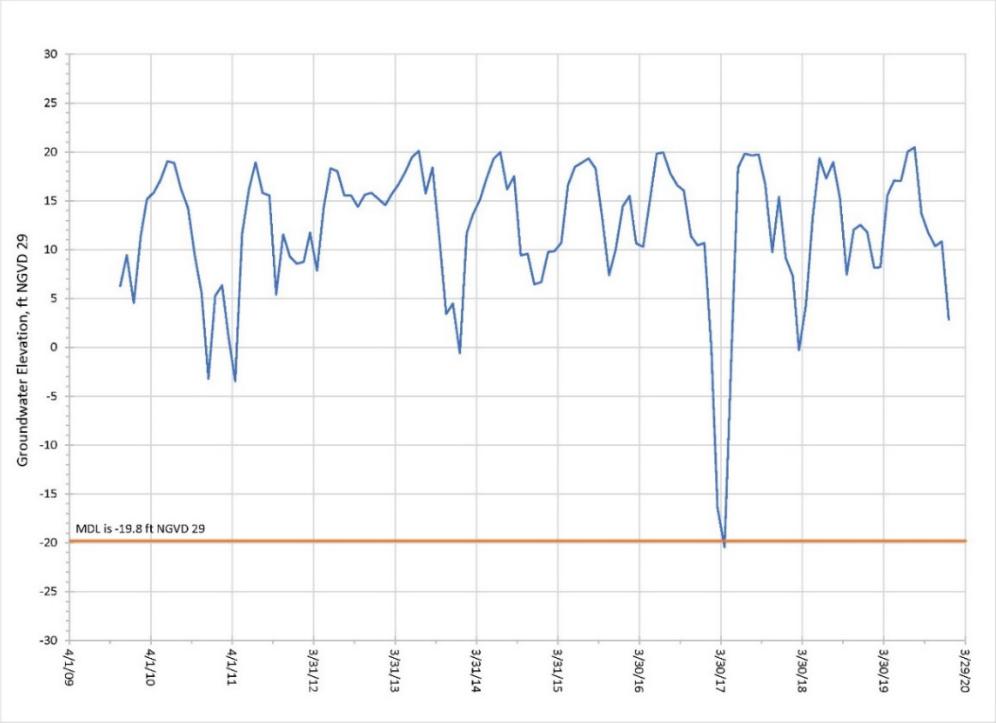

Figure 6-9. Groundwater elevations in Lower Tamiami aquifer well HES-26D (100 feet deep), and associated maximum developable limit elevation, eastern Hendry County.

Surficial Aquifer System Water Quality

Water quality monitoring is crucial to managing and protecting fresh groundwater sources, such as the SAS. Chloride concentration data are used to monitor saltwater intrusion, which can occur from the inland movement of the saltwater interface or the sustained upward movement of deeper saline groundwater (upconing). Chloride concentrations must be less than 250 milligrams per liter (mg/L) to meet the United States Environmental Protection Agency secondary drinking water standards (USEPA 2023).

The inland movement of seawater primarily affects coastal communities, while the upward movement of brackish groundwater is a concern for some inland areas (e.g., western Palm Beach and Broward counties). The east coast of Florida is particularly susceptible to lateral saltwater intrusion due to the following factors:

- Proximity to the Atlantic Ocean, inlets, and lagoons
- A large number of coastal wellfields
- Low land-surface elevations (less than 10 feet above mean sea level)
- Drainage canals that lower the water table, which reduces the water pressure exerted against the saltwater interface
- Canals without coastal water control structures or structures that are located inland
- Rising sea levels

Groundwater with chloride concentrations greater than 250 mg/L is found in portions of central and western Palm Beach and Broward counties and is attributed to relict seawater (connate water) in less transmissive portions of the SAS (Miller 1988, Reese and Wacker

2009). This underlying brackish water limits the depths and withdrawal rates for some PS and L/R irrigation wells. Chloride concentrations in shallow groundwater wells less than 20 feet deep in the Everglades Agricultural Area (EAA) range from 100 to 300 mg/L. Chloride concentrations increase with depth and can exceed 1,000 mg/L below 50 feet and 9,000 mg/L at depths to 200 feet. Therefore, SAS wells typically are not used for irrigation in the EAA as the high chloride concentrations would impact crops and the water resources. Higher salinities also are found in agricultural and flood control canals in western Palm Beach County where some canals intersect brackish portions of the SAS. Chloride concentrations in SFWMD canals in the EAA generally fluctuate between 50 and 200 mg/L over the year. Data collected from 2000 to 2009 at culverts 12 and 12A near Pahokee on Lake Okeechobee have recorded chloride concentration fluctuations up to 600 mg/L.

Saltwater Interface Mapping

The SFWMD periodically develops saltwater interface maps to help visualize and understand the potential degradation of the coastal aquifers and water supply wellfields tapping the SAS due to saltwater intrusion. Salinity data from monitor wells were compiled from multiple sources (e.g., USGS, SFWMD, water use permittees) and contoured to estimate the position of the saltwater interface, defined as the isochlor line with a 250 mg/L chloride concentration. To date, three series of maps have been developed (2009, 2014, and 2019), with plans to update the maps every 5 years. This approach allows tracking of the position of the saltwater interface over time, can be used to identify areas of concern that may need additional monitoring, and may suggest the need for changes in wellfield operations. The SFWMD's saltwater interface monitoring and mapping program is described by Shaw and Zamorano (2020). The 2019 saltwater interface maps are available on the SFWMD's webpage https://www.sfwmd.gov/documents-by-tag/saltwaterinterface.

In general, the 2019 maps are similar to the 2014 maps; however, relatively small differences indicate that the interface is regionally dynamic, with inland movement in some areas and seaward movement in other areas. Local-scale investigation of the saltwater interface could be warranted in some areas, depending on the network of monitor wells available, the proximity of the saltwater interface to specific wellfields, and groundwater withdrawal rates at these wellfields. In addition to SFWMD efforts, the USGS (2017) maintains a saltwater intrusion mapping webpage that graphically depicts statistical analyses of water level and salinity data collected from USGS monitoring sites in South Florida. This mapping tool also shows the SFWMD salinity control structures, the 2019 saltwater interface location in Palm Beach and Broward counties, and the 2021 saltwater interface location in Miami-Dade County.

Below is a brief description of the saltwater interface position in Palm Beach, Broward, and Miami-Dade counties, including analyses of select monitor wells. More detailed analyses of saltwater intrusion maps, as well as the results of electromagnetic induction logging of select wells, are provided in **Appendix D**.

Palm Beach County

The 2009, 2014, and 2019 saltwater interface positions in Palm Beach County are shown in **Figure 6-10**. In many areas, these lines overlap, meaning the interface position is stable. Chloride concentrations at the monitor well locations were measured in 2019. For reference, the figure also includes PS wellfield areas, which identify the cone of influence of the

withdrawals. Several utilities with wellfields near the coast (e.g., Tequesta, Lake Worth, Lantana) have made wellfield operational changes in response to saltwater intrusion that have effectively moved the saltwater interface seaward or stabilized it (**Figure 6-10**, Inset A).

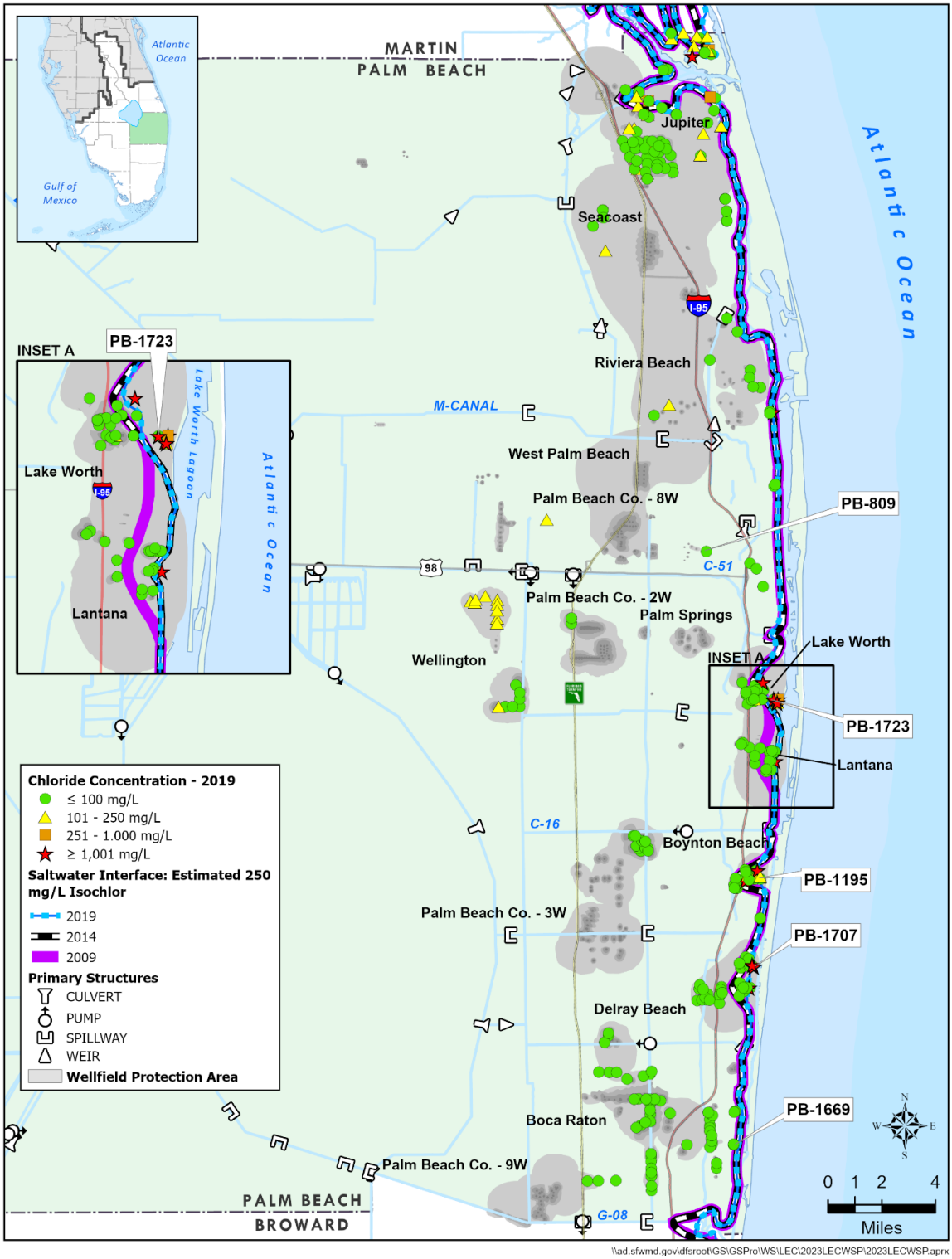

Figure 6-10. Surficial aquifer system chloride monitoring locations; chloride concentrations; and 2009, 2014, and 2019 saltwater interface positions in Palm Beach County.

Chloride concentrations in USGS well PB-809, located slightly inland, have increased from 40 to 80 mg/L over the past three decades (**Figure 6-11**). Groundwater elevations range between 9.5 to 11.5 feet NGVD. Data indicate the chloride concentrations and water levels are relatively stable at this location.

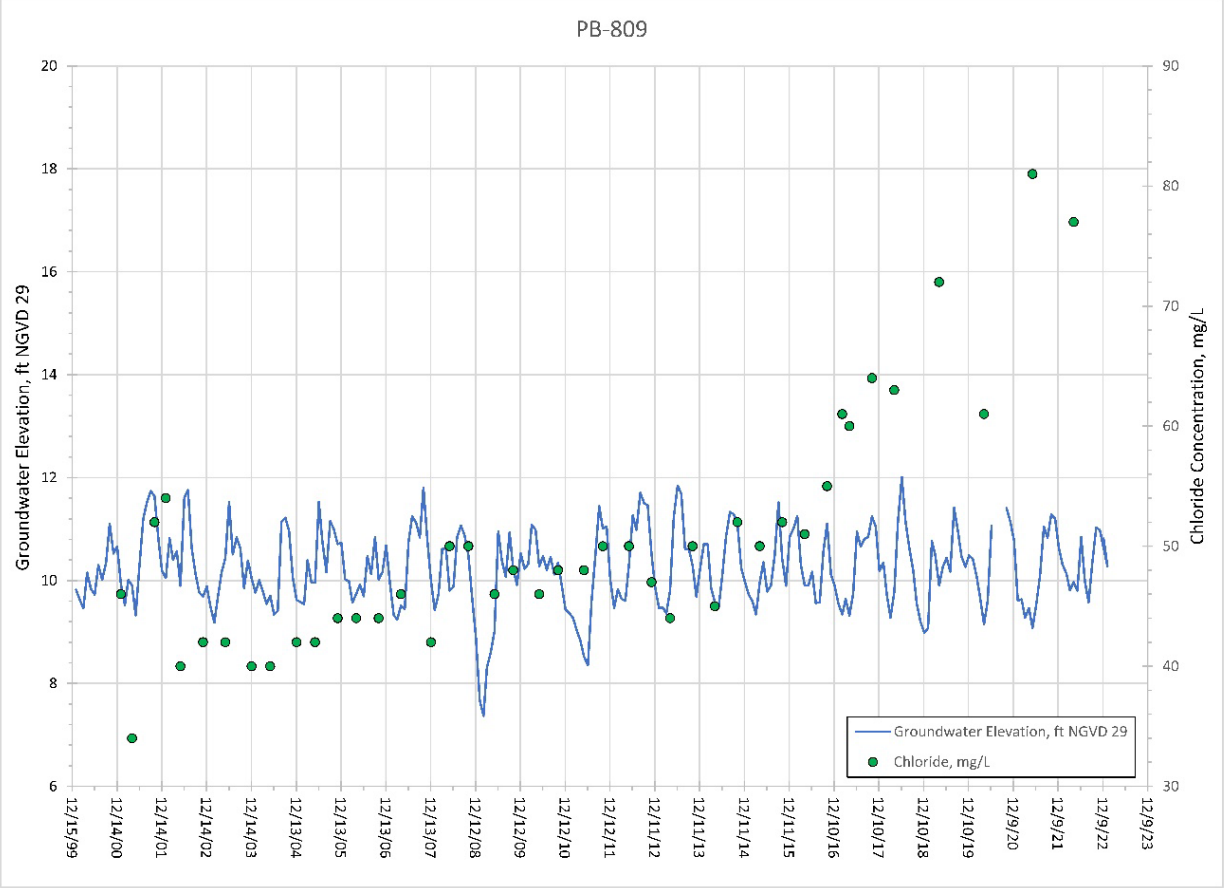

Figure 6-11. Chloride concentrations and groundwater elevations in monitor well PB-809 (150 feet deep) in West Palm Beach, east-central Palm Beach County.

Chloride concentrations in monitor well PB-1707, located east of the Delray Beach East wellfield, decreased from approximately 4,000 mg/L in 2014 to 3,000 mg/L in 2018 (**Figure 6-12**). Since 2018, chloride concentrations have rapidly increased to more than 14,000 mg/L, while groundwater elevations as low as -1 feet NGVD were recorded. A combination of temporarily increased reliance on the East wellfield and construction dewatering in the area is the likely cause of this condition. The City of Delray Beach should endeavor to maintain groundwater levels above +2 feet NGVD near this well by shifting more pumpage to its West wellfield to prevent further inland movement of the saltwater interface.

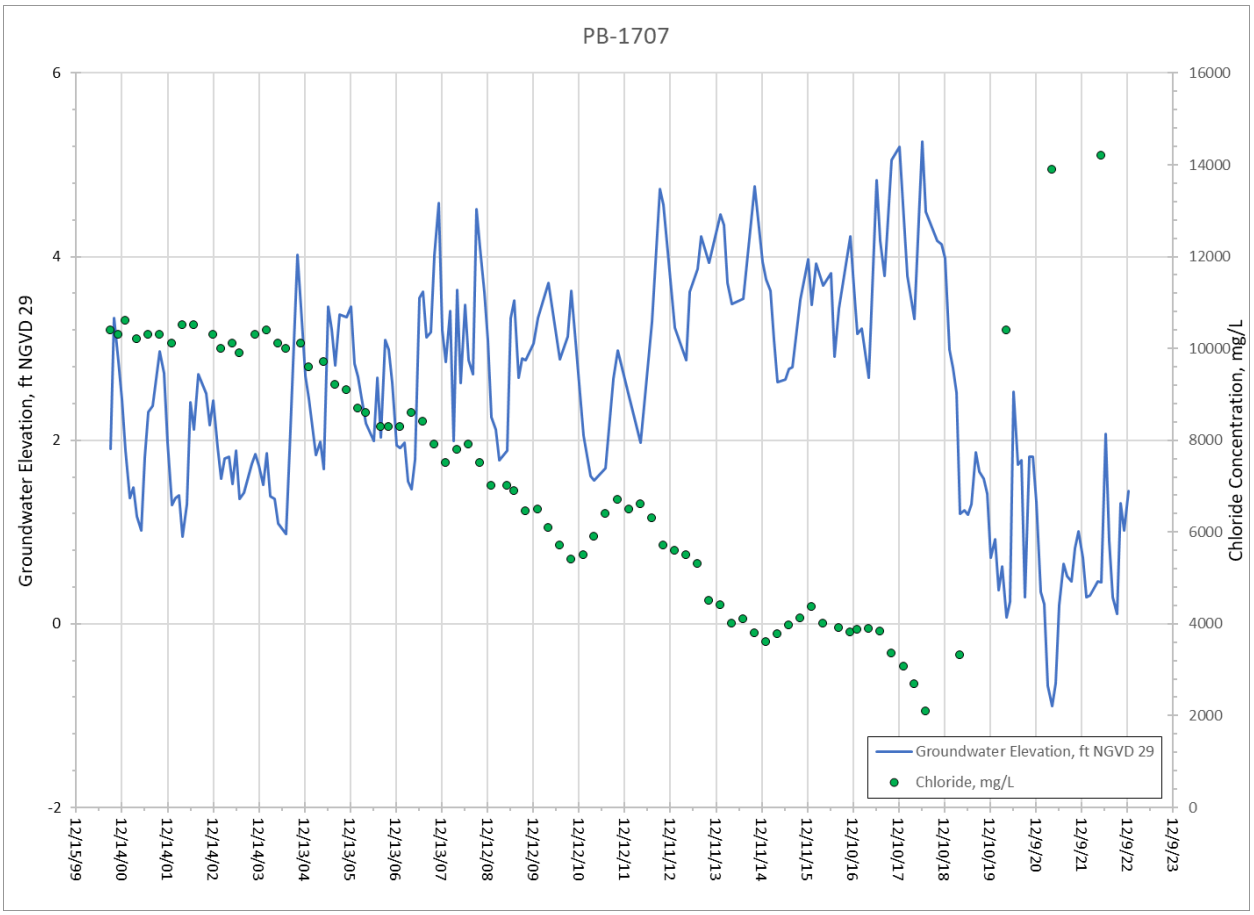

Figure 6-12. Chloride concentrations and groundwater elevations in monitor well PB-1707 (183 feet deep) in Delray Beach, southeastern Palm Beach County.

In the Boca Raton coastal area, chloride concentrations near the base of the aquifer remain around 45 mg/L as shown in USGS well PB-1669 (**Figure 6-13**). Because groundwater elevations rarely are below +4 feet NGVD, the saltwater interface has remained seaward of this well location.

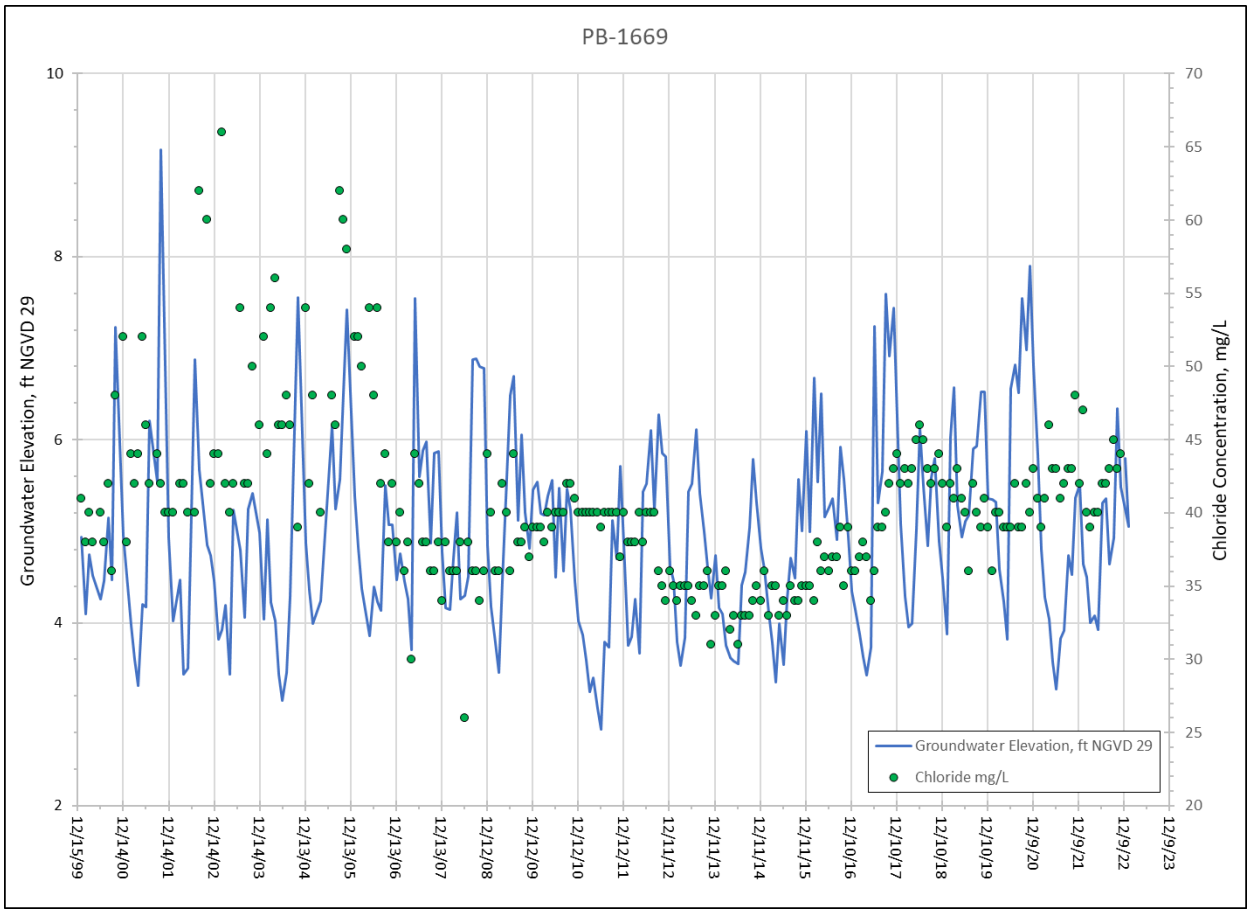

Figure 6-13. Chloride concentrations and groundwater elevations in monitor well PB-1669 (131 feet deep) in Boca Raton, southeastern Palm Beach County.

Broward County

The 2009, 2014, and 2019 saltwater interface positions and PS wellfield protection areas for Broward County are shown in **Figure 6-14**. Chloride concentrations were measured most recently in 2019. Changes in the extent of saltwater intrusion in 2014 and 2019 resulted from improved spatial information, particularly in the area of the C-11 and Hillsboro canals. In other areas, westward movement of the saltwater front is evident. However, the elevated chloride concentrations noted in the vicinity of the Broward County South Regional wellfield are the result of upconing of connate water from the base of the SAS and are not related to the movement of the saltwater interface.

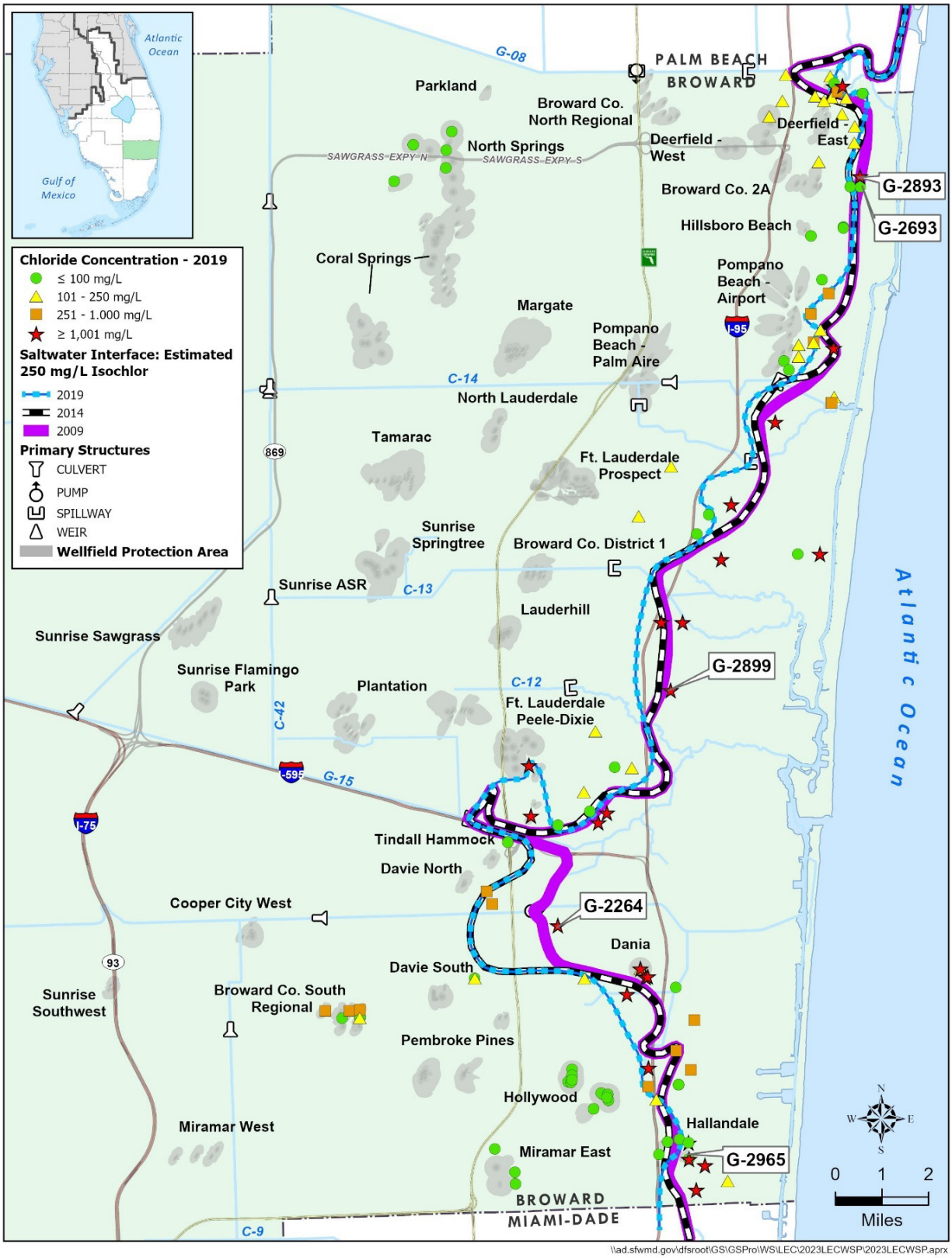

Figure 6-14. Surficial aquifer system chloride monitoring locations; chloride concentrations; and 2009, 2014, and 2019 saltwater interface positions in Broward County.

