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SOLVING FLORIDA'S BLUE-GREEN ALGAE CRISIS: A CONCERTED APPROACH

by Vittorio Nastasi

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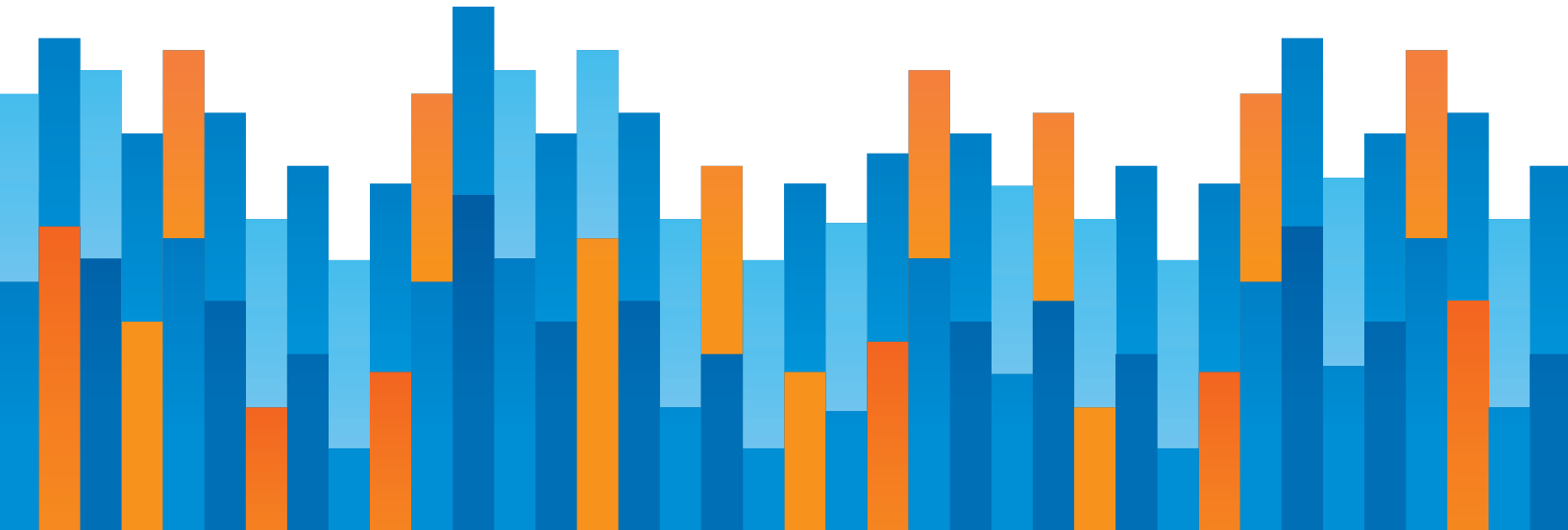

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ASR	Aquifer Storage and Recovery Well
BMAP	Basin Management Action Plan
BMP	Best Management Practices
C-111	C-111 South Dade Project
C-43	C-43 Storage Reservoir
C-44	C-44 Storage Reservoir
C&SF	Central and Southern Florida Project
CERP	Comprehensive Everglades Restoration Project
COP	Combined Operational Plan
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
EAA	Everglades Agricultural Area
EFA	Everglades Forever Act
ENP	Everglades National Park
FDACS	Florida Department of Agriculture and Consumer Services
FEB	Flow Equalization Basin
FWC	Florida Fish and Wildlife Conservation Commission
HABOS	Harmful Algal Bloom Operational Strategy
HHD	Herbert Hoover Dike
IDS	Integrated Delivery Schedule
IRL-S	Indian River Lagoon South Project
LOWCP	Lake Okeechobee Watershed Construction Project
LOPPU	Lake Okeechobee Protection Plan Update
LORS	Lake Okeechobee Regulation Schedule
LOSOM	Lake Okeechobee System Operation Manual
LOWRP	Lake Okeechobee Watershed Restoration Project
MWD	Modified Water Deliveries to Everglades National Park
NEEPP	Northern Everglades and Estuaries Protection Program
Ppb	Parts Per Billion
PPP	Public-Private Partnership
SFWMD	South Florida Water Management District
SMA	8.5 Square Mile Area
STA	Stormwater Treatment Area
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
WCA	Water Conservation Area
WY	Water Year

PART 1

INTRODUCTION

Florida is one of the fastest growing states in the nation with over 300,000 new residents arriving each year, but the environmental costs of rapid development could jeopardize future growth. Decades of water mismanagement have exacerbated naturally occurring algal blooms that are now plaguing the Sunshine State. Toxic cyanobacteria, or blue-green algae, thrive in freshwater and brackish habitats like the lakes, rivers, and estuaries found throughout Florida. Algal blooms occur when large amounts of nutrients—nitrogen and phosphorus—enter a body of water causing a slimy green layer to form on the water's surface in a process known as eutrophication.

Increased nutrient levels, combined with sunlight and slow-moving water, provide the necessary conditions for algal blooms to form. Non-toxic algae can kill fish by clogging their gills and kill plant-life by blocking sunlight from reaching below the surface. As the algae die, their decomposition consumes large amounts of oxygen in the water which suffocates fish and other marine animals. This oxygen depletion is known as hypoxia and leads to "dead zones" in oceans, lakes, and rivers.[1] Large algal blooms can result in thousands of dead fish whose decomposition further pollute water systems and contribute to further algal growth. In addition to the effects of non-toxic algal blooms, toxic blue-

[1] "Nutrient Pollution." *EPA.gov*, U.S. Environmental Protection Agency. Web. www.epa.gov/nutrientpollution/effects-environment Accessed 19 Feb. 2020.

green algae can accumulate through the food chain as smaller organisms consume algae and are then consumed by larger organisms. Severe blooms can kill wildlife and have serious health consequences for humans. According to state officials, contact with or accidental ingestion of the algae can cause irritation of the gastrointestinal tract, liver, nervous system, and skin.[2] Research also suggests that long-term exposure to blue-green algae through the consumption of aquatic organisms may be linked to the development of neurodegenerative disorders like ALS and Alzheimer's.[3]

Algal blooms and their associated health risks could hurt tourism along with large segments of Florida's economy. Tourists list Florida's beaches as their primary reason for visiting—more often than theme parks, retail, dining, and nightlife.[4] When tourists visit Florida, they stay in hotels, eat at restaurants, and shop—contributing to the state's overall economic activity. If algal blooms deter tourists, it could have rippling effects throughout the economy. Florida is also known as the sportfishing capital of the world. In the year 2011 alone, over 1.9 million residents and 1.2 million visitors fished in Florida waters, but algal blooms are threatening Florida's sportfishing industry and the economies of many coastal communities.[5] Marinas, boat charters, and bait shops have struggled as deteriorating water quality continues to reduce fish populations and drive away visiting anglers.[6]

Blue-green algal blooms occur in water bodies all around the state, including the St. Johns and Loxahatchee rivers, but Lake Okeechobee and the wider Everglades region are by far the largest and most complex components of Florida's water quality issues. Blooms are largely caused by nutrient runoff into the lake from Orlando and Kissimmee that then flows

2 "Cyanobacteria (Blue-Green Algae)." *myfwc.com*, Florida Fish and Wildlife Conservation Commission. Web. myfwc.com/research/wildlife/health/other-wildlife/cyanobacteria/ Accessed 19 Feb. 2020.

3 Kiniry, Mike and Julie Glenn. "Researchers Explore Possible Connections Between BMAA and Neurodegenerative Disorders." *WGCU Public Media*. 19 July 2019. Web. news.wgcu.org/post/researchers-explore-possible-connections-between-bmaa-and-neurodegenerative-disorders

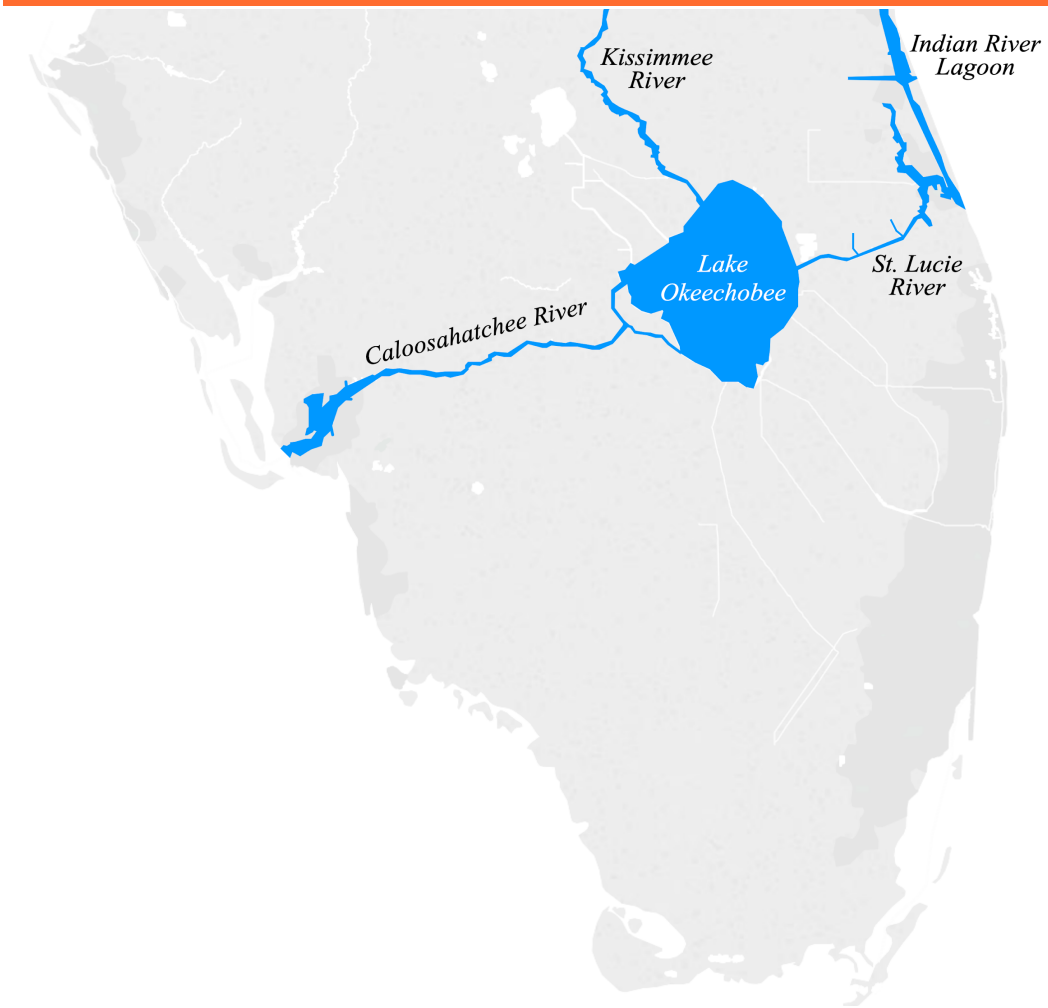
4 "Economic Evaluation of Florida's Investment in Beaches." Florida Office of Economic and Demographic Research. *EDR.state.fl.us*. January 2015. Web. edr.state.fl.us/Content/returnoninvestment/BeachReport.pdf 19 February 2020.

5 "2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation." U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. *Census.gov*. October 2018. Web. www2.census.gov/programs-surveys/fhwar/publications/2011/fhw11-fl.pdf 19 Feb. 2020.

6 McKean, Andrew. "Florida's Water Crisis Has Sport Fishing on the Brink of Collapse." *Outdoor Life*. Web. 2 July 2019. www.outdoorlife.com/floridas-water-crisis-has-sport-fishing-on-brink-collapse/ 19 Feb. 2020

to the coasts through the Caloosahatchee and St. Lucie Rivers (Figure 1). Severe algal blooms have become more frequent over recent years causing state of emergency declarations in 2016 and 2018. These episodes were largely triggered by major storm events and higher-than-average rainfall in those years.[7] In July 2018, the National Oceanic and Atmospheric Administration reported that up to 90% of Lake Okeechobee contained the toxic blue-green algae.[8] Later that summer, areas along the Caloosahatchee and St. Lucie rivers also experienced algal blooms, which led to environmental and economic damages in the surrounding communities.

