

2019 SOUTH FLORIDA Environmental Report



*Large white ibis nesting colony in the Everglades
(photo by Mark Cook, SFWMD).*

HIGHLIGHTS

The 2019 South Florida Environmental Report (SFER) documents a 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 full report covers environmental information for Water Year 2018 (May 1, 2017–April 30, 2018) and project/budgetary information for the South Florida Water Management District (SFWMD or District) Fiscal Year 2017-2018 (October 1, 2017–September 30, 2018). The full >2,600-page report is available online at www.sfwmd.gov/sfer.

WATER YEAR 2018 INFLOWS, OUTFLOWS, WATER LEVELS, AND STORMS

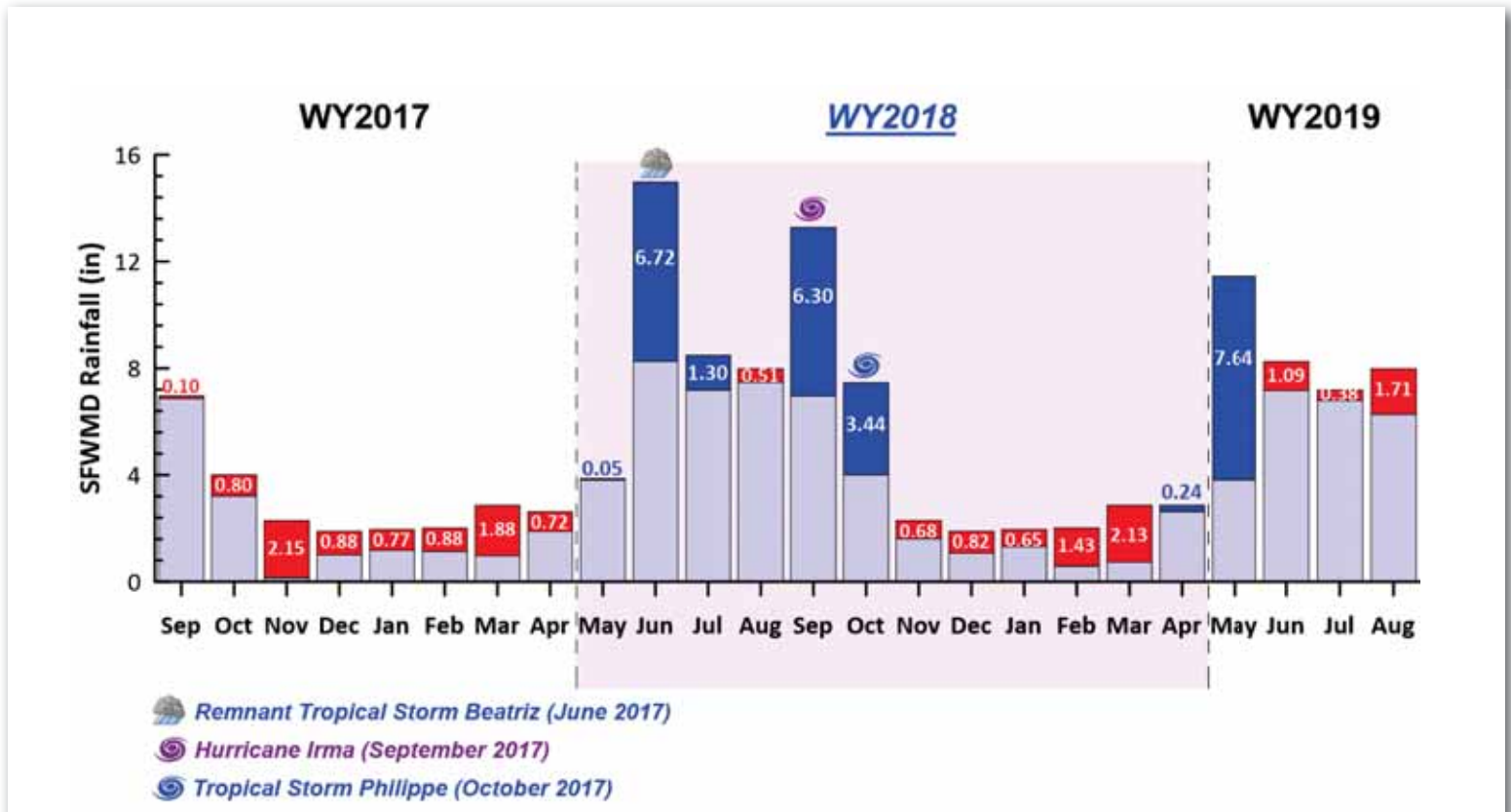
During Water Year 2018, all District regions received far above average rainfall. The wet season (June–October 2017) was the wettest on record (since 1932). An extreme rainfall event occurred from June 1 to June 8, 2017, which sharply increased water levels in the water conservation areas (WCAs) far above their regulation schedule, putting tree islands and animals at risk. In addition to the June 2017 extreme rainfall event, three tropical systems affected the District during the 2017 Hurricane Season (Water Year 2018): Tropical Storm Emily (July 30–August 1), Hurricane Irma (September 8–11), and Tropical Storm Philippe (October 28–29). Overall, these systems contributed over 12 inches of rainfall within the District area.

The extreme rain event in June prompted state and federal agencies to take immediate actions. On June 13, 2017, the Florida Fish and Wildlife Conservation Commission (FWC) restricted uses and public access in the Francis S. Taylor, Holey Land and Rotenberger wildlife management areas. The Florida Department of Environmental Protection (FDEP) issued an emergency final order on June 23, 2017, authorizing SFWMD and the U.S. Army Corps of Engineers (USACE) to take immediate action to deviate from permitted water management practices to move significant volumes of flood water out of the WCAs, which received about 20 inches of rain above normal. This amount of wet season rainfall in the WCAs is only expected approximately once every 100 years. SFWMD field station staff and crews and contractors deployed temporary pumps at six locations to assist in lowering WCA water levels.

Hurricane Irma affected most of the District. The storm made landfall in the Florida Keys on September 10, 2017, as a Category 4 storm. The storm caused catastrophic damage before crossing the Florida peninsula and making landfall near Marco Island as a Category 3 hurricane. Impacts on the water management system due to the winds and rainfall included fallen trees in canals, eroded levees and structure banks, damage to pump stations that interfered with pump performance, field station damage, and pump station access road flooding and damage. The storm also affected the Everglades Stormwater Treatment Areas including increased flows, phosphorus loads, and turbidity, and damage to vegetation.



Hurricane Irma damage.



Water Year 2018 wet season was the wettest on record since 1932 with 51.5 inches of rain. The red and blue shading represents inches of rainfall above (blue) or below (red) historical monthly averages.

Water Year 2018 Flows



Map ID	Water Body	Notes	WY2018 Flows Subtotals (acre-feet)	WY2018 Flows (acre-feet)
1	Lake Kissimmee Outflows			872,245
2	Lake Istokpoga Outflows			539,957
3	Lake Okeechobee Total Inflows			3,396,788
4,5,7	Lake Okeechobee Total Outflows			2,613,134
4	Flows to the South from Lake Okeechobee		525,091	
5	Flows into the St. Lucie Canal from Lake Okeechobee	a	636,399	
7	Flows into the Caloosahatchee Canal from Lake Okeechobee: Other Flows from Lake Okeechobee	b	1,324,234 127,410	
6	Flows into the St. Lucie Estuary through the St. Lucie Canal Lake Okeechobee Releases to St. Lucie Estuary C-44 Basin Runoff into St. Lucie Estuary	a, b, c, d a, b, c	585,620 79,844	665,464
8	Flows into the Caloosahatchee Estuary through the Caloosahatchee Canal Lake Okeechobee Releases to Caloosahatchee Estuary Basin Runoff into Caloosahatchee Estuary	b, c, e b, c	1,200,931 1,392,029	2,592,960
9	Water Conservation Area 1 Inflows			398,853
10	Water Conservation Area 1 Outflows			489,919
11	Water Conservation Area 2 Inflows			1,243,304
12	Water Conservation Area 2 Outflows			1,261,932
13	Water Conservation Area 3 Inflows			2,268,911
14,15	Water Conservation Area 3 Outflows			2,226,932
15,16	Everglades National Park Inflows			2,552,420

- a. Due to sensor errors, it appears that flows are overestimated from Lake Okeechobee and underestimated for C-44 Basin runoff. See Volume I, Chapter 2, Table 2-1 for details.
- b. This item is not shown on the map.
- c. Calculated value.
- d. Map ID 5 includes agricultural withdrawals.
- e. Map ID 7 includes agricultural and public water supply withdrawals.