Monitor well G-2693 (**Figure 6-15**) is located less than 1 mile from the coast in the Town of Hillsboro Beach. Chloride concentrations are stable between 30 to 40 mg/L, and groundwater elevations range between 3.5 to 7.0 feet NGVD.

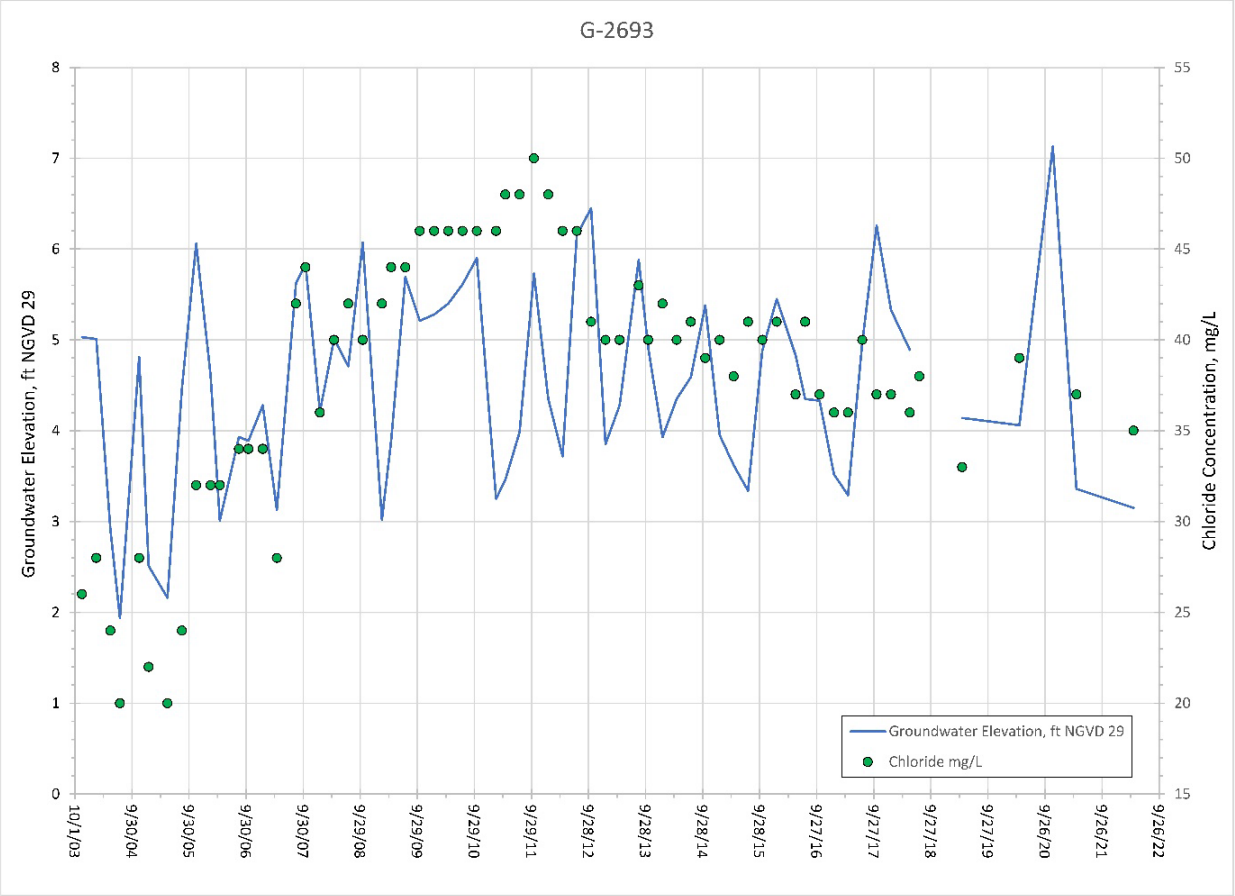

Figure 6-15. Chloride concentrations and groundwater elevations in monitor well G-2693 (229 feet deep) in Hillsboro Beach, northeastern Broward County.

Monitor well G-2899 is less than 1 mile east of Interstate 95 and just south of Sunrise Boulevard in Fort Lauderdale. Chloride concentrations in the well began exceeding 250 mg/L in 2005 and have steadily increased to 1,000 mg/L in 2018 and 1,350 mg/L in 2021 (**Figure 6-16**), suggesting inland movement of the saltwater interface at this location. There are no PS wellfields directly west of this monitor well.

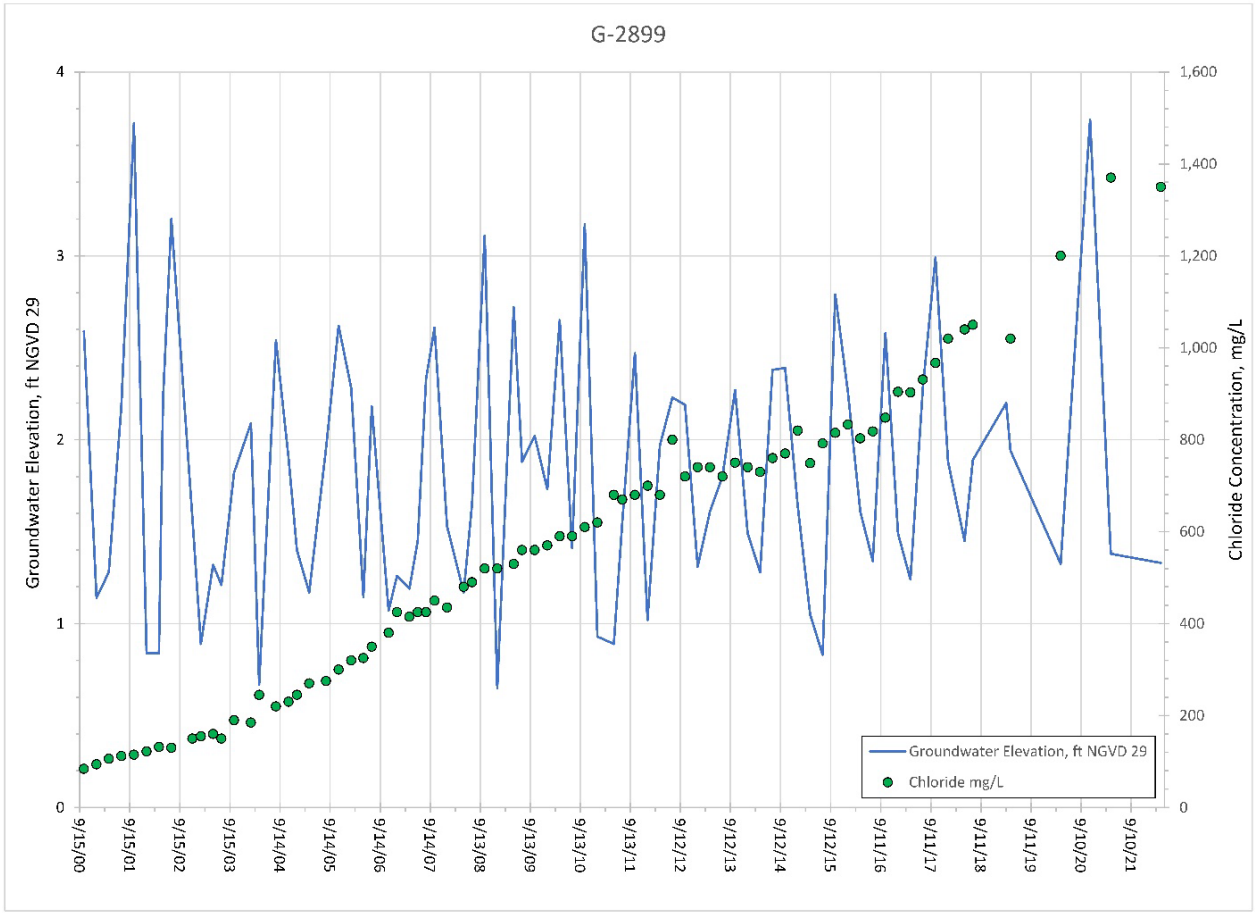

Figure 6-16. Chloride concentrations and groundwater elevations in monitor well G-2899 (165 feet deep) in Fort Lauderdale, eastern Broward County.

Miami-Dade County

The USGS 2008, 2011, 2016, and 2018 saltwater interface positions for Miami-Dade County are shown in **Figure 6-17** (Prinos et al. 2014; Prinos 2017). As with Broward County, some areas show inland movement of the saltwater interface along the coast, with the greatest historical movement in southern Miami-Dade County.

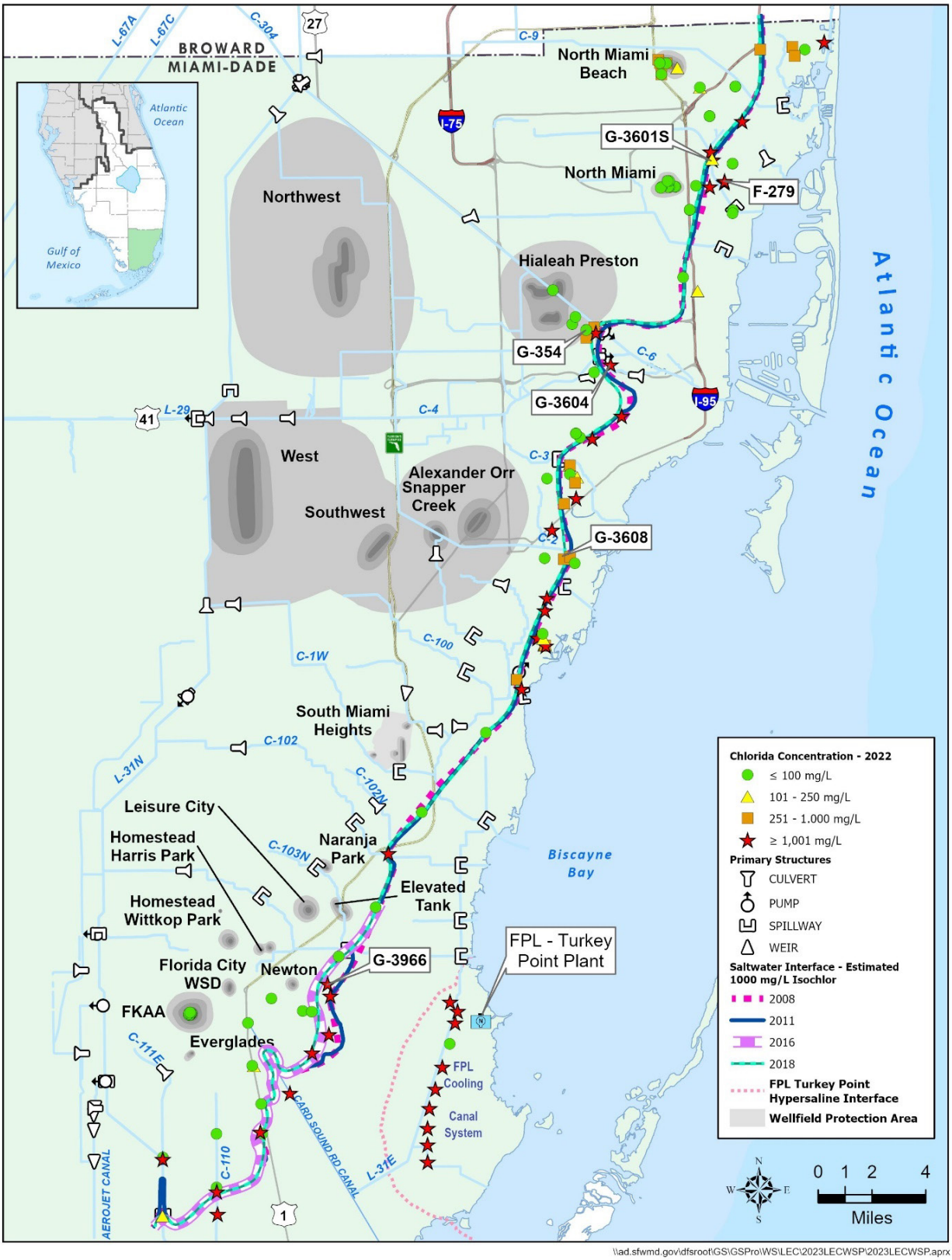

Figure 6-17. Surficial aquifer system chloride monitoring locations; chloride concentrations; and 2008, 2011, 2016, and 2018 saltwater interface positions in Miami-Dade County.

USGS monitor well F-279, located in eastern North Miami, has chloride concentration and groundwater elevation data from 1940 to present. Since 2018, chloride concentrations have increased from 4,500 to 6,000 mg/L, with concentrations moderating when water levels are above +2 feet NGVD (**Figure 6-18**). Although the saltwater interface has migrated inland beyond this monitor well, the data are valuable for determining the rate of inland movement.

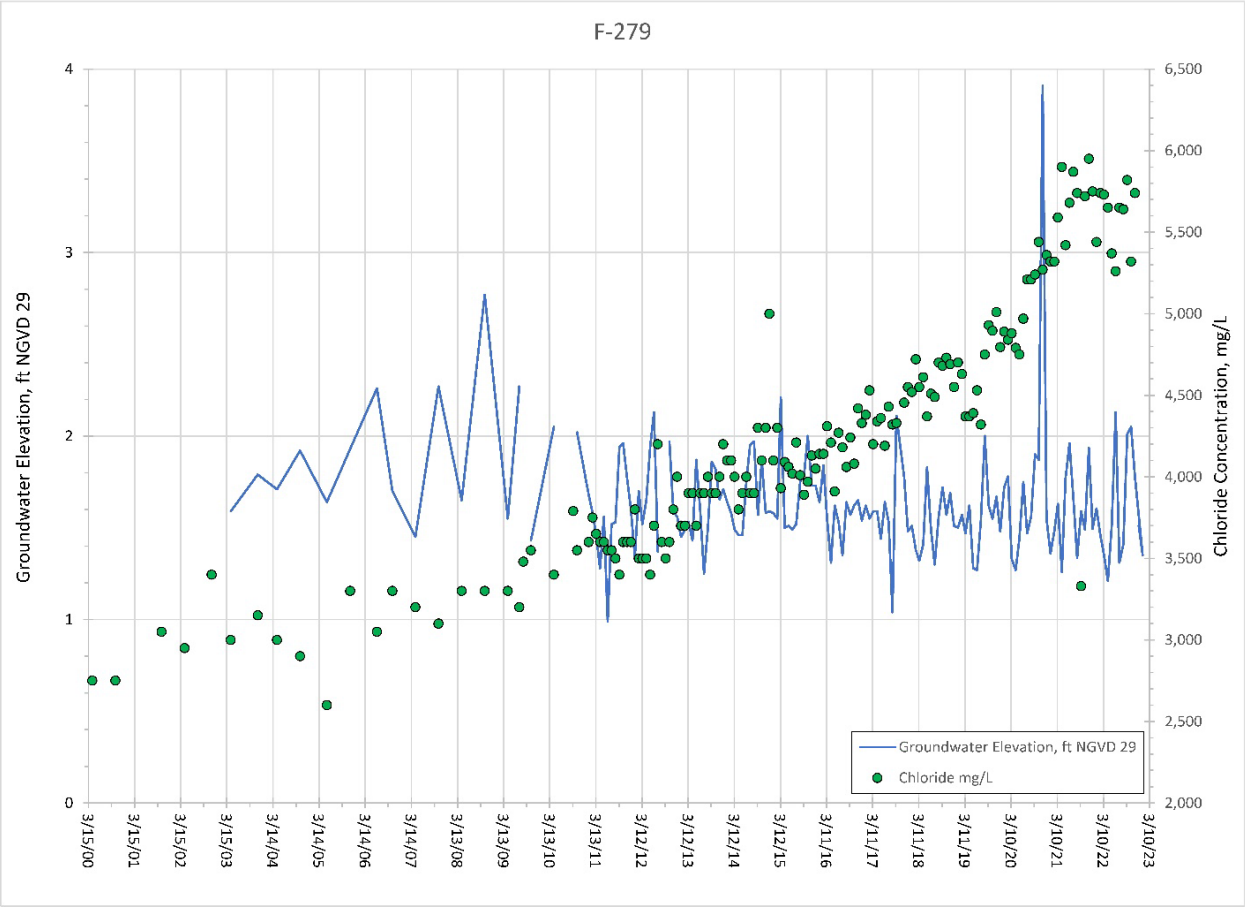

Figure 6-18. Chloride concentrations and groundwater elevations in monitor well F-279 (116 feet deep) in North Miami, northeastern Miami-Dade County.

The Miami-Dade Water and Sewer Department (MDWASD) saltwater interface monitor well G-354 (**Figure 6-19**) is upstream of the S-26 salinity control structure and east of the Hialeah, Preston, and Miami-Springs PS wellfields. Combined pumpage from these three wellfields has been capped since the early 1990s to prevent pollution from western sources. Well depths for the PS wells in these wellfields range from 107 to 115 feet below land surface (bls). Chloride concentrations have been decreasing and are less than 40 mg/L at well G-354 likely due to the S-26 Structure's ability to maintain water levels.

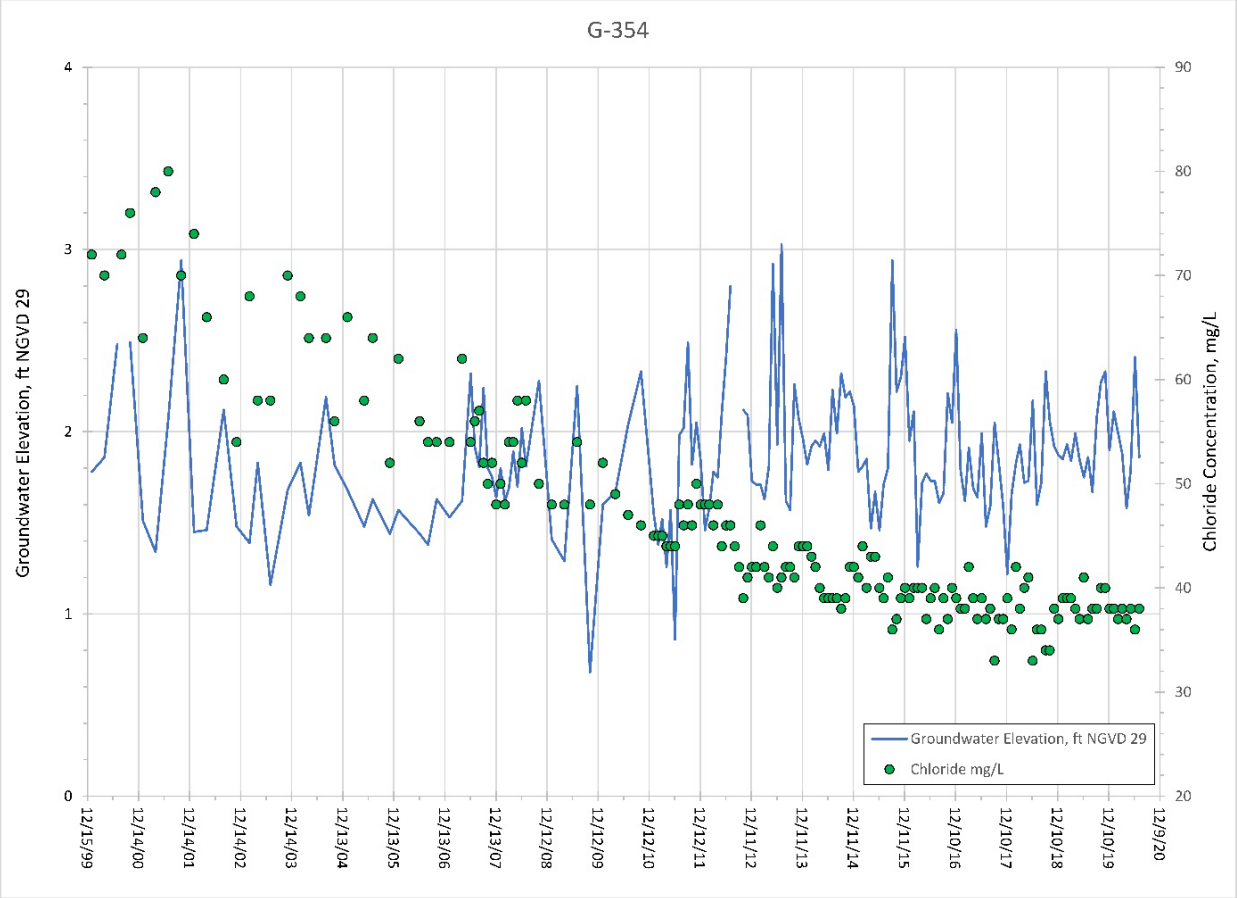

Figure 6-19. Chloride concentrations and groundwater elevations in monitor well G-354 (90 feet deep) in Hialeah, northwestern Miami-Dade County.

The Florida Power & Light (FPL) Turkey Point Clean Energy Center, approximately 8 miles east of Florida City, operates a cooling canal system (CCS) that encompasses 5,900 acres and 160 miles of shallow canals in hydrologic contact with the Biscayne aquifer (**Figure 6-17**). Since the system began operating in the early 1970s, a hypersaline (salinity greater than ocean water) plume has formed beneath it that has migrated westward away from the CCS within the lower of two high-flow zones, not in the deepest (less permeable) part of the Biscayne aquifer. The approximate extent of the hypersaline plume was estimated by a controlled-source electromagnetic survey (Enercon 2016) and chloride concentration data from monitor wells. Additionally, a local groundwater flow and solute transport model was developed to evaluate historical conditions that contributed to the present configuration of the hypersaline plume. The model was used to simulate different aquifer remediation system designs (Tetra Tech 2016).

The Florida Department of Environmental Protection (FDEP), FPL, SFWMD, and Miami-Dade County monitor the hypersaline plume through an extensive network of monitor wells at varying depths. Approximately 5 miles west of the CCS is a cluster of three monitor wells (**Figure 6-17**): TPGW-7S (26 feet bls), TPGW-7M (52 feet bls), and TPGW-7D (114 feet bls). Historical water level and water quality data are from monitor well TPGW-7D. Chloride concentrations in monitor wells TPGW-7S and TPGW-7M are less than 50 mg/L and not shown due to scale. However, salinity in the lower high-flow zone began increasing in 2014 and was most recently at more than 5,000 mg/L (**Figure 6-20**). Remedial measures being implemented by FPL through regulatory agreements with the FDEP and Miami-Dade County include 1) Biscayne aquifer recovery wells along the western edge of the CCS, 2) a deep injection well system to dispose of the recovered hypersaline groundwater, and 3) brackish Upper Floridan aquifer (UFA) well water conveyed into the CCS to reduce salinity. These measures are meant to abate the hypersaline migration and retract the hypersaline conditions back to the FPL property boundary.

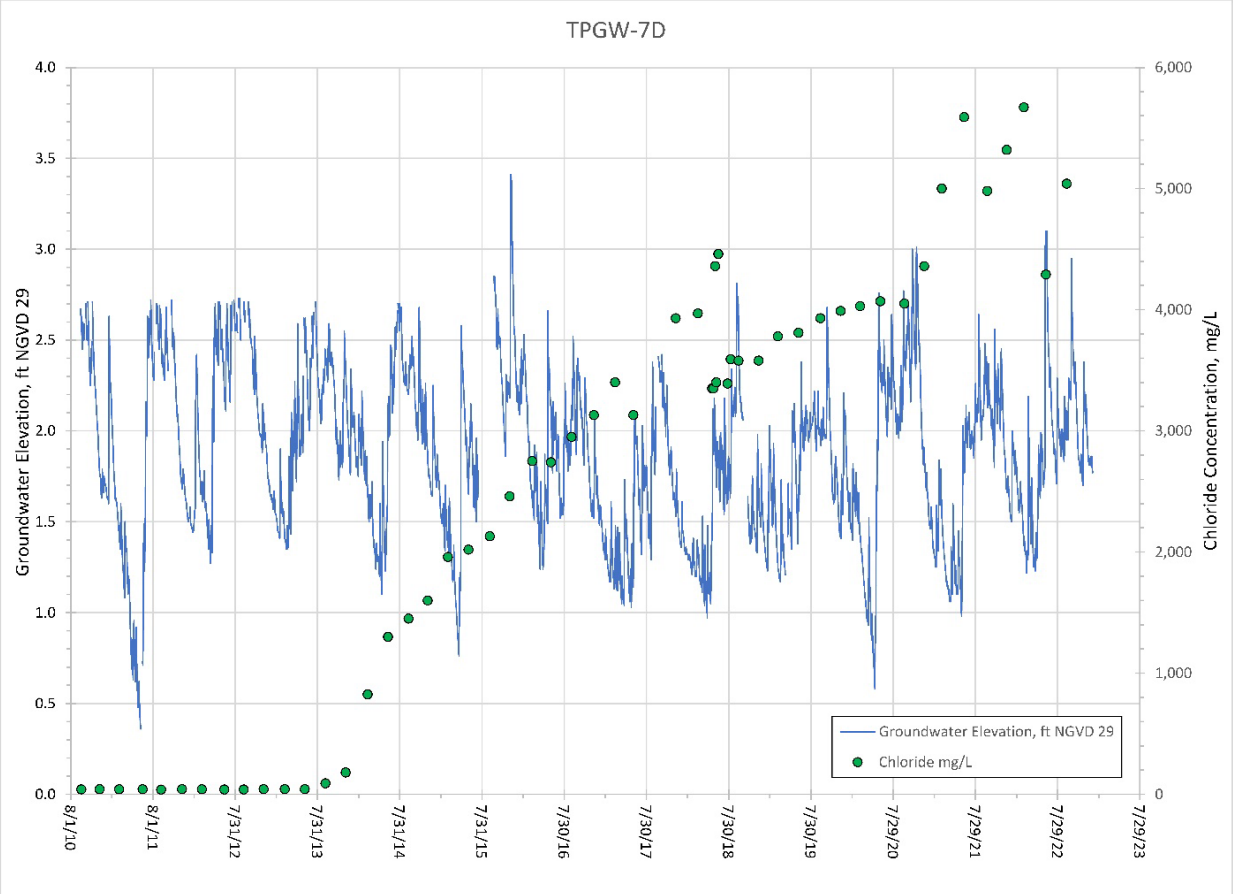

Figure 6-20. Chloride concentrations and groundwater elevations in monitor well TPGW-7D (114 feet deep) in Homestead, southeastern Miami-Dade County.

