procedures in the same FDEP SOP.

2.6.1.2 Field Blanks

Field blanks are required only when no other blank is collected. Field blanks consist of analyte free water poured into sample bottles and analyzed for all parameters collected during the event. Field blanks shall be collected in accordance with DEP-SOP-001/01 FQ 1000.

2.6.1.3 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field, but will not be identified as duplicate samples (blind duplicate) on the chain of custody (COC) record. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. Duplicate sample results are used to assess the precision of the sample collection process and for evaluating the homogeneity of composite samples. Field duplicates will be collected at a frequency of one for every 20 samples collected or one per sampling event, whichever is more frequent, for each analysis.

2.6.1.4 Field Splits

A field split sample is a single sample that is homogenized and divided into two equal parts for analysis. The sample containers are assigned an identification number in the field, such that they cannot be identified as split samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field split samples prior to the beginning of sample collection. Split sample results are used to assess laboratory analysis precision, and/or the performance between two or more laboratories. Field split samples will be collected if the Agencies require split samples for analysis by different laboratories for comparison purposes.

2.6.2 Sampling Equipment Decontamination Procedures

Sampling equipment decontamination procedures will follow DEP-SOP-001/01 – FC1000 Field Decontamination.

The cleaning/decontamination procedures must ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest. The cleaning reagents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure. The effectiveness of any cleaning procedure (including all cleaning reagents) must be supported by equipment blanks with reported non-detected values.

The types and grades of various cleaning supplies are specified in this paragraph. The reagent types have been selected to ensure that the cleaned equipment is free from any detectable contamination. When using detergents, use Luminox[®], Liquinox[®], or Alconox[®], and properly dispose of all wastes according to applicable regulations.

2.6.2.1 Storage of Cleaning Reagents

When storing cleaning reagents, the contents of all containers must be clearly marked. When storing detergents, store in the original container or in a high-density polyethylene (HDPE) or polypropylene (PP) container.

2.6.2.2 Before Sampling

Before the use of any sampling equipment, the equipment that will be exposed to the sample must be cleaned/decontaminated or be accompanied by a document certifying that it is new or pre-cleaned. Equipment dedicated to a single sampling point that will remain in contact with the sampling medium must also be cleaned before installation. This equipment must also be cleaned if it is removed for maintenance or repair at any time.

2.6.2.3 Sediment/Porewater Sampling

For the initial porewater survey and any porewater efforts that do not require sample collection for laboratory analysis, equipment will be cleaned in accordance with procedures outlined in Appendix A. During porewater collection for tracer suite, field instruments in contact with the sediment and porewater shall be cleaned according to DEP-SOP-001/01 FC 1000. Sediment sampling and porewater instruments will be wiped down with clean paper towels to remove excess sediment and rinsed thoroughly with analyte-free water. Where available, hot analyte-free water will be used.

2.6.2.4 Groundwater/Surface Water Sampling

Clean sampling containers will be obtained from commercial vendors as pre-cleaned containers. The cleaning grades must meet EPA analyte specific requirements. All records and documentation for the containers intended uses must be kept. Before use, all groundwater/surface water containers without preservatives must be rinsed one time with site water before filling with a sample. Do not rinse containers that contain preservatives.

Note that if the sampling container is new, it is not required to be cleaned before its first use. Hot water is preferred for cleaning procedures if available, although ambient temperature water is acceptable. The cleaning procedure for Teflon[®], stainless steel, and glass sampling equipment is as follows:

1. Rinse equipment with analyte-free water.
2. Soak equipment in a sudsy water solution (Liquinox[®] or equivalent).
3. Use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with analyte-free water.
5. Rinse Teflon[®] and glass only with a 10% hydrochloric acid (HCl) solution.
6. Triple-rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water. Allow to air dry as long as possible.
7. Place clean sampling equipment in a plastic bag for storage.

2.6.2.5 New Tubing

As a general rule, new tubing may be used without preliminary cleaning. Protect new tubing from potential environmental contamination by sealing it in untreated plastic bags or keep the tubing in the original sealed packaging until use. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples.

2.6.2.6 Shipping Containers

Reusable ice chests and shipping containers shall be washed, rinsed with tap water, and air dried after each use.

2.6.3 Sample Containers, Volumes, Container Types, and Preservation Requirements

Sample containers shall be purchased pre-cleaned and treated according to EPA specifications for the methods. Containers for laboratory sample collection will be provided by the laboratory and shipped to the site field team staging location. Sample bottles from the analyzing laboratory will be pre-preserved as required unless noted in the field notes. Containers will be stored on site in clean areas to prevent exposure to fuels, solvents, and other contaminants. Coolers and boxes containing precleaned bottles will be sealed with a custody

seal during transport to the field or while in storage prior to use. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

Tables 2.6-3 to 2.6-6 describe the preservation method, container material, maximum holding time, and the preferred and minimum sample volumes required for analysis. Samples requiring preservation will be preserved immediately on-site. The sample pH will be verified within 15 minutes of sample collection to ensure proper preservation before storage. Samples requiring filtration, (i.e. silica, SRP, NH_3 , NO_x , DOC, DIC, and strontium) in the field will be filtered on-site. The minimum volumes or weights are provided, in particular, for the porewater sampling. The amount of porewater that can be extracted from a given sediment may vary greatly and the preferred amount may not always be attainable. If the target volume is not attained at a specific sample location additional sampling attempts shall be made consistent with the procedures contained in Appendix A section 2.2.1.1.

Table 2.6-3. Groundwater and Surface Water Sample Volumes, Container Types, Preservation, and Holding Time Requirements

Analyte	Analytical Method	Container	Preservation	Preferred Sample Volume	Maximum Holding Time
Metals, Total Recoverable	EPA 200.7	Plastic	HNO ₃ to pH<2, or at least 24 hours prior to analysis	250 mL	180 days
Chromium (VI)	SM 3500-Cr B	Plastic	≤6°C, NaOH to pH>9.3-9.71	500 mL	24 hours
Mercury	EPA 245.1	Plastic	≤6°C, HNO ₃ to pH<2	250 mL	28 days
Common anions (Cl ⁻ , SO ₄ ²⁻ , F ⁻ , Br ⁻ , HCO ₃ ⁻)	EPA 300.0	Plastic	≤6°C	500 mL	28 days
Cations (Ca ²⁺ , Na ⁺ , Mg ²⁺ , K ⁺ , Sr ²⁺ , B ⁺)	EPA 6010B	Plastic	HNO ₃ to pH<2 or none if unfiltered	250 mL	180 days (48 hrs if not filtered / preserved)
Alkalinity	SM 2320 B	Plastic	≤6°C	1L	14 days
Ammonia as N	SM 4500-NH ₃ G	Plastic	≤6°C, H ₂ SO ₄ to pH<2, 0.45 µm filtered ²	250 mL	28 days
Unionized Ammonia as N – calculated ⁶	DEP SOP NH ₃	—	—	—	—
Nitrate + Nitrite as N (NO _x N)	EPA 353 .2	Plastic	≤6°C, H ₂ SO ₄ to pH<2, 0.45 µm filtered ²	250 mL	28 days
Nitrite (NO ₂ N) as N	EPA 353.2	Plastic	≤6°C, H ₂ SO ₄ to pH<2, 0.45 µm filtered ²	125 mL ⁷	48 hours
Total Kjeldahl Nitrogen	EPA 351.2	Plastic	≤6°C, H ₂ SO ₄ to pH<2	250 mL	28 days
Total Phosphorus	EPA 365.1	Plastic	≤6°C, H ₂ SO ₄ to pH<2	250 mL	28 Days
Soluble Reactive Phosphorus	SM 4500-P E	Plastic	≤6°C, 0.45µm filtered ²	250 mL	48 hours
Silica	EPA 200.7	Plastic	≤6°C, 0.45µm filtered ²	250 mL	28 days
Sulfides	SM 4500-S ₂ F	Plastic	≤6°C, NaOH to pH>9, 2mL zinc acetate	500 mL	7 days
TDS	SM 2540 C	Plastic	≤6°C	500 mL	7 days
Dissolved Organic Carbon	EPA 9060A	Glass	≤6°C, HCl to pH<2, 0.45µm filtered ¹	250 mL	28 days
Dissolved Carbon	EPA 9060A	Glass	≤6°C, 0.45µm filtered ²	120 mL	28 days
Isotope / Radiological Analyses					
³ H	EE-LSC ³	HDPE	N/A	250 mL	1 year
² H/ ¹ H	IRMS ⁴	HDPE Plastic	5 ± 2°C	500 mL	270 days
¹⁸ O/ ¹⁶ O	IRMS ⁴	HDPE Plastic	5 ± 2°C	500 mL	270 days
⁸⁷ Sr/ ⁸⁶ Sr	TIMS ⁵	Polyethylene	0.45µm filtered ² , HNO ₃ to pH<2	125 mL	1 year
¹³ C/ ¹² C	IRMS ⁴	HDPE Plastic	0.45µm filtered ² , 5 ±2°C	500 mL	180 days

Gross Alpha	EPA 900.0	Plastic	HNO ₃ to pH<2	1000 mL	180 days
-------------	-----------	---------	--------------------------	---------	----------

Notes:

- ¹ Preserved by the laboratory
- ² Filtered in the field
- ³ EE-LSC: Electrical Enrichment followed by Liquid Scintillation Counting.
- ⁴ IRMS: Isotope Ratio Mass Spectrometer.
- ⁵ TIMS: Thermal Ionization Mass Spectrometer
- ⁶ Calculated analytes do not have a container, preservation, sample volume, or holding time
- ⁷ Assuming analysis of this sample is conducted for nitrite only