Inflow/outflow map depicts flow numbers in acre-feet* of water for Water Year 2018 (May 1, 2017- April 30, 2018) moved through the water management system.

*An acre-foot of water is the volume needed to cover 1 acre of land with 1 foot of water.

Revised March 6, 2019

EVERGLADES TOTAL PHOSPHORUS IMPROVEMENTS

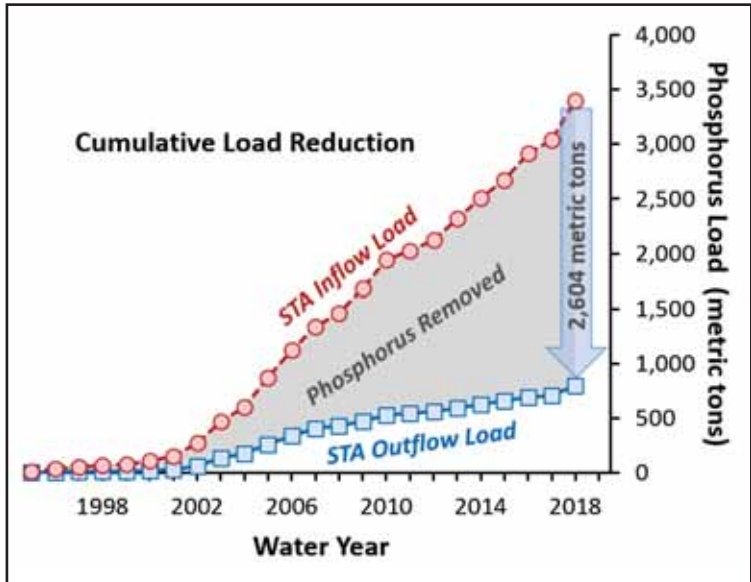
Phosphorus controls implemented in the 1990s to improve water quality in the Everglades Protection Area under the Everglades Forever Act (EFA) include the mandated Best Management Practice (BMP) Program and existing Everglades Stormwater Treatment Areas. More recent improvements are being implemented as part of the Restoration Strategies program, such as STA expansions, flow equalization basins, and subregional source controls.

Everglades Stormwater Treatment Areas

Over a 24-year operational history, the Everglades Stormwater Treatment Areas (STAs) have treated approximately 20.1 million acre-feet of water and retained 2,604 metric tons of total phosphorus (TP) with a 77% TP load reduction. In Water Year 2018, with 57,000 acres of treatment area, the STAs treated a combined 1.6 million acre-feet of water and retained 275 metric tons of TP, which equated to a 77% TP load reduction. Approximately 107,000 acre-feet of the water treated in the STAs came from Lake Okeechobee; the remaining water came from agricultural and urban runoff.

Except for STA-3/4, outflow flow-weighted mean TP concentrations from the STAs were markedly higher in Water Year 2018 compared to outflow concentrations in recent water years. This increase was attributed primarily to impacts from the large rain event in June

2017 and Hurricane Irma in September 2017. The percent TP load retained in Water Year 2018 ranged from 62% (STA-5/6) to 90% (STA-3/4).



Everglades Stormwater Treatment Areas (STAs) have prevented 2,604 metric tons of phosphorus from entering the Everglades since 1996.

Regional Nutrient Source Control Programs

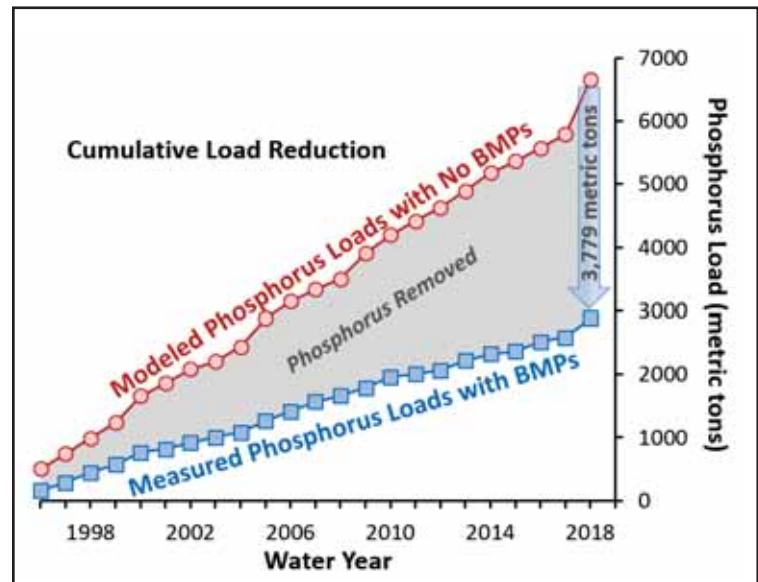
To date, 23 years of best management practices (BMPs) on agricultural lands have prevented 3,779 metric tons of phosphorus from leaving the Everglades Agricultural Area (EAA) Basin in stormwater runoff. The SFWMD Everglades Program mandates quantifiable phosphorus reductions at the source. Areas historically contributing the greatest proportion of the TP load to the Everglades Protection Area, the Everglades Agricultural Area and C-139 basins, both met their TP load performance measures in Water Year 2018. The EAA Basin achieved a 66% reduction in TP load from the pre-BMP baseline period; a minimum TP load reduction of 25% is required. The cumulative reduction in TP load in EAA Basin runoff since the program started in 1996 is 3,779 metric tons, or a long-term average annual TP load reduction of 57%.

Restoration Strategies

Under this program, the District is implementing a regional water quality plan that includes projects to supplement the existing Everglades Forever Act mandated projects. The plan includes 6,500 acres of new STAs and 116,000 acre-feet of additional water storage, utilizing flow equalization basins (FEBs) and subregional source controls within the EAA Basin. The design and construction of Restoration Strategies projects is ongoing with completion of all projects expected by December 2025.

Major milestones have been reached in design, construction and operation of Restoration Strategies projects in Water Year 2018:

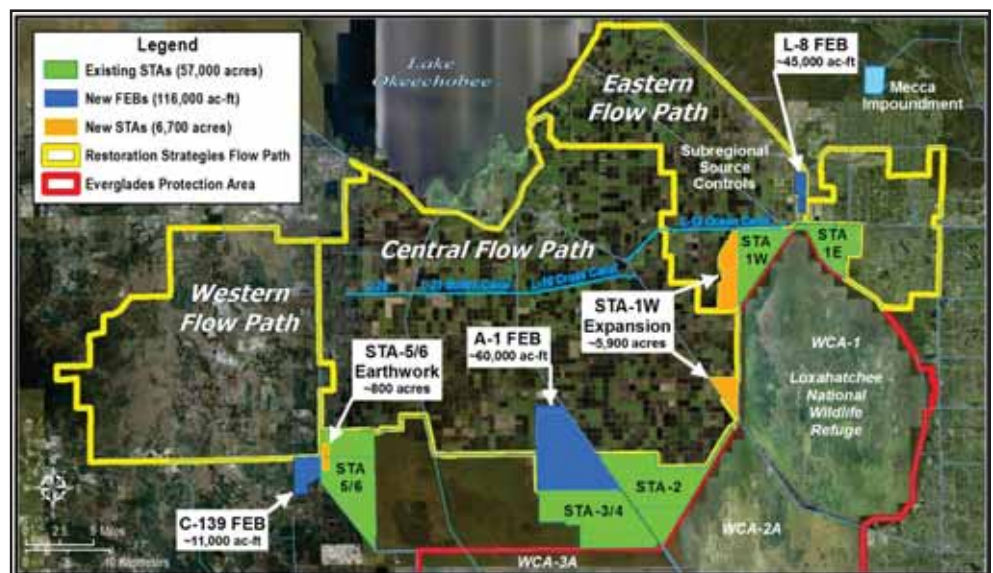
- Construction continued on STA-1 West Expansion #1 to create approximately 4,300 acres of additional effective treatment area. Construction was completed on December 21, 2018.
- The STA-1 West Expansion #2 project is anticipated to provide at least 1,600 acres of effective treatment area. Land acquisition was completed in January 2018 and project design started on September 21, 2018.
- Construction of the L-8 FEB was completed June 21, 2017.
- The G-341 Related Conveyance Improvements project is intended to improve conveyance within the eastern Everglades Agricultural Area, specifically in the Bolles East, Ocean, and Hillsboro canals. Construction of Bolles East (L-16) Canal Segments 1 and 2 conveyance improvements and a new Duda Road bridge is complete. Segment 3 construction started in May 2017, was approximately 50% complete as of April 2018, and is expected to be complete by February 2019. Segment 4 construction is expected to start by March 2019.