Surficial Aquifer System Conclusions

Analyses of the SAS indicate that water availability for increased water allocations is limited in many areas and cannot be the primary source for all projected water demands in the LEC Planning Area without harming the water resource, including related natural systems. Water levels and water quality in the SAS appear to be relatively stable with some exceptions at current withdrawal rates in Palm Beach County and northern Broward County. That said, central and southern Broward County and Miami-Dade County have definite locations where saltwater intrusion appears to be active based on monitoring data. The 2024 SFWMD saltwater interface mapping effort will provide further information on the extent of saltwater intrusion and identify additional monitoring and potential wellfield operational recommendations to address concerns. AWS sources (e.g., the C-51 Reservoir Phase 1, FAS, and reclaimed water) will need to be relied upon to meet increasing water demands in many urbanized areas.

Floridan Aquifer System Evaluation

The FAS is a productive and important aquifer used primarily by LEC PS utilities and seven golf courses, as an AWS. As development of the SAS has become maximized, several PS utilities currently use the FAS to meet a portion of their current demands, with a few new PS utilities proposing to tap the FAS to address water quality concerns and meet future demands (**Chapter 8**). The FAS is brackish in the LEC Planning Area and requires desalination prior to use. FAS wells primarily pump from the UFA. Currently, the Avon Park permeable zone (APPZ) and the Lower Floridan aquifer (LFA) are not widely used as water sources in the LEC Planning Area.

Water availability from the FAS is affected primarily by water quality degradation, which can be managed through appropriate wellfield design and operating protocols. One of the key objectives in this management strategy is to minimize upconing of higher saline water from deeper portions of the aquifer. To accomplish this, PS utilities can increase the spacing between newly installed wells to minimize interference effects and excessive drawdowns due to pumping, rotate the operation of individual wells to reduce pumping stress and excessive drawdowns, reduce pumping rates, and plug and abandon wells that have shown an increase in chloride concentrations or that were designed with open intervals intersecting multiple aquifer zones of varying water quality. Most PS utilities are required to monitor water quality at their wellfields as part of their water use permits. Future strategies to address managing withdrawals to minimize water quality degradation are provided in **Chapter 9**.

Groundwater monitoring provides water users with an understanding of the hydrogeologic system through long-term data collection, which is needed to evaluate current and expected future groundwater conditions, water supply potential, detect temporal trends in groundwater elevations and water quality, and develop and calibrate groundwater models.

Floridan Aquifer System Water Levels and Water Quality

The SFWMD and USGS monitor the FAS using a regional network of monitor wells. Additional data are collected by water use permittees as part of their water use permit monitoring requirements (issued by the SFWMD) and injection wells (issued by the FDEP) (**Figure 6-21**).

The SFWMD's Regional Floridan Groundwater monitoring program consists of a network of monitor wells (SFWMD wells on **Figure 6-21**) completed in the various producing zones of the FAS (i.e., UFA, APPZ, LFA) from which groundwater elevations and water quality samples are collected.

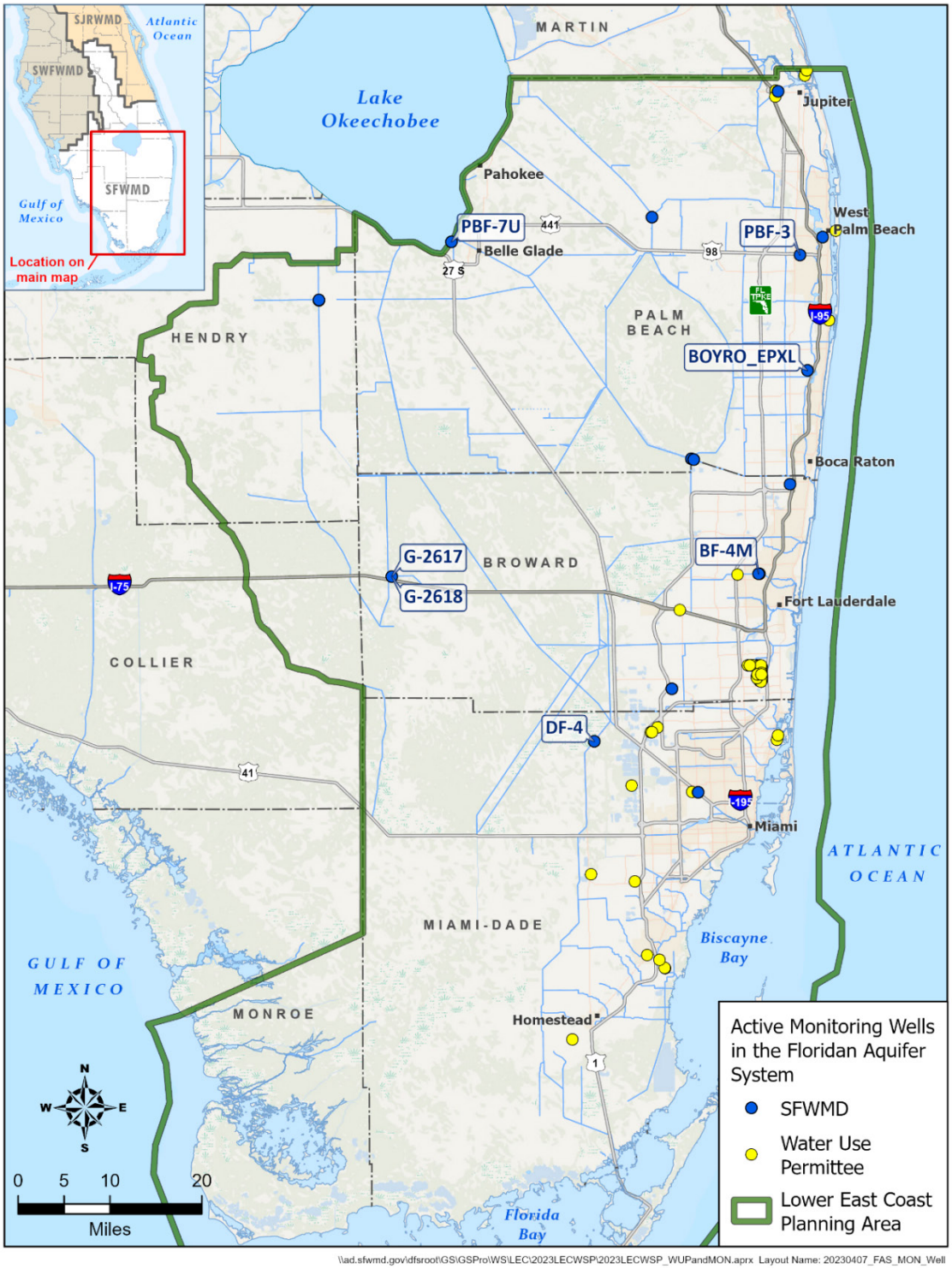

Figure 6-21. LEC Planning Area Floridan aquifer system monitor well locations and associated monitoring entities.

Upper Floridan Aquifer

In the LEC Planning Area, four wells completed in the UFA have long-term groundwater elevation and water quality data (chloride and total dissolved solids [TDS] concentrations) that were evaluated (**Tables 6-2** and **6-3**). Data from these wells indicate yearly, seasonal groundwater elevation fluctuations. Overall, groundwater elevations have remained relatively stable at UFA wells during their periods of record with the exception of well DF-4, which had a period of water level decline in 2012. Groundwater elevations at DF-4 returned to historical elevations in 2015 and have remained stable since 2015. Water quality data were reviewed and plotted for the same four UFA wells. Overall, the trend at each well is relatively stable, with chloride concentrations ranging from 557 to 2,800 mg/L for the period of record for all four wells (**Table 6-2** and **Figures 6-22** to **6-25**).

Several PS utilities in the LEC Planning Area use the UFA as an AWS source with reverse osmosis treatment. Nearly all PS utilities in the LEC Planning Area that use the UFA have experienced water quality degradation in one or more production wells. However, overall water quality of the UFA has remained relatively stable, and, with appropriate management, expanded use of this AWS source can help meet 2045 demands. More detailed information on PS utility FAS water elevation and quality can be found in **Appendix D**.

Table 6-2. Upper Floridan aquifer monitor wells in the LEC Planning Area with long-term groundwater elevation and water quality data.

Well Name	County	Open Hole Depth Interval (ft bls)	Chloride Concentration (mg/L)		Period of Record
			Minimum	Maximum	
DF-4	Miami-Dade	1,140 – 1,230	1,558	1,900	7/2002 to 12/2022
G-2618	Broward	1,104 – 1,164	557	1,100	7/2002 to 12/2022
PBF-3	Palm Beach	1,050 – 1,252	1,968	2,800	2/2003 to 12/2022
PBF-7U	Palm Beach	992 – 1,447	1,098	1,406	7/2002 to 12/2022

bls = below land surface; ft = feet; mg/L = milligrams per liter.

Table 6-3. Minimum, maximum, and average groundwater elevations for select Upper Floridan aquifer monitor wells in the LEC Planning Area.

Well Name	Minimum Groundwater Elevation	Maximum Groundwater Elevation	Average Groundwater Elevation
DF-4	31.93	53.70	50.19
G-2618	57.87	61.50	59.50
PBF-3	45.00	48.30	46.52
PBF-7U	51.85	56.12	53.50

Note: Elevations are in feet NGVD29 (National Geodetic Vertical Datum of 1929).

Chloride concentrations in well PBF-3, located in eastern Palm Beach County, fluctuate between 2,000 and 2,700 mg/L, with no discernable trend (**Figure 6-22**). However, only two samples have been collected since 2010. Groundwater elevations fluctuate seasonally by approximately 1 to 3 feet, but the long-term trend is stable with a slight trend of increasing average groundwater elevations since about 2012.

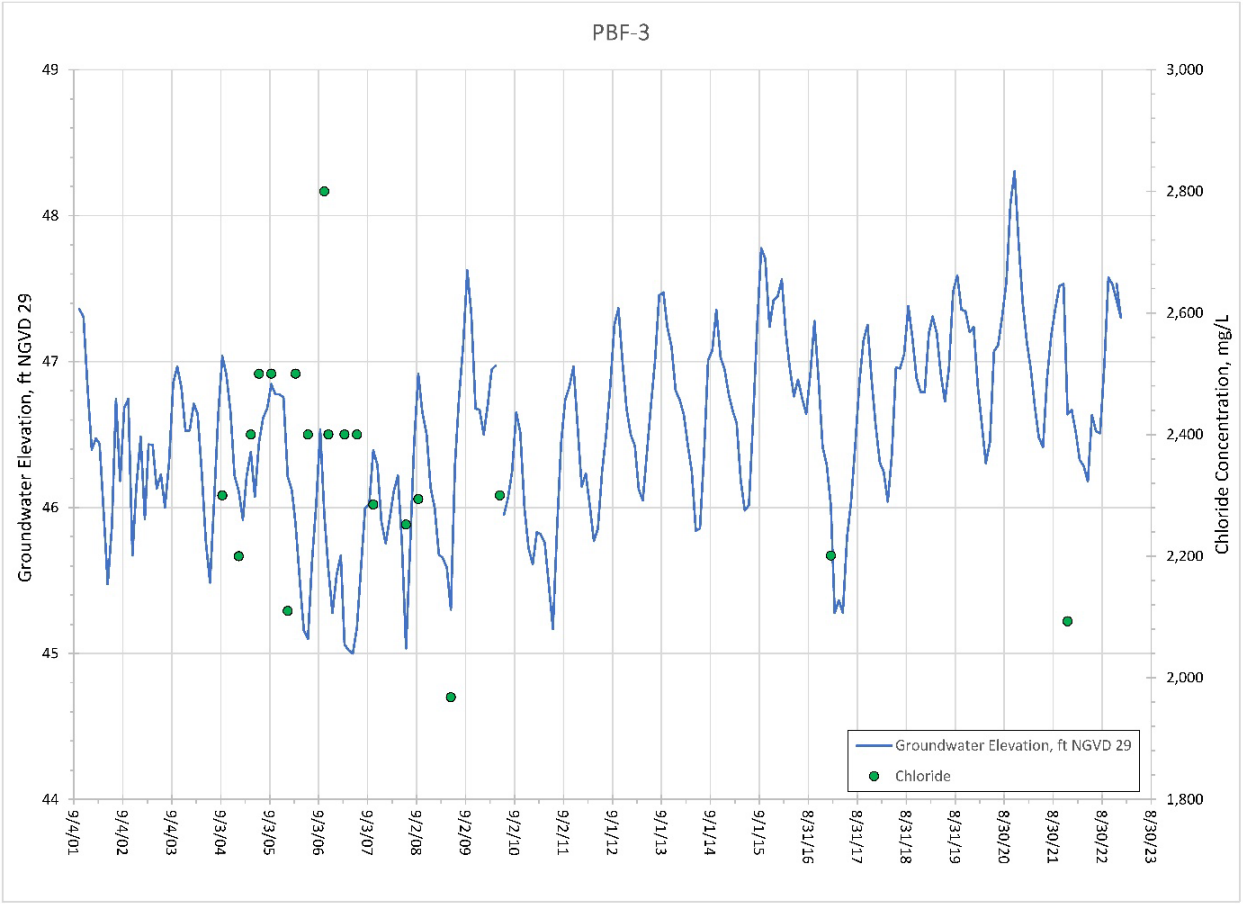

Figure 6-22. Chloride concentrations and groundwater elevations in Upper Floridan aquifer monitor well PBF-3 (1,252 feet deep), eastern Palm Beach County.

Chloride concentrations in well PBF-7U, in western Palm Beach County, are relatively stable, fluctuating between 100 to 200 mg/L (**Figure 6-23**). However, only two samples have been collected since 2010. Groundwater elevations show seasonal fluctuations of about 1 to 2 feet, but the long-term trend is also relatively stable.

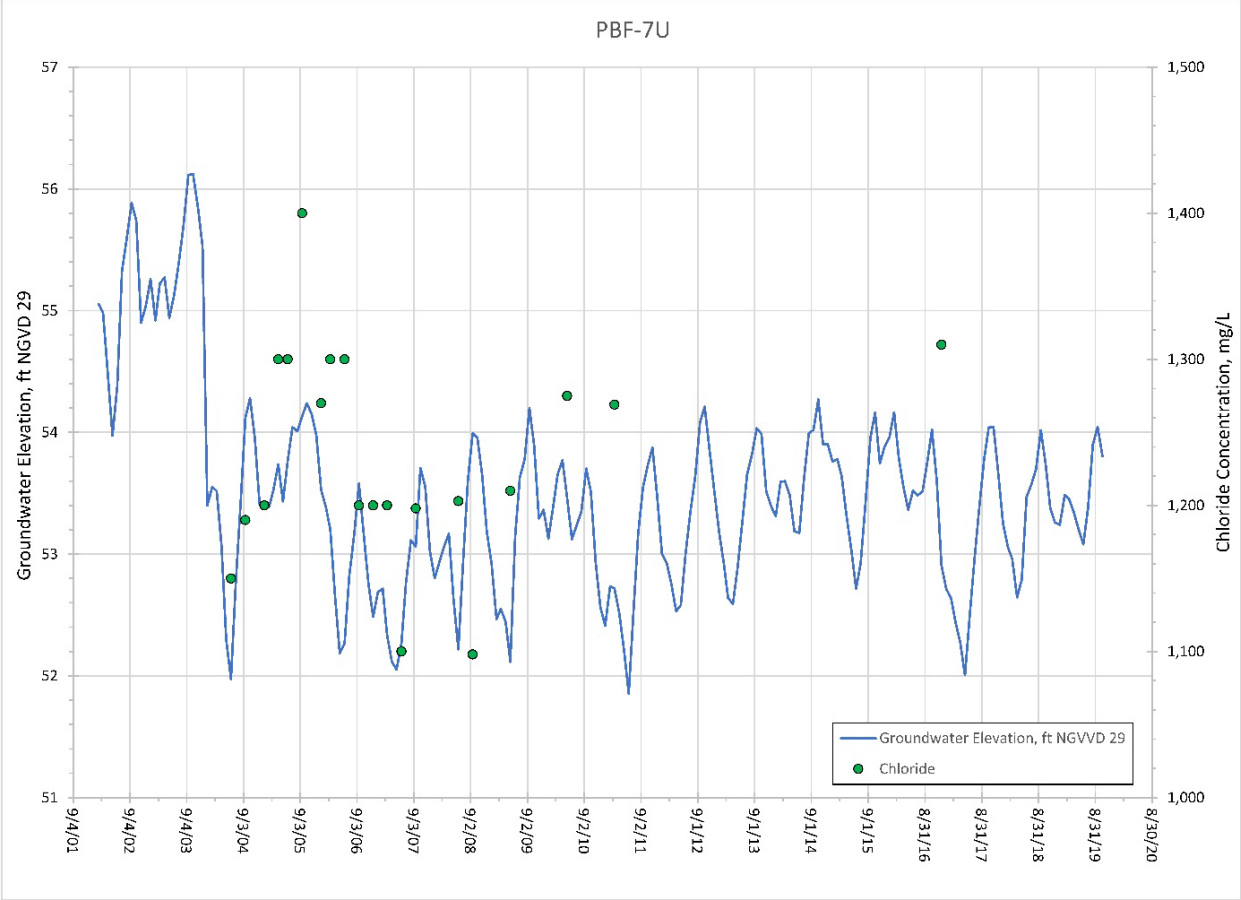

Figure 6-23. Chloride concentrations and groundwater elevations in Upper Floridan aquifer monitor well PBF-7U (1,447 feet deep), western Palm Beach County.

Chloride concentrations in well G-2618, located along Alligator Alley in Water Conservation Area 3A in western Broward County, have remained relatively stable at approximately 600 mg/L (**Figure 6-24**). However, only two samples have been collected since 2010. Groundwater elevations seasonally fluctuate approximately 3 feet, and there is variability over the long term. A slight increasing trend in groundwater elevations began in 2013.

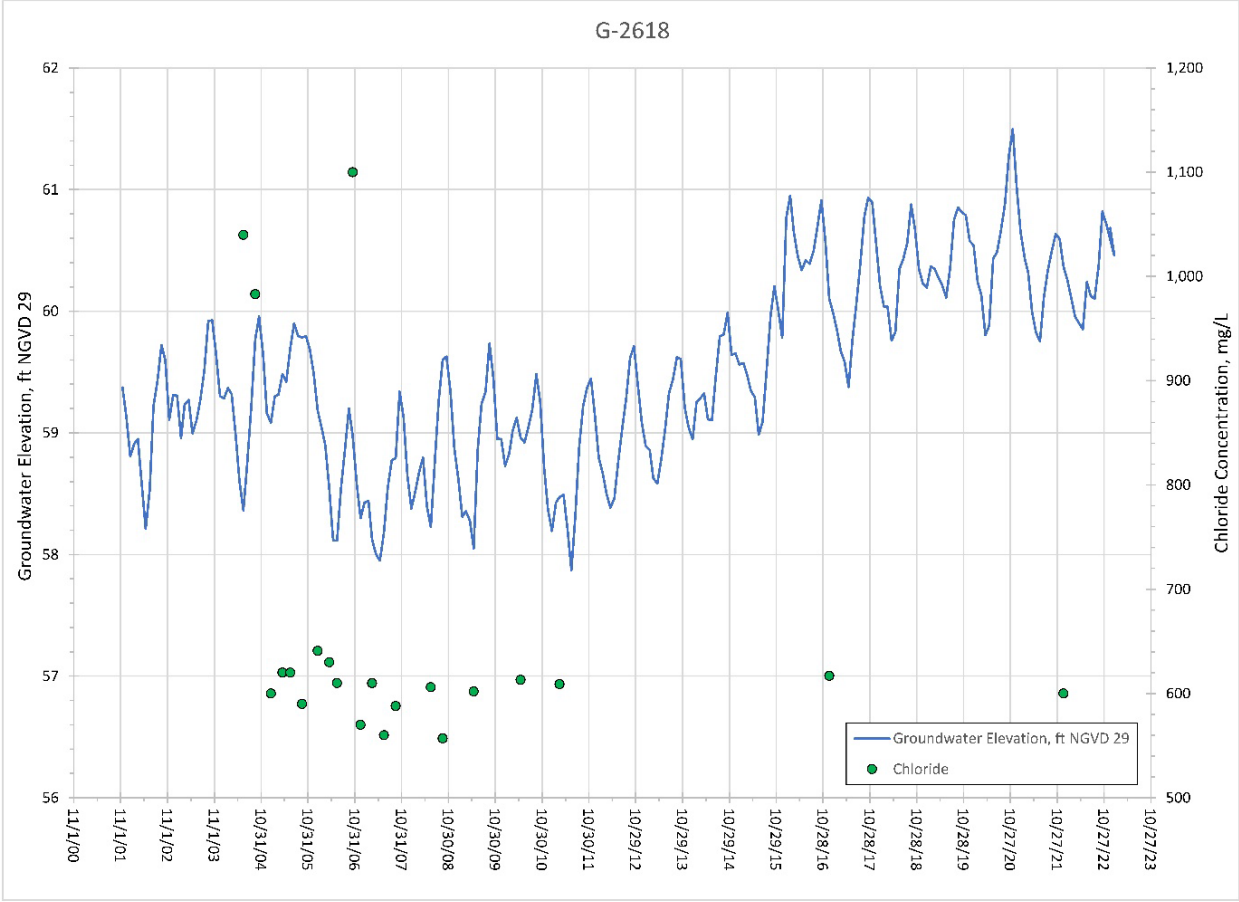

Figure 6-24. Chloride concentrations and groundwater elevations in Upper Floridan aquifer monitor well G-2618 (1,164 feet deep), western Broward County.

Chloride concentrations in well DF-4, in northern Miami-Dade County, have varied approximately 400 mg/L within a long-term stable trend (**Figure 6-25**). However, only two samples have been collected since 2015. Groundwater elevations seasonally fluctuate approximately 2 to 3 feet, and there is variability over the long term. A large (15 to 20 feet) groundwater elevation decrease occurred between 2012 and 2015, possibly due to a nearby pumping well. However, groundwater elevations returned to their previous elevations starting in 2015 and have remained stable until the present.

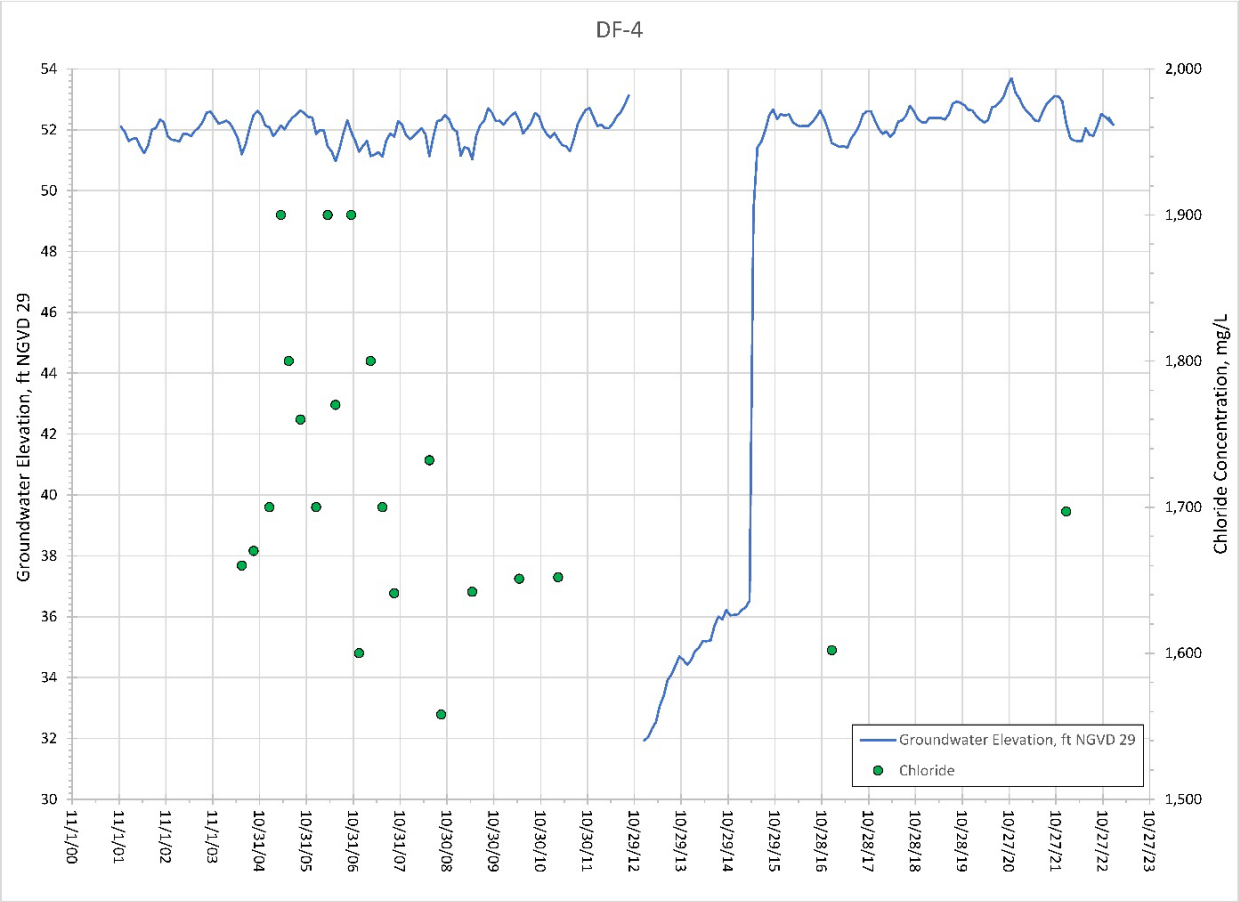

Figure 6-25. Chloride concentrations and groundwater elevations in Upper Floridan aquifer monitor well DF-4 (1,230 feet deep), northern Miami-Dade County.