Table 2.6-4. Sediment Sample Volumes, Container Types, and Preservation Requirements

Analyte	Analytical Method	Collection Container	Preservation	Preferred Sample Weight	Minimum Sample Weight	Maximum Holding Time
Total Nitrogen (TN)	EPA 440.0	Plastic	≤6°C when wet, dried to constant weight at < 65°C	10 g	1 g	1 year once dried
Total Phosphorous (TP)	EPA 365.4 after Dry Ash/Acid Extraction	Plastic		10 g	1 g	
Ash-free Dry Weight (AFDW)	Standard Method 10300	Plastic		10 g	5 g	
Total Carbon	EPA 440.0	Plastic		10 g	1 g	
Bulk Density	ASTM D5057-90	Plastic		50 g	10 g	28 Days
Percent Moisture	D2216	Plastic		50 g	10 g	

Table 2.6-5. Biota (vegetation) Sample Volumes, Container Types, and Preservation Requirements

Analyte	Analytical Method	Container	Preservation	Preferred Sample Weight	Minimum Sample Weight	Maximum Holding Time
Total Carbon (TC)	EPA 440.0	Plastic	≤6°C when wet, dried to constant weight at < 65°C	1 g dried	2-4 mg dried	1 year once dried
Total Nitrogen (TN)	EPA 440.0					
Nitrogen (¹⁵ N/ ¹⁴ N)	EA-IRMS					
Carbon (¹³ C/ ¹² C)	EA-IRMS					
Total Phosphorous (TP)	EPA 365.1	Plastic		1 g dried	0.2 g dried	

See appendix B. Elemental Analyzer-Isotope ratio mass spectrometer

Table 2.6-6. Porewater Sample Volumes, Container Types, Preservation, and Holding Time Requirements

Analyte	Analytical Method	Container	Preservation	Minimum Sample Volume	Maximum Holding Time
Isotopes					
³ H	EE-LSC ²	Plastic	N/A	50 mL	1 year
² H/ ¹ H	IRMS ³	Plastic	5 ± 2°C	50 mL	270 days
¹⁸ O/ ¹⁶ O	IRMS ³	Plastic	5 ± 2°C		270 days
⁸⁷ Sr/ ⁸⁶ Sr	TIMS ⁴	Plastic	0.45µm filtered ¹ , HNO ₃ to pH<2	50 mL	1 year
¹³ C/ ¹² C	IRMS ³	Plastic	0.45µm filtered ¹ , 5 ± 2°C, 1mL Hg ₂ Cl ₂	50 mL	180 days
Ions					
Metals, Total Recoverable (Fe,	EPA 200.7	Plastic	HNO ₃ to pH<2, (at least 24 hours prior to	50 mL	180 days

Analyte	Analytical Method	Container	Preservation	Minimum Sample Volume	Maximum Holding Time
Ba) ^a			analysis)		
Common anions (Cl ⁻ , SO ₄ ²⁻ , F ⁻ , Br ⁻ , HCO ₃ ⁻)	EPA 300.0	Plastic	≤6°C	50 mL	28 days
Cations (Ca ²⁺ , Na ⁺ , Mg ²⁺ , K ⁺ , Sr ²⁺ , B ³⁺)	EPA 6010B	Plastic	HNO ₃ to pH<2 or none if unfiltered	50 mL	180 days (48 hrs if not filtered / preserved)
Alkalinity	SM 2320 B	Plastic	≤6°C	100 mL	14 days
Sulfides	SM 4500-S ₂ F	Plastic	≤6°C, NaOH to pH>9, 2 mL zinc acetate	250 mL	7 days
Nutrients					
Total Phosphorus (TP)	EPA 365.5	Plastic	≤6°C, H ₂ SO ₄ to pH<2	50 mL	28 Days
Soluble Reactive Phosphorus (SRP)	SM 4500-P-E	Plastic	≤6°C, 0.45µm filtered ¹	50 mL	48 hours
Ammonia as N	SM 4500 NH ₃ G	Plastic	≤6°C, H ₂ SO ₄ to pH<2, 0.45 µm filtered ¹	50 mL	28 days
Unionized Ammonia as N – calculated ⁵	FDEP SOP NH ₃	—	—	—	—
Nitrate+Nitrite as N (NO _x N)	EPA 353.2	Plastic	≤6°C, H ₂ SO ₄ to pH<2 , 0.45 µm filtered ¹	50 mL	28 days
Nitrite (NO ₂ N) as N	EPA 353.2	Plastic	≤6°C, 0.45µm filtered ¹	125 mL ⁶	48 hours
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	Plastic	≤6°C, H ₂ SO ₄ to pH<2	50 mL	28 days
Dissolved Organic Carbon	EPA 9060A	Glass	≤6°C, HCl to pH<2, 0.45µm filtered ¹	250 mL	28 days
Dissolved Carbon	EPA 9060A	Glass	≤6°C, 0.45µm filtered ¹	40 mL	28 days

Notes:¹ Filtered in the field² EE-LSC: Electrical Enrichment followed by Liquid Scintillation Counting.³ IRMS: Isotope Ratio Mass Spectrometer.⁴ TIMS: Thermal Ionization Mass Spectrometer⁵ Calculated analytes do not have a container, preservation, sample volume, or holding time.⁶ Assuming analysis of this sample is conducted for nitrite only

2.6.4 Sampling Methods

SFWMD-FIELD-QM-001 will be used in conjunction with FDEP SOPs for field sampling procedures.

2.6.4.1 Surface Water Sampling

Surface water samples shall be collected by using a peristaltic pump and polyethylene tubing attached externally to a pipe or another approved sampling device (e.g., a Niskin bottle). If a Niskin sampler is used enough water should be collected to completely fill each required sampling container. Surface water samples shall not be collected while it is raining.

While sampling on- or offshore, the operating procedures described in FDEP SOP 001/01 FS 2100 shall be used to consistently collect representative surface water samples. If a Niskin[®] bottle is used, the bottle will be mounted horizontally and the sample collected in accordance

with FDEP FS2110. If a tubing setup is used, the tubing will be attached to the pipe so that the sample can be collected from 1 foot above the bottom and where applicable, 1 foot below the surface. The plastic tubing will be affixed to the pipe using plastic zip ties with the sampling end curved away and not touching the PVC pipe.

Sampling must be performed so that samples are neither contaminated nor altered from improper handling and disturbing sediments in the vicinity of the sampling location is to be avoided (FDEP SOP FS2100.2.3). When taking samples in a vessel, samples must be taken near the bow, away and upwind from any gasoline outboard engine. The vessel must also be oriented so that the bow is positioned in the up-current direction. When sampling while wading, samples shall be taken up-current from the body. Provisions must also be made so that sediments are not disturbed in the immediate area. When using the PVC tubing method the drop pipe must be lowered to a predetermined depth measured from a point on the sampling platform in order to ensure the tubing does not disturb the bottom sediments. The total depth used to determine the near bottom sampling depth must be verified after sampling has taken place. If using the PVC-tubing method, once the tubing is lowered to the appropriate depth using the pipe, water will be collected from tubing located at the shallow depth first.

Compositing buckets will be used when the total volume of sample water required from a sample site exceeds the volume of a single grab of the sampling equipment. Compositing the sample in a bucket prior to pouring into individual sample bottles will ensure that all water samples from a particular site are homogenized. Samples collected in the sampling device that do not require compositing will be shaken prior to pouring to ensure homogeneity. All general protocols applicable to aqueous sampling detailed in FDEP SOP 001/01 FS 2000 must be adhered to.

2.6.4.2 Groundwater Sampling Methods

Groundwater well purging and sampling will be conducted in accordance with DEP-SOP-001/01 – FS2200. For wells from which samples for metals are required, low-flow purging and groundwater sampling can be conducted in accordance with procedures outlined in DEP-SOP-001/01 – FS2213 to keep turbidity low. Since the well screens for this project will be set in highly permeable flow zones and will be completely submerged, the aquifer recharge rate will be sufficient to keep up with the purge rate. Before sampling is initiated, an initial inspection of the monitoring well will be performed to examine markings, sign plates, etc. The well cover and any water around the top of the well casing will be removed before opening the well cap.

For this project, there are two likely methods of purging:

- The first method is the low-flow purge using a peristaltic pump. Proper rigid tubing will be dedicated at each well location. The bottom of the tubing will be placed in the middle of the well screen. Purging will be conducted until the pH, DO, specific conductance, temperature, and turbidity stabilize. The first set of stabilization readings will be taken as soon as the purge rate equal to the well recovery rate is established and an additional three equipment volumes of water have been purged. Additional sets of stabilization readings will be taken no sooner than 2 minutes apart after the initial set until three sets of readings are within the required limits.

- The second method is the conventional purge using a peristaltic or centrifugal pump. In this method, the dedicated tubing intake will be placed at the top of the water column. The well will be pumped until the purge rate equals the recovery rate. Then, a minimum of one well volume will be removed from the well before the first set of stabilization readings can be collected. A minimum of one-fourth of the well volumes will be removed between subsequent readings. The purge is complete when three sets of readings are within the required limits shown below:

Temperature	$\pm 0.2^{\circ}\text{C}$
pH	± 0.2 standard units
specific conductance	$\pm 5\%$ of reading
Dissolved oxygen	$\leq 20\%$ saturation
Turbidity	≤ 20 NTU

Purge records will be kept on the well sampling data sheet (see Section 2.1). Samples will be collected immediately after the well purge is complete and no more than six hours following purging. Sampling cannot be performed using a centrifugal pump. Samples will be collected directly from the peristaltic pump into appropriate sample containers. Groundwater samples shall not be collected while it is raining.