FIGURE 1: OVERVIEW OF MAJOR WATER BODIES



7 "2019 South Florida Environmental Report: Highlights." South Florida Water Management District. *SFWMD.gov*. Web. apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/2019_sfer_highlights_hr.pdf 19 Feb. 2020

8 Elsken, Katrina. "NOAA: Blue-Green Algae in 90 Percent of Lake Okeechobee." *Lake Okeechobee News*. 3 July 2019. Web. lakeokeechobeenews.com/lake-okeechobee/noaa-blue-green-algae-covers-90-percent-of-lake-okeechobee/ 19 Feb. 2020

Florida lawmakers passed the sweeping Clean Waterways Act in 2020 which addressed many of the underlying causes of algal blooms. However, there is broad consensus that additional action is necessary. Disagreement over who is responsible and the best approach to mitigation will likely stall further management efforts. Environmental groups point to agricultural producers and the disruption of natural water flows through the Everglades. Others cite urban and suburban runoff including fertilizers and untreated wastewater. The truth is most likely a combination of all these factors. This report aims to identify the causes of water degradation, mechanisms for mitigation, and how to fund the necessary interventions. The findings and recommendations of the report closely align with the first round of recommendations from Florida's recently appointed Blue Green Algae Task Force.[9]

[9] "Blue-Green Algae Taskforce Consensus Document #1." Florida Department of Environmental Protection. *FloridaDEP.gov*. 11 Oct. 2019. Web. https://floridadep.gov/sites/default/files/Final%20Consensus%20%231_0.pdf

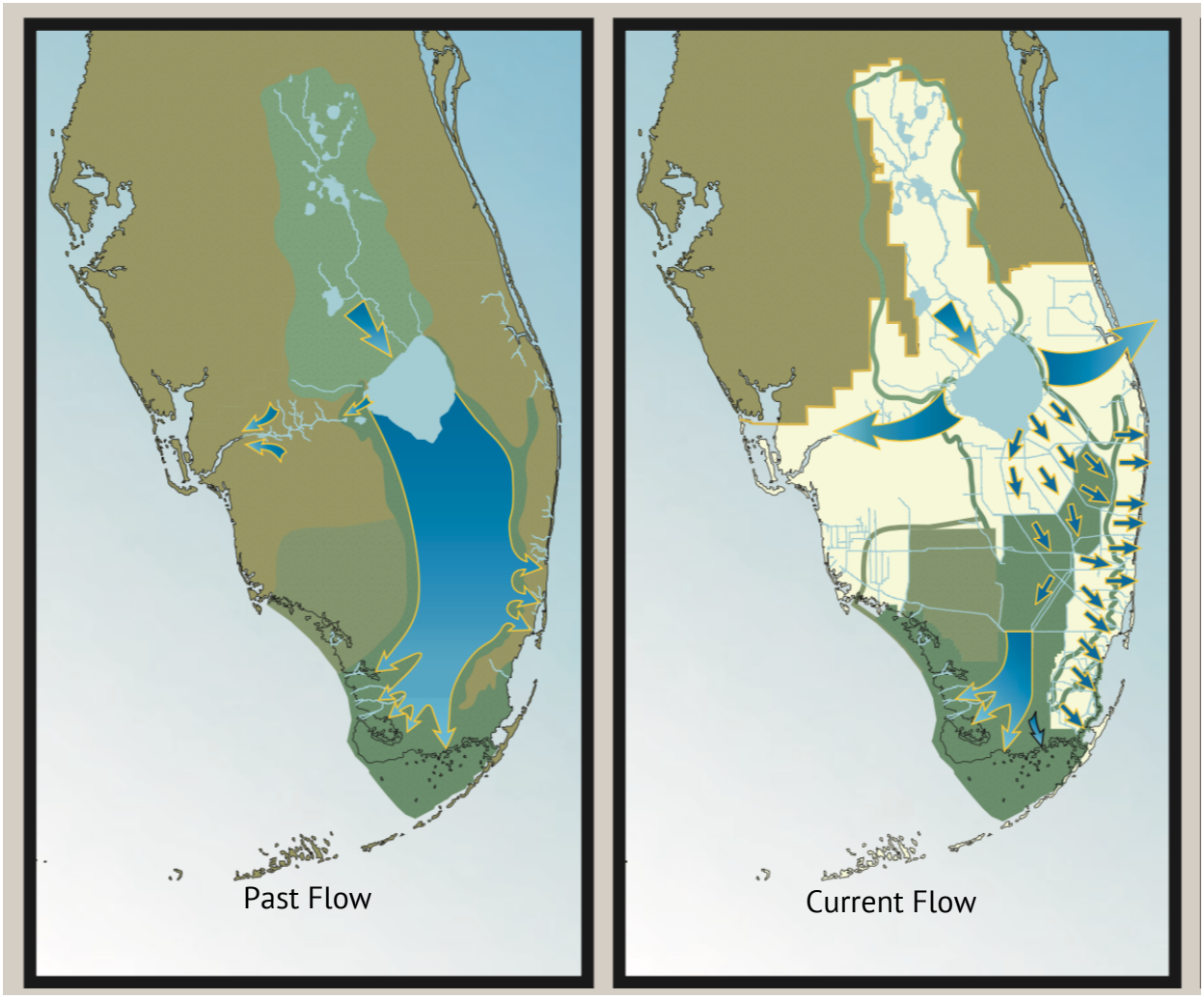
PART 2

HISTORY OF DEVELOPMENT IN THE EVERGLADES REGION

Prior to human settlement, the Everglades region was nearly twice the size it is today. Water flowed freely through the Everglades starting in Kissimmee, down through Lake Okeechobee, and into the Gulf from the southern end of the Florida peninsula (Figure 2). Nutrients including nitrogen and phosphorous originating upstream were taken up by a vast “river of grass” to the south. This flow of water and nutrients gave rise to a wide range of wildlife in one of the most unique and diverse ecosystems on the planet.

Prior to human settlement, the Everglades region was nearly twice the size it is today.

FIGURE 2: PAST AND CURRENT WATER FLOW THROUGH THE EVERGLADES



Source: U.S. Army Corps of Engineers https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/4195

Beginning in the 1850s with the passage of the Swamplands Act, lands in central and south Florida were cleared for agricultural development. The Act transferred 20 million acres of land from the federal government to the state of Florida, which was drained to make way for food crops and cattle farms. Drainage efforts continued through the middle of the 20th century as part of a national movement to settle undeveloped wetlands. In the early 1900s, Florida Governor Napoleon Bonaparte Broward initiated large-scale projects that were highly successful at draining land for agricultural use. These drainage projects created new opportunities for migrants looking to settle in central and south Florida, resulting in increased land values and massive population growth.

By the 1920s, an estimated 2,000 residents lived in the area surrounding Lake Okeechobee.[10] Canals were constructed and a modest levee was built out of muck and sand to prevent flooding south of the lake. However, two hurricanes in the 1920s caused waters to spill out of the lake, destroying homes and claiming thousands of lives. In response to these tragedies, President Herbert Hoover instructed the U.S. Army Corps of Engineers (USACE) to intervene. A plan was devised to surround the lake with a dike and construct additional canals to the east and west to direct excess water through the Caloosahatchee and St. Lucie rivers. The Herbert Hoover Dike (HHD)—a 143-mile-long earthen dam surrounding Lake Okeechobee—was completed in the 1930s and further development soon followed. Then, in 1947, another hurricane caused severe flooding and damages to life and property. To prevent future catastrophe, Congress authorized the Central and Southern Florida Project (C&SF) in 1948.

The C&SF is composed of a vast network of canals and levees that direct the flow of water in south Florida. The authorizing legislation also designated over 1,000 square miles of fertile land south of Lake Okeechobee as the Everglades Agricultural Area (EAA). In 1949, the Florida Legislature established the Central and Southern Florida Control District, the precursor to the South Florida Water Management District (SFWMD), to manage the project (Figure 3). The C&SF was very successful at preventing floods and protecting agricultural interests in the EAA, but significantly altered the natural flow of water and nutrients through the region.

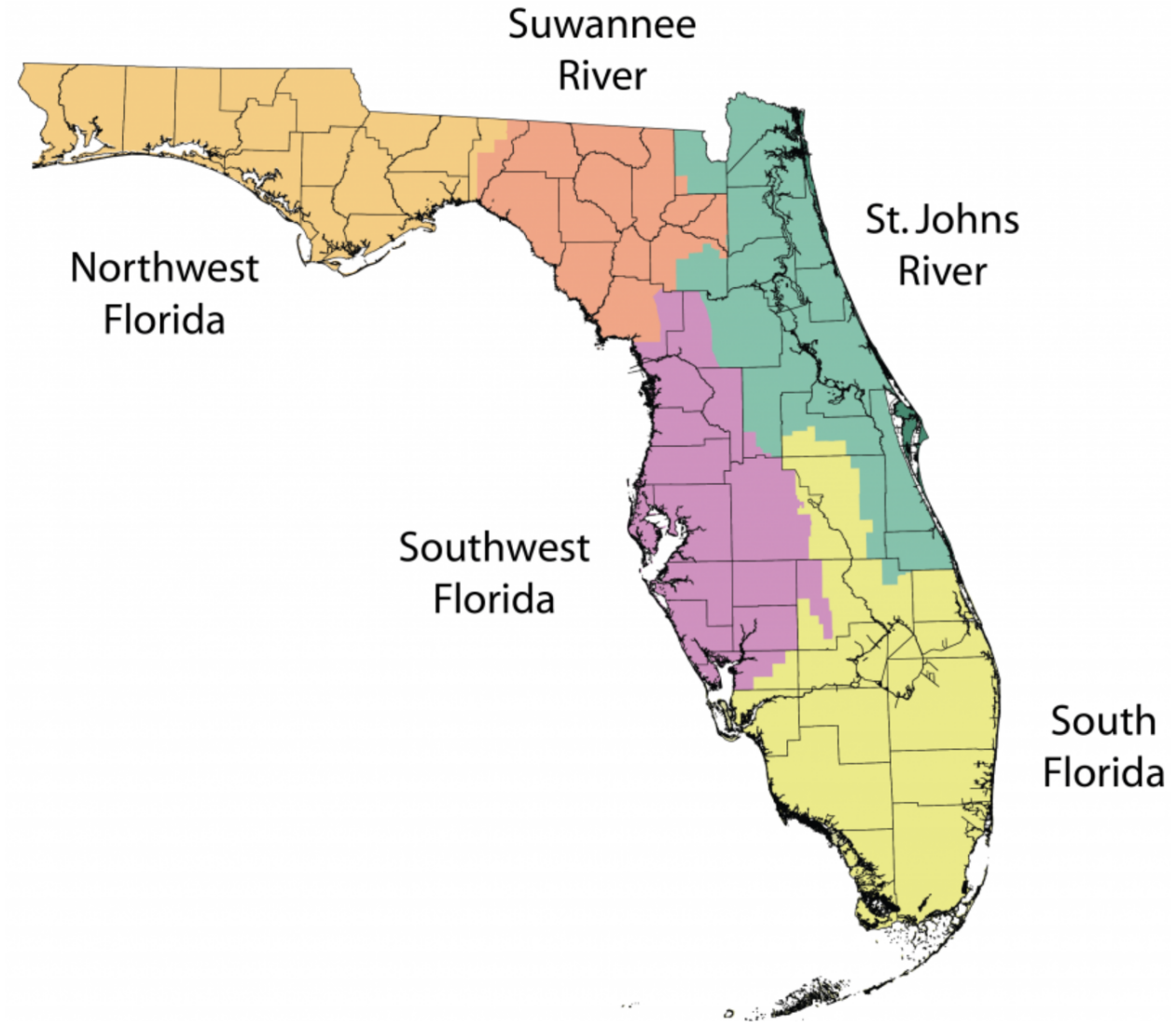
“In short, the development of the Everglades region has resulted in tremendous growth and agricultural productivity. These benefits, however, have come at great cost to Florida’s environment…”

In short, the development of the Everglades region has resulted in tremendous growth and agricultural productivity. These benefits, however, have come at great cost to Florida’s environment and required significant interventions by state and federal government. For

[10] Clement, Gail. “Everglades Timeline.” *Everglades.FIU.edu*, Publication of Archival Library and Museum Materials. Web. everglades.fiu.edu/reclaim/timeline/timeline7.htm Accessed 19 Feb. 2020.

over a century, drainage projects were pursued without a clear understanding of the Everglades ecosystem and the adverse effects of altering the flow of water through it. Consequently, millions of Floridians work and live on former wetlands that can never be fully restored. Overcoming the cumulative effects of more than a century of misguided interventions is no small task. Rather than simply curbing development, the state must fundamentally rethink the way it manages water resources in order to achieve long-term sustainability.

FIGURE 3: FLORIDA WATER MANAGEMENT DISTRICTS



Source: Florida Department of Environmental Protection. Water Management Districts. https://floridadep.gov/water-policy/water-policy/content/water-management-districts#SF

PART 3

OVERVIEW OF WATER ISSUES IN FLORIDA

Florida's water issues can be boiled down to the quality, quantity, timing, and distribution of water. The South Florida Water Management District is a regional agency that manages water resources in south Florida, including the historic Everglades region. The District serves over 8.7 million Floridians (40% of the state's population),[11] providing flood control and water supply through an expansive water control system including:

- Approximately 2,200 miles of canals and 2,100 miles of levees
- More than 778 water control structures and 621 project culverts
- 84 pump stations
- About 3,500 hydrological monitoring stations[12]

The U.S. Army Corps of Engineers operates the Herbert Hoover Dike and other water management projects throughout the Everglades region. Funding for many of these projects, including the Dike, is split evenly between the federal government and the state

11 "Who We Are." *SFWMD.gov*, South Florida Water Management District. Web. www.sfwmd.gov/who-we-are Accessed 19 Feb. 2020

12 "Quick Facts and Figures." *SFWMD.gov*, South Florida Water Management District. Web. www.sfwmd.gov/who-we-are/facts-and-figures Accessed 19 Feb. 2020

of Florida. The operation of these structures determines the quality, quantity, timing, and distribution of water in the region.

At the heart of Florida's water problems is the state's largest water storage mechanism, Lake Okeechobee. It is the largest lake in the southeastern United States with a surface area of 730 square miles. The volumes of water in question are so large they must be expressed in acre-feet rather than gallons. One acre-foot is equivalent to the volume of water needed to cover one acre of land with one foot of water (about 325,851 gallons). At an average depth of approximately nine feet, Lake Okeechobee has a carrying capacity of over four million acre-feet of water.

Much of the historical water-flow to the north of Lake Okeechobee remains intact, but the Herbert Hoover Dike and other flood control measures prevent water from flowing south of the lake (Figure 2). Reduced water flow combined with contamination and water-quality degradation has adversely affected Florida ecosystems.[13] Large volumes of nutrients including nitrogen and phosphorus enter Lake Okeechobee originating from residential fertilizers, sewer systems, and cattle ranches to the north. Water containing nutrients from agricultural fertilizers in the EAA is also pumped into the lake. These nutrients, combined with the Florida sun, create the perfect conditions for algae to form and grow. As a result, algal blooms in Lake Okeechobee are common.

In its annual South Florida Environmental Reports, the South Florida Water Management District reports water flows in and out of Lake Okeechobee. The reports measure water flows over the course of each "water year" beginning in May and ending in April. The reports use "water years" instead of calendar years to align more closely with the hydrological cycle of the region. Over three million acre-feet of water flowed into Lake Okeechobee in water year 2018 (May 2017–April 2018). Historically, water levels were allowed to rise with the inflow of water, but the Herbert Hoover Dike—at nearly 60 years old—has been weakened by age and seepage. The degradation of the Dike has led to concerns that high water levels in Lake Okeechobee could result in catastrophic failure. To prevent further seepage and reduce the risk of failure, water levels are discharged ahead of wet seasons and major storm events before increasing naturally due to rainfall. There are ongoing efforts to repair the Herbert Hoover Dike, which could increase the lake's storage

[13] National Academies of Sciences, Engineering, and Medicine. "Progress Toward Restoring the Everglades: The Seventh Biennial Review - 2018." Washington, DC: The National Academies Press, 2018. doi.org/10.17226/25198.

capacity by up to 364,000 acre-feet of water.[14] However, the additional capacity provided by repairs would not be sufficient to stem the mandated discharges from the lake and do not provide a long-term solution to the mandatory discharges.

