March 1, 2021

2021 SOUTH FLORIDA Environmental Report

Water Year 2020 (May 1, 2019–April 30, 2020)

Figure 1. *Blue-winged teals in flight in the flooplain of the Kissimmee River Restoration Project Phase I restoration area.*

HIGHLIGHTS

The *2021 South Florida Environmental Report* (SFER) documents an important year of restoration, scientific, and engineering accomplishments in the Kissimmee Basin, Lake Okeechobee, Everglades, and South Florida coastal areas. The report also provides extensive peer reviewed research summaries, data analyses, financial updates, and a searchable database of environmental projects. The report covers environmental information for Water Year 2020 (WY2020; May 1, 2019–April 30, 2020) and project budgetary information for the South Florida Water Management District (SFWMD or District) Fiscal Year 2020 (FY2020; October 1, 2019–September 30, 2020). The full 2,333-page report is available at www.sfwmd.gov/sfer.

PROGRESS RELATED TO EXECUTIVE ORDER 19-12: ACHIEVING MORE NOW FOR FLORIDA'S ENVIRONMENT

Governor Ron DeSantis signed *Executive Order 19-12: Achieving More Now For Florida's Environment* to implement major reforms and ensure the protection of Florida's environment and water quality. The order urged immediate action and investment in water quality and Everglades restoration. In response, SFWMD continues expediting critical Everglades restoration projects and expanding its water quality monitoring network (see *Northern Everglades and Estuaries Protection Program (NEEPP) Update* section beginning on page 16). In November 2019, the Governor released his "Bolder, Brighter, Better Future Budget," which calls for funding of $2.5 billion over four years. This is the largest funding for Everglades restoration and water quality improvements in Florida's history. To keep the public informed about important projects, SFWMD created a special web page where the public can monitor the progress of these important projects.

Momentum Building for Sending More Water South, Blasting Began for Canals at EAA Reservoir Project Site

Under the leadership of Governor DeSantis, Florida Department of Environmental Protection (FDEP) Secretary Noah Valenstein, and the SFWMD Governing Board, construction began for the Everglades Agricultural Area (EAA) Reservoir Project ahead of schedule. SFWMD began working on the project site in April 2020 for the 6,500-acre treatment wetland component, known as a stormwater treatment area (STA), of the EAA Reservoir Project.

The EAA Reservoir Project is one of the most important Everglades restoration projects of the Comprehensive Everglades Restoration Plan (CERP). The project will provide ecological benefits, reduce harmful discharges to the St. Lucie and Caloosahatchee estuaries, and send more clean water south to the Everglades. Governor DeSantis expedited this critical Everglades restoration project on his second day in office with the signing of Executive Order 19-12.

"When I took office, I made expediting the EAA Reservoir Project a top priority. Beginning construction means we are a big step closer to moving more clean water south to the Everglades and lessening harmful discharges from Lake Okeechobee into the Caloosahatchee and St. Lucie estuaries." - Governor Ron DeSantis

On August 28, 2020, SFWMD reached another milestone in the ongoing effort to expedite the EAA Reservoir Project. Blasting began on the project site for the canals needed to deliver water into the 6,500-acre STA component of the project (Figure 2). The blasts are part of the construction of the seepage canals and intake/outflow canals necessary for the EAA Reservoir Project's STA to receive and clean water. The blasts displaced 10,000 cubic yards of limestone to start building the canals. Once completed, the canal will be able to move 3,000 cubic feet per second (cfs) of water into the STA for cleaning so it can be moved south to the Everglades.

Figure 2. *Blasting for a canal at the EAA Reservoir Project site on August 28, 2020. (Photo by SFWMD.)*

SFWMD Completes S-333 North (S-333N) to Send More Water South

On October 21, 2020, Governor Ron DeSantis joined the leaders of FDEP, SFWMD, U.S. Army Corps of Engineers (USACE), and other state and federal officials to celebrate the completion of the S-333N structure (Figure 3). Projects like the S-333N and the entire Central Everglades Planning Project (CEPP) South will help restore the historic flow of water to the south to rehydrate Everglades National Park (ENP), deliver more fresh water to Florida Bay, and eliminate high water conditions in the Everglades Water Conservation Areas (WCAs) that hurt wildlife and plant communities. The S-333N structure, adjacent to the existing S-333 water control structure about 35 miles west of Miami, increases the amount of water that can be moved south through that area out of the WCAs and into ENP. The S-333N structure will work together with other critical Everglades restoration projects including the EAA Reservoir Project to decrease harmful estuary discharges and deliver more flows of water south. The structure can also be used during high water emergency situations to prevent high water conditions and wildlife drownings in the WCAs.

Figure 3. *Ribbon cutting ceremony for the newly completed S-333N structure. (Photo by SFWMD.)*

SFWMD and USACE Agreement to Move More Water South

The SFWMD Governing Board and USACE Jacksonville District entered into an agreement on July 27, 2020, to fund the CEPP South phase of CERP, which will move more water south to ENP. The project partnership agreement commits both SFWMD and USACE to construct projects that will result in billions of gallons of water flowing south. The agreement governs cost-sharing between the two agencies to fund components of CEPP South, one of three suites of projects that are part of the CEPP aimed at restoring the natural flow of water south from Lake Okeechobee to the Southern Everglades (see Figure 7 on page 4). CEPP South components include the construction of a pump station, installation of culverts and spillways, and removal of a roadway and levees that will all help increase flow of clean water south from WCA-3A to ENP. Under the agreement, the project construction costs are estimated to be $483 million of which SFWMD will fund approximately $241 million. The two agencies will share the estimated $7.4 million cost of maintaining and operating the components once they are built.

SFWMD Celebrates Completion of Water Quality Improvement Project North of Lake Okeechobee

On September 17, 2020, SFWMD and Lykes Bros. Inc. celebrated the completion of another of Governor Ron DeSantis' priority Everglades projects: the Brighton Valley Dispersed Water Management Project in Highlands County (Figure 4). The project is a public-private partnership with Lykes Bros. Inc. to provide important water storage and treatment north of Lake Okeechobee.

Figure 4. *Brighton Valley Dispersed Water Management Project. (Photo by SFWMD.)*

The 8,000-acre project pumps excess water from the C-41A canal and can capture 40,000 acre-feet (ac-ft) of water per year. It is anticipated to remove approximately 3 metric tons (t) of phosphorus and 27 t of nitrogen annually before it enters Lake Okeechobee. Project funding was provided by the Florida Legislature and is one of six regionally significant water quality improvement projects under the Northern Everglades Public Private Partnership Program.

SFWMD Removing Barrier to Moving More Water South

Removal of the Old Tamiami Trail roadbed (Figure 5) will restore flow of clean fresh water south. SFWMD is hard at work removing a 5.5-mile section of Old Tamiami Trail in Miami-Dade County to restore the natural flow of clean fresh water south. To keep progress going, SFWMD crews began working to remove the roadway in March 2020. The project is expected to be completed by January 2022. SFWMD and its partner agencies, including USACE, National Park Service, and Florida Department of Transportation, are also working on completing several other projects such as raising sections of Tamiami Trail that will also increase the flow of water south to ENP.

Figure 5. *Removing the roadbed of the old Tamiami Trail. (Photo by SFWMD.)*

SFWMD, FDEP, and Local Governments Completed a Feasibility Study on Ensuring Clean Water from the Caloosahatchee (C-43) Reservoir

SFWMD has invited the public to learn more about the Caloosahatchee Reservoir Water Quality Feasibility Study and provide input and ideas about additional water quality improvements for the Caloosahatchee River (C-43) West Basin Storage Reservoir Project. The reservoir will have a volume of approximately 170,000 ac-ft to store and release local basin stormwater runoff to reduce the need for releases to the Caloosahatchee Estuary (Figure 6) during the wet season and provide water needed to balance salinity levels during the dry season.

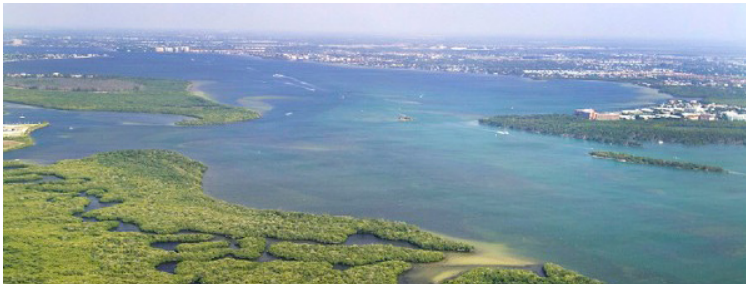


Figure 6. *The mouth of the Caloosahatchee River and Estuary. (Photo by SFWMD.)*

The feasibility study is being conducted by the Caloosahatchee Reservoir Water Quality Feasibility Study Working Group, which includes SFWMD, FDEP, Lee County, Hendry County, Lehigh Acres Municipal Services Improvement District, the City of Cape Coral, and the City of Sanibel. The first and second workshops took place in Fort Myers, Florida, on September 27, 2019, and LaBelle, Florida, on January 21, 2020, respectively. The remaining workshops were conducted online on March 25, July 16, and December 2, 2020. The working group successfully evaluated and presented to the public various treatment options. The list of available technologies and possibilities has been narrowed and the group is identifying the finer details of the project to address the needs of water quality treatment for the Caloosahatchee (C-43) Reservoir as identified in the Governor's Executive Order 19-12. The currently scheduled end date for the study is August 2021.

REQUIRED REPORTING FULFILLED BY 2021 SFER

The Florida Statutes (F.S.) contain specific reporting requirements that the SFER fulfills.

Consolidated Water Management District Annual Report

§373.036(7), F.S., requires a consolidated report on the management of water resources be submitted annually. The 2021 SFER fulfills this requirement for SFWMD:

Volume I

- Appendix 1-2 provides the Everglades restoration report.
- Appendix 1-3 provides the Everglades Trust Fund expenditure report.
- Chapters 3A, 3B, 4, 5A, 5B, 5C, 6, and 7 and associated appendices provide an update on Everglades progress.
- Chapters 8A and 8B provide the Lake Okeechobee Protection Program progress report.

Volume II

- Chapter 2 provides the annual work plan.
- Chapter 3 provides the minimum flows and minimum water levels (MFLs) annual priority list and schedule.
- Chapter 4 provides the five-year capital improvements plan.
- Chapter 5A provides the five-year water resource development work program and alternative water supplies updates.
- Appendix 5A-1 lists basin management action plan (BMAP) or recovery or prevention strategy projects.
- Chapter 5B provides a priority ranking and quantitative estimate benefits for projects and a grade for each watershed, water body, or water segment.
- Chapter 6A provides the Florida Forever work plan report.
- Chapter 7 provides the mitigation donation report.

Everglades Forever Act

The Everglades Forever Act (EFA; §373.4592, F.S.) requires restoration efforts for the Everglades Protection Area (EPA), which includes the Everglades WCAs and ENP within the Southern Everglades (Figure 7).

The EFA requirements include Everglades STAs, nutrient source control programs, integration with CERP components, and implementation of the *Restoration Strategies for Regional Water Quality Plan* (SFWMD 2012). The state Phosphorus Rule (62-302.540, Florida Administrative Code or F.A.C.) sets a long-term goal of 10 parts per billion (ppb) or micrograms per liter (µg/L) phosphorus for the EPA.

The EFA has specific requirements for Everglades research and monitoring. Data and findings must be provided as part of the consolidated annual report discussed above and it must be peer reviewed.
Volume I reports on these findings:

- Appendix 1-3 fulfills financial reporting requirements.
- Chapters 3A and 3B and Chapter 4 appendices report on water quality.
- Chapter 4 reports on nutrient source control programs.
- Chapter 5B and its appendices provide information related to the Everglades STAs.
- Chapter 5C reports on research seeking to optimize the design and operation of the STAs and other treatment and management methods.
- Chapter 6 reports the ecological and hydrological needs of the EPA.
- Chapter 7 provides information on the monitoring and control of exotic species within the SFWMD boundaries including the EPA.

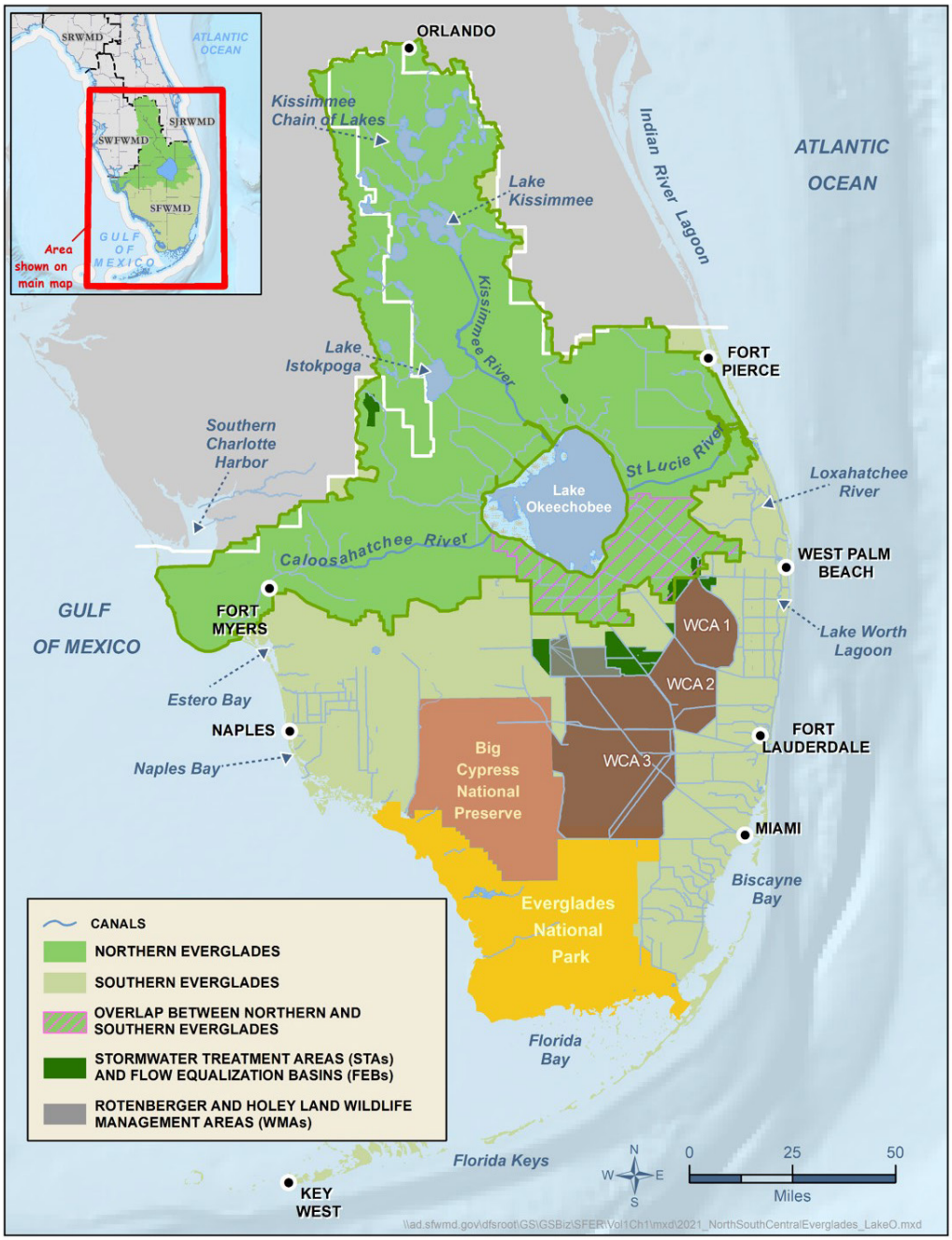


Figure 7. *Map showing Northern and Southern regions of the Everglades.*

Northern Everglades and Estuaries Protection Program (NEEPP)

§373.4595, F.S., requires restoration of the Northern Everglades including Lake Okeechobee and its watershed, the St. Lucie River Watershed, and the Caloosahatchee River Watershed. It requires the meeting of total maximum daily loads (TMDLs) for these water bodies. Restoration plans are published in watershed protection plans and BMAPs. In addition, the statute requires implementation of watershed construction projects, exotic species control programs, and research and water quality monitoring programs. Annual progress reports on fulfilling the mandates set forth in NEEPP legislation must be published and SFWMD has chosen to provide this information in the SFER. Progress reports are provided as follows:

- Chapter 8A: Northern Everglades and Estuaries Protection Program Annual Progress Report
- Chapter 8B: Lake Okeechobee Watershed Protection Plan Annual Progress Report
- Chapter 8C: St. Lucie River Watershed Protection Plan Annual Progress Report
- Chapter 8D: Caloosahatchee River Watershed Protection Plan Annual Progress Report

Annual Permit Reporting

Detailed permit-related annual reports and information pertaining to regional restoration projects are presented in Volume III. These reports are prepared annually to comply with permits issued by FDEP under the Comprehensive Everglades Restoration Plan Regulation Act (CERPRA; §373.1502, F.S.), EFA, NEEPP, and Environmental Resource Permitting (ERP; Chapter 373, Part IV, F.S., and Title 62, F.A.C.).

A more detailed discussion of the requirements mentioned in this section is provided in Chapter 1 of each of the three volumes of the SFER.

RESTORATION PROJECTS CONSTRUCTION AND OPERATION STATUS

Volume III of the 2021 SFER provides an annual update on environmental restoration projects to comply with permits issued by FDEP under CERPRA, EFA, NEEPP, and ERP state statutes. Currently, annual updates are provided for 6 projects under construction, 16 projects operating, and 6 projects operating that also had a phase or component under construction during the water year. Many of these projects are included in the priority project list that was developed as part of implementing *Executive Order 19-12*. WY2020 updates on most of these projects are provided below. Figure 9 on the next page shows the location of these projects. Restoration Strategies projects are discussed in more detail on page 14. Note that Volume III only provides information on projects that are under construction or are already operating. Projects in the planning stages during WY2020, such as the EAA Reservoir Project, do not yet require the submittal of annual permit reports.

Comprehensive Everglades Restoration Plan (CERP) Progress

Caloosahatchee River (C-43) West Basin Storage Reservoir

Once complete, the 10,700-acre reservoir with an average water depth of 17 feet (ft; deepest 25 ft) will have the capacity to store 170,000 ac-ft of water from Lake Okeechobee and runoff from the basin that is currently discharged to the river. The water will then be released when needed so the Caloosahatchee River and Estuary will have a more stable salinity regime. Recent progress follows:

- Construction of the 1,500-cfs S-470 inflow pump station, microwave tower, Townsend Canal improvements, and SR 80 bridge armoring is underway, with completion planned for March 2022.
- Six groundwater monitoring wells were plugged and abandoned to allow construction of the perimeter canal road. These wells will be relocated when road construction is complete.
- Construction of the approximate 19 miles of earthen embankment, 15 miles of perimeter canal, water control structures, bridges, and recreation features began in June 2019 with substantial completion scheduled for December 2023, and final completion in July 2024.