Avon Park Permeable Zone

In the LEC Planning Area, three wells (BF-4M, G-2617, and BOYRO_EPXL) completed in the APPZ that have long-term groundwater elevation and water quality (chloride and TDS concentrations) data were evaluated for this plan update (**Tables 6-4** and **6-5**). Groundwater elevation data from these wells indicate seasonal variations, but overall, groundwater elevations have remained relatively stable over the period of record.

Water quality data trends for the same three APPZ wells (**Figures 6-26** to **6-28**) showed varying trends. Well BOYRO_EPXL showed relatively stable chloride concentrations between 2,200 and 2,400 mg/L. Wells BF-4M and G-2617 recently had increasing chloride concentrations but did not exceed their historical maximum concentrations.

Table 6-4. Summary of long-term water level and water quality data collected at Avon Park permeable zone monitor wells in the LEC Planning Area.

Well Name	County	Open Hole Depth Interval (ft bls)	Chloride Concentration (mg/L)		Period of Record
			Minimum	Maximum	
BF-4M	Broward	1,500 – 1,600	2,158	2,434	07/2002 to 12/2022
G-2617	Broward	1,648 – 1,726	576	1,190	07/2002 to 12/2022
BOYRO_EPXL	Palm Beach	1,320 – 1,470	2,209	2,506	02/2007 to 12/2022

bls = below land surface; ft = feet; mg/L = milligrams per liter.

Table 6-5. Minimum, maximum, and average groundwater elevations for Avon Park permeable zone monitor wells in the LEC Planning Area.

Well Name	Minimum Groundwater Elevation	Maximum Groundwater Elevation	Average Groundwater Elevation
BF-4M	43.64	48.73	46.75
G-2617	58.48	61.00	59.79
BOYRO_EPXL	46.63	50.10	48.41

Note: Elevations are in feet NGVD29 (National Geodetic Vertical Datum of 1929).

Chloride concentrations in well BOYRO_EPXL, located in eastern Palm Beach County, were relatively consistent (generally ranging between 2,209 mg/L and 2,332 mg/L) until September 2019 and November 2021, when chloride concentrations increased to 2,367 mg/L and 2,506 mg/L, respectively (**Figure 6-26**). Additional chloride samples should be collected and tested at this location to determine if this increasing chloride concentration trend continues. Groundwater elevations seasonally fluctuate by up to 2 feet. The long-term groundwater elevation trend shows an increase in the average groundwater elevation at this well since 2011. Notable dry seasons (e.g., 2007, 2009, 2011, 2017) are followed by rebounds in water levels to previous wet season levels.

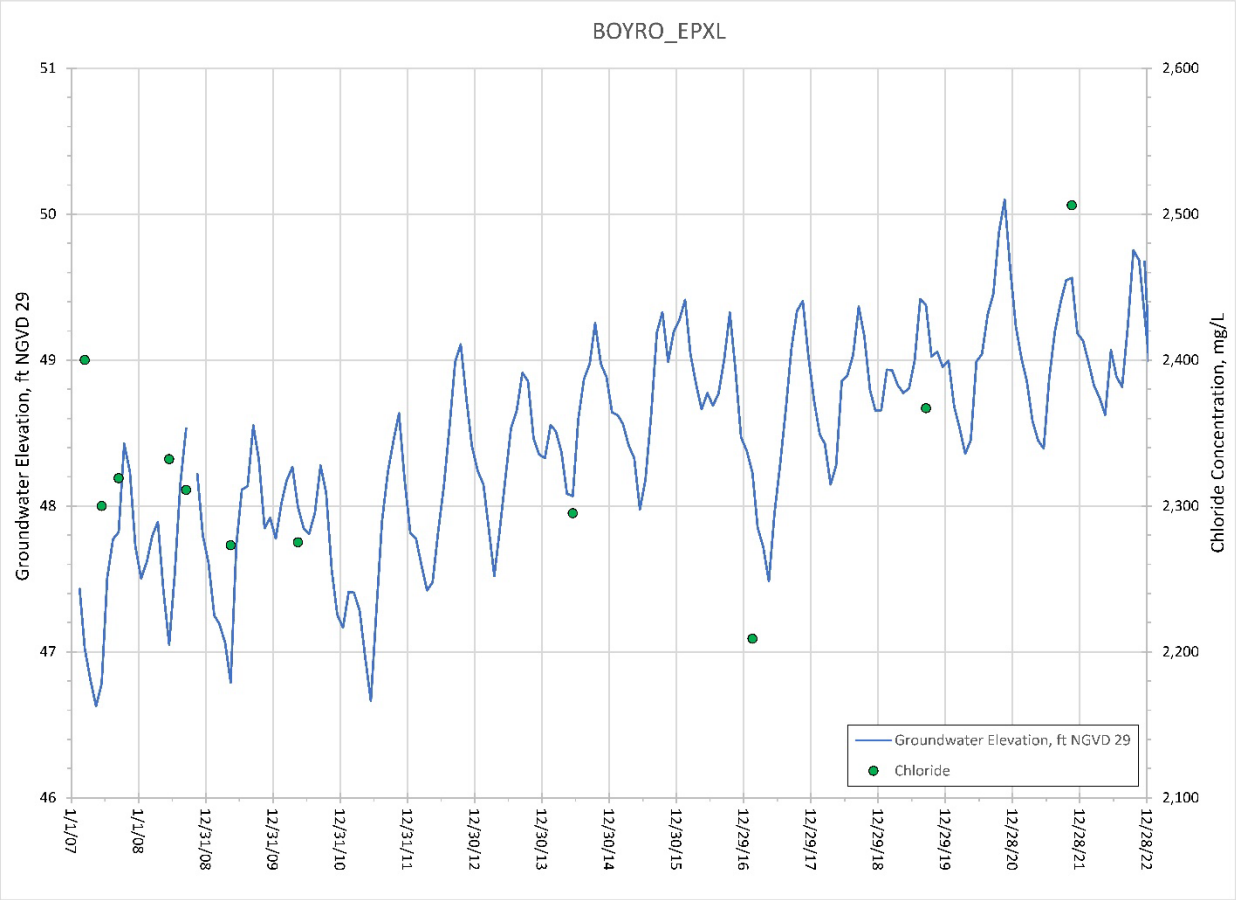

Figure 6-26. Chloride concentrations and groundwater elevations in Avon Park permeable zone monitor well BOYRO_EPXL, eastern Palm Beach County.

Chloride concentrations in monitor well BF-4M, in eastern Broward County, ranged over more than 250 mg/L during the past 11 years (**Figure 6-27**) but are currently at the highest historical concentration of 2,434 mg/L (December 15, 2021 sample). However, only two samples have been collected since 2014. Groundwater elevations have steadily increased since 2002.

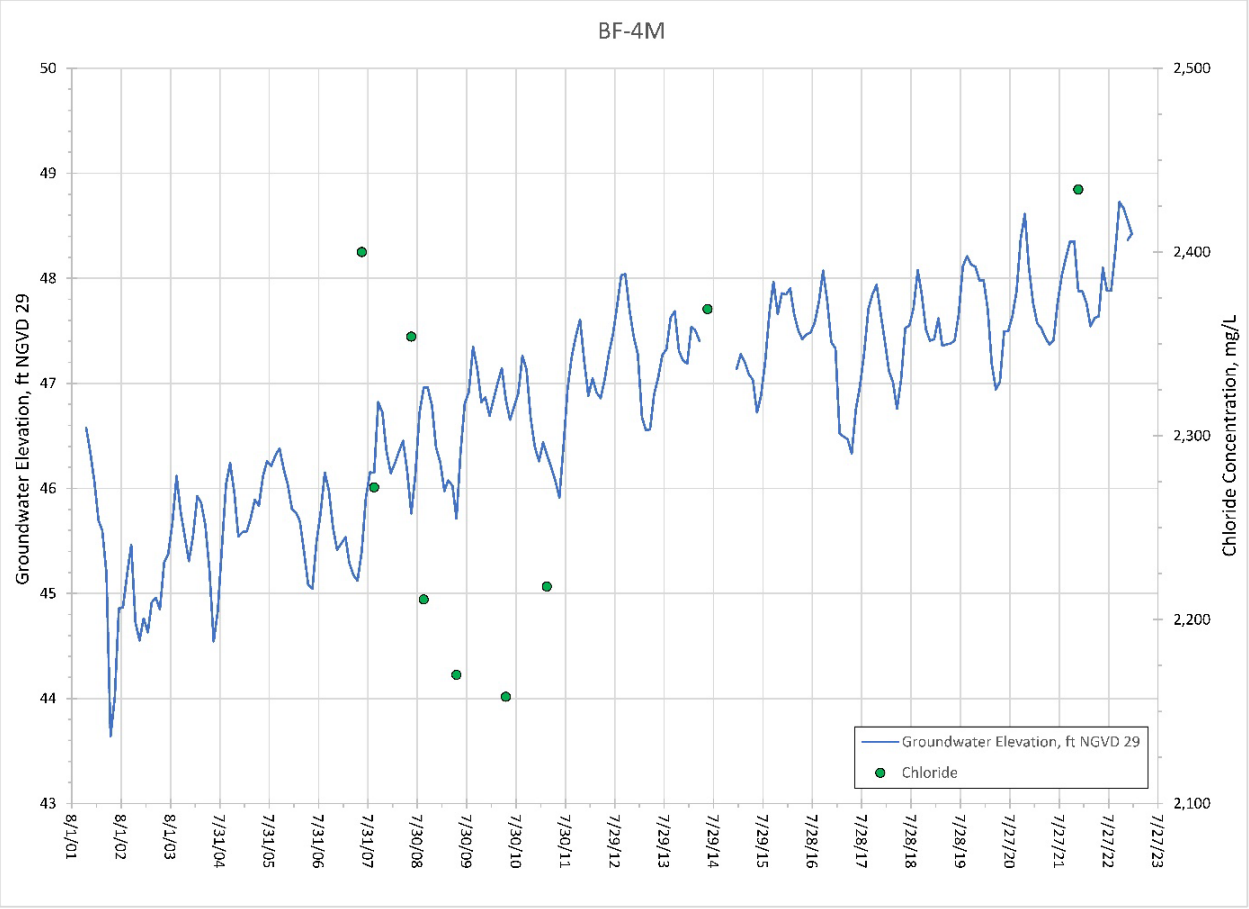

Figure 6-27. Chloride concentrations and groundwater elevations in Avon Park permeable zone monitor well BF-4M, eastern Broward County.

Chloride concentrations in well G-2617, in western Broward County, remain within their historical bounds (**Figure 6-28**). The most recent water quality sample collected in December 2021 had a chloride concentration of 1,067 mg/L. However, only two samples have been collected since 2016. Groundwater elevations seasonally fluctuate 1 to 2 feet, but the long-term trend is relatively stable. Notable dry season levels are followed by rebounds in water levels to previous wet season levels.

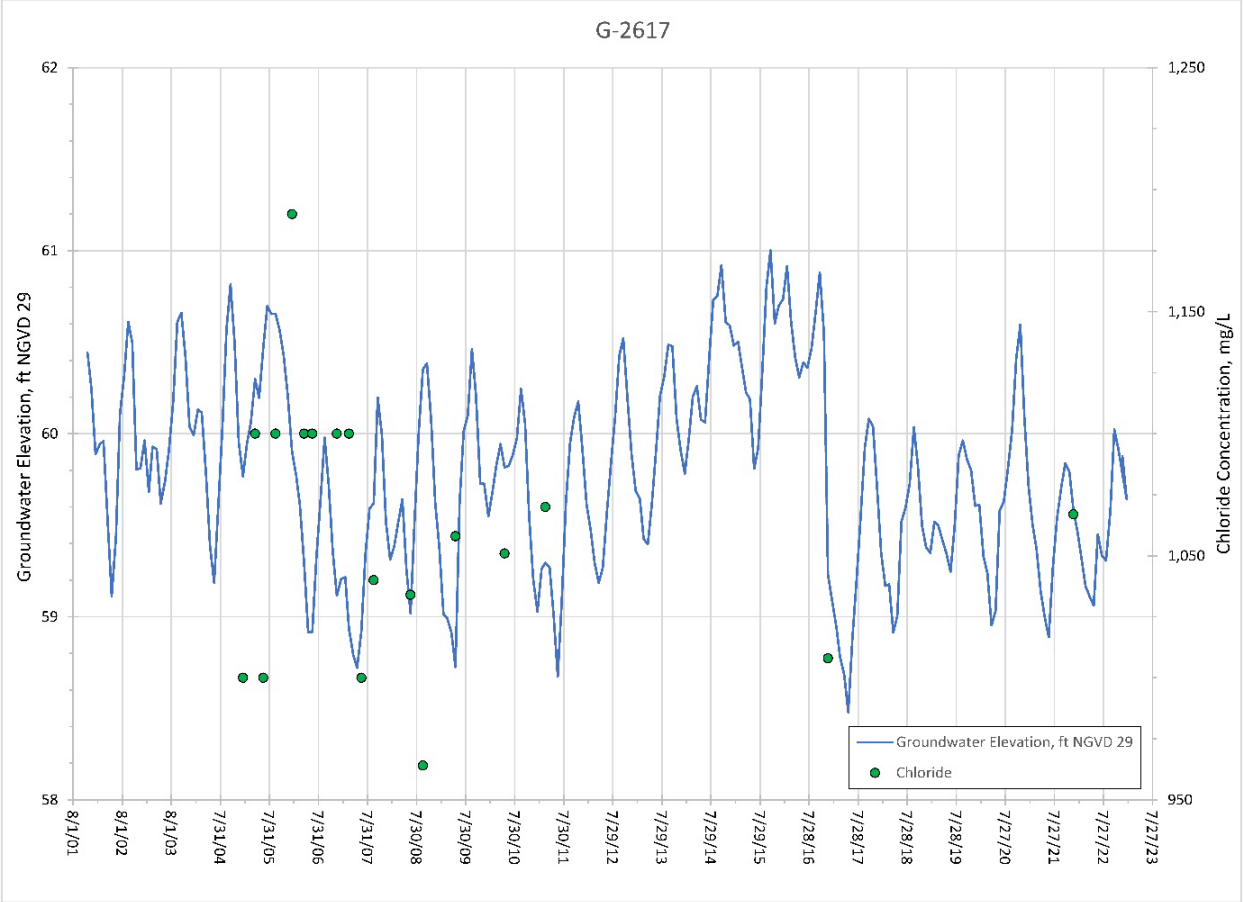

Figure 6-28. Chloride concentrations and groundwater elevations in Avon Park permeable zone monitor well G-2617, western Broward County.

Floridan Aquifer System Conclusions

Recent data and previous modeling results indicate the FAS can meet current and projected demands through 2045 with proper wellfield management. FAS water levels appear stable at current withdrawal rates. Where possible, more frequent sampling and analyses of FAS monitoring wells would aid in better defining the trends. Chloride concentration trends show PS FAS wellfields have experienced some water quality degradation after several years of operation, which is likely to continue. Water level reductions and water quality degradation can be minimized by PS utilities through the following activities:

- Maximizing well spacing to reduce interference effects and stress on the FAS

- Plugging and abandoning individual wells experiencing excessive chloride concentration increases and replacing them with new wells elsewhere in the wellfield area
- Partially back-plugging individual wells to isolate deeper poor-quality layers from overlying higher-quality layers
- Reducing pumping rates at individual wells to minimize the potential for poor-quality water to be pulled upward into the well's production zone from below
- Rotating the operation of individual wells to reduce pumping stress and the potential influx of poor-quality water from below
- Installing additional monitor wells to provide early warning of upconing or lateral movement of poor-quality water

As PS utilities expand use of the FAS, implementation of these wellfield management activities is important to minimize the effects of water level reductions and water quality degradation. If interference to existing legal users results from another user's withdrawals, the interference must be mitigated as described in the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2022b).

GROUNDWATER MODELS

The SFWMD has two groundwater models that can be used in the LEC Planning Area: The East Coast Floridan Model (ECFM) and the East Coast Surficial Model (ECSM) (**Figure 6-29**).

East Coast Floridan Model

The ECFM was most recently used in the LEC Planning Area in support of the 2018 LEC Plan Update (SFWMD 2018). Since the 2045 projected FAS water demands were of a similar magnitude to the 2040 FAS water demands presented in the 2018 LEC Plan Update, it was determined that the model did not need to be run again. Therefore, the reader is referred to the 2018 LEC Plan Update or the Groundwater Modeling webpage at www.sfwmd.gov/science-data/gw-modeling for more detailed information regarding ECFM simulations and conclusions. The 2018 LEC Plan Update concluded based on review of historical chloride data and the ECFM results that properly designed and managed FAS wellfields appear able to meet projected demands through 2040 in the LEC Planning Area.

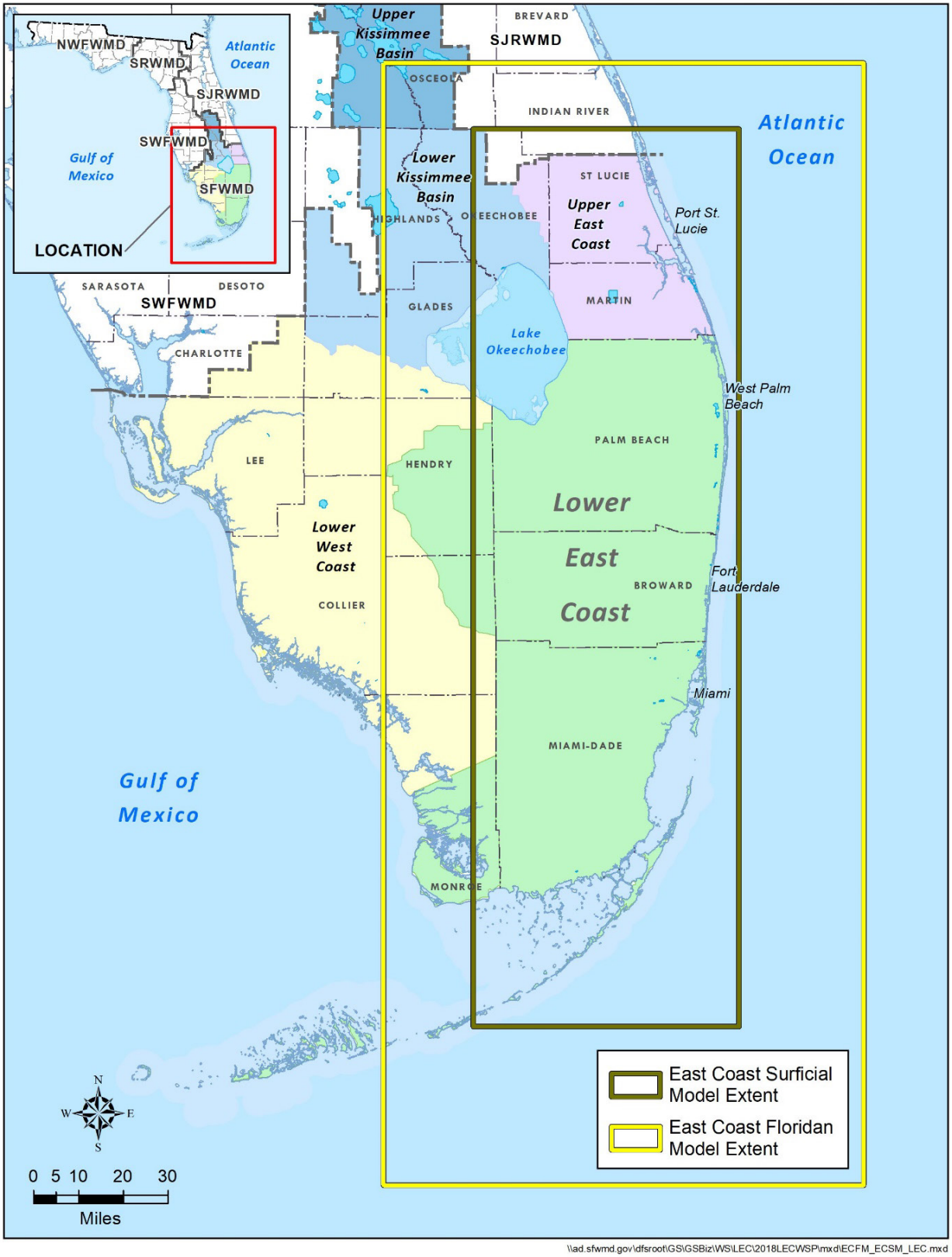

Figure 6-29. Model boundaries for the East Coast Surficial Model and East Coast Floridan Model.

East Coast Surficial Model

The ECSM is a three-dimensional, density-dependent groundwater model of the SAS that is currently under development. The ECSM is based upon the SFWMD's SEAWAT2022 (Rodberg 2022) computer code. SEAWAT2022 represents enhancements to a merger of the USGS's SEAWAT-2000 (Langevin et al. 2003) and SEAWAT-2000WMD (Restrepo and Montoya 2008) to accommodate density-dependent transport simulation options or packages previous code did not support. The ECSM is being calibrated to water levels and water quality (i.e., TDS concentrations) over thousands of wells, gauges, and stations within the model domain as shown in **Figure 6-29**. The model is simultaneously undergoing an independent peer review by a three-person panel of numerical modeling experts. The panel is providing input that staff are addressing as they proceed through the model's calibration and verification phase. Upon calibration completion, expected in 2024, the model will be utilized for predictive purposes. In particular, the ECSM will be used to evaluate the sustainability of existing and projected future demands from the SAS for the LEC and Upper East Coast planning areas and to identify areas where cumulative water use withdrawals may harm existing groundwater resources and natural systems (e.g., wetlands). The modeling effort will also investigate the potential for increased risk of saltwater intrusion in the SAS from water withdrawals and sea level rise.

CLIMATE CHANGE AND SEA LEVEL RISE

Climate change is an issue of concern globally and especially in coastal regions, such as South Florida. Because of its location, regional variability in climate, hydrology, geology, topography, natural resources, and dense coastal populations, South Florida is particularly vulnerable to the effects of changes in climate, including sea level rise. The nature and rate of change are highly uncertain, but the effects are already being experienced in South Florida.

Sea level rise affects flood control operations at coastal structures and contributes to inland movement of salt water into aquifers. In addition, increased air temperatures and changes in precipitation regimes and storm frequency associated with climate change could result in greater evaporation, longer drought periods, and higher risk of flooding. These changes could affect regional water resources and planning and thus need to be considered when evaluating the ability of water supplies to meet future demands.

The SFWMD is responsible for managing and protecting water resources in South Florida by balancing and improving flood control, water supply, water quality, and natural systems. Over the last decade, the SFWMD has implemented strategies to adapt its operations and infrastructure to ensure this mission continues to be met under changing climate conditions. The SFWMD's approach focuses on assessing how sea level rise and extreme events, including flood and drought events, are likely to happen under current and future climate conditions.

In addition, the SFWMD is working to ensure its resiliency planning is based on the best available science. To plan and prepare for regional climate change and sea level rise, the SFWMD is conducting research and computer modeling to better predict and reduce uncertainties, analyzing vulnerabilities in the current water management system, and developing effective adaptation strategies for the future. Effective solutions and adaptations require action across multiple agencies and administrative boundaries, including local and tribal governments; other regional, state, and federal agencies; universities;

nongovernmental entities; a wide array of stakeholders; and concerned citizens throughout South Florida. Coordination is vital to ensuring a common approach and shared information moving forward. Additional information regarding climate change and sea level rise within the LEC Planning Area is provided in **Appendix D**.

SUMMARY OF WATER RESOURCE ANALYSES

The evaluations and analyses associated with this 2023–2024 LEC Plan Update support the findings and conclusions of the 2018 LEC Plan Update (SFWMD 2018). The following are findings regarding the availability of water resources to meet projected 2045 water demands:

- New or increased allocations of surface water from Lake Okeechobee and LOSA are limited in accordance with RAA criteria.
- Surface water will remain the primary source for agricultural irrigation, with fresh groundwater from the SAS as a supplemental source.
- The SAS historically has served as the primary source of fresh water for potable and urban demands. However, expansion of SAS withdrawals is limited due to the rate of recharge, potential impacts to wetlands and increased potential for saltwater intrusion, proximity to contamination sources, and LEC Regional Water Availability criteria. New or increased allocations of water from the SAS in coastal areas beyond those currently permitted will require evaluation on an application-by-application basis.
- Monitoring well networks have been established for the SAS and FAS and provide valuable data for evaluation of saltwater intrusion, aquifer assessment, and groundwater modeling.
- Several large PS utilities in the LEC Planning Area currently use the FAS to meet some of their demands and more PS utilities have indicated a desire to do so.
- Since the 2045 projected FAS demands were similar in magnitude to those projected for 2040 in the 2018 LEC Plan Update, no new modeling of the FAS demands was conducted. Therefore, the conclusion that the FAS could sustainably meet the projected future demands is the conclusion carried forward from the 2018 LEC Plan Update to this plan update.
- Saltwater intrusion monitoring and mapping indicate noticeable inland movement of the saltwater interface in the SAS, particularly in portions of Broward and Miami-Dade counties from 2009 to 2019. Additional monitor wells have been installed and additional monitoring is being implemented in these areas to better evaluate and plan to meet demands while protecting the resource. In 2024, the ECSM will be used to simulate the demands projected in this plan to provide additional insights regarding potential movement of the saltwater interface.