Regulatory schedules mandate releases aiming to establish safe water levels. The current schedule, established in 2007, reduced the storage capacity of Lake Okeechobee by hundreds of thousands of acre-feet. The discharges flow through two canals to the east and west of the lake, spreading to Florida's interconnected system of lakes, rivers, and estuaries. Massive amounts of nutrient-laden water are discharged through the Caloosahatchee and St. Lucie rivers and into downstream estuaries along Florida's coast where they contribute to algal blooms and disrupt natural water conditions. In water year 2018, 1,324,234 acre-feet of water was discharged through the Caloosahatchee Canal from Lake Okeechobee. Another 636,399 acre-feet was discharged to the St. Lucie Canal while only 525,091 acre-feet flowed south. Table 1 provides a summary of water inflows and outflows to and from Lake Okeechobee.

TABLE 1: WATER FLOW IN AND OUT OF LAKE OKEECHOBEE (ACRE-FEET)

Water Body	WY2018	WY2015-WY2018 Average
Lake Okeechobee Total Inflows	3,386,788	2,915,881
Lake Okeechobee Total Outflows	2,613,134	2,385,574
• Caloosahatchee Canal	1,324,234	1,026,216
• St. Lucie Canal	636,399	387,164
• South	525,091	938,818
• Other	127,410	*

*** Other flows from Lake Okeechobee not available in 2015-2017 Environmental Reports.**
Source: South Florida Water Management District 2015-2019 Environmental Reports.

There are two key components to addressing toxic blue-green algal blooms in Florida. First, sources of nutrient pollution must be identified and managed to reduce the amount of nitrogen and phosphorus reaching Lake Okeechobee. Second, several existing and proposed water storage projects will reduce the need to release water from the lake into

[14] Peterson, Dan. "Everglades Restoration: Facts from the Past, Projects for the Present, Recommendations for the Future." The Coalition for Property Rights-FL, 2019. Web.

www.cpr-fl.org/everglades-restoration/ 19 Feb. 2020

the St. Lucie and Caloosahatchee rivers by allowing more water to flow south. Part 4 discusses nutrient pollution while Part 5 describes various projects to alter the current flow of water through central and south Florida. Part 6 describes policy recommendations to achieve restoration and realign incentives to protect Florida’s water resources from further degradation.

PART 4

SOURCES OF NUTRIENT POLLUTION

A watershed is the area of land that feeds into a body of water like a lake, river, or stream (Figure 4). When it rains, the topography of the land in an area determines where and how the water flows. Generally, water moves from areas of high elevation to water bodies at lower elevations. Water can travel over the ground surface as overland flow or percolate into the soil to flow as groundwater. Smaller water bodies such as streams often feed into larger lakes and rivers. Consequently, their watersheds can be considered sub-watersheds of the larger body. Human activity within a watershed can have detrimental effects on water quality in receiving water bodies. For example, nutrient runoff from urban and agricultural areas can make its way to lakes, rivers, and streams where elevated nutrient levels trigger algal blooms.

The sprawling Lake Okeechobee Watershed covers over 5,000 square miles (3,200,000 acres) including the Kissimmee River which begins just south of Orlando and conveys over 800,000 acre-feet of water from Lake Kissimmee to Lake Okeechobee annually (Figure 5). Stormwater runoff from Orlando and other inland areas flows to the Kissimmee River where it is carried to Lake Okeechobee, depositing nutrients like nitrogen and phosphorus along the way. In urban areas, residential fertilizers and wastewater are among the main sources of nutrient pollution. Agricultural areas also contribute through fertilizers and animal waste. A 2011 report from the South Florida Water Management District, Florida Department of Environmental Protection (FDEP), and Florida Department of Agriculture and

Consumer Services (FDACS) includes estimates of phosphorus imports by land use (Table 2, Figure 6). The findings indicated that agricultural land uses were responsible for the majority of phosphorus imports, but the contributions of different agricultural activities varied widely. The report also found that urban areas were responsible for 29% of net phosphorus imports to the Lake Okeechobee Watershed.[15]

FIGURE 4: HOW WATER FLOWS THROUGH A WATERSHED

Source: Lake County, IL Stormwater Management Commission http://www.lakecountyil.gov/2375/Watersheds

15 "Lake Okeechobee Protection Plan Update." South Florida Water Management District, Florida Department of Environmental Protection, and Florida Department of Agriculture and Consumer Services. *SFWMD.gov*. March 2011. 54–55. Web. www.sfwmd.gov/sites/default/files/documents/lopp_update_2011.pdf

FIGURE 5: LAND USE IN THE LAKE OKEECHOBEE WATERSHED

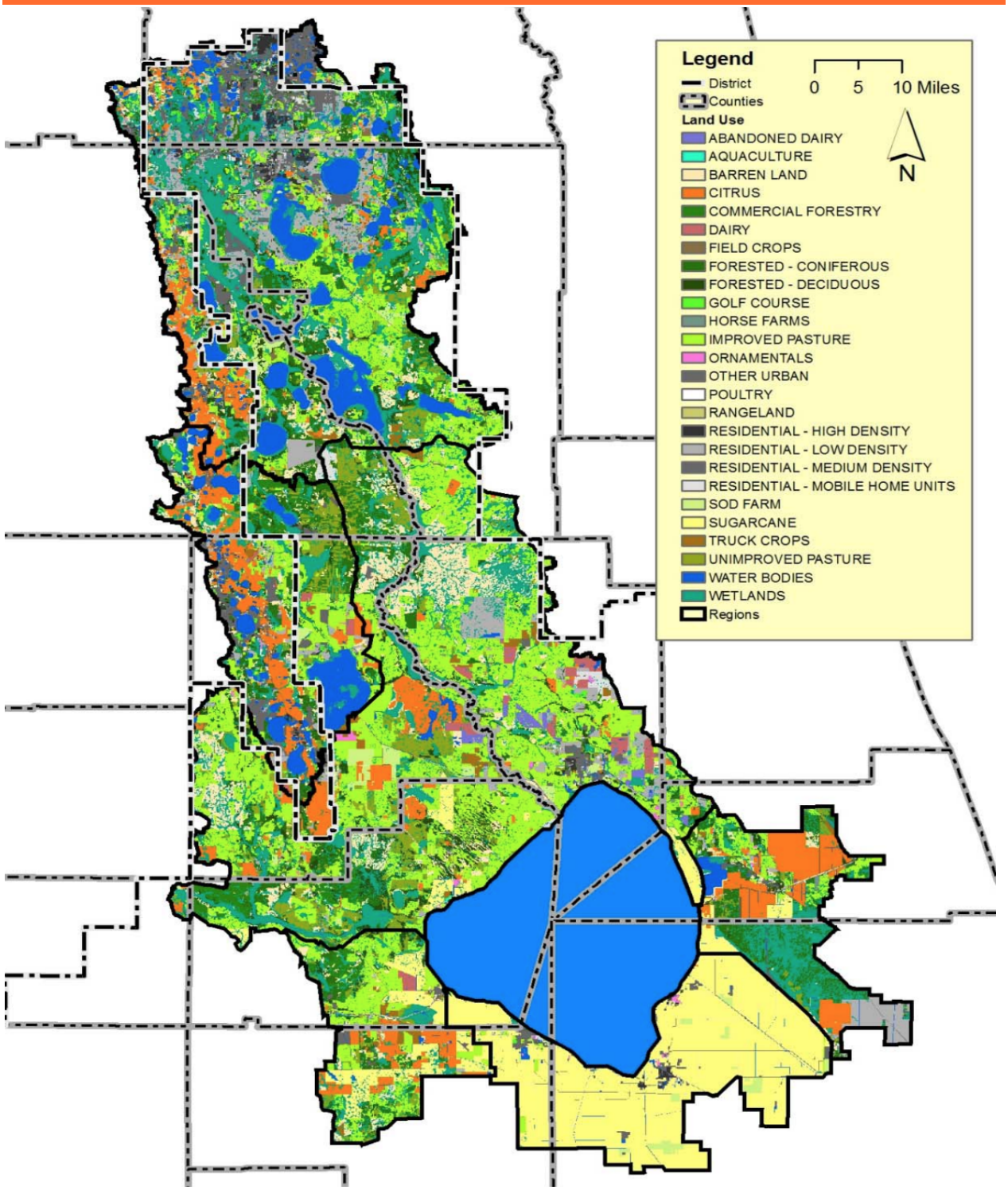


Image Source: "Lake Okeechobee Protection Plan Update." March 2011. https://www.sfwmd.gov/sites/default/files/documents/lopp_update_2011.pdf

In coastal communities, nutrient pollution quickly makes its way to estuaries, lagoons, or the ocean. Moreover, human interventions in the environment have exacerbated the spread of pollutants through Florida's water systems. Sources of pollution in the Lake Okeechobee Watershed also contribute to pollution in the Caloosahatchee and St. Lucie rivers. The artificial links between these rivers and the lake have effectively expanded estuarine watersheds to include all of the Lake Okeechobee Watershed (Figure 7). As a result, the water quality in the St. Lucie Estuary is dependent on conditions in the Kissimmee River, EAA, and Lake Okeechobee in addition to its own natural watershed.[16] This effect highlights the need to address both inland and coastal sources of nutrient pollution.

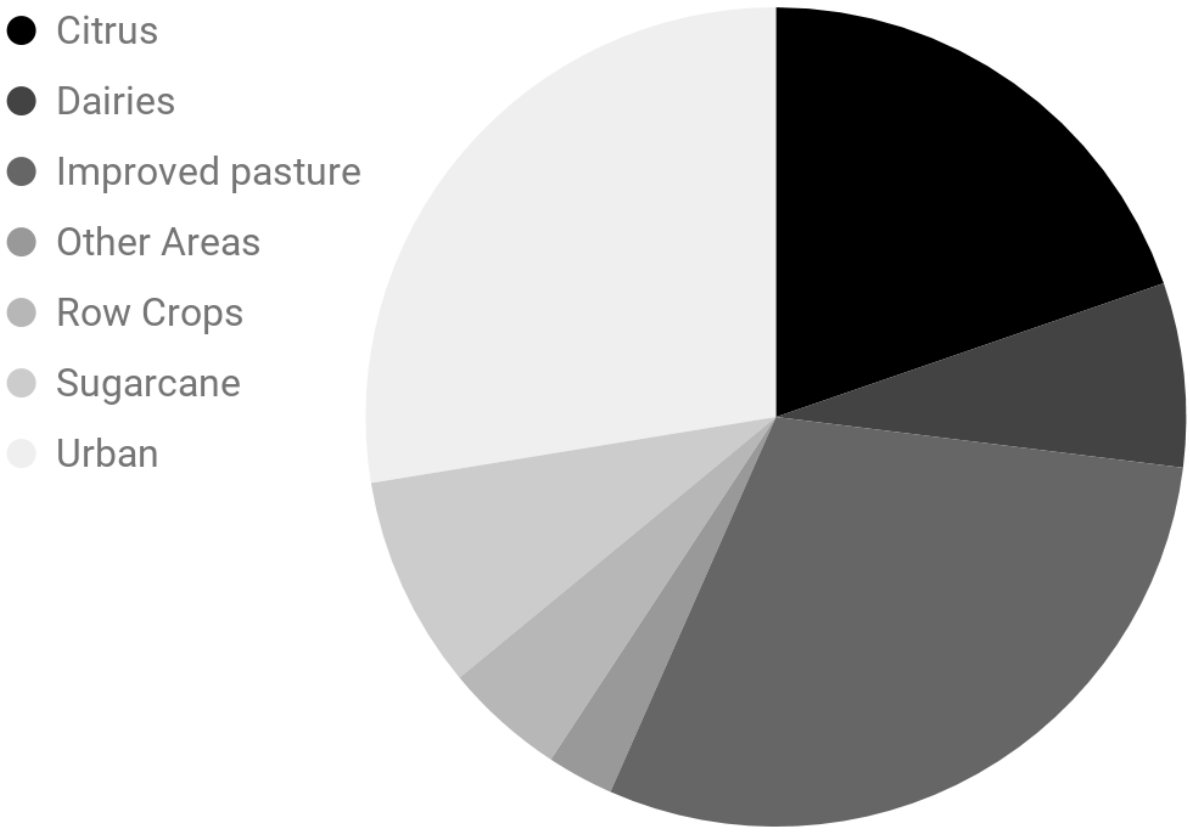
TABLE 2: NET PHOSPHORUS IMPORTS TO LAKE OKEECHOBEE WATERSHED BY LAND USE

Land-use	Area (Acres)	% (Area)	Net Phosphorus Import (mt)	% (Import)
Barren Land	41,318	1.20	–	0.00
Citrus	245,790	7.14	1,274	20.93
Dairies	23,361	0.68	470	7.72
Improved Pasture	676,991	19.67	1,916	31.47
Other Areas	30,935	0.90	170	2.79
Row Crops	23,238	0.68	309	5.08
Sod	38,425	1.12	-256	-4.20
Sugarcane	399,213	11.60	543	8.92
Unimproved Pastures/Rangeland	325,064	9.44	-84	-1.38
Upland Forest	392,200	11.39	-36	-0.59
Urban	410,397	11.92	1,783	29.29
Water Bodies	219,847	6.39	–	0.00
Wetlands	615,081	17.87	–	0.00
Totals	**3,441,861**	**100**	**6,088**	**100**

Source: "Lake Okeechobee Protection Plan Update. March 2011. https://www.sfwmd.gov/sites/default/files/documents/lopp_update_2011.pdf

[16] Lapointe, Brian E., Laura W. Harren and Bradley J. Bedford. "Effects of Hurricanes, Land Use, and Water Management on Nutrient and Microbial Pollution: St. Lucie Estuary, Southeast Florida." *Journal of Coastal Research* 28 (6) (2012). Web. doi.org/10.2112/JCOASTRES-D-12-00070.1