Biscayne Bay Coastal Wetlands

The purpose of this project is to rehydrate coastal wetlands and reduce abrupt point source freshwater discharge to Biscayne Bay and Biscayne National Park that are harmful to fish and benthic invertebrates in the bay near canal outlets. Recent progress includes the following:

- SFWMD completed land acquisition necessary to complete Biscayne Bay Coastal Wetlands (Phase I).
- The project was successful and short-term hydrologic improvements were realized in response to the Biscayne Bay Coastal Wetlands L-31E Flow-way Pilot Pump Test. The pump test improved quality, quantity, timing, and distribution of fresh water to Biscayne Bay, and minimized point source discharges by diverting freshwater flow to coastal wetlands via the L-31 East Flow-way culverts. This overland flow has improved saltwater wetlands salinity regimes, enhanced sheetflow, enhanced rehydration of freshwater and saltwater wetlands, and reduced salinity in surface water within the vicinity of the pump station and nearshore of this project. Pilot pump test results indicated that a 40-cfs pump station for this location meets all the project requirements.
- During WY2020, the project was unable to divert adequate fresh water through the L-31E culverts to the historical tidal wetlands and Biscayne Bay due to the inability to bring fresh water to the L-31E canal. SFWMD and USACE are building three pump stations to address this issue. As a result of the inability to pump water into the canal, water levels upstream and downstream of the L-31E culverts. were below the desired water level during low tide events.
- The wetlands remain dominated by a red mangrove overstory (20 to 57% cover) and white mangrove and buttonwood were also present. There were some plants in all plots, typically of the salt tolerant type. Periphyton was not observed to be forming cohesive mats likely indicating the predominance of higher salinity conditions.
- Expansion of sawgrass was observed within the project boundary along with various species of birds, amphibians, invertebrates, fish, and reptiles.

See Appendix 2-3 in Volume III for the annual permit report for this project.

C-44 Reservoir and STA

Part of the Indian River Lagoon-South project, the C-44 Reservoir (Figure 8) and STA will capture, store, and treat runoff from the C-44/S-153 basin prior to discharge to the St. Lucie Estuary, reducing damaging freshwater discharges, decreasing nutrient load, and maintaining desirable salinity regimes. The 3,400-acre reservoir with an average water depth of 15 ft will have the capacity to store 50,600 ac-ft of water. The STA will be approximately 6,300 acres. Status of the project follows:

- Construction of the C-44 STA was substantially completed in January 2021.
- Cells 1, 2, 3, and 4 became flow ready during WY2020.
- Cells 5 and 6 were under construction through the end of WY2020.
- C-44 Pump Station work was completed on November 28, 2018.
- Construction on the C-44 Troup Indiantown Pump Station commenced in August 2019 and was completed in February 2021.
- Note that the project experienced delays due to heavy rain from Hurricane Dorian in late August and early September 2019, and the completion schedule was extended accordingly.

Figure 8. *Aerial photo showing the C-44 pump station (center of photo), a small corner of the reservoir (left side), and a small part of the stormwater treatment areas (right side), located in southwestern Martin County. (Photo by SFWMD.)*

L-8 Flow Equalization Basin (FEB)

This Restoration Strategies feature is a deep belowground reservoir capable of storing approximately 45,000 ac-ft of water. It attenuates peak stormwater runoff flows, temporarily stores stormwater runoff, and improves delivery rates to STA-1 East and STA-1 West. This enhances the operation and phosphorus treatment performance of the STAs. Progress of the project follows:

- Routine operation began in December 2017 and continued throughout WY2020.
- A total of 50,129 ac-ft of water was conveyed into and 55,018 ac-ft of water was conveyed out of the L-8 FEB during WY2020.

Appendix 2-2 in Volume III provides the annual permit report for this project.

Figure 9. *Map showing the locations of restoration projects that are being constructed or are already operating.*

Picayune Strand Restoration Project
Restoration of 55,000 acres in southwestern Florida is being achieved by plugging 45 miles of canals, removing and degrading 260 miles of roads, construction and operation of three pump stations, and management of non-native species. Part of the project is in routine operations, while other components are still in the design and construction phase. Highlights for WY2020 are as follows:

- Work on the Southwest Protection Feature involved hydrologic modeling and engineering design for conveyance, construction of a levee to prevent flooding west of the project, and an environmental monitoring program. In August 2020, a permit was issued and contracts were awarded for levee construction and design of the conveyance features.
- The same permit allows the plugging of the upper 3.3 miles of the Faka Union Canal as modeling has shown that this can be plugged prior to the completion of the Southwest Protection Feature without negatively impacting lands west of the project. Clearing of vegetation from the spoil along the 3.3-mile section of the canal commenced in late summer 2020, and construction of engineered plugs under the tieback levee and spreader berm on the upper and lower side, respectively, of the spreader basin began in January 2021.
- Construction of the Miller Pump Station (S-486) by USACE was completed in June 2019 and transferred to SFWMD in March 2020.
- Both Faka Union (S-487) and Miller pump stations continue to be exercised but are not fully operational and will not begin routine operations until the Faka Union and Miller canals can be plugged. Plugging of Miller Canal and the remaining downstream portion of Faka Union Canal is scheduled for 2025 after construction of the Southwest Protection Feature is complete.
- The Miller Phase Logging Trams and Roads Removal contract was awarded in November 2019 and is expected to be complete in 2022.
- Approximately 4 miles of the Eastern Stair-Step Canal and the last quarter mile of the Merritt Canal have been plugged.
- Exotic fish and frog (Figure 10) populations have confounded documentation of restoration of native aquatic fauna within these groups of animals. However, there were significant changes in macroinvertebrate community structure from the baseline conditions including increased species richness, recolonization by several hydroperiod indicator taxa, and movement of macroinvertebrate communities in restored cypress and graminoid habitats toward reference conditions.
- The restored hydrology and associated reduction in severity of fires in the areas where the Prairie and Merritt canals have been plugged and are affected by the routine operations of the Merritt Pump Station is facilitating the recovery of wetland vegetation in this area and the elimination of upland vegetation that established after drainage.
- Vegetation management activities along the canal, road, logging tram, demolition, and remediation construction footprints have been effective in controlling the invasion of most exotic vegetation, resulting in natural vegetation reestablishing on these restored sites, particularly in areas where the hydrology has been significantly restored. However, exotic species that prefer wetter conditions have been invading the area and, subsequently, are being controlled to prevent their becoming problematic.

Figure 10. *The exotic Cuban tree frog (top) and native green tree frog (bottom). (Photos by SFWMD.)*

For additional information on the Picayune Strand Restoration Project, see Appendix 2-1 of Volume III.

C-111 Spreader Canal
This project, located in southern Miami-Dade County, will restore the quantity, timing, and distribution of water delivered to Florida Bay through Taylor Slough, optimize flow to support vegetation, restore flow patterns to historical sloughs and associated tributaries, and return coastal salinities in western Florida Bay as close as possible to historic levels by restoring upstream water levels in eastern ENP.

On October 9, 2019, SFWMD began implementing temporary operation adjustments intended to determine if operational changes to S-20 can maximize restoration benefits within the project area and if they can be made permanent. The adjustments are envisioned to be implemented through September 30, 2021. Appendix 2-4 of Volume III is the annual permit report for this project.

Central Everglades Planning Project (CEPP) S-333N Gated Spillway
Part of CEPP, the S-333N gated spillway will provide emergency, high water relief to WCA-3A. The fully automated, electrically operated, two-gate spillway has a design capacity of 1,150 cfs and is built adjacent to the existing S-333 gated spillway at the intersection of the L-67A and L-29 canals in Miami-Dade County. The project is complete and is in interim operations (Figure 11).

Figure 11. *Governor Ron DeSantis speaks at the S-333N ribbon cutting ceremony. (Photo by SFWMD.)*

WCA-3 Decompartmentalization and Sheetflow Enhancement (DECOMP) Physical Model (DPM) Test Project
The DPM Test Project is a large-scale field test located in Miami-Dade County along the southern end of the L-67A and L-67C canals within WCA-3. It is designed to address uncertainties with depth, hydroperiod, sheetflow, and canal backfilling associated with the full-scale CERP DECOMP project. Information gathered from the DPM Test Project will be used in the planning and design associated with the project. Features include 10 controllable gated culverts adjacent to the L-67A canal (S-152) in the L-67A levee, the degraded 3,000 linear ft of the L-67C levee, and three 1,000-ft treatment areas in the L-67C canal (no backfill, partial backfill, and complete backfill).

In February 2019, a permit was issued to SFWMD to continue the DPM Test Project, including operation of the S-152 structure. Operations were guided by the operating criteria included in Appendices A and B of the *Final Supplemental Environmental Assessment and Finding of No Significant Impact - Installation, Testing, and Monitoring of a Physical Model for the Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement Project* (USACE 2017). Two constraints limit operations of the S-152 structure: (1) the geometric mean total phosphorus (TP) concentration in the upstream canal over the period of S-152 operations (in a given water year) must be at or less than 10 parts per billion (ppb, which is equivalent to micrograms per liter [µg/L]), and (2) the WCA-3B gauge Site 71 (3-71) or SRS-1 must be at or less than 8.5 ft National Geodetic Vertical Datum of 1929 (NGVD29).

More information on DPM can be found in the *Physical Models Assist Researchers in Everglades Restoration* section of these Highlights, Chapter 6 in Volume I, and Appendix 2-7 in Volume III.

Ten Mile Creek Water Preserve Area (WPA)
This is a remediation project for water storage to improve the quantity and timing of water deliveries to the North Fork of the St. Lucie River by capturing and storing storm water originating in the Ten Mile Creek Basin and flowing through Ten Mile Creek (Figure 12). The project is also anticipated to help moderate salinity levels and reduce sediment loads in the St. Lucie River and Estuary. Progress of the project in WY2020 follows:

- A net inflow of 4,700 ac-ft of water was conveyed into the Ten Mile Creek WPA via inflow pump station S-382 and 507 ac-ft of water was conveyed out of the WPA via gated outflow structure S-384.
- Based on the review of available stage and flow data, the WPA operated as intended during the water year.
- The project had the additional benefit of phosphorus reduction. The TP flow-weighted mean concentration (FWMC) was 123 ppb (or µg/L) at the inflow and 18 ppb (or µg/L) at the outflow (S-384), representing a reduction of 85.4%.

Appendix 2-6, Volume III, is the annual permit report for the Ten Mile Creek WPA.

Figure 12. *Ten Mile Creek, WPA, and pump station. (Photo by SFWMD.)*

8.5 Square Mile Area and S-356 Pump Station
The purpose of this project is for interim operations and maintenance of the S-356 and S-357 pump stations and associated features. S-356 manages seepage to the L-30 and L-31N canals north of the Las Palmas Community (also known as the 8.5 Square Mile Area) within the interior of the outer levee (L-357W) while S-357 manages canal stages within the Las Palmas Community to prevent flooding as a result of increased flows to ENP as future phases of the Modified Water Deliveries to ENP project are implemented. Here is the WY2020 project status:

- All features have been constructed and the Combined Operating Plan (COP) is being implemented.
- SFWMD continued operation of the USACE constructed S-356 pump station consistent with the permit and the project's interim (i.e., prior to COP implementation) objectives.
- The operational scenario employed during WY2020 followed the criteria described in the Increment 2 Operational Strategy (SFWMD 2018a). USACE actively monitors the flood mitigation performance provided by the Modified Water Deliveries to ENP project and recommends changes to operations to facilitate meeting flood mitigation criteria. The criteria have been established in the approved COP.

For additional information see Appendix 2-5 in Volume III for the annual permit report.

Everglades Forever Act (EFA) Progress

Everglades STAs
These are considered EFA projects and an annual permit report (Appendix 3-1) is provided in Volume III. Also, Chapter 5B in Volume I provides information on the performance and operation of the Everglades STAs.

A-1 Flow Equalization Basin (FEB)
This Restoration Strategies feature is a 15,000-acre aboveground impoundment capable of storing approximately 60,000 ac-ft of water. It attenuates peak stormwater runoff flows, temporarily stores stormwater runoff, and improves delivery rates of water to STA-2 and STA-3/4. This enhances the operation and phosphorus treatment performance of the STAs. Progress during WY2020 is as follows:

- The project remained in routine operations during the water year.
- Approximately 299,393 ac-ft of water was conveyed into the FEB via structures G-720 and G-721 and approximately 209,767 ac-ft of water was conveyed out of it via structures G-722 and G-724A–J.
- Based on the review of available stage, flow, and water quality data, the A-1 FEB operated as intended and performed in a manner consistent with its design objectives.
- The A-1 FEB reduced the annual TP FWMC from 30 to 4 ppb (or µg/L), resulting in an annual TP load reduction of 87% (equivalent to 26 t).

The annual permit report for the A-1 FEB is Appendix 3-3 of Volume III.

Bolles East (L-16) Canal Conveyance Improvement
This project will increase the conveyance of water between the Hillsboro and North New River canals to improve operational flexibility of the Everglades STAs, help reduce flooding, and increase capacity to move water to the Everglades. The following is a WY2020 status update for the project:

- Construction continued throughout the water year.
- Segment 3, with the Jet Farms Bridge replacement (Figure 13), is expected to be completed in WY2021.
- On July 29, 2019, FDEP issued a minor modification to the permit authorizing construction of Segment 4. Segment 4 construction received the notice to proceed in November 2019 and final completion is anticipated in April 2021.

Figure 13. *Installation of the Jet Farms Bridge, part of the Bolles East (L-16) Canal Conveyance Improvement. (Photo by SFWMD.)*

Northern Everglades and Estuaries Protection Program (NEEPP) Construction Project Progress

Lake Hicpochee Hydrologic Enhancement
Located in the East Caloosahatchee Basin, Phase I of the project provides shallow water storage, rehydrate a portion of the lakebed to promote habitat restoration, and increase capacity for ancillary water quality enhancements. Substantial completion of the project was achieved on January 24, 2020.

Rolling Meadows Restoration Project
This project (Figure 14) will restore the natural habitat of an area known as Parcel B by establishing connectivity between the parcel and Lake Hatchineha and by the diversion of some of the flows from Catfish Creek into the parcel. Phase I was in routine operations and performed as designed during WY2020. For more information, see

Figure 14. *Rolling Meadows Restoration Project. (Photo by SFWMD.)*

Appendix 4-5 of Volume III.

Lakeside Ranch STA
Located in western Martin County on lands adjacent to Lake Okeechobee, this STA currently has an effective treatment area of 1,707 acres. Status of the project is as follows:

- Over the first 4 water years of operation (WY2014–WY2017), Phase I removed 37.7 t of TP that would have otherwise discharged to Lake Okeechobee from the S-191 basin.
- Phase II of the project transitioned from the initial operational testing and monitoring phase to the stabilization phase on September 23, 2019.
- The lack of available inflow to the project that began in WY2017 continued into WY2020 resulting in Phase I drying out, which resulted in vegetation decline and performance issues.
- The S-191 pump station is currently under construction.

See Appendix 4-3, Volume III for the annual permit report for this project.

Nubbin Slough STA
This is a pilot-scale STA located north of Lake Okeechobee designed to reduce phosphorus loading to the lake by capturing and treating runoff from Nubbin Slough. The STA is designed for an annual average TP load reduction of 3 to 5 t per year. Status of the project in WY2020 is as follows:

- The STA was in dryout during all of WY2020 due to the unavailability of fresh water. When available, water was retained primarily in Cell 1 to promote vegetative growth.
- Since there was no flow-through, the entire inflow TP load (384 kilograms), with an FWMC of 0.332 milligrams per liter (mg/L) was retained in the system. Having no flow-through is not the intended purpose of the system, but even under such a regime, the project diverted TP load from the downstream receiving body, attenuating the TP load input to Lake Okeechobee.
- In July 2019, to improve input pump functionality, the pump at station S-385 was adjusted to take advantage of the new Ovation telemetry system that allows better remote control and monitoring. The pump is now automatically turned on anytime the upstream stage is between 18.5 and 20.0 ft NGVD29, which is the full range of operation in the pump sump prior to bypass discharge at the S-385 weir at water elevations higher than 20.0 ft NGVD29. The result has been a significant increase in pump volume and a corresponding decrease in bypass weir flow.

Appendix 4-4 in Volume III is the annual permit report for this project.

Taylor Creek STA
This STA is a pilot-scale STA being implemented north of Lake Okeechobee, has an effective treatment area of 118 acres, and is predicted to remove up to 2 t of TP from the Taylor Creek drainage basin per year. Following is the WY2020 status of the project:

- The project demonstrated a net reduction in TP loads. The STA received 2,240 ac-ft of inflow and retained 0.4 t of TP of the 0.8 t received (54% TP load reduction).
- Dense floating aquatic vegetation accumulation in Taylor Creek prevented inflows via S-390 during June–July 2019 and March–April 2020. Although the STA was considered operational all year, there were five months with no outflow from the STA because pumping was avoided during the time of floating aquatic vegetation accumulation. The Florida Fish and Wildlife Conservation Commission (FWC) treated the accumulated vegetation in summer 2019 and March 2020.

Appendix 4-2, Volume III, contains the annual permit report for this project.

Environmental Resource Permit (ERP) Progress

Cypress Creek Restoration Project
Cypress Creek is a major tributary to the Northwest Fork of the Loxahatchee River, a federally-designated National Wild and Scenic River. This collaborative effort between Martin County and SFWMD will enhance the historic native biological community typical of the Loxahatchee River system by restoring wetland hydroperiods and improving natural storage, thus improving the timing of surface water discharges and base flow to the Northwest Fork. Martin County has secured all permits and easements associated with the project. Construction started in January 2021.

C-139 Annex Restoration
An approximately 15,000-acre former citrus grove in southeastern Hendry County will be restored to its historic condition as a wet prairie system with depression marshes, cypress domes, and hardwood hammocks (Figure 15). The project will provide benefits to groundwater, surface water, and water supply, and complement other comprehensive efforts to improve water quality for the Everglades. Phase I restoration activities have been underway since 2016. Removal of citrus trees within the Phase II restoration area began in late 2020 and will be completed in January 2021. The remaining construction for Phase II restoration started in January 2021.