REFERENCES

Enercon. 2016. *PTN Cooling Canal System Electromagnetic Conductance Geophysical Survey.* Final Report NEE270-REPT-001. Prepared for Florida Power & Light, Turkey Point Power Plant, Homestead, FL. Enercon Services, Inc., Temple Terrace, FL.

Langevin, C.D., W.B. Shoemaker, and W. Guo. 2003. *MODFLOW-2000, the U.S. Geological Survey Modular Ground-Water Model—Documentation of the SEAWAT-2000 Version with the Variable-Density Flow Process (VDF) and the Integrated MT3DMS Transport Process (IMT)*. Open-File Report 03-426. United States Geological Survey, Tallahassee, FL.

Miller, W.L. 1988. *Description and Evaluation of the Effects of Urban and Agricultural Development on the Surficial Aquifer System, Palm Beach County, Florida*. Water-Resources Investigations Report 88-4056. Prepared in cooperation with Palm Beach County, West Palm Beach, FL. United States Geological Survey, Tallahassee, FL.

Prinos, S.T. 2017. *Map of the Approximate Inland Extent of Saltwater at the Base of the Biscayne Aquifer in the Model Land Area of Miami-Dade County, Florida, 2016*. Scientific Investigations Map 3380. Prepared in cooperation with Miami-Dade County, Miami, FL. United States Geological Survey, Reston, VA.

Prinos, S.T., M.A. Wacker, K.J. Cunningham, and D.V. Fitterman. 2014. *Origins and Delineation of Saltwater Intrusion in the Biscayne Aquifer and Changes in the Distribution of Saltwater in Miami-Dade County, Florida*. Scientific Investigations Report 2014-5025. Prepared in cooperation with Miami-Dade County, Miami, FL. United States Geological Survey, Reston, VA.

Reese, R.S. and M.A. Wacker. 2009. *Hydrogeologic and Hydraulic Characterization of the Surficial Aquifer System, and Origin of High Salinity Groundwater, Palm Beach County, Florida*. Scientific Investigations Report 2009-5113. Prepared in cooperation with the South Florida Water Management District, West Palm Beach, FL. United States Geological Survey, Reston, VA.

Restrepo, J. and A. Montoya. 2008. *MODFLOW/SEAWAT-2000WMD Report—Version 4.* Prepared for the South Florida Water Management District, West Palm Beach, FL. Department of Geosciences, Florida Atlantic University, Boca Raton, FL. September 2008.

Rodberg, K.A. 2022. *SEAWAT2022 An Enhancement to SEAWAT-2000WMD Providing Variable Density Flow (VDF) and Integrated MT3DMS Transport Processing (IMT).* South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2018. *2018 Lower East Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL. November 2018.

SFWMD. 2022a. *2022 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL. December 2022.

SFWMD. 2022b. *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL. June 2022.

SFWMD. 2022c. *Physical Features and Water Resources of the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL. December 2022.

SFWMD. 2023. *Resilience Metrics Hub*. South Florida Water Management District, West Palm Beach, FL. Available online at https://sfwmd-district-resiliency-sfwmd.hub.arcgis.com.

Shaw, J.E. and M. Zamorano. 2020. *Saltwater Interface Monitoring and Mapping Program*. Technical Publication WS-58. South Florida Water Management District, West Palm Beach, FL. December 2020.

Tetra Tech. 2016. *A Groundwater Flow and Salt Transport Model of the Biscayne Aquifer*. Technical Report prepared for Florida Power & Light. June 2016.

USEPA. 2023. *Secondary Drinking Water Standards: Guidance for Nuisance Chemicals*. United States Environmental Protection Agency, Washington, DC. Updated February 14, 2023. Available online at https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals.

USGS. 2017. *Water Level and Salinity Analysis Mapper*. United States Geological Survey, Reston, VA. Updated March 2017. Available online at https://fl.water.usgs.gov/mapper.

Zumbro, J., S. Coonts, and A. Bouchier. 2023. *Hydrostratigraphy and Aquifer Hydraulic Properties Update for the Surficial and Intermediate Aquifer Systems, Lower West Coast Planning Area*. Technical Publication WS-62. South Florida Water Management District, West Palm Beach, FL. July 2023.

7

Water Resource Development Projects

This chapter addresses the roles of the South Florida Water Management District (SFWMD or District) and other parties in implementing water resource development projects and provides a summary of projects in the Lower East Coast (LEC) Planning Area. The water resource development efforts presented in this chapter reflect the current budget categories the SFWMD uses for funding new and ongoing water resource development projects. The project summaries serve as an overview of water resource-related activities in the region. This chapter was created using the Fiscal Year (FY) 2022 Districtwide water resource budget and includes schedules and costs for FY2024 to FY2028. Additional details on the status of these projects can be found in Chapter 5A (Adams and Beerens 2023) of the *2023 South Florida Environmental Report – Volume II* (https://www.sfwmd.gov/sfer).

TOPICS

Florida water law identifies two types of projects to meet water needs: water resource development projects (subject of this chapter) and water supply development projects (**Chapter 8**). Water resource development is defined in Section 373.019(24), Florida Statutes (F.S.), as follows:

> *…the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and groundwater data; structural and non-structural programs to protect and manage water resources; development of regional water resource implementation programs; construction, operation, and maintenance of major public works facilities to provide for flood, surface, and underground water storage and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately-owned water utilities.*

Most water resource development activities in the SFWMD support and enhance water supply development but do not directly yield specific quantities of water. Instead, these projects are intended to assess the availability of an adequate water supply for existing and future uses, including maintaining the functions of natural systems. For example, project-related hydrologic investigations as well as groundwater monitoring and modeling provide important information about aquifer characteristics (e.g., hydraulic properties, water quality), which are useful for designing appropriate facilities, identifying safe aquifer yields, and evaluating the economic viability of projects, but do not increase water availability.

Water supply development projects (**Chapter 8**) generally are the responsibility of water users (e.g., utilities) and involve the water source options described in **Chapter 5** to meet specific needs. These projects typically include construction of wellfields, water treatment plants, distribution lines, reclaimed water facilities, and storage systems.

Water resource development in the LEC Planning Area is strongly influenced by the Comprehensive Everglades Restoration Plan (CERP), which is a component of the South Florida Ecosystem Restoration Program. Authorized by the United States Congress in 2000, CERP builds on and complements other state and federal initiatives to revitalize South Florida's ecosystems. These efforts have multiple implementation phases, which are supported by water resource development activities, such as planning; land acquisition; design, including modeling; construction; and long-term operations and maintenance. CERP efforts (listed in **Table 7-1**) are described in this chapter and in the annual updates of the *South Florida Environmental Report* (https://www.sfwmd.gov/sfer).

Since 2005, the SFWMD has been working with a coalition of government agencies, nongovernmental organizations, farmers, ranchers, and researchers to enhance opportunities for storing excess surface water on private and public lands. The effort, known as dispersed water management, includes the former pilot project Florida Ranchlands Environmental Services Project (FRESP), Northern Everglades Payment for Environmental Services (NE-PES), water farming, storage on public lands, and Northern Everglades public-private partnerships. Dispersed water management projects are constructed and managed primarily to attenuate wet season water releases and improve water quality entering Lake Okeechobee and the coastal estuaries, with ancillary benefits including increased opportunities for groundwater recharge, hydrological enhancement, and habitat improvement. In some cases, dispersed water management projects with storage features are constructed and operated to offset irrigation demands and other water-related needs of the system. However, because this is shallow storage, the volume of water is insufficient to be considered a reliable water source during the dry season. Additional information can be found at https://www.sfwmd.gov/storage.

Table 7-1. Water resource development projects within the LEC Planning Area by region.

Region	Project
Lake Okeechobee	CERP Lake Okeechobee Watershed Restoration Project (LOWRP)*
	Lake Okeechobee Component A Storage Reservoir (LOCAR)*
	Northern Everglades and Estuaries Protection Program – Taylor Creek, Nubbin Slough, and Lakeside Ranch STAs
	USACE Herbert Hoover Dike Major Rehabilitation
Everglades	Everglades Forever Act projects, including Restoration Strategies Regional Water Quality Plan
	Modified Water Deliveries to Everglades National Park
	C-111 South Dade Project
	CERP WCA-3A Decompartmentalization Physical Model
	CERP Central Everglades Planning Project (CEPP)
	Florida Bay: S-197 Structure Replacement Project and Automation CERP C-111 Spreader Canal Western Project South Dade Study and Florida Bay Plan
Western Basins	CERP Western Everglades Restoration Project
	C-139 Annex Restoration Project
LEC Service Areas	Loxahatchee River: Restoration Plan for the Northwest Fork of the Loxahatchee River CERP Loxahatchee River Watershed Restoration Project Storage for the Loxahatchee River
	CERP Hillsboro Site 1 Impoundment/Fran Reich Preserve Reservoir
	CERP Broward County Water Preserve Areas (BCWPA)
	Biscayne Bay: CERP Biscayne Bay Coastal Wetlands (BBCW) Project CERP Biscayne Bay and Southeastern Everglades Ecosystem Restoration (BBSEER)

BBCW = Biscayne Bay Coastal Wetlands; BBSEER = Biscayne Bay and Southeastern Everglades Ecosystem Restoration; BCWPA = Broward County Water Preserve Areas; CEPP = Central Everglades Planning Project; CERP = Comprehensive Everglades Restoration Plan; LEC = Lower East Coast; LOCAR = Lake Okeechobee Component A Storage Reservoir; LOWRP = Lake Okeechobee Watershed Project; SFWMD = South Florida Water Management District; STA = stormwater treatment area; USACE = United States Army Corps of Engineers; WCA = water conservation area.
*Project is located outside of the LEC Planning Area but provides water supply component to Lake Okeechobee.

REGIONAL GROUNDWATER MODELING

The SFWMD funds development and application of numerical models for evaluation of groundwater and surface water resources in the District's planning areas. The models support development of regional water supply plans, minimum flows and minimum water levels (MFLs), water reservations, restricted allocation areas (RAAs), and other projects benefiting water resources. Regional groundwater flow models simulate the rate and direction of water movement through the subsurface. Such models include the major components of the hydrologic cycle and the hydrogeologic system and are used in water supply planning to understand the effects of current and future water use. More recently, advances in groundwater modeling to incorporate density-dependency and solute transport have been incorporated to better analyze brackish aquifers, such as the Floridan aquifer system (FAS), and are being developed to analyze the effects of climate change and sea level rise on the surficial aquifer system (SAS).

East Coast Surficial Model

The East Coast Surficial Model (ECSM) is a regional groundwater model that is currently being developed and is undergoing contemporaneous peer review. It is a three-dimensional, density-dependent groundwater flow and transport model that simulates changes in SAS and wetland water levels, canal flows, and water quality (i.e., total dissolved solids [TDS]) along the east coast of the District. Developed to evaluate potential impacts of additional SAS demands, the ECSM can simulate the response of the aquifer to the projected demands through wellfield pumpage, changes in recharge and return flow, sea level rise, and climate change. Results of the model simulations can provide guidance for developing water management strategies, support periodic updates to the regional water supply plans, evaluate resiliency, and be used in regulatory applications.

The ECSM domain extends from Indian River County to the Florida Keys and from the approximate center line of the Florida peninsula to just offshore of the east coast. The model has five primary layers that represent the permeable and semiconfining layers that constitute the SAS.

The current version of the model is being manually calibrated to water level and water quality (TDS) observations for transient conditions. The transient model is being calibrated to the period from 1985 through 2014, with verification from 2015 to 2016. There are more than 1,000 water level and water quality targets, and the model will be deemed calibrated when simulated versus observed data meet pre-established calibration criteria, in addition to the model simulating known general groundwater flow patterns and the position of the mapped saltwater interface.

Following completion of model calibration and verification, as well as incorporation of peer-review comments, the ECSM will be applied through the development of the planning demands for 2021 and 2045 model scenarios. The effects of these future demands on the SAS will be evaluated in support of this *2023–2024 Lower East Coast Water Supply Plan Update*.

East Coast Floridan Model

The East Coast Floridan Model (ECFM) is a peer-reviewed, three-dimensional, density-dependent groundwater flow and transport model that simulates changes in FAS water levels and water quality along the east coast of the District. Developed to evaluate potential impacts of additional FAS demands, the ECFM can simulate the response of the aquifers to the projected demands through wellfield pumpage, aquifer storage and recovery (ASR) systems, reductions in recharge, and climate change. Results of the model simulations can provide guidance for developing water management strategies, support periodic updates to the regional water supply plans, and be used in regulatory applications.

The ECFM domain extends from Indian River County to the Florida Keys and from the approximate center line of the Florida peninsula to the Florida Straits and Atlantic Ocean. The model has seven primary layers representing the Upper Floridan aquifer, Ocala-Avon Park low-permeability zone, Avon Park permeable zone, middle confining unit, first permeable zone of the Lower Floridan aquifer, Boulder Zone confining unit, and Boulder Zone.

The ECFM originally was developed by hydroGeologic in 2006 and modified by Golder Associates in 2008. The model was peer reviewed in 2011, and the peer review panel's comments and suggestions were incorporated into the 2014 version of the model (Giddings et al. 2014). The current version of the model (2021) includes updated hydrostratigraphic (layer) information to synchronize the model layer elevations with the East-Central Florida Transient Expanded (ECFTX) Model where the two models overlap. In addition, new hydrogeologic data from aquifer tests were incorporated in localized areas across the model domain to improve model confidence.

The current version of the model was manually calibrated to water level and water quality (TDS) observations for transient conditions. The transient model was calibrated to the period from January 1989 through December 2012 using 143 water level targets and 208 water quality targets. Model calibration results indicated the simulated water levels and water quality values are in general agreement with field-observed measurements at most monitoring wells (targets). Simulated flow patterns and concentration distributions in major aquifers generally matched observed conditions. The recalibrated ECFM was used to evaluate the impacts of current (2019) and proposed (2045) FAS demands within the Upper East Coast (UEC) Planning Area. Only demands in or near the UEC Planning Area were altered for the 2019 and 2045 simulations since the FAS demands for the Lower East Coast were similar in magnitude to the 2040 demands in the previous *2018 Lower East Coast Water Supply Update* (SFWMD 2018a). The ECFM results indicate the 2019 and 2045 FAS demands can be met without any widespread impacts to the aquifer system. For further information on the ECFM update and simulation results, see the *2021 Upper East Coast Water Supply Plan Update* (SFWMD 2021a).

Lower West Coast Surficial and Intermediate Aquifer Systems Model

The Lower West Coast Surficial Model was originally completed in 2006. The District completed a hydrostratigraphic reinterpretation report (Geddes et al. 2015) that incorporated new hydrostratigraphic, water level, water use, and saltwater interface data that cover both the surficial and intermediate aquifer systems (SAS and IAS). This report formed the basis for development of an updated groundwater flow model that incorporates both the SAS and IAS, now referred to as the Lower West Coast Surficial and Intermediate Aquifer Systems Model (LWCSIM). The model underwent contemporaneous peer review as it was being developed and calibrated (Bandara et al. 2020). This model was applied through development of the 2014 and 2040 simulations and used to evaluate regional water resources for this future condition. Additional information can be found in the *2022 Lower West Coast Water Supply Plan Update* (SFWMD 2022a).

DISTRICTWIDE WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects encompassing more than one planning area are considered Districtwide projects. The SFWMD is the implementing agency for the projects described in this section. **Table 7-2** summarizes the estimated costs through 2028 of Districtwide water resource development projects and regional projects that benefit water supply. The following categories are types of ongoing projects:

- MFLs, water reservation, and RAA rules
- Comprehensive Water Conservation Program
- Cooperative Funding Program
- Drilling and testing groundwater resources
- Groundwater assessment through data collection and modeling
- Groundwater, surface water, and wetland monitoring

MFL, Water Reservation, and RAA Rule Activities

MFLs, water reservations, RAAs, and other resource protection measures have been developed to ensure the sustainability of water resources within the District. **Chapter 4** and **Appendix C** provide further information on MFLs, water reservations, and RAAs in the LEC Planning Area. Additional information about water resource protection can be found in the *2021–2024 Support Document for the Water Supply Plan Updates* (2021–2024 Support Document; SFWMD 2021b).

Comprehensive Water Conservation Program

The long-standing conservation goal of SFWMD is to prevent and reduce wasteful, uneconomical, impractical, or unreasonable uses of water resources. This goal is addressed through planning; regulation; and use of alternative sources, including reclaimed water, public education, demand reduction through conservation technology, best management practices, and water-saving programs. The Comprehensive Water Conservation Program combines a series of implementation strategies designed to create an enduring conservation ethic and permanent reduction in water use. The program was developed in conjunction with stakeholders, and the program's planning document was approved by the District Governing Board in 2008. The program is organized into regulatory, voluntary, incentive-based, educational, and marketing initiatives. More detailed information is provided in *Water Conservation: A Comprehensive Program for South Florida* (SFWMD 2008) and on the SFWMD webpage (https://www.sfwmd.gov/conserve). Additional supporting information can be found in the 2021–2024 Support Document (SFWMD 2021b).

Cooperative Funding Program

Alternative water supply (AWS) projects and source diversification are important supplements and replacements to traditional water sources in order to meet current and future water needs Districtwide. The SFWMD has provided cost-share funding for AWS development for more than two decades. In 2016, the SFWMD combined funding programs

for stormwater, AWS, and water conservation projects into one streamlined program, the Cooperative Funding Program (**Chapter 8**). AWS funding helps water users develop reclaimed water projects, water reclamation facilities, brackish water wellfields, reverse osmosis treatment facilities, stormwater capture systems, and ASR well systems. A full description of AWS-related projects and associated funding is contained in the SFWMD's AWS annual reports, prepared pursuant to Section 373.707(7), F.S., and published in annual updates (Chapter 5A, Volume II) of the *South Florida Environmental Report* (https://www.sfwmd.gov/sfer). Further information about AWS options (e.g., reservoirs, ASR systems) is provided in **Chapter 5**.

Table 7-2. Fiscal Year 2024-2028 implementation schedule and projected expenditures (including salaries, benefits, and operating expenses) for water resource development activities within the SFWMD. All activities are ongoing unless noted otherwise (Modified from Payseno and Beerens 2024).

Regional Water Activities	Plan Implementation Costs ($ thousands)					Total
	2024	2025	2026	2027	2028	
Water Supply Planning	1,155	1,155	1,155	1,155	1,155	**5,775**
CFWI Water Supply Planning Project	583	583	583	583	583	**2,915**
Comprehensive Plan, Documents Review, and Technical Assistance to Local Governments	208	208	208	208	208	**1,040**
Water Supply Implementation	264	264	264	264	264	**1,320**
MFL, Water Reservation, and RAA Rule Activities	170	170	170	170	170	**850**
Comprehensive Water Conservation Program	397	397	397	397	397	**1,985**
Cooperative Funding Program	22,121	0[a]	0[a]	0[a]	0[a]	**22,121**
Groundwater Monitoring	1,576	1,576	1,576	1,576	1,576	**7,880**
Groundwater Modeling	1,048	1,048	1,048	1,048	1,048	**5,240**
Estimated Portion of C&SF Project Operation & Maintenance Budget Allocated to Water Supply[b]	161,670	161,670	161,670	161,670	161,670	**808,350**
Subtotal	**189,192**	**167,071**	**167,071**	**167,071**	**167,071**	**857,476**
Regional Projects Benefiting Water Supply						
Lake Okeechobee Watershed Restoration[c]	50,000[d]	50,000[d]	50,000[d]	50,000[d]	50,000[d]	250,000
EAA Storage Reservoir Conveyance Improvements and STA[c,e]	171,818	142,782	192,088	150,904	110,405	767,997
Other Projects Associated with MFL Prevention/Recovery Strategies[f]	178,876	346,618	368,259	487,327	465,225	1,848,305
C-25 Reservoir and STA	14,700	24,000	79,300	79,000	94,000	291,000
Subtotal	**415,394**	**565,400**	**689,647**	**767,231**	**719,630**	**3,157,302**
Total	**604,586**	**732,471**	**856,718**	**934,302**	**886,701**	**4,014,778**

C&SF Project = Central and Southern Florida Project; CFP = Cooperative Funding Program; CFWI = Central Florida Water Initiative; EAA = Everglades Agricultural Area; FY = Fiscal Year; MFL = minimum flow and minimum water level; RAA = restricted allocation area; SFWMD = South Florida Water Management District; STA = stormwater treatment area.

[a] A determination of what funds, if any, will be allocated for CFP projects will be made by the SFWMD Governing Board during the fiscal year budget development process.

[b] Approximated based on 50% of the FY2024 operation and maintenance budget, including resiliency funding.

[c] Project cost based on information contained in the FY2024-2028 SFWMD Five-Year Capital Improvement Plan.

[d] Funding contingent upon future state appropriations.

[e] Includes Reservoir Inflow Pump Station, Inflow Canal Reservoir/STA, A-2 Reservoir and STA, North New River and Miami Canal Improvements, and Bridges.

[f] Totals are from the South Florida Environmental Report (SFER) Table 5A-3, less the funding for the Lake Okeechobee Watershed Restoration and EAA Storage Reservoir Conveyance Improvements and STA. Refer to SFER Table 5A-6 for additional information.

Drilling and Testing Groundwater Resources

Evaluation of groundwater resources involves the installation of wells for short- and long-term monitoring of aquifer water levels and water quality. This work includes drilling and well construction, geophysical logging, aquifer tests, sediment analysis, lithologic descriptions, and water quality sampling to determine if the water is fresh or brackish. Knowledge of South Florida hydrogeology is enhanced through construction of exploratory and test wells and has improved the accuracy of the SFWMD's groundwater modeling and decision-making regarding water use permits.

Groundwater Assessment

Groundwater assessment includes analyzing results of drilling and testing programs as well as development of hydrostratigraphic and saltwater interface maps. A variety of technical publications related to hydrogeology, groundwater quality, project investigations, and saltwater interface mapping have been completed since the 2018 LEC Plan Update, as summarized below:

- **Hydrogeologic Investigation and Aquifer Performance Testing at Morikami Park, Southeastern Palm Beach County, Florida** – This technical publication documents the findings of a hydrogeologic investigation and two aquifer performance tests of the surficial aquifer in southeastern Palm Beach County. The results were used as part of an assessment of groundwater resources in the county and in two United States Geological Survey (USGS) scientific investigations (Lindstrom 2020).
- **Hydrogeology and Groundwater Salinity of Water Conservation Area 2A (WCA-2A)** – This study includes a geophysical assessment to assess changes in groundwater quality over two decades between WCA-2A and WCA-1A near the S-10C Structure. During the study period, the brackish/saltwater interface increased in elevation in the wetland wells from 4 to 21 feet and average chloride concentrations increased from 7 to 27%. These changes are reflected in the vegetation communities near the structure (Janzen and Baker 2020).
- **Miami-Dade County Stormwater Detention Area Hydrogeologic Investigation** – The Miami-Dade Department of Environmental Resources Management proposed construction of a stormwater detention area in the vicinity of the Military Canal located by Homestead Air Reserve Base. In support of this project, SFWMD conducted a hydrogeologic investigation and subsequently monitored groundwater levels and groundwater quality. The stormwater detention area was never put into operation; however, the hydrogeologic data collected further refined the understanding of the Biscayne aquifer in this area and are used for regional groundwater modeling (Shaw 2020).
- **Saltwater Interface Monitoring and Mapping Program** – SFWMD evaluates the extent of seawater intrusion into surficial and intermediate aquifers along the South Florida coastal areas. Water quality data are collected and compiled from multiple sources, and saltwater interface maps are published every 5 years. The most recent maps were published in 2019. The report documents the data and methods used in the mapping process. The maps are used as part of the water use permitting review process by utilities for planning purposes, and the program is part of the SFWMD adaption strategies (Shaw and Zamorano 2020).

- **Groundwater Modeling** – As described above, the ECSM is being calibrated and undergoing peer review. Upon calibration completion in 2024, the model will be used to evaluate the impacts of existing and future LEC and UEC planning demands from the SAS and the potential for increased saltwater intrusion. The ECFM was recalibrated and used to evaluate the impacts of current (2019) and future proposed (2045) FAS demands within the UEC Planning Area. Only demands in or near the UEC Planning Area were altered for the 2019 and 2045 simulations due to the 2045 FAS demands being of similar magnitude to the 2040 FAS demands in the *2018 Lower East Coast Water Supply Plan Update* (SFWMD 2018a).

Groundwater, Surface Water, and Wetland Monitoring

Water level and water quality monitoring at existing wells provide critical information for developing groundwater models, assessing groundwater conditions, and managing groundwater resources. The SFWMD maintains extensive groundwater monitoring networks and partners with the USGS to provide additional support for ongoing monitoring. Data are archived in the SFWMD's corporate environmental database, DBHYDRO, which stores hydrologic, meteorologic, hydrogeologic, and water quality data. Data are available on the SFWMD webpage https://www.sfwmd.gov/science-data/dbhydro. The USGS monitors, archives, and publishes data annually. **Appendix D** provides maps of the groundwater well network in the LEC Planning Area. Districtwide monitoring activities related to the LEC Planning Area include the following:

- **USGS water level monitoring** – In an ongoing effort by the USGS, with funding support from the SFWMD, groundwater level monitoring data are collected at 280 stations. The project includes well and recorder maintenance as well as archiving data in a USGS database for sites throughout the SFWMD.
- **Groundwater level monitoring** – In an ongoing effort by the SFWMD, groundwater levels are monitored throughout the District. As of 2023, Districtwide monitoring includes 501 active SFWMD groundwater stations for the SAS, IAS (where present), and FAS. The network includes 108 FAS monitoring wells. Data are collected, analyzed, validated, and archived in DBHYDRO.
- **Groundwater quality monitoring** – Chloride and TDS samples are collected annually at 60 key SAS wells for saltwater intrusion monitoring with an additional 30 SAS wells every 5 years in support of saltwater intrusion mapping. FAS wells are sampled for major ions and field parameters on a 5-year rotating basis based on upcoming water supply plan updates. Samples are analyzed and validated by the SFWMD Laboratory and archived in DBHYDRO. Groundwater quality data are used for mapping and in support of density-dependent groundwater modeling.
- **Hydrogeologic database improvements** – A data lens is now available in DBHYDRO Insights, a map-based application making hydrogeologic data more easily accessible to the public and stakeholders. This interface will replace the DBHYDRO browser in the near future.
- **Surface water monitoring** – The SFWMD monitors the water levels and water quality of several surface water bodies (e.g., L-8 Reservoir; Loxahatchee River; Lake Worth Lagoon; Nearshore Central Biscayne Bay; Florida Bay; A-1 Flow Equalization Basin [FEB]; WCAs 1, 2A, 2B, 3A, and 3B; L-3 canal system). Data are collected, analyzed, validated, and archived in DBHYDRO.