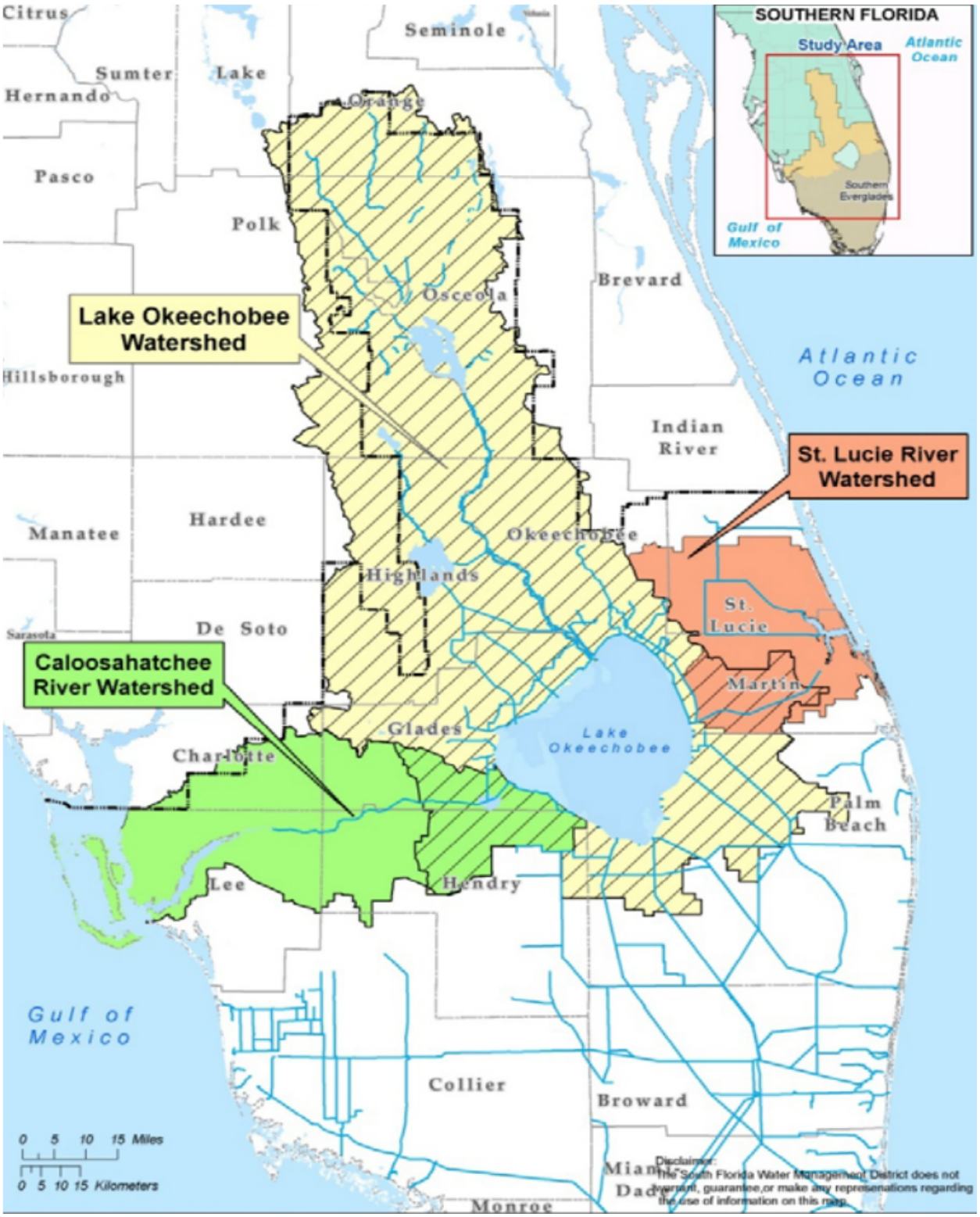
FIGURE 6: NET PHOSPHORUS IMPORTS TO LAKE OKEECHOBEE WATERSHED BY LAND USE



4.1 RESIDENTIAL AND AGRICULTURAL FERTILIZER RUNOFF

Residential and agricultural fertilizer use is a major source of nutrient pollution that feeds algal blooms. During storms, water runoff carries sediments and nutrients from fertilizers into nearby waterways where they provide the necessary conditions for algae to grow. Stormwater runoff from Orlando and other areas in the Lake Okeechobee Watershed makes it way to the Kissimmee River where it is carried to Lake Okeechobee, depositing nutrients along the way. This nutrient-laden water eventually gets discharged to the coast through the St. Lucie and Caloosahatchee rivers. Along the coast, runoff flows directly into the ocean, estuaries, and lagoons. In an effort to reduce urban fertilizer runoff, several municipalities have adopted ordinances to limit fertilizer application during wet seasons. Ongoing projects to increase water storage north of the lake will reduce the impacts of urban development to the north.

FIGURE 7: LAKE OKEECHOBEE, ST. LUCIE, AND CALOOSAHATCHEE WATERSHEDS



Source: South Florida Water Management District. "Lake Okeechobee Protection Plan Update." March 2011. https://www.sfwmd.gov/sites/default/files/documents/lopp_update_2011.pdf

Environmental groups frequently cite agricultural producers as the primary source of nutrient pollution that causes algal blooms. Indeed, the vast majority of phosphorus imports to the Lake Okeechobee Watershed are by agricultural producers, but the contributions of specific types of agricultural activities vary. Sugarcane fields dominate production in the EAA while cattle ranching is the primary activity to the north of Lake Okeechobee (Figure 5). Cattle ranches in the Lake Okeechobee Watershed likely contribute to nutrient pollution in the lake, but the impact of sugarcane producers is less clear. The 2011 report also found that dairies and pastures caused more than 37% of net phosphorous imports to the Lake Okeechobee Watershed (Table 2).[17] Meanwhile, sugarcane caused less than 10%.

Requiring agricultural producers to implement Best Management Practices (BMPs) has proven successful at reducing nutrient runoff from agricultural lands. The 1994 Everglades Forever Act defines a BMP as:

> *a practice or combination of practices determined by the district, in cooperation with the department, based on research, field-testing, and expert review, to be the most effective and practicable, including economic and technological considerations, on-farm means of improving water quality in agricultural discharges to a level that balances water quality improvements and agricultural productivity*.

The Florida Department of Agriculture and Consumer Services (FDACS) develops specific BMPs for different agricultural operations, which are outlined in BMP manuals. Typical components of BMPs include:

1. Nutrient management practices that optimize fertilizer and manure applications to minimize the impact of nutrients on water resources
2. Irrigation management to reduce water and nutrient runoff to the environment
3. Water resource protection in the form of buffers, setbacks, and swales to prevent the transport of nutrients to nearby water bodies[18]

Agricultural producers surrounding Lake Okeechobee and in other vulnerable watersheds are required to either implement BMPs or demonstrate compliance with water quality standards. Implementation of BMPs has resulted in an annual average of 55% phosphorus

[17] "Lake Okeechobee Protection Plan Update." South Florida Water Management District, Florida Department of Environmental Protection, and Florida Department of Agriculture and Consumer Services.

[18] "Agricultural Best Management Practices." *FreshFromFlorida.com,* Florida Department of Agriculture and Consumer Safety. Web. https://www.freshfromflorida.com/Agriculture-Industry/Water/Agricultural-Best-Management-Practices Accessed 19 Feb. 2020

reduction in the EAA since 1996—more than twice the reduction required under the Everglades Forever Act. According to the South Florida Water Management District, BMPs resulted in a 70% phosphorus reduction from EAA sources in 2017.[19] However, environmental groups challenge these figures because the District relies on "best-case-scenario" modeling to estimate phosphorus reductions. Moreover, the BMP program previously assumed compliance with water quality standards after producers enroll in the program. The Clean Waterways Act will now require on-site inspections by FDACs every two years to ensure practices are being implemented correctly. However, adequate water quality data and monitoring will ultimately be necessary to confirm that BMPs—in addition to being properly implemented—are achieving sufficient nutrient reductions. As recommended by the Blue-Green Algae Taskforce, the effectiveness of BMPs must "be supported by adequate data to justify the presumption of compliance with water quality standards granted upon enrollment and implementation."[20]

Data on the effectiveness of BMPs outside of the EAA is more limited. However, BMPs are generally regarded to have been less effective north of Lake Okeechobee than in the EAA because the northern watershed is less heavily engineered than the area to the south. The more natural topography north of Lake Okeechobee limits the potential benefits of BMPs alone.[21] Consequently, water storage and treatment infrastructure will be necessary components of any effort to mitigate the effects of fertilizer runoff from the north.

4.2 MUNICIPAL WASTEWATER MANAGEMENT

4.2.1 SEPTIC SYSTEMS AND LEACHING

The U.S. Environmental Protection Agency (EPA) defines septic systems as underground wastewater treatment structures consisting of septic tanks and drainfields or soil absorption fields (Figure 8).[22] Household wastewater flows into underground tanks where

19 "Everglades Water Quality Program Achieves 70 Percent Phosphorus Reduction." South Florida Water Management District. 13 July 2017. Press Release.

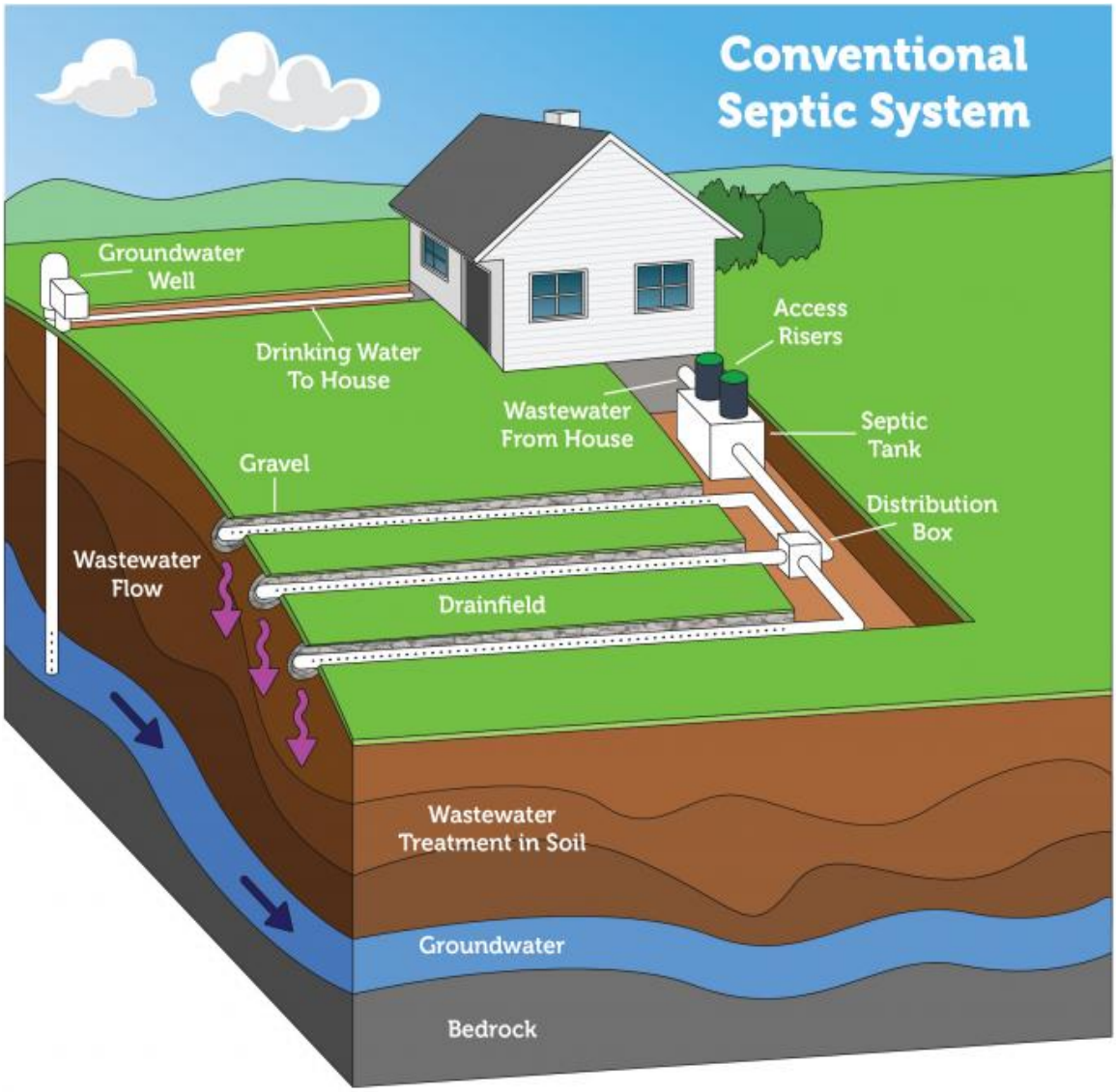
20 "Blue-Green Algae Taskforce Consensus Document #1." Florida Department of Environmental Protection. *FloridaDEP.gov*.

21 "Department of Environmental Protection Blue-Green Algae Task Force Part 1." The Florida Channel. 1 July 19. Video. https://thefloridachannel.org/videos/7-1-19-department-of-environmental-protection-blue-green-algae-task-force-part-1/

22 "How Your Septic System Works." *EPA.gov*, U.S. Environmental Protection Agency. 28 Aug. 2018. Web. https://www.epa.gov/septic/how-your-septic-system-works Accessed 19 Feb. 2020.

solids separate from lighter material like greases and fats. When systems operate properly, healthy bacteria break down waste matter before liquid known as “effluent” is discharged. Soil-based systems discharge effluent through a series of pipes that slowly release liquid into the surrounding soil. Effluent is filtered as it percolates through the soil before reaching groundwater. Other types of systems pass effluent through sand, sawdust, and other materials to neutralize pollutants before it is released into the soil. Septic systems are generally a safe and responsible means for waste disposal. However, failing systems and unfavorable topography can cause environmental and health hazards.

FIGURE 8: BASIC COMPONENTS OF SEPTIC SYSTEMS



Please note: Septic systems vary. Diagram is not to scale.