Dedicated tubing is placed in a plastic container lined with sterile plastic during cleaning and calibration of probes. Dedicated tubing must be secured to prevent contamination of the dedicated tubing between samplings. Securely seal the monitoring well in order to prevent tampering between samplings.

2.6.4.3 Rainfall Sampling

Rainfall will be collected in wet deposition collectors at locations specified in Appendix E of the Monitoring Plan and analyzed for tritium on a quarterly basis for a minimum of one year. For tritium levels greater than 10 pico Curies per liter (pCi/L), the data will be used to calculate the rainfall tritium deposition contribution to tritium levels detected in the monitoring wells.

The following protocols will be used for rainfall sample protection:

- Rainfall collectors will be deployed at the sampling locations continuously, and will be designed to integrate samples collected during a three-month time period if sufficient rainfall is available; and
- At the end of every three-month sampling period, collected rainfall will be sent to the laboratory for tritium analysis.

Rainfall will be collected in poly containers capped with a funnel with an aperture of approximately 0.5 inch (i.e. 12 mm) (Appendix I); the aperture will have a coarse filter to prevent dirt and debris from falling into the collector. The container will be of adequate size to contain three months of typical rainfall and will have a layer of mineral oil or equivalent, approximately 1 inch thick, to prevent evaporation of the water. Use of a hydrophobic liquid of

lower density than water (e.g., mineral oil) is a commonly used practice to prevent water loss to evaporation (Scholl 2006). Collectors will be enclosed in external housing to prevent vandalism and/or damage to the bottles (Figure 2.6-1 and 2.6-2).

Where the rainfall collectors are co-located with the rainfall gauges, an integrated setup will be used (Figures 2.6-1 and 2.6-1). The proposed rainfall gauge is a modified TB-3 tipping bucket rainfall collector (Hydrological Services Inc., Liverpool, New South Wales, Australia) with apertures at the bottom connected to tubing attached to the polyethylene rainfall collection bottles (Figure 2.6-1). The procedures for collecting rainwater samples in the field using an automated wet precipitation collection are summarized as follows:

1. Upon arrival, the general condition of the sampler and site shall be recorded in the field notes;
2. The rainfall sample will be poured into an appropriately labeled 125mL polyethylene bottle and sent to the laboratory for tritium analysis;
3. Dirt and debris will be removed from the funnel filter; and
4. The time and date of field collection for each sample must be recorded in the field log.



Figure 2.6-1. Integrated tipping bucket rain gauge with the rainfall collector located in a protective metal housing. The setup will also have a piece of polyethylene tubing connecting the rain gauge

to the collector. Evaporation from the collector will be prevented by a layer of mineral oil placed within the collector.



Figure 2.6-2. Top view of the tipping bucket rainfall gauge. The aperture is protected from debris by a screened cap.

2.6.4.4 Porewater Survey Field Measurements

The initial porewater survey methods are explained in Section 2.8.3 of the Monitoring Plan. Specific sampling details are provided in Appendix A. Briefly, porewater will be sampled using one of the two methods described below and samples are not required for further lab testing:

1. A single conductance-temperature probe inserted into 20-, 40-, and 60-cm depths consecutively after measurement at each depth; or
2. A PushPoint[®] sampler (EPA SESDPROC-513-R0; see Appendix A, Section 2.2.2) is installed into the sediment at needed depth, and a syringe with tubing is connected. The syringe removes porewater at depth (20 cm, 40 cm and/or 60 cm) and the extracted volume is poured into a 50 mL container where an Aqua TROLL[®] specific conductance-temperature probe is inserted to obtain measurements. Data will be

logged and recorded in a field book or on field datasheets. Upon completion of data collection, the porewater sample will be immediately discarded.

Sensors will be calibrated at the beginning and end of each day, similar to other field instrumentation as described in Sections 2.5.2 and 2.5.4 and criteria described in Table 2.5-1. Instrumentation to be used for initial dry season porewater sampling is the Aqua TROLL[®] 100. Specific conductance and temperature values will be recorded in field books or on field datasheets; all other data (actual conductance, TDS, water density, salinity, and resistivity) will be provided in raw data formats (e.g., csv or MSExcel). The Aqua TROLL[®] 100 has:

- Specific conductance range of 5 $\mu\text{S}/\text{cm}$ to 100,000 $\mu\text{S}/\text{cm}$;
- Accuracy of $\pm 0.5\%$ of reading plus 1 $\mu\text{S}/\text{cm}$ when readings are below 80,000 $\mu\text{S}/\text{cm}$;
- Accuracy of $\pm 1.0\%$ of reading when readings are above 80,000 $\mu\text{S}/\text{cm}$; and
- Resolution of 0.1 $\mu\text{S}/\text{cm}$ specific conductance.

For temperature, the Aqua TROLL[®] 100 has:

- Range of -20° to $+65^{\circ}\text{C}$ (-4° to $+149^{\circ}\text{F}$);
- Accuracy of $\pm 0.1^{\circ}\text{C}$
- Resolution of 0.01°C

A Garmin Rino[®] 530 HCX GPS with two-way radio will be used to track and save the porewater survey locations. The Rino[®] GPS will have an accuracy of < 3 m which is sufficient accuracy to locate the same site for a follow-up CCS tracer suite. The data will be recorded in decimal degrees, based on a NAD 83 datum system. During initial field sampling, distinctive characteristics will be recorded into the field book to make it easier to find the site if follow-up sampling is needed.

Readings for temperature and specific conductance are not expected to be found greater than the available range of the Aqua TROLL[®] 100; however, in the event that specific conductance readings are found at greater than 100,000 $\mu\text{S}/\text{cm}$, the site will be recorded and described in the field book and labeled as a possible site of interest for follow-up CCS tracer suite sampling. The criteria for calibration and verification for temperature in DEP SOP FT 1400 are the minimum data usability requirements that will be applied.

2.6.4.5 Porewater Nutrient and Tracer Suite Sampling

Porewater samples will be collected from the root zone (30 cm depth), per Section 2.8.6 through 2.8.8 of the Monitoring Plan, for nutrient and tracer suite sampling. Wetland porewater samples shall not be collected while it is raining. Samples will be extracted using a porewater sipper (e.g., stainless steel Push Point sampler attached to flexible tubing and a syringe/hand pump per EPA SESDPROC-513-R0 or equivalent). Use of a porewater sipper allows for quick installation, ease of use, and quick sampling technique. A total of ~ 1000 mL of water (per Table 2.6-6) will be collected in either new or pre-cleaned bottles (per FDEP standards) provided by the laboratories.

If composite samples are collected (e.g. from the ecological plots), each bottle will be filled with approximately 750 ml of water. Bottles will be shaken and mixed (by pouring back and forth six times) prior to pouring into individual samples bottles. Samples collected will be stored in ice as needed, and Parafilm. Samples requiring preservation will be preserved immediately on-site. The sample pH will be verified within 15 minutes of sample collection to ensure proper preservation before storage. Samples requiring filtration, (i.e. silica, SRP, NH₃, NO_x, DOC, DIC, and strontium) in the field will be filtered on-site. For a more detailed understanding of porewater sampling methods to be used see Appendix A.

2.6.4.6 Sediment Sampling

Soil cores will be collected from each plot in the wetlands as well as in Biscayne Bay as described in the Monitoring Plan (Section 2.8.6 through 2.8.8). Cores will be collected using cylindrical clear plexiglass corers (≥ 7.5 cm diameter, ≥ 40 cm long). A soil core 30 cm long (or up to bedrock depth if the bedrock is less than 30 cm deep) will be collected.

The length of the extracted core (L_c) will be measured, and compared to the depth of the hole (L_H) to calculate a compression rate.

$$\text{Compression rate (\%)} = (1 - [L_c/L_H]) \times 100\%$$

where:

L_c = length of the extracted core

L_H = depth of the hole

The soil compression rate is not to exceed 10% to minimize errors in bulk density calculations. The water level and the surrounding plant community within a 2-meter radius of the area where the soil is collected will be recorded.

Cores collected will be cut into 10-cm lengths, yielding an estimated volume per soil or sediment interval and transferred to polyethylene bags that will be sealed and refrigerated until ready for weighing and drying. Bulk density (wet and dry) will be estimated as described in Blake and Hartage (1986). Samples will be placed in a container of known weight and wet weight measured. Samples will be dried at $< 65^\circ\text{C}$ to prevent loss of ammonia from the nitrogen fraction of the sample. The loss in weight, associated with water loss, will then be multiplied by the sample site porewater salinity for the equivalent sample depth (as a decimal, i.e. 35 ppt = 0.035) to estimate the weight of residual salts from the dried porewater. This residual weight will be subtracted from the sample dry weight (Dadey, et. al., 1992). Bulk density is then calculated as the sample's dry weight per the original core interval volume (g/cm^3). Before nutrient analysis (total nitrogen [TN], total phosphorous [TP], ash-free dry weight [AFDW]), the 10-cm long cores will be composited as appropriate. Dried samples will be homogenized by the analytical laboratory selected according to FDEP FS4000 methods prior to analysis.

The dried sample homogenized with a mortar and pestle, or grinder for AFDW analysis. A weighed subsample is placed in a pre-weighed crucible and placed in a 500°C muffle furnace for 60 minutes or until the weight is constant. The crucible is removed from the furnace, allowed to cool, and reweighed to determine AFDW as a percentage of sample weight.

$$\text{AFDW (\%)} = (\text{Dry weight} - \text{Ashed weight}) / \text{Dry weight}$$

2.6.4.7 Sampling for Dissolved Constituents

Water samples collected for analysis of dissolved constituents will be field-filtered in accordance with DEP-SOP-001/01-FS2000. When filtering groundwater samples for metals, a one-piece, molded construction 0.45-micron filter will be used. Filters shall be purchased from the same manufacturer consistently throughout the project, if possible. Any change in filters shall be documented in the field logs, and include justification for change. Filtered sampling must begin within 15 minutes of collection of the non-filtered sample from the same location using the same sampling methodology selected for the non-filtered sample. Surface and groundwater samples will not be collected while it is raining.