Figure 15. *Caracara observed in the C-139 Annex Restoration. (Photo by SFWMD.)*

PHYSICAL MODELS ASSIST RESEARCHERS IN EVERGLADES RESTORATION

The District's actions and water management plans are based on the expertise of scientists, researchers, and modelers using the best available techniques and laboratory analyses. Unbiased and accurate data are mandatory for planning and implementing water quality improvements and environmental restoration efforts.

To assist with Everglades restoration, District scientists developed two physical models, the Loxahatchee Impoundment Landscape Assessment (LILA) and the Decomp Physical Model (DPM), to find answers to research questions that lead to refinement of restoration project designs and operations. Physical models are used in engineering and scientific research to provide insight on the response of some physical object to disturbance. Scientists and engineers utilize these models to provide insight into responses of components of the physical environment to changes on a landscape scale. Additional information on LILA, DPM, and the studies discussed in this section is available in Chapter 6 of Volume I.

Loxahatchee Impoundment Landscape Assessment (LILA)

LILA, a working, 80-acre model of the Everglades ecosystem (Figure 16), was built in 2003 at the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR) by SFWMD, U.S. Fish and Wildlife Service, and USACE. This "living laboratory" gives experts an opportunity to research and apply restoration techniques on a small, controlled scale before taking them into the 1.7 million-acre Everglades ecosystem. Scientists here can study the effects of water depth and flow rate on wading birds, tree islands, marsh plant communities, marsh fishes and invertebrates, and peat soils. Returning the flow to the currently impounded EPA is one of the goals of the ecosystem restoration effort.

Figure 16. *Aerial photo of the Loxahatchee Impoundment Landscape Assessment (LILA). (Photo by SFWMD.)*

The living laboratory is composed of four enclosed 20-acre marshes called "macrocosms" (Figure 17). Each macrocosm contains tree islands, ridges, and sloughs, which are the three key habitats found in the natural system of the EPA. Tree islands, the highest points in the marsh, support woody vegetation and are critical to the survival of both aquatic and terrestrial wildlife. Ridges are too wet for tree species and are dominated by sawgrass. Open water sloughs are at the lowest elevation and contain water lilies and other submerged aquatic plants that are critical for the survival of fish and other aquatic organisms. By providing different flows, inundation rates, and depths using a system of culverts, canals, and pumps, scientists can maintain specific conditions at LILA for their experimental designs in each macrocosm and study the effects of hydrology on water and soil processes, vegetation, and wildlife.

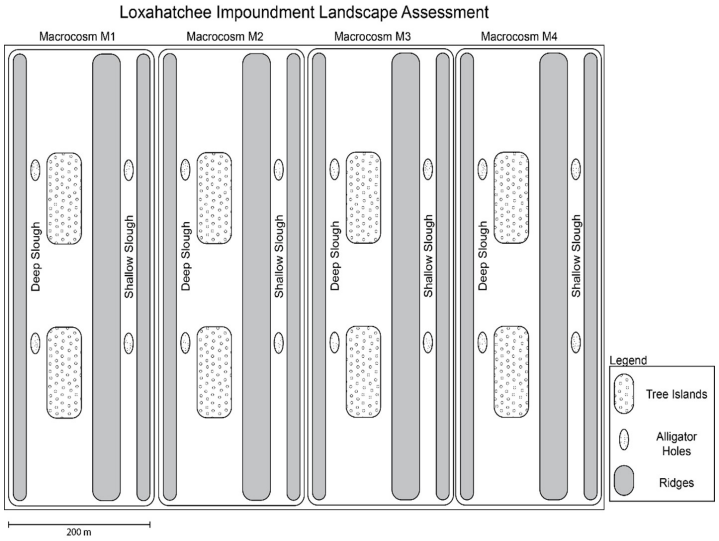


Figure 17. *Schematic of LILA.*

Each macrocosm includes a peat-based island that mimics the "battery" islands common in LNWR, and a limestone-core island that represents the "fixed" islands that form around bedrock highs throughout the Everglades. The islands were 233 x 141 ft upon construction with a flat center portion elevated ~3 ft above the surrounding slough surface. Peat islands were built from the organic surface sediments that characterized the pre-construction marshes. The core of the limestone island consisted of a 161- x 45-ft strip of locally-mined limestone along the central axis, capped throughout with ~1 ft of peat. The slopes from the central plateau of both island types were graded to 16:1 along the long north and south sides, and 12:1 along the shorter east and west edges.

In Chapter 6, Volume I, of the 2021 SFER, six LILA research projects are highlighted. A summary of these projects is provided here. The mandates assisted by these studies at LILA include CERP, CEPP, COP, EFA, and regulation and operational schedules.

Community Composition, Seasonality, and Impacts of Hydrological Regimes on Herpetofauna

Understanding the role that hydrological regimes play in structuring the herpetofaunal (amphibians and reptiles) community composition of the ridge-slough-tree island landscape in the Everglades will help meet CERP objectives. While there has not yet been a community-wide divergence as a result of the two hydrological treatments being tested in LILA, and as this new study has been in place for only two years, it appears that both native and non-native species respond to different hydrological regimes based on their individual natural histories. To date, these results provide support for two main points. First, the exotic brown anoles (Figure 18) respond positively to a constrained hydroperiod, suggesting that a drier Everglades may facilitate invasion. Second, these results demonstrate responses to the hydrological regimes are driven by individual species' natural history. Different native species responded positively to both of the hydrological regimes; therefore, it appears that a diversity of hydrological regimes is necessary to promote long-term maintenance of the entire herpetofaunal assemblage. Historically, differences in hydroperiod across the Everglades were maintained by small elevational gradients interacting with both seasonal and interannual

Figure 18. *Exotic brown anole. (Photo by SFWMD.)*

variation in rainfall. It will be necessary to continue to provide this diversity of hydroperiods within the now human-managed system to preserve the herpetofaunal community of the Everglades.

Contrasting Hydroperiod and Water Depth Control Tree Growth Pattern on Constructed Tree Islands

This study illustrates pronounced response of flood-tolerant tree species to variation in hydrological conditions. Trees planted across the islands (Figure 19) were subjected to two hydrologic treatments, with the individuals located in rain-driven macrocosms experiencing much more flooding stress. Regardless of the species, individual trees, located on tree islands subjected to the constrained-variability condition, experienced a more constant soil moisture stress than individual trees subjected to the rain-driven condition. Results from this study improve selection of species composition, allowing for early warning of flooding stress on tree islands. Equally as important, the study results serve as a suitable species guide for restoring degraded tree islands in the Everglades.

Figure 19. *Planting trees on a tree island in LILA. (Photo by SFWMD.)*

Invasive Apple Snail Locally Exclude Native Florida Apple Snail

It is well known that hydrologic factors impact the federally endangered snail kite and the apple snails upon which it feeds (Figure 20). However, adult densities of the native Florida apple snail have declined in many wetlands in Florida, and it is unknown if factors other than hydrology limit their densities. The recent invasion and establishment of the larger, and more fecund exotic island apple snail has led to frequent suggestions that the exotic species is excluding the native species. In LILA, a rapid composition shift towards dominance of the exotic island apple snail occurred between 2014 to 2019. This local native snail exclusion following invasion by the exotic snail, coupled with the finding of reduced juvenile growth of the native snail in the presence of juveniles of the exotic apple snail provide evidence for some kind of biotic displacement mechanism of the native apple snail population by a dominant non-native competitor.

Figure 20. *Snail kite with apple snail. (Photo by SFWMD.)*

Stand Survival and Growth along a Flooding Gradient in an Experimental Tree Island: Lessons for Forest Restoration

As CEPP moves towards execution, manipulative, field-scale experiments that address uncertainties in that project are invaluable, especially in dealing with long-lived species like the wetland hardwoods of the Everglades. The LILA tree island planting experiment (Figure 19) has allowed the scientists to test restoration theory and strategy on a realistic scale and in a range of hydrologic conditions representative of the Everglades. Compared to a nursery or shade house setting, this realism relieves some of the uncertainty inherent in choosing planting designs for the harsh Everglades environment. Tree biomass accumulation, studied for nearly a decade after planting, was influenced jointly by depth and hydroperiod, planting density, and their interactions. Four flood-tolerant species—cocoplum, red maple, pond apple, and wax myrtle—became more abundant over time and four less flood-tolerant species—gumbo limbo, white stopper, swamp bay, and strangler fig—became sharply reduced over time.

Diversity and Structure of Soil Fungal Communities on Experimental Everglades Tree Islands

The results of this study indicate that early restoration decisions can have long-term consequences for fungal communities and suggest that a drier future in the Everglades could reduce fungal diversity on imperiled tree islands. Given the substantial decrease in fungal diversity and the changes in fungal community composition and function found at dry sites in the study, it is likely that modifications to the LILA hydrologic environment are having significant consequences for the fungal communities on tree islands. Because of the importance of fungi in ecosystem functions, loss of fungal diversity and function on overly dry tree islands may underpin mechanisms causing tree island loss (e.g., reduced availability of the beneficial fungi on which trees depend, or loss of high quality decomposers required for nutrient recycling).

Decomp Physical Model (DPM)

A key aspect of Everglades restoration is the removal of certain levees to promote sheetflow through wetlands to better mimic the pre-drainage system. Restoring flow is critical for "getting the water right" in the Everglades. However, more information on pre-drainage flow is necessary and demonstrates the need for a landscape flow study. DPM is a large-scale field test designed to address uncertainties with depth, hydroperiod, sheetflow, and canal backfilling associated with the full-scale CERP WCA-3 Decompartmentalization and Sheetflow Enhancement (DECOMP) project. The model also assists in the planning and design of CEPP. Operations in the DPM Test Project include the S-152 structure, consisting of ten controllable gated culverts adjacent to the L-67A canal that move water from the L-67A canal into a portion of WCA-3B situated between the L-67A and L-67C levees (Figure 21).

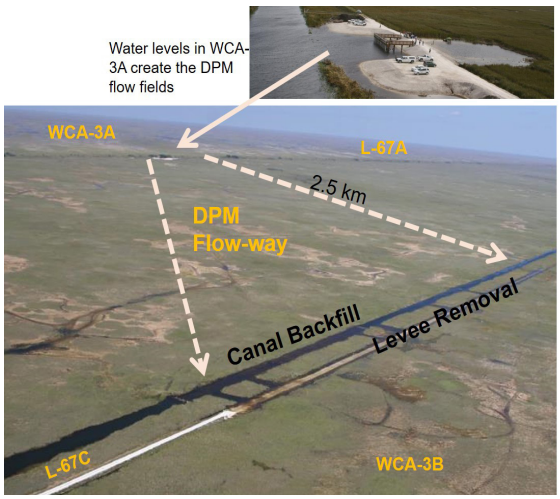


Figure 21. *The DPM study area. (Photo by SFWMD.)*

This year, in Chapter 6, Volume I, results of a study to assess the effects of restored sheetflow on food quality is discussed. The study determined that snails fed algal biomass from moderate (0.8 to 1.2 inches per second) and high flow (> 2.0 inches per second) sites in the DPM study grew 2.8 to 6.5 times larger, respectively, than those fed algae from non-flowing sites. The study adds to the body of DPM results pointing toward a "Goldilocks" envelope of moderate flows that produce physical and biological benefits while minimizing risks of nutrient enrichment. While it remains to be seen the extent to which invertebrate standing biomass is affected by flow, the improvement of food quality for invertebrates is consistent with a previous DPM study showing moderate flows improved algal food quality for small fish. These findings suggest the potential for an important ecological benefit of flow in improving the food base for Everglades food webs and larger predators.

In addition to Chapter 6, Volume I, information regarding DPM can be found in the first annual permit report for the project, which is Appendix 2-7 in Volume III.

PHOSPHORUS INFLOW IMPROVEMENTS IN THE EPA

Water Conservation Areas (WCAs)

From WY1978 to WY1990, the FWMC of TP inflows to the WCAs averaged 184, 116, and 74 ppb (or µg/L) for WCA-1, WCA-2, and WCA-3, respectively which is about an 83, 84, and 65% reductions, respectively, which resulted in reductions of 83, 84, and 65%, respectively (Figure 22). For the last 5 water years (WY2016–WY2020), the FWMCs have gone down to 30, 18, and 26 ppb, respectively (Figure 22). These reductions have been the result of the implementation of best management practices (BMPs) in the EAA Basin beginning in 1992 and the operations of the Everglades STAs beginning in 1994 with the 5,000-acre Everglades Nutrient Removal Project (now referred to as STA-1 West). Since then a total of 61,000 treatment acres of STAs have become operational and the two FEBs, the A-1 FEB and L-8 FEB, have also become operational. In addition, TP in inflows to WCA-3 have been reduced by implementation of BMPs in the C-139 Basin. Volume I of the 2021 SFER contains additional information on the EAA and C-139 BMP programs (Chapter 4), Everglades STAs operations (Chapter 5B), and TP in the EPA (Chapter 3A).

Everglades National Park (ENP)

Shark River Slough

Compliance with TP limits for Shark River Slough are calculated using concentrations and flow from the S-12s A through D and S-333 structures. From 1978 to 1990, the TP FWMC in inflows averaged 14.2 ppb (or µg/L). For the last five federal water years (October 1, 2014–September 30, 2019), the TP FWMC in inflows has decreased to 8.4 ppb, which is about a 41% reduction (Figure 23). The Everglades Settlement Agreement limit for Shark River Slough is a flow-based limit ranging from 12.8 ppb during years with very low flow to 7.6 ppb during any year with flow greater than about 1 million ac-ft. While the historical focus on controlling phosphorus sources upstream into the WCAs with the combination of BMPs and STAs continues with Restoration Strategies, additional attention on understanding localized nutrient transport within the WCAs has promise to inform future actions to maintain lower phosphorus levels entering Shark River Slough.

Taylor Slough

For Taylor Slough, the limit is a fixed TP FWMC in inflows of 11 ppb that became effective in 2007. From federal water years 1984 to 1990, the TP FWMC in inflows averaged 9.8 ppb (Figure 23). For the last five federal water years, the TP FWMC in inflows has gone down to 5.4 ppb, which is about a 45% reduction. The 12-month TP FWMC concentrations have consistently been well below 11 ppb since 1995.

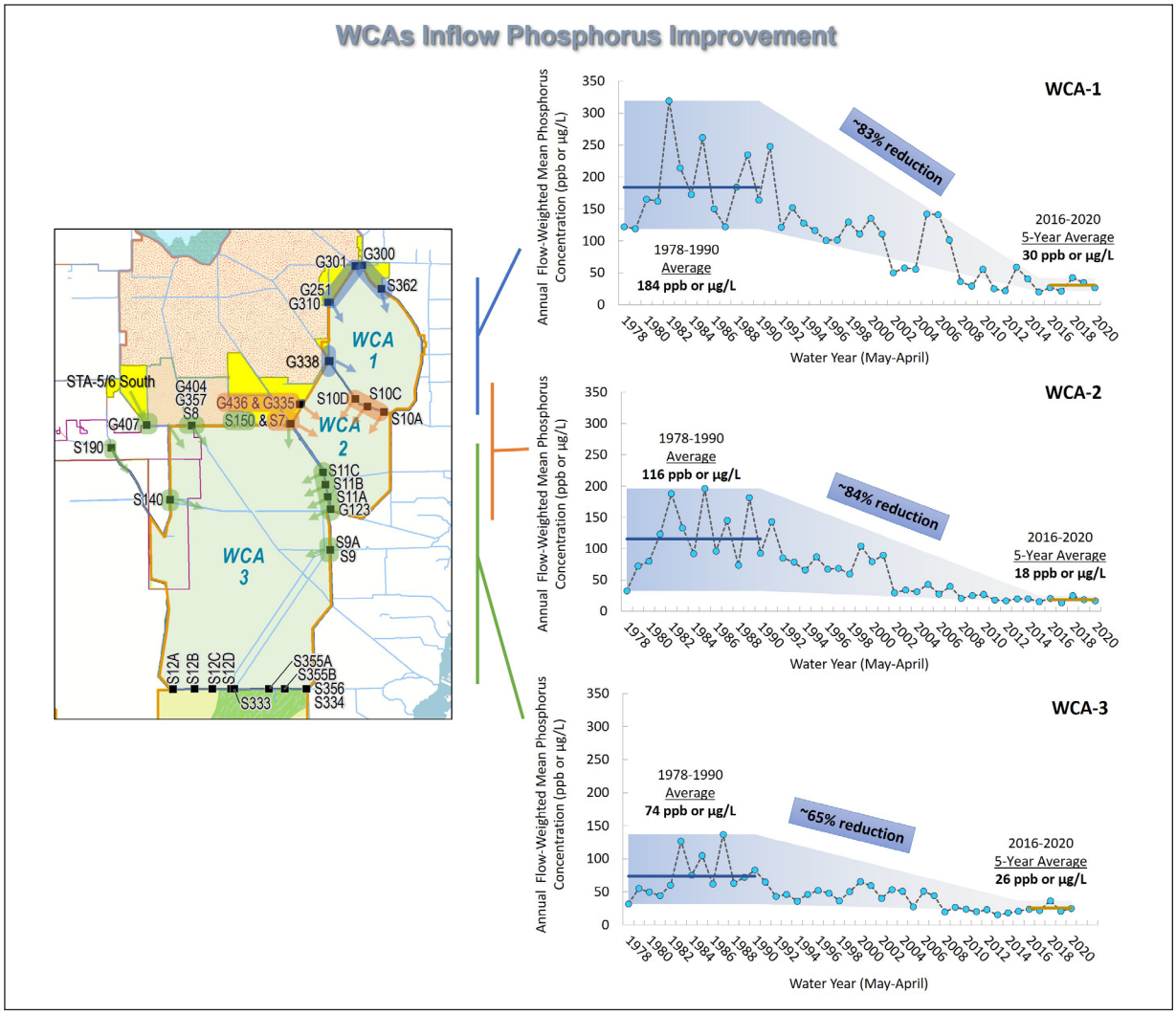


Figure 22. *Improvement of TP FWMC in inflows to the Everglades WCAs from WY1978 through WY2020 due to implementation of BMPs and operation of the Everglades STAs.*

