a 10% participation rate is achievable, a review of conservation projects funded by the SFWMD's Cooperative Funding Program reveals local governments in the LEC Planning Area have reached fewer than 10% of the prospective participants. Assuming the same participation rate as previously implemented programs, the combined expected savings for PS and DSS would be around 18.55 mgd over the planning horizon.

Agriculture

AG is the second largest water use category in the LEC Planning Area, accounting for an estimated 645.20 mgd of the total demand in 2021, which is projected to decrease to 637.66 mgd in 2045.

As discussed in **Chapter 2** and **Appendix A**, the annual Florida Statewide Agricultural Irrigation Demand (FSAID) report published by FDACS (2022) includes 20-year estimates and projections of agricultural acreage and water demands. Estimated efficiency improvement (i.e., conservation estimate) is one of the parameters calculated by the FSAID model, and the spatially based data that contribute to the water demand estimates and projections are available by water management district planning area. The potential AG conservation savings within the LEC Planning Area were determined using the FSAID geodatabase (https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning). The methodology for calculating the potential AG conservation savings is more fully described in Appendix E of the FSAID IX report (FDACS 2022), but generally is based on estimated historical use determined from the United States Department of Agriculture's Irrigation and Water Management Survey and actual water savings data from MILs. The projected conservation savings are based primarily on irrigation system changes, changes in scheduling, and sensor-based automation.

The total savings calculated by the FSAID model for any given year depends on the crops produced, the acreage of each crop, and the irrigation systems employed, as projected to exist in that year. Because these variables change over the planning horizon (2021 to 2045), projected savings also change and may be nonlinear. The estimated conservation potential for the AG water use category in 2045 is 16.15 mgd (**Table 3-1**).

Landscape/Recreational

The L/R use category is the third largest water use category in the LEC Planning Area and includes irrigation of landscaped areas, such as parks, athletic fields, roadway medians, commercial spaces, large private residential properties, and golf courses. Because their projected demands are estimated in different ways, golf course potential water savings are discussed separately from other permitted landscape irrigation.

L/R irrigation is projected to use a total of 199.18 mgd in 2045. There are 8,190 active landscape irrigation water use permits in the LEC Planning Area, which were estimated to have used approximately 158 mgd in 2021 (SFWMD 2023). To estimate the potential water conservation savings for landscaped areas, the average water use per permit by county was

determined. Then the average water savings attributed to installing a smart controller (16% savings) was applied to 30% (participation rate) of the available permits by county. This yields an estimated conservation potential for landscape irrigation of 7.58 mgd over the planning horizon.

Golf Courses

There are 159 active water use permits for golf courses in the LEC Planning Area (101 in Palm Beach, 33 in Broward, 24 in Miami-Dade, and 1 in Monroe counties) for golf course irrigation. Indoor potable water use at golf courses is assumed to be provided by a PS utility. There are no active golf course permits in the portion of Hendry County within the LEC Planning Area boundary.

Irrigation demands for golf courses in the LEC Planning Area are projected to increase by 2% as acreage devoted to golf courses is projected to rise from 21,032 acres in 2021 to 21,347 acres in 2045. Most golf courses are irrigated with a high degree of efficiency. According to a 2019 statewide survey of Florida Golf Course Superintendents Association members, 55% of golf courses use advanced irrigation controllers (Irwin and Wanvestraut 2020). A conservation program would therefore aim to affect the golf courses not yet using advanced irrigation controllers.

To estimate the potential water conservation savings for golf courses, 45% of the active permits were assumed not to be using advanced irrigation controllers. Then the average water use per permit by county was determined. Applying the average water savings attributed to installing a smart controller (16% savings) to 30% (participation rate) of the available permits by county yielded an estimated conservation potential for golf courses of 1.70 mgd over the planning horizon. Those savings combined with the potential savings for landscape irrigation (7.58 mgd) is a total savings of 9.28 mgd for the L/R use category (**Table 3-1**).

Commercial/Industrial/Institutional

For CII permit holders, indoor potable water use is assumed to be provided by a PS utility. Therefore, conservation savings estimates were captured during the PS analysis by the measures targeting nonresidential users (i.e., high-efficiency restroom fixtures). CII permitted water use was not analyzed for conservation potential as those uses were assumed to be process-specific and, therefore, difficult to estimate within the scope of a regional analysis.

Power Generation

PG facilities use large quantities of water for cooling, but most of the water is returned to the source from which it was obtained. As a result, there are minimal efficiency gains to be had from the cooling process. Potential savings for PG were not estimated as part of this analysis. As with the CII use category, indoor potable water use at PG facilities is assumed to be

provided by a PS utility. Therefore, conservation savings estimates were captured during the PS analysis in the AWE Tool by the measures specifically targeting nonresidential users (i.e., high-efficiency restroom fixtures).

CONCLUSIONS

Table 3-1 summarizes potential water savings for the LEC Planning Area in all use categories using common water conservation measures. Greater conservation savings may be possible if additional measures are implemented or if increased participation rates are realized. Participation rates can be influenced by ineffective marketing and high implementation costs. The estimates presented in this report are conservative and not intended to represent the full conservation potential utilizing all measures available. Studies have found adoption of demand-side water conservation is highly variable (Rasoulkhani et al. 2018). A comprehensive list of conservation measures and applicable water use categories can be found in the 2021–2024 Support Document (SFWMD 2021).

Table 3-1. Potential water saved (in mgd) in the LEC Planning Area based on demand reduction estimates achievable by 2045.

Use Category	County					2045 Total by Sector
	Broward	Hendry[a]	Miami-Dade	Monroe	Palm Beach	
Public Supply[b]	12.20	0.04	16.93	1.67	8.03	**38.88**
Agriculture	0.27	1.96	9.43	0.00	4.49	**16.15**
Landscape/Recreational[c]	1.76	0.00	0.80	0.01	3.82	**6.39**
Domestic Self-Supply[b]	0.07	0.20	0.13	0.00	0.32	**0.71**
Total	**14.30**	**2.20**	**27.29**	**1.68**	**16.66**	**62.13**

LEC = Lower East Coast; mgd = million gallons per day.

[a] Values listed for Hendry County are only for the areas within the LEC Planning Area boundaries.

[b] Includes passive savings.

[c] Includes golf and landscape/recreational savings.

The largest projected savings were identified for the PS (utilities) sector. Utilities should develop, fund, and implement comprehensive water conservation plans, particularly in areas where water demands are projected to exceed the available supply of traditional sources of water. Reducing demands through water conservation is almost always less expensive than developing new alternative water supply sources and associated treatment facilities. Utilities should consider the use of conservation planning tools, develop a robust public outreach and education component, and target high water users with water conservation messaging and measures. Lastly, utilities should take advantage of funding opportunities like the District's Cooperative Funding Program to assist individual users to make the necessary investments in conservation. Agricultural and landscape users should perform water use audits to identify leaks, poor design, and inefficient irrigation equipment and methods. Domestic users should identify opportunities, both outdoors and indoors, to replace inefficient, outdated hardware with more efficient WaterSense labeled equipment. All landscape irrigation should be conducted while following watering restrictions for both times and days. Finally, District staff are available to assist conservation program developers with technical support, collaborative program implementation, ordinance review, and long-term demand management planning.

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4

Water Resource Protection

This chapter provides an overview of protections afforded to water resources in the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District) through statutory and regulatory criteria. The ability to meet the water demands described in **Chapter 2** largely depends on the future availability of water resources. Understanding the relationship between projected water demands, water sources, and limitations imposed on withdrawals is critical to water supply planning.

TOPICS

- Regulatory Protection of Water Resources
- Summary of Water Resource Protection

Past analyses indicated that fresh water from the surficial aquifer system and from surface water in Lake Okeechobee and hydraulically connected canals was insufficient to meet the growing needs of the LEC Planning Area during 1-in-10-year drought conditions. Increased use of these water bodies as water sources is limited in much of the region due to potential impacts on wetlands, the saltwater interface, and other existing uses. Previous water supply plans identified a variety of alternative water supply development projects to minimize water resource impacts, avoid competition between water users, and provide a sustainable supply of water through the targeted planning horizon (SFWMD 2000a, 2006, 2013, 2018). Implementation of these projects is ongoing and includes increased water conservation, use of reclaimed water, surface water storage and management, and use of brackish water as a treated water supply. Active water supply development projects are discussed in **Chapter 8**.

NOTE

The MFL and prevention strategy for Lower West Coast aquifers affect a portion of the LEC Planning Area but are included in the Lower West Coast water supply plan updates.

To further protect water resources in the LEC Planning Area, minimum flows and minimum water levels (MFLs) were adopted for Lake Okeechobee, the Everglades, the Northwest Fork of the Loxahatchee River, Florida Bay, the Biscayne aquifer, and the Lower West Coast aquifers. A water reservation for the protection of fish and wildlife was adopted for Nearshore Central Biscayne Bay in 2013, and in 2021, a water reservation was adopted for the Everglades Agricultural Area (EAA) Reservoir. Restricted allocation areas (RAAs) were established for the L-1, L-2, and L-3 canal system in 1981; the North Palm Beach County/Loxahatchee River Watershed Waterbodies and LEC Everglades Waterbodies in 2007 (amended in 2022); the Lake Okeechobee Service Area (LOSA) in 2008; and the water stored via aquifer storage and recovery (ASR) wells at the C-18W Reservoir site in 2022.

REGULATORY PROTECTION OF WATER RESOURCES

Water Use Permitting

Unless exempt by statute or identified in the Water Rights Compact of 1987, the right to use water is authorized by permit, which allows for the use of water for reasonable-beneficial uses while protecting natural systems from harm. Water use permit applicants must provide assurances that the proposed water use 1) is reasonable-beneficial, 2) will not interfere with any existing legal use of water, and 3) is consistent with the public interest as required by Section 373.223(1), Florida Statutes (F.S.). The proposed water use must comply with the water resource protection criteria (see Rule 40E-2.301, Florida Administrative Code [F.A.C.], and the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* [Applicant's Handbook; SFWMD 2022]), including 1) implementation criteria for regulatory components of an adopted MFL prevention or recovery strategy, 2) implementation criteria for water reservations, and 3) RAA criteria. The LOSA RAA criteria adopted by the District in Section 3.2.1F 1-5 of the Applicant's Handbook (SFWMD 2022) for the Lake Okeechobee Service Area and the water shortage restrictions as described in Chapter 40E-21 F.A.C. comprise the regulatory component of the Lake Okeechobee MFL recovery strategy. Applications that meet the criteria contained in Section 3.2.1F 1-5 of the Applicant's Handbook satisfy the minimum flow and level implementation strategy. Additional information about water use permitting can be found in the *2021–2024 Support Document for the Water Supply Plan Updates* (2021-2024 Support Document; SFWMD 2021).

INFO

The Seminole Tribe of Florida has a surface water entitlement pursuant to the 1987 Water Rights Compact among the Seminole Tribe of Florida, the State of Florida, and the SFWMD (Public Law 100-228, 101 Statute 1556, and Chapter 87-292, Laws of Florida, as codified in Section 285.165, F.S.). The Miccosukee Tribe was established as a sovereign nation in 1962.

Minimum Flows and Minimum Water Levels

MFL criteria are the minimum flows or minimum water levels at which water resources, or the ecology of the area, would experience significant harm from further withdrawals. MFL criteria are applied individually to affected water bodies and define the minimum flow or minimum water level for surface water bodies, or minimum water level for groundwater in aquifers. Adopted MFLs in the SFWMD are contained in Chapter 40E-8, F.A.C. The SFWMD adopts a prevention or recovery strategy when an MFL is initially adopted (Rule 40E-8.421, F.A.C.) and, if needed, when an MFL is reevaluated or revised. The SFWMD fulfills its statutory obligation to identify key water bodies for which MFLs should be developed or reevaluated by providing a Priority Water Body List and Schedule in Chapter 3 of the annual updates to the *South Florida Environmental Report – Volume II* per Section 373.042(3), F.S. More information about MFLs, including prevention and recovery strategies, is provided in the 2021–2024 Support Document (SFWMD 2021). Additional information about MFLs can be found on the SFWMD webpage (http://www.sfwmd.gov/mfls) and in Chapter 40E-8, F.A.C.

Within the LEC Planning Area, MFLs and prevention and recovery strategies have been adopted for Lake Okeechobee, the Everglades, the Northwest Fork of the Loxahatchee River,

Florida Bay, and the Biscayne aquifer (**Figure 4-1**). Recovery strategies have been adopted for Lake Okeechobee, the Everglades, and the Northwest Fork of the Loxahatchee River, and prevention strategies have been adopted for Florida Bay and the Biscayne aquifer. Brief summaries of the MFLs are provided here; additional information, including prevention and recovery strategies, can be found in **Appendix C**.

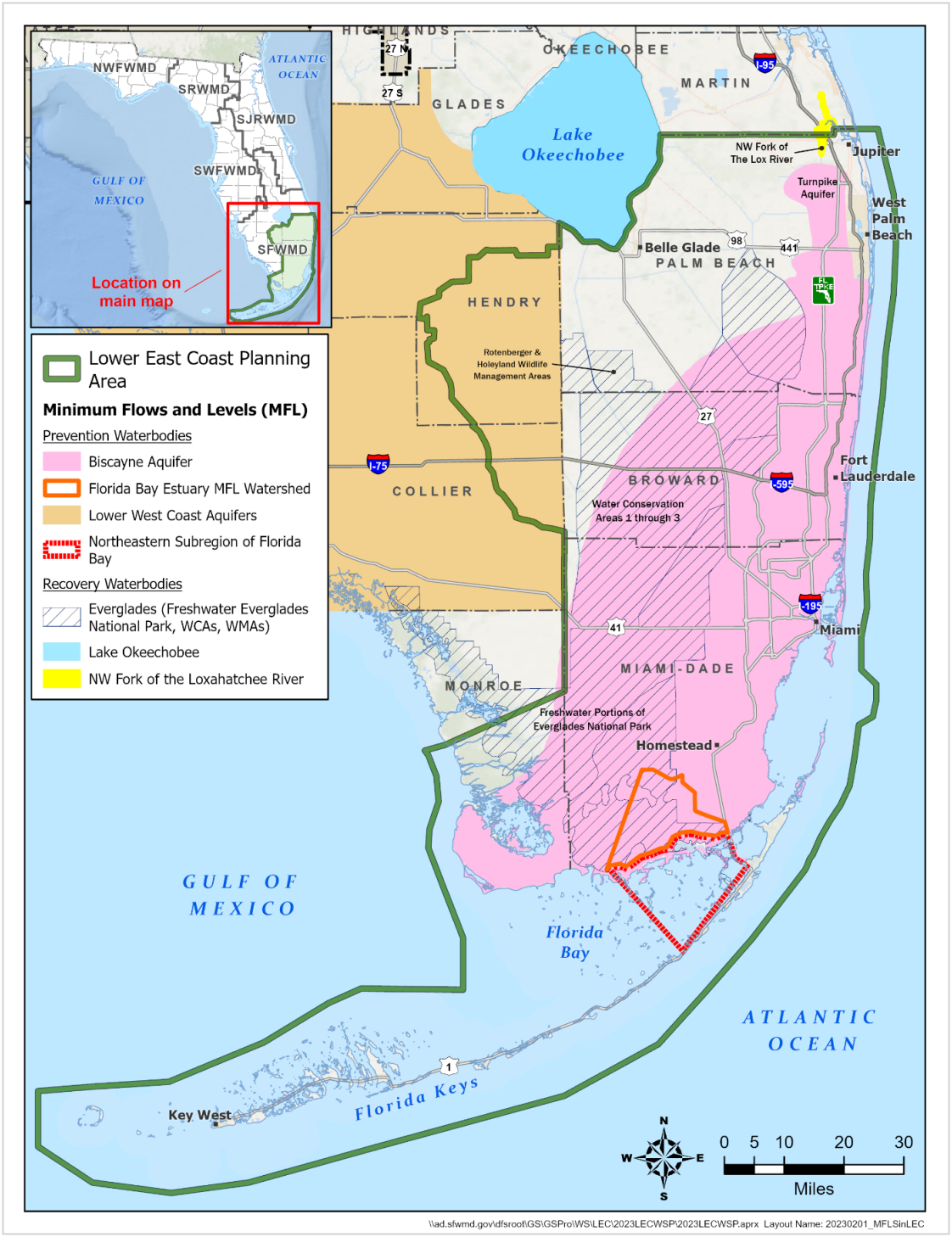

Figure 4-1. Adopted minimum flows and minimum water levels in the LEC Planning Area.

Lake Okeechobee

The SFWMD adopted an MFL of 11 feet National Geodetic Vertical Datum of 1929 (NGVD29) for Lake Okeechobee in 2001 pursuant to Subsection 40E-8.221(1), F.A.C. A prevention strategy was adopted for the lake simultaneously with MFL adoption, but it was changed in 2008 to a recovery strategy in Subsection 40E-8.421(2), F.A.C., while maintaining the MFL at 11 feet NGVD29. This change was made in anticipation of lowered lake levels and resulting MFL violations from implementation of the Lake Okeechobee Regulation Schedule 2008 (LORS08) by the United States Army Corps of Engineers (USACE). Additional water can be stored in Lake Okeechobee resulting from the completion of the dike repairs and the revised regulation schedule, known as the Lake Okeechobee System Operating Manual (LOSOM). Capital projects will also be implemented to provide additional storage in the basin. Additional details about the MFL and updated recovery strategy are provided in **Appendix C**.

Everglades

To protect water supplies for the Everglades, the SFWMD adopted an MFL for the region in 2001 as set forth in Subsection 40E-8.221(3), F.A.C. The Everglades MFL covers the lands and waters of the water conservation areas (WCAs), Holey Land and Rotenberger wildlife management areas, and freshwater portions of Everglades National Park as provided by Subsection 40E-8.021(7), F.A.C. The MFL criteria for the Everglades are a set of minimum water levels and return frequencies for peat- and marl-forming wetlands. A recovery strategy was adopted simultaneously with MFL adoption under Subsection 40E-8.421(2), F.A.C. Additional details about the MFL and recovery strategy are provided in **Appendix C**.

Northwest Fork of the Loxahatchee River

The SFWMD adopted an MFL for the Northwest Fork of the Loxahatchee River in 2003 as set forth in Subsection 40E-8.221(4), F.A.C. The MFL criteria are a minimum flow of 35 cubic feet per second over Lainhart Dam and an average daily salinity of less than 2 at river mile 9.2. Because the Northwest Fork was not meeting the MFL at the time of adoption, a recovery strategy as described in Subsection 40E-8.421(6), F.A.C., was adopted simultaneously with MFL adoption. Additional details about the MFL and recovery strategy are provided in **Appendix C**.

Lainhart Dam

Florida Bay

To protect the salinity regimes needed for flora and fauna in Florida Bay, the SFWMD adopted an MFL for the bay in 2006 as required by Subsection 40E-8.221(5), F.A.C. The MFL is a flow criterion with a salinity performance indicator. It includes a net minimum flow into Florida Bay over a 365-day period of 105,000 acre-feet, which was found through analyses to be needed to maintain a salinity of no greater than 30 at the Taylor River salinity monitoring station. A prevention strategy under Subsection 40E-8.421(8), F.A.C., was adopted simultaneously with MFL adoption. The MFL was reevaluated in 2014 based on several years

of additional research. Results of the 2014 reevaluation indicated the existing MFL criterion was an adequate threshold of significant harm to Florida Bay. Additional details about the MFL and prevention strategy are provided in **Appendix C**.

Biscayne Aquifer

The SFWMD adopted an MFL for the Biscayne aquifer in 2001 in accordance with Rule 40E-8.231, F.A.C., based on analyses of the relationships between groundwater and regional canal water levels and the potential for saltwater intrusion (SFWMD 2000b). The MFL criterion is the water level in the aquifer that results in movement of the saltwater interface landward to the extent that groundwater quality at an established withdrawal point is insufficient to serve as a water supply source. Maintaining sufficient water levels (stages) in coastal canals is crucial for recharging the aquifer and maintaining the necessary water level in the aquifer to meet the MFL. A prevention strategy under Rule 40E-8.421, F.A.C., was adopted simultaneously with the MFL adoption. Additional details about the MFL and prevention strategy are provided in **Appendix C**.

Water Reservations

Section 373.709, F.S., requires regional water supply plans to include reservations of water for the planning area, which are defined and adopted by rule. A water reservation sets aside a volume of water for the protection of fish and wildlife or public health and safety. Water reservations can be developed based on existing water availability or in consideration of future water supplies made available by water resource development projects. Reserved volumes of water are unavailable for allocation to consumptive uses (Section 373.223, F.S.). Additionally, water reservations may be components of MFL prevention or recovery strategies or be adopted to protect water for Comprehensive Everglades Restoration Plan (CERP) projects prior to their construction. More information about water reservations is provided in the 2021–2024 Support Document (SFWMD 2021).

Nearshore Central Biscayne Bay

The SFWMD adopted a water reservation for Nearshore Central Biscayne Bay in 2013 under Subsections 40E-10.061(1) and (2), F.A.C., (**Figure 4-2**) to protect the water needed for the CERP Biscayne Bay Coastal Wetlands Project – Phase 1. Nearshore Central Biscayne Bay is defined in Subsection 40E-10.021(4), F.A.C., as the area within Biscayne Bay up to 1,640 feet (500 meters) of the shoreline, beginning south of Shoal Point and extending southward to north of Turkey Point. The water reservation reserves from allocation all surface water contained within and flowing into Nearshore Central Biscayne Bay (**Figure 4-3**). Supporting documentation is available on the SFWMD webpage http://www.sfwmd.gov/reservations.

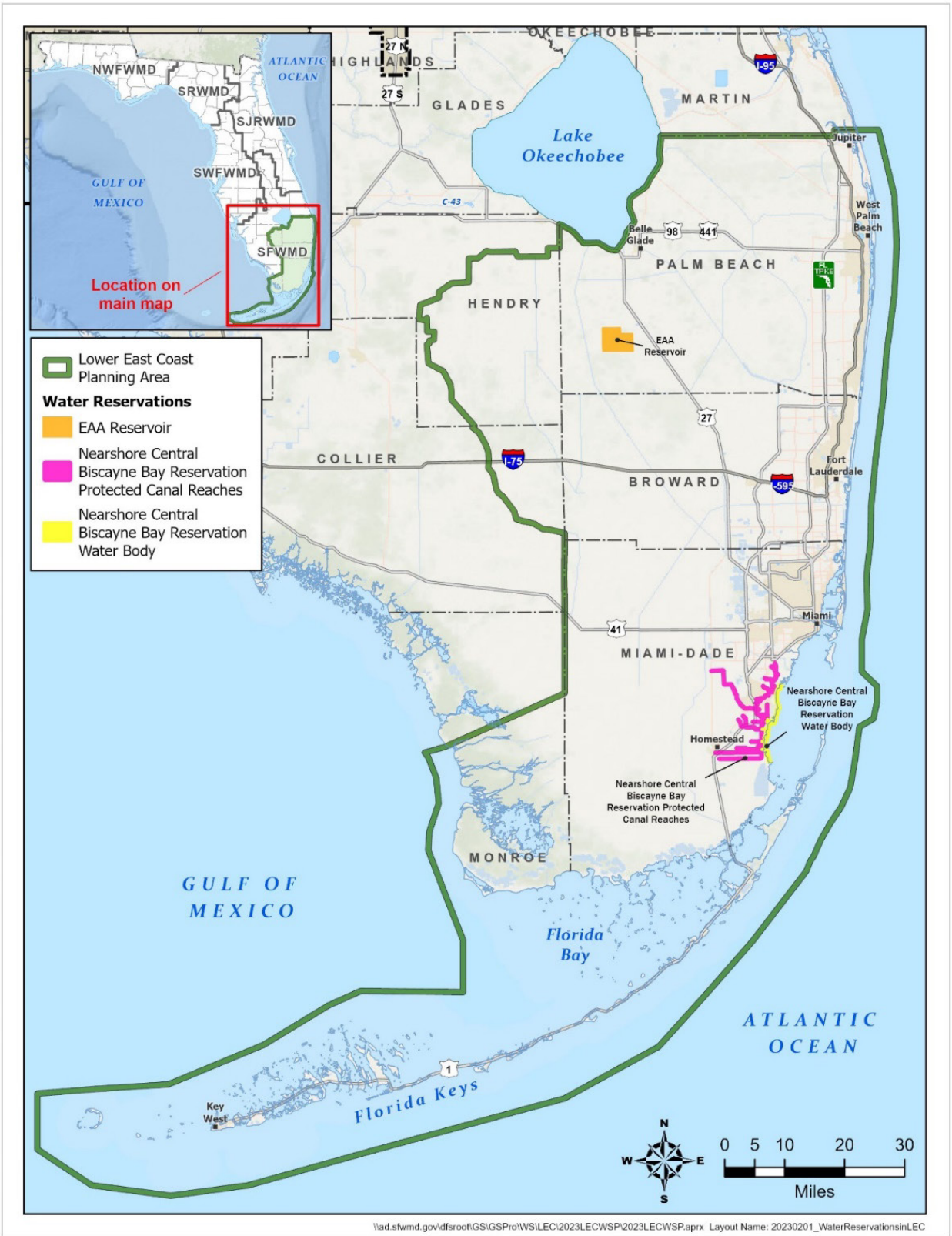

Figure 4-2. Adopted water reservations in the LEC Planning Area.