- **MFL-required monitoring** – In support of adopted MFL prevention and recovery strategies, the SFWMD monitors changes in surface water and groundwater levels, flows, and specific MFL-related constituents; the location of the saltwater interface; and the floral and faunal populations.

COMPREHENSIVE EVERGLADES RESTORATION PLAN

CERP provides a framework to restore, protect, and preserve the greater Everglades system. The United States Congress approved the restoration plan in the Water Resources Development Act (WRDA) of 2000. The lead federal agency is the United States Army Corps of Engineers (USACE), and the SFWMD is the local non-federal sponsor. CERP efforts are reported in annual updates of the *South Florida Environmental Report* (https://www.sfwmd.gov/sfer). CERP projects in the LEC Planning Area are summarized below.

Lake Okeechobee

The following water resource development projects discussed in this section are within the LEC Planning Area or are outside of the planning area but have an effect on the Lake Okeechobee region (**Figure 7-1**):

- CERP Lake Okeechobee Watershed Restoration Project (LOWRP)
- Lake Okeechobee Component A Storage Reservoir (LOCAR)
- Northern Everglades and Estuaries Protection Program
  - Taylor Creek Stormwater Treatment Area (STA)
  - Nubbin Slough STA
  - Lakeside Ranch STA
- USACE Herbert Hoover Dike Major Rehabilitation (completed)

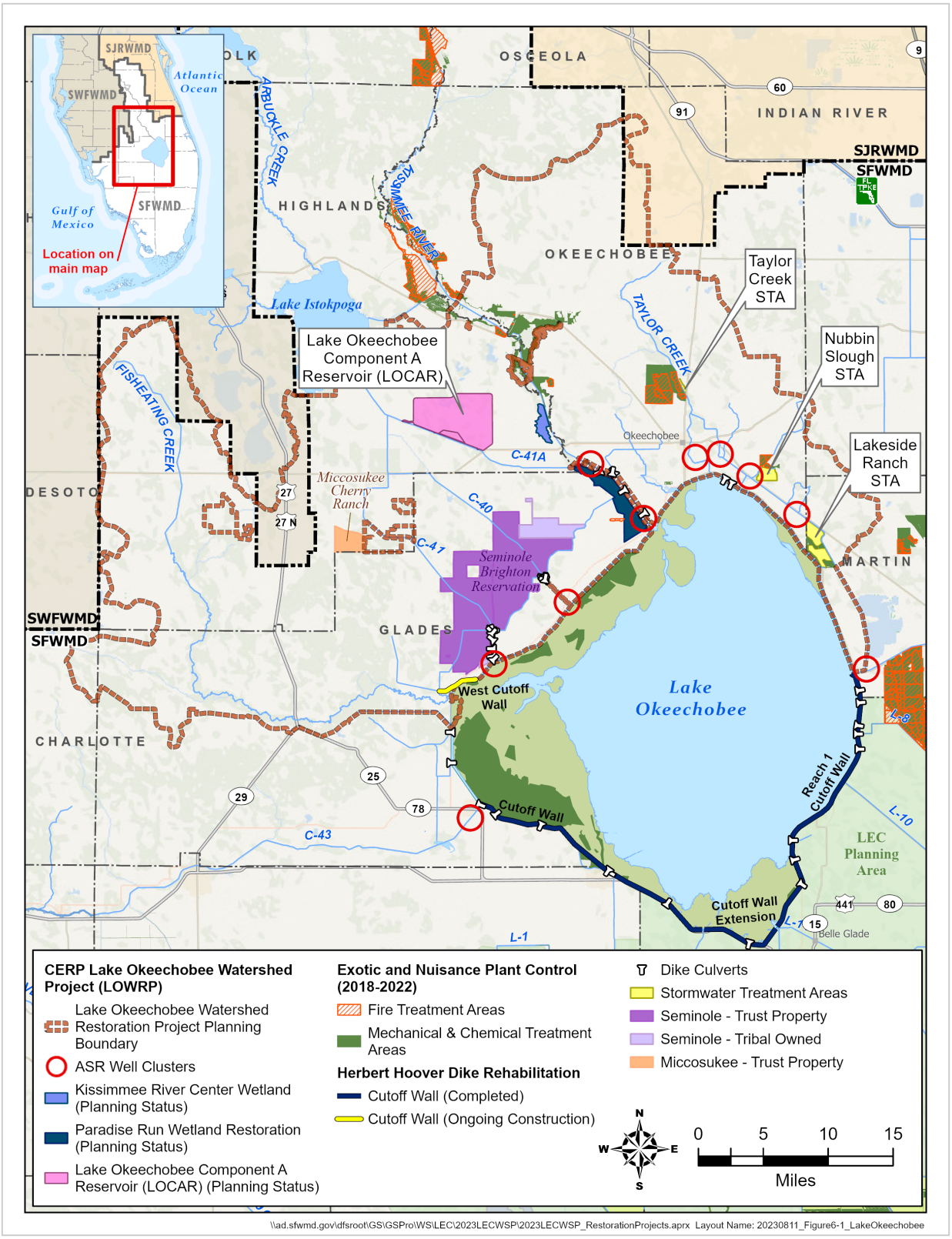

Figure 7-1. Water resource development projects in the Lake Okeechobee region.

CERP Lake Okeechobee Watershed Restoration Project

The CERP LOWRP area (**Figure 7-1**) covers approximately 920,000 acres, including the four major drainage basins that supply water to Lake Okeechobee: Fisheating Creek, Indian Prairie, Taylor Creek/Nubbin Slough, and Lower Kissimmee (S-65D and S-65E). In 2016, the USACE and SFWMD began planning efforts for the LOWRP, with the following goals and objectives:

- Improve the quantity, timing, and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stages more often.
- Improve the quantity and timing of discharges to the St. Lucie and Caloosahatchee estuaries.
- Increase the extent and functionality of aquatic and wildlife habitat within Lake Okeechobee and the surrounding watershed.
- Increase the availability of water supply to existing legal water users of Lake Okeechobee.

Lake Okeechobee Component A Storage Reservoir

To achieve these project goals and objectives, the LOWRP team evaluated various management measures, such as water storage features (e.g., aboveground reservoirs, ASR wells) and wetland restoration components. Since that time, the reservoir and wetland attenuation feature has been removed from the project design. To maintain the planned 200,000 acre-feet of aboveground storage in the basin, the SFWMD began a feasibility study pursuant to Section 203 of the WRDA of 1986, as amended, for the LOCAR. The LOCAR Section 203 Feasibility Study, which was finalized in January and submitted with the Environmental Impact Statement in February 2024 to Congress, is a distinctly separate project from the LOWRP and not formally considered a CERP project. By creating additional water storage north of Lake Okeechobee, the LOWRP ASR systems, in addition to the LOCAR reservoir, can improve flexibility in the timing and distribution of water in the lake to the estuaries and throughout the watershed. Water can be stored during wet times to reduce damaging high lake levels and be released into the lake during dry times to reduce adverse impacts of low lake levels. Wetland restoration components of the LOWRP are designed to improve the functionality and habitat value of degraded wetlands. After evaluating various project options, the LOWRP team identified a Tentatively Selected Plan in 2018 for further review and analysis prior to formal submittal for a USACE agency decision. The USACE Chief of Engineers Report for the first phase of the LOWRP, including the wetland restoration components and possibly the ASR wells, is anticipated to be considered in the WRDA of 2026. There are uncertainties with the water quality of the ASR wells, and further technical studies are required prior to consideration in the LOWRP, which may delay the inclusion of the ASR wells in the WRDA of 2026.

Northern Everglades and Estuaries Protection Program

The goals and objectives of CERP and the Northern Everglades and Estuaries Protection Program overlap considerably, and the projects often complement one another. Numerous efforts have been conducted as part of the Northern Everglades and Estuaries Protection Program, including completion of two pilot-scale STAs in Taylor Creek and Nubbin Slough as

well as the Lakeside Ranch STA. The Lake Okeechobee Watershed Construction Project was developed to identify the issues that are affecting the water quality and quantity in each of the sub-watersheds and basins within the Lake Okeechobee Watershed. Analyses were conducted to determine if projects, also known as management measures, were addressing those issues. The Lake Okeechobee Watershed Construction Project update is complete and was submitted to the Florida Department of Environmental Protection (FDEP) to be incorporated into the Lake Okeechobee Basin Management Action Plan.

Taylor Creek STA

The Taylor Creek STA was constructed by the USACE in central Okeechobee County in 2006 and is included in the Lake Okeechobee Basin Management Action Plan. The 142-acre STA, which diverts and treats runoff from the Upper Taylor Creek before it enters Lake Okeechobee, has an effective treatment area of 118 acres (**Figure 7-2**). Initial operations began in 2008, were subsequently suspended for repairs, and resumed in September 2010. The USACE and SFWMD co-sponsor the project and have a 50-50 cost-share agreement. The SFWMD is responsible for the operation, monitoring, and maintenance of the facility under a FDEP permit (as of May 2011).

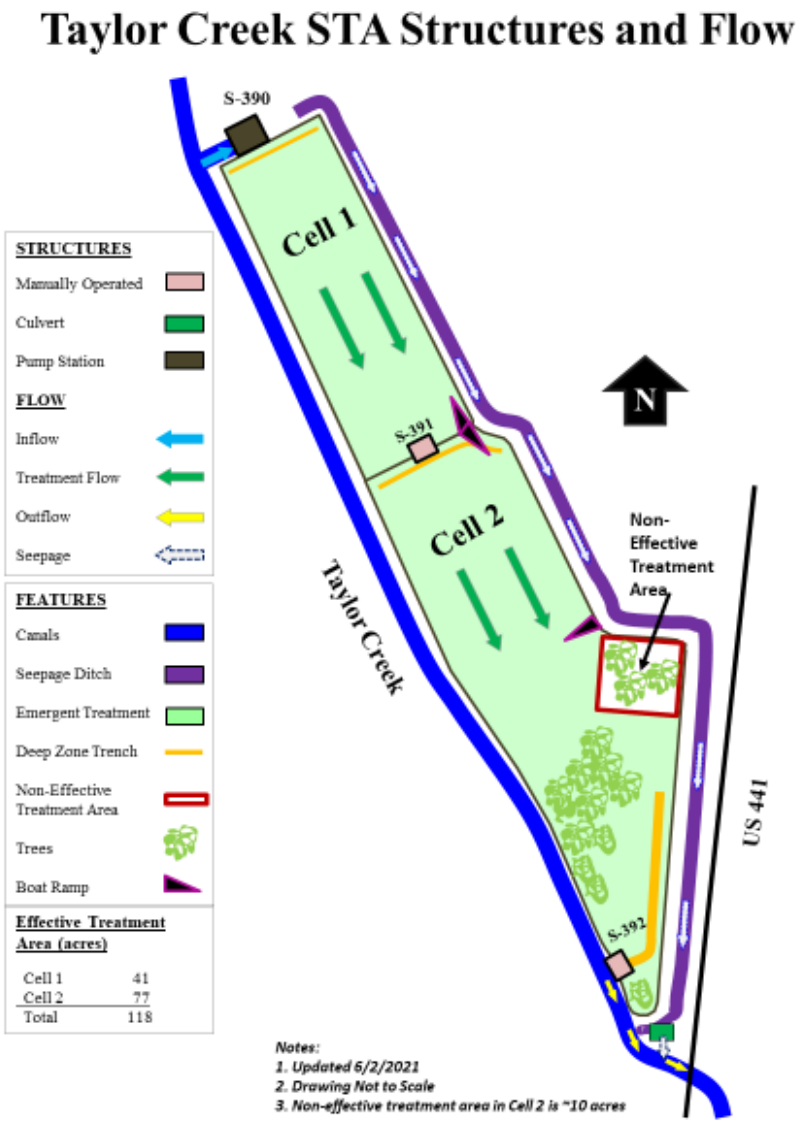

Figure 7-2. Taylor Creek STA structures, flows, and features.

Nubbin Slough STA

Under Phase 1 of the Lake Okeechobee Watershed Construction Project, the Nubbin Slough STA was constructed by the USACE in 2006. Located approximately 7 miles southeast of the City of Okeechobee, this 809-acre STA has two cells, with a total effective treatment area of 773 acres (**Figure 7-3**). The project began operations in 2012, and then underwent repairs through December 2014. The SFWMD is the project's local sponsor and has operated the facility under an FDEP operation and maintenance permit since March 2015. The STA was taken offline in 2020 for additional levee repairs which were completed in 2022. The STA remains in the post-construction vegetation grow-in phase as of 2023.

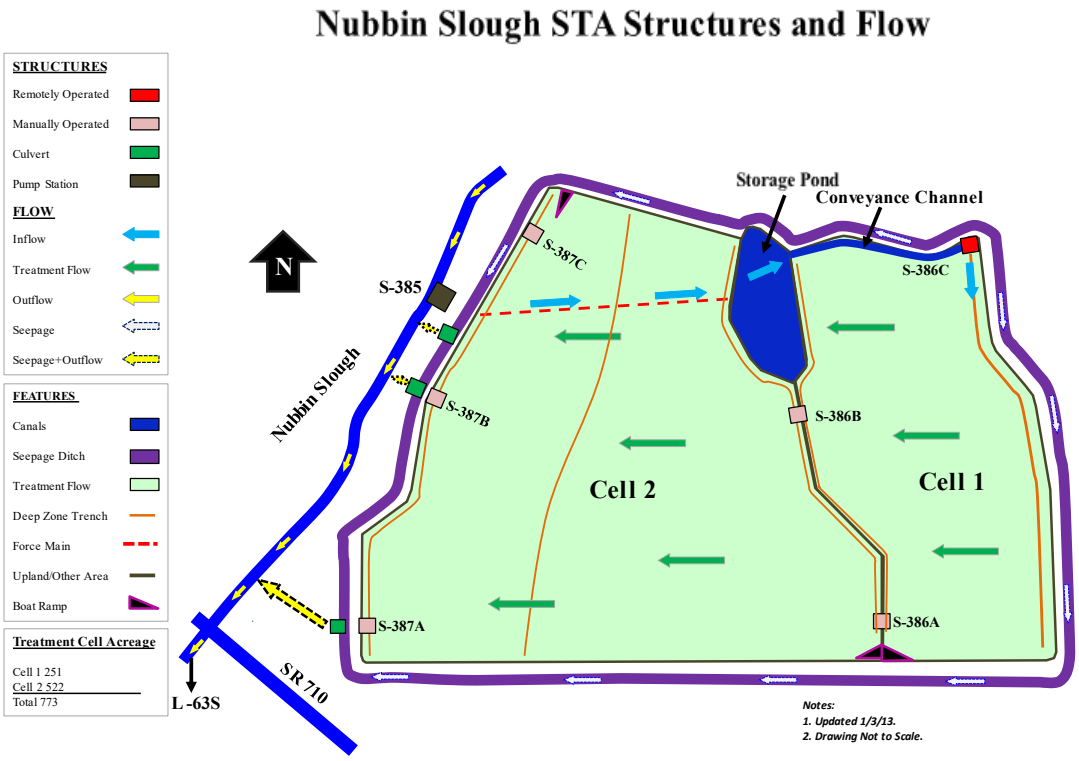

Figure 7-3. Nubbin Slough STA structures, flows, and features.

Lakeside Ranch STA

Located in western Martin County, the Lakeside Ranch STA plays a crucial role in restoring the Lake Okeechobee watershed by improving the quality of water flowing into the lake (**Figure 7-4**). The wetland area treats stormwater runoff from the Taylor Creek and Nubbin Slough basins to the north before that runoff enters Lake Okeechobee. The 2,700-acre project, with a total effective treatment area of 1,707 acres, is a component of the Lake Okeechobee Watershed Construction Project, which is designed to reduce phosphorus loads to Lake Okeechobee. Phase 1 (cells 1 to 3) became operational in 2014. Phase 2 (cells 4 to 8) included construction of the S-191A Pump Station to assist with S-135 Basin flood control as well as delivery of hydration water from the lake to the STA (and recirculation of STA discharges) to help prevent treatment cell dryout. Prior to the construction of S-191A, the STA experienced dryout leading to vegetation decline and performance issues. The Phase 2 project was completed in August 2021.

Figure 7-4. Lakeside Ranch STA structures, flows, and features.

USACE Herbert Hoover Dike Major Rehabilitation

Herbert Hoover Dike Rehabilitation Construction

The Herbert Hoover Dike, a 143-mile series of levees and structures surrounding Lake Okeechobee, was authorized in 1930 and constructed by hydraulic dredge and fill methods. In 2006, the USACE assigned the Herbert Hoover Dike a Dam Safety Action Classification of DSAC Level 1, representing the highest risk of failure and requiring remedial action.

Rehabilitation of the Herbert Hoover Dike to address structural integrity concerns began in 2005 and was completed in early 2023. The Dam Safety Action Classification rating improved from a Level 1 to a Level 4 (lowest risk of dam failure). A major component of the rehabilitation was the construction of a 56.2-mile seepage barrier including 52.1 miles between Port Mayaca to west of Moore Haven and 4.1 miles in the Lakeport area on the west side of the lake. In addition, 28 culverts were replaced, 4 were removed, and armoring was placed at the S-71, S-72, and Harney Pond Canal State Road 78 Bridge to reduce risk of failures due to storm surges (**Figure 7-5**).

Additional water can be stored in Lake Okeechobee resulting from the completion of the dike repairs and the revised Lake Okeechobee System Operating Manual (LOSOM). Capital projects to increase storage in the basin are being designed and constructed, such as ASR systems and aboveground storage reservoirs.

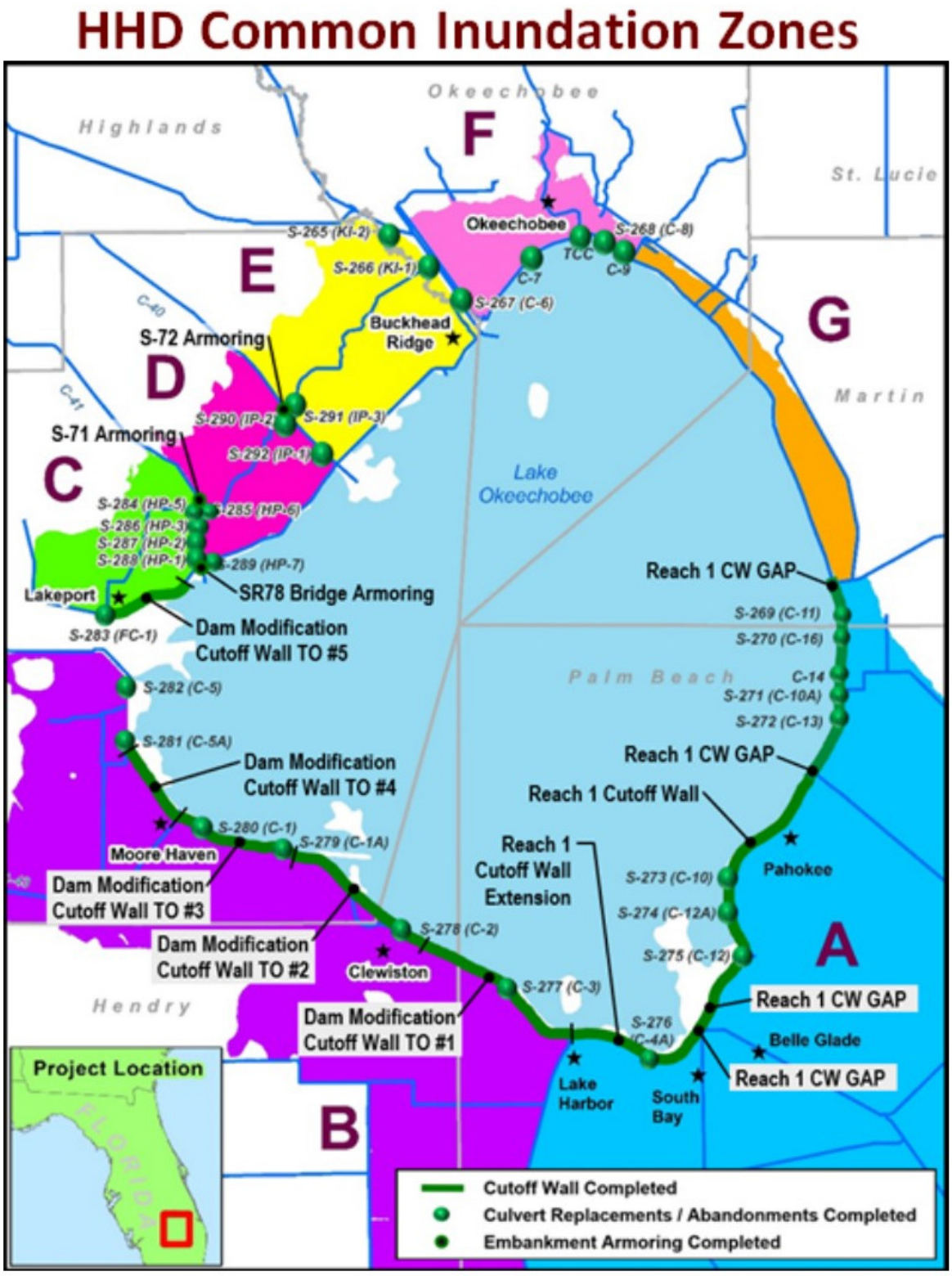

Figure 7-5. Herbert Hoover Dike rehabilitation components (From USACE 2023a)

Everglades

The following water resource development projects are within, have an effect on, or are affected by the Everglades region and are discussed in this section (shown in **Figure 7-6**):

- Everglades Forever Act projects, including the Restoration Strategies Regional Water Quality Plan
- Modified Water Deliveries (ModWaters) to Everglades National Park
- C-111 South Dade Project
- CERP WCA-3A Decompartmentalization Physical Model
- CERP Central Everglades Planning Project (CEPP)
  - CEPP Everglades Agricultural Area (EAA) Phase
  - CEPP North Phase
  - CEPP South Phase
  - CEPP New Water Phase
- Florida Bay projects
  - S-197 Structure Replacement Project and Automation
  - CERP C-111 Spreader Canal Western Project
  - South Dade Study and Florida Bay Plan

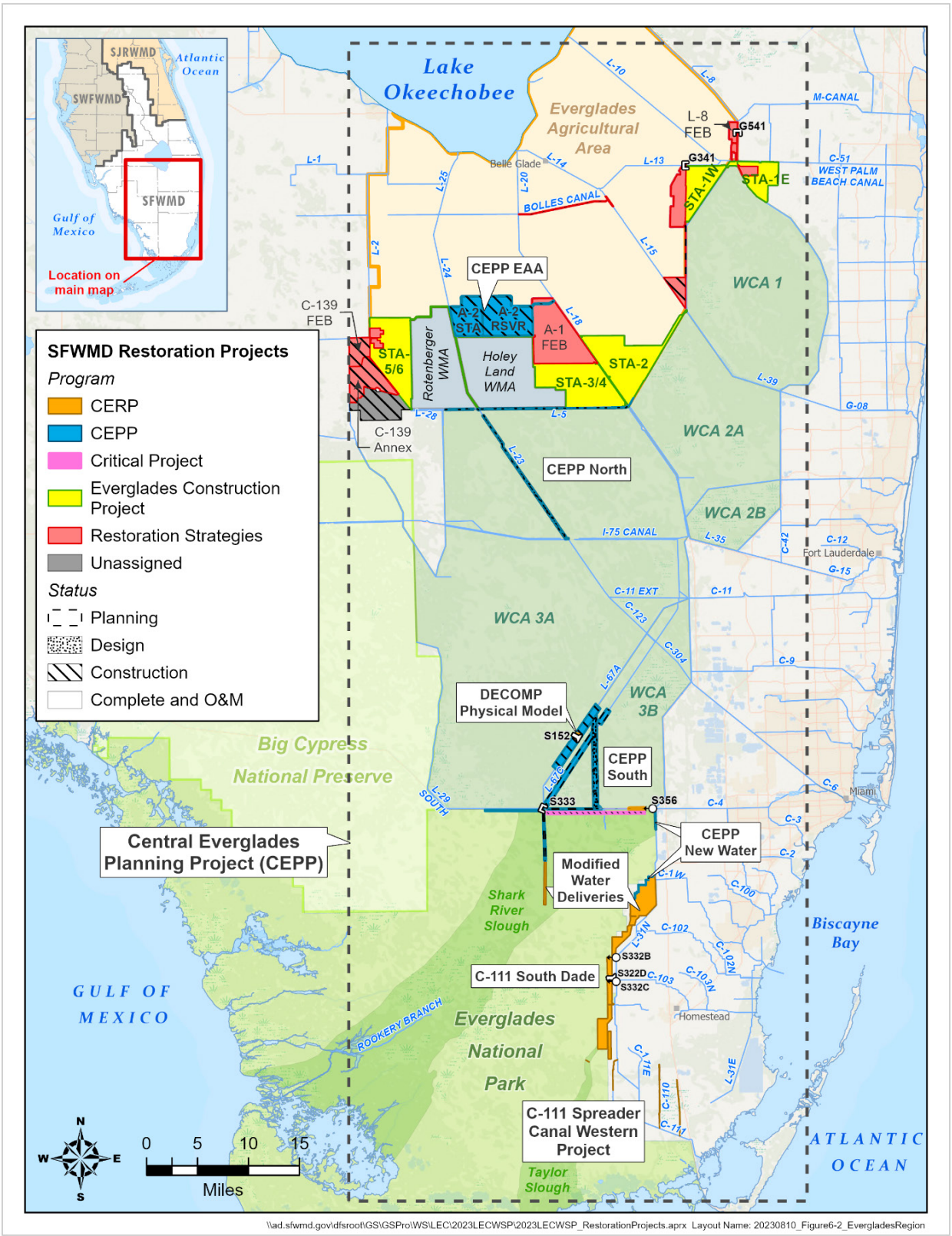

Figure 7-6. Water resource development projects in the Everglades region of the LEC Planning Area. (Note: Florida Bay projects are shown in greater detail in **Figure 7-10**).