Source: U.S. Environmental Protection Agency https://www.epa.gov/septic/types-septic-systems

There are an estimated 2.6 million septic systems operating in Florida, accounting for 30% of Floridians' wastewater treatment and 12% of septic systems in the United States.[23] In relatively rural, low-density areas with sufficient separation between the drainfield and groundwater, septic systems are acceptable alternatives to public sewer systems. However, septic systems can be a major problem in high-density areas, in close proximity to waterways, or in areas with higher water tables. Under these conditions, seepage from septic tanks can release substantial amounts of nitrogen and phosphorus into the groundwater. In fact, septic systems are the second largest source of nitrogen pollution in Florida waters behind agriculture.[24] Nutrient-polluted groundwater can make its way into lakes, rivers, and estuaries, feeding algal blooms around the state. During heavy rain events, the water table rises and soils become water-saturated, causing wastewater to flow to the ground surface where it may run off into surrounding water bodies. Research suggests that septic systems in residential areas near the St. Lucie Estuary contribute to blooms.[25] Systems north of Lake Okeechobee (Figure 9) contribute to the high nutrient levels found in the lake that then spread to the coasts following mandatory discharges.

New septic installations in most areas across the state require 24 inches of separation between the drainfield and water table. Regulations also require setbacks from water bodies, water pipes, and water wells.[26] After installation, however, there are no regular inspections of conventional septic systems to ensure proper function and compliance with regulations. As a result, existing systems are generally only inspected at the homeowner's request or if a failure is reported. As recommended by the Blue-Green Algae Task Force, a septic system inspection and monitoring program could be used to more readily identify failing systems.[27]

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23 "Onsite Sewage." *FloridaHealth.gov*, Florida Department of Health. 21 June 2018. Web. http://www.floridahealth.gov/environmental-health/onsite-sewage/index.html Accessed 19 Feb. 2020

24 Lapointe, Brian, Laura Herren, Armelle Paule, Anne Sleeman and Rachel Brewton. "Charlotte County Water Quality Assessment Phase I: Data Analysis and Recommendations for Long-Term Monitoring." Harbor Branch Oceanographic Institute, Florida Atlantic University, 2016. Web.

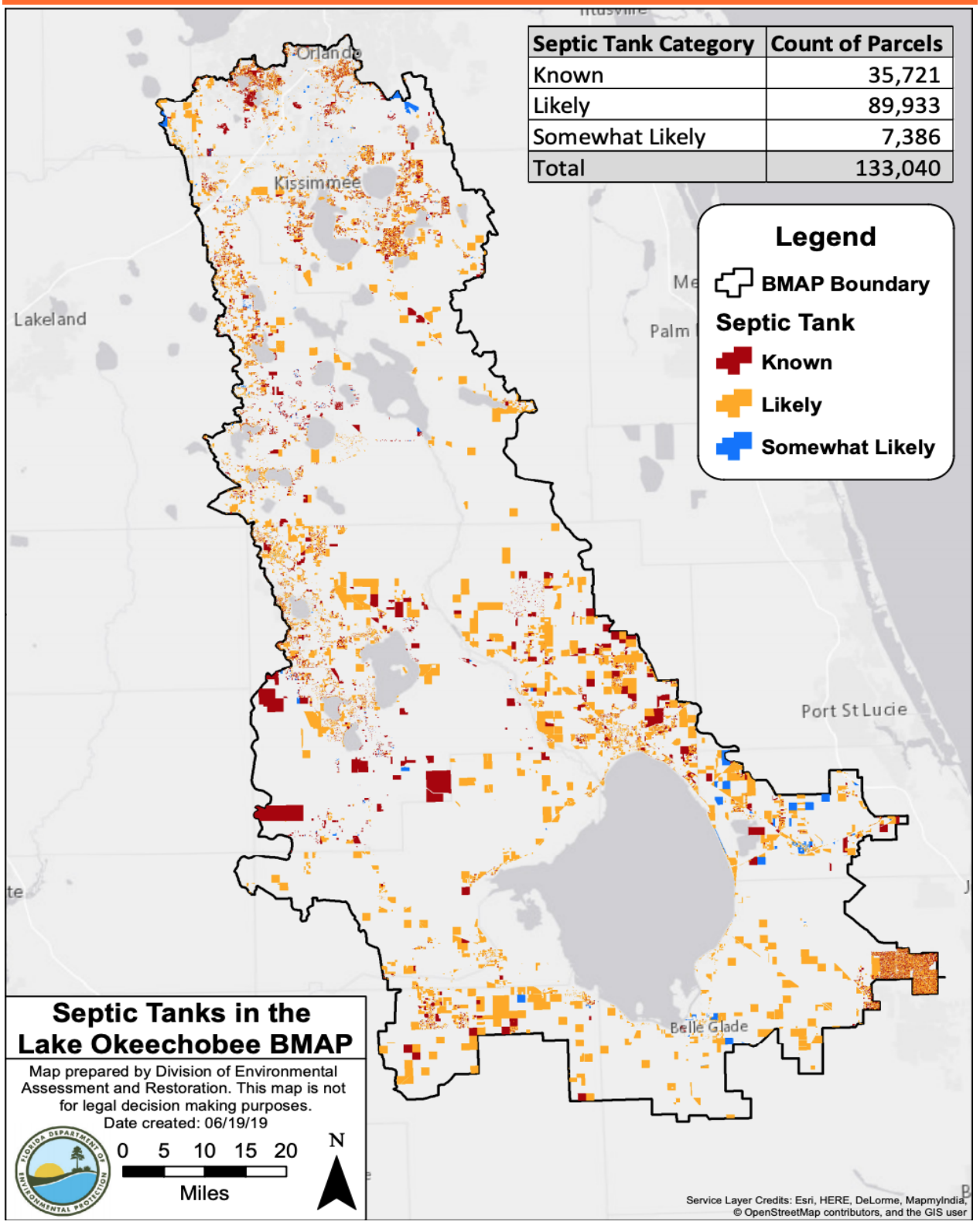
https://www.charlottecountyfl.gov/dept/utilities/Site%20Documents/Charlotte%20County%20HBOI.FAU.PhaseI.Final%20Report.12.12.2016.pdf Accessed 19 Feb. 2020.

25 Lapointe, Brian E., Laura W. Herren and Armelle L. Paule. "Septic Systems Contribute to Nutrient Pollution and Harmful Algal Blooms in the St. Lucie Estuary, Southeast Florida, USA." *Harmful Algae* 70 (2017). 1-22. Web. https://www.researchgate.net/publication/320991096_Septic_systems_contribute_to_nutrient_pollution_and_harmful_algal_blooms_in_the_St_Lucie_Estuary_Southeast_Florida_USA

26 "Standards for Onsite Sewage Treatment and Disposal Systems." Chapter 64E-6, Florida Administrative Code.

27 "Blue-Green Algae Taskforce Consensus Document #1." Florida Department of Environmental Protection. *FloridaDEP.gov*.

FIGURE 9: SEPTIC TANKS IN THE LAKE OKEECHOBEE WATERSHED



Source: Florida Department of Environmental Protection
https://floridadep.gov/sites/default/files/2c.%20Septic%20Tanks%20LOW.pdf

The 2016 Florida Springs and Aquifer Protection Act requires "advanced" nitrogen-reducing systems in certain areas of the state.[28] However, these requirements are limited to the watersheds of springs in north Florida and do not apply to areas connected to Lake Okeechobee or the Caloosahatchee and St. Lucie estuaries. The advanced systems are intended to reduce nitrogen pollution but require electricity to operate. They are also more expensive than conventional systems and require more frequent monitoring.

Oversight of septic system installation, repairs, and removal was recently transferred from the Florida Department of Health (FDOH) to the Department of Environmental Protection (FDEP). In most cases, systems are only required to be removed if they are (1) failing and (2) have less than six inches between the drainfield and the water table. If both these conditions are met, the system must be removed at the property owner's expense. The DOH has an ongoing project to track the location of septic systems in Florida, but the data are not currently complete and are largely based on estimates.

Municipalities have been slow to move existing development off of septic because of associated financial costs. The Clean Waterways Act created a wastewater grant program which requires a 50% match of local funds. Funding from the program can be used for projects to upgrade septic systems or connect systems to central sewer facilities. Nevertheless, millions of existing septic systems continue to pose environmental risks, and limited local budgets will slow progress on system upgrades. Some municipalities require developers to pay for sewage extension to new construction because it is far more expensive to convert existing development than to extend sewer systems beforehand.

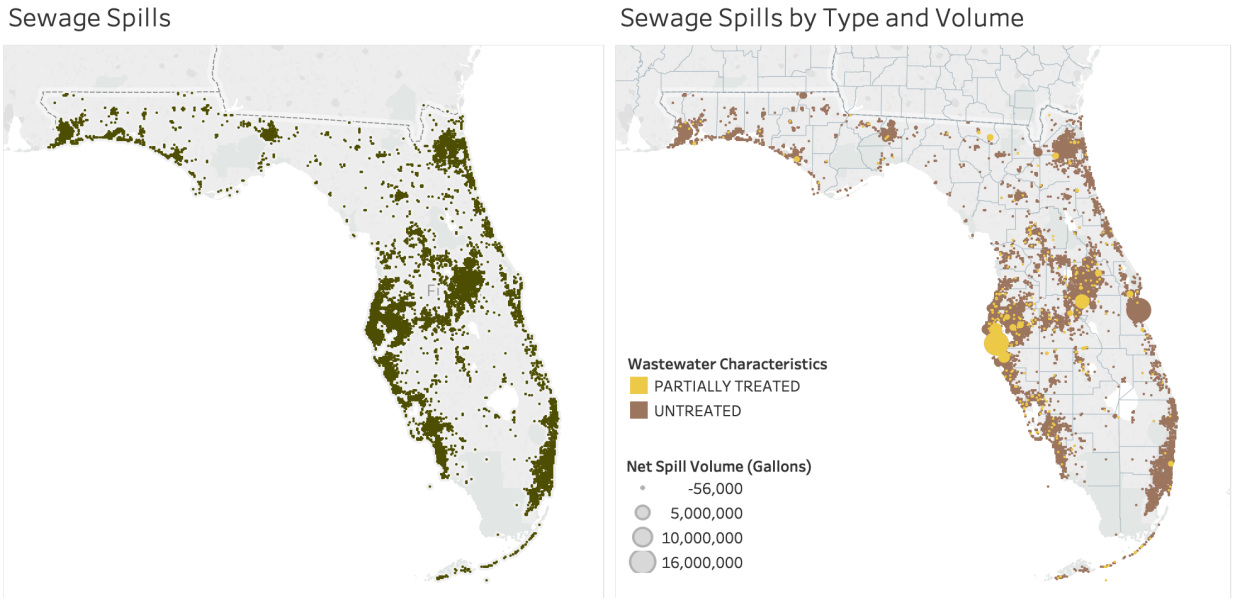
The Clean Waterways Act now requires that municipal governments develop septic system remediation plans in areas where FDEP determines that septic systems are responsible for at least 20% percent of nutrient pollution. The plans must include an inventory of septic systems in the area including systems that need to be replaced or converted, the estimated costs of improvements, and timelines for implementation. This is a reasonable approach, but determining the relative contribution of septic systems will require more robust water quality monitoring than is currently available.

[28] "Springs Protection and Basin Management Action Plans (BMAPS)." *FloridaHealth.gov*, Florida Department of Health. 11 March 2019. Web. http://www.floridahealth.gov/environmental-health/onsite-sewage/springs-nreducing-systems.html

4.2.2 PUBLIC WASTEWATER INFRASTRUCTURE FAILURE

Aging public sewer systems also pose a threat when they are not sufficiently maintained or replaced over time. According to a recent report from GateHouse Media, 1.6 billion gallons of sewage were spilled in Florida over the past decade, more than 370 million gallons of which were untreated (Figure 10). Over the same period, a total of 980 million gallons—220 million gallons of which were untreated—entered Florida waterways.[29]

FIGURE 10: SEWAGE SPILLS (2009-2018)



Source: Salman, Josh et al. "Sewer Crisis in the State of Florida: Aging Infrastructure and Storms Contribute to Massive Spills." GateHouse Media http://gatehousenews.com/sewers/

Breaks in sewer lines were the most frequent cause of spills identified in the report. This can occur when tree roots grow into sewer pipelines. Major storm events—especially along the coast—can also lead to sewage infrastructure failure. Large inflows of rainwater can overload systems, causing power outages that prevent pumps from moving sewage through lines creating backups. Since 2009, nearly one billion gallons of sewage was spilled as a result of rain and power outages.[30] Households can also contribute to spills by improperly

[29] Salman, Josh, Jennifer Borresen, Daphne Chen and Dak Le. "Sewer Crisis in the State of Florida." *USATodayNetwork.com*, GateHouse Media. Web. https://stories.usatodaynetwork.com/sewers/

[30] Ibid.

disposing of fats and greases through sinks or flushing materials like baby wipes down toilets. These activities can block pipes and force ruptures in sewage lines.

Like seepage from septic tanks, sewage spills contribute to nutrient pollution in Lake Okeechobee, leading to algal blooms in the lake and connecting rivers. Spills in coastal communities and near other bodies of water also fuel algae growth along the coast and local waterways. Any effort to tackle blue-green algae in Florida has to address the state's failing wastewater infrastructure—especially if existing septic systems are converted to traditional sewer systems.

Similar to septic systems, the Clean Waterways Act requires municipal governments to develop wastewater treatment plans in areas where wastewater facilities contribute at least 20% of nutrient pollution. The plans must identify necessary expansions and upgrades, estimates of nutrient loads, construction timelines, and cost estimates. Again, more robust water quality monitoring is required to determine the relative contribution of wastewater facilities.

PART 5

SOUTH FLORIDA ECOSYSTEM RESTORATION (SFER)

In addition to feeding algal blooms in the estuaries of the Caloosahatchee and St. Lucie rivers, the altered water flows resulting from the Central & South Florida Project have reduced water flow to the Everglades region. This has parched large portions of wetlands, causing salinity levels to increase and threatening wildlife populations in southern Florida. The South Florida Ecosystem Restoration (SFER) Program is a jointly managed effort between federal, state, and local governments to establish a more natural flow of water through the Everglades and mitigate the impacts of previous interventions. The Integrated Delivery Schedule (Figure 11) is a document that provides a sequencing plan for SFER projects and is updated regularly by the U.S. Army Corps of Engineers. More than 50 projects are included in the Integrated Delivery Schedule with timelines that span several decades. Most of these projects fall under the Comprehensive Everglades Restoration Plan (CERP). Foundation projects are non-CERP projects that are necessary for implementation of CERP.