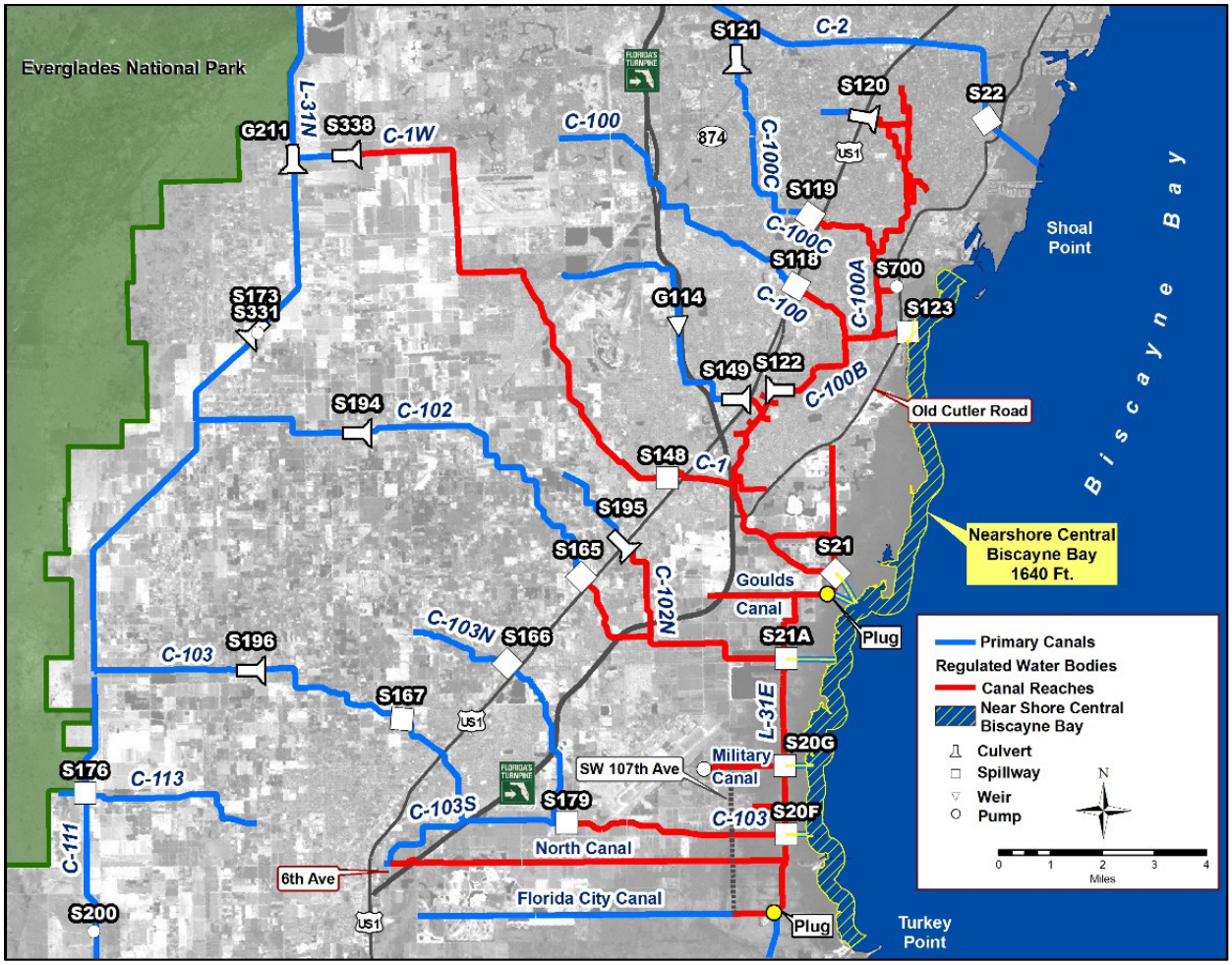

Figure 4-3. Nearshore Central Biscayne Bay reservation water body (includes yellow crosshatching along the coast and red canal reaches extending west).

EAA Reservoir

The SFWMD adopted a water reservation for the EAA Reservoir in 2021 as set forth in Subsection 40E-10.061(3), F.A.C., for all surface water released through structures S-624, S-625, and S-626 to the LEC Everglades Waterbodies. Water released through structure S-628 is not reserved from allocation (**Figure 4-4**). The EAA Reservoir is defined in Subsection 40E-10.021(7), F.A.C., as a reservoir located in Palm Beach County, Florida, south of the City of South Bay between the Miami and North New River canals. Construction began in 2023, and the USACE anticipates completion of construction in 2030. Additional details of the project description are included in **Chapter 5**.

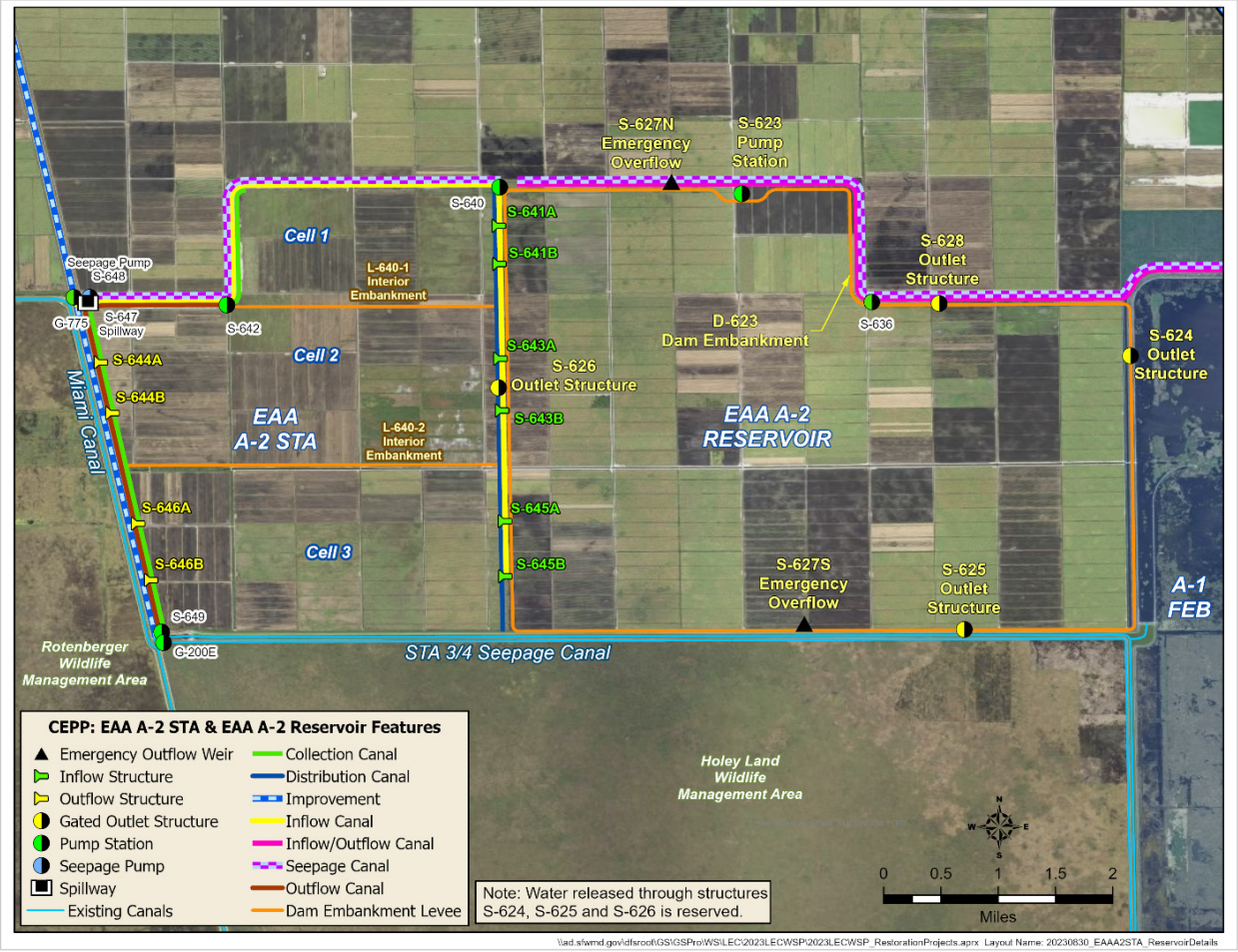

Figure 4-4. Location of the EAA Reservoir and associated structures.

Restricted Allocation Areas

RAAs are defined geographic areas where water allocations from water resources (e.g., lakes, rivers, wetlands, canals, aquifers) are limited. Additional allocations beyond the established limitation are restricted or prohibited. RAAs are established for a variety of reasons, including 1) where there is a lack of available water to meet the projected needs of a region, 2) to protect water for natural systems and future restoration projects (e.g., CERP), or 3) as part of MFL prevention or recovery strategies. RAA criteria are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2022), which is incorporated by reference in Rule 40E-2.091, F.A.C. **Figure 4-5** shows the locations of established RAAs wholly or partially within the LEC Planning Area.

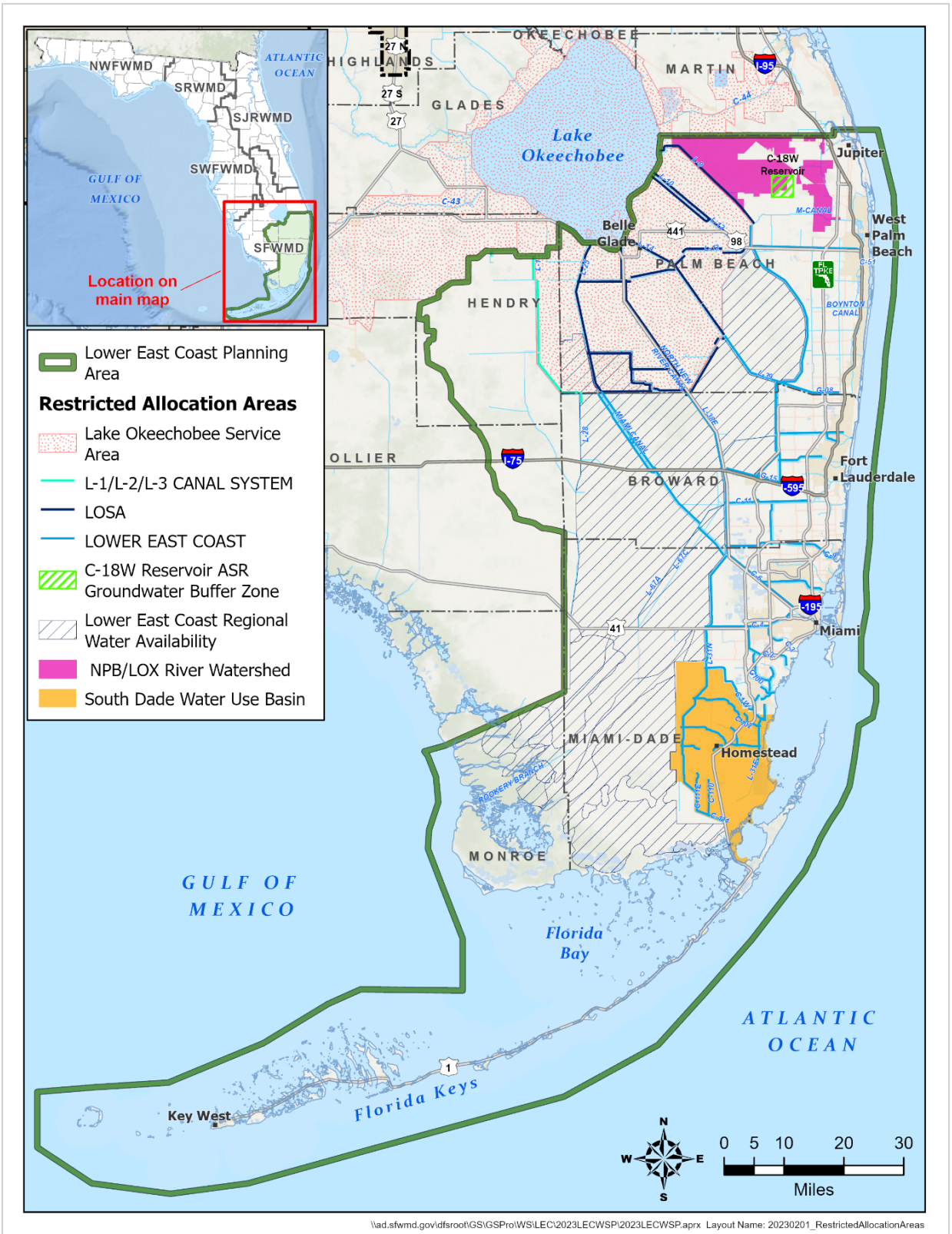

Figure 4-5. Adopted restricted allocation areas in the LEC Planning Area.

L-1, L-2, and L-3 Canal System

In 1981, an RAA was established for the L-1, L-2, and L-3 canal system (Section 3.2.1.C of the Applicant's Handbook [SFWMD 2022]), which lies along the western boundary of LOSA. This canal system is a limited surface water network that is not connected to Lake Okeechobee. The RAA prohibits increases in surface water pump capacity and additional surface water allocations from the L-1, L-2, and L-3 canals above existing allocations.

North Palm Beach County/Loxahatchee River Watershed Waterbodies

In 2007, the SFWMD established an RAA for the North Palm Beach County/Loxahatchee River Watershed Waterbodies (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2022]). The RAA originally included surface water and shallow groundwater in the City of West Palm Beach's Water Catchment Area and Grassy Waters Preserve, Pal-Mar, J.W. Corbett Wildlife Management Area, Loxahatchee Slough, Loxahatchee River, Riverbend Park, Dupuis Reserve, Jonathan Dickinson State Park, Kitching Creek, Moonshine Creek, Cypress Creek, and Hobe Grove Ditch. In 2022, the RAA was amended to include additional lands in the Hungryland Slough, Cypress Creek, Pine Glades, and Sweetbay natural areas as well as the land for the C-18W Reservoir. These additional lands are within the CERP Loxahatchee River Watershed Restoration Project footprint. The RAA also includes the integrated conveyance systems that are hydraulically connected to and receive water from the North Palm Beach County/Loxahatchee River Watershed Waterbodies, such as Central and Southern Florida Project (C&SF Project) primary canals and the secondary and tertiary canals that derive water from the primary canals.

Net increases in the volume or changes in timing on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA are prohibited over that resulting from base condition uses permitted as of April 1, 2006 or April 1, 2022, whichever is applicable. Allocations over the base condition water use are only allowed through sources detailed in Section 3.2.1.E.5 of the Applicant's Handbook (SFWMD 2022), such as certified project water; implementation of offsets; alternative water supply; terminated or reduced base condition water use that existed as of April 1, 2006 or April 1, 2022, whichever is applicable; or available wet season water. The RAA is part of the MFL recovery strategy for the Northwest Fork of the Loxahatchee River.

Lower East Coast Everglades Waterbodies

In 2007, an RAA was established for the Lower East Coast Everglades Waterbodies (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2022]). The RAA covers more than 1.5 million acres and includes WCAs 1, 2A, 2B, 3A, and 3B; the Holey Land and Rotenberger wildlife management areas; and the freshwater portions of Everglades National Park. The RAA also includes the integrated conveyance systems that are hydraulically connected to and receive water from the Lower East Coast Everglades Waterbodies, such as C&SF Project primary canals and the secondary and tertiary canals that derive water from the primary canals. Net increases in the volume or changes in timing on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA are prohibited over that resulting from base condition uses permitted as of April 1, 2006. Allocations over the base condition water use are only allowed through sources detailed in Subsection 3.2.1.E.5 of the RAA, such as certified project water, implementation of offsets, alternative water supply, terminated or

reduced base condition water use that existed as of April 1, 2006, or available wet season water. The Lower East Coast Everglades Waterbodies RAA is part of the MFL recovery strategy for the Everglades.

Lake Okeechobee Service Area

In 2008, the SFWMD adopted RAA criteria for LOSA, which spans more than 1.8 million acres (Section 3.2.1.F of the Applicant's Handbook [SFWMD 2022]). The criteria limit surface water withdrawals from Lake Okeechobee and all surface water hydraulically connected to the lake, such as the C-43 Canal, the C-44 Canal, and secondary canal systems that receive Lake Okeechobee water for water supply purposes via gravity flow or pump. Net increases in the volume of surface water withdrawn from the RAA waterbodies are prohibited over that resulting from base condition water uses occurring from April 1, 2001 to January 1, 2008. Allocations over the base condition water use are only allowed through sources detailed in Section 3.2.1.F.3.c of the Applicant's Handbook (SFWMD 2022), such as certified project water, implementation of offsets, alternative water supply, available and unassigned base condition water use, or base condition water use that was terminated or reduced after January 1, 2008. The RAA has been and will continue to be part of the MFL recovery strategy for Lake Okeechobee.

ASR Storage Horizon Near the C-18W Reservoir

The SFWMD established an RAA in 2022 for the underground storage horizon of the ASR wells associated with the CERP Loxahatchee River Watershed Restoration Project (Section 3.2.1.G of the Applicant's Handbook [SFWMD 2022]). The ASR component of the project will store excess surface water in the Upper Floridan aquifer (UFA) or Avon Park permeable zone (APPZ) via four ASR wells adjacent to the C-18W Reservoir. Based on information from previous ASR investigations and modeling performed for the project, a 1-mile buffer from the boundaries of the C-18W Reservoir parcel was determined as the extent necessary to protect the project water stored via ASR. The RAA prohibits withdrawals from the same storage horizon, UFA or APPZ, as the C-18W Reservoir ASR wells that adversely impact the applicable groundwater buffer zone (**Figure 4-6**). Supporting documentation for the development of this RAA is available on the SFWMD webpage http://www.sfwmd.gov/raas.

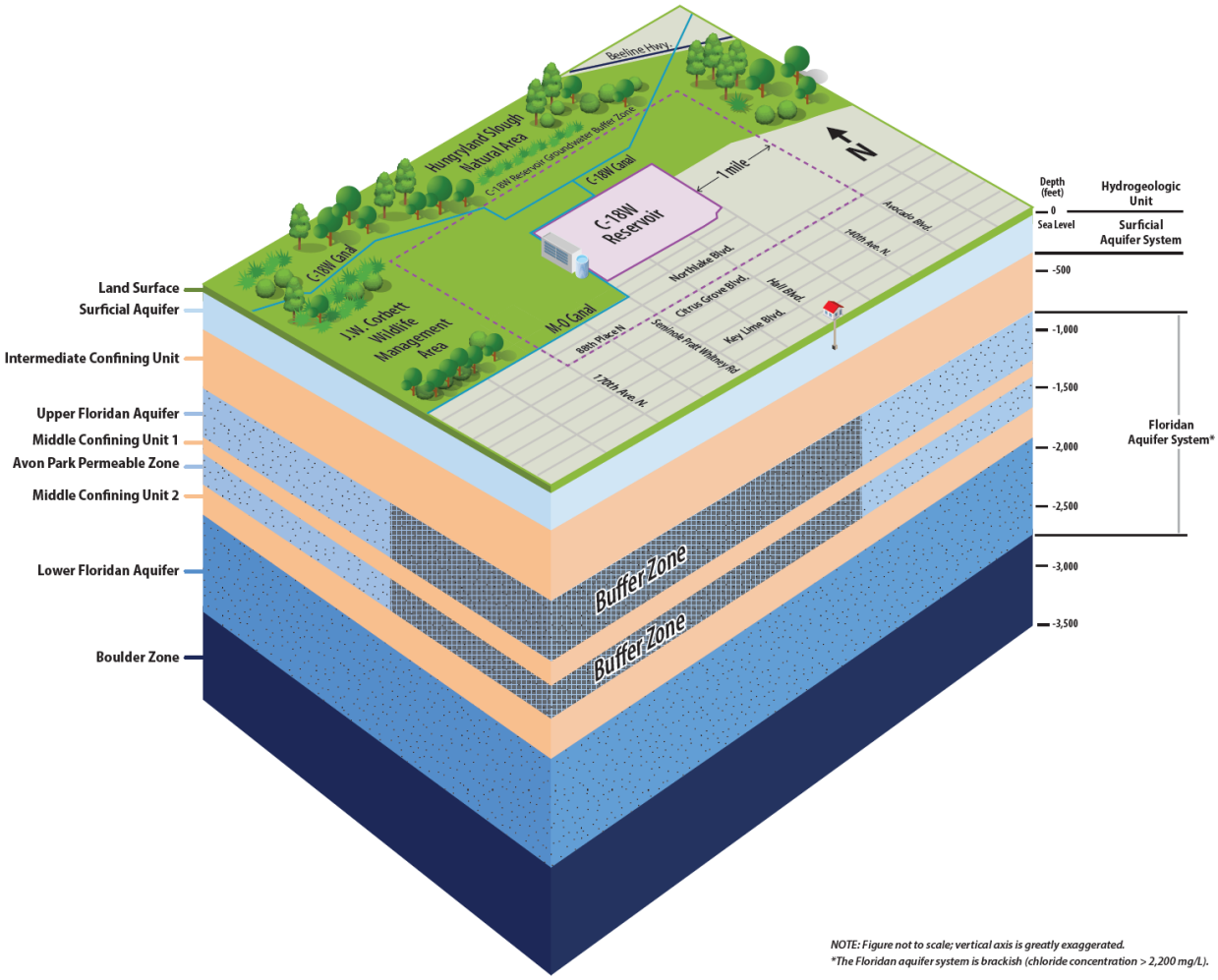

Figure 4-6. Protected areas in the Upper Floridan aquifer and Avon Park permeable zone related to the aquifer storage and recovery wells at the C-18W Reservoir.

SUMMARY OF WATER RESOURCE PROTECTION

- The LEC Planning Area has the following resource protections in place:
  - Water use permitting criteria
  - MFLs for Lake Okeechobee, the Everglades, the Northwest Fork of the Loxahatchee River, Florida Bay, the Biscayne aquifer, and the Lower West Coast aquifers
  - Water reservations for the Nearshore Central Biscayne Bay and EAA Reservoir
  - RAAs for the L-1, L-2, and L-3 canal system; the North Palm Beach County/Loxahatchee River Watershed Waterbodies and Lower East Coast Everglades Waterbodies; LOSA; and the ASR storage horizon near the C-18W Reservoir.
- A new RAA was established in 2022 for the same storage horizon, UFA or APPZ, as the ASR wells at the C-18W Reservoir site to protect this groundwater component of the CERP Loxahatchee River Watershed Restoration Project.
- The North Palm Beach County/Loxahatchee River Watershed Waterbodies RAA was amended in 2022 to fully protect the surface water components of the CERP Loxahatchee River Watershed Restoration Project.
- Further information on water shortage management and water use permitting is available in the 2021–2024 Support Document (SFWMD 2021).

NAVIGATE

Detailed information about MFLs is available on the SFWMD webpage http://www.sfwmd.gov/mfls.

Detailed information about water reservations is available on the SFWMD webpage http://www.sfwmd.gov/reservations.

Detailed information about RAAs is available in the Applicant's Handbook (SFWMD 2022), which can be accessed through the SFWMD webpage http://www.sfwmd.gov/raas.

MFL, water reservation, and RAA status updates are provided annually in Chapter 3 of the *South Florida Environmental Report – Volume II*, available at http://www.sfwmd.gov/sfer.

Further information can be found in the 2021–2024 Support Document (SFWMD 2021) and **Appendix C**.

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5

Water Source Options

TOPICS

- Surface Water
- Groundwater
- Reclaimed Water
- Water Storage
- Seawater
- Summary of Water Supply Source Options

This chapter of the *2023–2024 Lower East Coast Water Supply Plan Update* (2023–2024 LEC Plan Update) presents water supply source options that could be available through 2045 to accommodate urban and agricultural demands in the LEC Planning Area while sustaining the natural systems. Descriptions of these sources, current and projected uses, and factors that affect availability for water supply purposes are provided. **Chapter 6** presents the South Florida Water Management District's (SFWMD or District) analyses of the surface water and groundwater conditions in the region. Information about water treatment technologies and their related costs is provided in the *2021–2024 Support Document for Water Supply Plan Updates* (2021–2024 Support Document; SFWMD 2021) and the recently updated *Water Supply Cost Estimation Study* (Kimley Horn 2023).

In the LEC Planning Area, fresh groundwater from the surficial aquifer system (SAS) and surface water from canals and lakes are considered traditional water sources. Alternative water supply (AWS) or nontraditional water source options include brackish groundwater from the Floridan aquifer system (FAS), reclaimed water, water stored in aquifer storage and recovery (ASR) wells or in aboveground reservoirs, and seawater.

To meet water supply needs, water users primarily rely on fresh groundwater and surface water (**Figures 5-1** and **5-2**). However, withdrawals from these sources have approached sustainable limits because of aquifer productivity, environmental concerns, resource protection criteria, and regulatory limitations (**Chapter 4**). As a result, over the last two decades, brackish groundwater from the FAS and reclaimed water have become vital to urbanized areas to meet increased demands. AWS source use is an integral part of current and future water supply strategies. Fresh groundwater and surface water combined currently supply 94% of Public Supply (PS) and 99% of Agriculture (AG) needs in the LEC Planning Area (**Figure 5-2**).

Of the 54 PS utilities in the LEC Planning Area, 51 utilities use fresh groundwater from the SAS to supply the majority of the potable water demand, 24 utilities use or plan to use brackish groundwater for a portion of or all their needs, and two utilities have standby FAS wells. Agricultural operations in the Everglades Agricultural Area (EAA) rely on surface water, while growers in eastern Palm Beach and Miami-Dade counties and in the LEC Planning Area portion of Hendry County use a combination of fresh groundwater and surface water. Existing allocations and infrastructure can meet a substantial portion of the 2045

water needs for PS and AG. However, most of the increased demands for PS will be met with proposed AWS projects using brackish groundwater and surface water offsets. New withdrawals from traditional groundwater sources that induce seepage from regional surface water sources are limited by restricted allocation area (RAA) permitting criteria (**Chapter 4**).