Best management practices (BMPs) have prevented 3,779 metric tons of phosphorus from leaving the Everglades Agricultural Area (EAA) Basin in stormwater runoff since 1996.

- The A-1 FEB operational monitoring and testing period was completed in July 2018.
- Design of STA-5/6 internal improvements started in April 2018.

The District continues to make progress in implementing the Restoration Strategies Science Plan, which began implementation in 2013. The scientific studies under this plan investigate ways for improving operation and maintenance of the STAs to optimize treatment performance and help achieve the water quality-based effluent limit for TP. Overall, 12 studies



Location of phosphorus controls upstream of the water conservation areas (WCAs), including existing and new stormwater treatment areas (STAs) and flow equalization basins (FEBs). "New" in the figure refers to all STAs and FEBs planned and constructed as a part of Restoration Strategies as opposed to those that existed prior to implementation of Restoration Strategies. Some are already constructed: A-1 FEB, L-8 FEB, and the northern portion of the STA-1W Expansion.

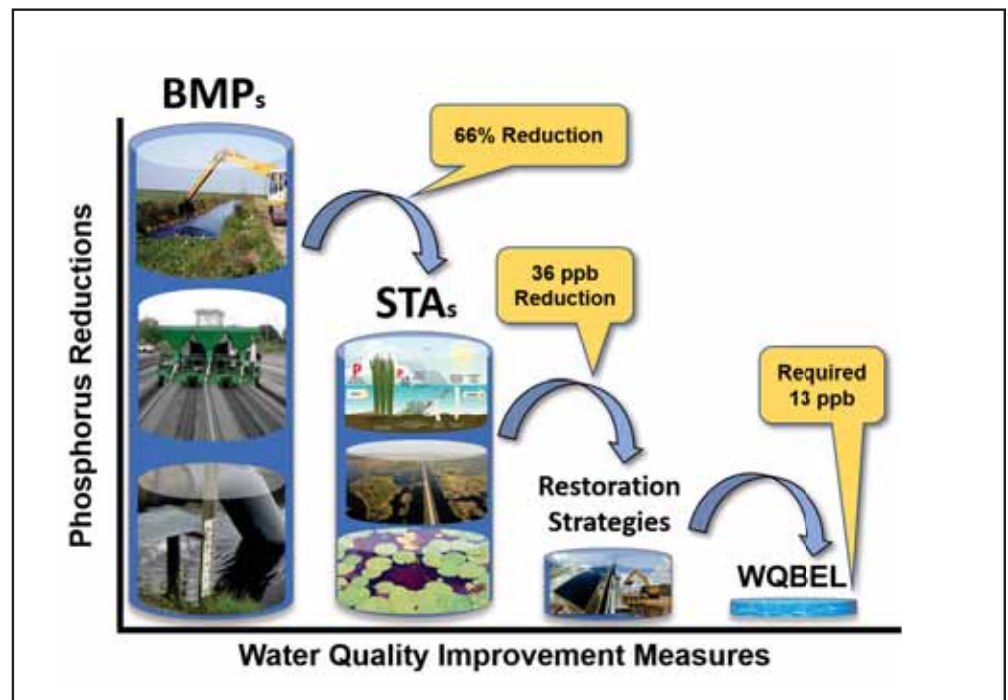
have been undertaken. Of these, two were completed prior to Water Year 2018, one was completed during Water Year 2018, and two were recently completed in September 2018 (Water Year 2019).

As part of the **P Flux Study**, which evaluates mechanisms and factors that affect phosphorus treatment performance in the Everglades STAs, seven controlled flow events and associated measurements already have been carried out and three flow events are planned in Water Year 2019 for the STA-3/4 Western Flow-way.

The **Evaluation of Inundation Depth and Duration for Cattail Sustainability** study is evaluating cattail community sustainability in the STAs through field monitoring and evaluation of growth in test cells. These evaluations will continue through the next few water years.

The **Use of Soil Amendments and/or Management to Control P Flux** study investigates the application of soil amendments and soil management to reduce internal loading of phosphorus in the STAs. A field-scale investigation of the benefits of soil inversion will be performed at the STA-1 West Expansion Area #1 beginning in 2019.

The **PSTA Study**, which evaluated the ability of periphyton-based treatment to remove phosphorus as a final polishing step, was completed in late 2018.



Phosphorus improvements have been and will be achieved through load and concentration reductions from the regional nutrient source control programs' best management practices (BMPs), existing Everglades Stormwater Treatment Areas (STAs), and Restoration Strategies. WQBEL is the Water Quality Based Effluent Limit.

The **rFAV Study**, which evaluated the potential benefit of rooted floating aquatic vegetation (rFAV) in removing phosphorus, was completed in late 2018.

The **Evaluation of Factors Contributing to the Formation of Floating Tussocks in the STAs** study evaluates potential factors that may have triggered the formation of floating tussocks in the STAs. This study is ongoing through 2019.



STA-1W Outflow Pump Station G-310 with structures and canals being constructed as part of STA-1W Expansion #1, looking northwest (photo by SFWMD, May 2018).

The **Investigation of the Effects of Abundant Faunal Species on P Cycling in the STAs** study, which is determining the influence of animal population in phosphorus cycling and reduction in the STAs, is ongoing through 2019.

The **Improving Resilience of Submerged Aquatic Vegetation in the STAs** study, which investigates the effects of operational and environmental conditions on the health of submerged aquatic vegetation in the STAs, is ongoing through 2019.

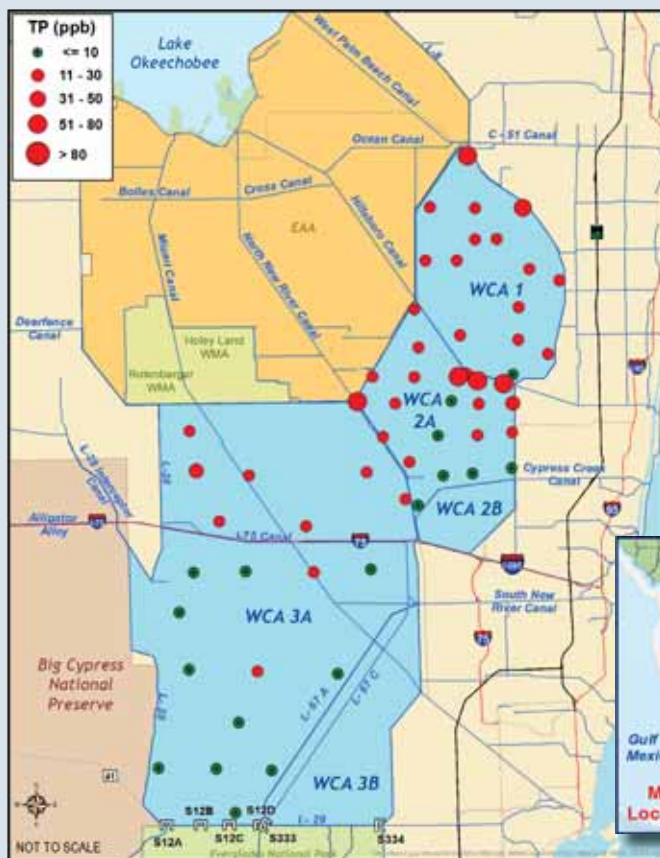
The **STA Water and Phosphorus Budget Improvements** study will improve annual STA water and phosphorus budgets to provide a more accurate estimation of STA cell performance and to identify areas of uncertainty. This study is ongoing through 2023.

Everglades Total Phosphorus in Water Year 2018

Everglades water quality in relation to total phosphorus continues to show improvement. In Water Year 2018, inflow TP concentrations for the Everglades Protection Area ranged from 8.8 parts per billion (ppb) for Everglades National Park to 28.5 ppb for Water Conservation Area (WCA) 3. TP concentrations at interior regions ranged from 4.7 ppb in Everglades National Park to 10.5 ppb in WCA-2. Individual interior marsh monitoring stations ranged from 2.9 ppb in some unimpacted portions of the marsh to 36.1 ppb at sites that are highly influenced by canal inputs. The investments made over the last two decades are making a difference, improving Everglades water quality with over 90% of the Everglades Protection Area at or below 10 ppb TP.