Everglades Forever Act Projects

The Everglades Forever Act was passed in 1994 (Section 373.4592, F.S.) to ensure all water discharged to the Everglades Protection Area meets stringent water quality (phosphorus) standards. The status of the impacted areas, construction progress, best management practice implementation, and exotic species removal is updated annually in the *South Florida Environmental Report* (https://www.sfwmd.gov/sfer).

In 2012, the FDEP and SFWMD, in coordination with the United States Environmental Protection Agency, reached consensus on new restoration strategies to expand water quality improvement projects and achieve the water quality (phosphorus) standard established for the Everglades Protection Area. Under these strategies, the SFWMD implemented the Restoration Strategies Regional Water Quality Plan to complete and operate multiple water treatment and storage projects. The projects primarily consist of FEBs, STA expansions, and associated infrastructure and conveyance improvements, though some projects address pollution reduction at the source in the EAA. These restoration strategies provide for the addition of 116,000 acre-feet of storage in FEBs, 6,500 acres of new STAs, and nearly 2,000 acres of improved effective treatment areas. Approximately 1,800 acres of new STAs and 11,000 acre-feet of water storage is all that remains to be created by the restoration strategies projects (**Figure 7-6**). Construction of these projects is scheduled through 2025 (**Table 7-4**).

INFO ⓘ

Flow equalization basins are constructed storage features used to capture peak stormwater flows in order to provide a steadier flow of water to stormwater treatment areas, helping to maintain water levels needed to achieve optimal water quality treatment performance.

As part of the Restoration Strategies Regional Water Quality Plan, the SFWMD implemented the Science Plan in 2013 and updated it in 2018 (SFWMD 2018c). The Science Plan investigates the factors that influence performance of the Everglades STAs. As of 2023, 12 of the 21 Science Plan studies had been completed, 3 studies are nearing completion, and 6 are scheduled for completion in 2024.

Modified Water Deliveries to Everglades National Park

The United States Department of the Interior and USACE co-sponsored ModWaters, a foundation project for CERP completed in 2018 that was the first major restoration effort for Everglades National Park. The goal of ModWaters was to 1) restore natural flow into eastern Everglades National Park, which was altered by construction of roads, levees, and canals; and 2) control seepage eastward into urban areas. ModWaters was essential to provide the flow capacity necessary for future CERP projects and Everglades MFL recovery. All features of the ModWaters project have been constructed and are operational. These features include the Taylor Slough Bridge, 8.5-Square Mile Area Flood Mitigation Project Protection Features, Tamiami Trail Modifications and S-356 Pump Station.

C-111 South Dade Project

In 1995, the USACE and SFWMD executed a cost-share agreement to jointly implement the C-111 South Dade Project, a foundation project completed in 2018, that CERP builds upon to deliver essential restoration benefits to the Everglades. The objective of the C-111 South Dade project is to restore natural hydrologic conditions in Taylor Slough and the eastern panhandle of Everglades National Park while also preserving the current level of flood protection for agricultural lands in southern Miami-Dade County. The project, which works with the infrastructure constructed for ModWaters, created a hydraulic ridge to prevent groundwater from seeping out of Everglades National Park and allows additional water to flow into Florida Bay. This project provides environmental water supplies identified in the Florida Bay MFL prevention strategy.

The C-111 South Dade Project, composed of 12 contracts, began in 1994, with construction commencing in 1996. As of 2013, 7 of the 12 contracts had been executed, 3 contracts were deferred, and 2 are ongoing. In 2014, the cost-share agreement between the USACE and SFWMD was amended to enable the USACE and SFWMD to continue construction and complete the remaining features. The following work was completed:

- Two interim pump stations and one permanent pump station were constructed between 1997 and 2002.
- 4.75 miles of spoil mounds along the lower C-111 Canal were removed in 1997.
- Taylor Slough Bridge was replaced in 1999.
- Partial retention/detention zones were completed in 2000 and 2002.
- The S-331 Command and Control Center was constructed in 2009.
- The South Detention Area, linking previously separated pump station detention areas, was constructed in 2009.
- Construction of 10 plugs in the L-31W Canal as well as rebuilding of the L-31W Levee and the Taylor Slough integrated weir was completed in early 2018.
- Construction of the North Detention Area was completed in 2018.
- The L-359 and South detention areas were modified to create an eastern flow-way between the S-357 and S-332C pump stations (approximately 8 miles) in 2018.

The next step is to replace the interim pumps at the S-332B and S-332C pump stations with permanent ones. Congress authorized the replacement of the permanent pump stations in 2020. The SFWMD is designing both pump stations and will begin construction of S-332B in FY2024. The USACE is expected to start construction of S-332C in the near future.

The Combined Operational Plan (COP) is the last step to implement operational changes to convey water from WCA-3A to Everglades National Park using the constructed features of the pre-CERP foundation projects (i.e., ModWaters and C-111 South Dade projects) and would result in a change to the 2012 Water Control Plan for the WCAs, Everglades National Park, and Everglades National Park to the South Dade Conveyance System. The COP redistributes the existing water budget in WCA-3A and Everglades National Park to balance the ecological objectives of the ModWaters and C-111 South Dade projects while adhering to project constraints.

The ModWaters project was designed to provide a system of water deliveries to Everglades National Park across the full width of the historic Shark River Slough Flow-Way. The C-111 South Dade project was designed to control groundwater seepage out of Everglades National Park and reduce damaging freshwater discharges to Manatee Bay/Barnes Sound while maintaining flood risk management for agricultural lands east of the C-111 Canal. The COP defines operations for the constructed features of the ModWaters to Everglades National Park and C-111 South Dade project components. Under the COP, the Central and Southern Florida (C&SF) Project infrastructure is being operated to deliver hydrologic benefits to the environment.

CERP WCA-3A Decompartmentalization Physical Model

The CERP WCA-3A Decompartmentalization and Sheetflow Enhancement Project was designed to re-establish sheetflow in the Everglades by hydrologically reconnecting WCA-3A, WCA-3B, and northeastern Shark River Slough (**Figure 7-7**). Part of this project, the CERP WCA-3A Decompartmentalization Physical Model, is a field-scale test assessing the effects of pulsed flows on hydrology, sediment transport, vegetation, and wildlife as well as the ecological effects of backfilling canals and modifying levees. This project will help determine the water supplies needed to meet the Everglades MFL recovery strategy.

Figure 7-7. CERP WCA-3A Decompartmentalization Physical Model (From USACE 2021).

Installation of the CERP WCA-3A Decompartmentalization Physical Model was completed in October 2013. Project components included 10 gated culverts in the L-67A Levee (S-152) and a 3,000-foot gap in the L-67C Levee with three backfill treatments (no backfill, partial backfill, and complete backfill). The S-152 Structure allows for pulsed releases toward the various backfill treatments in the L-67C gap. Phase 1 operational testing periods have occurred between the November and January testing window from 2013 to 2017. Phase 2 operational testing has been under way since 2018. The CERP WCA-3A Decompartmentalization Physical Model was constructed as a temporary feature, but in 2023, the S-152 Structure and the L-67C backfill treatments were authorized as permanent features of the CEPP South Phase. These features will provide greater operational flexibility and additional opportunities for localized benefits in the WCAs.

CERP Central Everglades Planning Project

Authorized by Congress in 2016, CEPP combines a series of CERP components into one Project Implementation Report (PIR). The purpose of CEPP is to improve the quantity, quality, timing, and distribution of water flows to the northern estuaries, central Everglades (WCA-3A, WCA-3B, and Everglades National Park), and Florida Bay while increasing water supply for municipal, industrial, and agricultural users. In 2014, the USACE and SFWMD (2014) completed the *Comprehensive Everglades Restoration Plan: Central Everglades Planning Project: Final Integrated Project Implementation Report and Environmental Impact Statement*, which describes the project purpose and need, location, evaluation of alternatives, and Recommended Plan.

In 2018, the SFWMD prepared a Post Authorization Change Report (PACR; SFWMD 2018b) to CEPP under the authority provided by Section 203 of the WRDA of 1986, as amended. In section 1308(a) of the WRDA of 2018, Congress authorized the CEPP PACR. which included increasing the amount of water storage and treatment authorized in CEPP to reduce damaging discharges from Lake Okeechobee to the northern estuaries and allow more water to move to the central Everglades. The modifications to CEPP are 1) change the A-2 FEB to a 240,000-acre-foot reservoir with multipurpose operational flexibility and a 6,500-acre STA, and 2) increase conveyance in the North New River and Miami canals. The authorized project is currently divided into four phases: CEPP EAA, CEPP North, CEPP South, and CEPP New Water. The overall CEPP project will occur over multiple years due to the size and complexity of the project. The following CEPP components for storage and treatment, distribution and conveyance, and seepage management are included in the Recommended Plan (**Figure 7-8**). The four phases and their components are described in detail below.

According to the Restoration Coordination and Verification (RECOVER) Program system progress report (USACE and SFWMD 2019), water quality is generally improving, but there are still some localized issues which can be further improved upon completion and operation of CEPP EAA, North, South, and New Water components.

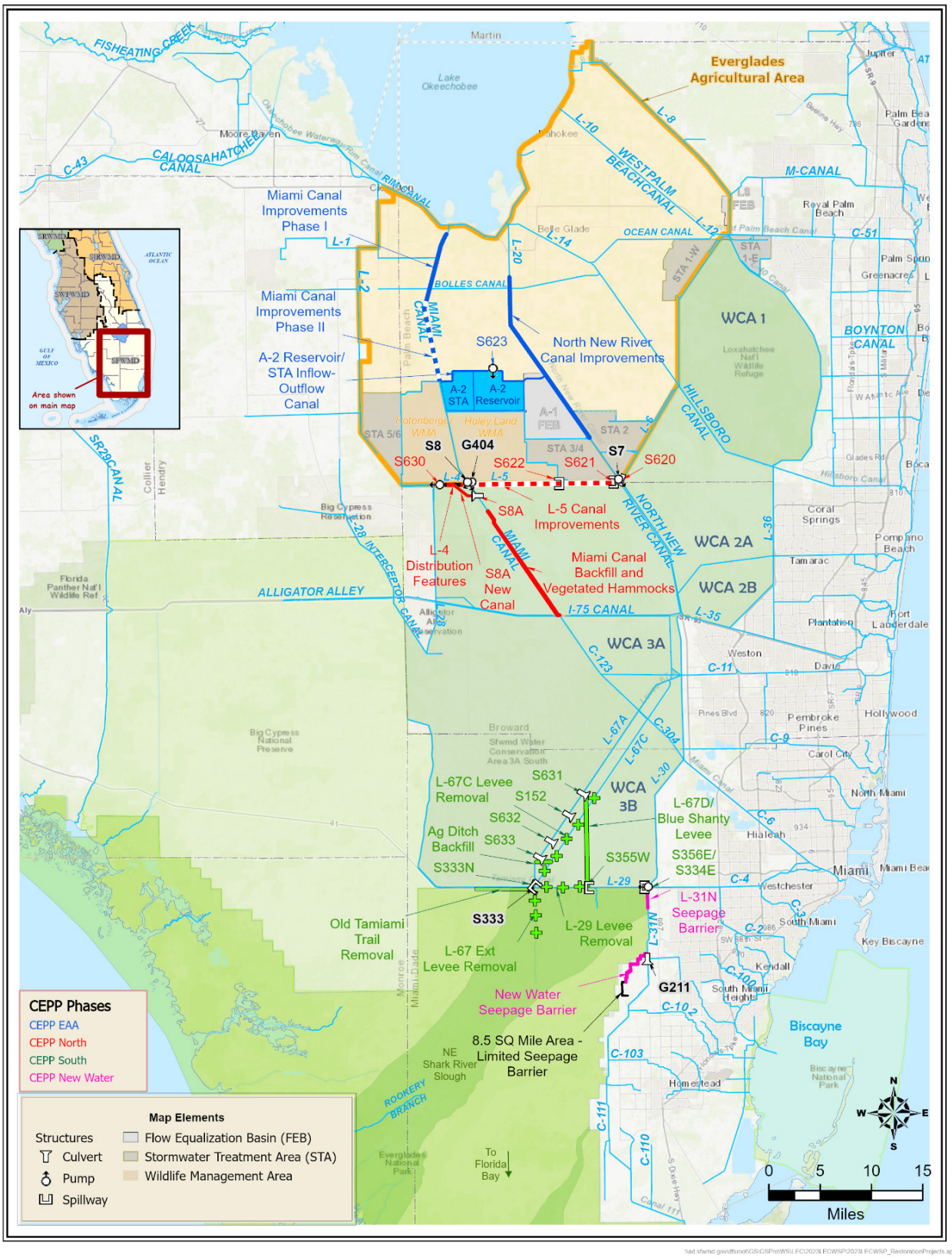

Figure 7-8. Central Everglades Planning Project features.

CEPP EAA Phase

The CEPP EAA Phase is an important part of restoring the Everglades and will dramatically reduce damaging discharges from Lake Okeechobee to the northern estuaries. The project includes a 10,500-acre aboveground storage reservoir (A-2 Reservoir), a 6,500-acre stormwater treatment area (A-2 STA), and canal conveyance improvements to the North New River and Miami canals (**Figure 7-9**). The CEPP EAA Phase project components will provide the water storage and water quality improvements to move an additional 370,000 acre-feet per year on average of water south to the Everglades.

Construction of the A-2 Reservoir, which will have a capacity to store approximately 240,000 acre-feet of water, has recently commenced with the USACE's award of a contract for the Inflow-Outflow Canal, which is scheduled to be completed in November 2024. Based on the most recently approved Integrated Delivery Schedule (USACE 2023b), all aspects of the A-2 Reservoir should be completed in FY2030.

Construction of the A-2 STA, which is being led by the SFWMD, is well under way and the initial hydration of the first of three cells occurred in January of 2024. The SFWMD led design of the Canal Conveyance Improvement projects which are also progressing, with completion of the North New River Conveyance Improvements scheduled for November 2025, and completion of the Miami Canal Improvements scheduled for May 2027.

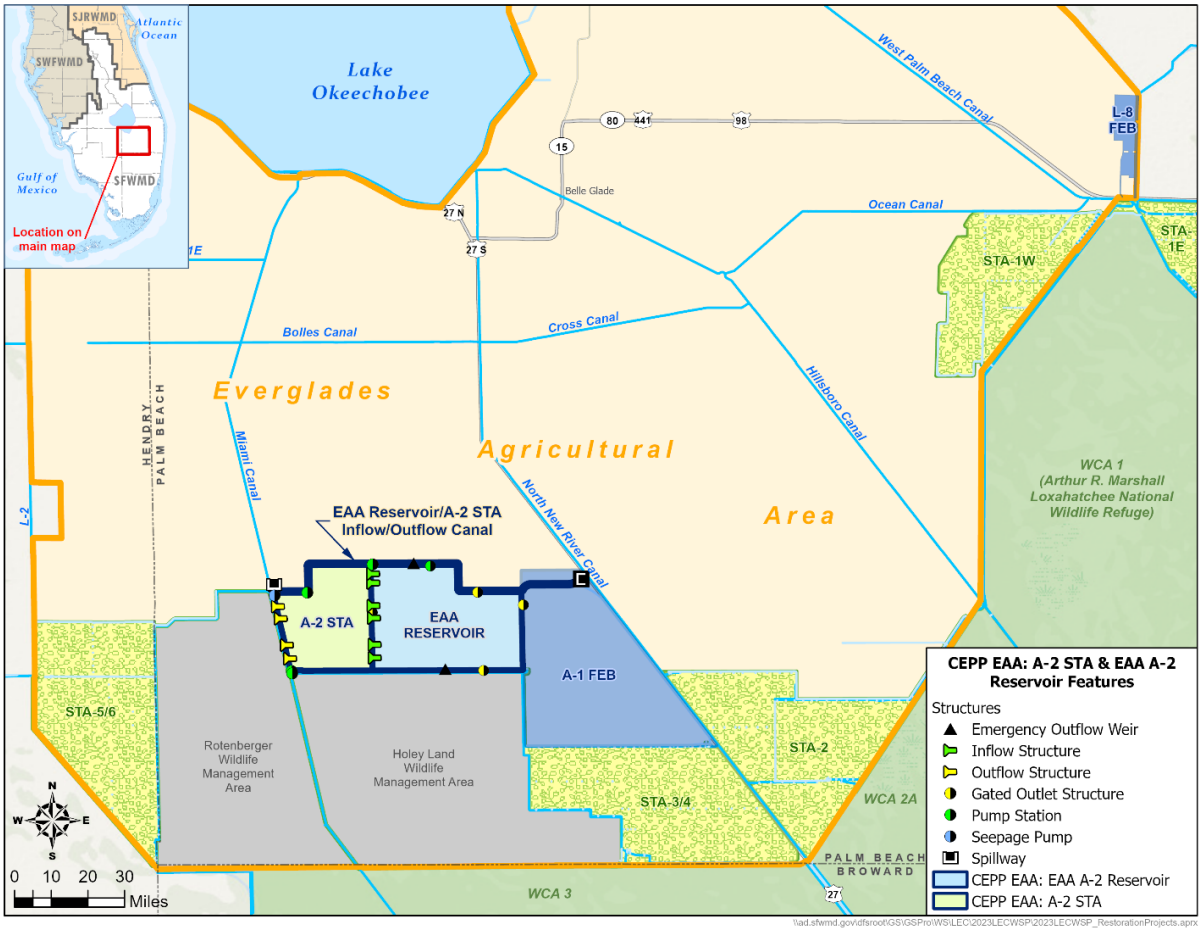

Figure 7-9. Key elements of the A-2 Reservoir and A-2 STA.

CEPP North Phase

The CEPP North Phase provides inflow needed to restore northern WCA-3A and move additional water south and consists of the following components:

- S-620 – 500 cubic feet per second (cfs) gated culvert to deliver water from the L-6 Canal to the L-5 Canal, and L-5 remnant Canal and L-5 conveyance improvements
- S-621 – 2,500 cfs gated spillway and S-622 500 cfs gated culvert to deliver water from east to west in the L-5 Canal
- L-4 Canal – improvement and distribution features to achieve effective distribution into WCA-3A
- S-8A – 2,000 cfs spillway and connecting canal and repurposing the existing S-8 Pump Station
- S-630 – 360 cfs gravity structure to maintain existing water supply deliveries
- Miami Canal – backfill and spoil mound removal (beginning 1.5 miles south of the S-8 Structure and ending at Interstate 75)

CEPP South Phase

The CEPP South Phase removes water flow barriers in the southern portion of the project area to allow more natural flow of water into Everglades National Park and consists of the following components:

- Increase S-333 capacity to 2,500 cfs (S-333N Gated Spillway) delivers water from the L-67A Canal to the L-29 Canal and supplements the existing S-333 Gated Spillway; Modify the S-333 Structure.
- Operate one 500 cfs gated structure (S-631) north of the L-67D Levee (Blue Shanty levee) and utilize a 6,000-foot gap in the L-67C Levee to deliver water from WCA-3A to WCA-3B, east of the L-67D Levee.
- Operate two 500 cfs gated structures in the L-67A Canal (S-632, S-633) and perform 0.5-mile spoil removal west of the L-67A Canal to deliver water from WCA-3A to WCA-3B, west of the L-67D Levee.
- Remove approximately 8 miles of the L-67C Levee in the Blue Shanty Flow-Way (no canal backfill) to allow a more natural flow of water from WCA-3A to WCA-3B.
- Construct approximately 8.5-mile L-67D Levee in WCA-3B, connecting the L-67A Canal to the L-29 Canal.
- Remove approximately 4.3 miles of the L-29 Levee in the Blue Shanty Flow-Way to allow water to move through WCA-3B Flow-Way.
- Divide structure (S-355W) to the east of Tamiami Trail Next Steps western bridge which will maintain water deliveries to the eastern L-29 Canal to aid in meeting Everglades National Park ecological objectives.
- Construct a gated structure along the L-67A Levee and a 6,000-foot gap in the L-67C Levee.

- Remove all 5.5 miles of the L-67 Extension Levee and backfill of the L-67 Extension Canal to allow a more natural flow of water and provide a direct hydrologic connection between waterways.
- Remove approximately 6 miles of Old Tamiami Trail road from the L-67 Extension Levee to Everglades National Park's Tram Road which provides increased wetland acreage.
- Replace the S-356 Pump Station with S-356E and increase its capacity to 1,000 cfs for seepage return to Everglades National Park.

CEPP New Water Phase

The CEPP New Water Phase includes the elimination of losses due to levee seepage to the east coast and includes the following components:

- Construction of a partial depth seepage barrier south of Tamiami Trail (along the L-31N Levee) has been replaced with an approximately 55-foot-deep, 5-mile-long seepage barrier located in the L-357W Levee.

Independent of CEPP, the SFWMD constructed a limited-length seepage wall within the existing L-357W Levee by trenching approximately 2.3 miles and installing a cement bentonite curtain wall along the L-357W Levee located northwest of the S-357 Pump Station. The curtain wall is designed to keep restoration flows in Everglades National Park while augmenting the current 8.5-Square Mile Area Flood Mitigation Project Protection Features to support meeting its flood mitigation requirements.

Florida Bay

Water resource development projects that affect Florida Bay are discussed in this section as shown in **Figure 7-10**.

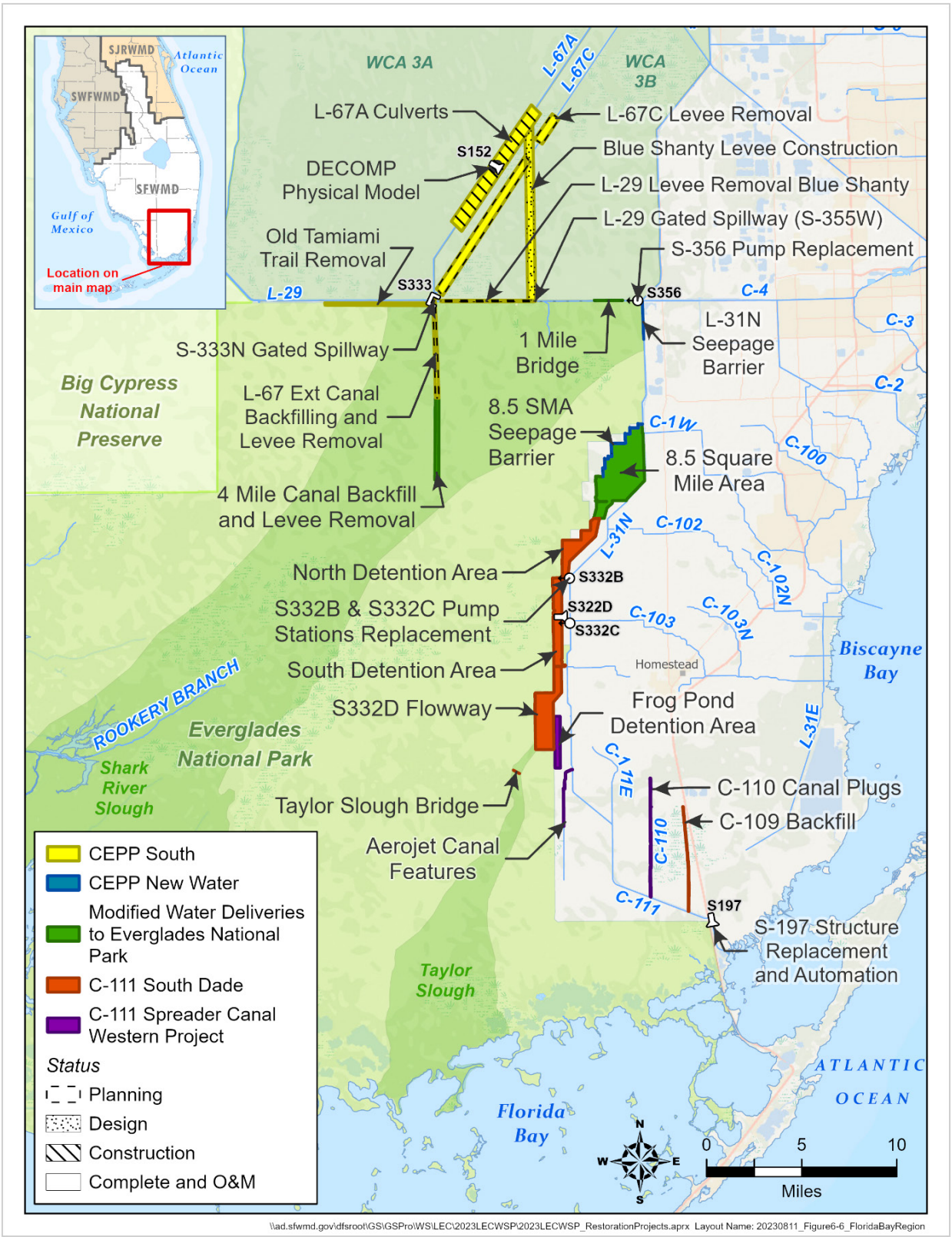

Figure 7-10. Water resource development projects in the Florida Bay region that support Everglades restoration.

S-197 Structure Replacement Project and Automation

Located in southern Miami-Dade County near Manatee Bay, the S-197 Structure is an important flood control component that also provides environmental benefits and water resource protection by preventing saltwater intrusion into coastal fresh waters. In 2013, the SFWMD replaced the S-197 Structure using the same operation criteria, location, and discharge capacity to ensure it continues to be an effective component of flood control operations in the C-111 Canal. In 2020, the SFWMD completed the project to automate operation of the S-197 Structure, allowing remote operation from SFWMD control centers.