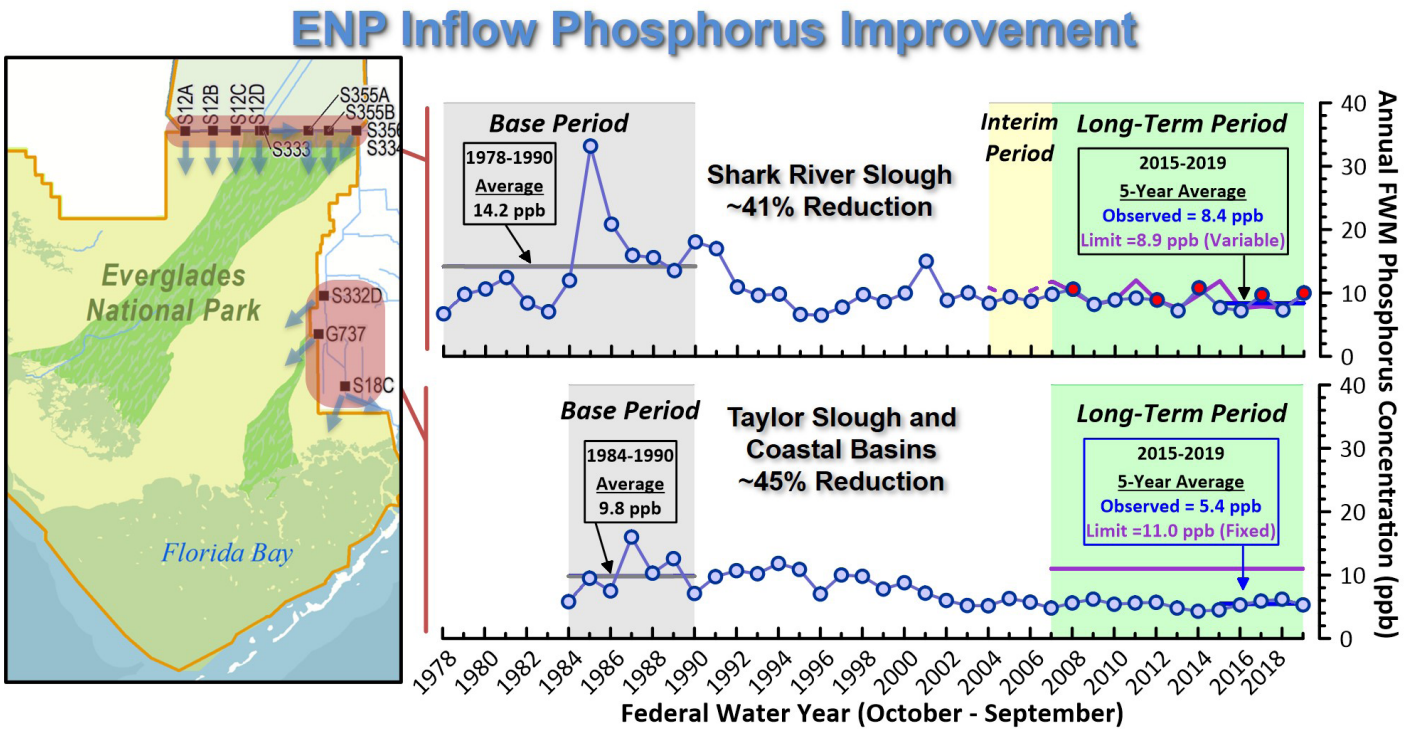


Figure 23. *Improvement of TP FWMC in inflows to ENP from Federal WY1978 through Federal WY2019. The interim and long-term periods of the Everglades Settlement Agreement are also shown. (Federal water year is from October 1 through September 30.)*

FLORIDA BAY IMPROVEMENT PROJECT

This project was developed in direct response to a submerged aquatic vegetation (SAV) die-off event in July 2015 that was likely caused by a localized drought during 2014 and 2015. The purpose of the project is to send additional fresh water into Taylor Slough and ultimately Florida Bay. There is considerable uncertainty regarding the indirect effects of changing freshwater flow, particularly the potential for changing the export of dissolved organic matter from the Everglades and the fate and effects of this nutrient source in the bay.

During WY2020, water quality in the bay was not impacted by tropical storms or hurricanes, allowing the chlorophyll *a* and nutrient concentrations to return close to their long-term period-of-record medians. Smaller storms and other events (wind and precipitation) can also impact the bay's water quality. These events can result in nutrient inputs directly from the precipitation and indirectly from overland flows into the bay. These flows are restricted to a few creeks in the eastern and central region and are dependent on the amount of fresh water available in the coastal marsh and mangrove zones that feed into the bay. The modifications to the South Dade Conveyance System are expected to increase freshwater flows to the bay with the goal of lowering the salinity in the bay, especially the nearshore coastal region.

There are few notable results from WY2020, with the following exceptions: an elevated chlorophyll *a* level in the central and western regions in October 2019 continuing in the western region into December 2019; peaks in dissolved inorganic nitrogen in the eastern and central region during January through March 2020; and a turbidity peak in the eastern region in January 2020. These are likely weather related; however, the levels are well below those seen after the storms of 2017 and 2018.

Units of Measurement Used in Analyses and Discussions of Water Quality and Quantity

Loads: The cumulative mass, weight, or volume delivered to the same location. Loads are typically measured in units such as metric tons (t), kilograms (kg), or pounds (lbs).

Concentrations: The mass, weight, or volume of a constituent relative to a volume (e.g., phosphorus, nitrogen, sediments, etc.). Concentrations are typically reported in units such as milligrams per liter (mg/L) and micrograms per liter (µg/L) (sometimes as parts per billion [ppb]).

Flow-weighted mean concentrations (FWMCs): The total load divided by the total volume of flow for a given period of time (FWMC) = load/flow). FWMCs are typically reported in units such as mg/L or µg/L (sometimes as ppb).

Geometric mean: Statistical average of a set of transformed numbers, often used to represent a central tendency in highly variable data, such as water quality. This is calculated from data transformed using powers or logarithms and then transformed back to the original scale after averaging.

National Geodetic Vertical Datum of 1929 (NGVD29): Reference for vertical control surveying elevation data that was established within the United States in 1929.

RESTORATION STRATEGIES

The *Restoration Strategies Regional Water Quality Plan* (SFWMD 2012) was developed to address water quality concerns associated with existing flows to the EPA. It contains a suite of additional water quality improvement projects (Figure 24) to work in conjunction with the existing Everglades STAs to meet the water quality based effluent limit (WQBEL) to achieve compliance with the State of Florida's numeric TP criterion for the EPA.

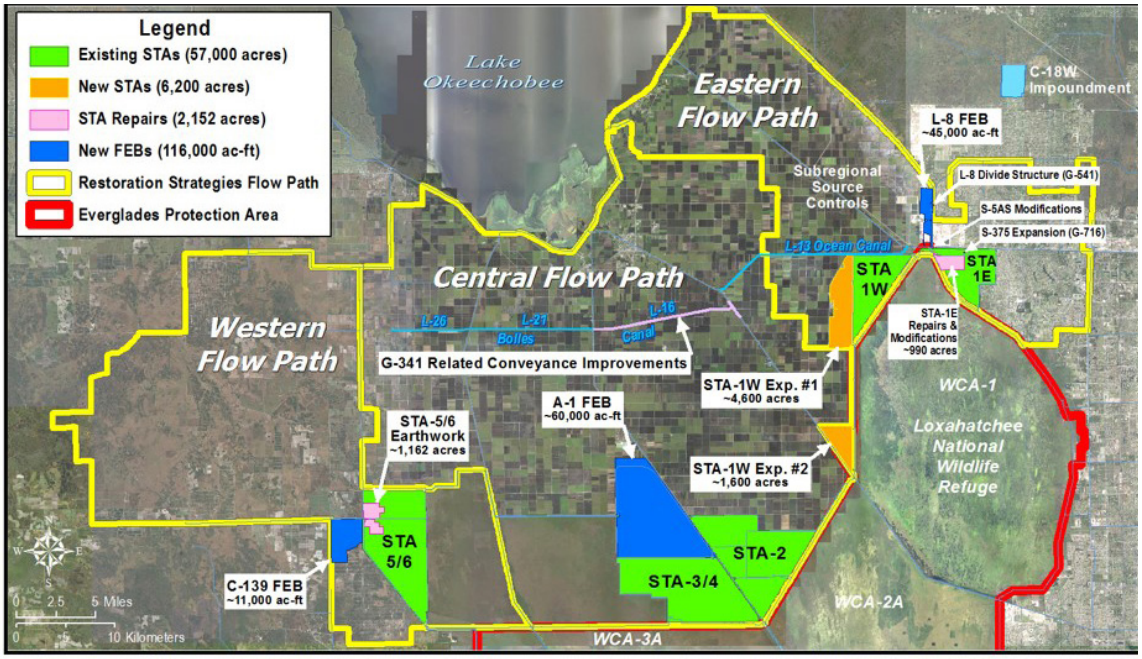


Figure 24. *Key projects of the Restoration Strategies Regional Water Quality Plan.*

Design and Construction Status of Water Quality Improvement Projects

The design and construction of Restoration Strategies projects are ongoing with completion of all projects expected by December 2025. Here is the status of the projects at the end of WY2020:

- Projects in the construction phase are STA-1 West (STA-1W) Expansion #2 and C-139 FEB.
- Projects under construction are STA-1 East (STA-1E) Repairs and Modifications, G-341 Related Conveyance Improvements, and STA-5/6 Internal Improvements.
- STA -1W Expansion #1 is in the initial flooding and optimization period.
- L-8 FEB is in multi-purpose operation.
- Completed projects are the A-1 FEB, STA-2 Expansion, STA-5/6 Expansion, S-375 Expansion, L-8 Divide Structure, and S-5AS Modifications.

In WY2020, several milestones were met:

- State and federal permits applications were submitted on July 26, 2019, for the STA-1W Expansion #2 and on August 23, 2019, for the C-139 FEB.
- A construction status report was submitted for the STA-5/6 Internal Improvements on September 20, 2019.
- Construction for STA-1E Repairs and Modifications in Cells 5 and 7 was initiated in April 2020 following the approval of the design in March 2020.
- Installation of underground pipes for the connector canal of STA-1W Expansion #2, within the Expansion #1 Cell 8 footprint, has been started.

Science Plan

SFWMD developed and implemented the *Science Plan for the Everglades Stormwater Treatment Areas*—referred to as the Science Plan—as a requirement of Restoration Strategies (SFWMD 2013, 2018b). The Science Plan is a framework to develop and coordinate scientific research related to phosphorus reduction in the Everglades STAs. This Science Plan was developed and published in 2013 and updated in 2018 to evaluate processes that influence phosphorus reduction in STAs. This plan focuses primarily on key factors that affect removal of TP in low TP environments (e.g., within the outflow region where TP concentrations are at or below 20 ppb or µg/L). The ultimate purpose of this scientific research is to support the design, operation, and management of the Everglades STAs to achieve and sustain TP discharge concentrations that meet the WQBEL for the STAs.

The Science Plan is based on a set of key questions regarding physical, chemical, and biological processes, as well as optimization of management of the STAs. These questions are used to develop research studies. Sixteen studies of various focus, size and complexity have been initiated; seven of these studies are now complete:

- **Investigation of STA-3/4 Periphyton-based Stormwater Treatment Area Technology Performance, Design, and Operational Factors** – Initiated in 2013 and completed in 2018, this study assessed the chemical, biological, design, and operational factors of the Periphyton-based Stormwater Treatment Area (PSTA) Cell that contribute to the superior performance of this technology. While this study is complete, the facility continues to operate, and annual and period-of-record TP reduction performance of the cell is reported. Over the period of record, inflow TP FWMC was 15 ppb (or µg/L) and outflow TP FWMC was 10 ppb (or µg/L).
- **Evaluation of the Role of Rooted Floating Aquatic Vegetation in STAs** – Initiated in 2016 and completed in 2018, this study assessed the ability of rooted floating aquatic vegetation (rFAV) to further enhance low-level phosphorus reduction performance of SAV communities. In the outflow regions of the STAs, TP concentrations in SAV communities were significantly lower than in rFAV communities.
- **Development of Operational Guidance for FEB and STA Regional Operation** – Initiated in 2013 and completed in 2017, this study created tools and methodologies to provide operational guidance for FEBs and STAs. The modeling indicated that the FEBs provide operational flexibility that allows the STAs to reach the WQBEL.
- **Influence of Canal Conveyance Features on STA and FEB Inflow and Outflow Phosphorus Concentrations** – Initiated in 2013 and completed in 2017, this study determined if and how conveyance through STA inflow or outflow canals alters TP concentrations or loads. Under most circumstances, with the exception of high flow events, the canals do not significantly alter TP concentrations or loads.
- **Evaluation of Sampling Methods for TP** – Initiated in 2013 and completed in 2017, this study identified sampling procedures that may bias water quality monitoring results for the STAs. The study determined that grab sample and autosample estimates of annual TP loads and FWMC were comparable. However, autosample methods may be affected by wildlife interference (primarily bioturbation).

- **Evaluation of Phosphorus Sources, Forms, Flux and Transformation Processes in the STAs** – Initiated in 2013, this study improved understanding of the mechanisms and factors that affect phosphorus reduction in the STAs, particularly in the lower reaches of the treatment flow-ways. All laboratory and field work associated with the study were completed in 2019. The study demonstrated that TP in the water column, floc, recently accreted soils, vegetation, and internal loads from soils decreased from the inflow to the outflow within well performing STAs. These internal loads reduce the effectiveness of phosphorus removal in the STAs. The study also demonstrated that emergent aquatic vegetation (EAV) and SAV regions remove phosphorus in different ways. EAV was mostly through uptake and deposition of phosphorus in organic forms, while SAV were primarily through precipitation of phosphorus with calcium carbonate due to changes in pH from photosynthesis. Further data evaluation and report writing continued through 2020.
- **STA Water and Phosphorus Budget Improvements** – Initiated in 2013 and completed in 2020, this study improved annual STA water and phosphorus budget estimates of treatment cells to better understand and assess phosphorus reduction within the STAs (Figure 25). This study provided more accurate estimates of STA cell phosphorus reduction and identified areas of uncertainty. Accurate water and phosphorus budgets for EAV-dominant and mixed EAV and SAV were important to both assess and predict STA treatment performance. STA-2 and STA-3/4 water and TP budgets and performance evaluations were completed in 2019.

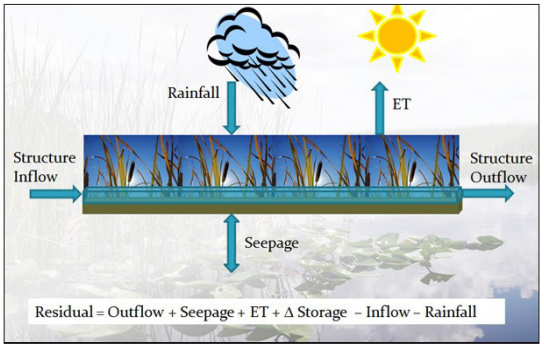


Figure 25. *Conceptual model for a water budget in the STAs.*

- **Evaluation of Inundation Depth and Duration Threshold for Cattail Sustainability** – Initiated in 2013, this study assesses cattail health under different water depths and durations to identify thresholds for cattail sustainability. Analysis of the cattail monitoring data collected in Phase II of the project is in its early stages. Initial results indicate that deep (41 inches) and extremely deep inundation treatments (49 inches) stressed cattail plants—observed from differences in density, photosynthesis, foliage area index, and leaf elongation—more than those from the moderate (33 inches) and shallow (24 inches) depth treatments. These preliminary results are consistent with the Phase I study results. This study is nearing completion.
- **Use of Soil Amendments and/or Management to Control Phosphorus Flux (Soil Management Study)** – Initiated in 2013, this ongoing study evaluates the benefits of soil amendment applications and/or soil management techniques to reduce internal loading of phosphorus. A field-scale treatment of soil inversion for copper remediation was initiated in 2017 in the STA-1W Expansion Area #1. This treatment was used in this soil management study to evaluate the effects of inversion on phosphorus concentrations. Water and soil samples are being analyzed along with SAV growth to determine if soil inversion improves initial and long-term STA performance in reducing phosphorus discharge.
- **Evaluation of Factors Contributing to the Formation of Floating Tussocks in the STAs** – Initiated in 2018, this study evaluates key factors that cause floating wetlands and cattail tussocks to form and the probability of their formation in STAs. Floating wetland communities were identified and measured in two EAV cells using a drone. The study is ongoing.
- **Investigation of the Effects of Abundant Faunal Species on Phosphorus Cycling in the STAs** – Initiated in 2018, this ongoing study evaluates the influence of fauna, specifically large populations of fish and aquatic invertebrates, on phosphorus reduction in STAs. Specifically, this study estimates aquatic-animal contributions to water column nutrient concentrations by fish excretion and bioturbation. Results to date suggest a pivotal role of animals in STA nutrient cycling. Further work continues measuring excretion, bioturbation, and effects of herbivory on SAV to evaluate effects on phosphorus.
- **Improving Resilience of SAV in the STAs** – Initiated in 2018, this ongoing study is investigating the effects of operational and natural environmental conditions on SAV health in the STAs. Factors that may contribute to SAV species distribution, persistence, colonization, and recovery in the STAs include SAV biology, water chemistry, nutrient loading, soil/sediment chemistry including deposition of fine marl sediments, physical characteristics, herbivory, and interactions among these factors. Temporal changes of soil characteristics and extreme weather events (e.g., hurricanes and drought) also have resulted in stress on SAV in the STAs.
- **Quantifying Life Cycle and Phosphorus Uptake and Release from Periphyton and Phytoplankton Communities** – Initiated in 2019, this ongoing study evaluates nutrient dynamics of periphyton and phytoplankton in downstream areas of STA treatment flow-ways where TP concentrations are low (≤ 20 ppb or µg/L). Phase I reviewed periphyton literature regarding nutrient uptake, growth, respiration, and death in tropical and subtropical oligotrophic (low nutrient) or mesotrophic (moderate nutrient) freshwater wetlands subjected to low phosphorus conditions. Phase II began in September 2020 with a sub-study designed to measure the bioavailability of dissolved organic nitrogen and phosphorus material by periphyton.
- **L-8 FEB and STA Operational Guidance** – Initiated in 2019, this ongoing study will provide guidance for FEB operations to moderate TP concentrations in discharge as potentially affected by stage, flow, and groundwater. Phase I focused on the influence of groundwater on L-8 FEB phosphorus concentrations. Monthly water quality sampling in the interior compartments of the FEB and quarterly water quality sampling in the surrounding groundwater wells from January to August 2019 found no evidence that groundwater is a major source of phosphorus. Phase II is focused on the possible resuspension of sediments into the water contributing to elevated TP in the FEB.
- **Quantifying the Recalcitrance and Lability of Phosphorus within STAs** – Initiated in 2019, this study evaluates relationships between organic matter and phosphorus that capture the sources and potential turnover of phosphorus within the STAs. Field work planning began in October 2020 and sampling began in November 2020.
- **Data Integration and Analysis** – Initiated in 2020, this study integrates STA and Science Plan data and documents to support management decision making.