FIGURE 11: INTEGRATED DELIVERY SCHEDULE

Project	Construction Complete	Project Complete
Modified Water Deliversies to Everglades National Park	2018	2020
Herbert Hoover Dike	2022	2022
Restoration Strategies	2026	2026
Tamiami Trail Next Steps Phase 2	2022	2022
Kissimmee River Restoration Construction	2021	2021
Kissimmee River Restoration Monitoring	-	2026
C-111 South Dade Construction	2019	2020
C-111 South Dade PACR	2026	2026
Picayune Strand Restoration	-	-
Faka Union Pump Station	-	2018
Miller Pump Station	2018	2020
Flood Protection Features - Conveyance	2023	2023
Flood Protection Features - Levee	2024	2024
Road Removal	2021	2021
Canal Plugging	2023	2023
Indian River Lagoon-South	-	-
C-44 Reservoir	2021	2023
C-44 STA & Pump Station	2020	2023
C-23/24 Reservoir North	2028	2028
C-23/24 Reservoir South	2028	2028
C-23/24 STA	2025	2025
C-25 Reservoir	2027	2027
C-25 STA	2029	2029
C-23/C-44 Interconnect	2023	2024
Caloosahatchee River (C-43) West Basin Storage	-	-
Pump Station and Reservoir	2023	2025
Broward County Water Preserve Areas	-	-
Mitigation Areas A Berm	2019	2019
C-11 Impoundment	2026	2026
WCA 3A & 3B Seepage Management	2027	2027
C-9 Impoundment	**Beyond 2030**	**Beyond 2030**
Biscayne Bay Coastal Wetlands Phase 1	-	-
L-31 East Flow-way - Federal	2022	2022
Cutler Wetlands	2021	2021
C-111 Spreader Canal Western Project (Requires PPA)	2023	2023
Central Everglades Planning Project (2016 WRDA)	-	-
Decomp Physical Model	-	2021
CEPP South: Additional outlet structures needed to move more water south	-	-
Validation Report		2019
Remove Old Tamiami Trail	2021	2021
Structure S-631 & gap in L-67C Levee and Structure S-633 with gap in L-67C	2022	2024
Increase in S-356 Pump Station	2026	2028
Spillway S-355W	2024	2026
Structure S-333N	2020	2021
Structure S-632	2022	2024
Removal L-67C & L-67 Ext, Constr L-67D Levee	2026	2026
Removal L-29 Levee & Backfill L-67 Ext	2027	2027
CEPP North: Inflow facilities needed to restore northern WCA-3A and move additional water south to Everglades	-	-
Validation Report		2022

Project	Construction Complete	Project Complete
L-4 Degrade & Pump Station S-630	2025	2027
S-8 Pump Station Modifications	2025	2027
Miami Canal Backfill/Tree Islands	2026	2028
L-5 Canal Improvements	2026	2028
L-6 Diversion	2025	2027
CEPP New Water: Moves New Water South, Stores It, and Treats It Before Going to the Everglades	-	2020
Validation Report		
Seepage Barrier L-31N	2024	2026
Canal Conveyance Improvements - Miami and North New River	2023	2025
EAA Reservoir - A-2 STA, Inflow-Outflow Canal and Bridge	2022	2024
EAA Reservoir - A-2 STA	2023	2025
EAA Reservoir - Inflow-Outflow Canal, Bridges, Spillway	2023	2025
EAA Reservoir - Inflow Pump Station	2027	2029
EAA Reservoir: Cutoff Wall, Culverts & Embankment	2027	2029
Loxahatchee River Watershed Restoration Project	TBD	TBD
Lake Okeechobee Watershed Restoration Project	TBD	TBD
Western Everglades Restoration Project	TBD	TBD
BBCW Phase 2	TBD	TBD
C-111 Spreader Canal Eastern	TBD	TBD
Lake Okeechobee System Operating Manual	-	2023
ASR/Decomp Phase 2	TBD	TBD
Non-CERP & Foundation Projects		
CERP Generation 1 Projects - Authorized, Project Partnership Agreement (PPA) Executed		
CERP Generation 2 Projects - Authorized, PPA Executed Except Where Noted		
CEPP - Authorized, Features added in WRDA 2018, PPA in 2020		
Planning Phase - Initiated and Proposed		

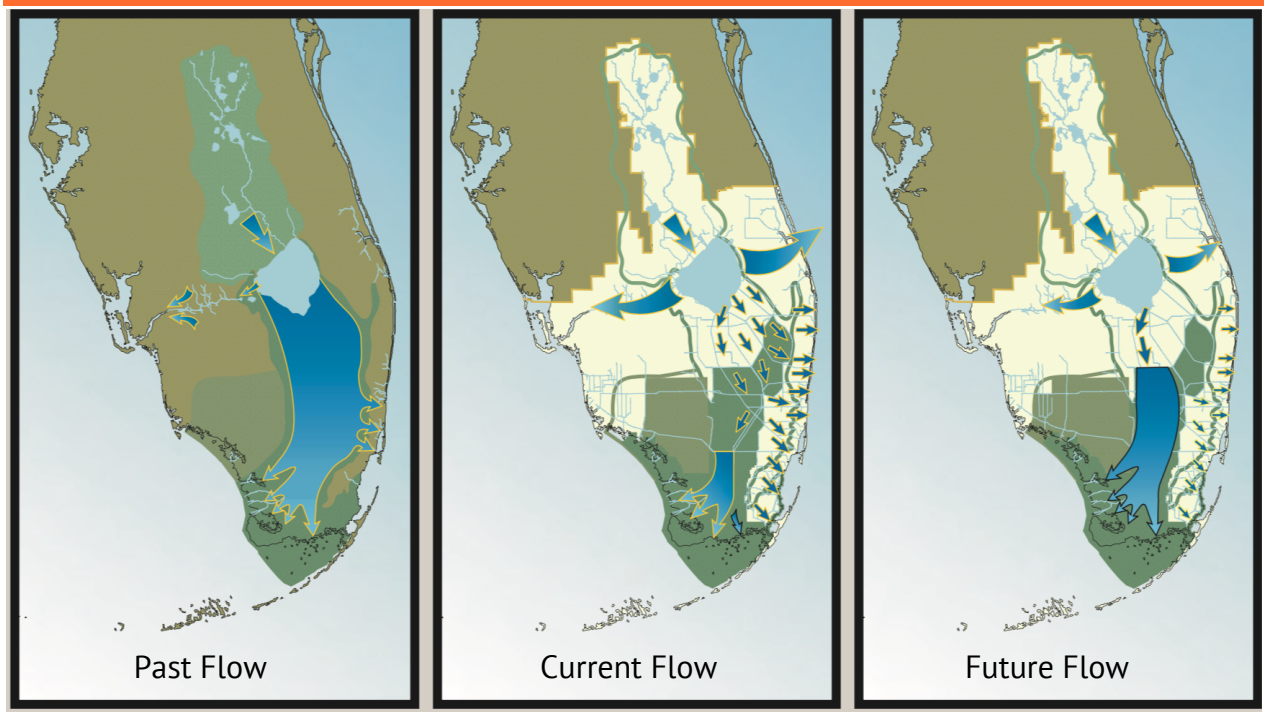
Source: U.S. Army Corps of Engineers https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/2641

Authorized by Congress in 2000, CERP is the most substantial project to restore the Everglades and is widely considered the largest ecosystem restoration plan in the world.[31] Collectively, the goal of these projects is to "get the water right"—in other words, to improve water flows along four dimensions: quality, quantity, timing, and distribution. While CERP aims to restore the natural hydrological conditions in the Everglades region within the constraints of extant human development (Figure 12), a more forward-looking approach will be necessary in light of global climate change and associated sea level rise. In fact, the most recent Biennial Review of progress toward CERP goals recommended a rigorous mid-course assessment of CERP implementation to better understand the potential impacts of sea level rise and the combined impact the projects completed to date.[32]

[31] "Ecosystem Restoration." U.S. Army Corps of Engineers. Web. https://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/

[32] National Academies of Sciences, Engineering, and Medicine. "Progress Toward Restoring the Everglades: The Seventh Biennial Review - 2018."

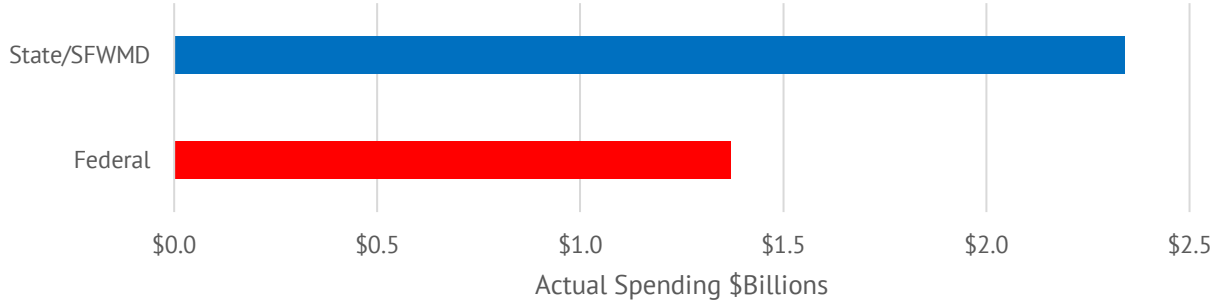
FIGURE 12: PAST, CURRENT, AND FUTURE WATER FLOWS THROUGH THE EVERGLADES



Source: U.S. Army Corps of Engineers
https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/4195

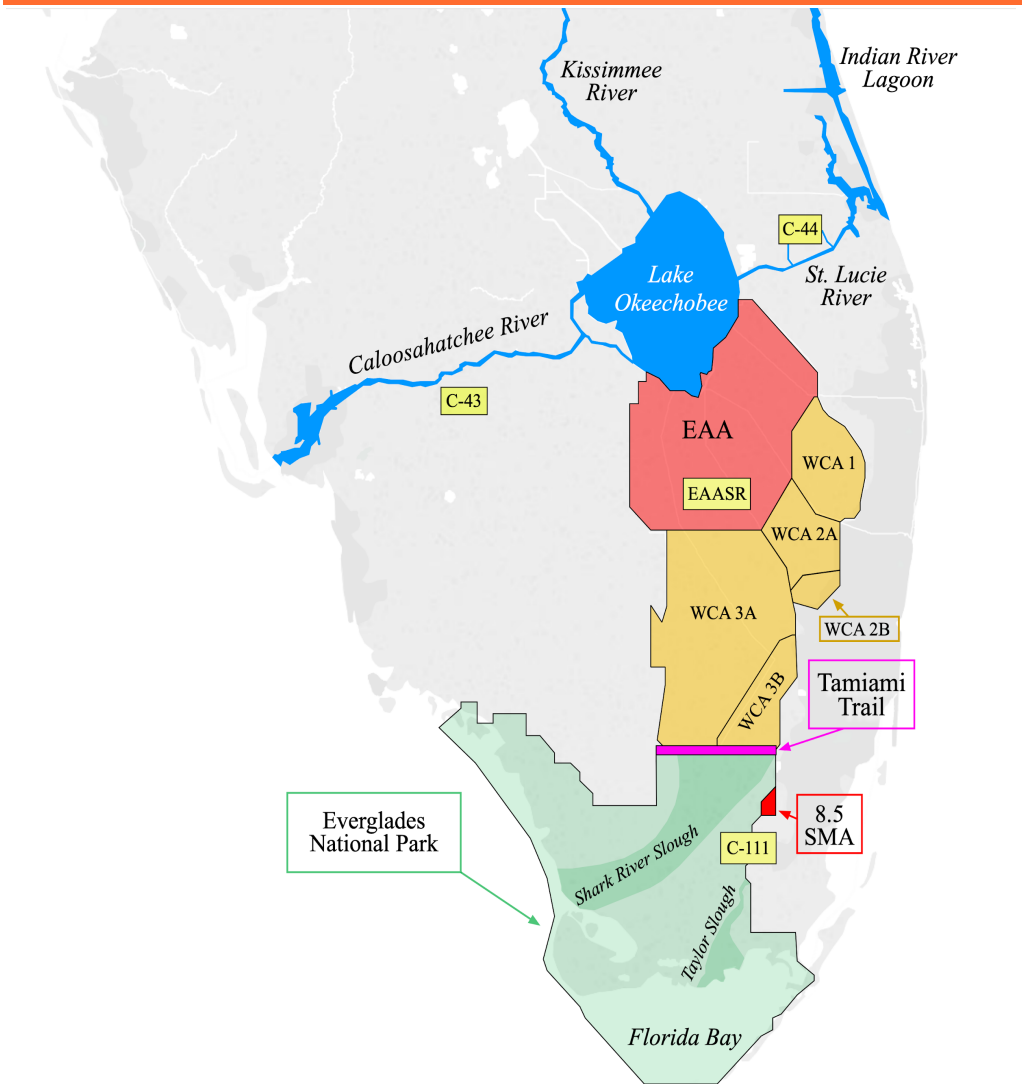
While most of the foundation projects are nearing completion, political factors have delayed implementation of CERP resulting in extended timelines and increased costs. Most glaringly, the federal government is more than $1 billion behind the state in fulfilling its funding obligations despite an equal funding agreement (Figure 13). Several key CERP projects are described in the remainder of this section and displayed in Figure 14.

FIGURE 13: TOTAL STATE VS. FEDERAL CERP SPENDING (OCT 1, 2000– JUN 30, 2018)



Source: South Florida Water Management District
https://www.sfwmd.gov/our-work/cerp-project-planning/cerp-implementation

FIGURE 14: OVERVIEW OF SFER PROJECTS



5.1

KEY TERMS AND TOOLS FOR WATER MANAGEMENT

5.1.1 RESERVOIRS AND AQUIFER STORAGE AND RECOVERY (ASR) WELLS

Reducing harmful discharges to the Caloosahatchee and St. Lucie estuaries demands additional water storage. A 2015 report from the University of Florida Water Institute indicated a need for additional storage capacities of 400,000 acre-feet in the Caloosahatchee River Watershed, 200,000 acre-feet in the St. Lucie Watershed, and

1,000,000 acre-feet north and south of Lake Okeechobee.[33] The primary tools for expanding storage capacity are reservoirs and Aquifer Storage and Recovery (ASR) wells. Reservoirs are massive pieces of above-ground storage infrastructure capable of storing hundreds of thousands of acre-feet of water. Because water stored in reservoirs is largely stagnant and exposed to sunlight, there is some concern that algal blooms could form within reservoirs. For this reason, reservoirs are sometimes accompanied by water treatment features. ASR wells allow water to be stored below ground in the Florida Aquifer system. Water is pumped into ASR wells for storage during wet seasons before being recovered for use during dry seasons. ASR wells have the potential to store large quantities of water around Lake Okeechobee with a much smaller footprint than above-ground reservoirs.