CERP C-111 Spreader Canal Western Project

The CERP C-111 Spreader Canal Western Project (**Figure 7-11**) involves structural and operational changes to improve 1) the quantity, timing, and distribution of water delivered to Florida Bay via Taylor Slough; and 2) hydroperiods within the wetlands of the Southern Glades and Model lands. The project provides more natural sheetflow to Florida Bay and decreases damaging discharges to Manatee Bay and Barnes Sound without adversely impacting existing levels of flood protection to adjacent agricultural and urban lands. The project provides environmental water supplies identified in the Florida Bay MFL prevention strategy.

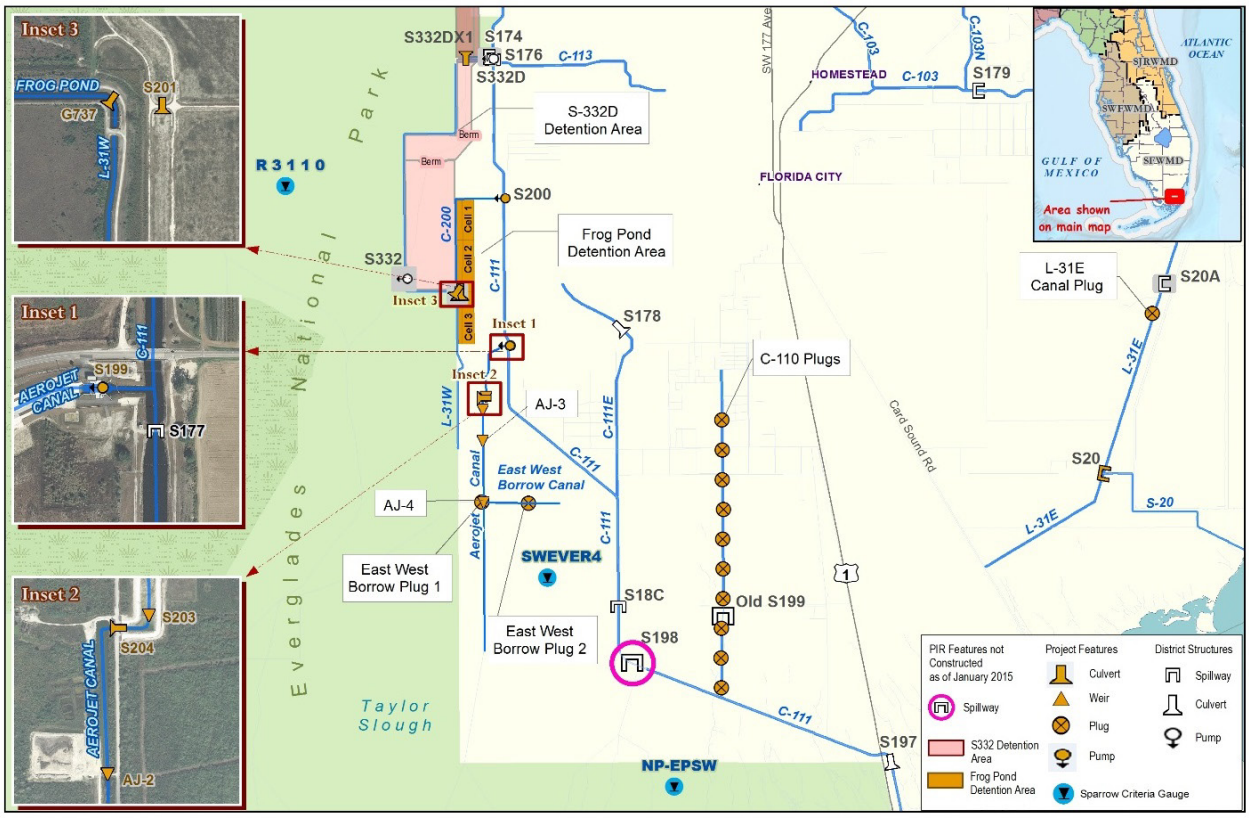

Figure 7-11. C-111 Spreader Canal Western Project – Phase 1.

The SFWMD completed construction of the CERP C-111 Spreader Canal Western Project in 2012 using state funds to create a 6-mile hydraulic ridge adjacent to Everglades National Park, which keeps more natural rainfall and water flows within Taylor Slough. Congress authorized the CERP C-111 Spreader Canal Western Project in 2014.

In 2015, the SFWMD sought to improve flows to Taylor Slough by expanding the capacity of the S-200 and S-199 pump stations to 300 cfs to move water from the C-111 Canal to the Frog Pond Detention Area and Aerojet Canal. The USACE and FDEP issued permits, and construction of both features was completed in 2018. The SFWMD also added culverts (G-737) in 2017 to connect the S-200 Pump Station to the L-31W Canal to deliver water to Taylor Slough.

Important changes in the hydrology and ecology of the southern Everglades wetlands, the mangrove ecotone, and Florida Bay are expected to occur as a result of the CERP C-111 Spreader Canal Western Project. The ecological effects of the project are being assessed by comparing baseline and post-implementation monitoring data. Previous monitoring efforts developed baseline data for operational and restoration planning, performance measures and targets, and simulation models. Post-implementation monitoring is ongoing and includes the following:

- Monitor changes in nutrient and organic matter transport and transformations in water flowing from canals and through the wetlands of the southern Everglades to Florida Bay.
- Document changes in salinity patterns within coastal wetlands and estuaries.
- Synthesize the findings from a large wetland monitoring network with complementary monitoring and research efforts in the region to assess status, trends, and causes of change.

According to the most recent Restoration Coordination and Verification (RECOVER) Program system progress report (USACE and SFWMD 2022), water quality is generally improving. However, some localized issues remain that can be further improved upon with the completion and operation of CEPP EAA, North, South, and New Water components.

The SFWMD is conducting additional long-term monitoring, including comprehensive ecological monitoring assessing hydrology, nutrients, water quality, vegetation and fauna and their interactions in the footprint and downstream of the C-111 Spreader Canal Western Project operations. The project will provide water quality and ecological data necessary for the CERP C-111 Spreader Canal Western Project as well as the following:

- Restoration Coordination and Verification (RECOVER) Program system status reports available at https://www.evergladesrestoration.gov/report-indexquick-links, System Status Report (CERP; RECOVER)
- Assessment of the southern Everglades and Florida Bay portions of the Everglades Protection Area pertaining to the Everglades Forever Act
- Assessment of ongoing operational plans and effects

South Dade Study and Florida Bay Plan

In July 2016, the District Governing Board implemented a plan to expedite additional operational and structural projects that would deliver fresh water to Florida Bay to help reduce salinity levels in the bay and promote the recovery of seagrasses. The plan for Florida Bay was developed out of the work from the South Dade Study. The SFWMD initiated the 6-month South Dade Study in September 2015 to examine water resource management in southern Miami-Dade County and its effects on Taylor Slough restoration, critical habitats of the Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*) in Everglades National Park, and active agricultural operations and urban areas. Water management in this area also affects the eastern panhandle of Everglades National Park, Biscayne Bay, and wetlands in southeastern Miami-Dade County. The study identified projects to reduce flood risks in urban and agricultural areas of Miami-Dade County while providing water to natural areas. Selected operational and structural projects were incorporated into ongoing and upcoming efforts in C-111 projects and were expedited by the SFWMD to deliver more freshwater to Taylor Slough, which connects to Florida Bay. **Figure 7-12** depicts the operational and structural changes implemented by the SFWMD between 2016 and 2018.

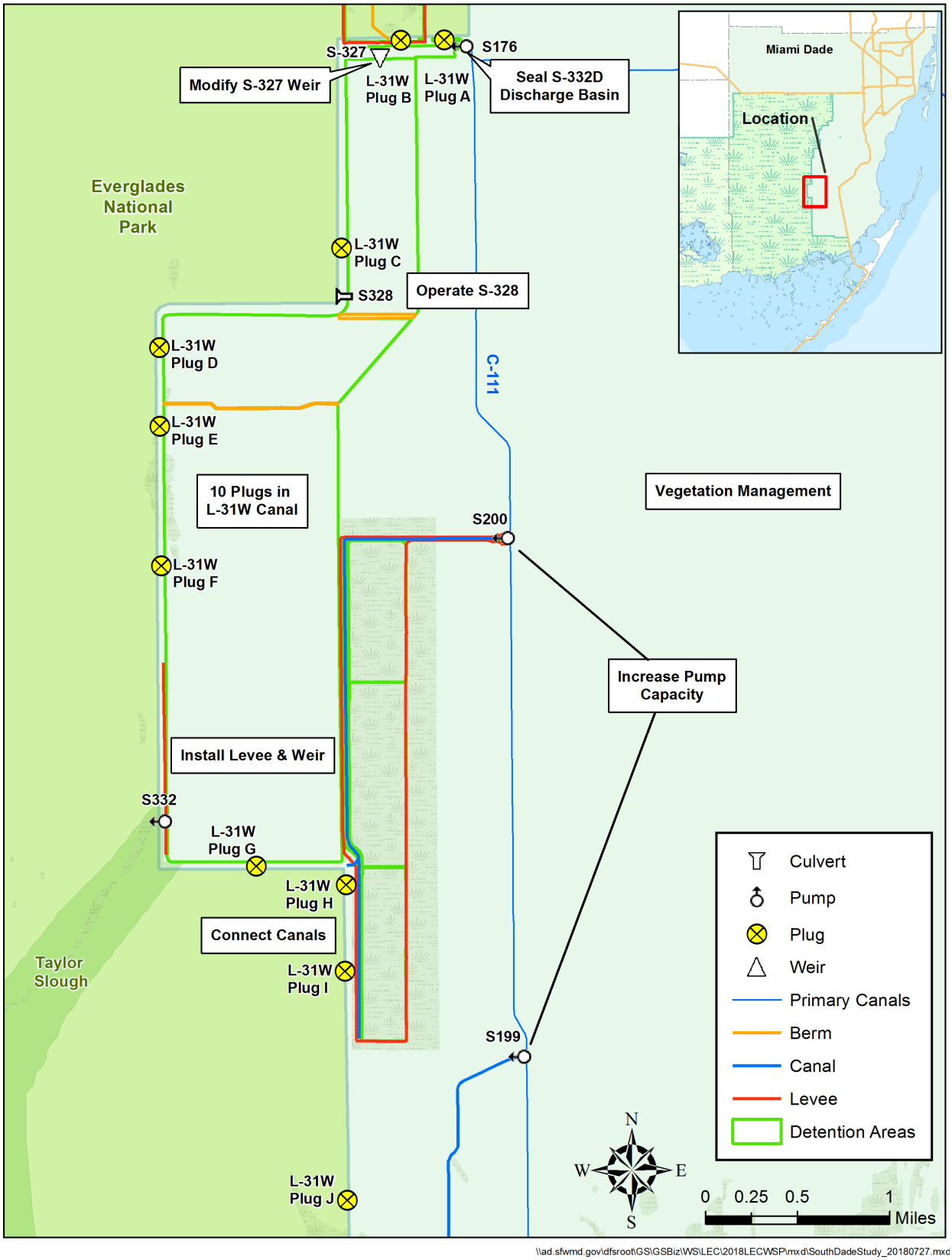

Figure 7-12. South Dade Study and Florida Bay Plan features with operational changes since 2016.

Western Basins

Encompassing approximately 440,000 acres, the C-139, Feeder Canal, L-28, and L-28 Gap drainage basins along the western edge of the Everglades are collectively known as the Western Basins. The following water resource development projects are within the Western Basins and are discussed in this section (shown in **Figure 7-13**):

- CERP Western Everglades Restoration Project
- C-139 Annex Restoration Project

CERP Western Everglades Restoration Project

The CERP Western Everglades Restoration Project (WERP) area encompasses approximately 772,700 acres west of the EAA and WCA-3A. Within the LEC Planning Area, WERP includes the Western Basins, Big Cypress National Preserve, western WCA-3A, Seminole Tribe of Florida Big Cypress Reservation, and Miccosukee Federal Reservation (**Figure 7-13**). Through the use of water management and water quality features, as well as canal and levee alterations, WERP is designed to achieve the following goals:

Big Cypress National Preserve

- Re-establish sheetflow across the Seminole Tribe of Florida Big Cypress Reservation and into Big Cypress National Preserve.
- Maintain existing levels of flood protection.
- Restore oligotrophic (low-nutrient) conditions to re-establish and sustain native flora and fauna.
- Re-establish ecological connectivity of wetland and upland habitats in the western Everglades with restored freshwater flow paths, flow volumes and timing, seasonal hydroperiods, and historical distributions of sheetflow.
- Reduce the frequency of intense wildfires that damage the underlying geomorphic condition of the western Everglades.
- Promote systemwide resilience considering future change (e.g., climate change, sea level rise).

WERP is currently in the planning phase. Based on the results of the project analyses, the USACE identified a Tentatively Selected Plan in August of 2023.

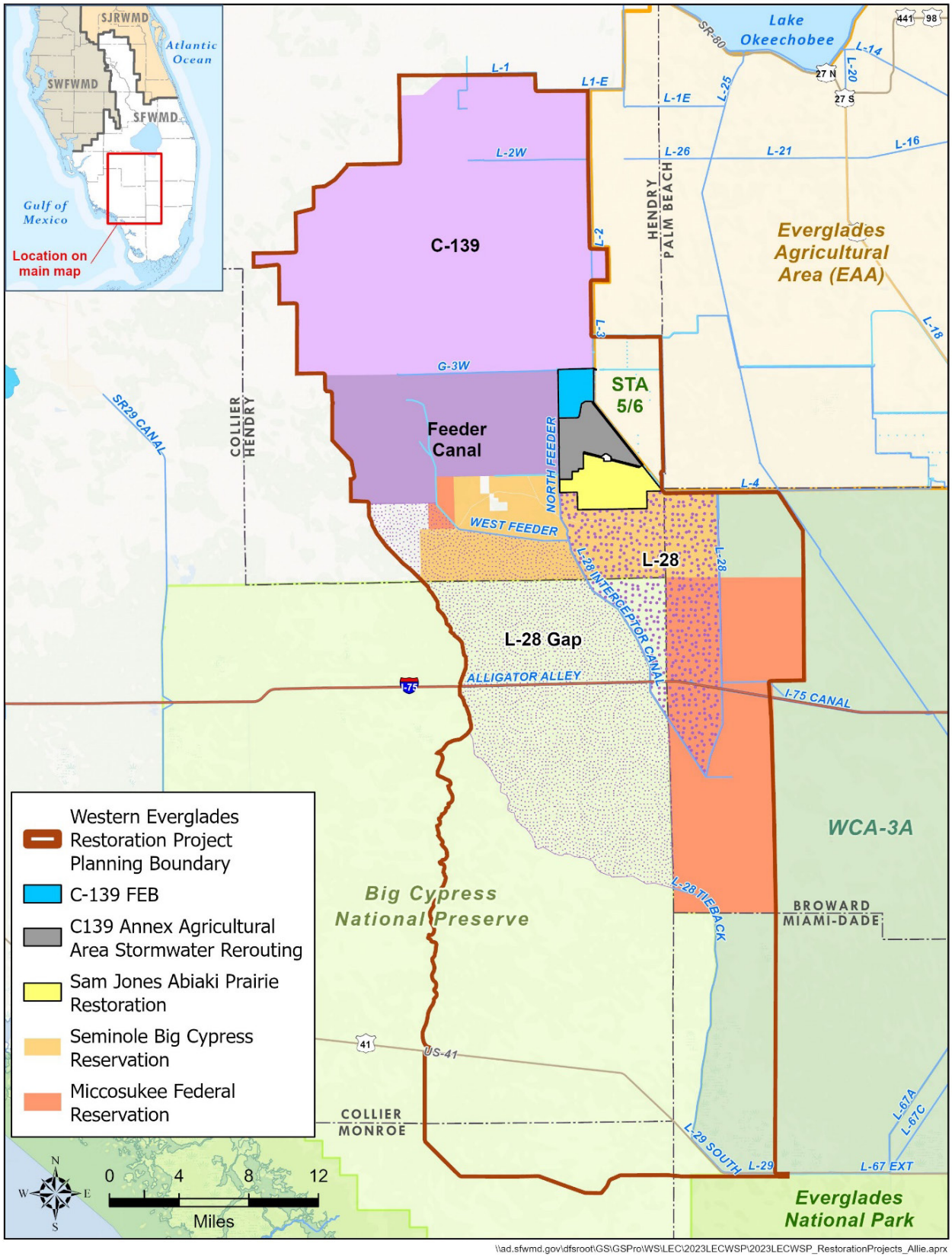

Figure 7-13. Western Everglades Restoration Project area including the C-139 Annex Restoration Project.

C-139 Annex Restoration Project

The C-139 Annex was purchased by the District in 2010 for water resource projects. It contains two projects currently under construction: the C-139 FEB at the north end and the Sam Jones/Abiaki Prairie restoration in the south (**Figure 7-13**). The C-139 FEB is a shallow reservoir with 11,000 acre-feet of storage and will store local basin runoff from the C-139 Basin and control the flow of water to the adjacent STA 5/6. This will help improve the performance of STA 5/6, removing nutrients from stormwater and improving the quality of the water before it flows south to Everglades National Park and Florida Bay. Construction of the FEB began in 2021 with an expected completion date of 2025.

Much of the central area of the property is available for use to construct the future WERP North Feeder STA. This STA, with 3,240 acres of treatment wetlands, would provide water quality improvement for North Feeder Canal water and redirect it to the northwest corner of WCA-3A. Design and construction of the STA is pending congressional authorization of WERP and funding.

The goal of the Sam Jones/Abiaki Prairie restoration is to restore the historical functions of the wet and dry prairies, sloughs, depression marshes, and tree islands of this former 7,800-acre citrus grove in Hendry County. The restoration is occurring in two phases, and upon completion in 2027, the smaller first phase will supply the native plant material for the larger second phase with implementation through 2032. The project is being implemented with mitigation funds from limestone mining activities in the Miami-Dade County Lake Belt region.

Lower East Coast Service Areas

The following water resource development projects are within the LEC Service Areas and are discussed in this section (**Figure 7-14**):

- Loxahatchee River projects
  - Restoration Plan for the Northwest Fork of the Loxahatchee River
  - CERP Loxahatchee River Watershed Restoration Project
  - Storage for the Loxahatchee River
- CERP Hillsboro Site 1 Impoundment/Fran Reich Preserve Reservoir (formerly Site 1 Reservoir)
- CERP Broward County Water Preserve Areas (BCWPA)
- Biscayne Bay projects
  - CERP Biscayne Bay Coastal Wetlands (BBCW) Project
  - CERP Biscayne Bay and Southeastern Everglades Ecosystem Restoration (BBSEER)

Loxahatchee River

Restoration Plan for the Northwest Fork of the Loxahatchee River

Loxahatchee River

In April 2003, an MFL and recovery strategy were adopted for the Northwest Fork of the Loxahatchee River. The recovery strategy included continued partnership with the FDEP and other partners to establish a practical restoration goal and plan for the Loxahatchee River watershed and restore flows to the Northwest Fork of the river, which was completed in 2006 (SFWMD et al. 2006). The restoration plan includes the MFL recovery strategy of achieving a sustained flow of 65 cfs to the Northwest Fork approximately 94% of the time. The restoration plan was updated in 2011 (SFWMD et al. 2012) to provide information on the latest vegetation monitoring, soil salinity, and groundwater well monitoring studies conducted by staff from the SFWMD, FDEP, Florida Park Service, and Loxahatchee River District. Initial modeling that established restoration flow targets for the Northwest Fork was re-examined using new flow, salinity, and biological data and were found to be valid. The flow targets are being used in the most recent CERP effort.

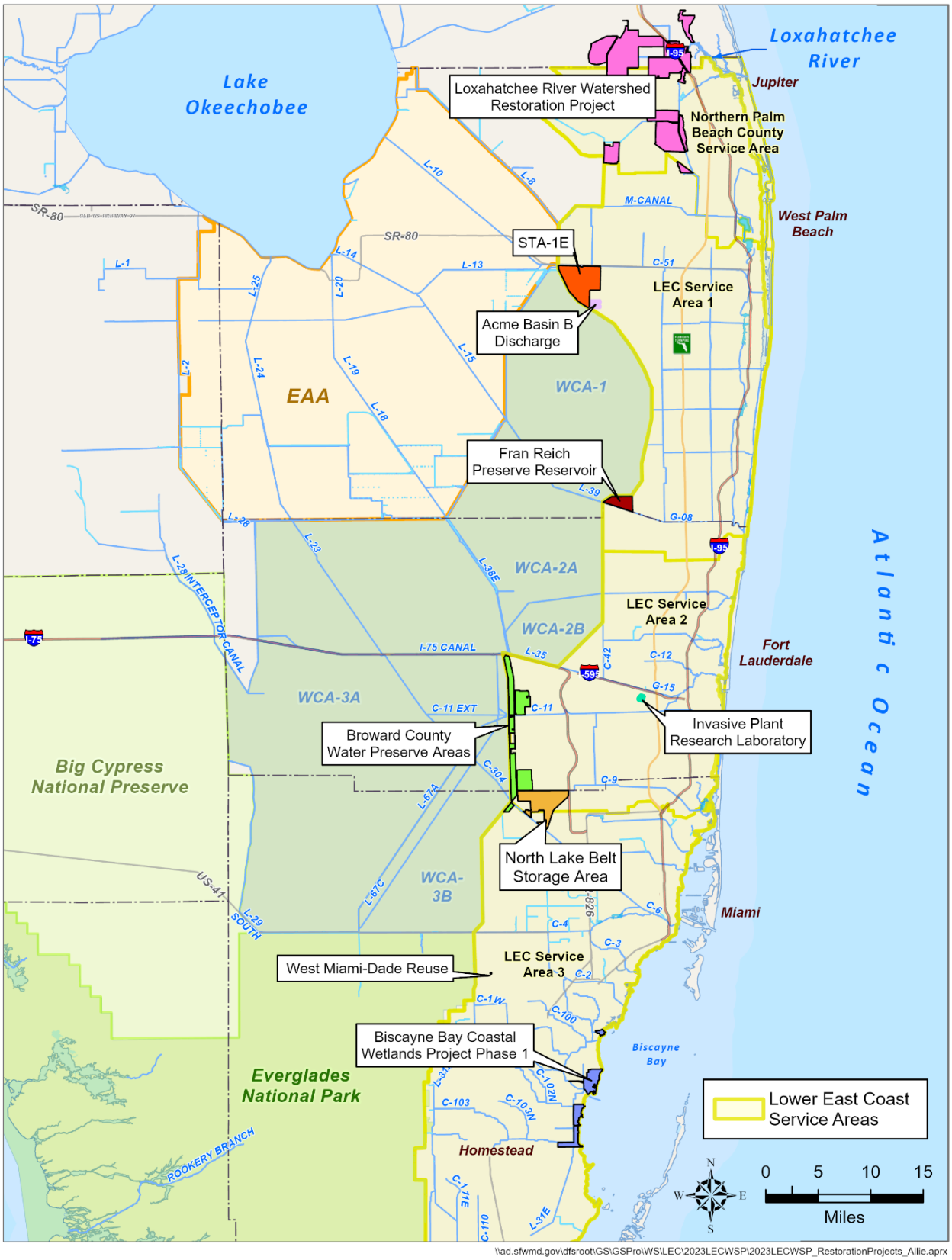

Figure 7-14. Water resource development projects in the LEC Service Areas.

The SFWMD acquired the following parcels of land for additional storage opportunities in support of the Northwest Fork of the Loxahatchee River restoration (**Figure 7-14**):

- Culpepper (1,282 acres)
- Cypress Creek (3,398 acres)
- Pal Mar East – Nine Gems (2,895 acres)
- Loxahatchee Slough (592 acres)
- Mecca Farms and associated easements (1,850 acres)

The following projects benefiting the Loxahatchee River have been constructed by the SFWMD or with SFWMD support:

- Installation of the G-160 (2004) and G-161 (2007) structures
- Widening of the M-Canal – initial section completed in 2007
- Nine Gems restoration – initial activities completed in 2010
- C-18 Project Culvert replacements – completed in 2011
- Culpepper hydrologic restoration – initial activities completed in 2011
- Lainhart and Masten dams refurbishments – completed in 2017
- Loxahatchee Slough Natural Area Hydrological Restoration Project – ongoing

The Lainhart and Masten dams, first built in the 1930s, regulate upstream flow stages in the Northwest Fork of the Loxahatchee River and maintain the hydrology of the riverine floodplain ecosystem. Without the dams, upstream water levels would be approximately 1.5 feet lower, draining the freshwater swamp and facilitating saltwater intrusion. Repairs were made to decayed areas of the dams where water was no longer being held back, and soil under and around the dams was stabilized to reduce seepage. Dam restoration work cost $2.5 million and was completed in 2017.

The Loxahatchee Slough encompasses almost 13,000 acres and, along with Hungryland Slough and Grassy Waters Preserve, forms the headwaters for the Loxahatchee River. Palm Beach County owns and manages the slough, with a small portion leased from the SFWMD. Extensive restoration activities have been conducted to restore areas impacted by overdrainage, agricultural uses, and invasion of non-native plant species.

CERP Loxahatchee River Watershed Restoration Project

The CERP Loxahatchee River Watershed Restoration Project (formerly known as the North Palm Beach County Project – Part 1) encompasses 481,000 acres between the C-44 and C-51 canals, from Lake Okeechobee to the Atlantic Coast. The project area includes extensive urban areas, limited agricultural areas, and large natural areas, such as J.W. Corbett Wildlife Management Area, DuPuis Reserve, Jonathan Dickinson State Park, Grassy Waters Preserve, and Loxahatchee Slough and River (**Figure 7-15**). The project objectives are as follows:

- Restore wet and dry season flows to the Northwest Fork of the Loxahatchee River.
- Restore or maintain estuarine communities (e.g., oysters, fish, seagrass).
- Increase natural areal extent of wetlands.
- Restore connections between natural areas.
- Restore native plant and animal species abundance and diversity.