2.6.5 Tritium Sampling

As mentioned in the previous sections, tritium sampling necessitates a few additional precautions. These are presented again below:

- Samples will not be filtered or preserved;
- No luminescent watches may be worn when sampling for tritium since tritium in luminescent watches could contaminate the sample;
- Sample shall be collected to minimize headspace (i.e. evaporation) for shipping and storage;
- Surface and groundwater samples will not be collected during a rain event; and
- Samples with expected tritium levels over 500 pCi/L (those from the CCS and those from the monitoring wells located just to the west of the CCS) will be noted on the COC and will be shipped in separate coolers from other site samples to prevent cross-contamination.

2.6.6 Sample Handling and Custody

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times are specified in Table 2.6-3. If the holding time for a sample is specified in hours up to 48 hours, the time (i.e., hours and minutes) and the date will be included on the sample label and field COC documents.

2.6.6.1 Chain of Custody (COC)

The primary objective of the COC procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from the receipt of precleaned sample bottles through completion of all required analyses. A sample is “in custody” if it is:

- In a team member’s physical possession;
- In a team member’s view;

- Locked up; or
- Kept in a secured area that is restricted to authorized personnel.

The COC record must be completed in duplicate (one for the laboratory and one for project records) by the field personnel designated by the PM as responsible for sample shipment to the appropriate laboratory for analysis. The COC will include all samples collected, including QC, sampling dates, matrix, preservation, and requested analyses. For hypersaline samples, the term “Hypersaline” will be recorded on the COC in the “Remarks” section. This will assist the laboratory to determine the appropriate preparation and analysis. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or holding time limitations) a representative from the laboratory will be notified. The custody record must also indicate any special preservation techniques necessary or whether the samples need to be filtered. Copies of the COC records are maintained with the project file.

The coolers in which the samples are packed must be accompanied by a COC record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the COC record.

Sample shipping containers (coolers or boxes) are sealed in as many places as necessary to ensure security. Upon receipt at the laboratory, the custodian must check that seals or taping on boxes and/or coolers are intact.

The transportation and handling of samples must be accomplished in a manner that protects the integrity of the samples. Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- All sample lids must stay with the original containers;
- The sample volume level can be marked by placing the top of the label at the appropriate sample height or by using a waterproof marker. This will help the laboratory determine if any leakage occurred during shipping;
- All sample bottles shall be placed in plastic bags;
- If required by lab method, samples shall be placed in ice immediately after collection;
- Shipping coolers must be partially filled with packaging materials and ice (when required) to prevent the bottles from moving during shipment;
- Wet ice will be used to cool samples during shipping;
- A duplicate custody record must be placed in a plastic bag and taped to the inside of the cooler lid; and
- Custody seals are affixed to the sample cooler by the laboratory shipping agent..

2.7 Automated Flow Data Collection

Several stations are proposed to measure velocity and, subsequently, flow at strategic locations in the CCS. Three flowmeters are proposed, one each where water enters and exits the CCS, and a third at the southern end of the CCS before the water enters the Grand Canal (Figure 2.7-1). A Sontek Argonaut[®]-SL side looking acoustic Doppler current meter (SL 500) that can assess flow across the complete width of the CCS canal is proposed (see Appendix I). Data from the current meters will be collected at 15-minute intervals and electronically uploaded at the end of each day or on a regular basis. This information will be used as part of the water budget to help estimate water losses and gains in the CCS.



Figure 2.7-1. Proposed locations of the three acoustic Doppler sensors within the CCS (04/09/10).

The current meters must be installed and maintained in accordance with the manufacturers' instructions and in a manner that will enable the collection of accurate data. A schedule for routine maintenance will be created. All maintenance requirements to the instrument will be documented in accordance with DEP-SOP-001/01 FD 3000. Adjustments may be needed based on environmental conditions and durability of the current meters. If needed, adjustments will be performed after consultation and approval by the SFWMD.

When selecting the flow measuring locations, possible obstructions to the meter measurements shall be avoided to obtain the most accurate measurements. The channel has to be clear of plant material at the banks. If plant material is located, then the unit shall be extended out of the area, as turbulence will disturb the measurement.

Flow velocities will be checked with an acoustic Doppler current profiler called the Riversurveyor[®] M9 from Sontek or similar type device. The M9 will be used to obtain vertical profiles of the canal and a discharge measurement. Four passes shall be made and all passes will be compared and averaged to obtain the best velocity data.

A rating curve will be derived using USGS methods. Velocity data from the SL500 will initially be collected for 30 days and this data, in conjunction with the M9 data, will be used for the rating equation. The rating equation shall be verified once per year.

The channel cross-sectional areas where the flow meters will be installed shall be verified at a minimum of once per year. Table 2.7-1 provides a summary of flow equipment performance criteria.

Table 2.7-1. Flow Data Collection Equipment Performance Criteria

Parameter	Unit of Measure	Accuracy	Resolution	Velocity Range	Sampling Frequency
Water Velocity	m/s	±1%	0.001	±6 (SL500) ±20 (M9)	15 minutes

2.8 Automated Meteorological Data Collection

Rainfall and other meteorological data (temperature, solar radiation, wind speed, wind direction, and relative humidity) will be collected to help determine the amount of rainfall entering into and evaporating from the CCS. This information will be used in water mass balance calculations for the CCS. To acquire the data for these calculations, one meteorological station and five rainfall gauging stations will be set up around the CCS. Specifications for the meteorological equipment are included in Appendix I.

Instrumentation will be deployed at each station location in accordance with manufacturers' recommendations and guidance included in SFWMD Quality Assurance System Requirements (QASR) Chapter 6. Instrument calibrations will be performed by the manufacturer.

Table 2.8-1 presents a list of accuracy guidelines (adapted from SFWMD Quality Assurance Task Force (QATF) – Quality Guidelines for SHDM Deliverables) for the types of meteorological data to be collected.

Table 2.8-1. Meteorological Data Collection Accuracy Quality Guideline

Parameter	Unit of Measure	Accuracy	Resolution	Range	Sampling Frequency
Temperature	°C	±0.5°C	0.1°C	-33°C - 48°C	15 minutes
Solar Radiation	kW/m ² (kilowatt per meter squared)	±5 kW/m ² for readings over 0.0926 kW/m ² and ± 0.0046 kW/m ² for readings under 0.0926 kW/m ²	Sensitivity of these devices is based on the type of device. In general, the device should read to the nearest 0.001 kW/m ²	0 - 1.3 kW/m ²	1 minute
Wind Speed	mph	±1.1 mph for readings less than 22 mph and ±5% of readings above 22 mph	0.2 mph	varies	1 second
Wind Direction	degrees to true north	±5%	1°	0 - 360°	1 second
Relative Humidity	%	±5%	1%	5 - 100%	1 minute
Precipitation	inches	±0.01 inches however accuracy of most rain gauges is 0.5% at 0.5 inches per hour	0.01 inches	varies	15 minutes

In addition to the accuracy quality guidelines, there are quality guidelines for availability, completeness, and timeliness. For all the instruments, the availability quality guidelines include a component for reliability and maintainability. The definitions for these guidelines are discussed in Section 1, while the guidelines specific to the meteorological stations are detailed in Table 2.8-2 below.

Table 2.8-2. Additional Quality Guidelines – Meteorological Station

Parameter	Units	Quality Guideline
Reliability	months	24 ¹
Maintainability	hours	72 ²
Completeness	%	95
Timeliness	hours	24 ³

Key:

1 = mean time between failures (relative humidity guideline is 12 months)

2 = failure repaired within guideline timeframe for 95% of all incidents

3 = real-time delay for stations with telemetry and post-processing delay

In general, inspections of the equipment at each station will be performed at least quarterly. Table 2.8-2 provides inspection guidance for each of the instruments. Maintenance items will be performed, as required, and instrument re-calibrations will be performed in accordance with the manufacturers' recommendations. If accuracy requirements are exceeded for any instrument at a given location, corrective action in the form of inspection, re-calibration, repair, and/or replacement will be initiated as soon as practical after discovery of the problem following the procedures in Section 6.

Table 2.8-2. Inspection Guidance for Station Equipment

Instrument	Inspection Guidance
Weather Transmitter (Temp., wind speed and direction, relative humidity, barometric pressure, precipitation)	<p>Inspect the housing for visible damage and any debris.</p> <p>Leaves and other debris should be removed from the precipitation sensor</p> <p>The housing, sensors, and solar panel should be cleaned with a soft, lint-free cloth moistened with mild detergent as needed.</p> <p>Be extremely careful when cleaning the wind sensors (three protruding prongs). Sensors should not be rubbed or twisted.</p> <p>Check sensor alignment to ensure that the arrow at the bottom of the sensor is still pointed north.</p> <p>Send device to manufacturer for calibration and service as appropriate.</p>
Solar Radiation Instrumentation	<p>Check the instrument for visible damage and note any moisture inside the receiver.</p> <p>Confirm the sensor is free from bird perching and shadows.</p> <p>Clean the instrument with a lint-free cloth with mild detergent as needed.</p> <p>Replace the desiccant, if needed, at the frequency recommended by the manufacturer.</p> <p>Check readings and confirm they fall within allowed limit by comparing with another sensor used as a standard for field testing.</p>
Rain Collector / Gauge	<p>Clean the outer funnel; inspect screens and drains wiping them free of all debris and obstruction.</p> <p>Wipe the tipping bucket and inner funnel clean and clear of all insect materials. Be especially observant of spider webbing on the side of the tipping bucket.</p> <p>Move the bucket from side to side to ensure that the pivot pin has enough play for it not to bind yet not fall out. Ensure that the receiver is level.</p> <p>Inspect the general appearance and condition of the rain gauge. Look for signs of corrosion, mechanical wear, vandalism, etc., and ensure that the rain gauge is level.</p> <p>Inspect all conduits, cables, and wiring for tightness and damage.</p>

Table 2.8-2. Inspection Guidance for Station Equipment

Instrument	Inspection Guidance
Water Level & Temp Instruments	Clean any biofouling agents off the body of the probe. Clean sensor heads carefully with manufacturer-provided brushes/cleaning tips. Inspect the general appearance of the probes and cables. Note any corrosion, wear, or damage.