There are four additional studies proposed in the 2018 Science Plan: Sustainable Landscape and Treatment in an STA, Effects of Vertical Advective Transport on TP Concentrations in the STAs, Phosphorus Dynamics in the Everglades STAs, and Assess Benefits and Feasibility of Consolidating Accrued Marl in the SAV Cells. An additional study was proposed in 2019, the Phosphorus Retention Study. For more information on active and completed studies, see Chapter 5C, Volume I, the 2018 Science Plan (SFWMD 2018b), and past SFERs (www.sfwmd.gov/sfer).

NORTHERN EVERGLADES AND ESTUARIES PROTECTION PROGRAM (NEEPP) UPDATE

The Florida legislature adopted NEEPP (§373.4595, F.S.) to protect and restore surface water resources and achieve and maintain compliance with water quality standards in the Northern Everglades region – comprised of the Lake Okeechobee, St. Lucie River, and Caloosahatchee River watersheds (Figure 27) – and downstream receiving waters. NEEPP indicates that basin management action plans (BMAPs) shall be the component of the watershed protection programs that address pollutant loading or TMDLs. BMAPs utilize a phased implementation of comprehensive and innovative management strategies that promote timely, cost-effective actions and integration with other programs. Chapters 8A, 8B, 8C, and 8D and associated appendices in Volume I provide annual progress reports for NEEPP.

Coordinating Agencies

Three agencies are responsible for fulfilling NEEPP mandates: FDEP, Florida Department of Agriculture and Consumer Services (FDACS), and SFWMD (Figure 26.) They are collectively referred to as the coordinating agencies. Figure 26 shows each agencies area of responsibility.

Expanded Monitoring Efforts

Executive Order 19-12 directs agencies to provide data and information to FDEP to support key water quality restoration efforts. On August 8, 2019, the SFWMD Governing Board approved an expansion of the existing upstream and in-lake monitoring programs within the Northern Everglades watersheds. Monitoring was expanded by adding 78 new stations (37 upstream and 13 in-lake stations, and 15 stations in each of the river watersheds, Figure 27), increasing the frequency of collection, and analyzing TP, total nitrogen (TN), and other key water quality parameters. The expanded monitoring network is also providing additional scientific data to determine pollutant sources to support progress by the Blue Green Algae Task Force and FDEP to achieve TMDLs. Data will be used to evaluate trends; identify water quality issues; measure potential impacts of activities to SFWMD projects and works; provide insight on selecting appropriate technologies and projects; and comply with §373, F.S., which declares that the SFWMD Governing Board shall take into account cumulative impacts on water resources and manage those resources in a manner to ensure sustainability and to minimize degradation caused by discharge of stormwater.

FDEP Basin Management Action Plans (BMAPs)

During 2019, progress continued on FDEP BMAPs designed to implement nutrient reductions established by the TMDLs for the Northern Everglades watersheds. The *2019 Statewide Annual Report on Total Maximum Daily Loads, Basin Management Action Plans, Minimum Flows or Minimum Water Levels, and Recovery or Prevention Strategies* (FDEP 2020a) details the progress made through December 31, 2019, on implementation of the NEEPP BMAPs. In accordance with Executive Order 19-12, BMAP updates for Lake Okeechobee (FDEP 2020c), St. Lucie River and Estuary (FDEP 2020d), and Caloosahatchee River and Estuary (FDEP 2020b) were adopted by secretarial orders in February 2020. The loads, allocations, and reductions are estimated based on the models used during the development of the updated BMAPs.

SFWMD Watershed Protection Plans – Annual Reviews

Watershed protection plans are science-driven and include a research and water quality monitoring program and a watershed construction project. The monitoring programs are used to build upon existing information, carry out future efforts, and assess plans. Watershed construction projects provide a comprehensive strategy consisting of constructed facilities and programs implemented for improving the quality, quantity, timing, and distribution of surface water.

Annual reviews are electively being done by SFWMD to maintain real-time input to the BMAP process. Public workshops were held to facilitate stakeholder participation in the development process to ensure consideration of local expertise and comprehensive problem solving. The focus for WY2020 was to conduct a preliminary analysis for each subwatershed as the foundation for future detailed assessments. The analysis presents characteristics such as hydrology, land use, SFWMD project status and cost, and nutrient levels. The analysis presented in this SFER identified the need to address data gaps.

As part of the watershed protection plans, SFWMD continued implementing several construction projects with both water storage and water quality benefits to improve conditions across the Northern Everglades watersheds. Further details on the annual reviews can be found in Volume I, Chapters 8B, 8C, and 8D.

Under SFWMD programs, draft rule text for amendments to Chapter 40E-61, F.A.C., was presented at a series of public workshops. The NEEPP legislation directs SFWMD to amend Chapter 40E-61, F.A.C., to provide a monitoring program for nonpoint source dischargers that are required to monitor water quality under §403.067, F.S., and report the results of such monitoring to FDEP and FDACS. The Governing Board adopted the new rule at its February 2021 business meeting and authorized publishing a notice of Proposed Rule in the Florida Administrative Register. The new rule is anticipated to become effective in April 2021.

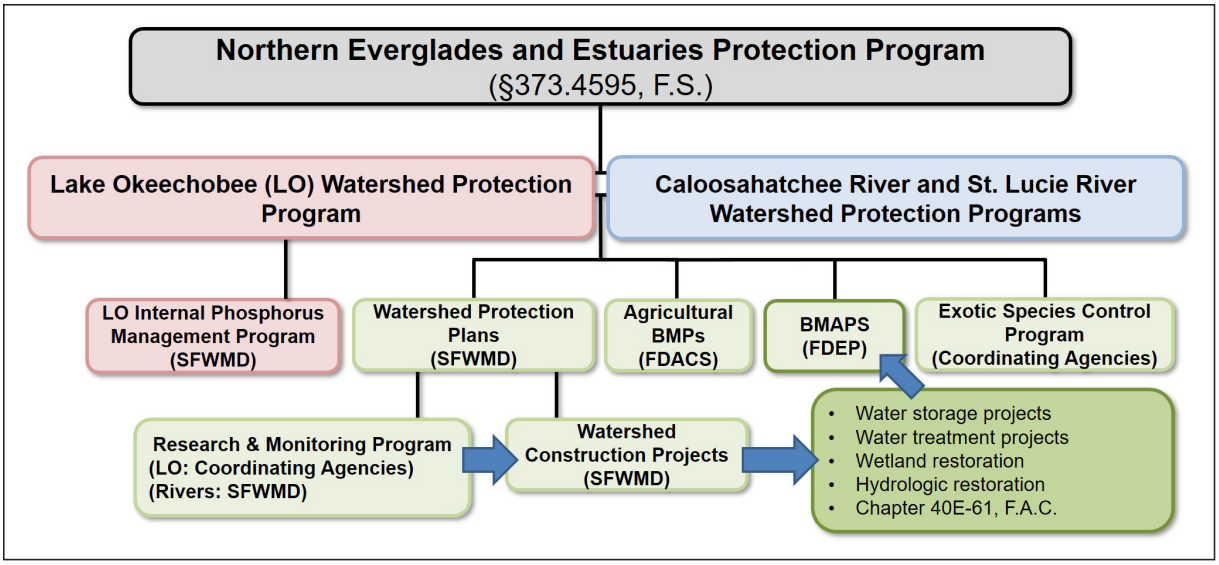


Figure 26. *Overview of NEEPP including key program components and primary responsibilities of the coordinating agencies.*

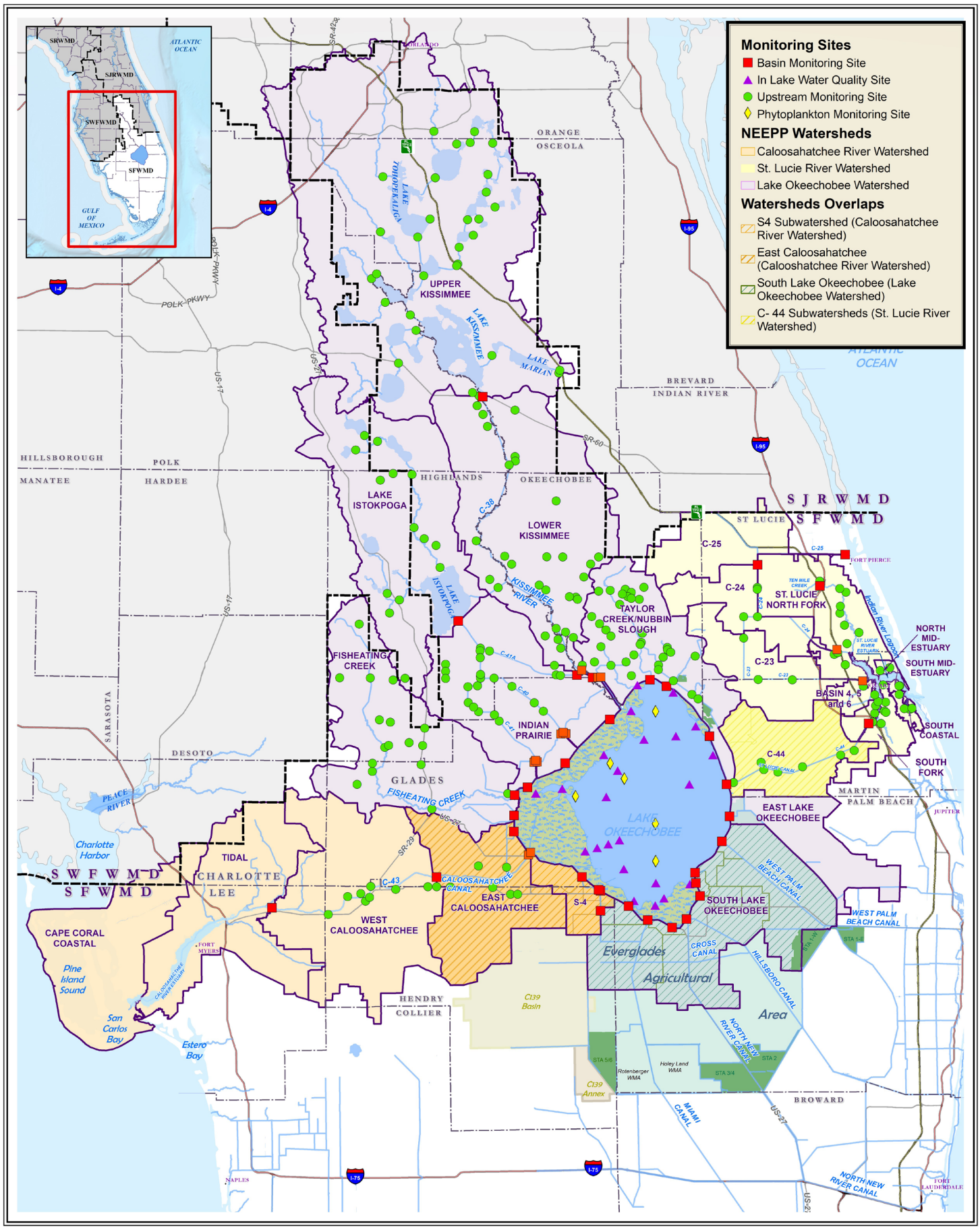


Figure 27. *Existing and new monitoring sites within the NEEPP watershed boundaries.*

Lake Okeechobee Watershed

Lake Okeechobee is a central part of the interconnected South Florida aquatic ecosystem and the USACE Central and Southern Florida Flood Control Project (C&SF Project). The lake receives surface water mainly from a watershed that includes the Kissimmee Chain of Lakes, Kissimmee River, Lake Istokpoga, Fisheating Creek, and other tributaries (Figure 27). Except for Fisheating Creek, all major inflows to Lake Okeechobee are controlled by water control structures. The Lake Okeechobee Watershed is comprised of nine subwatersheds: Upper Kissimmee, Lower Kissimmee, Taylor Creek/Nubbin Slough, Lake Istokpoga, Indian Prairie, Fisheating Creek, East Lake Okeechobee, West Lake Okeechobee, and South Lake Okeechobee, which includes the S-4 basin, and most basins in the EAA, as well as various Chapter 298, F.S., Districts.

FDEP has identified Lake Okeechobee as an impaired water body and established a TMDL of 140 metric tons per year (t/yr) of TP to Lake Okeechobee. This TMDL establishes the maximum amount of TP that Lake Okeechobee can assimilate while maintaining its designated uses. The 140 t/yr of TP from the TMDL consists of 35 t/yr that is estimated to fall directly on Lake Okeechobee through atmospheric deposition, and 105 t/yr, which is allocated to the contributing watershed.

Research and Water Quality Monitoring Program

Rainfall. WY2020 rainfall in the Upper and Lower Kissimmee areas averaged 48.5 and 47 inches, respectively. Rainfall over Lake Okeechobee was 43 inches. Rainfall over the Lake Okeechobee Watershed for WY2020 was approximately 47 inches, which is about 6 inches below district-wide historical average rainfall for the 1933–1995 period of record. Both wet season and dry seasons were drier than average, and the dry condition began in WY2019.

Runoff. Total runoff from the Lake Okeechobee Watershed (computed as inflow volumes divided by drainage area) was 5.2 inches. The highest amount of runoff (in terms of unit area) came from the Upper Kissimmee (7.5 inches), Lower Kissimmee (6.5 inches), and Indian Prairie (6.3 inches) subwatersheds.

TP Loads. TP load to Lake Okeechobee was 324 t in WY2020, which includes an estimated 35 t from atmospheric deposition. See Figure 29 on the next page for a breakdown of the subwatershed loads.

TN Loads. The WY2020 TN load to the lake was 4,299 t. See Figure 30 on the next page for a breakdown of the subwatershed loads.

Long-term Trends. Water quality parameters including monthly flow, TP load, TP FWMC, TN load, and TN FWMC were analyzed for long-term trends for 14 upstream loading stations. Seven of the 14 stations analyzed revealed statistically significant trends for one or more of the five parameters, only one of which was a decreasing trend in TN FWMC. Three had increasing trends in both flow and TP load; two had increasing trends in TP FWMC; three had increasing trends in both flow and TN load; two had increasing trends in TN FWMC; and one had increasing trends for all five parameters.

Progress on New Items. The expanded in-lake water quality monitoring network was implemented as designed. Photosynthetically active radiation (PAR) sensors will be deployed at three locations to monitor light penetration along the littoral zone in the southwest quadrant of the lake. SFWMD budgeted funds for the University of Florida to conduct a sediment mapping project that began in fall 2020. The university will also conduct sediment-water nutrient flux studies to evaluate how the sediments affect water quality of the lake. SFWMD hired a consultant to model the effects of constructed underwater weirs on water circulation in the southern portion of the lake; results will be presented in the next SFER. An improved performance measure for Lake Okeechobee stage evaluations was developed by SFWMD and was accepted by the CERP's Restoration Coordination and Verification program (RECOVER) management team in late WY2020.

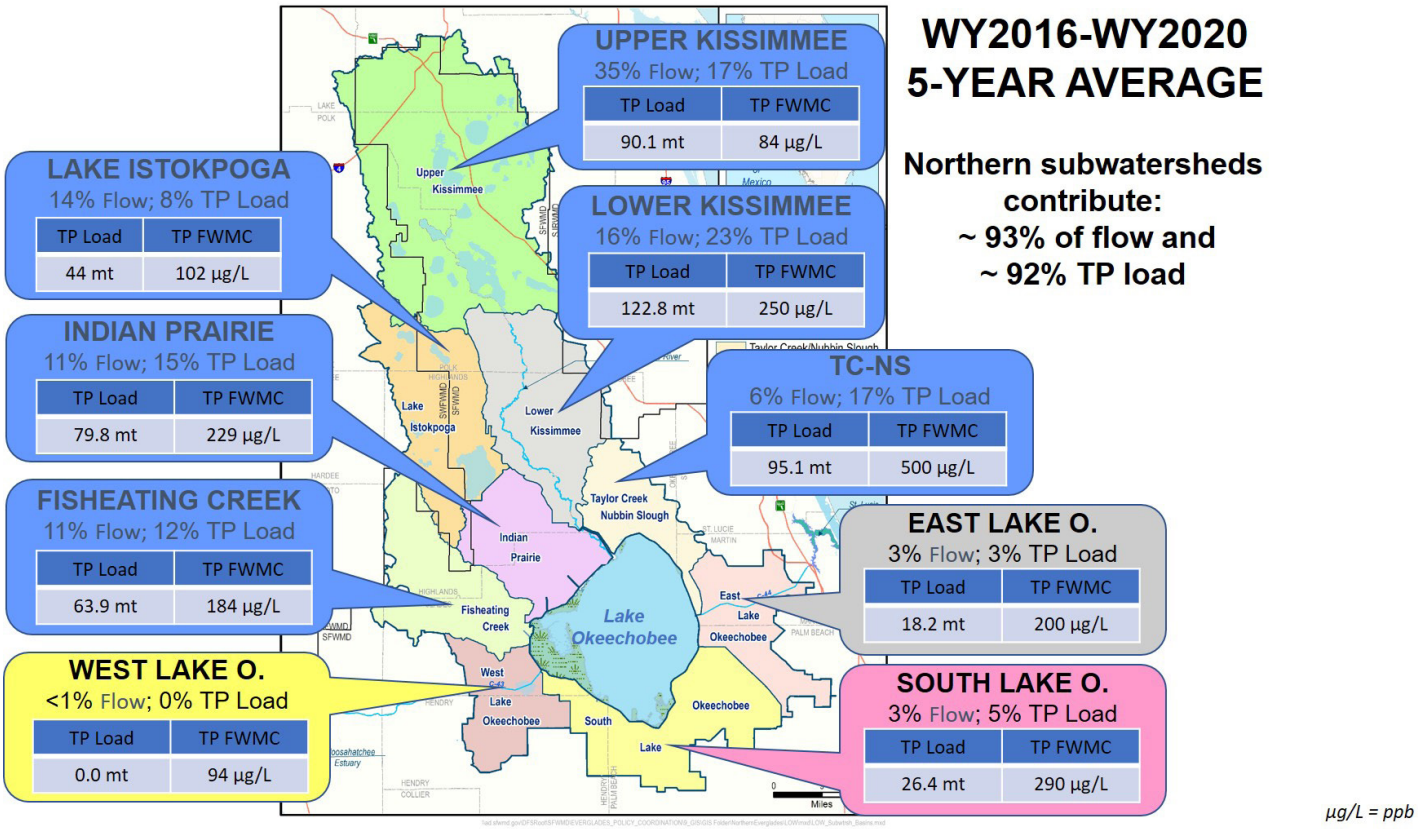
Watershed Construction Project

WY2020 highlights for the watershed construction project are as follows:

- In FY2020, SFWMD received $50 million from the Florida Legislature for design, engineering, and construction of specific components for the CERP's Lake Okeechobee Watershed Restoration Project. SFWMD and USACE are currently moving forward with investigating the feasibility of aquifer storage and recovery (ASR) well cluster locations based on legislative direction.
- Planning was completed and design commenced for the S-191 Basin Surface Runoff Phosphorus Removal, a new project that plans to remove TP from surface water upstream of the S-191 structure using an innovative ferrate treatment technology.
- Feasibility studies were launched for the Grassy Island and Brady Ranch FEB and ASR projects to optimize both planned project areas and their associated features.
- Construction is underway for the S-191 pump station under Phase III of the Lakeside Ranch STA, and this priority work is planned to be completed by April 2021.
- Construction activities also progressed for the Kissimmee River Restoration Project, in partnership with USACE, with remaining work to be completed in spring 2021. See the *Kissimmee River Restoration Construction Status* section later in this document for more information.
- Construction of the Istokpoga Marsh Watershed Improvement District – Phase I project was completed in March 2020 and is operating.
- Facility operations continued for the Lakeside Ranch STA (Phase I – Northern STA and Phase II – Southern STA), Taylor Creek STA (Figure 28), Nubbin Slough STA, and Rolling Meadows – Phase I projects. Also, of note for the Nubbin Slough STA, SFWMD planning was executed to repair the Cell 2 levee as a priority effort in WY2021; this will allow this STA to treat local stormwater runoff from the Nubbin Slough basin and improve the quality of water flowing into Lake Okeechobee.
- FDACS operations of the five hybrid wetland treatment technology (HWTT) facilities—Lemkin Creek, Wolff Ditch, Grassy Island, Nubbin Slough, and Mosquito Creek—continued over the past year; a total of 3,089 million gallons was treated, removing 4.6 t TP and 14.5 t TN.
- Optimization of the FDACS Fisheating Creek Floating Aquatic Vegetation Tilling (FAVT) along with extensive renovations occurred this past year; during reduced operations, a total of 1,922 million gallons was treated, removing 1.5 t TP and 5.0 t TN.