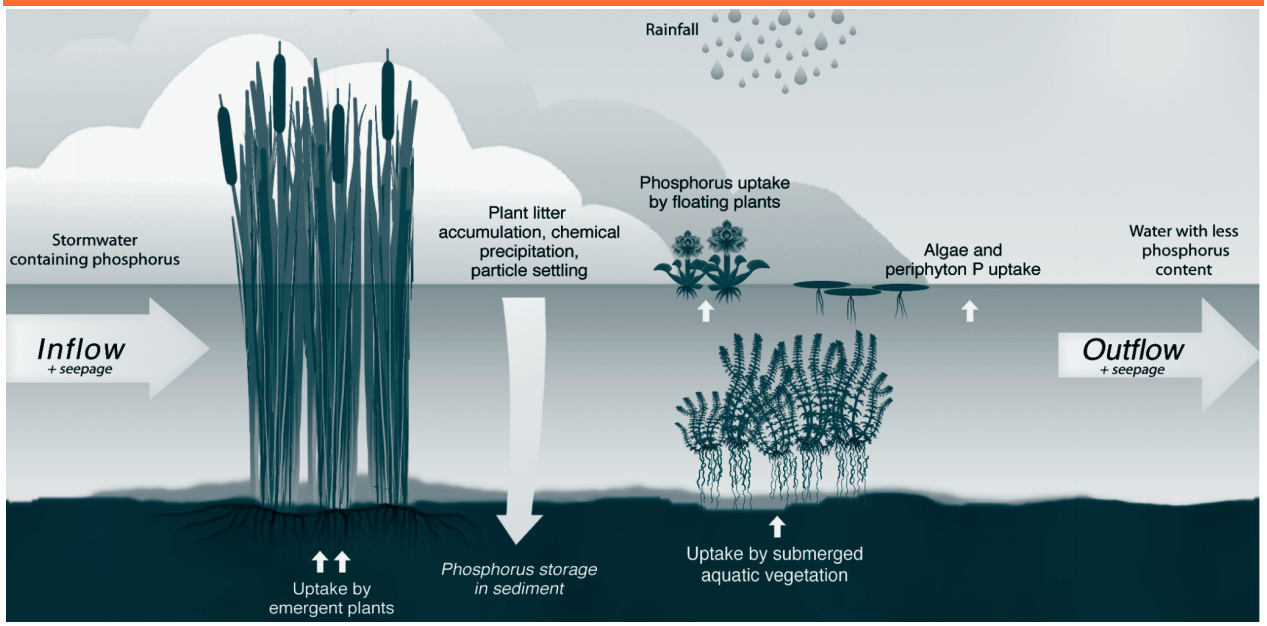
5.1.2 STORMWATER TREATMENT AREAS (STAS) AND FLOW EQUALIZATION BASINS (FEBS)

Stormwater Treatment Areas (STAs) are vast, constructed wetlands that remove nutrients from agricultural and urban runoff. Aquatic vegetation in STAs treat water by absorbing nutrients that are stored in soils after plants die and decompose (Figure 15). There are currently five STAs—covering 57,000 acres—operating south of Lake Okeechobee that treat excess water from agricultural areas before it is discharged to the Everglades and other natural areas. To the north and east of Lake Okeechobee, STAs treat water before it enters the lake and is discharged to the Caloosahatchee and St. Lucie rivers. However, the STAs do not have sufficient capacity to treat high-volume discharges released before major storm events. Two additional STAs are being planned north of the lake. According to the South Florida Water Management District, phosphorus concentrations in Everglades-bound waters are as low as 11 parts per billion (ppb) compared to 170 ppb before the construction of STAs.[34] Flow Equalization Basins (FEBs) are shallow storage features typically used to moderate water flows to STAs. In 2017 one FEB, named the A-1, opened to the public for recreational activities including hiking, fishing, and hunting. Both STAs and FEBs are managed by the District.

[33] Agnelo, Mary J. "Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades: An Independent Technical Review by the University of Florida Water Institute." Research Paper No. 15-25. University of Florida Levin College of Law, 2015. Available at SSRN: https://ssrn.com/abstract=2687498

[34] "Water Quality Improvement." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/wq-stas 19 Feb 2020

FIGURE 15: BASIC FUNCTION OF STORMWATER TREATMENT AREAS (STAS)



Source: South Florida Water Management District
https://www.sfwmd.gov/sites/default/files/documents/bts_sta.pdf

5.1.3 WATER CONSERVATION AREAS (WCAS)

Water Conservation Areas (WCAs) are wetlands south of Lake Okeechobee where water historically flowed before reaching Florida Bay. The Florida Fish and Wildlife Conservation Commission (FWC) manage these areas, with ownership split between the state and private owners.[35] According to the FWC, the areas were designated to capture and store excess water from adjacent areas.[36] The stored water can then be used for municipal, urban, and agricultural purposes. Levees and canals have altered the historic flow of water through WCAs, contributing to water management problems in Lake Okeechobee and the Everglades region. Allowing more water to flow south through WCAs is key to Everglades restoration efforts and addressing discharges from Lake Okeechobee.

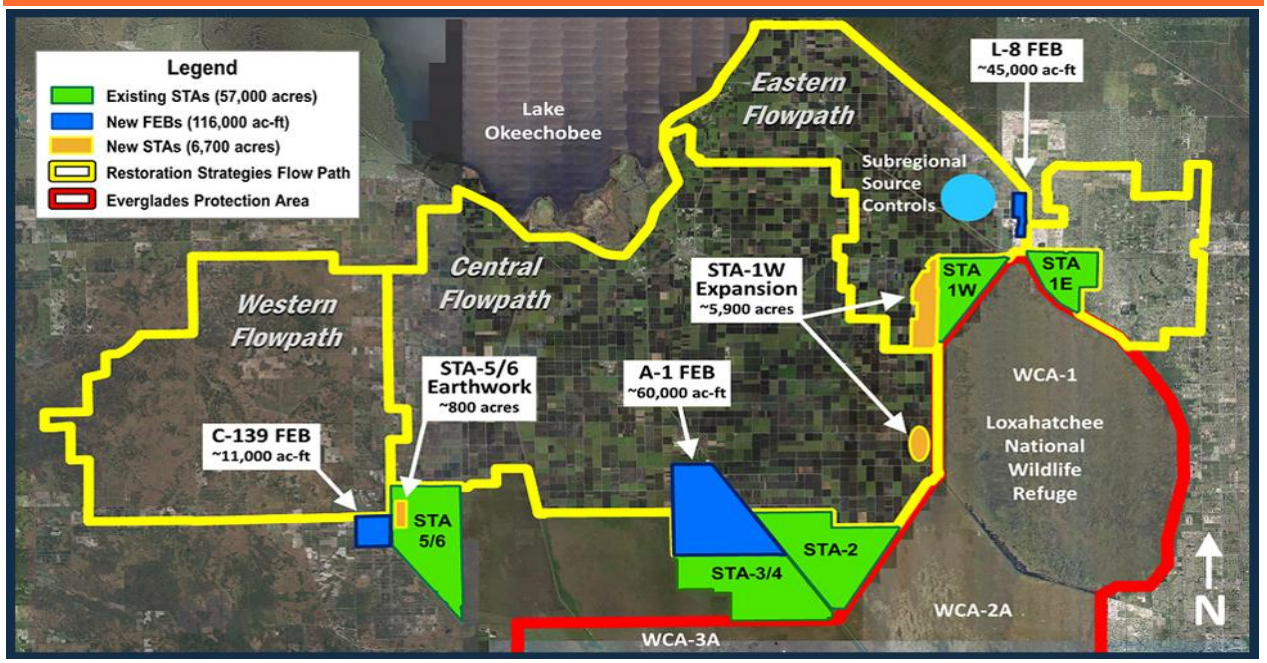
35 "Water Conservation Areas 2 and 3 (Everglades & Francis S. Taylor Wildlife Management Area)." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/recreation-site/water-conservation-areas-2-and-3-everglades-francis-s-taylor-wildlife-management

36 "Everglades Water Conservation Areas." *MyFWC.com*, Florida Fish and Wildlife Conservation Commission. Web. https://myfwc.com/fishing/freshwater/sites-forecasts/s/everglades-water-conservation-areas/

5.2 STATE-MANAGED RESTORATION STRATEGIES

The South Florida Water Management District is constructing a series of water storage and treatment facilities independent from the federal government and CERP. These projects are collectively referred to as Restoration Strategies and include more than 6,500 acres of STAs and 116,000 acre-feet of new storage through the construction of FEBs (Figure 16).[37] The following sections discuss Key Restoration Strategies projects in more detail.

FIGURE 16: RESTORATION STRATEGIES - KEY PROJECTS



Source: South Florida Water Management District
https://www.sfwmd.gov/our-work/restoration-strategies

5.2.1 NEW FLOW EQUALIZATION BASINS (FEBS)

The A-1 FEB is the largest FEB included under Restoration Strategies and provides 60,000 acre-feet of storage. The FEB is designed to capture and temporarily store stormwater before it enters STA-2 and STA-3/4 for treatment. The FEB itself also provides some treatment through vegetation that removes phosphorus from stored stormwater.[38]

37 "Restoration Strategies for Clean Water for the Everglades." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/restoration-strategies

38 "Quick Facts on Restoration Strategies for Clean Water for the Everglades." South Florida Water Management District. Feb. 2017. https://www.sfwmd.gov/sites/default/files/documents/spl_restoration_strategies.pdf

Construction was completed in July 2015. Construction of the 58-foot deep L-8 FEB was completed in July 2017.[39] It is capable of storing 45,000 acre-feet of water and will moderate flows to STA-1 East and STA-1 West to optimize treatment of stormwater runoff. The C-139 FEB is currently in the design stage with construction scheduled for completion by December 2023. Once complete, the FEB will be capable of storing 11,000 acre-feet of water to deliver to STA 5/6.

5.2.2 STORMWATER TREATMENT AREA (STA) MODIFICATIONS AND EXPANSIONS

The STA-1 West is undergoing a two-phase 6,500-acre expansion that will double the treatment capacity of the existing STA. The STA will remove nutrients from stormwater before it is sent south through Water Conservation Area 1 (WCA-1). Construction of Phase 1 was completed in 2018 and will begin operation by December 2020. Construction of Phase 2 is expected to be completed by December 2022. Modifications to the 13,700-acre STA-5/6 will level out high areas to improve the treatment capabilities of the STA. The internal improvements are scheduled for completion by December 2020.[40]

5.3 ADDRESSING NORTHERN RUNOFF

Runoff from urban and agricultural areas to the north of Lake Okeechobee contributes to toxic algal blooms by transporting nutrients from fertilizers and wastewater into the lake. Addressing blue-green algae requires management of the Lake Okeechobee Watershed to reduce the volume of nutrients reaching the lake and downstream estuaries. Several projects are underway to regulate inflows to Lake Okeechobee and improve the quantity and timing of freshwater discharges to the Caloosahatchee and St. Lucie rivers.

5.3.1 LAKE OKEECHOBEE WATERSHED RESTORATION

The area north of Lake Okeechobee has been dramatically altered by human settlement. Historically, wetlands comprised 40% of the area, but over time that figure has dropped to

[39] "FYI: L-8 Flow Equalization Basin." South Florida Water Management District. https://www.sfwmd.gov/sites/default/files/documents/fyi_l8_feb.pdf

[40] "Restoration Strategies for Clean Water for the Everglades." *SFWMD.gov*, South Florida Water Management District.

just 15%.[41] Most of the land is used for agricultural activity with approximately 51% of the area dedicated to pasture. Currently in the planning and design stage, the Lake Okeechobee Watershed Restoration Project (LOWRP) is an effort to improve water levels in Lake Okeechobee and improve the quantity and timing of discharges to the Caloosahatchee and St. Lucie estuaries with a study area over 1,450,000 acres. Planning for the project was put on hold in 2006 before resuming in 2016. The current plan, referred to as the Tentatively Selected Plan (TSP), includes a wetland attenuation feature with a storage capacity of 43,000-acre feet, 80 aquifer storage and recovery (ASR) wells with a combined storage capacity of 448,000-acre feet per year, and over 5,300 acres of wetland restoration. These features will capture, store, and redistribute water entering Lake Okeechobee from the north. According to the Army Corps of Engineers, the LOWRP—in conjunction with other authorized projects—will result in a 57% reduction in the volume of water discharged to the estuaries.[42]

5.3.2 KISSIMMEE RIVER RESTORATION PROJECT

In the 1960s, as part of the Central & South Florida Project, the Army Corps of Engineers significantly altered the Kissimmee River to reduce flooding in the surrounding areas. The once meandering river was straightened, deepened, and widened through the construction of the C-38 Canal. While this effort was successful as a flood control measure, it had severe ecological consequences. In addition to destroying floodplain habitats, the channelization significantly increased the speed of water flow into Lake Okeechobee. The river once collected nutrients along its winding banks, but after these alterations, large volumes of nutrient-laden water rushed into the lake. As a response to these unforeseen consequences, the Kissimmee River Restoration project was authorized in 1992 to reverse the alterations. Since construction began in 1999, 24 of the planned 44 miles have been restored to the previous natural, meandering flow.[43] The project is scheduled for completion in 2020 at a cost of over $1 billion split between Army Corps of Engineers and South Florida Water

41 "Lake Okeechobee Watershed Restoration Project: Draft Integrated Project Implementation Report and Environmental Impact Statement (Appendix G)." U.S. Army Corps of Engineers and South Florida Water Management District. July 2018. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/7427

42 "Lake Okeechobee Watershed Restoration Project | LOWRP: Facts and Information." U.S. Army Corps of Engineers. April 2019. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/3833