Field notes and maintenance logs will be taken to the site during each field visit. Inspection notes will be recorded and calibration and maintenance efforts will be noted on the appropriate logs. These data sheets will be kept on file as outlined in Section 4.

The meteorological equipment proposed for this project (except for rainfall buckets that will collect rainwater for tritium samples) will be automated and will collect data as specified in the Monitoring Plan. The data will be stored on site and downloaded daily from the instruments into the central database for use in calculations.

2.9 Ecological Monitoring

Ecological monitoring consists of a Broad Scale Vegetation Survey, an Initial Ecological Condition Characterization, and the Continual Ecological Monitoring Surveys. The Monitoring Plan outlines the sites where surveying should be performed.

2.9.1 Broad-Scale Vegetation Survey

The Broad-Scale Vegetation Survey will utilize available Restoration, Coordination and Verification (RECOVER) Program 2009 imagery as well as any SFWMD aerial imagery of the geographic area of interest to assess the landscape around Turkey Point Nuclear Power Plant. The area of interest extends east to west, from 4 kilometers offshore (in BNP) to the Model Lands wetlands to the west (bounded by Tallahassee Road). The north-south boundaries are Florida City Canal and Card Sound Road, respectively.

The high-resolution imagery will be reviewed jointly by agency scientists and FPL and its contractors to determine areas of ecological interest within the landscape. In the terrestrial assessment, features of interest include apparently stressed areas within the marsh and mangrove wetlands, areas of atypical mangrove growth, remnant creeks, tree islands, and areas of possible groundwater upwelling. In Biscayne Bay and Card Sound, focal areas include sinkholes, the Barge Canal, and areas of limited vegetation growth.

Areas of interest identified will be examined further as part of the Initial Porewater Characterization Study, and potentially included in the ecological monitoring transects.

2.9.2 Initial Ecological Condition Characterization

The Initial Ecological Condition Characterization will be conducted in accordance with the Monitoring Plan. Porewater-specific conductance and temperature will be measured in-situ at 20-cm depth intervals up to a maximum depth of 60 cm or refusal using sondes (see Appendix A and Section 2.6.4.4). For a more detailed explanation of porewater sampling procedures, methodology, and review of figures depicting Areas of Special Concern and general sampling

locations, refer to the Porewater Operation Guidelines in Appendix A. Porewater surveys will be conducted in the wetlands during the dry season, but in both the wet and dry seasons in Biscayne Bay.

Sampling locations will focus on areas of ecological interest defined in the Broad-Scale Vegetation Survey, any areas of additional interest defined by the agencies, and across the landscape in a grid fashion as defined in Section 2.8.2 of the Monitoring Plan. Two locations will be sampled at each area of identified ecological interest, while single-point locations will be sampled within each grid to result in ≥ 100 points.

Sampling within each habitat (either wetlands or Biscayne Bay), once initiated, will be conducted within as short a time period as possible to minimize climatic changes and variability that will influence data interpretation. All data will be reviewed at the end of the day; measurements will be repeated within 24 hours to confirm observations if inaccuracies in the data and/or potential anomalies are suspected.

After review and assessment of the porewater survey data, FPL will consult with the SFWMD to determine the need for and locations of the CCS tracer suite measurements (Table 2-6 in Monitoring Plan). Subject to the findings of the porewater measurements, samples will be collected for the tracer suite parameters in each wetland zone (mangrove and marsh) during the dry season and in Biscayne Bay during the dry and wet season. Tracer suite sampling is expected to occur 4 to 8 weeks after the completion of the porewater surveys unless directed otherwise by the SFWMD. Sampling of water from a 30-cm depth at each chosen site will follow protocols for porewater sample collection as defined in Section 2.6.4.5 of this QAPP.

2.9.3 Ecological Monitoring Surveys

The Monitoring Plan (Sections 2.8.4 to 2.8.8) has defined the approximate locations of the survey transects in areas of possible ecological interest; however, the exact locations of these transects was determined based on the dry season porewater characterization findings after consultation with the agencies.

2.9.3.1 Setup of Transects

The specific start point of each transect will be a function of access and subsequent findings from the transect assessment of porewater conductance and temperature assessments every 500 meters along the proposed transect. Points will be named according to the nomenclature defined in Section 2.2 of this QAPP.

In the wetlands, once transect start and end locations have been determined, two or four 20-meter by 20-meter major plots will be set up along the transect length unless porewater assessments along the transects indicate areas of interest that would necessitate a different spacing interval. Plots will be set up along each transect (Figure 2-7 in Monitoring Plan). The 5-m x 5-m and 1-m x 1-m subplots will be determined randomly within each quadrant of the major plots as defined in Section 2.8.6 of the Monitoring Plan. The locations of the start-end points of each transect as well as the northeast corner points of all major plots and subplots will be geopositioned.

In the upland areas (i.e., Model Marsh Lands), at initial setup, semi-permanent markers (i.e., aluminum poles) will be installed on northeast corners of all the plots for visual relocation. Transect ends will not be marked in terrestrial areas.

In Biscayne Bay, the transect locations parallel to the shoreline will be determined based on the Monitoring Plan and initial porewater characterization findings in consultation with the Agencies. The location of the transects closest to shore (250 m offshore) will be a function of ease of access. The start and end points of each transect will be geopositioned after agreement with the Agencies. Subplots will be randomly determined along each transect. Biscayne Bay transect ends will not be marked or staked; sites will be relocated via GPS coordinates.

Transect locations in Biscayne Bay will be found using a Trimble® GeoHX™ or GeoHT™ handheld unit. The Trimble® GeoHT™ applies horizontal root mean squared (HRMS) accuracy and differential correction to provide submeter accuracy. The Trimble® GeoHT™ provides real-time subfoot accuracy using the Satellite Based Augmentation System (SBAS) or an external source for correction (Trimble 2009a). The Trimble® GeoHX™ uses real-time positioning and maintains accuracy with H-Star8™ technology. An internal antenna within a virtual reference station (VRS) network or less than 80 kilometers (km) provides accuracy at the subfoot level at less than 30 cm.

2.9.3.2 Ecological Assessment

Freshwater and Mangrove Wetlands

Vegetation in the wetlands will be classified as either woody or herbaceous. Measurements at each plot level will be conducted at the frequency shown and consist of the parameters listed in Table 2.9-1. Derived parameters that will provide ecological information on the health and structure of these areas are shown in Table 2.9-2 and Table 2.9-3 (presented at the end of Section 2.9). Measurements will only be conducted in plots where this information is applicable (e.g., no herbaceous measures will be conducted if there are no emergent herbaceous species within the mangroves and no woody species measures will be conducted where only marsh grasses/sedges are present).

Plots will be set up by marking all corners of the 20 m x 20 m plots with aluminum poles. The 5 m x 5 m plots will be marked and string used to demarcate the boundaries if woody plants are present and measured within. The 1 m x 1 m plots will also be marked similarly in plots where herbaceous vegetation occurs.

Table 2.9-1. Frequency and Parameters Measured within each of the Plot Sizes

Parameter	Units	Preferred Method	Reference	Plot Size		
				20-m x 20-m (1x/year)	5-m x 5-m (2x/year)*	1-m x 1-m (4x/year)
Canopy cover	%	Cover scale (5% increments)	<p>Heard, L. and B. Channon. 1997. Guide to a Native Vegetation Survey using the biological survey of south Australia methodology.</p> <p>Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. NY. Wiley and Sons. New York.</p>	X	X	
Canopy height	m	Extensible pole		X		
Herbaceous layer height	m	Marked 2 m pole		X		
Herbaceous cover	%	Cover scale (5% increments)	<p>Heard, L. and B. Channon. 1997. Guide to a Native Vegetation Survey using the biological survey of south Australia methodology.</p> <p>Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. NY. Wiley and Sons. New York.</p>	X		X
Species composition	Number of species	Shannon-Wiener Index of Biodiversity	Kempton, R. A. 1979. The Structure of Species Abundance and Measurement of Diversity. Perspectives in Biometry. 35(1): 307-321.		(Trees) X	(Herbaceous) X
Species abundance	Number of species	Shannon-Weiner Index of Biodiversity	Kempton, R. A. 1979. The Structure of Species Abundance and Measurement of Diversity. Perspectives in Biometry. 35(1): 307-321.		(Trees) X	(Herbaceous) X