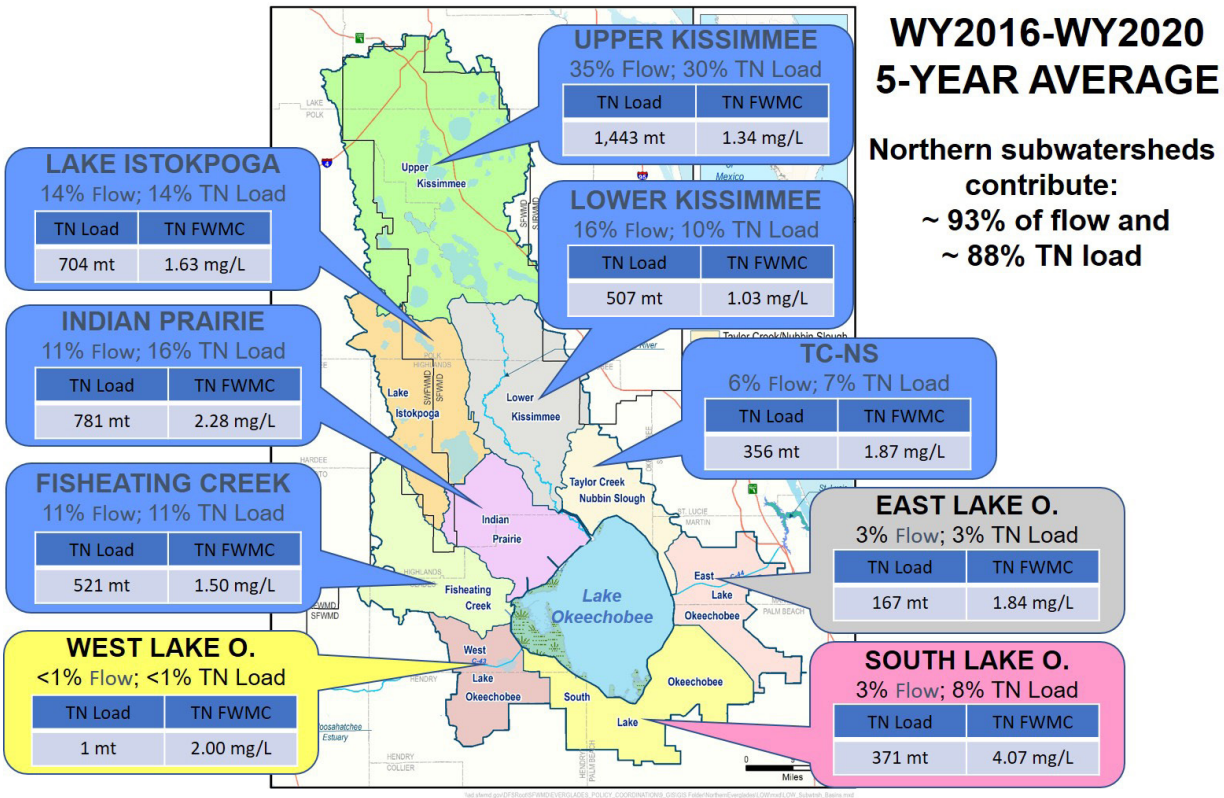
For more information on Lake Okeechobee and its watershed, see Chapter 8B in Volume I.

Figure 28. *Roseate spoonbills and a glossy ibis at the Taylor Creek STA.*



µg/L = ppb

Figure 29. *Summary of contributions from each subwatershed within the Lake Okeechobee Watershed with 5-year average (WY2016–WY2020) TP loads and FWMCs and percent flow volumes and loads.*



mg/L = ppm

Figure 30. *Summary of contributions from each subwatershed within the Lake Okeechobee Watershed with 5-year average (WY2016–WY2020) TN loads and FWMCs and percent flow volumes and loads.*

St. Lucie River Watershed

To quantify and assess relative inputs of fresh water and nutrients to the St. Lucie Estuary (SLE), the St. Lucie River Watershed is divided into three contributing areas: Lake Okeechobee, the St. Lucie Basins (represents 69% of the watershed area), and the Tidal Basins (represents 31% of the watershed area) (Figure 27 on page 17). The St. Lucie Basins are composed of the C-44, C-23, C-24, and Ten Mile Creek basins, and the Tidal Basins are composed of the North Fork; North Mid-Estuary; Basin 4, 5, 6; South Fork; South Mid-Estuary; and South Coastal basins.

Research and Water Quality Monitoring Program

Rainfall. Average total rainfall across the St. Lucie River Watershed in WY2020 was 51.6 inches, slightly above the long-term (WY1997–WY2020) annual average (48.8 inches). In WY2020, 66% of the precipitation occurred in the wet season and 34% in the dry season.

St. Lucie River Watershed Contributing Area Inflows and TP and TN Loads. During the 5-year averaged period (WY2016–WY2020), the percent contribution of the inflows and loads from the SLE contributing areas, that is the St. Lucie Basins, Tidal Basins, and Lake Okeechobee releases to the SLE, indicate that the St. Lucie Basins represented the largest contribution, with 44% of total flow, 64% of TP load, and 45% of TN load (Figures 32 and 33 on the next page). The WY2016–WY2020 five-year averages indicate that of the St. Lucie Basins, the C-24 basin represented the largest contribution, with 12% of total flow, 18% of TP load, and 14% of TN load. The WY2016–WY2020 five-year averages indicate Lake Okeechobee contributed 31% of total flow, 26% of TP load, and 38% of TN load. However, in WY2020, there were no Lake Okeechobee releases to the estuary.

Estuary Water Quality. WY2020 average concentrations of TP and TN in the SLE were lower than the long-term (WY1997–WY2020) average. The lower and middle estuary sites exhibited lower chlorophyll *a* concentrations than the long-term (WY1997–WY2020) annual average, whereas for the upstream site in the North Fork, chlorophyll *a* concentrations were higher than those of the long-term average due to a peak concentration in summer 2020.

Watershed Construction Project

WY2020 highlights for the watershed construction project are as follows:

- Construction advanced on the CERP Indian River Lagoon – South projects, in partnership with USACE.
- As priority efforts, the C-44 STA and reservoir are planned to be completed in 2021; full operation is expected to begin in FY2022.
- Design began in FY2020 for the C-23 and C-24 reservoirs and STAs, and the C-24/C-44 interconnect.
- Facility operations continued for the Ten Mile Creek WPA (Figure 31). In support of project improvements, the North St. Lucie River Water Control District (NSLRWCD) has requested a permit to repair the C-96 discharge canal. The permit was issued to NSLRWCD on December 8, 2020. Also, NSLRWCD issued a state permit for SFWMD to perform work on 4 canals. Canal repairs began on December 9, 2020, and should be completed during WY2021.
- FDACS operations of the three HWTT facilities—Ideal 2 Grove, Bessey Creek, and Danforth Creek—continued over the past year; a total of 1,514 million gallons was treated, removing 1.44 t TP and 4.0 t TN.
- SFWMD reviewed a series of potential projects proposed within the watershed and continues to investigate opportunities to optimize performance of existing projects. This provided SFWMD an opportunity to have project information available to apply for FDEP water quality grants for reducing nutrients in storm water.

Caloosahatchee River Watershed

To quantify and assess relative inputs of fresh water and nutrients to the Caloosahatchee River Estuary, the watershed is divided into three contributing areas (Figure 27 on page 17): Lake Okeechobee, Caloosahatchee Basins (representing 71% of the watershed area), and Tidal Basin (representing 29% of the watershed area). The Caloosahatchee Basins include the East Caloosahatchee, West Caloosahatchee, and S-4 basins. The Tidal Basin includes all areas draining to the estuary downstream of the S-79 structure (W.P. Franklin Lock and Dam).

Research and Water Quality Monitoring Program

Rainfall. Average annual rainfall across the watershed in WY2020 was 45.6 inches, with 78% occurring in the wet season and 22% occurring in the dry season. This was lower than the annual average (52 inches) for the period of record (WY1997–WY2020).

Caloosahatchee River Watershed Contributing Inflows and TP and TN Loads. In WY2020, the total freshwater inflow to the Caloosahatchee River Estuary was 1,249,420 ac-ft, of which 58% was from the Caloosahatchee Basins (East, West, and S-4 basins), 28% from the Tidal Basin, and 14% was from Lake Okeechobee (Figures 34 and 35 on page 22). Total inflows were lower than the WY1997–WY2020 average.

Estuary Water Quality. The annual average concentrations of TP and TN at the upper, mid, and lower CRE stations in WY2020 were lower than the long-term average concentrations. WY2020 average chlorophyll *a* concentrations at the mid and lower estuary monitoring sites were lower than the long-term averages at these sites. A spike in November 2019 at the upper estuary site increased the annual average WY2020 relative to the long-term period of record.

Watershed Construction Project

WY2020 highlights for the watershed construction project are as follows:

- In January 2020, project planning efforts commenced for the C-43 Water Quality Treatment and Testing Facility – Phase II (Test Cells)
- Also in January 2020, conceptual design was launched for the Boma FEB on SFWMD-owned lands.
- Construction was fully completed on Phase I of the Lake Hicpochee Hydrologic Enhancement Project in November 2019, followed by initiation of operations, while the conceptual design of the Lake Hicpochee Expansion under Phase II began in March 2020 as part of priority efforts.
- Construction also progressed on the CERP Caloosahatchee (C-43) West Basin Storage Reservoir, in partnership with USACE; the reservoir is planned to be completed by the end of 2023. As part of the Water Quality Component Project, priority work on the feasibility study was completed in 2020.
- FDACS operations of the East Caloosahatchee FAVT continued over the past year with unusually extended periods of no or low flow. A total of 6,384 million gallons was treated, removing 2.3 t TP and 5.0 t TN.

Figure 31. *Woodstorks at Ten Mile Creek. (Photo by SFWMD.)*

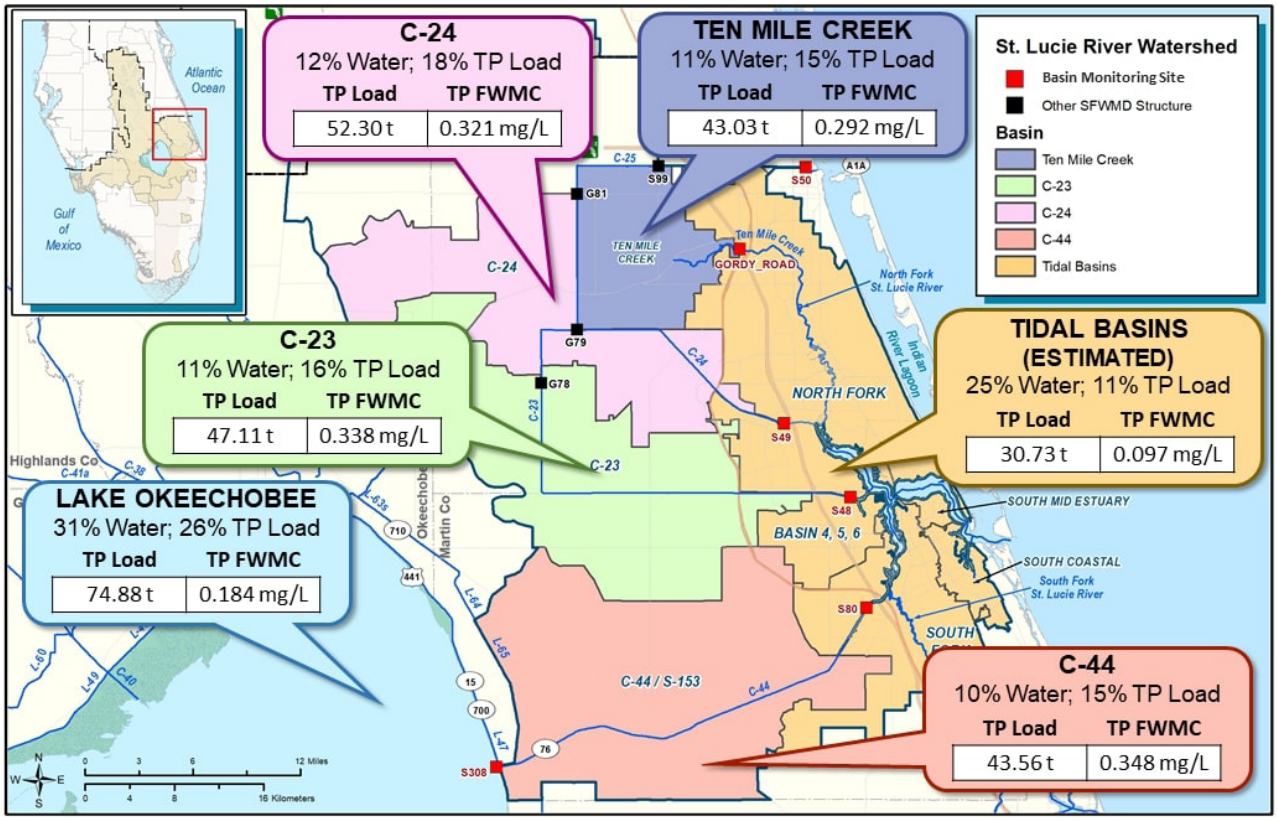


Figure 32. *Summary of contributions from each St. Lucie River Watershed basin to the St. Lucie Estuary with the most recent 5-year average (WY2016–WY2020) TP Loads and FWMCs and percent flow volume and load.*

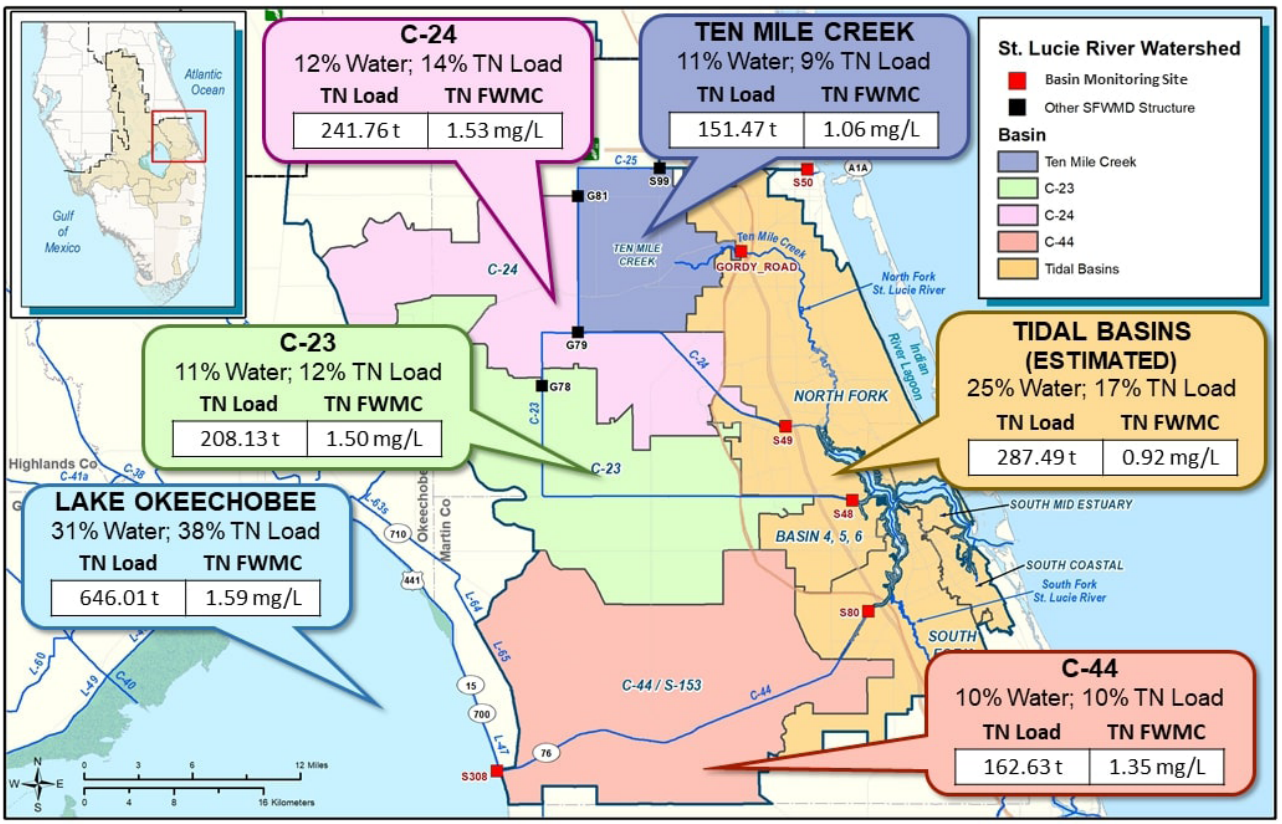


Figure 33. *Summary of contributions from each St. Lucie River Watershed basin to the St. Lucie Estuary with the most recent 5-year average (WY2016–WY2020) TN Loads and FWMCs and percent flow volume and loads.*