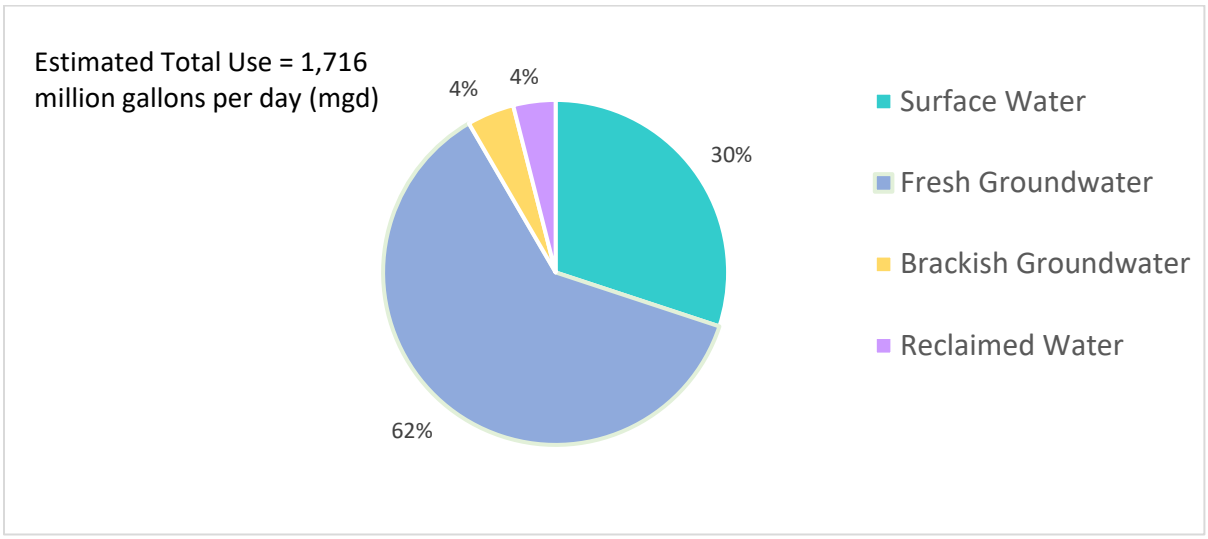

Figure 5-1. Water use percentage of the estimated total use of 1,716 mgd in the LEC Planning Area in 2021 by source (Data from SFWMD 2023).

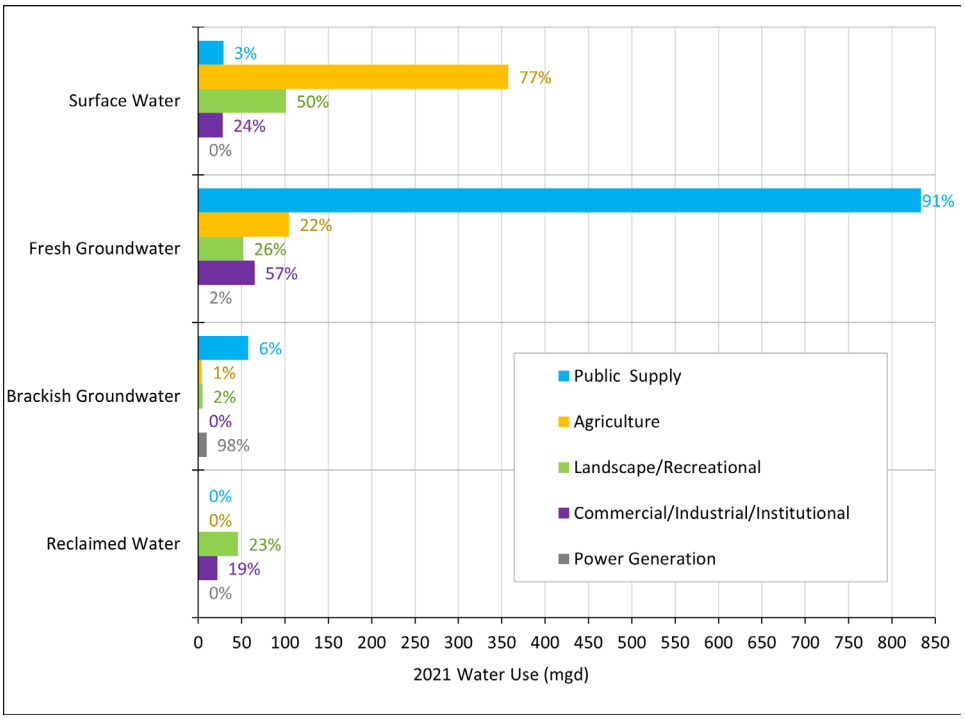

Figure 5-2. Water use in the LEC Planning Area in 2021 (Data from SFWMD 2023) by source and use type. (Notes: Fresh groundwater supplies 100% of Domestic Self-Supply demand. Percentages may not equal 100% due to rounding.)

SURFACE WATER

Surface water sources, primarily used for urban and agricultural irrigation, include rivers, canals, lakes, and reservoirs. Although the LEC Planning Area has multiple surface water sources, most are limited by regulatory protections (**Chapter 4**). Primary surface water sources are Lake Okeechobee and its connected canals, water conservation areas (WCAs), and diversion and impoundment systems. Local canals, lakes, and reservoirs also provide a considerable amount of surface water supply in the LEC Planning Area.

As discussed in **Chapter 4**, the SFWMD adopted RAA criteria in 2008 for the Lake Okeechobee Service Area as part of the minimum flow and minimum water level (MFL) recovery strategy for Lake Okeechobee. The criteria limit allocations from Lake Okeechobee and integrated conveyance systems that are hydraulically connected to and receive water from the lake, including the C-43 and C-44 canals, to base condition water uses that occurred from April 1, 2001 to January 1, 2008 (Section 3.2.1.F of the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* [Applicant's Handbook; SFWMD 2022]). Following adoption of the RAA, all irrigation users in the Lake Okeechobee Service Area were required to renew their water use permits. The unique water management activities within the EAA result in more efficient use of water (75% efficiency) compared to other agricultural areas using similar seepage irrigation systems (50% efficiency) and result in lower water needs for the basin. By changing the efficiency applied to water use permit renewals in the EAA, there was a 33% decrease in the renewal allocation for the basin.

In 2007, the SFWMD adopted the LEC Regional Water Availability criteria to prohibit increases in surface water and groundwater withdrawn from the North Palm Beach County/Loxahatchee River Watershed Waterbodies and Lower East Coast Everglades Waterbodies above base condition water uses permitted as of April 1, 2006 (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2022]). This also includes canals that are connected to and receive water from these water bodies. New direct surface water withdrawals are prohibited from the Everglades and Loxahatchee River watersheds and from the integrated conveyance systems. These criteria are components of the MFL recovery strategies for the Everglades and the Northwest Fork of the Loxahatchee River (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2022]).

An RAA was adopted for the L-1, L-2, and L-3 canals in eastern Hendry County in 1981. The limited network of surface water drainage canals within this area does not receive water from Lake Okeechobee. The RAA prohibits allocation of additional surface water from the L-1, L-2, and L-3 canals beyond existing allocations, and it also prohibits increases in surface water pump capacity (Section 3.2.1.C of the Applicant's Handbook [SFWMD 2022]). More information about MFLs, associated prevention and recovery strategies, and RAAs is provided in **Chapter 4**, **Appendix C**, and the Applicant's Handbook (SFWMD 2022]).

Lake Okeechobee and Water Conservation Areas

Lake Okeechobee, its connected conveyance system, and the WCAs are the most important surface water sources for the LEC Planning Area. These sources supply surface water to the regional system via canals and recharge the SAS, which prevents saltwater intrusion along the coast. Lake Okeechobee serves multiple purposes, including flood control during the wet

season and water supply during the dry season. AG is the predominant user of surface water from Lake Okeechobee, which serves as a supplemental water supply source when rainfall is insufficient to meet demands. At lower lake levels, the SFWMD can use supplemental pumps to meet water supply needs in the EAA and the Seminole Tribe of Florida Big Cypress and Brighton reservations. Water from the lake is used as a backup source for urban users in the LEC Service Areas during dry times primarily to recharge PS wellfields and, depending on availability, may provide pass-through water to the WCAs in accordance with their regulation schedules. The Lake Okeechobee Regulation Schedule 2008 (LORS08) resulted in an average reduction of approximately 430,000 acre-feet of water storage in the lake.

In 2019, the United States Army Corps of Engineers (USACE) initiated development of the new Lake Okeechobee System Operating Manual (LOSOM) that reevaluates and defines operations for the lake taking into account the additional infrastructure, including the Herbert Hoover Dike rehabilitation and Kissimmee River Restoration Project as well as the Comprehensive Everglades Restoration Plan (CERP) C-43 West Basin Storage Reservoir and C-44 Reservoir and Stormwater Treatment Area (STA). The resulting LOSOM, which was finalized in August of 2024, includes a new lake regulation schedule addressing the congressionally authorized purposes that include flood risk management; water supply for agricultural irrigation, municipalities and industry, environment, and Native American Tribes; navigation; enhancement of fish and wildlife; and recreation. Analyses conducted as part of LOSOM indicate the LOSOM water control plan modestly improves water supply performance; therefore, the lake will remain in recovery status. The MFL recovery strategy has been revised as part of this 2023–2024 LEC Plan Update to determine the appropriate projects needed to create additional storage volumes. A storage assessment analysis was performed as part of this plan to support the revised recovery strategy (**Appendix C**). Canals connected to the lake will continue to provide fresh surface water for supplemental agricultural and urban irrigation in the future, consistent with water use permits.

Local Surface Water Sources

Local surface water sources that provide water supply in the LEC Planning Area include the following:

- **Central and Southern Florida Project (C&SF Project) Canals** – These primary regional canals move water from Lake Okeechobee to coastal areas to recharge the SAS during the dry season and to prevent saltwater intrusion (**Figure 5-3**). Water for AG and Landscape/Recreational irrigation (L/R) is withdrawn directly from the canals or diverted to local canal systems for additional storage and use. However, regulatory constraints (RAA criteria) restrict new or increased permit allocations from these regional canals.
- **Water Control (298) Districts** – Several water control districts, established under Chapter 298, Florida Statutes (F.S.), are operated for flood control and water supply in the LEC Planning Area. Stormwater from the interconnected lakes and canals can be held in the water control district canal systems for irrigation. Some of the water control districts divert water from C&SF Project canals to maintain specific water levels within their boundaries (**Figure 5-4**). In the LEC Service Areas, diversions are for recharging the SAS and managing saltwater intrusion. In the EAA, water control districts provide water supply for AG.

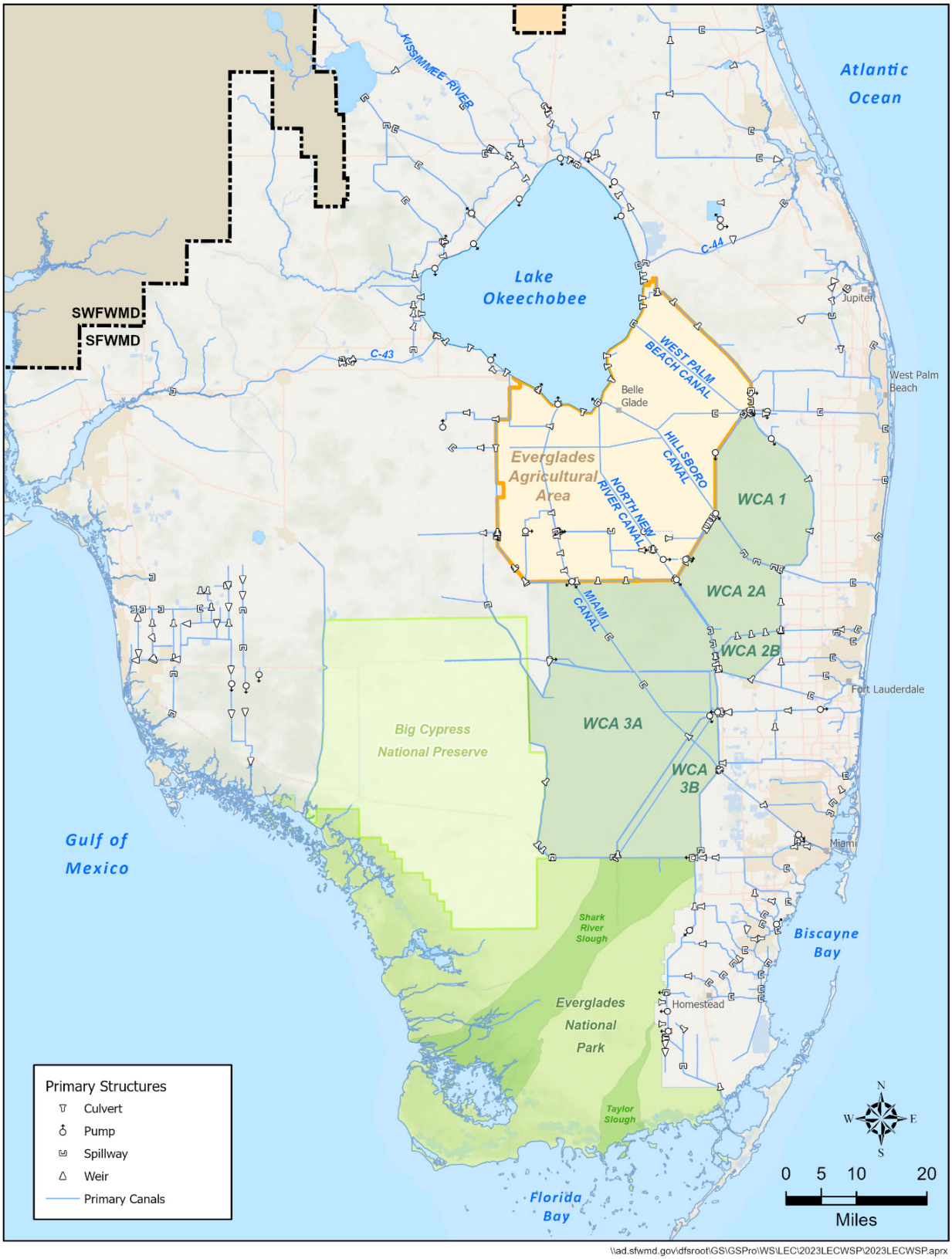

Figure 5-3. Central and Southern Florida Project canal system.

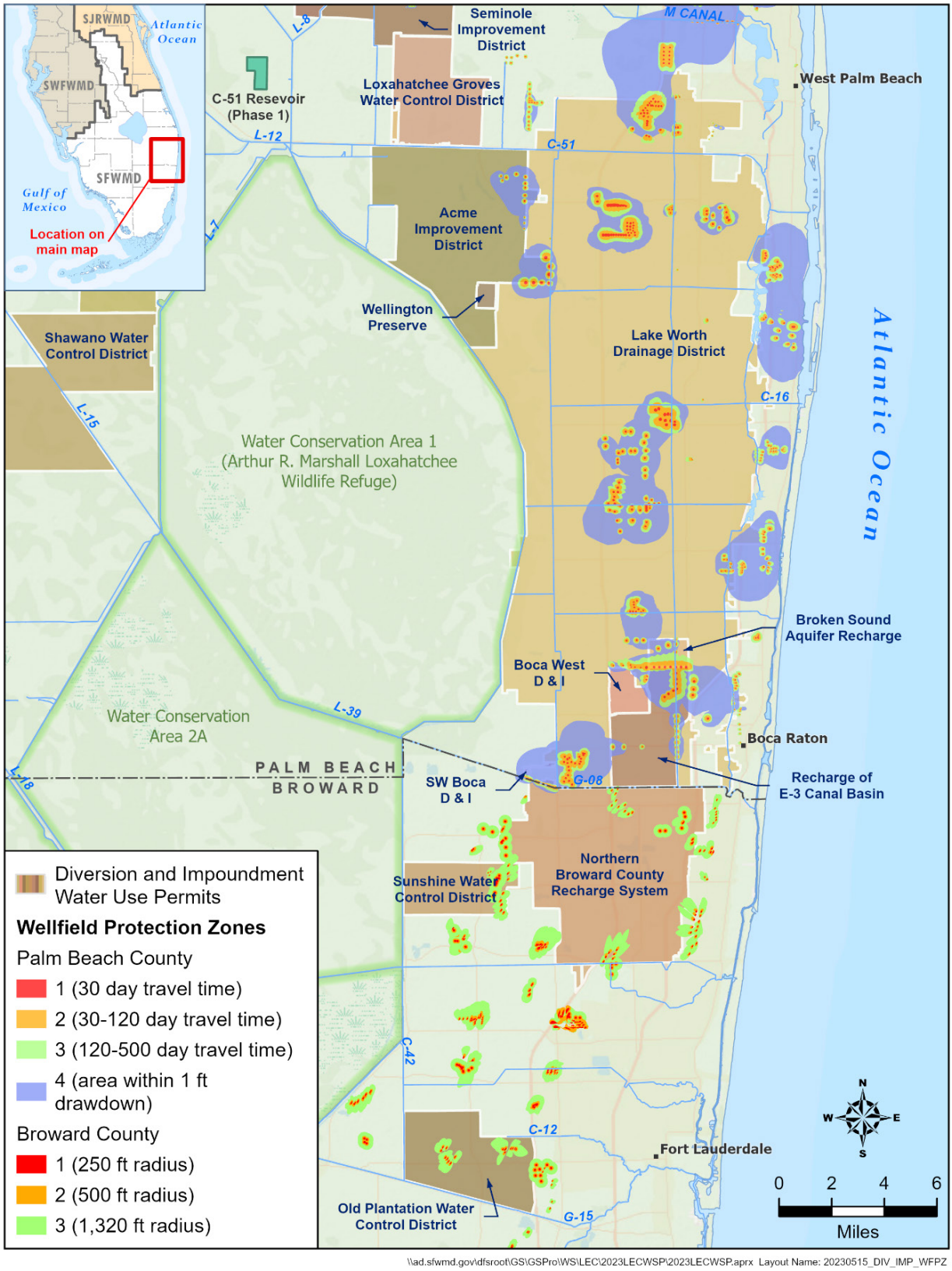

Figure 5-4. Water control districts that divert regional water to recharge Public Supply wellfields in the LEC Planning Area.

Existing and Future Use of Surface Water

AG is the largest user of surface water in the LEC Planning Area. In 2021, approximately 77% of AG demands were met with surface water (**Figure 5-2**) and this percentage is expected to remain the same through 2045. Most AG acreage is in the EAA (**Chapter 2**), and supplemental irrigation is supplied by surface water from canals connected to Lake Okeechobee. AG users in eastern Palm Beach County also rely on surface water from the regional canal network, WCA-1, and Lake Okeechobee for supplemental irrigation. Some smaller agricultural uses, including nurseries and aquaculture in Broward and Miami-Dade counties, use surface water from adjacent local canals or on-site lakes. Projected water demands for the EAA have declined due to a reduction in irrigated acres associated with the construction of the EAA A-2 Reservoir and STA. A slight decrease in AG demands is projected from 2021 to 2045. Permitted AG surface water withdrawal locations in the LEC Planning Area are shown in **Figure 5-5**.

Approximately 50% of L/R irrigation demands in the LEC Planning Area, including golf courses, were met with surface water in 2021 (**Figure 5-2**). Withdrawals primarily are from on-site ponds or adjacent local canals. L/R use is expected to increase approximately 11% by 2045; however, surface water withdrawals may decrease as new demands and some existing demands are met with reclaimed water. Permitted L/R surface water withdrawal locations in the LEC Planning Area are shown in **Figure 5-6**.

In 2021, surface water was used to meet 24% of Commercial/Industrial/Institutional (CII) demands in the LEC Planning Area (**Figure 5-2**). Surface water supplied 31% of CII demand in Palm Beach County, 3% in Broward County, and 24% in Miami-Dade County. Sand, gravel, and stone mining operations account for most of the CII water demands. For the CII category, some surface water withdrawals may be replaced with reclaimed water if available.

The City of West Palm Beach is the only PS utility in the LEC Planning Area that uses surface water as its primary source. The city withdraws water from Clear Lake, which is connected to Lake Okeechobee via tie-back canals (L-8 Canal and M-Canal) and Grassy Waters Preserve, a water impoundment area.

Surface water is used primarily for AG and to a lesser extent L/R, CII, and PS uses. Based on the revised demand projections for this plan update, which are 3% higher than the previously projected 2040 demands in the *2018 Lower East Coast Water Supply Plan Update* (SFWMD 2018), surface water sources appear sufficient to meet the projected 2045 demands.

Surface Water Supplies to the Seminole Tribe of Florida

The Seminole Tribe of Florida has two reservations in the LEC Planning Area: Big Cypress and Hollywood (**Figure 1-1**). At the Big Cypress Reservation, surface water is delivered via the G-409 Structure, at the junction of the L-3 and L-4 canals, and via the North and West Feeder canals (**Figure 5-5**). Lake Okeechobee, via the Miami Canal and the G-404 water control structure, is a secondary supplemental irrigation supply source, with specific volumes of water identified for delivery to the Big Cypress Reservation. The Seminole Tribe of Florida also owns other facilities and land within the LEC Planning Area (such as the Coconut Creek Casino). Demands, if any, associated with these other properties and the Hollywood

Reservation are included within the AG, L/R, and PS water use categories and are met primarily with groundwater.

The Seminole Tribe of Florida has surface water entitlement rights pursuant to the 1987 Water Rights Compact between the Seminole Tribe of Florida, State of Florida, and SFWMD (Public Law 100-228, 101 Statute 1566, and Chapter 87-292, Laws of Florida, as codified in Section 285.165, F.S.). The parties executed subsequent documents addressing the compact entitlement provisions. One such document is the 1996 agreement addressing the SFWMD's mitigation responsibilities regarding impacts to the Seminole Tribe of Florida's ability to obtain surface water supplies at the Brighton (northwest of Lake Okeechobee beyond the LEC Planning Area boundaries) and Big Cypress reservations.

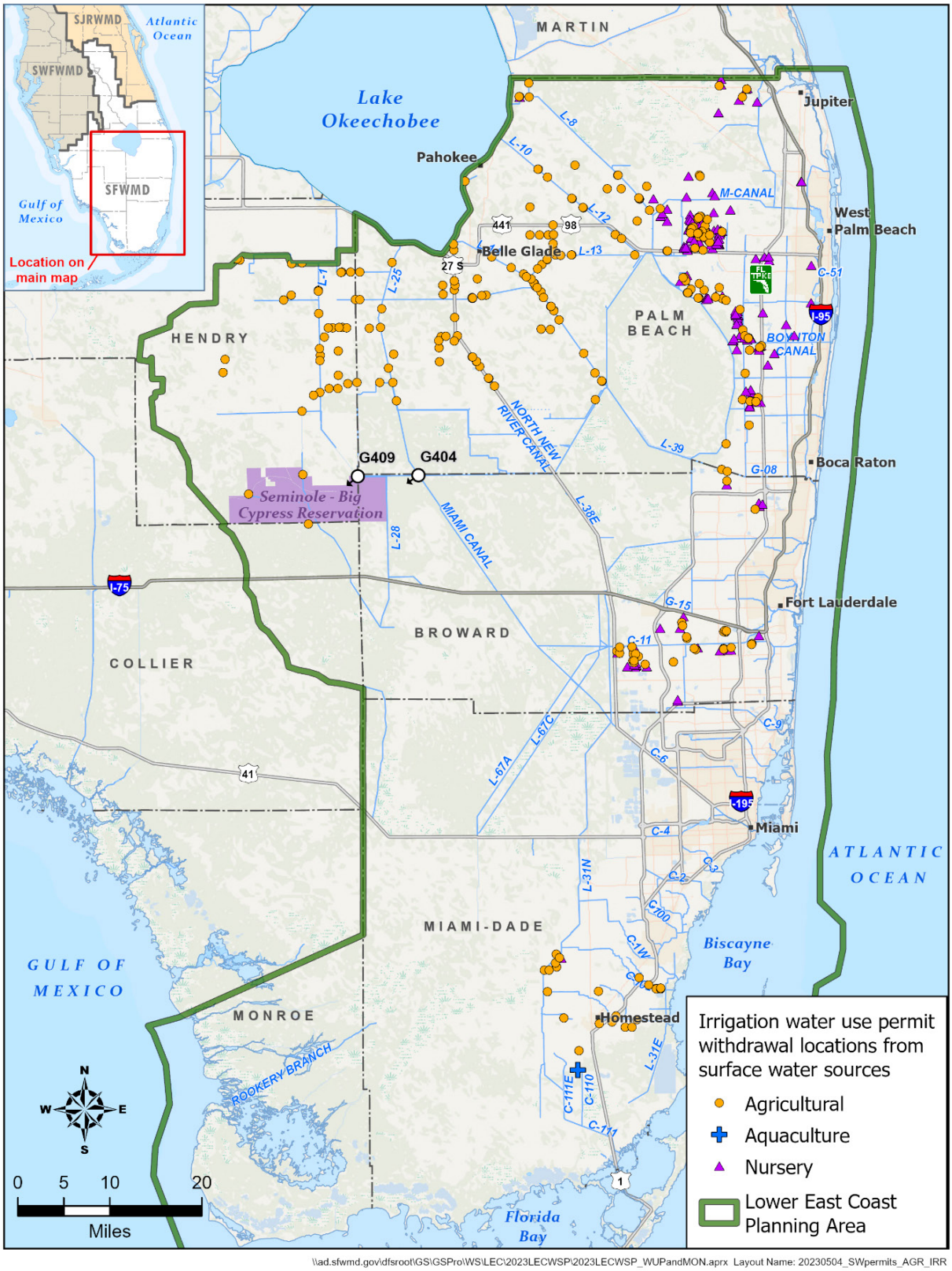

Figure 5-5. Agricultural irrigation water use permit withdrawal locations from surface water within the LEC Planning Area.