Table 2.9-1. Frequency and Parameters Measured within each of the Plot Sizes

Parameter	Units	Preferred Method	Reference	Plot Size		
				20-m x 20-m (1x/year)	5-m x 5-m (2x/year)*	1-m x 1-m (4x/year)
Individual tree dimensions [height, diameter at breast height (DBH), canopy width, canopy length]**	Height, canopy width and canopy length in m, DBH in cm**	Extensible pole DBH tape measure	Natural Resources Conservation Service. 2004. National Forestry Handbook. Title 190. Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. NY. Wiley and Sons. New York.		X	
Leaf and stem growth and turnover	grams/year	Ruler or meter tape	Miao, S. L. and F. H. Sklar. 1998. Biomass and Nutrient Allocation of Sawgrass and Cattail along a Nutrient Gradient in the Florida Everglades. Wetlands Ecol. Manage. 5:245-263.		X	X
Leaf morphology (length and width)	cm	Ruler or meter tape			X	
Dominant Herbaceous species leaf length	cm	Ruler or meter tape				X
Dominant Herbaceous species biomass turnover	grams/year	Calculation of biomass change over time. Equations to estimate biomass described in Daoust and Childers	Daoust, R. and D. Childers. 1998. Quantifying aboveground biomass and estimating net aboveground primary production for wetland macrophytes using a non-destructive phenometric technique. Aquatic Botany. 62:15-133.			X

Table 2.9-1. Frequency and Parameters Measured within each of the Plot Sizes

Parameter	Units	Preferred Method	Reference	Plot Size		
				20-m x 20-m (1x/year)	5-m x 5-m (2x/year)*	1-m x 1-m (4x/year)
Water content	% water		Chiariello, N. R., H. Mooney and K. Williams. 1989. Growth, Carbon Allocation and Cost of Plant Tissues. In: Plant Physiological Ecology: Field Methods and Instrumentation. Percy, R. W., J. Ehleringer, H. A. Mooney and P. W. Rundel (eds.). Chapman and Hall, London, New York. pp. 327-365		X	
Leaf chemistry: C	% C	EPA 440.0	Zimmermann, C.F., and C.W. Keefe. 1997. Method 440.0. Determination of carbon and nitrogen in sediments and particulates of estuarine/coastal waters using Elemental Analysis (rev. 1.4). National Exposure Research Laboratory. US EPA.		X	X
Leaf chemistry: N	% N $\left[\frac{\text{grams of nitrogen}}{\text{grams of biomass}} \right]$	EPA 440.0	Zimmermann, C.F., and C.W. Keefe. 1997. Method 440.0. Determination of carbon and nitrogen in sediments and particulates of estuarine/coastal waters using Elemental Analysis (rev. 1.4). National Exposure Research Laboratory. US EPA.		X	X
Leaf chemistry: P	% P $\left[\frac{\text{grams of phosphorus}}{\text{grams of biomass}} \right]$	EPA 365.1 after Dry Ash/Acid Extraction	O'Dell J.W. 1993. Method 365.1 Determination of phosphorus by semi-automated colorimetry (v. 2). Environmental Monitoring Systems Laboratory, US EPA. .		X	X
Leaf chemistry: Leaf carbon isotope ($\delta^{13}\text{C}$)	‰	IRMS	See Appendix B		X	X

Notes:

*. All parameters will be measured 2x/year except for individual tree dimensions which will be measured 1x/year, at the end of each growing season (October-November).

**If woody species are short (e.g. scrub mangroves), the DBH measurement will be obtained at 40cm above the ground. Due to frequently overlapping and intertwining canopies on the tree islands, the canopy width and length will be estimated

Table 2.9-2. Calculated Ecological Parameters from the Plots Measurements

Parameter	Units	Method Reference	Plot Size		
			20-m x 20-m (1x/year)	5-m x 5-m Woody Species (2x/year)*	1-m x 1-m Herbaceous (4x/year)
Shannon-Wiener Species Diversity Index		Ludwig, J. A. and J. F. Reynolds. 1988. Statistical Ecology: A Primer in Methods and Computing. John Wiley & Sons, Inc. New York, NY		X	X
Species Evenness		Ludwig, J. A. and J. F. Reynolds. 1988. Statistical Ecology: A Primer in Methods and Computing. John Wiley & Sons, Inc. New York, NY		X	X
Species Importance Value		Ludwig, J. A. and J. F. Reynolds. 1988. Statistical Ecology: A Primer in Methods and Computing. John Wiley & Sons, Inc. New York, NY		X	X
Total Biomass	kg/ha	<p>For 5m x 5m plots: Ross, M. S., P. L. Ruiz, G. J. Telesnicki and J. F. Meeder. 2001 Estimating Above- ground Biomass and Production in Mangrove Communities of Biscayne National Park, Florida [USA]. Wetland Ecology and Management.. 9:27-37.</p> <p>Coronado-Molina, C., J. W. Day Jr., E. Reyes, and B. C. Perez. 2004. Standing Crop and Aboveground Biomass Partitioning of a Dwarf Mangrove Forest in Taylor River Slough, Florida. Wetland Ecology and Management. 12:157-164.</p> <p>For 1m x 1m plots, modified from: Daoust, R. and D. Childers. 1998. Quantifying aboveground biomass and estimating net aboveground primary production for wetland macrophytes using a non-destructive phenometric technique. Aquatic Botany. 62:115-133.</p> <p>Miao, S. L. and F. H. Sklar. 1998. Biomass and Nutrient Allocation of Sawgrass and Cattail a Nutrient Gradient in the Florida Everglades. Wetlands Ecol. Manage. 5:245-263.</p>		X	X
Plant productivity	kg/plant/yr	See references in Total Biomass		X	X

Table 2.9-2. Calculated Ecological Parameters from the Plots Measurements

Parameter	Units	Method Reference	Plot Size		
			20-m x 20-m (1x/year)	5-m x 5-m Woody Species (2x/year)*	1-m x 1-m Herbaceous (4x/year)
	kg/culm/yr				
Stand productivity	kg/ha/year	Daoust, R. and D. Childers. 1998. Controls of Emergent Macrophyte Composition, Abundance, and Productivity in Freshwater Everglades Wetlands Communities. Wetlands 19:262-275.		X	X
Sclerophylly	g/cm ²	Specific leaf area (SLA) as an index of sclerophylly, as referenced in: Medina E., Garcia, V., and E Cuevas. 1990. Sclerophylly and Oligotrophic Environments: Relationships Between Leaf Structure, Mineral Nutrient Content, and Drought Resistance in Tropical Rain Forests of the Upper Rio Negro Region. Biotropica. 22(1):51-64.		X	
δ ¹³ C	‰	See Table 2.9-1		X	X
Nutrient content (C, N and P)	%	See Table 2.9-1		X	X

Note: Culm is a group or bunch of herbaceous stems

* Plants measured 2x/year but productivity is calculated annually.

Key:

m² = meters squared

ha = hectares

kg = kilograms.

Woody and herbaceous species cover within the 20-m x 20-m plots will be determined annually using aerial imagery from RECOVER, SFWMD, FPL, or Google Earth. The type, quality, date, resolution and source of arials will be documented in the annual report when available. The minimum acceptable resolution for the source arials is 0.5 m. Additionally, the lag time between the aerial flight and ground verification will be noted; the maximum lag time between aerial flight and date for verification will not exceed 4 months and will occur within one season (i.e. wet season). Photographs/images will be digitized to estimate percent cover of each community type (e.g., mangroves, herbaceous species, invasive species) within a plot. The percent cover values will be confirmed during field visits to determine species composition and abundance. Canopy cover will follow the classification scale outlined in Heard and Channon (1997).

As part of the ecological measurements (Table 2.9-1), canopy and herbaceous species cover and height within these plots will be confirmed from the ground. Canopy cover assessment from the ground will also follow Heard and Channon (1997). Vegetation canopy is defined as the average height of the woody species within the plot (includes scrub mangroves <2 meters tall). The number of individuals (i.e., abundance) and species (i.e., composition) of herbaceous and woody plants within one 1 m and 5 m subplot per plot will be identified to calculate species diversity using the Shannon-Wiener Index of Biodiversity and determine species Evenness (Kempton 1979) and Importance Values (Table 2.9-2).

Subplot locations will be defined based on a fixed random design per the Monitoring Plan. There will be one 5 m x 5 m and one 1 m x 1 m subplot within each of the four quadrants of the 20 m x 20 m plot. The location of each subplot will be determined randomly within each quadrant at the onset of monitoring. Once determined, the same subplot locations will be measured throughout the project unless circumstances (e.g. fire) require plot relocation.

An annual survey of all woody species present will be conducted within the 5-m x 5-m subplots. Relative abundance will be assessed using percent cover of each woody species. Using the Institute for Regional Conservation's online Floristic Inventory of South Florida database, a list of trees present in Biscayne National Park will be generated. This list will serve as a baseline guide to distinguish trees from shrubs. No Class I invasive exotic species will be tagged or monitored for productivity measurements as FPL and the Agencies maintain active invasive species removal programs on their lands. Average tree height and diameter at breast height (or in scrub mangrove forests, at 40 cm aboveground, CARICOMP 2001), canopy width and length will be determined annually for up to three trees per 5-m x 5-m subplot subplot. Growth rates and survivorship information of each species will be derived from the data gathered. Additionally, basal area and total biomass within each plot will be determined from published allometric equations (e.g. Ross et al. 2001, Coronado-Molina et al. 2004) or from equations for species of similar growth form and habit.

Leaf and stem production will also be determined within the four 5-m x 5-m subplots by tagging (i.e., using bird bands or metal tags) six terminal branch tips on the trees selected for productivity measurements. The initial tag should encompass leaves on each terminal branch and the rate of leaf increase and loss from that point forward will be documented. This will allow for the calculation of leaf turnover. Stem length of each marked terminal branch will be measured from the base (where it becomes the first order branch) to the base of the stem, below

the terminal leaflet(s). Twice a year (i.e., once at the end of both the wet and dry season) at these 5-m x 5-m subplots, the number of branches on the tagged plants will be counted to extrapolate the number of leaves on each plant; branch length will also be measured to determine stem growth.