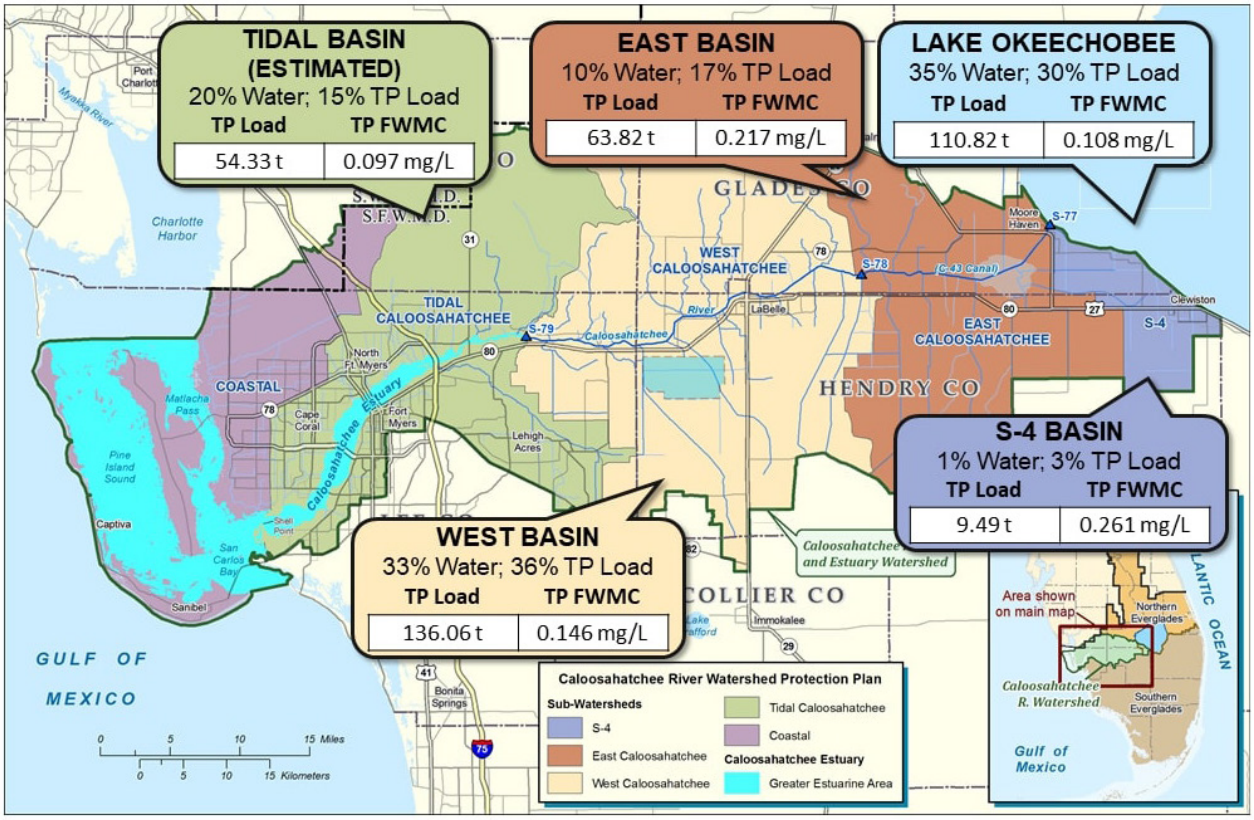


Figure 34. *Summary of contributions from each Caloosahatchee River Watershed basin to the Caloosahatchee Estuary for the most recent 5-year period (WY2016–WY2020) with the most recent 5-year average (WY2016–WY2020) TP Loads and FWMCs and percent flow volume and loads.*

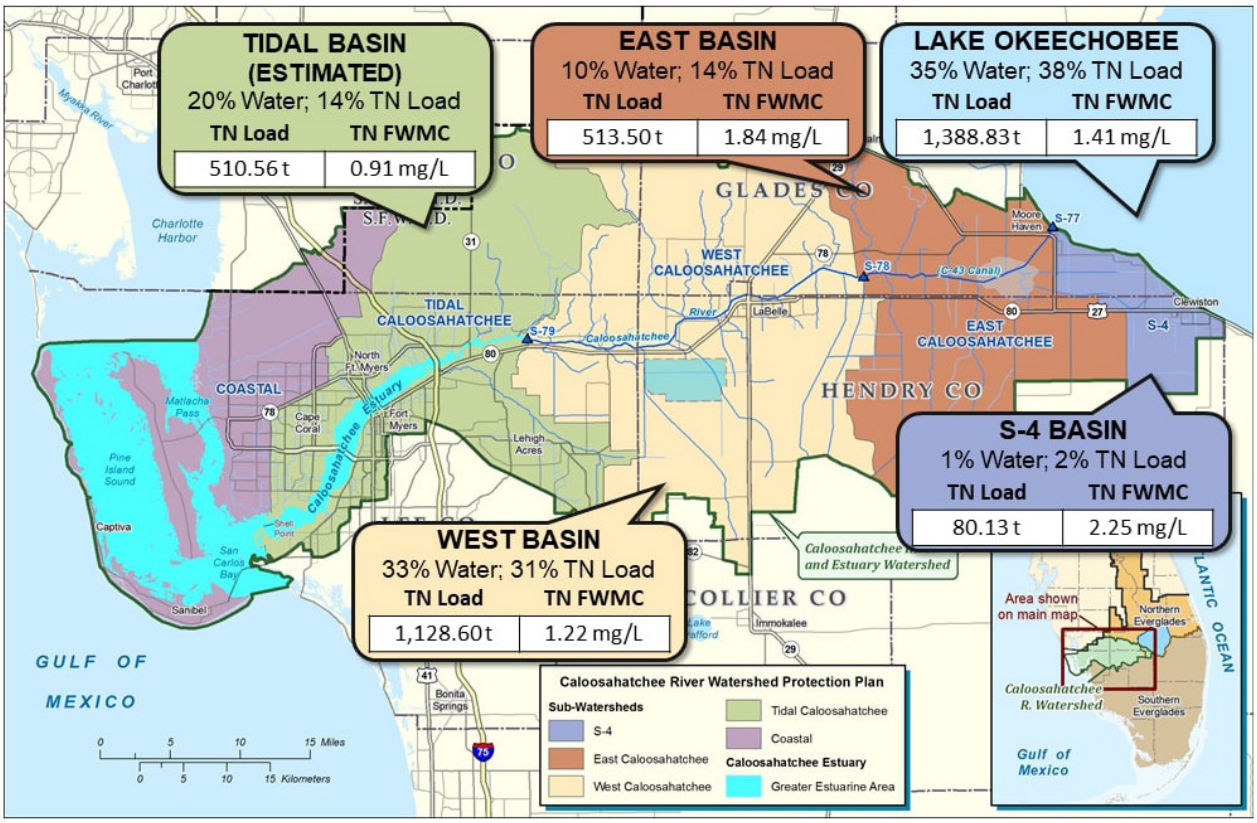


Figure 35. *Summary of contributions from each Caloosahatchee River Watershed basin to the Caloosahatchee Estuary for the most recent 5-year period (WY2016–WY2020) with the most recent 5-year average (WY2016–WY2020) TN Loads and FWMCs and percent flow volume and loads.*

KISSIMMEE RIVER RESTORATION CONSTRUCTION STATUS

The Kissimmee River Restoration Project (Figure 37) will culminate with implementation of a new stage regulation schedule, called the Headwaters Revitalization Schedule, to operate the S-65 water control structure. The Headwaters Revitalization Schedule will allow lake water levels to rise up to 1.5 ft higher than the current S-65 schedule and will increase the water storage capacity of Lakes Kissimmee, Hatchineha, Cypress, and Tiger by approximately 100,000 ac-ft to allow storage of water for releases that more closely approximate the historic flows needed for restoration of the Kissimmee River and its floodplain wetlands. Almost all of the land in the Upper Kissimmee Basin that will be affected by the higher water levels have been acquired, and all projects needed to increase the conveyance capacity of canals and structures are in place to accommodate the larger storage volume. The few remaining land acquisitions were finalized in 2020.

Construction continued for the Kissimmee River Restoration Project. Backfilling of the C-38 canal in the Reach 2 area began in January 2017 and will continue into 2021. An additional seven miles of the C-38 canal has been filled and water control structure S-65C has been removed, routing the flow of water to the native channel and floodplain of the Kissimmee River, reestablishing hydrologic continuity between the river and floodplain in former Pools C and D for the first time since the C-38 canal was completed in 1971. Repair of erosion damage caused by Hurricane Irma in both Reach 2 and Reach 3 is ongoing and scheduled for completion in 2021.

KISSIMMEE BASIN ECOLOGICAL STATUS

Lower Kissimmee Basin

Hydrology. One floodplain inundation event met the depth criterion of at least 1 ft; however, it lasted only 67 days, far shorter than the 210-day duration criterion. Instead of the single recession event that was typical of pre-channelization conditions, two recession events occurred, one of which was due to discharge for flood control, and the recession rates were too high. Consequently, the hydrology targets were not met. While it may not be possible to fully meet these targets prior to implementation of the Headwaters Revitalization Schedule, performance can be improved now by implementation of discharge plans that use 1,400 cfs as a minimum discharge when Headwaters Lakes stage is above a specified threshold (currently 50 ft).

Dissolved Oxygen (DO). Concentrations of daytime DO in the river channel of the Kissimmee River Phase I restoration area continued overall to be higher in WY2020 than pre-restoration levels, but two declines in DO concentration occurred, one in July 2019 when DO declined to zero for 10 days, resulting in a large fish kill, and another on August 4, 2019, when DO declined to 1 mg/L for 23 days.

Fisheries. During the anoxic (low DO) event in July 2019, centrarchid fish abundance was reduced by 93% and included a total loss of largemouth bass. Six months later, centrarchid abundance was 20% greater than the pre-event conditions reported in May. However, much of the increase in centrarchid abundance was due to young-of-the-year bluegill that likely were spawned after the anoxic event. The floodplain has been inundated during bass spawning season in only three of the past seven years, limiting reproductive success.

Wading Bird and Waterfowl Abundance. In sections of the river to which flow has been reestablished, wading bird and waterfowl (Figure 1 on page 1) abundance was significantly greater than the restoration expectations.

Floodplain Vegetation Management. In the past year, herbicide application and biocontrol agents were used to control some invasive plant species in the Kissimmee River floodplain. Populations of the brown lygodium moth continue to be released to combat the invasive exotic Old World climbing fern.

Upper Kissimmee Basin

Habitat Enhancement. The Florida Fish and Wildlife Conservation Commission (FWC) conducted a lake drawdown habitat enhancement project on East Lake Tohopekaliga this water year. Lower water levels temporarily exposed approximately 875 acres of additional littoral zone around the lakeshore allowing the scraping of nuisance and exotic plants and organic sediments, improving 105 acres on the east shore.

Snail Kites. Overall, the 2019 snail kite breeding season in South Florida saw a dramatic decrease in nesting effort from 2018. Nesting within the Kissimmee Chain of Lakes was close to average for the region but made up a significant proportion of overall nesting due to lack of nesting in other areas of the state. Lake Tohopekaliga rebounded from three consecutive years of declining nesting effort and success. Although nesting effort on Lake Kissimmee declined from 2018, the nesting effort in 2019 was still the second highest level on recent record.

Alligators. FWC monitors American alligator (Figure 36) populations using spotlight surveys at night, which showed very high populations on Lakes Tohopekaliga, Kissimmee, and Hatchineha for the 2019 sampling period. Populations increased slightly from 2018 and continue to follow an increasing trend over the last 9 to 12 years.

Figure 36. *An American alligator. (Photo by SFWMD.)*

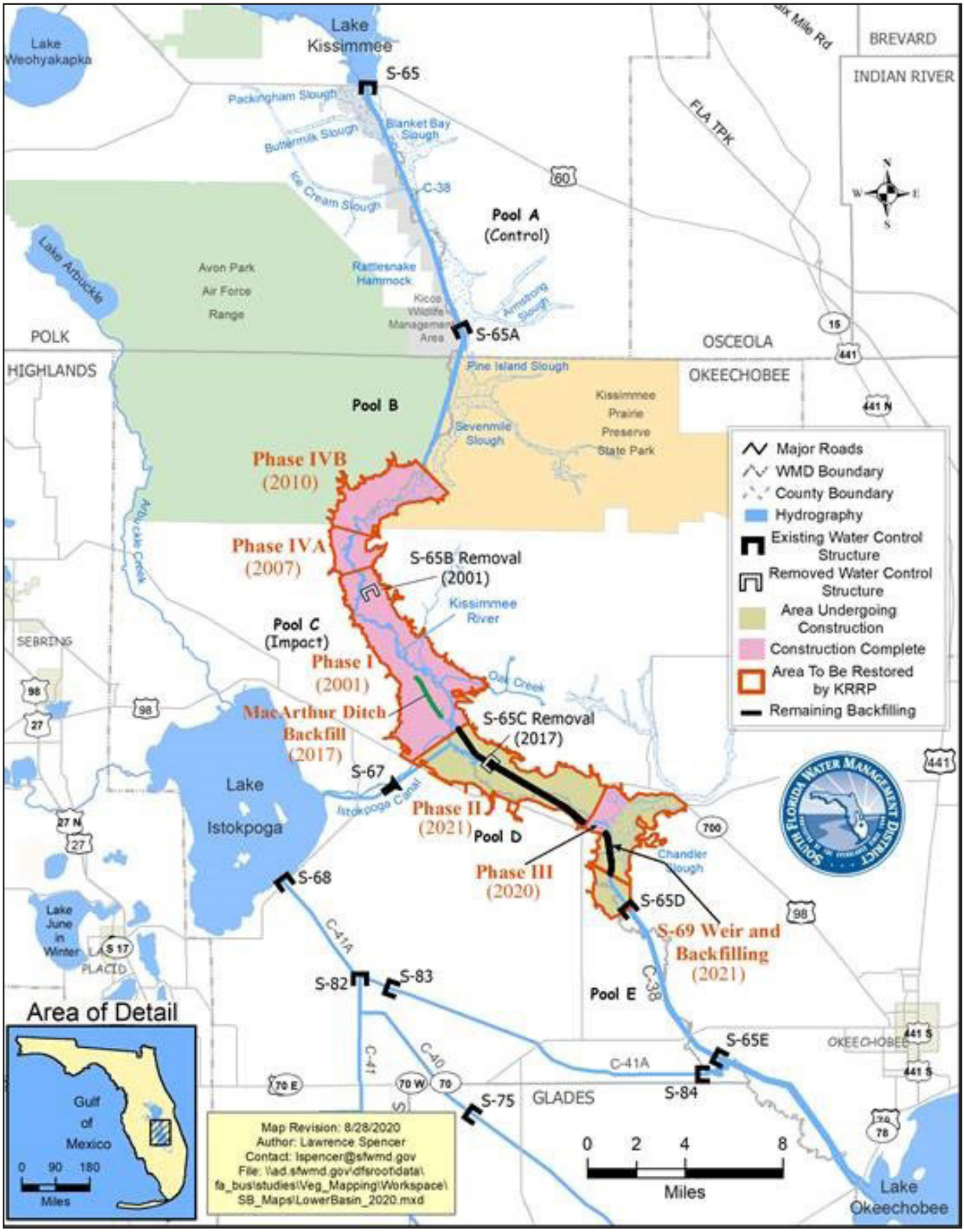


Figure 37. *A map of the Kissimmee River Restoration Project.*

WY2020 HYDROLOGY AND WATER MANAGEMENT

WY2020 had a total of 48.2 inches rainfall over the lands managed by SFWMD, which is 4.6 inches below historical average rainfall for the 1933–1995 period of record. Rainfall amounts in both the wet season (June 2019–October 2019) and dry season (November 2019–April 2020) were below historical averages. Severe rainfall deficits occurred in September 2019 (33% of average) and March 2020 (9% of average). The record lowest March rainfall (since 1932) in the late dry season deepened dry conditions. The dry condition was the most severe in the west basins and lasted to the end of the water year (April 2020).

Because of low rainfall during the dry season, water levels in major water bodies were near or below their respective regulation schedule targeted ranges. WCA-1 stage was relatively high in the dry season, while WCA-2A was almost dried out, and the WCA-3A stage was well below the historical average. In addition, Lake Okeechobee stayed in low stage range throughout the water year, starting and ending near the Water Shortage Management Band of the current Lake Okeechobee regulation schedule, LORS2008.

All surface inflows into and outflows from major water bodies were lower than historical averages due to low rainfall (Table 1 and Figure 38). The below average rainfall condition allowed a large percentage (63%) of southward outflow from Lake Okeechobee with a volume of 645,000 ac-ft (equivalent to 645 thousand acre-feet or 645 kac-ft). The rest of the outflow was directed to the Caloosahatchee River (27% of the total outflow; 277 kac-ft) and St. Lucie River (2% of the outflow; 20 kac-ft). No lake releases passed to the St. Lucie Estuary.

The average stages in the ENP wet prairie and slough were lower than their respective WY2019 stages due to low rainfall. A marsh fire started on April 19, 2020, in the southern and eastern part of ENP and continued burning through the end of April 2020. SFWMD and USACE helped control the fire by modifying water management operations. In WY2020, the WCAs and South Dade Conveyance System were operated under Modified Water Deliveries to ENP Project Increment 2 operational criteria.