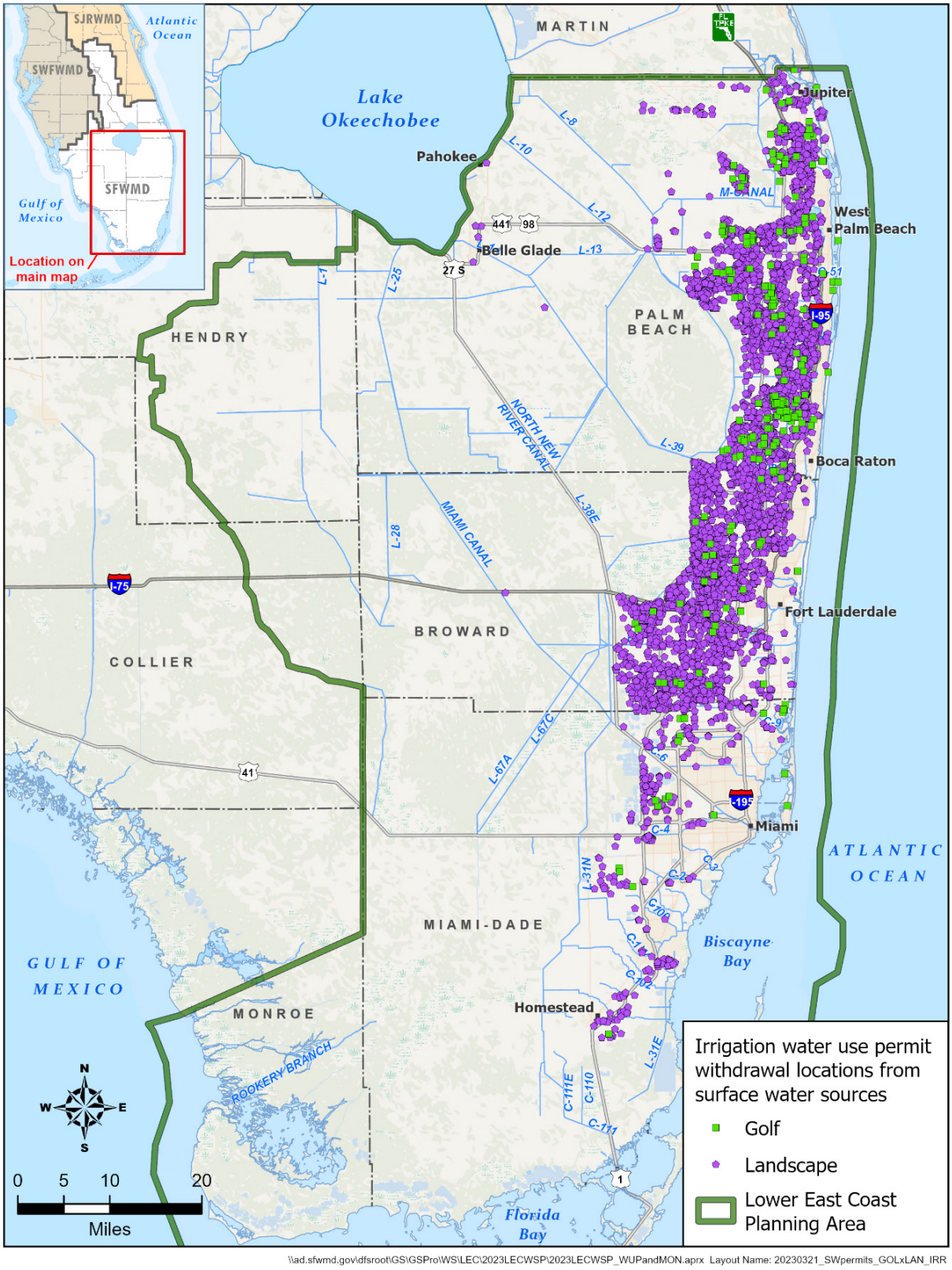

Figure 5-6. Golf and landscape irrigation water use permit withdrawal locations from surface water within the LEC Planning Area.

GROUNDWATER

Groundwater is produced from two major aquifer systems in the LEC Planning Area: the SAS and the FAS (**Figure 5-7**). The SAS provides fresh groundwater from the Biscayne aquifer underlying Broward and Miami-Dade counties, undifferentiated surficial aquifers underlying Palm Beach County, and the Lower Tamiami aquifer (LTA) underlying Hendry County. The FAS provides brackish groundwater from the Upper Floridan aquifer (UFA) throughout the region.

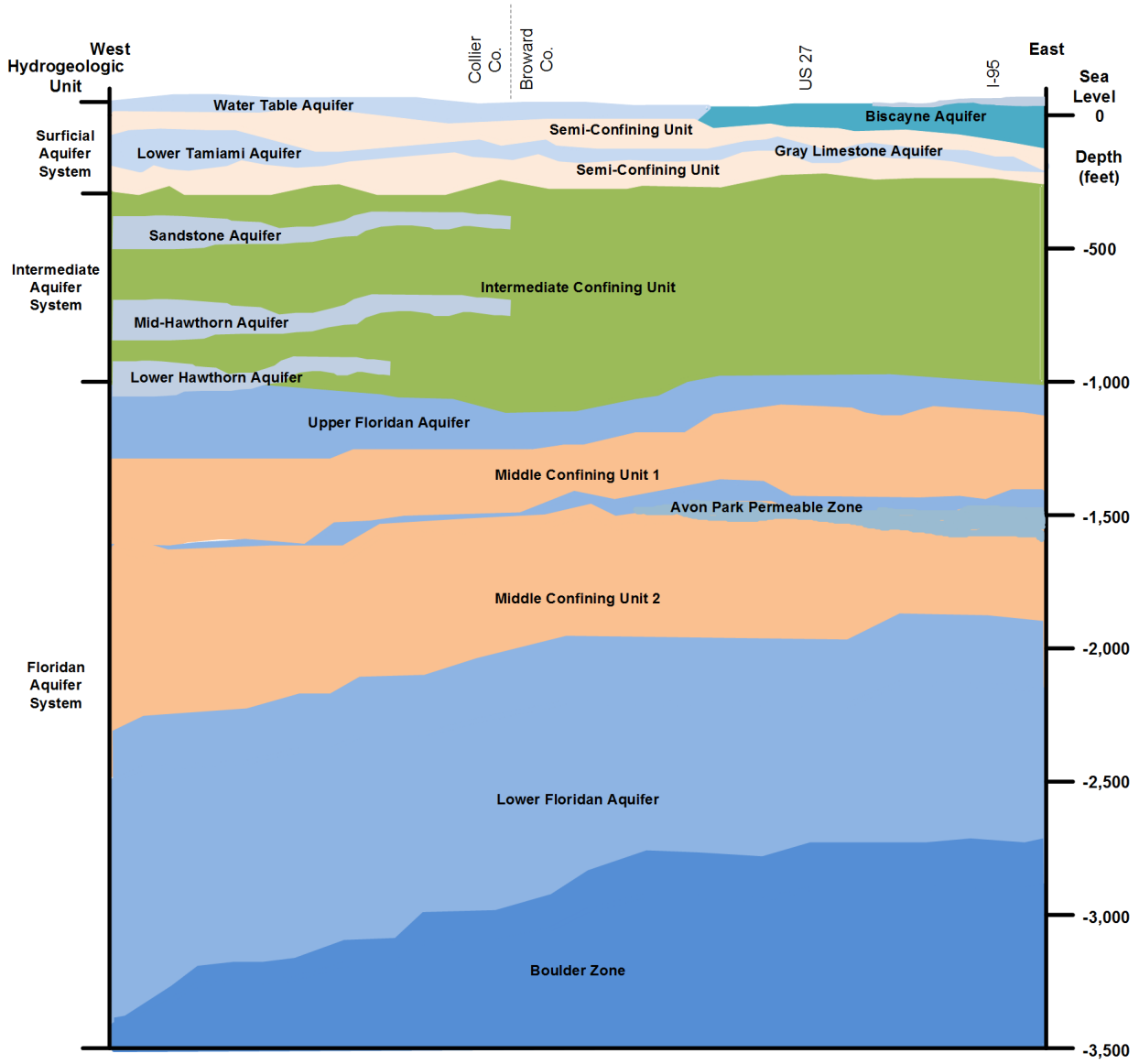

Figure 5-7. Generalized hydrogeologic cross section of the LEC Planning Area.

Fresh Groundwater

Surficial Aquifer System

Fresh groundwater from the SAS has chloride concentrations less than 250 milligrams per liter (mg/L), which meets the United States Environmental Protection Agency secondary drinking water standards (USEPA 2023). Fresh groundwater is the primary source of supply for PS, Domestic Self-Supply (DSS), AG, L/R, and CII uses in the LEC Planning Area. Water availability from the SAS is limited by the rate of groundwater recharge, potential wetland impacts, proximity to contamination sources, saltwater intrusion, and other existing legal users in the area.

Lower East Coast Service Areas

In the LEC Service Areas, the SAS includes the Water Table aquifer, Biscayne aquifer, and undifferentiated surficial sediments, separated by less permeable semiconfining units. The SAS is an unconfined to semiconfined aquifer system composed of solutioned limestone, sandstone, sand, shell, and clayey sand. Recharge to the SAS is by local rainfall, canals, groundwater seepage from the WCAs and Everglades National Park, and surface water deliveries from the WCAs. When sufficient water is available, surface water from Lake Okeechobee also can be routed to the WCAs, then to regional canals and local water control districts to maintain water levels and recharge the SAS. During droughts, lower regional groundwater levels may cause inland movement of the saltwater interface in the SAS. In this case, water shortage restrictions may be declared by the SFWMD Governing Board to conserve freshwater supplies and reduce the risk of saltwater intrusion.

The SAS produces high-quality fresh water from relatively shallow wells in most of the LEC Planning Area. In some cases, the ambient water quality meets primary and secondary drinking water quality standards. However, in central and western Palm Beach and Broward counties, high salinities in the SAS are attributed to relict seawater (connate water) in less transmissive and deeper portions of the SAS (Fish 1988, Reese and Wacker 2009). This underlying saline water affects some PS wellfields and irrigation well withdrawals. Higher salinities also are found in EAA canals where portions of the canals are within the SAS. Development of new SAS groundwater sources may be feasible in some areas; however, permitting new water supplies will depend on local resource conditions.

Western Basins – Lower Tamiami Aquifer

The SAS is composed of the Water Table aquifer and LTA in the Western Basins. It is an unconfined to semiconfined aquifer system composed of limestone, sandstone, sand, shell, and clayey sand. The Water Table aquifer generally is 20 feet or less in thickness and does not produce substantial quantities of water. An intermittent clayey layer (leaky confining zone) separates the Water Table aquifer from the underlying LTA. Below the LTA, the Sandstone and Mid-Hawthorn aquifers in the intermediate aquifer system are not productive in the Western Basins.

The LTA is the major source of groundwater in eastern Hendry County and extends east into the LEC Service Areas as the gray limestone aquifer (Reese and Cunningham 2000). The aquifer is composed of shelly sand, course-grained sandy limestone, and sandstone 25 to

200 feet below land surface. Transmissivities of the LTA increase from north to south in eastern Hendry County.

The SAS produces high-quality fresh water from relatively shallow wells in the Western Basins. With moderate transmissivities and substantial AG withdrawals, water levels in the LTA are monitored for potentially harmful declines below the top of the aquifer. LTA monitor well locations and hydrographs are provided in **Appendix D**.

Existing and Future Use of Groundwater

PS is the largest user of fresh and brackish groundwater in the LEC Planning Area, with relatively consistent withdrawals for the past 15 years (**Figure 5-8**). The reduction in demands starting in 2008 reflects a combination of water shortage restrictions, new irrigation rules, the economic downturn, and increased water conservation awareness.

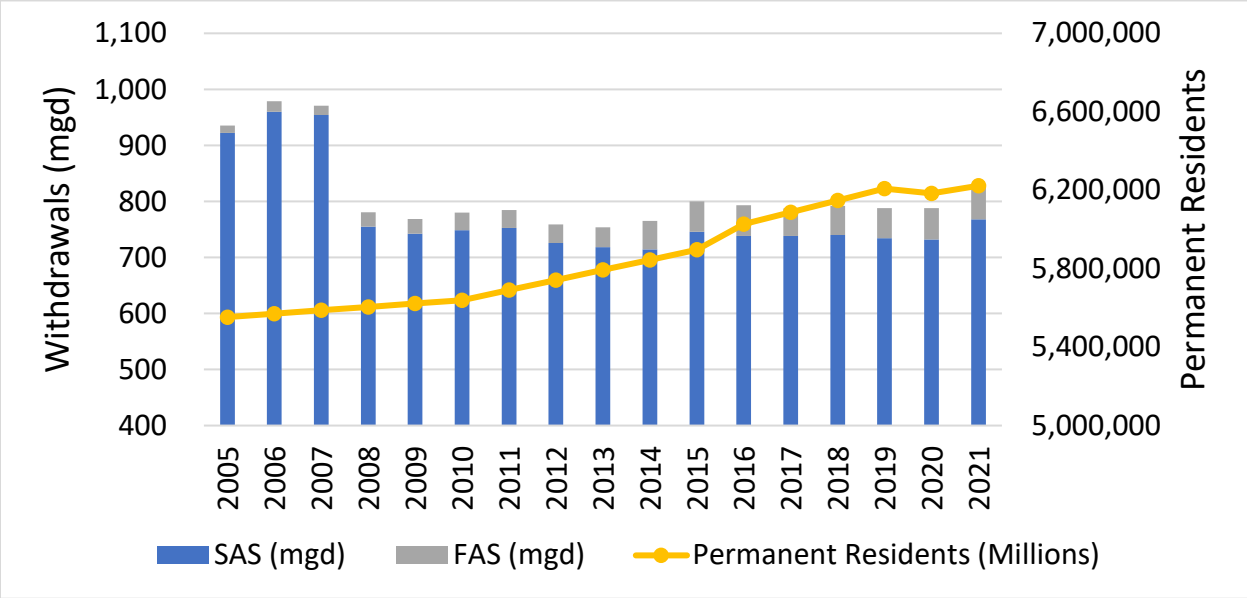

Figure 5-8. Public Supply withdrawals from the surficial and Floridan aquifer systems in the LEC Planning Area (2005 to 2021).

In 2021, fresh groundwater supplied 91% of the region's total PS demand (**Figure 5-2**). However, existing allocations of fresh groundwater will not meet projected 2045 demands for 22 of the 54 PS utilities in the LEC Planning Area (**Chapter 8**). By 2045, approximately 91% of PS demand will continue to be met with fresh groundwater from the SAS, and the remainder will be supplied by surface water and brackish groundwater from the FAS. **Appendix E** contains information about actual and permitted withdrawals from each source as well as wellfield maps by county. Permitted PS and small utilities with fresh groundwater withdrawal locations in the LEC Planning Area are shown in **Figure 5-9**.

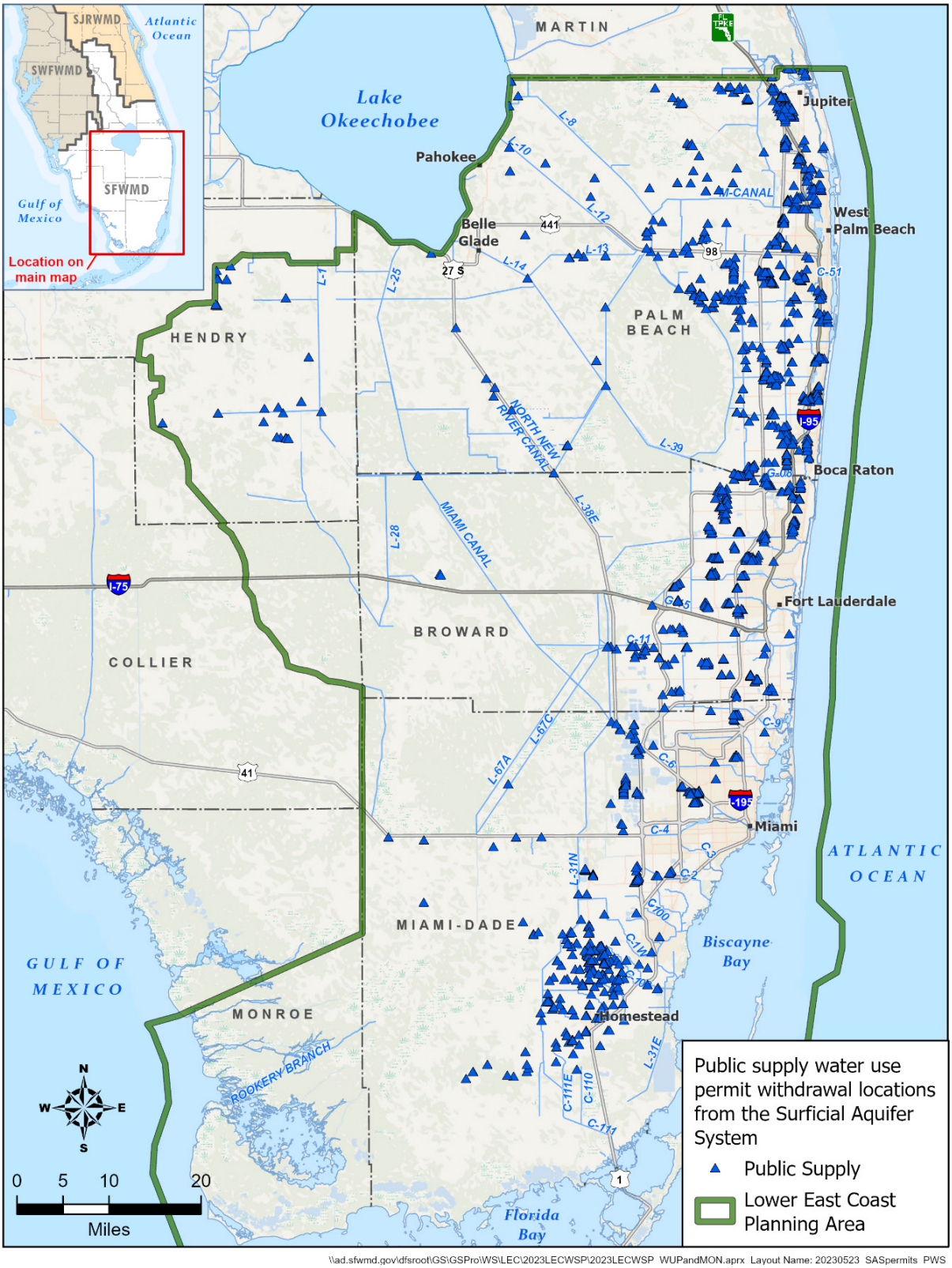

Figure 5-9. Public Supply and small utilities with water use permit withdrawal locations from the surficial aquifer system within the LEC Planning Area.

In the LEC Planning Area, fresh groundwater supplied 100% of the estimated demand (approximately 10 million gallons per day [mgd]) for DSS users in 2021. By 2045, DSS demand is expected to increase to 14.45 mgd. Fresh groundwater from the SAS will continue to supply 100% of the DSS demands through 2045.

CII is currently the second largest user of fresh groundwater. In 2021, approximately 57% of the CII demand was met with fresh groundwater (**Figure 5-2**). For the CII category, some fresh groundwater withdrawals may be replaced with reclaimed water if available. Permitted CII fresh groundwater withdrawal locations in the LEC Planning Area are shown in **Figure 5-10**.

In 2021, approximately 105 mgd of AG demand (22% of total AG demand) in the LEC Service Areas was met using fresh groundwater from the SAS (**Figure 5-2**). Use of fresh groundwater for AG is projected to decrease slightly over the planning period. Permitted AG fresh groundwater withdrawal locations in the LEC Planning Area are shown in **Figure 5-11**.

The Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida have reservations in the Western Basins (**Figure 1-1**) and require water for residents, agriculture, and wetlands. The LTA is used for PS, DSS, and AG in the Seminole Tribe of Florida Big Cypress Reservation. The SAS provides water for DSS in the Miccosukee Federal Reservation and for PS in the Miccosukee Tamiami Trail Reservation.

In 2021, approximately 26% of L/R demand, including golf courses, was met with fresh groundwater (**Figure 5-2**). L/R demands are expected to increase 24% by 2045, based on population growth. Fresh groundwater is expected to meet approximately 20% of the increased demand, depending on availability at specific locations. It is anticipated that some fresh groundwater withdrawals may be replaced with reclaimed water if available for the L/R category. Permitted L/R fresh groundwater withdrawal locations in the LEC Planning Area are shown in **Figure 5-12**.

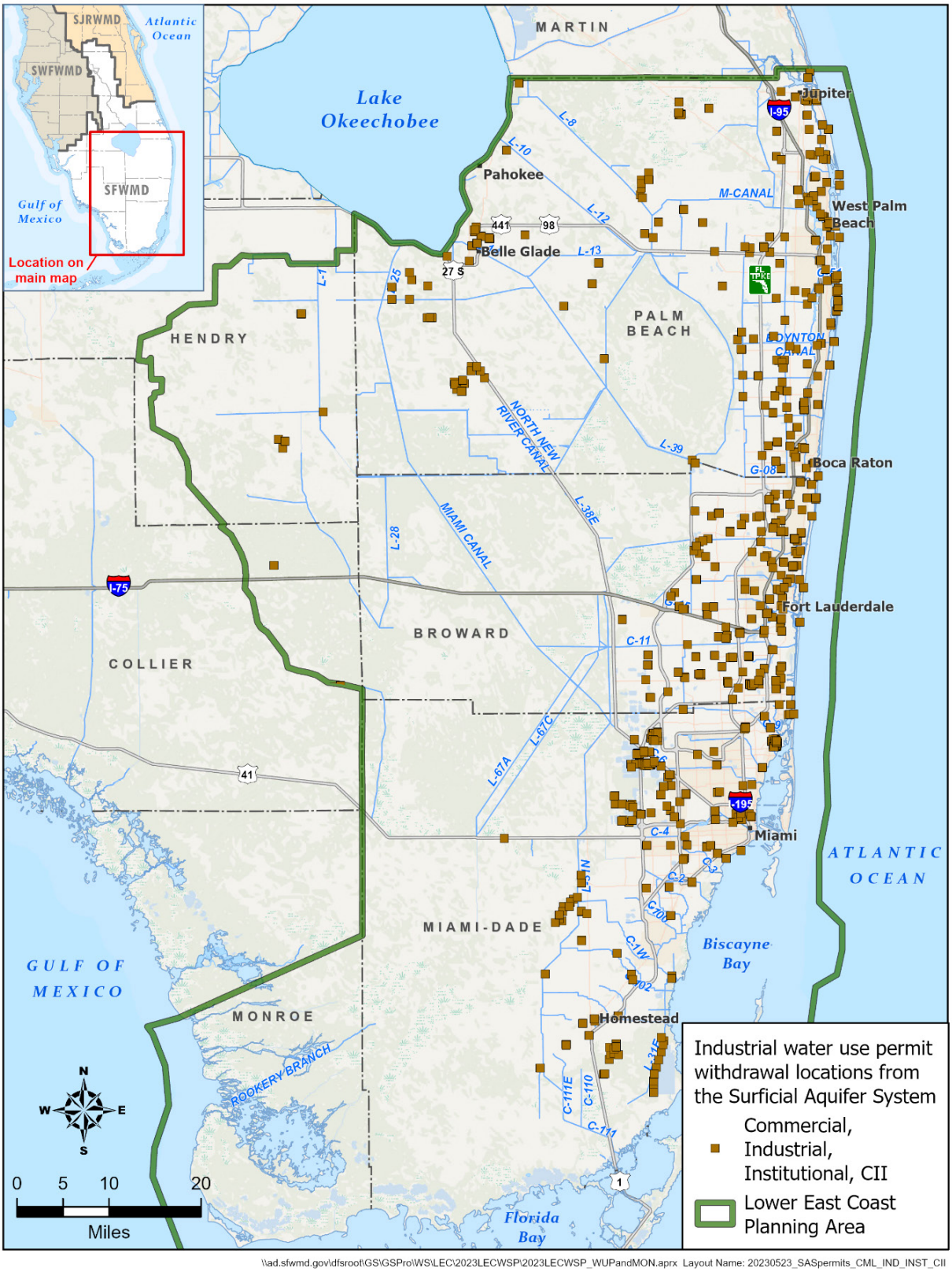

Figure 5-10. Commercial/Industrial/Institutional water use permit withdrawal locations from the surficial aquifer system within the LEC Planning Area.

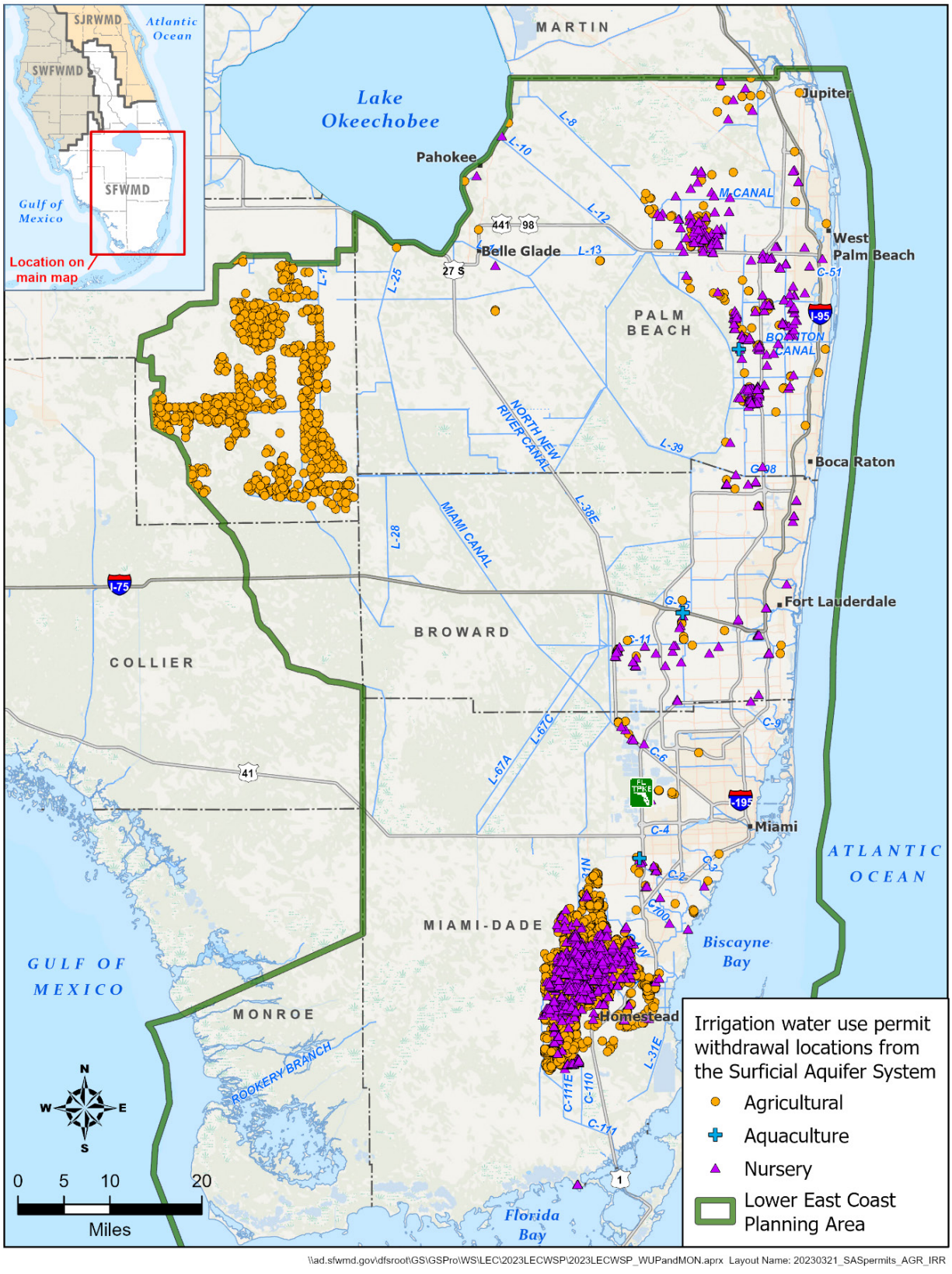

Figure 5-11. Agricultural irrigation water use permit withdrawal locations from the surficial aquifer system within the LEC Planning Area.