If a tagged individual has died, it will be recorded. Where available, the nearest healthy neighbor (< 1 m distant for herbaceous species and < 5 m for woody species) will be tagged as a replacement. Five percent (5%) of the data will be re-measured by a second observer as a QA check.

To determine productivity within the 1-m x 1-m subplot, all vascular plant species present will be recorded. It is understood that sometimes seedlings, damaged plants, juvenile graminoids etc. may be unidentifiable. Each identified taxa will be assigned a percent cover based on cover classes (e.g. 0-1; 2-5; 6-25; 26-50; 51-75; 76-100). Based on the percent covers obtained during the species inventory, dominant species will be selected for measurements used in estimating leaf productivity. If there is one clear dominant species within the plot, then only that species will be tagged and measured for leaf productivity studies. If it is determined that there are 2-3 co-dominant species within the subplot, then productivity measurements will be conducted for the co-dominant species. For sawgrass, leaf productivity for thirty percent or up to 15 individuals (whichever is greater) of the dominant herbaceous species will be estimated based on leaf number, basal diameter, and length (Daoust et al. 1998).). In the case of *Eleocharis* spp. and *Juncus* spp. which are more sensitive to measurements and handling, the length of the stems and diameter at the base will be measured on a minimum of ten percent of tagged individuals per subplot. For ferns and emergent aquatics (i.e. on tree islands), only the length of the leaves will be measured on 30% or up to 15 individuals in the subplot. Productivity data will be gathered twice per year (once each in wet and dry seasons) and calculated annually (Table 2.9-2). Species-specific biomass estimates based on leaf number and/or longest leaf length will be used where available. Where species-specific biomass equations are not available, plant biomass determination will be determined from published allometric equations or from related genera.

At the end of the wet and dry seasons, leaves will be collected from areas close to, but outside of the dominant woody (from the 5-m x 5-m subplots) and herbaceous (from 1 m x 1 m subplots) species subplots. Three leaves of each dominant species within a subplot will be collected. This collection will be made from conspecific individuals occurring outside the 20 m x 20 m plot but nearest to the subplot. For both the woody and herbaceous species in the marsh, mangrove and tree island, sun-exposed mature leaves generated from that season's growth will be collected. All leaves will be collected, stored in plastic bags with a moist paper towel, and put on ice. Leaves will be processed as soon as possible.

Leaf morphological parameters (such as length, width, thickness [i.e., leaf area divided by dry mass] and water content [dry/wet weight]), physiological ($\delta^{13}\text{C}$), and nutrient (TC, TN, TP) characteristics (Table 2.6-5) will be determined. Changes in these parameters over time will provide insight into the ecological conditions of these species.

Plants will be dried at less than or equal to 60°C for two weeks prior to being ground for nutrient and isotope analyses. Average leaf weights for each species will then be used in conjunction with the leaf production data to obtain an estimated rate of biomass change (i.e.,

turnover) per plant for that period. This information can be scaled up to obtain whole-plant biomass and, subsequently, aboveground annual productivity for the plot.

Carbon stable isotopes ($\delta^{13}\text{C}$) will be reported per mil units (‰) and represents the ratio of ^{13}C in a sample compared to a known ^{12}C Pee Dee Belemnite (PDB) standard (details of isotopic calculations provided in Appendix B). The leaf morphological isotope and nutrient parameters will then be used to estimate the seasonal change in sclerophylly (defined as Leaf Mass Area [g cm^{-2}] and incorporating leaf water content and thickness measures), integrated water-use efficiency (WUE) over the growing season (as based on leaf $\delta^{13}\text{C}$ values), and nutrient health (%TC, TP, TN) of the plants (Table 2.9-2). Differences among plots within a transect, among transects across the landscape, and changes across time will be analyzed. The rationale for these analyses is to provide insight into the changing ecological (nutrients) and physiological (as determined by the SLA, WUE) characteristics of plants across the landscape over time.

Biscayne Bay

Transect locations and the general design for the benthic surveys will be as described in the Monitoring Plan (Section 2.8.8). Any changes will be determined in consultation with the Agencies and the District shall authorize all amendments to the monitoring plan consistent with provisions in the Fifth Supplemental Agreement.

The sampling to determine species composition, abundance, and cover of SAV, drift and sessile macroalgae (green, red, or brown), and benthic fauna (corals, sponges) will be conducted using the Braun-Blanquet Cover Assessment (BBCA) methodology (Fourqurean et al. 2002, Table 2.9-3). The technique is a percent cover estimation method (on a 1 to 5 non-linear scale) that is used to survey species cover over large areas rapidly. Percent cover within a plot is defined as bottom occlusion. For this monitoring effort, 0.25-m² PVC quadrats will be used to measure four locations each at eight random points along every transect and will be sampled two times per year. Each quadrat will be thrown away from the boat around the sampling point without consideration of bottom conditions. A diver/snorkeler will then be deployed to conduct the BBCA and other ecological parameters. The BBCA scores for each functional group (i.e., seagrasses, macroalgae) will be calculated and statistically analyzed for differences across time, north-south across the landscape, and with distance from Turkey Point Nuclear Power Plant. The presence of sponges, corals gorgonians and rare species will be noted. Ecological parameters (Table 2.9-3) such as light extinction (i.e., PAR), water level, tidal conditions, porewater, and Bay water (approximately 1 ft from the surface and bottom) conductance, sediment depth (either <30 cm or >30 cm depth), and temperature for each transect will be measured, as well. To ensure within-event sampling consistency, one point per transect (4 out of 32 of the 0.25-m² plots along a transect) will be scored by two individuals as a QA check. All four quadrats will be independently scored by a second biologist. The quadrats will be left in place for review until scores are compared, discussed, and final agreement (100% agreement) is reached. This result is reported along with all scores recorded by all individuals during the QA check.

All monitoring points (eight points/transect, total of 20 2-km-long transects) will be pre-defined prior to the field sampling event and entered into a high-precision GPS (e.g. Trimble® XT). All points will be numbered 1 to 8, starting from the north. The exact locations of these points will be defined randomly within fixed-distance sections of 250 m. Points will be re-located using the GPS as there will be no subtidal transect or point markers along these transects.

Leaf nutrient and water quality sampling will be conducted bi-annually as described in the Monitoring Plan using methods as described previously and as outlined in Table 2.9-3.

As the BBCA method can be highly variable among observers, the same individuals and team will participate in the SFWMD annual inter-calibration exercise to ensure consistency in observations. To the extent possible, measurements within and between events will be made by the same individuals over the monitoring duration to the extent practical. Care will be taken to minimize disturbance to the sediment in shallow areas. An example datasheet is provided in Appendix C.

Faunal sampling within Biscayne Bay will be associated with the transect set up for BBCA assessment. One 1-m x 1-m faunal trap will be haphazardly thrown at four points along each transect; these points are coincident with the locations of SAV sampling at each transect. At the transect closest to shore (Transect “a”), the odd numbered points will be measured. At the next transect, the even numbered points will be sampled. If vegetation is observed at the location, care will be taken to ensure that the bottom of the traps are well placed on the sediment to prevent fauna from escaping from the confined areas. The trap will have 45 cm high aluminum sides that are open on the top and bottom. Two panels of a fine 1/32 inch delta mesh netting will be attached to parallel sides of the upper frame to serve as a cover to keep organisms in when the trap is deployed. A diver will descend with the faunal throw trap to cover the top as it settles on the bottom.

The methodology of clearing the traps will be based on the Fish and Invertebrate Assessment Network (FIAN) protocols (Robblee 1998). Briefly, once the trap is firmly in place, it is cleared of animals with three to five separate passes with a 1-meter-wide framed sweep net of mesh size similar to the panels unless a significant number of organisms still remain (at which 3-5 more passes will be made until most of the organisms have been captured).

All vegetative matter and detritus collected will be placed in a livewell with running seawater and sorted by hand. All organisms will be separated. Fish, caridean and panaeid shrimp, and portunid crabs that can be identified in the field will be measured (i.e., total length, standard length, mantle length, carapace length, carapace width, disk width), counted, and released. Non-target organisms (starfish, urchins, hermit crabs, etc.) that can be identified at a higher taxonomic level will be counted and released. Published and in-house field guides will be available on the boat to assist with field identification. Small, questionable, or problematic species will be preserved and returned to the lab for identification, measurement, and enumeration. Unidentifiable specimens will also be kept for further identification. Additionally, one individual of each species from each size class will be kept as a voucher specimen. Size class will be labeled on the field sheets with voucher specimens that have been collected on previous samplings indicated. Copies of recently filed sheets will be available during sampling as a reference and to avoid redundant collection. Samples retained will be initially fixed with formaldehyde and subsequently transferred to ethanol for long-term storage once identified. Measurements of organisms will be entered in a datasheet (Appendix C). Samples will be used as a reference collection and be stored at the Ecological Associates, Inc. (EAI) laboratory in Jensen Beach, Florida and transferred to the South Florida Natural Resources Center for long-term storage of the collection.

The reference collection will be verified by an independent third party; all unidentifiable specimens will be sent to third-party experts for identification (third-party credential available upon request to FPL). All vouchered specimens will be measured, photographed, and entered into the reference collection database. Specimens will be maintained in a reference collection over the life of the project; upon project completion, all samples will be transported to the South Florida Natural Resources Collection for archiving.