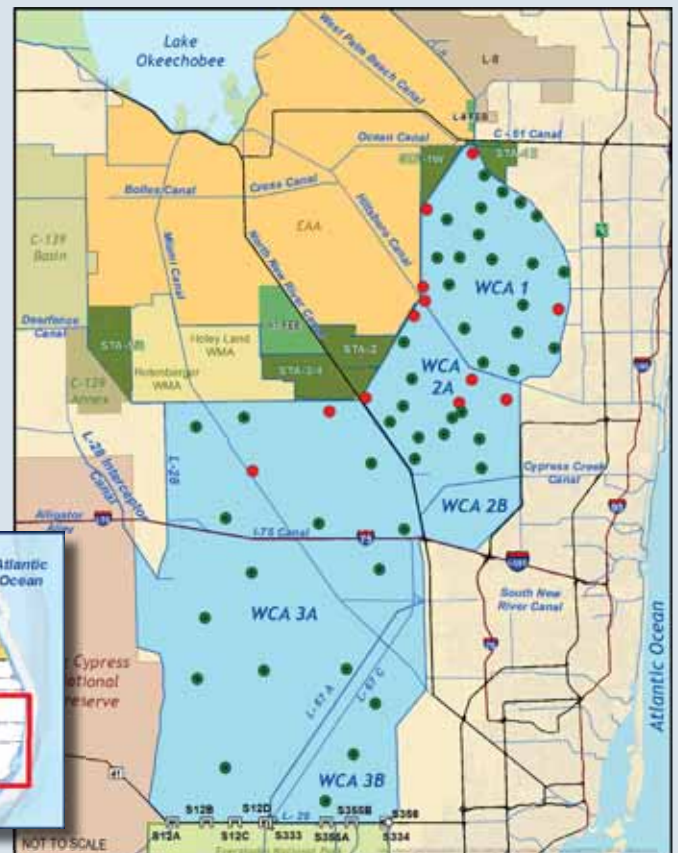
Baseline Period: Water Years 1979–1983

High total phosphorus in water conservation areas



Progress Today: Water Years 2014–2018

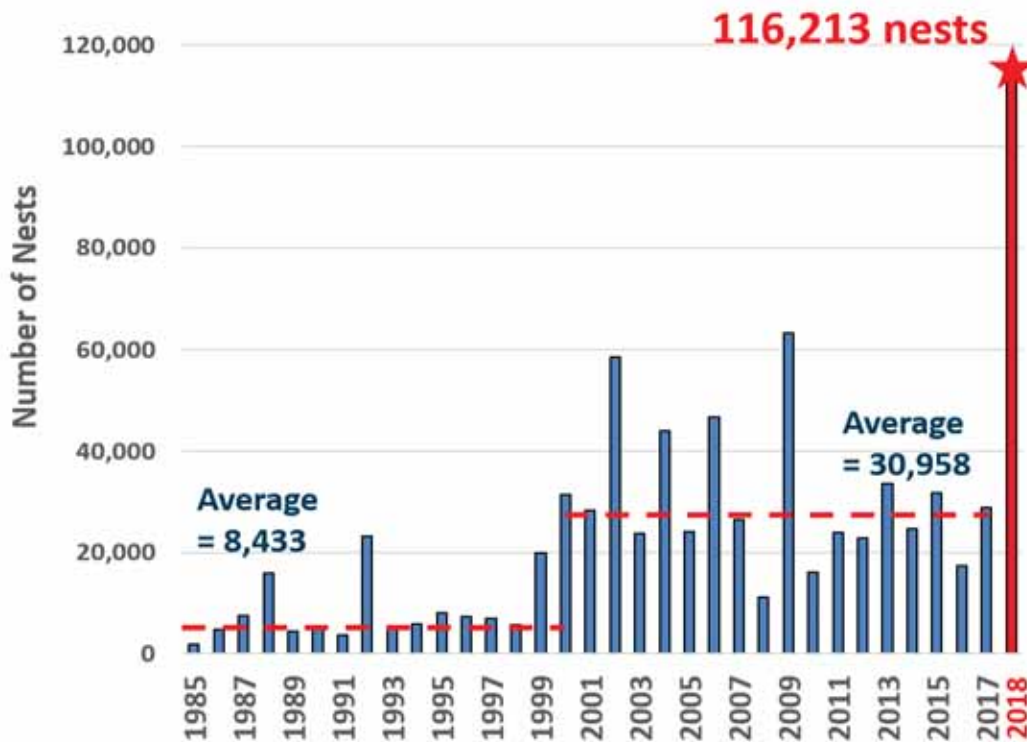
Majority of area below 10 parts per billion (ppb)



Over the last two decades, average total phosphorus (TP) concentrations within the Everglades marsh have been reduced in the water conservation areas from 24 parts per billion (ppb) to less than 10 ppb, and averaged 4.7 ppb within Everglades National Park in Water Year 2018.

Red dots show areas with levels of TP measuring over 10 ppb prior to restoration efforts and today with most areas restored to water quality healthy to Everglades ecology. The larger the dot, the higher the TP level. Green dots show areas with TP levels at or under 10 ppb. The handful of monitoring stations above 10 ppb continue to make significant progress in achieving that standard.

Nesting effort in 2018 was comparable to that of the 1930s and 1940s!



Annual total number of nests of four freshwater bird species in the Everglades Protection Area over the last 33 years. Nesting effort in 2018 was comparable to that of the 1930s and 1940s. Data source: P. Frederick, University of Florida; L. Oberhofer, Everglades National Park; and M. Cook, SFWMD. Photo source: M. Cook, SFWMD.

EVERGLADES WADING BIRD NESTING SUCCESS

The drainage of the Everglades after the 1940s affected wading bird reproduction with a decrease in nesting birds, and a shift in the location of the nesting colonies from the historic nesting sites along the coast to the ponded marshes of the water conservation areas. Delayed wood stork nesting caused a decline in nesting success because chicks are often still in the nest when food availability declines during the wet season.

There is considerable variability in nesting effort each year in response to fluctuations in hydrological conditions and prey resources. Nesting success increased beginning around 2000 when the climate shifted to wetter conditions, mercury levels declined, and water management began to consider the ecology of the birds in its decision-making. Several exceptional nesting years occurred during this recent period, including the record breaking 2009 with a very respectable 63,000 nests. Water Year 2018 nesting was almost double this number with over 116,000 nests recorded within the water conservation areas and Everglades National Park.

This was by far the largest nesting response observed in the last 80 years and comparable with the supercolony nesting events of the 1930s and 1940s. The federally threatened wood stork had an excellent year with 3,500 nests, almost three times the average and the second largest nesting effort since the early 1960s, because nesting began early enough in the dry season to reach completion before food becomes unavailable during the wet season. A huge surge in nesting by the white ibis with 95,000 nests, accounted for about 78% of all wading bird nests in the Everglades this year – 75,000 more nests than usual, or 150,000 additional adults. Nearly 40,000 nests were initiated near the coast, which is by far the largest nesting effort in this region since the 1940s.

So why was WY2018 such a record breaking year for wading birds in the Everglades? There are three hypotheses: Relatively dry conditions during last year's dry season (Water Year 2017) led to increased crayfish recruitment. Extreme rainfall during Water Year 2018's wet season (spring and summer 2017) led to increased crayfish and small fish production. Consistent drying during the nesting season produced prey concentrations across the landscape at the right time and place; or, a combination of all three.

Beyond the nesting responses reported for the Everglades, wading bird nesting colonies were also monitored throughout South Florida. Details on nesting activities from the Everglades and other locations are documented annually in the South Florida Wading Bird Report, which is available online at www.sfwmd.gov/sfer by clicking on the Wading Bird Reports link provided under Technical Publications.

INVASIVE SPECIES

The District has one of the country's largest invasive plant management programs, controlling aquatic and terrestrial vegetation systemwide. Seventy-five species of nonindigenous plants are District priorities for control. Old World climbing fern, melaleuca, Brazilian pepper, and Australian pine are systemwide priorities, while aquatic plants such as hydrilla, water hyacinth, and tropical American watergrass are priorities in the Kissimmee Basin and Lake Okeechobee.

Interagency efforts to achieve maintenance control of priority invasive plant species in areas with more severe infestations continue:

- The U.S. Fish and Wildlife Service (USFWS), Florida Fish and Wildlife Conservation Commission (FWC), and SFWMD are actively engaged in aggressive control efforts in the Arthur R. Marshall Loxahatchee National Wildlife Refuge where melaleuca and Old World climbing fern remain problematic.
- National Park Service resource managers are collaborating with FWC and SFWMD invasive species biologists to leverage

resources towards achieving maintenance level control of melaleuca, Brazilian pepper, and other aggressive invaders in Everglades National Park and Big Cypress National Preserve.