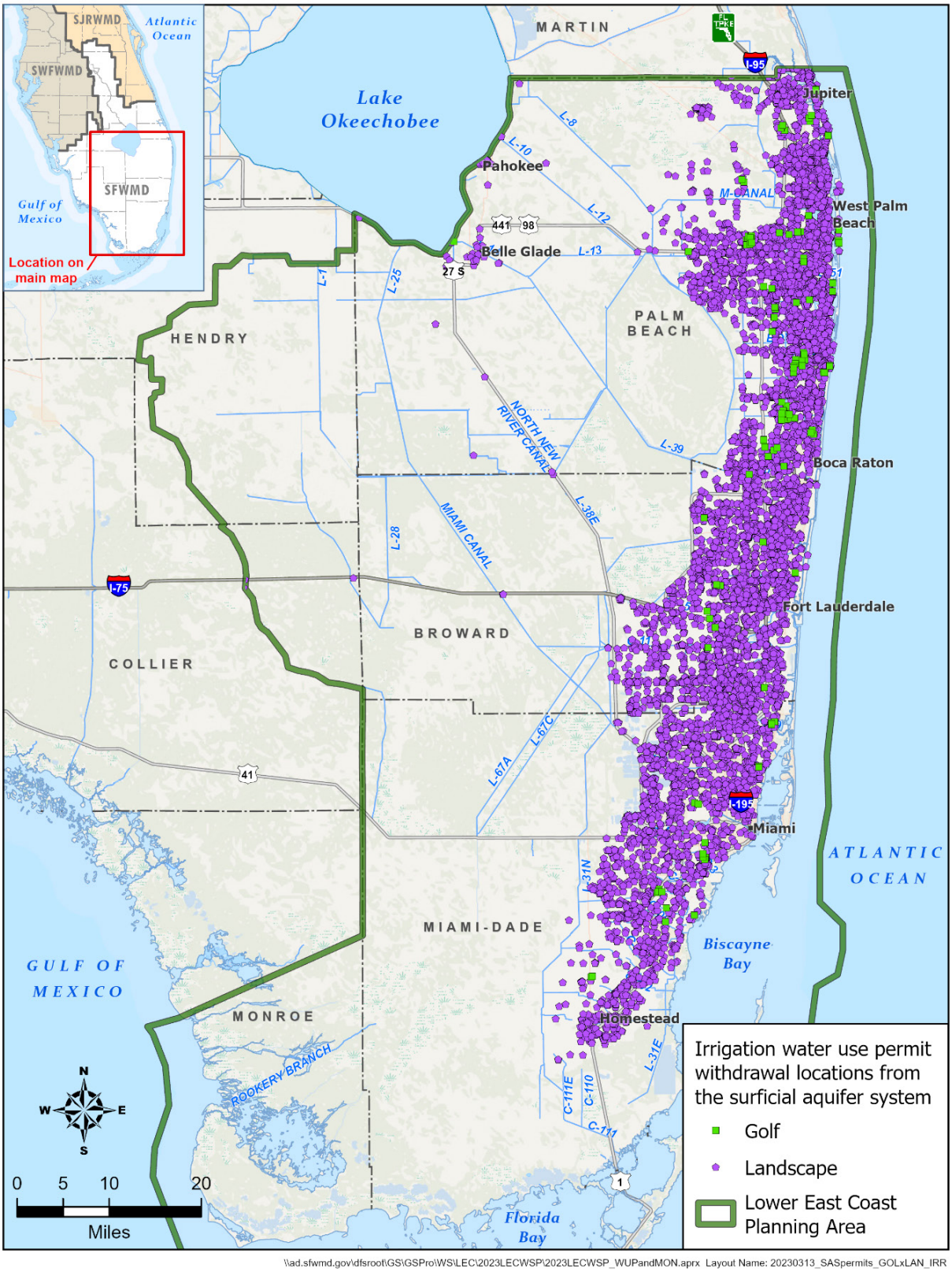

Figure 5-12. Golf and landscape irrigation water use permit withdrawal locations from the surficial aquifer system within the LEC Planning Area.

Increased allocations from the SAS are generally limited by water resource restrictions due to potential impacts on wetlands and existing legal water uses, including DSS and the potential for saltwater intrusion. Therefore, traditional freshwater sources in the LEC Planning Area may not be sufficient to meet 2045 projected water use demands and alternative sources need to be developed to meet increased demands. Water availability from the SAS is further discussed in **Chapter 6** and **Appendix D**. In addition, the Biscayne aquifer also is an MFL water body, and withdrawals cannot cause further inward movement of the saltwater interface. Potential impacts on the regional system are addressed by the RAA criteria for withdrawals within the LEC Service Areas and Northern Palm Beach County Service Areas as discussed earlier. Future strategies to address limits on availability are provided in **Chapter 9**.

Brackish Groundwater

Floridan Aquifer System

In the LEC Planning Area, water from the FAS typically has chloride concentrations greater than 1,000 mg/L and is considered brackish. Desalination or blending with fresh water is required before this water supply source is suitable for most uses, including irrigation and human consumption. Water quality in the FAS degrades substantially from central to southern Florida, with increasing hardness, chlorides, and salinity. Salinity also increases with depth, making the deeper producing zones less desirable for development than shallower parts of the system. The FAS is productive in the LEC Planning Area; however, use of this brackish water source is limited by water quality concerns and treatment costs (**Chapter 6**).

The FAS is a confined, high-yield aquifer system that provides substantial volumes of water. Overall, the productivity of the FAS is considerably greater than that of the SAS, except for the highly transmissive Biscayne aquifer, in the region. The top of the FAS is separated from the SAS by the low-permeability sediments of the intermediate confining unit that is several hundred feet in thickness. The FAS has several discrete aquifers separated by low-permeability confining units, including the brackish UFA and Avon Park permeable zone and the more saline Lower Floridan aquifer (**Figure 5-7**). Though generally not considered useful as a water supply source in the LEC Planning Area due to high salinity, the Lower Floridan aquifer includes the Boulder Zone (approximately 2,100 to 3,500 feet below mean sea level), a cavernous and highly transmissive interval used for disposal of wastewater effluent and concentrate from reverse osmosis (RO) treatment facilities through the use of deep injection wells.

The SFWMD partners with other agencies (e.g., the United States Geological Survey) to monitor the FAS through regional monitor well networks and through permittees as part of reporting requirements for water use (SFWMD) and deep injection wells (Florida Department of Environmental Protection [FDEP]). Data from these wells indicate some seasonal variations in water levels; however, overall, levels have remained stable over the period of record. Nearly all PS utilities in the LEC Planning Area that use the UFA have had one or more production wells experience degraded (increasing salinity) water quality. **Chapter 6** and **Appendix D** contain monitor well location information and data from the regional FAS network as well as water quality graphs from several PS utility wellfields.

Existing and Future Use of Brackish Groundwater

In the LEC Planning Area, the UFA provides brackish groundwater for PS, L/R, and Power Generation (PG) demands. From 2005 to 2021, FAS withdrawals for PS increased from 13.33 to 57.86 mgd (**Figures 5-8** and **5-13**) and are expected to increase to 113.78 mgd by 2045. In the LEC Planning Area, 24 PS utilities have UFA allocations, totaling 176.01 mgd (without C-51 offset, an alternative supply for PS as described in **Chapter 8**). The UFA is not used for PS in the portions of Collier and Hendry counties within the LEC Planning Area. The Florida Keys Aqueduct Authority uses the UFA to meet a portion of the PS demands in Monroe County, but the UFA wellfield is located in Miami-Dade County.

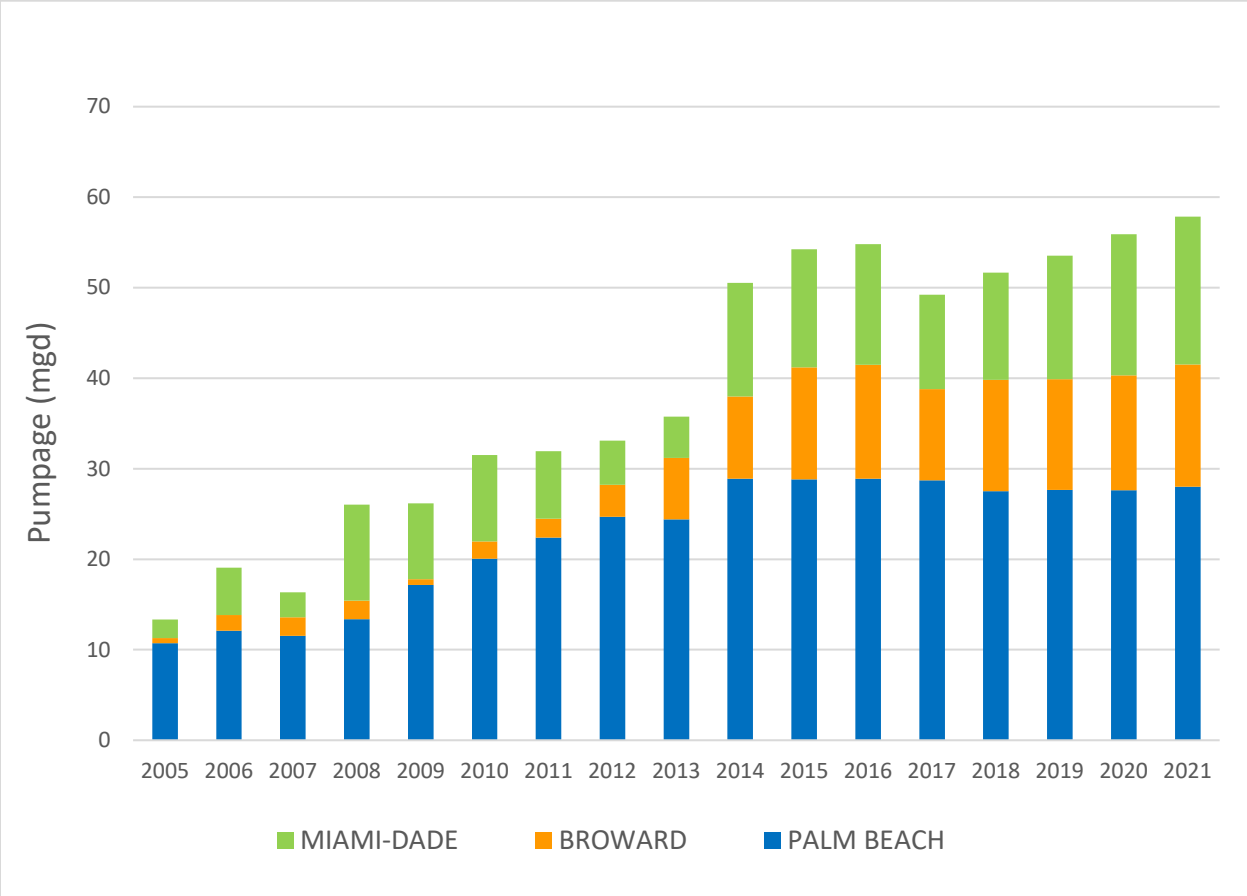

Figure 5-13. Public Water Supply withdrawals from the Floridan aquifer system in the LEC Planning Area (2005 to 2021).

In some limited cases, brackish groundwater from the FAS is used by L/R (2%), AG (1%), and CII (less than 1%) as an AWS source (**Figure 5-2**) and provides the majority of the demands for PG (98%). L/R FAS users include eight golf courses: Seminole, Lost Tree, Everglades Club, Breakers, Palm Beach Country Club, and Palm Beach Par 3 in Palm Beach County; North Key Largo [Ocean Reef Club] in Monroe County; and Gulfstream Park in Broward County. Three power generation facilities are also FAS users: Florida Power & Light (FPL) Turkey Point Clean Energy Center in Miami-Dade County; and FPL West County Energy Center (backup wells) and Okeelanta Cogeneration Facility in Palm Beach County. L/R demands from the FAS are expected to increase slightly, and PG demands from the FAS are expected to decrease with

the increased use of reclaimed water. Permitted withdrawal locations from the FAS for AG, L/R, PG, and PS are shown in **Figure 5-14**.

PS utilities use RO to remove or reduce excess salinity to acceptable drinking water quality. The approximate production efficiency, or recovery, for brackish water RO facilities Districtwide is between 75% and 85%, depending on the membrane technology employed and the salinity of the source water (Carollo Engineers 2009). There currently are 15 PS utilities using RO water treatment plants with a combined treatment capacity of 82.50 mgd. To some extent, saline groundwater can be blended with fresh water from other sources and treated with lime softening or membrane softening technology to meet chloride drinking water standards. The ability to use blending depends on the water quality of the saline source and other raw water used for blending by the utility.

Several FAS wellfields in the LEC Planning Area have experienced some water quality degradation, but current operations have shown this can be managed by PS utilities through appropriate wellfield design and operating protocols, including the following activities:

- Increasing well spacing (more than 1,000 feet) to minimize interference effects and to reduce stress on the FAS.
- Rotating the operation of individual wells, thereby reducing overall pumping stress on the well's production zone.
- Plugging and abandoning individual wells experiencing increases in chloride concentration and replacing them with new wells elsewhere within the wellfield area.
- Reducing pumping rates at individual wells to minimize water level declines, which increase the potential for poor-quality water to enter the well's production zone from below.
- Installing monitor wells to provide early warning of the need for changes to wellfield operations to minimize upconing or lateral movement of poor-quality water.

Future strategies to address limits on availability are provided in **Chapter 9**.

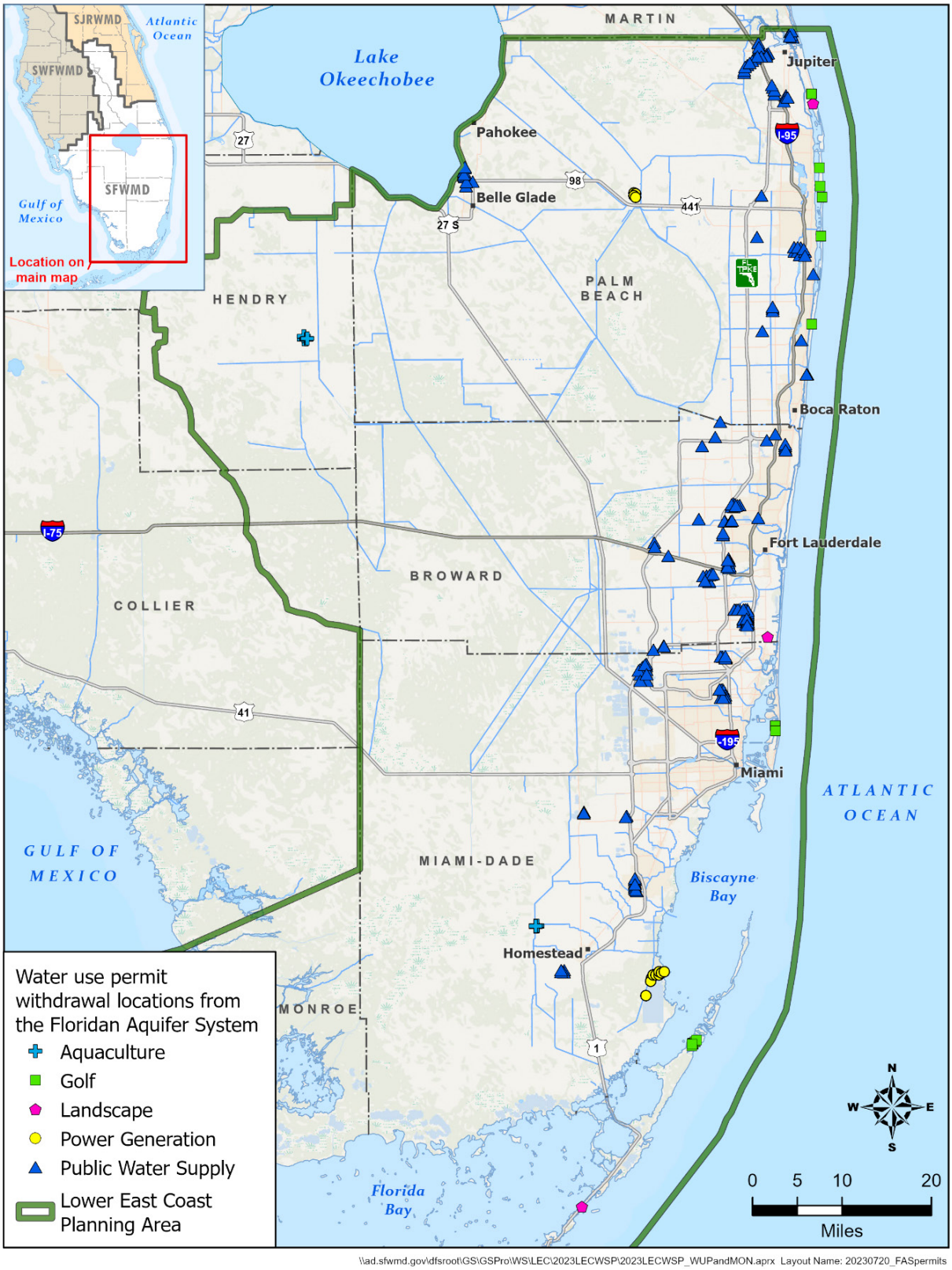

Figure 5-14. Water use permit withdrawal locations from the Floridan aquifer system within the LEC Planning Area.

RECLAIMED WATER

Reclaimed water is wastewater that has received at least secondary treatment and basic disinfection and is reused after leaving a domestic wastewater treatment facility (WWTF) in accordance with Rule 62-600.200, Florida Administrative Code (F.A.C.). Reuse is the deliberate application of reclaimed water for a beneficial purpose. Criteria used to classify projects as "reuse" or "effluent disposal" are contained in Rule 62-610.810, F.A.C.

Section 373.250, F.S., identifies reclaimed water as an AWS, including declaring reclaimed water supply projects as eligible for AWS funding. The Water Resource Implementation Rule (Chapter 62-40, F.A.C.) requires the FDEP and water management districts to advocate and direct the use of reclaimed water as an integral part of water management programs, rules, and plans. The SFWMD requires all water use permit applicants proposing to use more than 0.10 mgd of water and applicants within a mandatory reuse zone, as designated by local governments through ordinance, to use reclaimed water if feasible. In addition, substitution credits and impact offsets, resulting from use of reclaimed water, may be included in a water use permit. A substitution credit is the use of reclaimed water to replace a portion, or all, of an existing permitted use of a limited surface water or groundwater resource, allowing a different user to initiate or increase withdrawals from the resource. Impact offsets are derived from the use of reclaimed water to reduce or eliminate a harmful impact that has occurred or would occur due to a surface water or groundwater withdrawal.

Wastewater reuse conserves water resources by reducing reliance on traditional freshwater sources for many uses, like irrigation, often at a lower cost. Because wastewater is generated year-round, reclaimed water is considered a highly reliable water source and an environmentally sound alternative to traditional wastewater disposal methods, such as ocean outfalls and deep well injection. However, some utilities may require backup disposal methods during wet periods when irrigation demand is low.

Existing Reuse

Wastewater, reuse, and related flows for 2021 were analyzed for the 45 treatment facilities in the LEC Planning Area with a capacity of 0.10 mgd or greater. Flow data for the 34 facilities permitted to produce reclaimed water were obtained from the individual reuse inventory reports submitted to the FDEP for the year 2021 (FDEP 2022). For the remaining 11 facilities not permitted to produce reclaimed water (wastewater treatment permitted only), flow data for 2021 were obtained through direct communications with the utility or facility staff.

Reclaimed water used for a beneficial purpose (e.g., landscape irrigation, golf course irrigation, cooling water, and other industrial uses) has increased almost tenfold between 1994 and 2021 (**Figure 5-15**). Annual fluctuations in the volume of reclaimed water used are due to the addition of new users and variable amounts of rainfall.

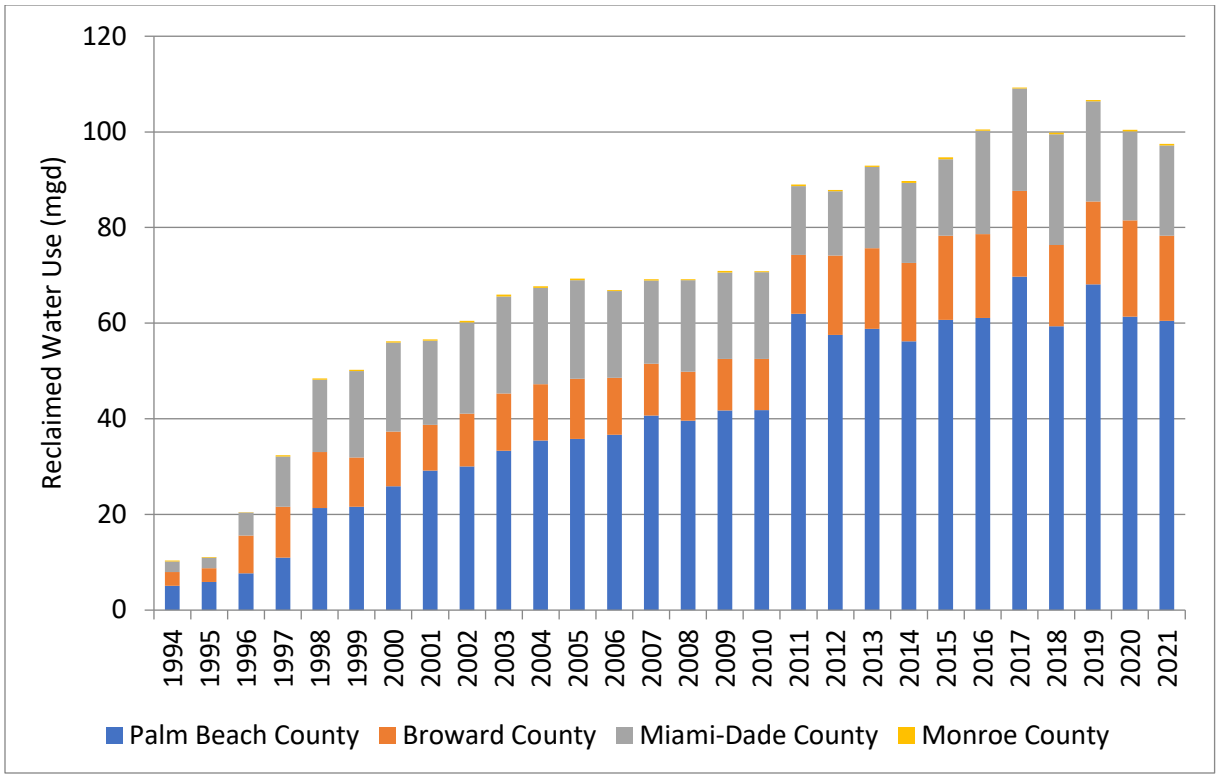

Figure 5-15. Annual average reclaimed water used in the LEC Planning Area from 1994 to 2021.

In 2021, the 45 facilities analyzed for this update treated an annual daily average wastewater flow of 675.66 mgd. Of that total, approximately 97.47 mgd was reused (including 4.31 mgd of supplemental water flows). The county data indicated 7.9% of wastewater generated in Broward, 5.9% in Miami-Dade, 3.3% in Monroe, and 48.1% in Palm Beach was reused for irrigation, industrial applications, wetland hydration, and aquifer recharge (**Figure 5-16**).

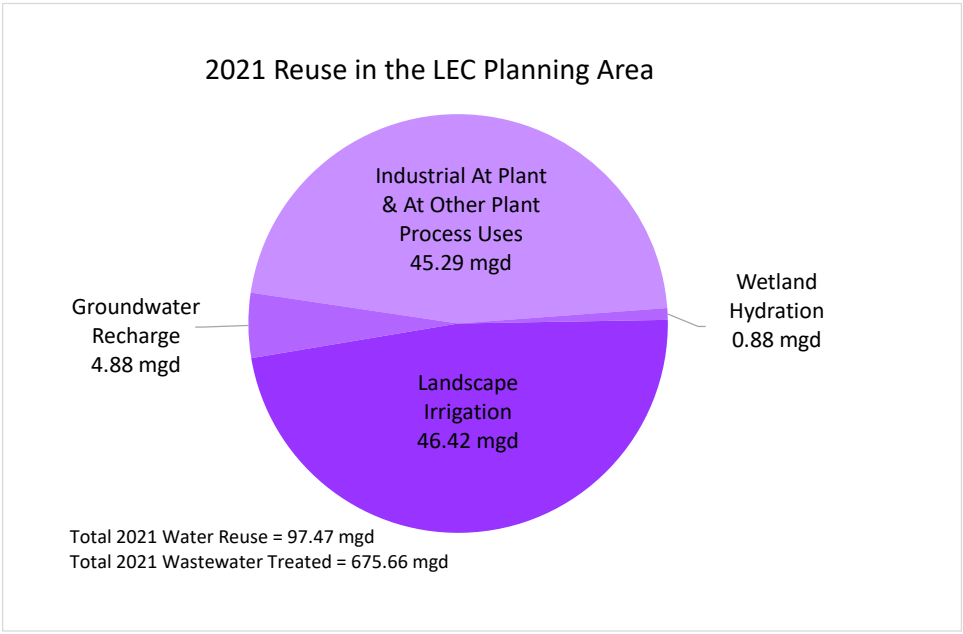

Figure 5-16. 2021 reuse in the LEC Planning Area.