Map ID	Water Body	Subtotal	Total
1	Lake Kissimmee outflows		643
2	Lake Istokpoga outflows		225
3	Lake Okeechobee total inflows		1484
4,5,7	Lake Okeechobee total outflows		1031
4	To south (S-351, S-352, and S-354)	645	
5	Caloosahatchee River inflow (S-77)	277	
7	St. Lucie River inflow (S-308)	20	
	Other outflows	89	
6	Caloosahatchee River outflow (S-79)		899
8	St. Lucie River outflow (S-80)		31
9	North Fork of St. Lucie Estuary inflows (S-48, S-49, and Ten Mile Creek)		201
10	Upper East Coast C-25 canal outflow at S-50		69
11	WCA-1 inflows		257
	WCA-1 outflows		159
12	To WCA-2 via S-10s	153	
	To east	6	
12,13	WCA-2 inflows		492
12	From WCA-1 via S-10s	153	
13	From STAs	338	
14,15	WCA-2 outflows		393
14	To WCA-3 via S-11s	292	
15	To east	102	
14,16,17a,17b	WCA-3 inflows		1053
14	From WCA-2 via S-11s	292	
16	Northwestern (S-8, STA-5/6, S-140, and S-190)	473	
17a,17b	EAA-STA (S-150) and S-9s	289	
18a,19	WCA-3 outflows		607
18a	To ENP and S-334	555	
19	Other outflows	52	
18b,20	ENP inflows		842
18b	Shark River Slough	584	
20	Taylor Slough and Eastern Panhandle	258	

Table 1. *WY2020 major surface flow in 1,000 ac-ft for WY2020. Note that the Map ID refers to the numbers in Figure 37 on page 25.*

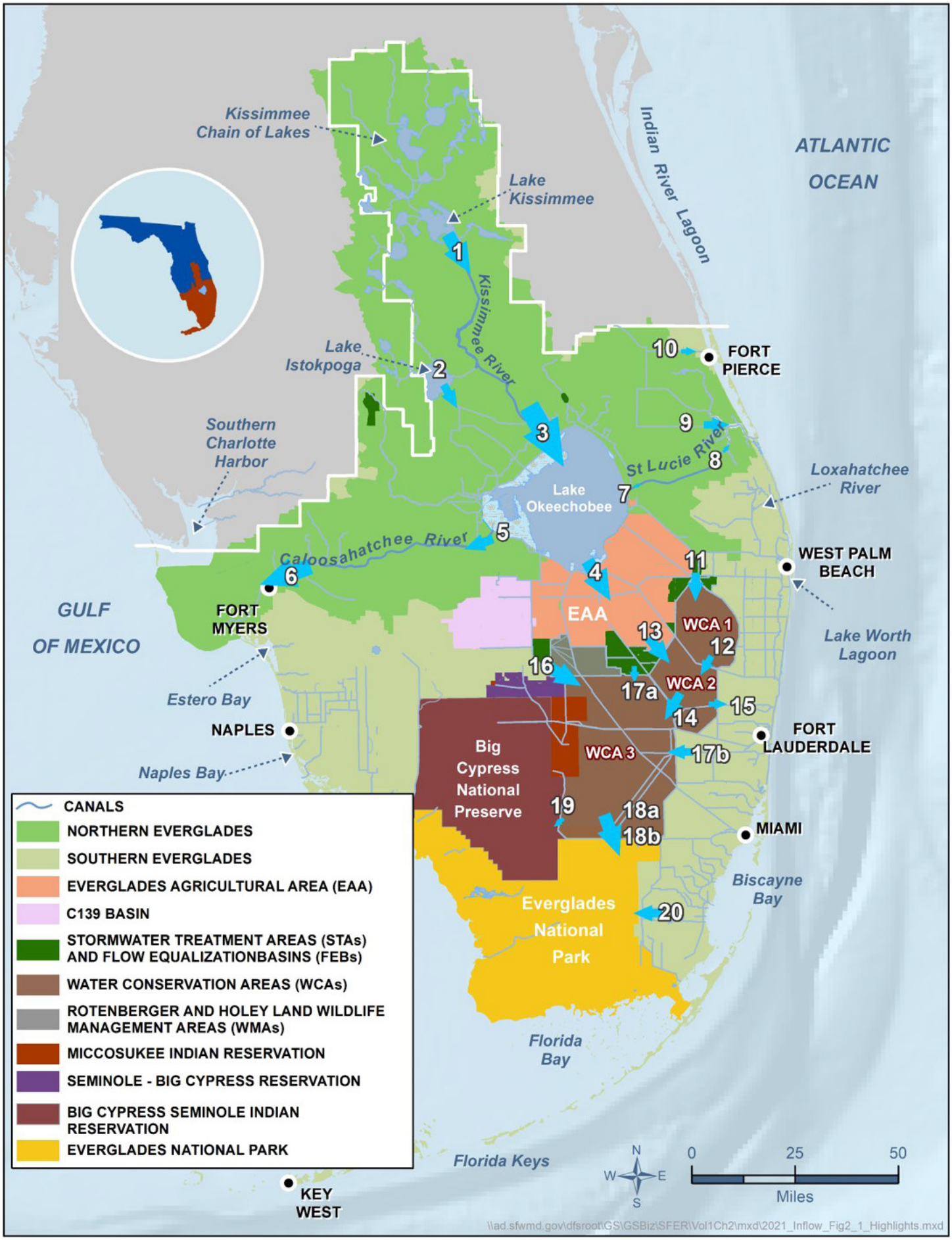


Figure 38. *WY2020 major surface flow directions.*
The numbered arrows match the Map IDs in Table 1, which provides the flow amounts for each inflow and outflow on the map.

UPDATE ON PYTHON REMOVAL FROM THE EVERGLADES

Burmese pythons continue to be observed and removed in the Everglades and surrounding areas. SFWMD conducts regional search and removal operations. In addition, SFWMD and FWC began independent python removal incentive programs in March 2017 (Figure 39). As of October 27, 2020, the two programs have resulted in the removal of 6,229 Burmese pythons. During WY2020, SFWMD and FWC expanded and aligned the two python incentive programs to increase the total number of removal agents to 100 and expand survey and removal efforts to additional areas. Through these programs, skilled, motivated contractors are an effective means of locating and removing giant constrictors from levees and roadways. See Chapter 7, Volume I, of the 2021 SFER for more information.

Figure 39. *SFWMD python removal contractor Amy Siewe with a 17.4-ft Burmese python from Big Cypress National Preserve. (Photo by Myron Looker.)*

BIOCONTROL EFFORTS FOR INVASIVE PLANT SPECIES

Most non-native plant species in Florida arrived without their specialized natural enemies, which allows them to grow larger, produce more offspring, spread more quickly, and often end up dominating and degrading important habitats in Florida. Classical biological control is a scientific process that provides a safe and effective management option that reunites these non-native weeds with their natural enemies after extensive testing for environmental safety. It is the only practical management tactic with the potential to not only fundamentally transform an invasive species into a less aggressive form, but also increase their susceptibility to conventional control methods for an overall better outcome.

CERP's Biological Control Implementation Project continues rearing and release of approved agents at the U.S. Department of Agriculture's Agricultural Research Service biological control laboratory in Davie, Florida. During WY2020, the program continued releases of biological control agents for Old World climbing fern (or lygodium) and waterhyacinth and initiated rearing and release of a recently-approved agent for Brazilian pepper. Since the project's inception in 2013, there have been 2,841 release events resulting in the release of over 8 million biocontrol agents (Figure 40).

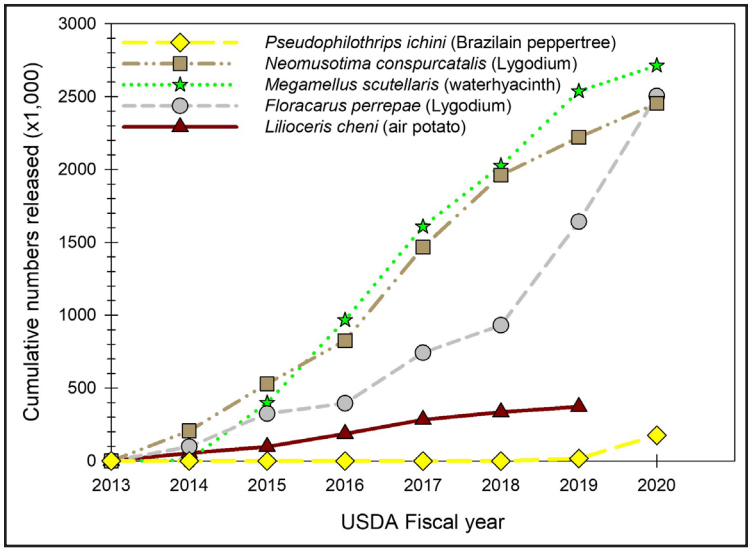


Figure 40. *Cumulative numbers of biological control agents released between December 2013 and June 2020 within CERP project footprints.*

Melaleuca

Three biocontrol agents have been released to battle the invasion of melaleuca in the State of Florida: melaleuca weevil (first released in 1997), melaleuca psyllid (first released in 2002), and melaleuca midge (first released in 2008). Together these agents reduce the tree's reproductive potential, reduce its growth rate, shorten its height by half, result in smaller flowers containing fewer seeds, decrease canopy cover, reduce reinvasion, and stimulate the formation of galls, which divert the tree's resources away from growth and reproduction. A new biocontrol agent, a pea-galling midge, has completed testing and found to be host specific to melaleuca. We anticipate this insect will be approved for release by September 2022.

Old World Climbing Fern

The brown lygodium moth (first released in 2008) causes heavy damage to this invasive species (Figure 41) without negative impacts to native plants. During FY2020, 182,684 brown lygodium moths or larvae were released in South Florida. Another agent, the lygodium gall mite, induces leaf roll galls and damages the new growing tips, reducing vine growth. The mite can quickly colonize Old World climbing fern regrowth following prescribed burns. In FY2020, more than 1.1 million mites were released in South Florida. In addition to the two established agents, host range testing is also under way.

Figure 41. *Damage to Old World climbing fern from the brown lygodium moth in 2019. (Photo by USDA.)*

Waterhyacinth

This exotic floating plant aggressively colonized freshwater ecosystems (Figure 42) including the Everglades. Three biological control agents were introduced during the 1970s and have reduced biomass by more than 50% and seed production by 90%, but additional agents are needed to reduce surface coverage. The latest biocontrol agent, the waterhyacinth planthopper, was released into the field in February 2010. Experimental field evaluations of waterhyacinth herbivory from the plant hopper and the previously established waterhyacinth weevils demonstrate that these agents can exert considerable herbivory pressure on the aquatic weed as well as increase the efficacy of herbicidal control. Other biological control agents are currently being considered for waterhyacinth.

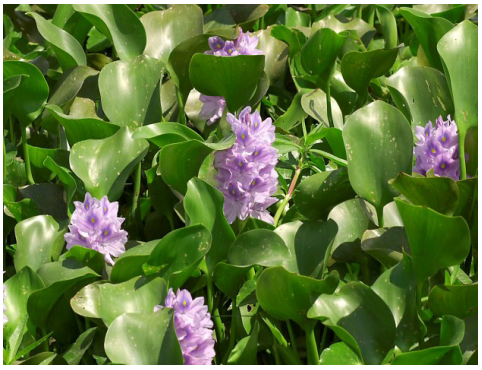


Figure 42. *Waterhyacinth forms dense floating mats. (Photo by SFWMD).*

For more information on the status of biocontrol agents, see Chapter 7 in Volume I of the 2021 SFER.

PRIORITY WATER BODY PROGRAM PROGRESS

EAA Reservoir Water Reservation

In January 2021, SFWMD completed a water reservation for the EAA Reservoir that reserves water needed for the protection of fish and wildlife in the Central Everglades. Reserving the water created by CERP projects is required by federal law. As part of CERP, the EAA Reservoir was authorized by the Water Resources Development Act of 2018 as a multi-purpose reservoir. When constructed and operational, the reservoir will store regulatory releases from Lake Okeechobee and EAA Basin runoff, thereby substantially decreasing the frequency and intensity of harmful discharges to the St. Lucie and Caloosahatchee estuaries. Model simulations of the draft operating protocol predict the EAA Reservoir, together with existing and planned infrastructure and a modified Lake Okeechobee schedule, will convey 825,000 ac-ft of surface water during an average annual water year, thereby increasing existing flows on average annually to the WCAs by 370,000 ac-ft over the period of simulation (1965–2005), benefiting fish and wildlife. It will also enhance regional water supplies for existing legal users, which will increase the water available to meet environmental needs. More information concerning the EAA Reservoir Water Reservation is available in Chapter 3, Volume II.

Kissimmee River and Chain of Lakes Water Reservations

Development of water reservations for the Kissimmee River and Chain of Lakes is anticipated to be complete in March 2021. The water reservations will provide water essential for the protection of fish and wildlife and support the objectives of the Kissimmee River Restoration Project. The water reservations will reserve from allocation (1) all surface water in the Kissimmee River, its floodplain, and Lakes Kissimmee, Cypress, and Hatchineha (Headwaters Lakes); (2) quantities of surface water up to specific water reservation stages in the Upper Chain of Lakes; and (3) surface water and groundwater in the surficial aquifer system and water bodies that contribute water to the reservation lakes and the Kissimmee River and floodplain. Federal authorizations for the Kissimmee River Restoration Project form the basis for reserving all surface water in the Kissimmee River and floodplain and in the Headwaters Lakes. The water reservations criteria will be implemented in coordination with SFWMD's water use permitting program to ensure future water users will not withdraw reserved water and the Kissimmee River Restoration Project restoration targets are achieved. The proposed rule also includes regulatory criteria to protect downstream users in the Lake Okeechobee Service Area. More information concerning the Kissimmee River and Chain of Lakes water reservations is available in Chapter 3, Volume II.

FIVE-YEAR CAPITAL IMPROVEMENTS PLAN

Over the next five years, SFWMD estimates spending $3.3 billion on projects contained in its Five-Year Capital Improvements Plan. The plan reflects the Governing Board's commitment to expediting Everglades restoration and preparing for the impacts of sea level rise and climate change. The plan also supports the Governor's strong commitment to the Everglades and the environment. The five-year plan includes funding dedicated by the Governor to implement the EAA Reservoir Project with associated STA and canal conveyance components, the Caloosahatchee Reservoir and Water Quality Study, Lake Okeechobee Watershed Restoration Project, Northern Everglades and Estuaries Protection Program, and ongoing Restoration Strategies and Long-Term Plan projects.

The remaining funds address priorities related to flood control and stormwater/water supply throughout the water management system. The Fiscal Year 2021 adopted budget included a planned capital improvements project budget of $771.6 million. Based on revised estimated project schedules, the District's Five-Year Capital Improvements Plan was adjusted to a total of $703.3 million for Fiscal Year 2021. The difference of $68.3 million is largely attributed to Everglades Restoration projects' multi-year cash flow requirements.

The SFWMD Five-Year Capital Improvements Plan supports implementing priority projects in support of Governor DeSantis' *Executive Order 19-12: Achieving More Now For Florida's Environment.* To keep the public informed about important projects, SFWMD created a special web page where the public can monitor the progress of these projects. Additional information can also be found in Volume II, Chapter 4.

ADDITIONAL EFFORTS

Chapter 2 in Volume II provides a summary of SFWMD efforts during FY2020. Some of the efforts fall under programs and projects whose status has already been provided in this document. Here we highlight some of the other efforts:

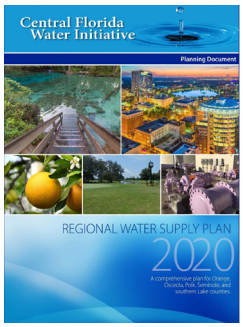


Figure 43. *2020 Central Florida Water Initiative Regional Water Supply Plan Update was approved by the Governing Board in November 2020.*

- Approximately 20,000 wetland acres west and northwest of WCA-3 have been permanently protected from oil and gas drilling.
- Land acquisition for the CERP Indian River Lagoon – South C-23/C-24 Reservoir is complete.
- Acting on sea level rise and climate change, the first SFWMD Resiliency Officer was appointed.
- The Governing Board approved the 2020 *Central Florida Water Initiative Regional Water Supply Plan Update* in November 2020 (Figure 43; CFWI 2020).
- At the direction of the SFWMD Governing Board, an Irrigation Ordinance Adoption Effort was launched. SFWMD reviewed local ordinances and sent letters to local governments, of which 15 have adopted the SFWMD Irrigation Ordinance and 140 have engaged with SFWMD staff to work towards implementing the ordinance.
- The SFWMD Governing Board approved 107 contracts worth a total of $710 million to perform SFWMD's mission. Note that this includes $591 million in contracts since SFWMD entered into COVID-19 operations.
- SFWMD staff have conducted 15,000 compliance activities including 7,181 field inspections.
- SFWMD issued 2,400 Environmental Resource Permits and 1,900 Water Use Permits.
- Volume 25 of the Annual South Florida Wading Bird Report was published in September 2020 (Figure 44).
- The final integrated project implementation report and environmental impact statements for the Loxahatchee River and Lake Okeechobee watershed restoration projects were published in January and August 2020, respectively (USACE and SFWMD 2020b, c).
- The project management plan (USACE and SFWMD 2020a) for the Biscayne Bay and Southeastern Everglades Ecosystem Restoration (formerly Phase II of the Biscayne Bay Coastal Wetlands project) was published in September 2020.
- The Integrated Delivery Schedule for South Florida Ecosystem Restoration was updated in October 2019.
- The Allapattah Wetlands Reserve Program project was completed.

Figure 44. *Reddish egret. (Photo by Mark Cook, SFWMD.)*

CONSOLIDATED PROJECT REPORT DATABASE

The online SFER Consolidated Project Report Database at www.sfwmd.gov/sfer provides rapid data sorting, searches, and retrieval for comprehensive updates on many projects referenced in the 2021 SFER.

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What are nutrients (phosphorus and nitrogen)?
Nutrients are essential for the survival of an organism. In aquatic environments, nitrogen and phosphorus are key nutrients that affect the growth rate of plants. Although the nutrients phosphorus and nitrogen are vital in all natural systems, they are also fertilizer components. These nutrients flow across the landscape in stormwater runoff as pollution (urban and agricultural) harming natural areas by promoting algae growth and an overabundance of non-native plants, crowding out natural vegetation and disrupting food sources and habitats used by native wildlife. The Everglades is naturally a low-nutrient system. Even small amounts of additional nutrients can upset the ecological balance needed by the native plants and animals in the historic "River of Grass." Phosphorus is normally recorded in micrograms per liter (µg/L) or parts per billion (ppb) and nitrogen is normally recorded in milligrams per liter (mg/L) or parts per million (ppm). In this document, total phosphorus (TP) and total nitrogen (TN) are used to denote measurement when monitoring the nutrients found in water bodies or as they relate to inflows and outflows of water. Phosphorus and nitrogen are used when referencing all other aspects of the nutrient in general terms.

What are STAs?
Stormwater treatment areas (STAs) are large, constructed wetlands with inflow and outflow structures for controlling water movement. Aquatic plants in the STAs remove and store excess nutrients (phosphorus) found in the stormwater runoff through growth and accumulation of dead plant material in the layers of sediment. This natural process cleanses the water before it is moved out of the STA and into the Everglades or other water bodies.

What are an FEBs?
Flow equalization basins (FEBs) are constructed impoundments designed to capture stormwater runoff and provide a steadier flow of water to the STAs, helping to maintain desired water levels needed to achieve optimal water quality improvement performance and prevent dry out, which can be extremely damaging to STA vegetation.

How much is an acre-foot?
An acre-foot is the volume needed to cover 1 acre of land with 1 foot, or 325,851 gallons, of water.