- The federal and Florida noxious weed, mission grass, is a new focus for regional containment following its discovery in southeastern Florida. Local, state, and federal partner agencies began a rapid response effort in 2017.
- The interagency melaleuca management program continues to be a national model for regional, interagency invasive plant control programs.

In addition, a considerable numbers of nonindigenous animals are known to occur in South Florida, ranging from approximately 62 species in the Kissimmee Basin to more than 130 species in the Everglades.

Invasive animal species were also the focus of agency efforts in Water Year 2018:

- The SFWMD and FWC python hunter incentive programs that began in March 2017 have resulted in the removal of approximately 2,000 Burmese pythons.
- During 2017–2018, federal, state, local, and tribal partners continued efforts to control expanding populations of several invasive animal species including northern African pythons, Argentine black and white tegu, and spectacled caimans.

Priority Plant Species for Control



Australian pine

Tony Pernas, National Park Service



hydrilla

Leslie Mehrhoff, U of Connecticut



Brazilian pepper

Stephanie Sanchez



water hyacinth



Old World climbing fern



melaleuca

Starr Environmental



tropical American watergrass

Tony Pernas, National Park Service



mission grass

Starr Environmental

Priority Animal Species for Control



Burmese python

Tony Pernas, National Park Service



spectacled caiman

Croc Docs, University of Florida



Argentine black and white tegu



northern African python

Shawn Heflick, Florida Fish and Wildlife Conservation Commission

- The University of Florida continued to operate the Everglades Invasive Reptile and Amphibian Monitoring Program (EIRAMP) in cooperation with and with support from SFWMD, FWC, the United States Geological Survey, National Park Service, and USFWS. The purpose of EIRAMP is to develop an early detection, rapid response, removal, and monitoring program for invasive reptiles and amphibians within Greater Everglades ecosystems.

ECOLOGY RESEARCH AND ASSESSMENT

In addition to wading bird nesting success, Everglades ecology research and assessment made the following progress during Water Year 2018:

- Water budgets were developed for five lakes in two parallel chains of lakes discharging through the Alligator Creek system and McCormick Creek system in the central lakes area of Florida Bay. The McCormick Creek system contributes most of the water to the central bay and appears to be groundwater fed by Taylor Slough. **Recent increases in this flow may indicate positive response to additional water from the C-111 Spreader Canal project.**
- **Shoal grass (*Halodule wrightii*) colonization** of Rankin Lake following a 2015 turtlegrass (*Thalassia testudinum*) die-off was hampered in Water Year 2018 by Hurricane Irma, but preliminary data suggest that the recovering seagrass beds were not severely affected. The cause of seagrass die-off in

Florida Bay is being studied in a series of lab experiments evaluating how hypersalinity can disrupt plant tissue metabolism in turtlegrass.

- Scientists working on the **Cattail Habitat Improvement Project** have documented a decline in phosphorus concentrations in open versus control plots. This decline is associated with the accumulation of more mineral soils, which could serve as a cap to minimize legacy phosphorus flux coming from underlying enriched soils.
- Greatly elevated nutrient and **chlorophyll *a*** levels occurred throughout Florida Bay in the aftermath of Hurricane Irma in September 2017. It is likely that runoff and resuspended nutrients from decaying vegetation from the seagrass die-off facilitated algal growth. By the end of the water year, chlorophyll *a* levels had returned to their long-term levels or were trending in that direction.
- Effects of openings of the **S-197 structure**, an outlet from the C-111 Canal into the Manatee Bay-Barnes Sound region, were assessed. Water released during a 2017 emergency order reduced surface water salinities as much as 20, but not the benthic salinity, which buffered SAV from damage.
- **Decomp Physical Model** data was synthesized to produce models for water, sediment, and sediment phosphorus budgets across the L-67C Canal Backfill Treatment Area.

NORTHERN EVERGLADES AND ESTUARIES PROTECTION PROGRAM

The District, Florida Department of Environmental Protection (FDEP), and Florida Department of Agriculture and Consumer Services (FDACS) continued to implement the Northern Everglades and Estuaries Protection Program (NEEPP) during Water Year 2018.

■ Basin Management Action Plans

As of December 31, 2017, 23% of the TP reductions needed to meet the Lake Okeechobee Watershed Total Maximum Daily Load (TMDL), 51% of the required total nitrogen (TN) reductions and 35% of the required TP reductions needed to meet the St. Lucie River Basin TMDLs, and 59% of the TN reductions needed to meet the Caloosahatchee Estuary TMDL were achieved. Additional details on the status of the basin management action plans can be found on the FDEP website at <https://floridadep.gov/dear/water-quality-restoration/content/basin-management-action-plans-bmaps>.

■ STAR

Appendix A of the *Florida Statewide Annual Report on Total Maximum Daily Loads, Basin Management Action Plans, Minimum Flows or Minimum Water Levels, and Recovery or Prevention Strategies* (STAR) details the progress made through December 31, 2017, on implementation of NEEPP BMAPs. Details are available at <https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report>.

■ Lake Okeechobee Watershed Construction Project

Construction of the southern section of the Lakeside Ranch STA – Phase II and the Kissimmee River Restoration Project continued. Operations continued for Lakeside Ranch STA Phase I, Taylor Creek STA, and Nubbin Slough STA. Additionally, the planning and design phase was launched for construction of estuary protection wells.

■ St. Lucie and Caloosahatchee River Watersheds Construction Projects

Construction continued on the Comprehensive Everglades Restoration Plan (CERP) Caloosahatchee River (C-43) West Basin Storage Reservoir, CERP Indian River Lagoon South – C-44 Reservoir/STA, and Lake Hicpochee Hydrologic Enhancement – North Project. Operations and monitoring of Phase I mesocosms of the C-43 Water Quality Treatment and Testing Facility Project continued. Construction of a remediation project for water storage at Ten Mile Creek was completed. Implementation of hybrid wetland treatment technologies and floating aquatic vegetative tilling technologies to remove nutrients at subbasin and farm scales also progressed in the Northern Everglades watersheds.

■ Dispersed Water Management Program (DWM)

The storage provided by the operational projects within the DWM Program for the water year was estimated to be more than 66,000 acre-feet (ac-ft). Two new projects were added: Caulkins Water Farm Expansion, which became operational in December 2017 with an estimated average annual benefit of 60,000 ac-ft/year, and C-23/24 Interim Storage Section C Water Farm, which became operational in August 2017 with an estimated average annual benefit of 3,850 ac-ft/year.

■ Agricultural Non-Point BMP Update

To date, BMP manuals for cow/calf, citrus, vegetable and agronomic crops, nurseries, equine, sod, dairy, poultry, and specialty fruit and nut operations have been published by FDACS, which is directed by NEEPP as the lead agency for agricultural BMPs. Acreages enrolled in the program as of April 30, 2018, are 1,756,839 acres in the Lake Okeechobee Watershed, 279,115 acres in the St. Lucie River Watershed, and 426,747 acres in the Caloosahatchee River Watershed. Details are available at www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy.

Lake Okeechobee Conditions for Water Year 2018

In Water Year 2018, TP load to Lake Okeechobee from the watershed (1,046 metric tons) was substantially higher than last water year's TP load (449 metric tons). This increase may be attributed to an extremely wet September and October 2017, when inflows to the lake were very high after Hurricane Irma. Runoff from the watershed and resuspension of sediments after the storm resulted in a one-week increase in the average measured TP concentrations. Post-storm water clarity also markedly decreased. Strong winds experienced in January 2018 caused even further sediment resuspension, resulting in the highest in-lake average turbidity levels since the 2004 and 2005 hurricanes. Hurricane Irma further decreased the estimated coverage of submerged aquatic vegetation in the lake, which was already relatively low due to high water levels associated with El Niño events in early 2016. Low inflows prior to summer 2017 led to conditions favorable to algal blooms in the lake.

St. Lucie River Estuary Conditions for Water Year 2018

A high amount of wet season rain was the driver for increased discharges to the estuary during Water Year 2018. This in turn increased TP and TN loading to the estuary. TN loading (3,135 metric tons) was almost twice the long-term average (1,779 metric tons). TP (556 metric tons) was 70% higher than the long-term average (327 metric tons). Salinity was too low for oysters 38% of the time and too high 16% of the time, most of which occurred in the wet season. Live oyster densities were high at the beginning of the 2018 wet season, averaging 1,047 oysters per square meter, but density fell to less than one oyster per square meter after Hurricane Irma and remained low through the dry season due to low larval recruitment. The prevalence of the oyster marine parasite, *Perkinsus marinus* (Dermo) was comparatively low in Water Year 2018 before the hurricane; assessment was not possible after the storm due to lack of live oysters.