Landscape irrigation at golf courses, residential lots, and other public access areas (e.g., parks, schools, and roadways) was the largest use. Industrial use at wastewater treatment plants (e.g., for cooling seals and filter backwashing) and at other industrial facilities for cooling, washing, and dust control was the second largest use (**Figure 5-16**).


Wakodahatchee Wetlands

The remainder of the total reuse provided groundwater recharge, either through rapid infiltration basins, absorption fields, and borrow pits (4.88 mgd), or wetland hydration projects (0.88 mgd), such as the Palm Beach County Water Utilities Department (Wakodahatchee, Green Cay Phase I, Green Cay Phase II wetlands, and South County Reclaimed Water Transmission Pipeline) and Wellington Utilities (Peaceful Waters Sanctuary), which indirectly recharge the SAS.

Reported disposals of treated wastewater totaled 601.90 mgd in 2021, with 413.95 mgd being injected into deep wells, 4.10 mgd into shallow wells (limited to Monroe County), 0.14 mgd released to a soakage pit, and 183.71 mgd being disposed of via ocean outfalls.

As mentioned above, utilities can receive a substitution credit as part of their water use permit when use of groundwater or surface water is replaced with reclaimed water. In the LEC Planning Area, several utilities have substitution credits or impact offsets incorporated into their current water use permit.

Supplemental Sources to Meet Reclaimed Water Demand

The use of supplemental water supplies to meet peak demands for reclaimed water may enable a wastewater utility to maximize its use of reclaimed water. However, during times of drought, water sources (e.g., surface water, groundwater, and stormwater) may not be available to supplement reclaimed water supplies in some areas. Use of supplemental water supplies is subject to consumptive use permitting and water shortage restrictions by the SFWMD. Seven facilities from six utilities in the LEC Planning Area used a total of 4.31 mgd supplemental water to support their water reuse systems in 2021.

Leah Schad Memorial Ocean Outfall Program

The Florida Legislature enacted an Ocean Outfall Law (OOL) as defined in Section 403.086(10), F.S., requiring elimination of the use of six ocean outfalls in southeastern Florida as the primary means for disposal of treated domestic wastewater by December 31, 2025. The objectives of this statute were to reduce nutrient loadings to the environment and to more efficiently use treated wastewater to meet demands. In addition, affected wastewater utilities are required to reuse at least 60% of their baseline outfall flows by December 31, 2025. Beginning in 2026, ocean outfalls should be used only for backup disposal.

The Leah Schad Memorial Ocean Outfall Program applies to seven wastewater utilities (**Table 5-1**), six of which have direct ocean outfalls: South Central Regional (Delray Beach and Boynton Beach), Boca Raton, Broward County North Regional, Hollywood Southern Regional, Miami-Dade Water and Sewer Department (MDWASD) (three facilities). Cooper City and the Town of Davie are permitted to discharge effluent through the Hollywood Southern Regional WWTF. Therefore, these two water departments have obligations to meet the ocean outfall requirements for their portion of wastewater contributions. The reuse requirements for Miami-Dade County WWTFs may be met countywide because the North, Central, and South District facilities are owned and operated by one utility (MDWASD), have interconnected transmission systems, and are therefore considered one system.

The OOL provides utilities an option to satisfy their reuse requirements by entering into a contract with another utility under provisions of Section 163.01, F.S., (i.e., Florida Interlocal Cooperation Act of 1969). Under these interlocal agreements, one city/utility can contribute financially to the development of the reuse system of another city/utility and receive credit for the subsequent reuse flows. The City of Miramar has entered into agreements with the cities of Hollywood and Cooper City for contractual water reuse, assisting these two cities to meet their functional reuse system development obligations. In **Table 5-1**, 2045 flows for some utilities may differ from 2045 flows for Broward County in **Appendix E** to avoid double counting of contractual reuse flows and reclaimed water deliveries and to properly represent these utilities' reuse system developments.

Table 5-1. Reuse flows for 2021, functional reuse requirement, and total, projected reuse flows for 2026 and 2045 for utilities affected by the Ocean Outfall Law.

Facility	2021 Reuse Flows (mgd)	Functional Reuse System Requirement[a] (mgd)	2026 Projected Reuse Flows (mgd)	2045 Projected Reuse Flows (mgd)
Boca Raton	11.10	11.80	11.10	11.49
Broward County – North Regional	3.55	25.95[b]	12.00	38.75[c]
Cooper City	0.00	0.90	1.00[d]	1.00[d]
Davie	0.67	1.10	1.00	1.48
Hollywood Southern Regional	5.45	12.30[e]	6.30	12.50[f]
MDWASD (three facilities)	13.68	131.50	29.55	116.68
South Central Regional[g]	5.94	13.30	7.06	7.06

MDWASD = Miami Dade Water and Sewer Department; mgd = million gallons per day.

[a] The total reuse amount required by December 31, 2025 is the sum of the reuse amount existing in 2008 and the additional 60% reuse baseline requirement.

[b] The total reuse system flow requirement was reduced by 0.94 mgd per flows taken by Pompano Beach for use in its reuse program.

[c] Includes reclaimed water deliveries of 10.51 mgd, 10.00 mgd, 2.49 mgd, 2.00 mgd, and 1.00 mgd to Palm Beach County Water Utilities Department, Pompano Beach, Coconut Creek, North Springs Improvement District, and Deerfield Beach, respectively, plus approximately 12.75 mgd reuse implemented to users within the Broward County service area.

[d] Includes 1.00 mgd of "virtual reuse," as allowed under Section 163.01, F.S., implemented through the City of Miramar's reuse program.

[e] The total December 31, 2025 reuse system flow was reduced by 10.4 mgd to reflect feasibility issues. However, the OOL requires Hollywood to continue to pursue the 60% reuse goal after December 31, 2025.

[f] Includes 2.00 mgd of "virtual reuse," as allowed under Section 163.01, F.S., implemented through the City of Miramar's reuse program and 2.50 mgd "virtual reuse" at other (yet to be determined) cities.

[g] Includes Delray Beach and Boynton Beach.

The City of Boca Raton is the only utility that has currently met the OOL reuse requirements. The remaining utilities are working toward meeting the requirements and the 2025 deadline. **Appendix E** provides further details on the status of each ocean outfall utility.

Reuse (including contractual flows) at the utilities and cities affected by the OOL is projected to increase by greater than 145 mgd, and decrease approximately 20 mgd in total disposals, and approximately 160 mgd in ocean outfall disposals from 2021 to 2045. During the same time period, those utilities and cities could see an estimated increase in treated wastewater of 100 mgd (**Figure 5-17**).

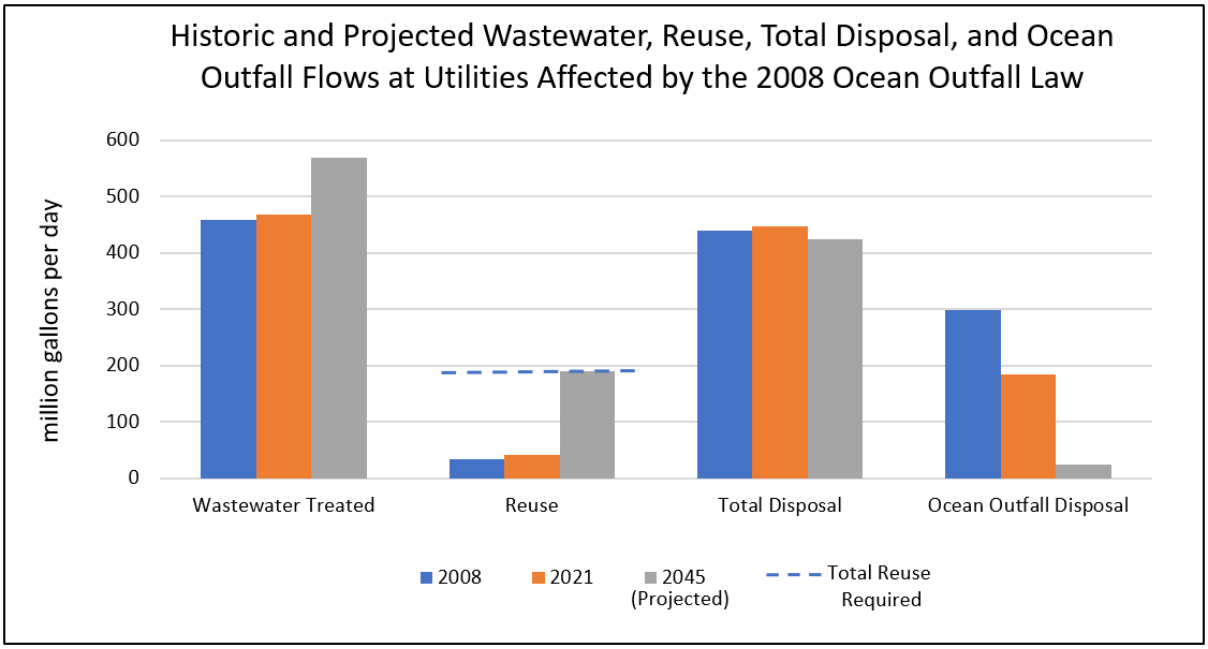

Figure 5-17. Historic and projected wastewater, reuse, total disposal, and ocean outfall flows at utilities affected by the 2008 Ocean Outfall Law.

Future Reuse in the LEC Planning Area

Projections for 2045 annual average daily wastewater, reuse, discharges, and supplemental flows were obtained directly from the utilities for all 45 treatment facilities analyzed in this section (**Appendix E**).

While using reclaimed water for irrigation will continue to be an important part of reuse in the LEC Planning Area, industrial reuse (primarily in wastewater facility treatment processes and industrial cooling) is projected to become the largest reuse category by 2045. However, some cooling processes only increase the temperature of the reclaimed water, allowing it to be reused again. Innovative uses of reclaimed water may also increase to help meet water demands or offset potential impacts associated with future withdrawals. For example, Palm Beach County Water Utilities Department will be expanding the Green Cay wetland to include a 63-acre public access park, which will receive reclaimed water treated to potable standards, surrounded by production wells to create an indirect potable reuse system. Additionally, the Key Largo facility, which currently does not have a functioning reuse system, is planning to implement a direct potable reuse system. **Figure 5-18** shows the 2045 projected reuse in the LEC Planning Area.

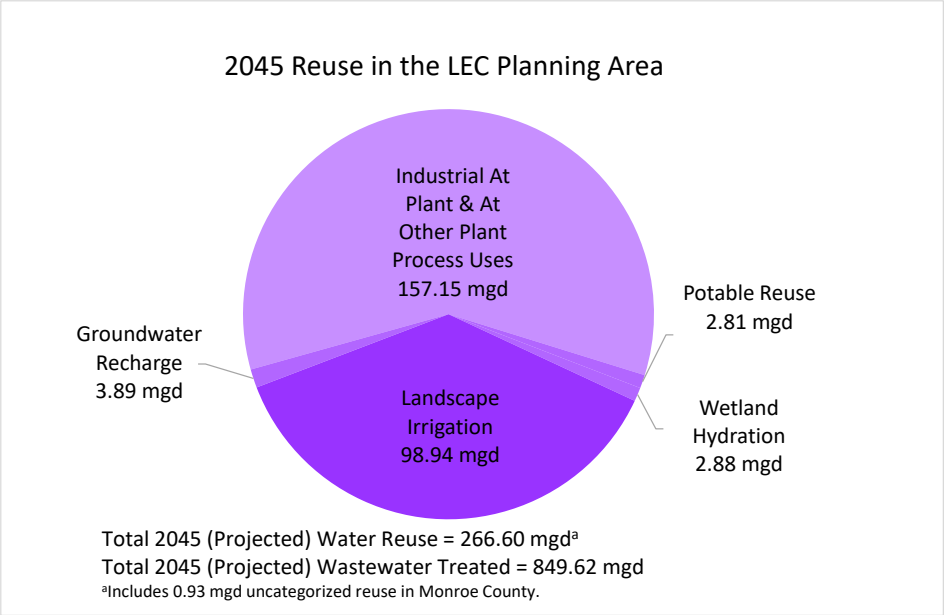

Figure 5-18. 2045 projected reuse in the LEC Planning Area.

Reuse as a percentage of treated wastewater, is projected to double from approximately 14% to 31%, and almost triple in flow volume from 97.47 mgd in 2021 to 266.60 mgd in 2045. The increase in reuse will largely be driven by utilities and cities affected by the OOL, which will account for more than two-thirds of the overall increase. In addition, the disposal of treated wastewater, as a percentage of total treated wastewater, could drop by more than 17% over the same time period as wastewater flows increase by approximately 25% (**Table 5-2**).

Table 5-2. Documented 2021 and projected 2045 annual average daily flows for reuse and related flows by county.

County	AAD Wastewater Flows (mgd)		AAD Disposal Flows (mgd)		AAD Supplemental Flows (mgd)		AAD Reuse (mgd)	
	2021	2045	2021	2045	2021	2045	2021	2045
Broward County Total	224.18	280.63	208.25	207.38	0.02	0.09	17.82	51.06
Miami-Dade County Total	320.83	395.04	317.88	310.29	0.00	0.00	18.84	125.68
Monroe County Total	9.06	10.94	8.73	6.84	0.02	0.02	0.32	4.10
Palm Beach County Total	121.59	163.02	67.03	87.02	4.27	2.11	60.49	85.76
LEC Planning Area Totals	**675.66**	**849.62**	**601.89**	**611.53**	**4.31**	**2.21**	**97.47**	**266.60**

AAD = annual average daily; mgd = million gallons per day.

Utilities currently distributing reclaimed water to customers intend to continue and expand their reuse systems as additional reclaimed water end users become available. Most major utilities in the region are planning to provide more reclaimed water and have begun or anticipate constructing the required treatment facilities by 2045. In many cases, future reuse will occur in new residential developments, which will decrease the demands needed from other sources for irrigation. In some areas, local government development approval requires use of reclaimed water and extension of reclaimed water pipelines, increasing the projected volume of reuse by 2045. However, much of the LEC Planning Area is already developed, which presents challenges to utilities needing to expand reuse distribution systems to new end users.

There are 19 distribution expansion projects, 2 storage projects, 7 treatment capacity expansion projects, and 4 projects with both treatment and distribution components proposed to be completed by 2045. The full listing of these proposed projects can be found in **Chapter 8**.

WATER STORAGE

Capturing surface water and groundwater during wet conditions for use during dry conditions increases the amount of available water. Approximately three-quarters of South Florida's annual rainfall of 57 inches occurs during the wet season. Without sufficient storage capacity, much of this water discharges to the ocean through surface water management systems and natural drainage. In the LEC Planning Area, potential water storage options include ASR systems and reservoirs, both of which are considered AWS options.

Aquifer Storage and Recovery

ASR involves storing stormwater, surface water, fresh groundwater, drinking water, or reclaimed water in an aquifer that has appropriate attributes (e.g., modest transmissivity, intergranular porosity, overlain by a competent confining unit, low ambient water salinity) and subsequently recovering the water. In this process, an aquifer acts as an underground reservoir for recharged (injected) water. The injected water is treated to appropriate standards, which may vary depending on the water quality of the receiving aquifer, and then pumped into the aquifer through a well (i.e., stored). The water is pumped back out (i.e., recovered) at a later date for use. The amount of water recovered depends on subsurface conditions, storage time, and water quality. The level of treatment required during recovery depends on the intended use of the water (e.g., public consumption, irrigation, surface water augmentation, wetlands enhancement).

The volume of water made available through ASR depends on several factors, including well yield, water availability, aquifer characteristics, variability in water supply and demand, and use type. There are uncertainties that need to be addressed with the implementation of ASR systems, but this storage option has the potential to retain substantial quantities of water that otherwise would be lost to the ocean, deep well injection, or evaporation.

Most of the ASR systems in the SFWMD have been built by PS utilities to store potable water during periods of low seasonal demand for subsequent recovery during periods of high demand. The SFWMD, in cooperation with the USACE, is pursuing regional ASR systems as part of CERP. The Loxahatchee River Watershed Restoration project, in northern Palm Beach County, includes the construction of up to four ASR wells in the project plan. Further information about these projects is provided in **Chapter 7**.

Figure 5-19 shows the locations of the ASR systems constructed in the LEC Planning Area and the source type. As described below, two are active, three are idle and available for operation (Hillsboro and MDWASD), one was abandoned (Broward County Water and Wastewater Services District 2A), and several others were repurposed as FAS supply wells (City of Sunrise, City of Fort Lauderdale, and Palm Beach County Water Utilities Department).

- **SFWMD Hillsboro CERP Pilot Project** – The SFWMD constructed and initially tested the Hillsboro ASR pilot project through 2012 using treated surface water from the Hillsboro Canal. The system was inactive until 2016, when it was briefly reactivated to store water during an unusually wet period. The system is currently inactive although the Lake Worth Drainage District is evaluating the potential of operating the system through an interlocal agreement approved in 2022 with the SFWMD.
- **City of West Palm Beach** – In 1996, the City of West Palm Beach constructed an ASR system at the water treatment plant and tested it through 1998 using partially treated surface water from Clear Lake. The system was inactive until 2012, when the FDEP issued a permit to reactivate operational testing beginning in 2013. In 2015, the FDEP granted a limited aquifer exemption for the ASR system, allowing the city to eliminate the disinfection process. Since then, the city has continued operating the system although it has temporarily halted operation to conduct some upgrades to the filtration and pumping components.
- **City of Boynton Beach** – The City of Boynton Beach constructed its first ASR system at the East Water Treatment Plant in 1992 and has since stored treated drinking water in the UFA for recovery to meet peak demands. The city constructed a second ASR well in 2007 and since then has used both wells annually to meet peak seasonal demands.

Boynton Beach ASR System

- **Miami-Dade Water and Sewer Department** – The MDWASD has constructed two ASR systems at its West and Southwest wellfields, with the intention of recharging wet season groundwater from supply wells completed in the Biscayne aquifer. Both systems have remained largely dormant; however, the utility is considering activating the wells at the Southwest wellfield for cycle testing within the next year.

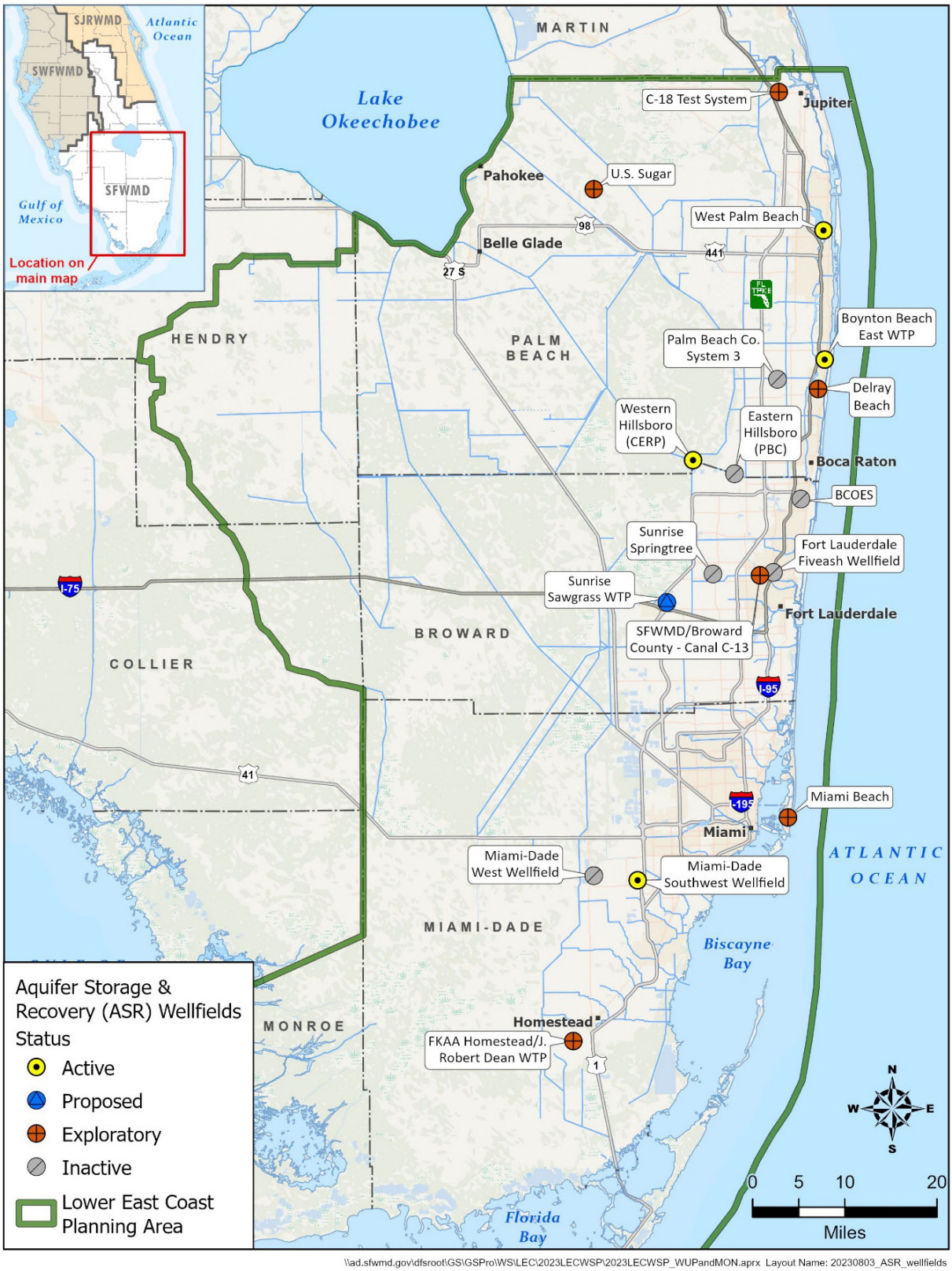

Figure 5-19. Floridan aquifer system aquifer storage and recovery systems within the LEC Planning Area.

Local and Regional Reservoirs

Surface water reservoirs allow storage of water, primarily captured during wet weather conditions, for use in the dry season and are considered an AWS source. Water typically is captured and pumped from rivers or canals and stored in aboveground or inground reservoirs, which are referred to as off-stream reservoirs. The C-51 Reservoir is an example of a large-scale, off-stream regional reservoir. Small-scale (local) reservoirs are used by agricultural operations for storage of recycled irrigation water or collection of stormwater runoff. These reservoirs also may provide water quality treatment before off-site discharge. Large-scale (regional) reservoirs are used for stormwater attenuation, water quality treatment in conjunction with STAs, and storage of seasonally available water. Examples include Grassy Waters Preserve, the C-51 Reservoir, and the EAA A-2 Reservoir and STA. Water supply development projects designed to capture, treat, and store water are discussed in **Chapter 7**.

C-51 Reservoir

The C-51 Reservoir project consists of two phases. The C-51 Reservoir Phase 1 project is a public-private partnership developed by Palm Beach Aggregates, LLC, in cooperation with PS utilities and water supply authorities for use as an AWS source by offsetting increased wellfield withdrawals. The C-51 Reservoir (**Figure 5-20**) is a former rock mine owned by Palm Beach Aggregates in central Palm Beach County, north of the C-51 Canal in Palm Beach County and adjacent to the SFWMD's L-8 flow equalization basin (FEB). Ten PS utilities have executed agreements with the property owners to purchase capacity as part of total reservoir storage. The utilities have modified their water use permits to reflect this AWS source as a means for meeting future demands. All 10 participating PS utilities have entered into capacity allocation agreements for the total of the available 35 mgd in Phase 1 as follows:

Table 5-3. Ten participating Public Supply utilities and total committed capacity.

Utility	Capacity (mgd)
BCWWS District 1	1.00
BCWWS District 2A	2.00
BCWWS SRW	3.00
Dania Beach	1.00
Fort Lauderdale	3.00
Hallandale Beach	1.00
Margate	2.00
MDWASD	15.00
Pompano Beach	2.00
Sunrise	5.00
Total Committed	**35.00**

BCWWS = Broward County Water and Wastewater Services; BCWWS–SRW = Broward County Water and Wastewater Services South Regional Wellfield; MDWASD = Miami-Dade Water and Sewer Department; mgd = million gallons per day.

The area that comprises Phase 1 has been designed to store an estimated 14,000 acre-feet of surface water and provide up to 35 mgd of canal/SAS recharge near PS withdrawals and was completed in 2023. The FDEP has issued a diversion and impoundment consumptive use permit and an environmental resource permit for construction and operation of Phase 1. A connection between the C-51 Reservoir Phase 1 and the L-8 FEB was completed in 2023.

Phase 2 of the project could provide an additional 46,000 acre-feet of storage, capable of producing 155 mgd of water during the dry season under 1-in-10-year drought conditions. The FDEP has issued a conceptual environmental resource permit for Phase 2. The design of Phase 2 has commenced.

The SFWMD continues to explore its operational role and was authorized by the FDEP in Consumptive Use Permit 50-301070-003 to withdraw 4,889 million gallons of water annually from the C-51 Canal to fill the reservoir during wet weather conditions. In 2011, a memorandum of understanding between the SFWMD and Palm Beach Aggregates was executed to identify the responsibilities of each entity for design, finance, construction, conveyance, assistance in permitting, and operation of the project. As part of this process, utilities and local governments approved creation of the C-51 Governance and Finance Work Group, which conducted a third-party review of the project (C-51 Governance and Finance Work Group 2015). Utilities have revised their water use permits to address applicable regulatory criteria to use the reservoir as a water source.