Table 2.9-3. Calculated and Measured Ecological Parameters for SAV Plots

Parameter	Units	Preferred Method	Method Reference
Light extinction	% Loss	Quantum sensor	Refer to Section 2.5.7
Species composition	Number of Species	Modified Braun-Blanquet	Fourqurean, J.W., M.J. Durako, M.O. Hall, and L.N. Hefty. 2002. Seagrass distribution in South Florida: A Multi-Agency Coordinated Monitoring Program. In: The Everglades, Florida Bay and Coral Reefs of the Florida Keys: An Ecosystem Sourcebook. Poorter, J.W., and K.G. Poorter (eds.). CRC Press. Boca Raton, Florida. pp. 497-522.
Species abundance	Number of Species	Modified Braun-Blanquet	Fourqurean, J.W., M.J. Durako, M.O. Hall, and L.N. Hefty. 2002. Seagrass distribution in South Florida: A Multi-Agency Coordinated Monitoring Program. In: The Everglades, Florida Bay and Coral Reefs of the Florida Keys: An Ecosystem Sourcebook. Poorter, J.W., and K.G. Poorter (eds.). CRC Press. Boca Raton, Florida. pp. 497-522.
Cover of vegetation and fauna	Cover Class	Modified Braun-Blanquet	Fourqurean, J.W., M.J. Durako, M.O. Hall, and L.N. Hefty. 2002. Seagrass distribution in South Florida: A Multi-Agency Coordinated Monitoring Program. In: The Everglades, Florida Bay and Coral Reefs of the Florida Keys: An Ecosystem Sourcebook. Poorter, J.W., and K.G. Poorter (eds.). CRC Press. Boca Raton, Florida. pp. 497-522.
Seagrass leaf C, N and P	%	See Table 2.9-1	
Seagrass $\delta^{13}\text{C}$	‰	See Table 2.9-1	
Seagrass $\delta^{15}\text{N}$	‰	See Table 2.9-1	Minagawa, M., D.A. Winter, and I.R. Kaplan. 1984. Comparison of Kjeldahl and Combustion Methods for Measurement of Nitrogen Isotope Ratios in Organic Matter. Anal. Chem. 56:1859-61
Tracer suite and Nutrients in porewater (TKN, TP, NO _x N, Amonia, SRP, DOC, DIC)	mg/L	See Table 2.6-6	
Porewater and bottom water conductivity and temperature	°C	PushPoint Sampling	Lewis, B. 2007. Pore Water Sampling Operating Procedure. U.S. Environmental Protection Agency. SEDSPROC-513-R0

Water depth	cm, m	Sounding rod	
Sediment depth (0-30 cm, ≥ 30 cm) at porewater sites	cm	Microtopography rod	

2.10 Biscayne Bay Geophysical Survey

A boat-based geophysical investigation will be made over a portion of Biscayne Bay using a combination of continuous resistivity profiling (CRP) and distributed temperature sensing (DTS). Readings for CRP will be collected along transects that run parallel and perpendicular to shore. The transects will be labeled in a logical manner (e.g., 1 N/S, 2 N/S, 1E/W). A DTS cable will be deployed on a grid pattern with data collected for at least two tidal cycles along the same transects. GPS technology will be used to establish horizontal control of the geophysical survey locations.

The work will be conducted by the USGS, an entity experienced with CRP and DTS data collection and interpretations. All work will be overseen by a geologist registered in the state of Florida who has working knowledge of South Florida geology and hydrogeology.

All field instruments will be calibrated as applicable in accordance with manufacturers' instructions. Procedures used to calibrate the instruments and the associated calibration results will be documented by the entity conducting the geophysical survey.

To help interpret the results, other information being collected as part of the monitoring effort will be used as applicable including but not limited to:

- The boring logs from the deep pilot boreholes;
- Borehole geophysical data;
- Conductance/salinity data collected from the monitoring well clusters; and
- Temperature data collected from the monitoring well clusters.

Prior to the initiation of work, FPL will obtain information from the entity conducting the CRP and DTS survey regarding experience of staff, specific equipment to be utilized, and field QA/QC procedures that will be implemented; this information, together with the field and analytical procedures, will be added to an appendix when available.

2.11 Bathymetric Survey

A one-time bathymetric study will be conducted on the CCS to help determine the volume of water in the CCS to support water budget calculations. In addition, a bathymetric survey will be conducted in the Interceptor Ditch. Table 2.11-1 and the following text provide a summary of the bathymetric survey and QA/QC procedures.

Table 2.11-1. Bathymetric Survey Quality Control Procedures

To Verify	Procedure
1. Monument designation	Digital photo, record stamping
2. Monument elevation	RTK / GPS
3. Monument coordinates	RTK / GPS
4. Cross-section alignment	RTK / GPS
5. Upland cross-section	a) RTK check-in b) Offshore profile overlap with onshore
6. Offshore positioning	a) DGPS position check b) Onshore overlap with offshore c) Check profile between survey days
7. Water surface measurements	a) Closed bench loops b) Boat RTK vs. upland RTK c) Check profile between survey days
8. Depth soundings	a) Squat, settlement, draft calibration of vessel b) Bar check calibration of fathometer c) Check profile between survey days
9. Final cross-section view	a) Onshore / offshore overlap b) Plot plan view data on aerial images c) Check profile between survey days

The bathymetric survey will be conducted predominantly using sonar equipment and a real-time GPS system to collect data along regularly spaced transects. Cross-section alignments perpendicular to canal lengths will be established at a minimum of 1,000-foot (304-m) intervals starting from north of the CCS for all canals in the CCS. Horizontal and vertical control will be established throughout the project area. The survey crew will recover and verify the coordinates and elevations on two horizontal and five vertical control points surrounding the project area and will set five additional project control points within the survey area to be utilized as Real Time Kinematic (RTK)/GPS base station control points. RTK/GPS will be used to set the project control located from two of the published control points.

In areas of immediate proximity to the bank, the water in some locations may be too shallow for a boat to obtain a sounding. Also, the bathymetric survey cannot record readings on the banks above the water line. Since it is expected that changes in water levels in these areas will constitute less than 2.5% of the water volume, manual surveying of potentially hundreds of cross-sections at all locations in shallow water areas near the bank and up the bank is not required. In these instances, the surveyor will estimate that portion of the cross-section based on an extension of the surveyed slope and/or visual observation. However, at a minimum, manual surveying using RTK/GPS to verify/spot check the shallow water and embankment slopes that are commonly observed will be performed. A RTK base station will be set on a control point with known vertical coordinates and elevation, and the rover will be taken to another horizontal/vertical control point to check the rover's position and elevation. This "check-in" will be performed at the beginning and end of each survey day.

For the boat accessible in-water portion, RTK/GPS, together with digital echosounder and Hypack[®] navigation software, will be used to establish bottom elevations. The survey skiff and/or airboat will be calibrated for draft, squat, and settlement while underway. The fathometer will be calibrated for variations in the speed of sound in water using a "bar check" calibration. A bar will be suspended below the fathometer transducer using cables marked off in feet and the fathometer will be adjusted to display the correct depth of the suspended bar. Additionally, the

upland crew will measure an elevation on the canal water surface when the boat is collecting bottom elevation data to verify the boat's RTK water surface elevation. The survey boat will also re-run selected survey lines on different days as a "second-independent check" on the bathymetric survey data accuracy.

Where the upland cross-section elevation data overlaps the data collected by the boat crew, the two data sets will be plotted together to check for any horizontal or vertical offsets. If the onshore and offshore data compares favorably, the two data sets will be merged into one xyz file.

The survey will be conducted by a surveying crew with experience in bathymetric surveying and overseen by a surveyor licensed in the state of Florida in accordance with the current Florida Minimal Survey Technical Standards and the most recent update of the USACE EM1110-2-1003, Hydrographic Survey Standards.

The data collected will be tied to established horizontal and vertical datums and recorded as described below:

- State Planar Coordinates NAD of 1983, Florida East Zone;
- State Planar Coordinates NAD of 1927, Florida East Zone;
- NAVD; and
- NGVD.

The accuracy of the instrumentation and the horizontal and vertical datums to be recorded should correspond not only to one another, but also relate to other surveys being done for the project. The vertical accuracy will be decimeter GPS. Since the volume of water in the CCS will vary hourly, the water surface will be monitored during the survey and all depths will be corrected to reflect the depth below the vertical datums and the associated elevation.

The accuracy and precision of the instrumentation must be maintained by calibration and maintenance as specified by the manufacturers' specifications. Field calibrations and alternate depth sensing will be used throughout the sampling to validate the data that have been taken.

At a minimum, confirmation that data have been recorded and stored appropriately in the equipment must be performed at regular intervals throughout the day. During the survey, any changes necessitated by site conditions (vegetation in the canal, obstructions in the transect, etc.) from the protocol established prior to the start of the survey will be noted in the logbook. At the end of each day, all data acquired that day will be digitally backed up, and non-electronic data should be copied and uploaded, as well.

A plan view drawing showing the elevation data points referenced to NGVD 29 and NAVD 88 will be plotted together with the cross-section views at 1,000-foot stations. A digital terrain model (DTM) will be developed using a combination of the elevation data and points digitized from a geo-referenced digital aerial image using Land Development desktop software. Additionally, an elevation surface model of the average water surface elevation will be

developed and the volume of water will be computed for each of the north-south mile-long CCS sections (four total).

2.12 Water Budget

Daily values input to the water budget and monthly water budget results will be documented in MS Excel format in electronic form so that the water budget results can be readily verified. The water budget will be address both volume and salt mass exchanges across the CCS boundaries. A computer model may be used to generate the water budget as described in the monitoring plan but the equations and algorithms used to generate values for water budget terms on a daily basis will be clearly documented and include all relevant data, assumptions and calculations so that the calculations and results can be verified independently from the model used if necessary. Those algorithms will be based on approved methods of calculating values of water budget terms, e.g., the estimate of evaporative losses will be based a method that accounts for the increased temperature of the water in the CCS control volume as well as other meteorological parameters collected at the site. Details regarding the District's approved methodology will be included in first annual report.

This page left blank intentionally.