Caloosahatchee River Estuary Conditions for Water Year 2018

High rainfall during the Water Year 2018 wet season drove increased discharge to the estuary, resulting in increased TN and TP loading to the estuary. TN increased 74% from a long-term average of 3,070 to 5,329 metric tons and TP loading (643 metric tons) was 116% higher than the long-term average (297 metric tons). At the Ft. Myers station, only 69% of the days in the water year had a salinity of less than 10, which is the target for tape grass (*Vallisneria americana*). Average live oyster density at Bird Island in the lower estuary was relatively low (813 oysters per square meter pre-hurricane) and declined post-hurricane to 587 oysters per square meter. Oyster larval recruitment was low. Iona Cove was similarly impacted by the hurricane.

KISSIMMEE RIVER RESTORATION

The final phases of construction for the Kissimmee River Restoration Project are nearing completion. This work involves backfilling an additional 6.5 miles of the C-38 canal (referred to as Reach 2), removal of the S-65C structure, and construction of the S-69 weir. The Reach 2 backfilling and structure removal contract began in January 2017 and is projected to be completed in 2020. The S-69 weir construction contract was awarded in 2017 and construction began in November 2018. The projected completion date is also in 2020. Once all construction and land acquisition are complete, the Headwaters Revitalization Schedule, which will regulate water flow to the river, will be implemented.

FUNDING RESTORATION PROJECTS

Continuing the state's strong support of Everglades Restoration, the Florida Legislature appropriated over \$230 million for Fiscal Year 2016-17 and over \$247 million for Fiscal Year 2017-18 for CERP, Northern Everglades and Restoration Strategies. Governor Ron DeSantis has called for achieving more now for Florida's environment in signing Executive Order 19-12, seeking \$2.5 billion over the next four years, the highest level of funding for restoration in Florida's history, to expedite Everglades restoration and protection of water resources.

RESTORATION PROJECTS STATUS

Volume III of the 2019 SFER provides an annual update on environmental restoration projects to comply with permits issued

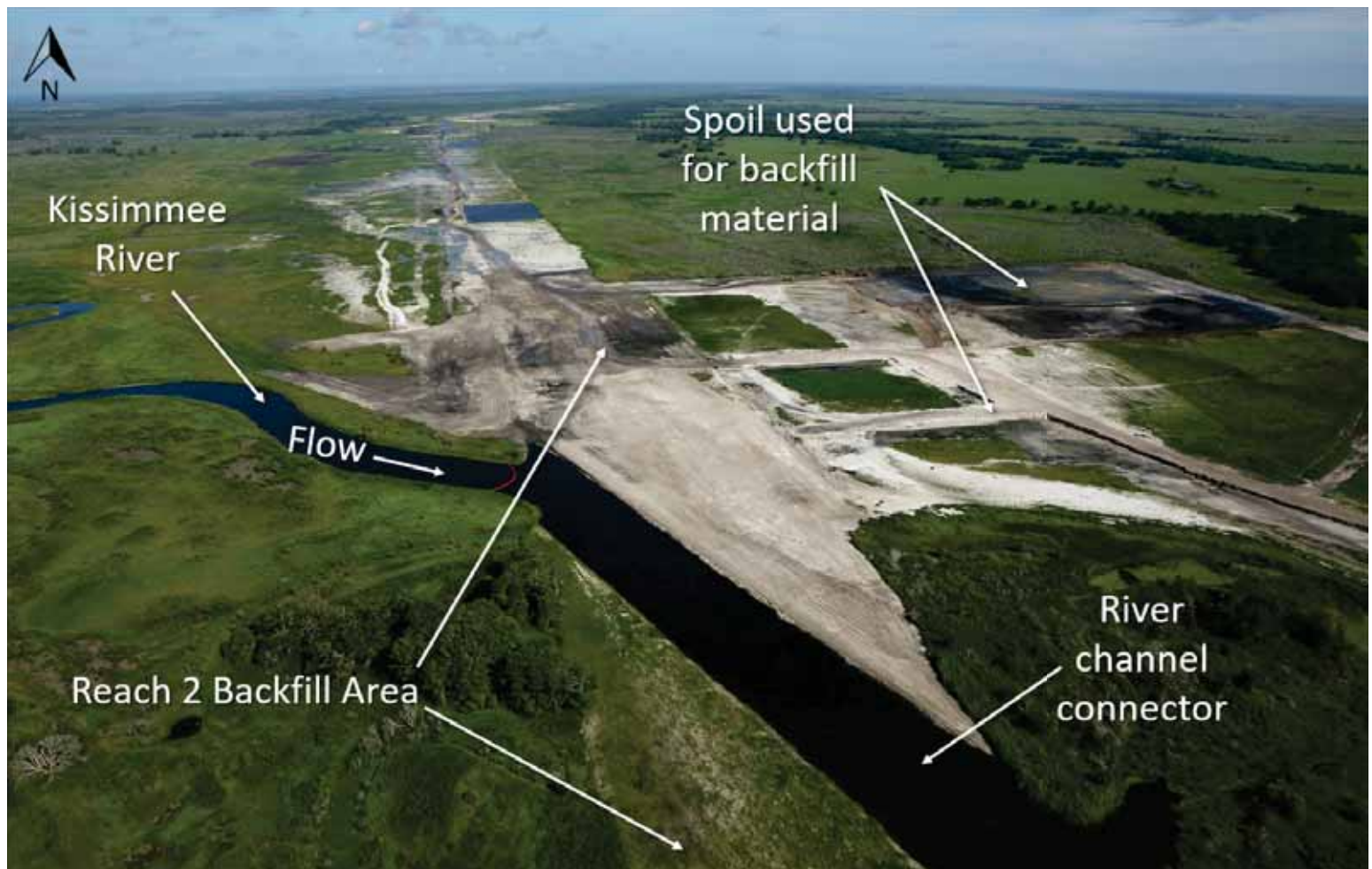
by the Florida Department of Environmental Protection under the Comprehensive Everglades Restoration Plan Regulation Act (CERPRA), Everglades Forever Act (EFA), Northern Everglades and Estuaries Protection Program (NEEPP), and Environmental Resource Permit (ERP) state statutes. Currently, annual updates are provided for 30 projects: 7 projects under construction, 18 projects operating and 5 with a phase under construction while at least one other phase is operating. Water Year 2018 updates on most of these projects are provided below. The map on page 15 shows the location of these projects. Restoration Strategies projects are discussed in more detail in the subsection on page 4.

Comprehensive Everglades Restoration Plan (CERP) Progress

Picayune Strand Restoration Project

This project includes the restoration of 55,000 acres of native Florida wetlands and uplands located between Alligator Alley (Interstate 75) and the Tamiami Trail (U.S. 41) in the southwestern corner of Florida. Restoration 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. In Water Year 2018, the following was accomplished.

- Work progressed on hydrologic modeling of the Southwest Protection Feature's project area to provide the basis for construction.



Kissimmee River Restoration Project Reach 2 backfilling progress.

- Miller Pump Station (S-486) construction was complete in June 2018.
- The dry winter and spring set the stage for fires that severely burned the southern portion of Picayune Strand. The fire only entered the fringes of the partially hydrologically restored areas.
- Vegetation management activities on the canal, road, logging tram, demolition, and remediation construction footprints have been effective in controlling the invasion of most exotic vegetation and allowing natural vegetation to become established on these restored sites, particularly in areas where the hydrology has been greatly restored.

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 physiologically stressful to fish and benthic invertebrates in the bay near canal outlets. Recent progress includes the following.

- Operations of the interim pump installed last water year began in August 2017. Pumping maintained the L-31E canal stage at an optimal level, allowing fresh water to be diverted and delivered via sheet flow and rehydrated historical tidal creeks to the coastal wetlands.
- The SFWMD completed design and plans to implement the construction of Culverts 706A, 706B, 706C, and 708 in the L-31

Canal, starting in May 2018. Construction of these remaining culverts was completed in October 2018 and will provide additional freshwater flow to remnant tidal creeks and coastal wetlands in Biscayne National Park.