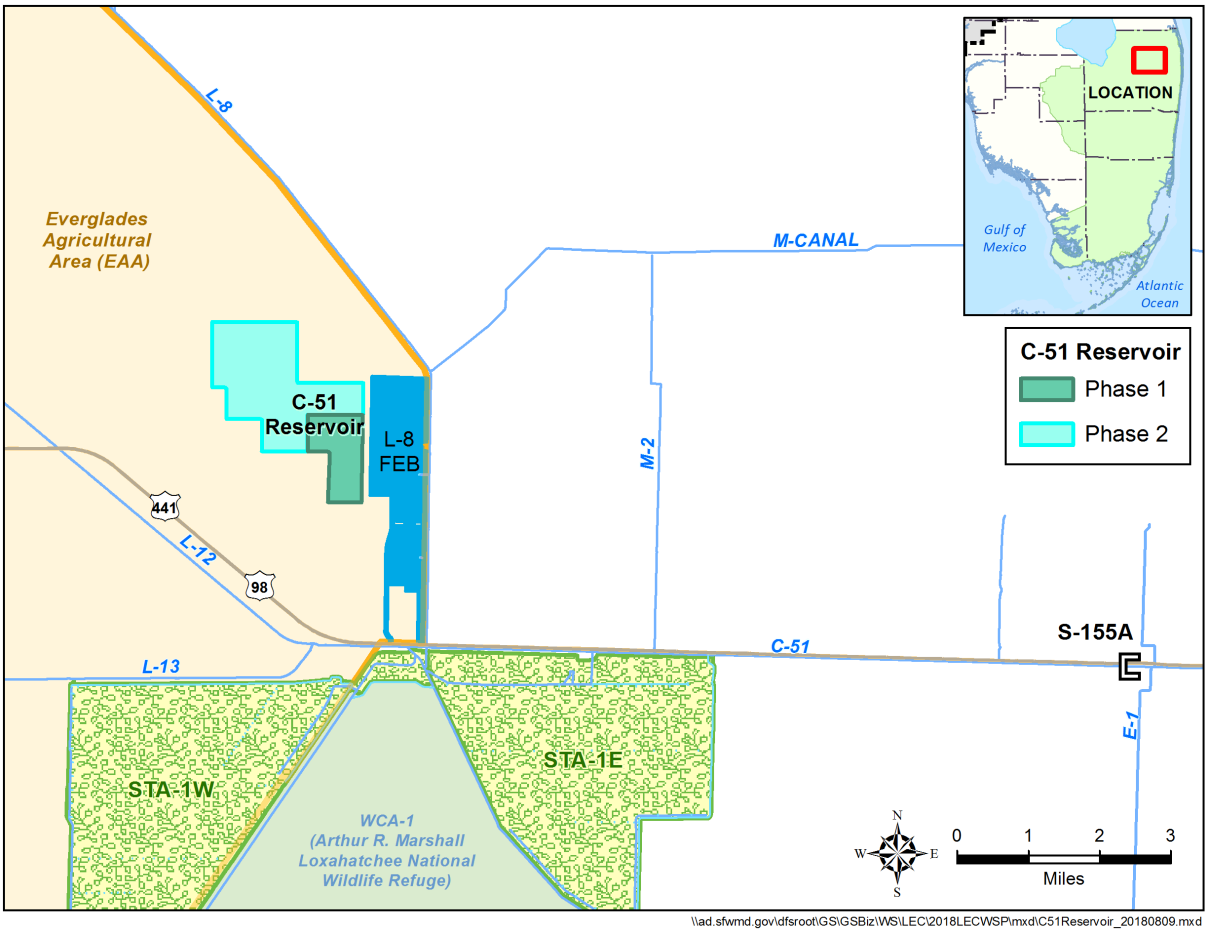

Figure 5-20. Proposed C-51 Reservoir in central Palm Beach County.

Everglades Agricultural Area A-2 Reservoir and Stormwater Treatment Area

The EAA A-2 Reservoir and STA is a joint Everglades restoration project between the SFWMD and the USACE and is part of the Central Everglades Planning Project (CEPP). The USACE is constructing the reservoir, which will be 10,500-acres, 23 feet deep, with 240,000 acre-feet of water storage. The SFWMD has constructed the EAA A-2 STA, which is a 6,500-acre treatment wetland. The treatment wetland has been scheduled with an initial hydration date of December 2024. The EAA A-2 STA will use three separate treatment cells of aquatic vegetation to naturally remove nutrients from the water before it flows south into the Everglades. This project, together with conveyance improvements to the North New River and Miami canals, will capture, store, treat, and deliver an additional annual average of 370,000 acre-feet of clean water to the Everglades and Florida Bay, while protecting the St. Lucie and Caloosahatchee estuaries from damaging releases from Lake Okeechobee. Based on the most recently approved Integrated Delivery Schedule, all aspects of the EAA A-2 Reservoir and STA should be completed in Fiscal Year 2034. **Figure 5-21** shows the locations of both the reservoir and STA.

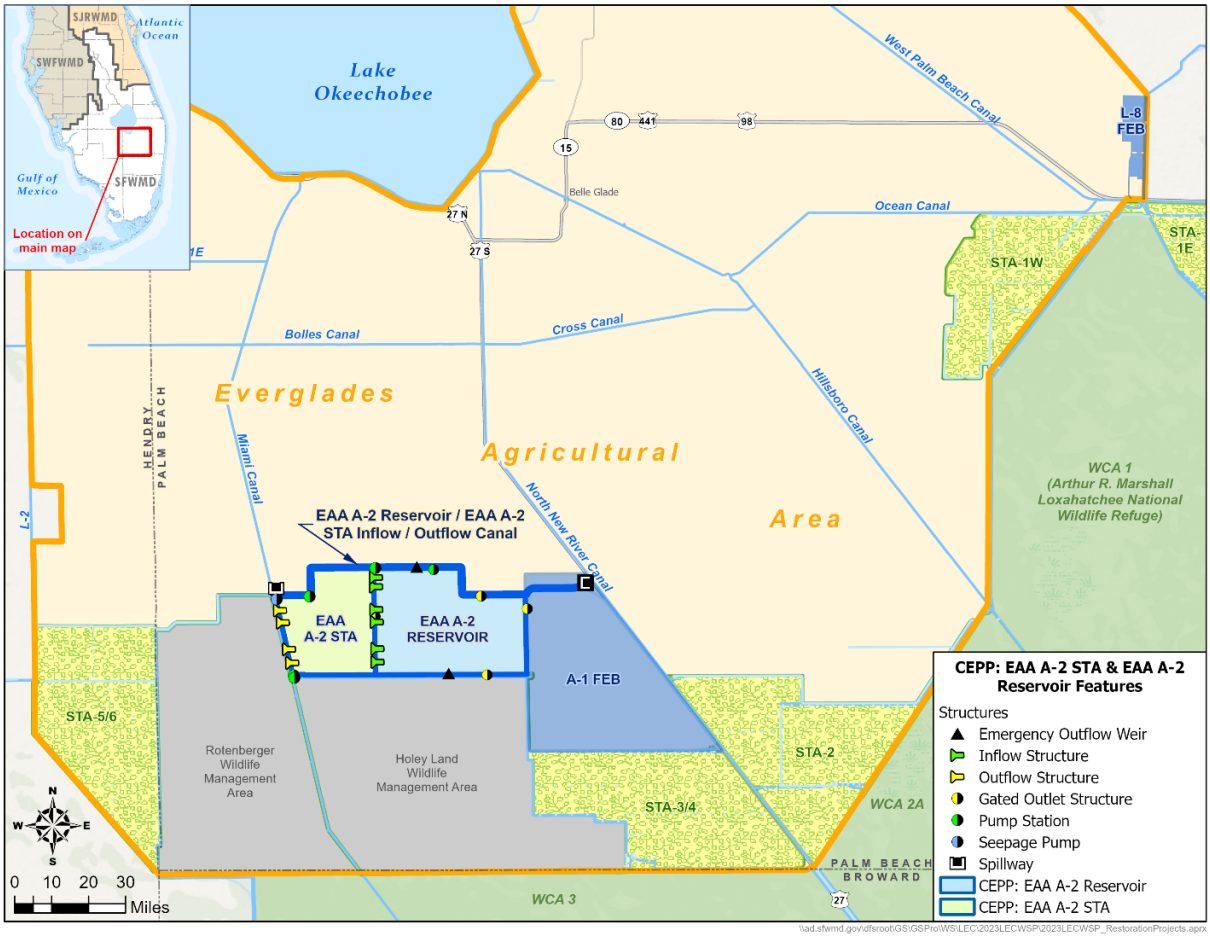

Figure 5-21. Everglades Agricultural Area A-2 Reservoir and Stormwater Treatment Area in Palm Beach County.

SEAWATER

The use of untreated and desalinated seawater from the Atlantic Ocean is an AWS source option for the LEC Planning Area. The SFWMD does not require water use permits for use of seawater. Three power generation facilities in the LEC Planning Area use untreated seawater for cooling purposes: FPL Riviera Beach Next Generation Clean Energy Center, FPL Port Everglades Next Generation Clean Energy Center, and FPL Dania Beach Clean Energy Center (**Figure 2-2**). The ocean is an abundant source of water; however, desalination is required before seawater can be used for most water supply purposes. Desalination treatment technologies include distillation, RO, and electrodialysis reversal. RO is the most common desalination technology. There are two RO seawater desalination treatment plants in the LEC Planning Area operated for emergencies by the Florida Keys Aqueduct Authority. The Stock Island plant—the first desalination plant built in Florida—can produce up to 2 mgd of potable water, and the Marathon plant can produce another 1 mgd. In addition, there is one proposed desalination plant in Crawl Key, which will be able to produce up to 4 mgd of potable water. Also, there are plans to expand and rehabilitate the existing Stock Island plant, adding another 4 mgd of potable water.

Major advances in seawater desalination treatment and efficiencies have occurred over the past decade. As a result, seawater desalination costs are declining; however, the cost of standalone seawater desalination facilities remains higher than brackish water desalination. Co-locating seawater desalination facilities with coastal power plants results in cost savings, decreasing the cost difference compared to other AWS options. Additional information regarding seawater desalination is provided in the 2021–2024 Support Document (SFWMD 2021).

SUMMARY OF WATER SUPPLY SOURCE OPTIONS

Water users in the LEC Planning Area rely on fresh groundwater and surface water for urban, agricultural, and industrial uses. However, traditional freshwater sources are not sufficient to meet projected 2045 water demands; therefore, continued development of AWS sources is needed.

The Herbert Hoover Dike rehabilitation was completed in 2023. In 2019, the USACE initiated development of the new LOSOM that was finalized in August of 2024. Analyses conducted as part of LOSOM indicate the LOSOM water control plan modestly improves water supply performance; therefore, Lake Okeechobee will remain in recovery status. A storage assessment analysis was performed as part of this 2023–2024 LEC Plan Update to support the revised MFL recovery strategy (**Appendix C**).

The SAS historically has served as the primary source of groundwater to meet PS demands in the LEC Planning Area. Large-scale expansion of SAS withdrawals is limited due to resource constraints, impacts to existing users, environmental impacts to natural systems, and water level decreases in the Western Basins.

Surface water bodies and the SAS will remain primary water sources for existing agricultural and landscape irrigation uses. Large-scale expansion of surface water and groundwater withdrawals is limited due to resource and regulatory constraints. As urban growth occurs,

some agricultural land is expected to transition to urban community uses. Many existing agricultural areas have water use permits to use fresh groundwater for crop irrigation. While water use permits cannot be directly transferred from one land use type to another, conversion of agricultural lands to another use may result in available fresh groundwater consistent with regulatory criteria.

In addition, the potential impacts of climate change and resulting sea level rise on water supply need to be better understood. Correspondingly, work on characterizing, monitoring, and designing adaption solutions should continue. **Appendix D** provides further details on climate change and sea level rise.

The following findings could increase the availability of water resources in the LEC Planning Area to meet the projected 2045 water demands:

- The FAS is a brackish water source that requires blending or desalination before use. Twenty-four PS utilities use the FAS as an AWS source to meet a portion of their demands. The FAS will provide an increasing portion of the water needed to meet 2045 projected demands. East Coast Floridan Model results, as discussed in **Chapter 6** and **Appendix D**, indicate the FAS will be able to meet demand in terms of volume and water quality.
- A decrease in 160 mgd of treated wastewater disposed of through ocean outfall and an increase in reuse of 145 mgd is expected from 2021 to 2045. Reclaimed water is primarily being reused for public access irrigation and PG cooling processes. Further development of reclaimed water as an AWS option is expected, mostly due to compliance with OOL requirements.
- Approximately three-quarters of the LEC Planning Area's annual rainfall of 57 inches occurs during the wet season; however, without sufficient storage capacity, much of this water discharges to tide. In the LEC Planning Area, potential types of needed water storage are under development, including ASR systems and reservoirs.
- Climate changes (e.g., increased air temperatures, changes in precipitation regimes, and increased storm frequencies) could result in greater evaporation, longer drought periods, and higher risk of flooding which could affect regional water resources. Therefore, climate changes need to be considered when evaluating the ability of water sources to meet future demands.

Water source options depend on location, use type, demand, regulatory requirements, and cost. As competition for limited water resources increases, development of AWS sources also will increase. The findings and conclusions of previous plan updates continue to represent the issues considered to meet the 2045 projected water demands within the LEC Planning Area.

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6

Water Resource Analyses

This chapter provides historical data and analyzes the current and future status of water resources in the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District) as well as their limitations and ability to meet the projected demands described in **Chapter 2**. The issues identified in this chapter may affect the use of existing water resources and the development of new supplies to meet projected water demands for 2045. **Appendix D** provides additional data and analyses regarding surficial aquifer system (SAS) groundwater elevations (levels), saltwater intrusion data and maps, electromagnetic induction logs, Floridan aquifer system (FAS) water quality, SAS groundwater modeling, climate change, and sea level rise. Understanding the effects of meeting water demands through withdrawals from water resources is critical to water supply planning.

TOPICS

- Summary of Issues and Considerations Identified for 2045
- Evaluation and Analyses
- Surface Water Availability
- Groundwater Availability
- Groundwater Models
- Climate Change and Sea Level Rise
- Summary of Water Resource Analyses

SUMMARY OF ISSUES AND CONSIDERATIONS IDENTIFIED FOR 2045

Traditional freshwater sources in the LEC Planning Area are not sufficient to meet 2021 and 2045 projected water use demands. Past analyses indicate that fresh groundwater, in conjunction with currently permitted surface water, is not adequate to meet the growing needs of the LEC Planning Area during 1-in-10-year drought conditions. As a result, water users from several use categories are expanding their use of alternative water supply (AWS) sources. Several Public Supply (PS) utilities are using brackish water from the FAS to meet a portion of their current demands and to meet increased demands through 2045. Several other PS utilities are permitted to use surface water from the C-51 Reservoir Phase 1 totaling 35 million gallons per day (mgd) to offset increased SAS withdrawals to meet a portion of their demands. To meet greenspace irrigation demands, the use of reclaimed water is projected to increase in the LEC Planning Area. Several golf courses are also using brackish water from the FAS and reverse osmosis to meet their water needs. Additionally, continued decreases in irrigated agricultural acreage and associated demands have resulted in reduced demands on surface water sources. The following issues and considerations identified in this *2023–2024 Lower East Coast Water Supply Plan Update* (2023–2024 LEC Plan Update) are

consistent with those in previous plan updates and continue to influence water supply planning efforts in the LEC Planning Area:

- Increased withdrawals from the SAS are limited by the Biscayne aquifer minimum flow and minimum water level (MFL), LEC Regional Water Availability criteria, potential impacts on the regional system, wetlands, pollution, and existing legal users as well as the potential for saltwater intrusion or upconing of relict seawater in the western portions of the planning area.
- Available water supplies for allocation in eastern Hendry County from the Lower Tamiami aquifer are constrained by the presence of isolated wetlands and the Lower West Coast Aquifers MFL, which is discussed in detail in the *2022 Lower West Coast Water Supply Plan Update* (SFWMD 2022a).
- Specific surface water volumes in eastern Hendry County are identified for the Seminole Tribe of Florida Big Cypress Reservation in addition to a secondary irrigation supply from Lake Okeechobee.
- Withdrawals from the FAS are expected to increase to meet future demands. Continued monitoring of water levels and water quality in the FAS is necessary to ensure long-term sustainability of the resource.
- The C-51 Reservoir Phase 1 is envisioned to deliver 35 mgd of stored surface water to several PS utility wellfields to offset increased SAS withdrawals in Broward and Miami-Dade counties.
- Climate change and sea level rise are increasingly likely to negatively affect the availability of freshwater resources in the LEC Planning Area.
- The new Lake Okeechobee System Operating Manual, associated with completion of the Herbert Hoover Dike repairs, will have effects on water supply and the Lake Okeechobee MFL.
- Recent developments by the United States Environmental Protection Agency on the regulatory criteria for polyfluoroalkyl substances or PFAS could require changes in the level of treatment required and may result in increased demands.

Previous LEC water supply plan updates identified a variety of AWS projects to avoid water resource impacts and competition among water users and to provide a sustainable supply of water. AWS projects include the use of reclaimed water, storage of water using aquifer storage and recovery wells and reservoirs, storage of surface water otherwise discharged to tide (e.g., C-51 Reservoir), and development and use of brackish water sources.

While the development of fresh groundwater is limited in many areas of the LEC Planning Area, it may be available in portions of the region. As population growth increases pressure for urban expansion, some agricultural land is expected to transition to urban community uses. While water use permits cannot be directly transferred from one land use type to another, conversion of agricultural lands to another use may result in available fresh groundwater and surface water.

EVALUATION AND ANALYSES

Data and information from many sources were considered in developing this water supply plan update. The following information sources were used to evaluate water resources in the LEC Planning Area, including their availability and ability to meet projected demands considering the issues listed above:

- Water use permits and permit applications
- Water supply demand projections for 2045
- Groundwater levels and groundwater quality data for the SAS and FAS
- Updated (2019) saltwater interface maps for Broward, Palm Beach, and Miami-Dade counties
- Input from planning area stakeholders and the public
- Updated Water Supply Facilities Work Plans and capital improvement elements from local governments
- Activities and progress since the *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update; SFWMD 2018), including AWS project implementation
- Data and information from the Comprehensive Everglades Restoration Plan (CERP), including status of CERP projects from the associated Integrated Delivery Schedule
- Lake Okeechobee System Operating Manual
- FAS groundwater modeling

Based on information from these data sources, issues identified in the 2018 LEC Plan Update (SFWMD 2018) were determined to be applicable for this 5-year plan update. The projected 2045 gross water demands for all water use categories in this plan update are more than the projected 2040 demands in the 2018 LEC Plan Update (**Chapter 2**). Total projected demand is estimated to increase by 3% primarily due to the Commercial/Industrial/Institutional (CII) and Landscape/Recreational (L/R) categories. As a result, the findings and conclusions of previous plan updates are still representative of current and projected scenarios.

SURFACE WATER AVAILABILITY

In the LEC Planning Area, surface water is primarily used for agricultural and urban irrigation and to a much lesser extent direct withdrawal for public supply. Notable surface water sources for the region are divided into five hydrologically related areas that include the Lake Okeechobee Service Area (LOSA), Everglades Protection Area (encompassing the water conservation areas), Everglades National Park and Florida Bay, Western Basins in eastern Hendry and Collier counties, and the Lower East Coast Service Areas, which are fully described in the 2018 LEC Plan Update (SFWMD 2018) and the 2022 *Physical Features and Water Resources of the South Florida Water Management District* (SFWMD 2022c) documents. Resource protection criteria (**Chapter 4**) must be considered when determining the availability of water sources. Surface water use is limited by restricted allocation area (RAA) criteria adopted for Lake Okeechobee and LOSA; North Palm Beach County/Loxahatchee River Watershed Waterbodies; and the L-1, L-2, and L-3 canal system (**Chapter 4**). The RAA

for Lake Okeechobee and LOSA restricts additional allocations of surface water from Lake Okeechobee and the integrated conveyance systems that are hydraulically connected to and receive water from Lake Okeechobee, such as the Hillsboro, North New River, and Miami canals. The RAA for the North Palm Beach County/Loxahatchee River Watershed Waterbodies limits net increases in the volume (or changes in timing) on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA above existing allocations. The RAA for the L-1, L-2, and L-3 canal system prohibits additional surface water allocations above existing allocations. Therefore, these water bodies cannot be relied upon to meet additional future demands. However, use of these surface water bodies has decreased with the decline in agricultural acreage. In the future, some surface water use may be replaced with AWS sources, such as reclaimed water, if it becomes available.

In addition to water supply, canals and other surface water bodies are used for flood control, groundwater recharge, and preventing saltwater intrusion among other uses. Depending on location, water elevations in canals are controlled to meet one or more objectives. Surface water level monitoring is a key component in managing surface water sources and is performed for a variety of reasons including the following:

- Evaluating saltwater intrusion potential by measuring freshwater head at coastal canal structures.
- Monitoring hydroperiods in natural and man-made water bodies (i.e., wetlands) by measuring surface water gauges.
- Guiding operations for flood control and water supply by measuring surface water levels in lakes, reservoirs, and canals.
- Establishing MFL criteria and monitoring compliance using surface water levels.

Several factors were considered when evaluating surface water availability to meet current and future demands in the LEC Planning Area. Based on monitoring data and resource protection criteria (i.e., RAAs, MFLs), surface water use for water supply is limited and is expected to remain so throughout the planning horizon. Increased future demands in the region likely will be met using groundwater sources.

GROUNDWATER AVAILABILITY

In the LEC Planning Area, approximately 70% of the total water demand is being met with groundwater, including 97% of PS demands. Monitoring programs are used to guide operations, provide early warning of threats to water supply, protect existing users and natural systems, and provide data for regional surface water and groundwater models. Monitoring programs associated with environmental restoration are identified in **Chapter 7**, and monitoring results can be found in the annual *South Florida Environmental Report* available at https://www.sfwmd.gov/sfer. Real-time and long-term climate monitoring information obtained by the SFWMD is available on the Resilience Metrics Hub (SFWMD 2023). Historical and current hydrologic, meteorologic, hydrogeologic, and water quality data for the 16 counties within the District's boundaries are available from the SFWMD's corporate environmental database, DBHYDRO, at https://www.sfwmd.gov/science-data/dbhydro.

The SAS and FAS are the major groundwater sources in the LEC Planning Area (**Chapter 5**). Historically, the SAS has served as the major source of fresh groundwater for the six use types (i.e., Public Supply, Domestic Self-Supply, Agricultural irrigation, Landscape/Recreational irrigation, Commercial/Industrial/Institutional, and Power Generation). However, past and present analyses of the SAS indicate that it is a limited source in many areas and, therefore, cannot be the primary source for all the projected water demands in the LEC Planning Area without harming the environment or the resource. The FAS has been and continues to be developed as an AWS source to meet increased demands for PS in the LEC Planning area. The SFWMD has previously developed a regional groundwater model for the FAS (i.e., East Coast Floridan Model [ECFM] and is currently developing a groundwater model for the SAS (i.e., East Coast Surficial Model [ECSM]) to evaluate the ability of these resources to sustainably meet future demands.

The following sections provide data and analyses of groundwater elevations and groundwater quality data in the SAS and FAS within the LEC Planning Area. Time-series graphs are plotted to evaluate these data, including identification of trends, if any. Water quality data in these time-series plots are provided by PS utilities as part of their water use permit monitoring requirements and from United States Geological Survey (USGS) monitor wells. Additional information about PS utilities, including permitted allocations, treatment facilities, and proposed projects, is available in **Appendix B**.

This chapter provides information on the following:

- Long-term trends in water levels and water quality at specific wells in the SAS (including Biscayne and Lower Tamiami aquifers)
- Location of the saltwater interface in the SAS for Palm Beach, Broward, and Miami-Dade counties and time-series graphs of chloride concentrations
- Historical water quality trends for FAS wells used by utilities and the regional FAS monitoring network
- Groundwater models
- Climate change and sea level rise

More detailed saltwater intrusion data and analyses, including electromagnetic logs from select wells and saltwater intrusion mapping and analyses, can be found in **Appendix D**.

Surficial Aquifer System Evaluation

In the coastal portions of the LEC Planning Area, a primary water supply concern for SAS users is saltwater intrusion, both laterally from the ocean and vertically from underlying salt water that has already intruded into the aquifer. Groundwater elevations and chloride concentrations are used to evaluate the rate and level of impact of saltwater intrusion. In the portions of Hendry and Collier counties within the LEC Planning Area, saltwater intrusion is not an issue; however, water levels are the principal concern regarding water supply availability in these areas. The SAS (and its associated wetlands) depend on local rainfall and lateral seepage from surface-water bodies and canals for aquifer recharge. During dry conditions, evapotranspiration increases, recharge diminishes, drainage persists, and irrigation and other demands increase, compounding stress on the SAS and wetland systems.

Surficial Aquifer System Groundwater Elevations

Historically, the SAS has been the primary source of potable water and urban irrigation water in the LEC Planning Area. PS utilities use both the SAS and FAS but are meeting increased demands with groundwater from the FAS. For water supply planning purposes, 12 monitor wells (locations labeled in **Figure 6-1**) in the LEC Planning Area were chosen to evaluate long-term trends in regional groundwater elevations (**Table 6-1; Figure 6-1**). These representative monitor wells generally show an annual wet-to-dry-season variation in groundwater elevations of approximately 2 to 4 feet, which is typical in rainfall-driven aquifers, such as the SAS, that are recharged by infiltration from rainfall and local surface water bodies. While the magnitude of these fluctuations may vary from year to year, the historical groundwater elevation time-series data shown in these hydrographs indicate relatively stable average groundwater elevation trends in the LEC Planning Area.