- Comparison of water quality and ecological monitoring data collected during the last six years with previous baseline data indicates that the project is trending towards success. Water quality in the bay and wetlands has improved as fresh water is redirected from canals to wetlands and point source freshwater discharges to the bay have been reduced.
- Vegetation within the vicinity of the Deering Estate component is responding to improved hydrology demonstrated by die-off of upland vegetation, emergence of wetland species, and expansion of sawgrass. During Water Year 2018, sawgrass recruitment was observed in areas to the east and west of the L-31E canal within the wetlands.
- An increased abundance of various bird species, amphibians, invertebrates, and fish was observed within the project in Water Year 2018.

C-111 Spreader Canal

This project, located in south Miami-Dade County, will restore the quantity, timing, and distribution of water delivered to Florida Bay through Taylor Slough, optimize flow to support vegetation and restore flow patterns to historical sloughs and associated tributaries, and return coastal salinities in western Florida Bay as



Merritt Canal, once in the foreground, is now replaced with native vegetation in the plugged canal area.

close as possible to historic levels by restoring upstream water levels in eastern Everglades National Park. The project includes pump stations, detention areas, culverts, conveyance canals, and 10 plugs and/or water control structures. Progress recently made on the project follows.

- Work continued on the installation of additional 75 cubic feet per second (cfs) electric pumps (one each at S-199 and S-200).
- Installation of two stage/flow monitoring platforms began on November 20, 2017, and was deemed substantially complete in April 2018.

Caloosahatchee River (C-43) West Basin Storage Reservoir

Once complete, the 10,700-acre reservoir with an average water depth of 17 feet (deepest 25 feet) will have the capacity to store 170,000 acre-feet 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.

- The pre-loading phase of construction began with site clearing and demolition in Cells 1 and 2 in October 2015. It included construction of seven preload mounds for consolidating the foundation of the dam where it would be penetrated by structures, and removal of all agricultural production facilities within the project footprint. This work was completed in both cells in July 2017.
- Construction of a small 195-cfs irrigation supply pump station S-476 began in June 2016 and is anticipated to be completed in February 2019.
- Construction of the 1,500-cfs reservoir inflow pump station S-470 has begun, with completion planned for April 2022.
- Copper soils remediation commenced in August 2017 with the 5-acre pilot test and 200-acre clearing and grubbing completed. The soils remediation is in progress.

C-44 Reservoir and STA

Part of the Indian River Lagoon-South project, 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 feet will have the capacity to store 50,600 acre-feet of water. The STA will be approximately 6,300 acres.

- Construction of the inlet and outlet structures for the six STA cells continued.
- Construction of the pump station building, intake basin and portions of cell berms and collection and distribution canals, and installation of pumps and drivers was completed.

Southern Corkscrew Regional Ecosystem Watershed (CREW)

This project will provide significant benefits to the ecosystem, including restoring wetlands and the natural sheet flow of water, improving regional flood protection drainage, increasing water storage and aquifer recharge capability, and reducing the amount of nutrient-rich stormwater reaching the Imperial River and Estero Bay.

- Phase II construction, which encompassed 4,150 acres and consisted of backfilling, ditch plugging, road degradation, and construction of low water crossings, was completed in March 2018.

Ten Mile Creek Water Preserve Area (WPA)

This is a remediation project for water storage and will help moderate salinity levels and reduce sediment loads in the St. Lucie River and Estuary.

- During its first year of operations, the project performed as intended by capturing and storing stormwater originating in the Ten Mile Creek Basin, improving the quantity and timing of water deliveries to the North Fork of the St. Lucie River. The project reduced phosphorus in water passing through the project by almost 90%.

8.5 Square Mile Area and S-356 Pump Station

The purpose of this project is to provide flood mitigation to residents of the Las Palmas Community (also known as the 8.5 Square Mile Area) within the interior of the outer levee (L-357W), resulting from increased flows to Everglades National Park as future phases of the Modified Water Deliveries to Everglades National Park project are implemented.

- The project is successfully performing as designed even though the extreme rainfall in early June 2017 caused high water conditions and flooding in the WCAs. In order to mitigate flooding within the southwest corner of Las Palmas (i.e., the 8.5 Square Mile Area) associated with the high water emergency, S-357N remained partially opened throughout the remainder of the water year.
- To facilitate the transfer of water further south to the North Detention Area during the high water conditions post-Hurricane Irma, partial degradation of the L-359 levee and S-360W weir was completed on September 23, 2017. Once the emergency conditions passed, a temporary levee (earthen plug) was installed to facilitate construction of the Northern Detention Area downstream. The permanent removal of the L-359 levee west of the S-360W concrete weir was completed in July 2018.

Everglades Forever Act (EFA) Progress

L-8 Flow Equalization Basin (FEB)

This Restoration Strategies feature is a deep belowground reservoir capable of storing 45,000 acre-feet (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.

- Construction of the project, including the L-8 divide structure (G-541), was completed during the water year and routine operations began in December 2017.
- During the water year, 53,736 ac-ft of water was conveyed into and 76,878 ac-ft of water was conveyed out of the L-8 FEB during operational cycle testing and operation.

A-1 Flow Equalization Basin (FEB)

This Restoration Strategies feature is an approximately 15,000-acre aboveground impoundment capable of storing approximately 60,000 acre-feet of water. It attenuates peak stormwater runoff flows, temporarily stores stormwater runoff, and improves delivery rates to STA-2 and STA-3/4. This enhances the operation and phosphorus treatment performance of the STAs.

- The FEB continued operational testing during the water year, with 372,659 ac-ft of water conveyed into and 245,176 ac-ft of water conveyed out of the FEB.
- Based on the review of available stage, flow, and water quality data, the FEB has operated as intended and performed in a manner consistent with its design objectives.
- Although it was not designed to be a water quality treatment facility, it retained 89% of inflow TP load (equivalent to 47.2 metric tons).
- Hurricane Irma passed to the south of this FEB causing erosion to approximately 3 miles along the interior toe of the northern perimeter levee, and minor erosion to two boat ramps. Repair of the boat ramps was completed in fall 2017. The repairs due to erosion damage are scheduled to be completed by October 2019.

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 the efficiency of the Everglades STAs and help reduce flooding and improve irrigation water supply for adjacent farmlands.

- Substantial completion for Segments 1 and 2 occurred on April 9, 2017.
- By the end of the water year, Segment 3 was approximately 57% complete and is expected to be completed in 2019.

Non-Everglades Construction Project (Non-ECP)

The components of this project are all water control structures associated with the Everglades Protection Area that are not associated with the Everglades STAs.

- Construction at S-34 and S-141, which started in January 2017, was substantially complete on February 1, 2019; final completion is expected in early April 2019. S-140 pump station improvement started in January 2017 and is expected to be completed in May 2019.
- Because of the high water levels in the WCAs, operation of the Non-ECP and S-197 structures were temporarily modified and remedial management strategies to redress the emergency were authorized.

Northern Everglades and Estuaries Protection Program (NEPP) Progress

Lake Hicpochee Hydrologic Enhancement

Located in the East Caloosahatchee Basin, Phase I of the project will provide shallow water storage, rehydrate a portion of the lake bed to promote habitat restoration, provide storage, and increase capacity for ancillary water quality enhancements.

- Construction commenced in April 2017. Levee construction was 95% complete and pump station construction was 60% complete at the end of Water Year 2018. Construction is expected to be completed by spring 2019.

Rolling Meadows Restoration Project

This project will restore the natural habitat by establishing connectivity to Lake Hatchineha and by the diversion of some of the flows from Catfish Creek into the parcel.

- Operations were initiated just prior to the water year and the project has performed as designed.

Taylor Creek STA

This STA, one of two pilot-scale STAs being implemented north of Lake Okeechobee, has an effective treatment area of 118 acres and is predicted to remove up to two metric tons of TP from the Taylor Creek drainage basin per year.

- The project reduced TP load by 59% during Water Year 2018.

Nubbin Slough STA

The second pilot-scale STA located north of Lake Okeechobee, which will treat runoff from Nubbin Slough, is designed for an annual average TP load reduction of 3 to 5 metric tons per year.

- Water Year 2018 was the first full 12-month period of operation for this STA. There were times when flows or stages in the STA were insufficient to operate the S-385 inflow pump for a long enough duration to keep the treatment cells from drying out. Also, during WY2018, similar to WY2017, stage restrictions were in place in Cell 2 due to structural deficiencies in the levees.