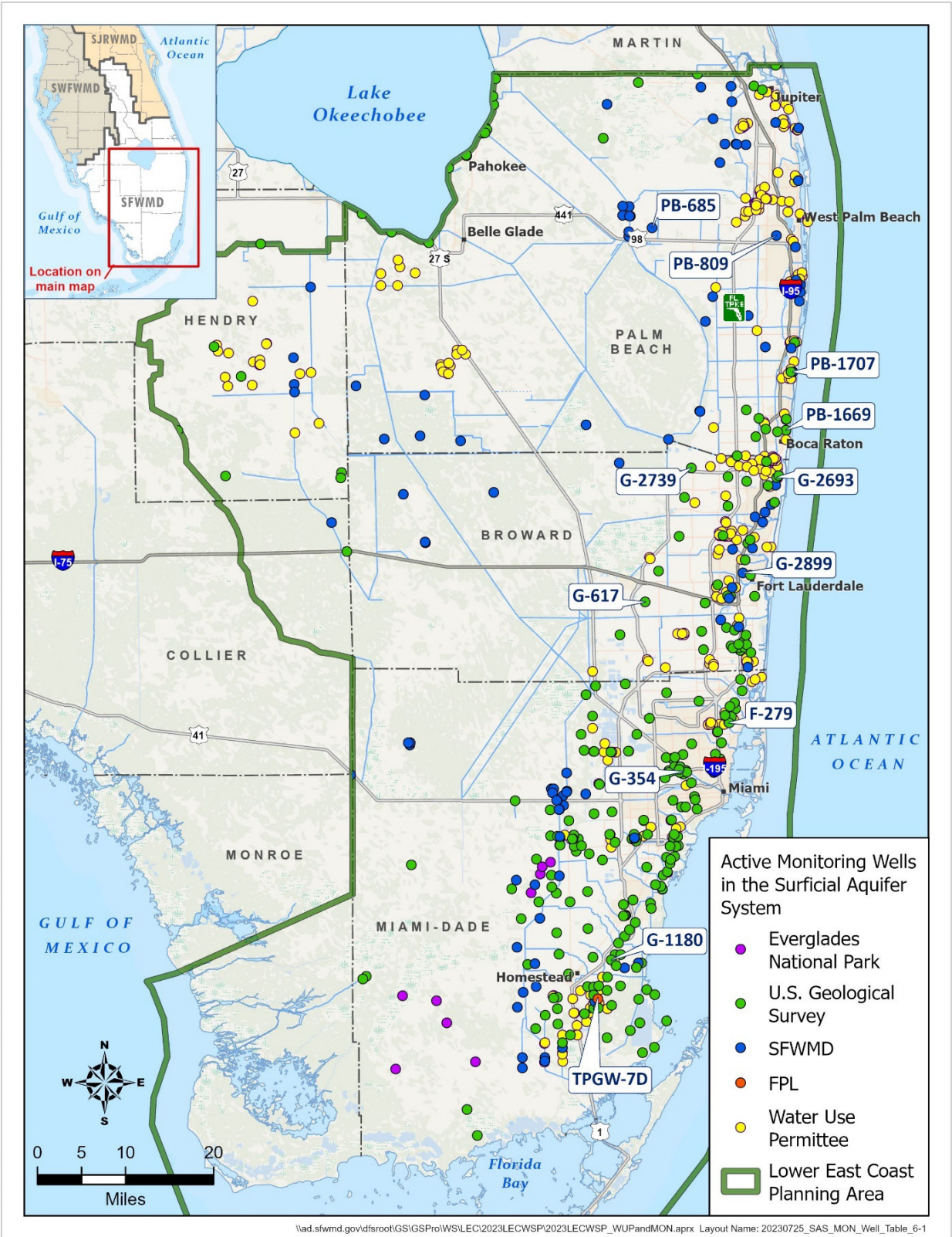

Figure 6-1. Locations of representative surficial aquifer system monitor wells and monitoring entities in the LEC Planning Area.

Table 6-1. Minimum, maximum, and average groundwater elevations for select surficial aquifer system monitor wells in the LEC Planning Area.

County	Well Name	Total Depth (ft bls)	Minimum Groundwater Elevation	Maximum Groundwater Elevation	Average Groundwater Elevation
Broward	**G-617**	29	2.98	4.85	3.89
	G-2693	229	1.94	7.13	4.50
	G-2739	21	5.60	9.16	7.80
	G-2899	165	0.65	3.74	1.82
Miami-Dade	**F-279**	117	0.99	3.91	1.65
	G-354	90	0.68	3.03	1.86
	G-1180	67	0.75	3.18	2.06
	TPGW-7D	114	-4.14	2.05	0.42
Palm Beach	**PB-685**	17	11.61	16.79	13.67
	PB-809	150	7.37	12.01	10.23
	PB-1669	131	2.84	9.17	4.95
	PB-1707	183	-0.90	5.25	2.42

bls = below land surface; ft = feet.
Notes: Groundwater elevations are in feet NGVD29 (National Geodetic Vertical Datum of 1929). The period of record is 1/01/2000 to 12/31/2022. Wells in bold font are presented here, with the remaining wells presented in **Appendix D**.

Figures 6-2 to **6-6** are long-term hydrographs for five shallow monitor wells located in inland Palm Beach, Broward, and Miami-Dade counties (**Figure 6-1**). These time-series hydrographs illustrate long-term seasonal fluctuations in groundwater elevations between each wet and dry season, as well as long-term trends in groundwater elevations. None of the time-series hydrographs in this section show long-term groundwater elevation trends. These monitor wells are near canal systems that can influence groundwater elevations in nearby wells, but only well G-617 is directly adjacent to a canal.

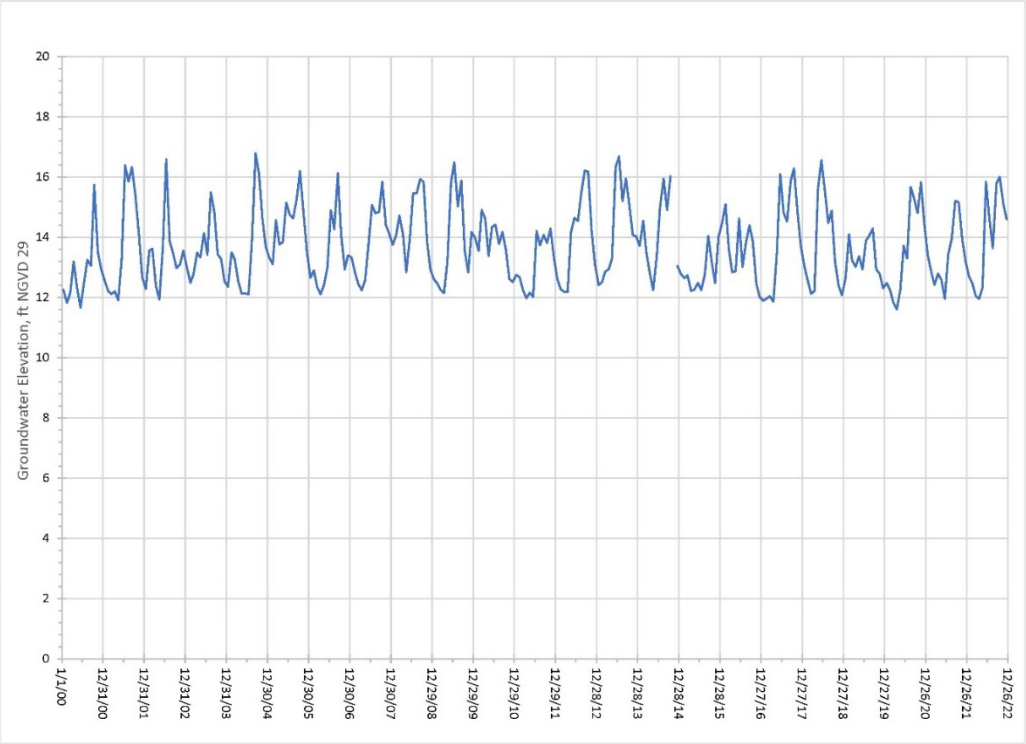

Figure 6-2. Groundwater elevations at surficial aquifer system well PB-685 (17 feet deep) in Loxahatchee, central Palm Beach County.

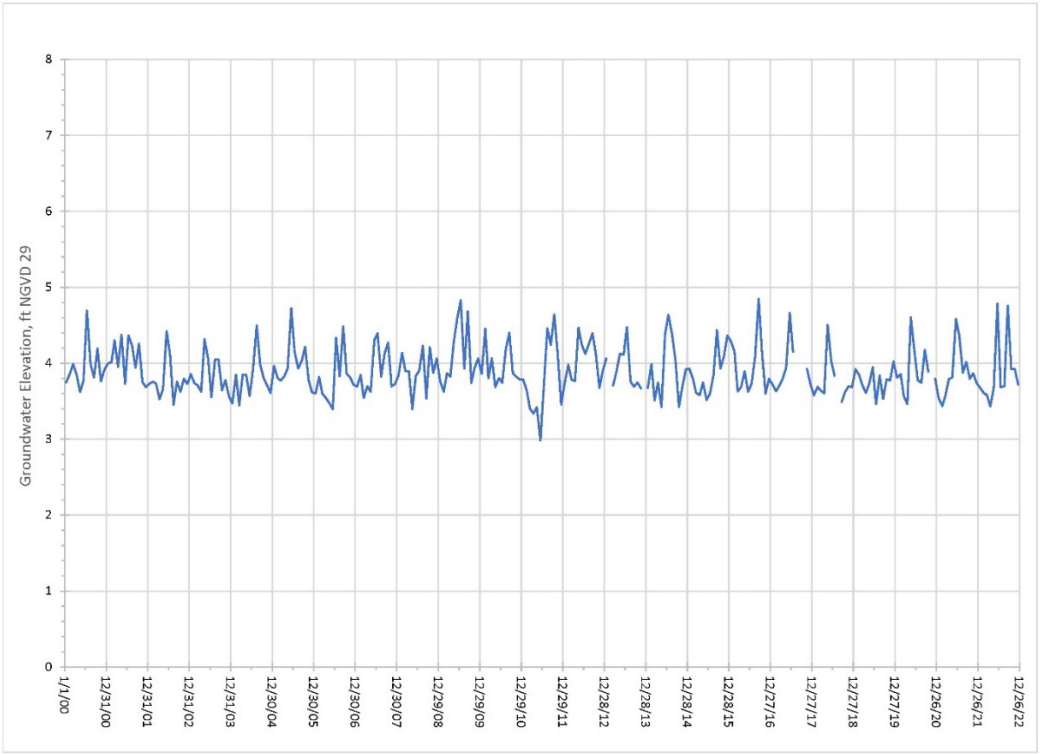

Figure 6-3. Groundwater elevations at surficial aquifer system well G-617 (29 feet deep) in Davie, central Broward County.

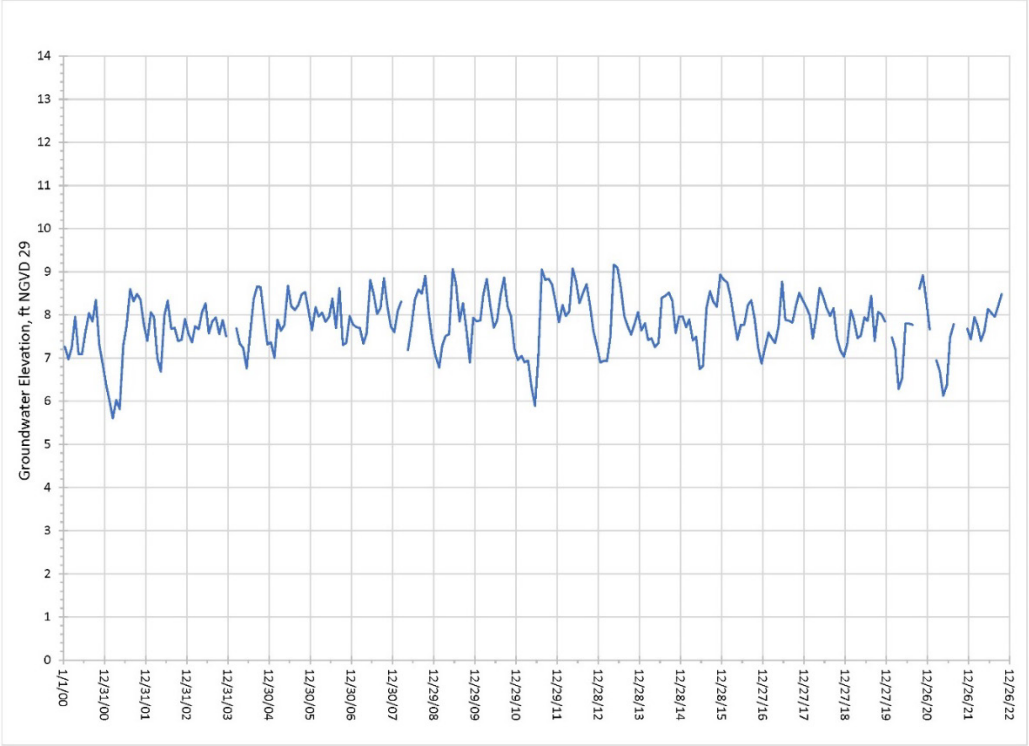

Figure 6-4. Groundwater elevations at surficial aquifer system well G-2739 (21 feet deep) in Parkland, northern Broward County.

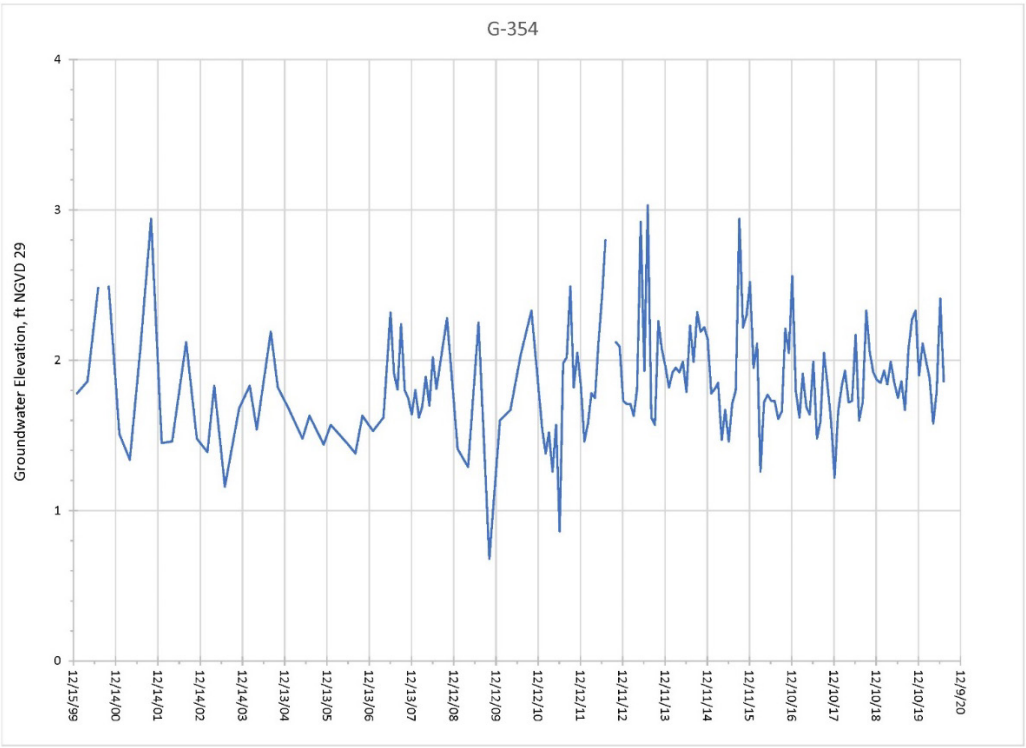

Figure 6-5. Groundwater elevations at surficial aquifer system well G-354 (90 feet deep) in Miami Springs, central Miami-Dade County.

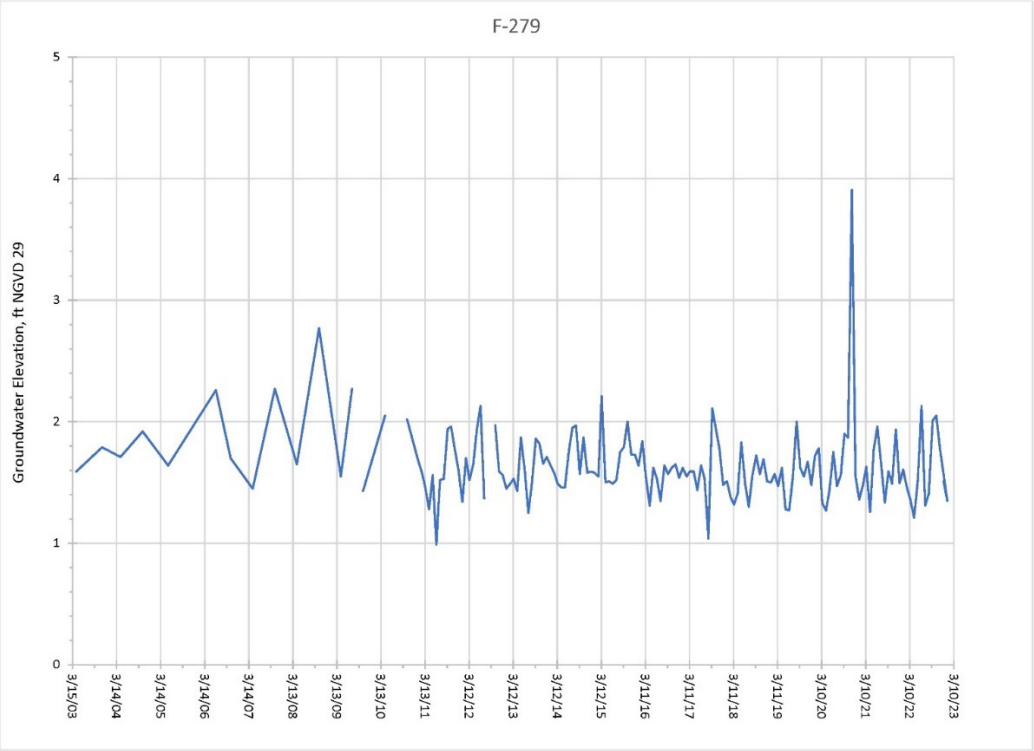

Figure 6-6. Groundwater elevations at surficial aquifer system well F-279 (117 feet deep) in North Miami, central Miami-Dade County.

Lower Tamiami Aquifer Maximum Developable Limit

In 2003, the SFWMD adopted maximum developable limit (MDL) permitting criteria for the Lower Tamiami aquifer (LTA), which underlies the portion of eastern Hendry County within the LEC Planning Area, as well as much of the Lower West Coast Planning Area. The MDL criteria limit withdrawals from the LTA in order to maintain the potentiometric head of the aquifer at an elevation that is at least 20 feet above the top of the aquifer at any point during 1-in-10-year drought conditions. LTA monitor wells are used to track regional groundwater elevations and ensure that the MDL is not exceeded (**Figure 6-7**).

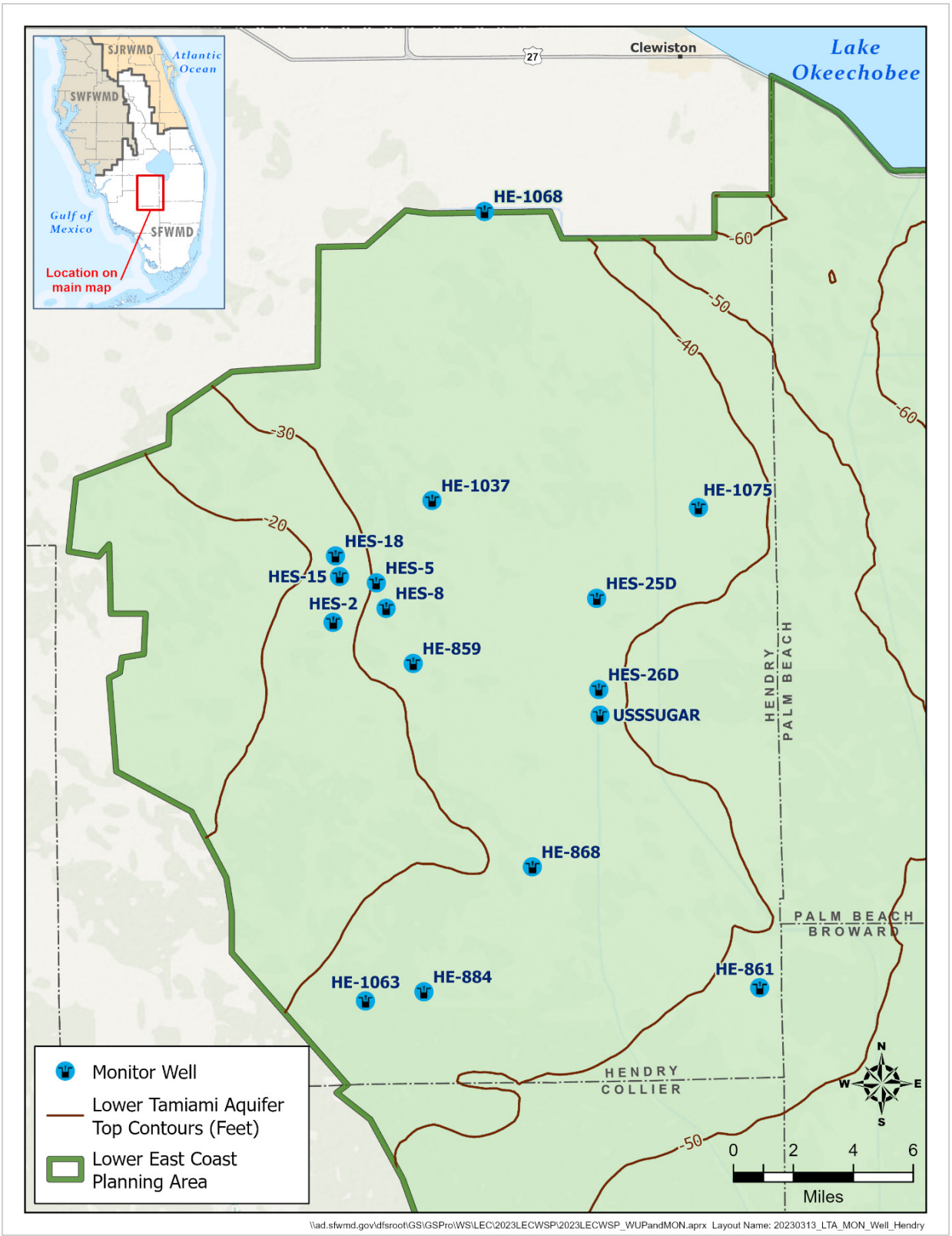

Figure 6-7. Contour map of the elevation of the top of the Lower Tamiami aquifer and locations of Lower Tamiami aquifer monitor wells, eastern Hendry County.

Figures 6-8 and **6-9** present hydrographs showing the MDL in relation to historical groundwater elevations in select monitor wells. The MDL for each well was determined based on the elevation of the top of the LTA as described in SFWMD's recent 2022-2023 hydrostratigraphic unit mapping update for the Lower West Coast aquifers (Zumbro et al. 2023).

Groundwater elevations in monitor well USSUGAR have come within 10 feet of the MDL in the past, with the most recent groundwater elevation low being recorded in spring of 2017. At HES-26D, groundwater elevations are generally 20 to 40 feet above the MDL, except for spring 2017, when the groundwater elevation briefly dropped below the MDL. Since that time, groundwater elevations at this well have fluctuated between approximately 14 and 36 feet above the MDL. Since 2017, the seasonally lowest groundwater elevations have been around -2 feet National Geodetic Vertical Datum of 1929 (NGVD29) as opposed to -5 to -16 feet NGVD29 prior to 2017.

Because agricultural water use in eastern Hendry County is expected to increase over the planning horizon (2021 to 2045), groundwater levels will require close monitoring, particularly in areas where the MDL has been reached or exceeded during 1-in-10-year drought conditions. AWS options may need to be developed in some areas to ensure adequate future supply and prevent harm to the aquifer (**Chapter 7**).

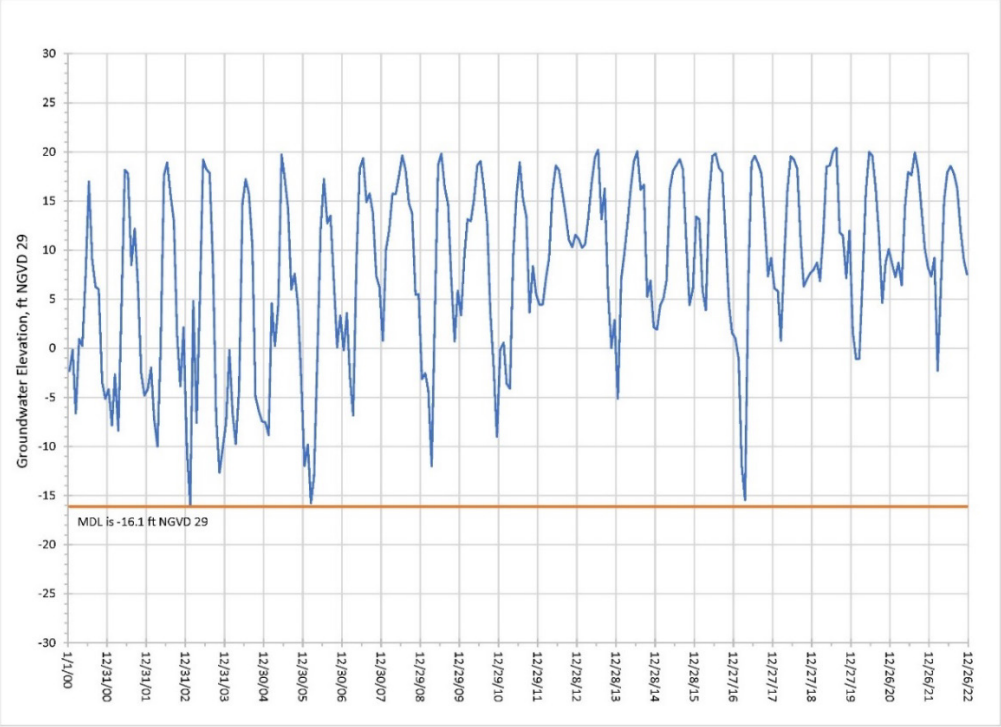

Figure 6-8. Groundwater elevations in Lower Tamiami aquifer well USSUGAR (100 feet deep), and associated maximum developable limit elevation, eastern Hendry County.