Lakeside Ranch STA

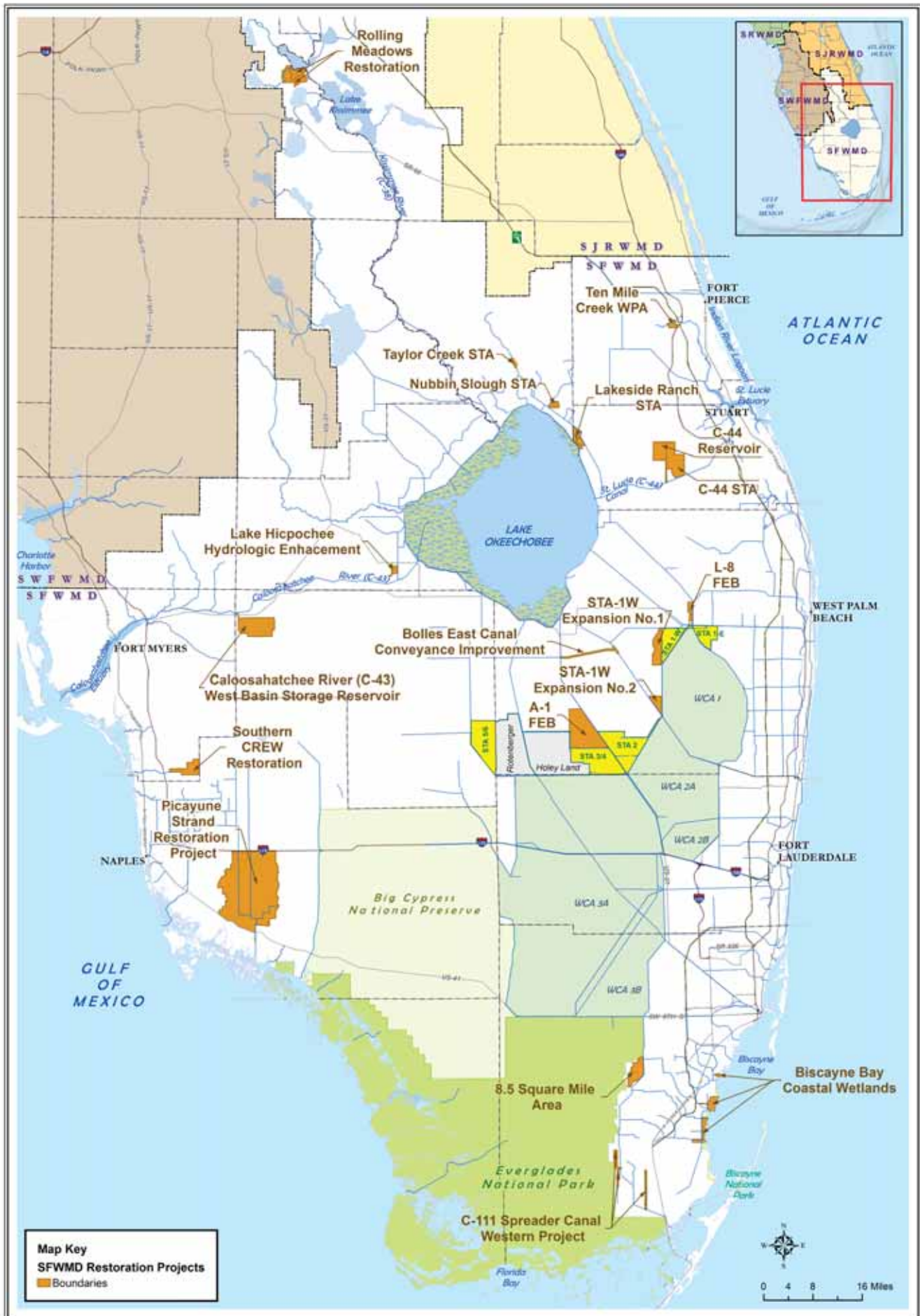
Located in western Martin County on lands adjacent to Lake Okeechobee, this STA currently has an effective treatment area of 919 acres.

- Phase I had a net TP load export of 0.9 metric tons. Aside from dryout and poor vegetation condition, the factors contributing to the phosphorus export need to be investigated. Ongoing vegetation management activities in existing cells and operation of Phase II are expected to improve treatment performance.
- Phase II of the project is under construction and anticipated to be completed in Water Year 2019. Under Phase II, construction of the southern STA was completed in 2018; construction of the S-191A pump station began on October 1, 2018, and is expected to be finished in March 2020.

FLORIDA BAY

SFWMD initiated implementation of an innovative plan to deliver additional fresh water to Florida Bay, an immediate action to help reduce salinity levels in the bay and promote recovery of seagrasses. Operational improvements increase flow of fresh water directly into Taylor Slough in Everglades National Park, a major source of fresh water for the bay. Additional water reaching the bay during both dry and wet seasons meets stringent water quality standards.

A comprehensive ecological and water quality monitoring plan was initiated to evaluate the Florida Bay project and the effects of increased flow. Water samples are collected both from the neighboring canals and from marsh locations. These samples are processed for total nitrogen, total phosphorus, total organic carbon, calcium, magnesium, potassium, sodium, chloride, sulfate, and alkalinity. Periphyton and macrophyte samples will also be analyzed for total carbon, total nitrogen, and total phosphorus. Analyses of this data will be reported in the 2020 South Florida Environmental Report.



Restoration Project Map.

EAA STORAGE RESERVOIR PROJECT

Approved in May, 2017, the Water Resources Law of 2017 (Laws of Florida, Chapter 2017-10, Senate Bill 10) directs the expedited design and construction of a water storage reservoir in the EAA to provide for a significant increase in water storage south of Lake Okeechobee to reduce harmful discharges to the Caloosahatchee and St. Lucie estuaries. The law requires the District to meet certain timelines for implementing the project.

In March 2018, the SFWMD Governing Board approved a plan for the EAA Storage Reservoir to be sent to the Assistant Secretary of the Army for Civil Works for federal review, approval and submittal to the United States Congress. The EAA Storage Reservoir was authorized by Congress with passage of the America's Water Infrastructure Act of 2018 and signed into law by President Donald Trump in October 2018.

On January 10, 2019, Governor Ron DeSantis signed Executive Order 19-12, implementing major reforms to ensure the protection of Florida's environment. The order calls for achieving more now for Florida's environment, seeking \$2.5 billion over the next four years for Everglades restoration and protection of water resources (the highest level of funding for restoration in Florida's history) and instruction to the South Florida Water Management District to immediately start the next phase of the Storage Reservoir Project design and ensure the U.S. Army Corps of Engineers approves the project according to schedule.

Follow the District's progress at Everglades Agricultural Area Reservoir Project Tracker (<https://sfwmd.maps.arcgis.com/apps/MapSeries/index.html?appid=4d9807e424894aec9e9c1f74d323f17e>).

FIVE-YEAR CAPITAL IMPROVEMENTS PLAN

Over the next five years, SFWMD estimates spending \$2.3 billion on projects contained in its Five-Year Capital Improvements Plan. The plan reflects ongoing commitments to District Governing Board priorities for Fiscal Year 2018-2019 through Fiscal Year 2022-2023, including an estimated \$1.9 billion for restoration projects in support of Governor DeSantis' vision for restoration with \$360 million per year. The five-year plan includes funding dedicated by the Governor to build the Everglades Agricultural Area (EAA) Reservoir Stormwater Treatment area and canal conveyance components as part of Central Everglades Planning Project (CEPP) New Water, C-43 West Basin Storage Reservoir and completion of C-44 STA.

The remaining funds address agency priorities related to flood control and water supply throughout the water management system. The Fiscal Year 2018-2019 adopted budget included a planned capital improvements project budget of \$391 million. Based on the revised estimated project schedules, the District's Five-Year Capital Improvement Plan was adjusted to a total of \$328 million for Fiscal Year 2018-2019. The difference of \$63 million is largely attributed to Everglades Restoration projects multi-year cash flow requirements.

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 2019 SFER.

The complete *2019 South Florida Environmental Report* is available online at www.sfwmd.gov/sfer.

What is phosphorus?

Although phosphorus is a vital nutrient in all natural systems, it is also a fertilizer component. It flows across the landscape in stormwater runoff (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 ($\mu\text{g/L}$) or parts per billion (ppb). In this document, total phosphorus (TP) is used to denote measurement when monitoring phosphorus found in water bodies or as it relates to inflows and outflows of water. Phosphorus is used when referencing all other aspects of the nutrient in general terms.

What is an STA?

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 the 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 is an FEB?

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.



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