43 "Kissimmee River." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/kissimmee-river Accessed 20 Feb. 2020

Management District.[44] A total of 102,061 acres of land has been acquired to complete the project. Once completed, the Kissimmee River Restoration will contribute to reducing nutrient pollution in Lake Okeechobee and restore nearly 12,398 acres of wetlands.[45]

5.4 LAKE OKEECHOBEE

5.4.1 HERBERT HOOVER DIKE REHABILITATION

During wet seasons, especially in the presence of major storm events, large volumes of water enter Lake Okeechobee. Historically, this water would have flowed over the southern banks of the lake and into the Everglades. However, the Herbert Hoover Dike now contains the water to prevent flooding in agricultural and urban areas to the south. The Dike has weakened with age and can no longer withstand high water levels without posing a risk of catastrophic failure. A 2006 report from the South Florida Water Management District stated that the "Herbert Hoover Dike poses a grave and imminent danger to the people and the environment of South Florida."[46] The International Hurricane Research Center at Florida International University ranks Lake Okeechobee as the second most vulnerable area in the U.S. behind New Orleans, Louisiana.[47] In 2008, the Army Corps of Engineers lowered the maximum safe water level to between 12.5 and 15.5 feet. This reduced capacity has resulted in harmful discharges to the Caloosahatchee and St. Lucie rivers. Since 2001, the Army Corps of Engineers has invested over $1 billion in repairing the Dike with total costs expected to exceed $1.7 billion. These rehabilitation efforts will reduce the risk of failure, but repairs will not significantly increase the capacity of the lake. Moreover, higher water levels in the lake come with further ecological trade-offs. Many native species of aquatic plants cannot survive when water levels are consistently held above 16 feet while invasive plant species tend to spread at higher water levels.[48]

44 "Advancing Key Priority Projects." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/AchieveMoreNow#project26 Accessed 20 Feb. 2020

45 "Kissimmee River | Restoration Project: Facts and Information." U.S. Army Corps of Engineers. April 2019. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/3842

46 Gillis, Chad. "Herbert Hoover Dike: Region at Risk" *News-Press*. 5 Oct. 2014. *News-Press.com*. Web. https://www.news-press.com/story/news/local/2014/10/04/herbet-hoover-dike-region-risk/16737395/

47 "The Herbert Hoover Dike: A Discussion of the vulnerability of Lake Okeechobee to Levee Failure; Cause, Effect and the Future." Lloyd's. Feb. 2007. Web. https://www.lloyds.com/_test/library/natural-environment/lake-okeechobee

48 National Academies of Sciences, Engineering, and Medicine. "Progress Toward Restoring the Everglades: The Seventh Biennial Review - 2018."

5.4.2 LAKE OKEECHOBEE REGULATION SCHEDULE (LORS)

The Lake Okeechobee Regulation Schedule is developed by the Army Corps of Engineers and governs the operations of the Herbert Hoover Dike. Various goals including flood control, public safety, water supply, and ecological health must be balanced in determining optimal operations.[49] The current schedule was released in 2008 and lowered the maximum safe water level allowed in the lake. This significantly reduced the lake's storage capacity. Water flows into Lake Okeechobee about six times faster than it can be released due to modification of the natural system.[50] To prevent the lake from exceeding safe water levels, water is released ahead of the wet season and major storm events. Canals to the east and west have far greater capacity than southern outlets to quickly release large volumes of water.[51] As a result, more water must be discharged to the east and west through the Caloosahatchee and St. Lucie rivers than is released south.

The Army Corps of Engineers recently deviated from the LORS through the implementation of a "Harmful Algal Bloom Operational Strategy" or HABOS. Under the new operational strategy, larger volumes of water can be discharged to the east and west when algal blooms are not present. According to the Army Corps of Engineers, this would allow greater flexibility to reduce releases when blooms are present. While large releases of freshwater can be harmful to the estuaries because they alter salinity, the increased volumes under the HABOS are below identified thresholds for harm. Moreover, the cumulative volume of water released from the lake will be the same as would be the case under the LORS. These operations are limited to instances when one or more of the following conditions are met:

- If a [Harmful Algal Bloom (HAB)] is currently in Lake Okeechobee, C-43, C-44, the Caloosahatchee Estuary, or the St. Lucie Estuary.
- If the state of Florida declares a state of emergency due to HABs on Lake Okeechobee, C-43, C-44, the Caloosahatchee Estuary, or the St. Lucie Estuary.
- If a HAB is anticipated to occur on Lake Okeechobee, C-43, C-44, the Caloosahatchee Estuary, or the St. Lucie Estuary.

[49] Agnelo. "Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades."

[50] "Just the Facts: Lake Okeechobee Coastal Releases." South Florida Water Management District. Web. https://www.sfwmd.gov/sites/default/files/documents/jtf_lakeo_releases.pdf

[51] Agnelo. "Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades."

- If a HAB has occurred and caused harm or has impacted public safety during the last 18 months within Lake Okeechobee, C-43, C-44, the Caloosahatchee Estuary, or the St. Lucie Estuary.[52]

In August 2018, the U.S. Sugar Corporation filed a lawsuit against the Army Corps of Engineers over its deviation from the LORS. In a press release, a spokesperson for U.S. Sugar Corporation stated that "Since November of 2018, the Corps has released unprecedented volumes of water from Lake Okeechobee, and as a result they've recently driven the lake into the water shortage band (which requires the South Florida Water Management District to implement water shortage policies) during the rainy season."[53] The U.S. Sugar Corporation further claimed that they were joining environmental groups in their concerns about the operation of Lake Okeechobee. However, environmental groups have pushed back on this claim and generally favor deviation from the LORS.[54]

The HABOS may be terminated at any time and may only be extended until the LORS is replaced by a new water control plan. A new operating schedule, known as the Lake Okeechobee System Operation Manual (LOSOM) is planned for implementation in 2022. The LOSOM will take into account new infrastructure that has been constructed since the development of the LORS.[55] The Army Corps of Engineers also plans to include provisions in the LOSOM that allow for adaptation as additional infrastructure is completed.[56]

52 "Harmful Algae Bloom Operational Strategy." U.S. Army Corps of Engineers. 7 Sept. 2019. Web. https://d3n8a8pro7vhmx.cloudfront.net/bullsugar/mailings/1419/attachments/original/*Corps_Deviation_Document-2.pdf?1564658187

53 "Lawsuit Filed Over Lake Okeechobee Releases and U.S. Army Corps-Created Water Shortage" *USSugar.com*, U.S. Sugar Corporation. 1 Aug. 2019. Web. https://www.ussugar.com/news/lawsuit-filed-over-lake-okeechobee-releases-and-u-s-army-corps-created-water-shortage/

54 Gillis, Chad. "U.S. Sugar files lawsuit against Army Corps over Lake Okeechobee management, low water levels." *News-Press*. 2 Aug. 2019. Web. https://www.news-press.com/story/news/2019/08/01/us-sugar-army-corps-engineers-okeechobee-lake-caloosahatchee-river-everglades-clewiston-district/1888771001/

55 "Lake Okeechobee System Operating Manual (LOSOM), a Component of the Central & Southern Florida (C&SF) System Operating Plan." U.S. Army Corps of Engineers. Web. https://www.saj.usace.army.mil/LOSOM/

56 "Fact Sheet: Lake Okeechobee System Operating Manual (LOSOM) Operation & Maintenance (O&M)." U.S. Army Corps of Engineers. March 2019. Web. https://www.saj.usace.army.mil/About/Congressional-Fact-Sheets-2019/Lake-Okeechobee-System-Operating-Manual-LOSOM-O-M/

5.5 RIVERS AND ESTUARIES

5.5.1 CALOOSAHATCHEE RIVER (C-43) WEST BASIN STORAGE RESERVOIR

Currently under construction, the C-43 Storage Reservoir is a project to restore the Caloosahatchee River and Estuary. In the wet season, freshwater discharges from Lake Okeechobee introduce nutrient pollution and reduce salinity levels in the Caloosahatchee Estuary. Salinity levels increase in the dry season when too little water is released into the river. Both low and high salinity levels have detrimental effects on ecological conditions in the estuary while nutrient pollution feeds algal blooms. The C-43 project will allow for a more consistent flow of fresh water to the estuary. It includes a 10,500-acre storage reservoir, pumps, and a perimeter canal to convey drainage off site. Once construction is completed, the reservoir will be capable of storing 170,000 acre-feet of water.[57] This storage will be used to manage water flows into the river. The reservoir will capture excess runoff from the C-43 basin and mitigate the impacts of regulatory releases from Lake Okeechobee in wet seasons. During dry seasons, the water can be released to improve salinity conditions and maintain a more stable flow of water to the estuary year-round.

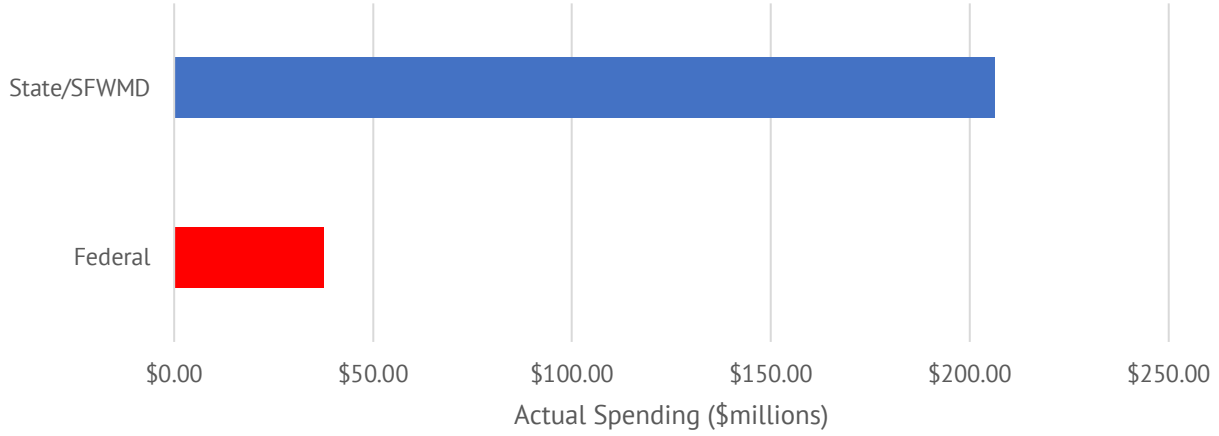
Original plans for the C-43 reservoir did not include any water treatment components, raising concerns that algal blooms could form within the reservoir before being discharged to the Caloosahatchee Estuary. An Executive Order from Florida Governor Ron DeSantis instructed the South Florida Water Management District to "add stormwater treatment to the C-43 Reservoir to provide additional treatment and improve the quality of water leaving this important storage component."[58] The total cost of the project—excluding the additional treatment component—is now estimated to be $1.1 billion. Securing full funding requires congressional authorization to increase the existing authorization from $850 million. State funding significantly outpaced federal funding for the C-43 Reservoir between 2000 and 2018 (Figure 17). Construction is scheduled for completion by December 2023.[59]

[57] "Caloosahatchee River (C-43) | West Basin Storage Reservoir: Facts and Information." U.S. Army Corps of Engineers. January 2019. Web. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/3140

[58] "Executive Order No. 19-12: Achieving More Now for Florida's Environment." State of Florida. 10 Jan. 2019. Web. https://www.flgov.com/wp-content/uploads/2019/01/EO-19-12-.pdf

[59] "Advancing Key Priority Projects." *SFWMD.gov*, South Florida Water Management District.

FIGURE 17: STATE VS. FEDERAL SPENDING ON CALOOSAHATCHEE (C-43) WEST RESERVOIR (ACTUAL SPENDING $MILLIONS)



Source: South Florida Water Management District
https://www.sfwmd.gov/our-work/cerp-project-planning/cerp-implementation

INDIAN RIVER LAGOON - SOUTH (IRL-S) RESTORATION PROJECT

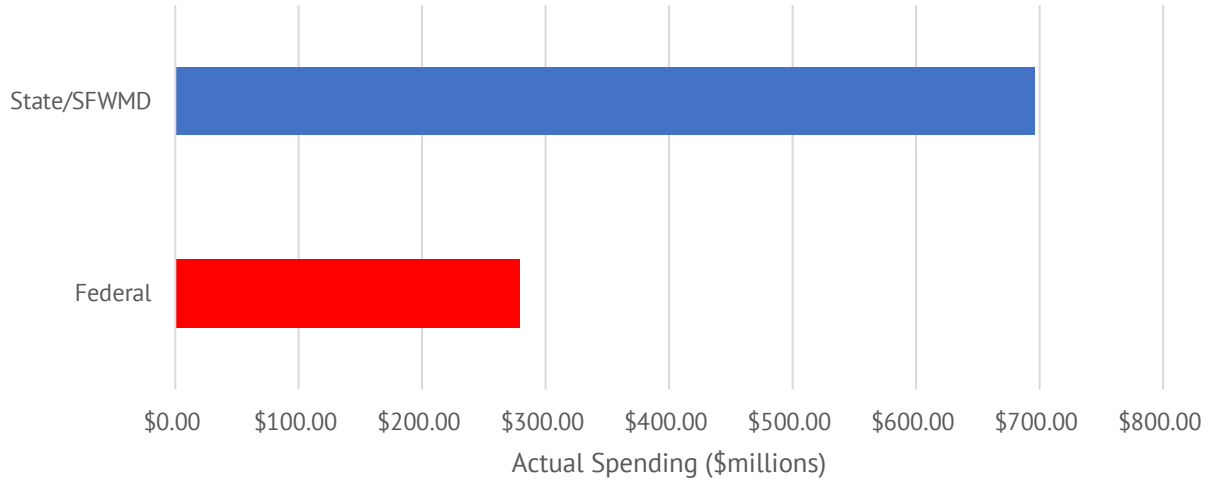
The Indian River Lagoon is a body of water that adjoins the estuary of the St. Lucie River and experiences frequent algal blooms resulting from local nutrient runoff and large-volume discharges from Lake Okeechobee. The Indian River Lagoon - South (IRL-S) project is a multi-faceted effort to mitigate the damage caused by pollution and large freshwater discharges. Once complete, the IRL-S project is expected to result in a 41% long-term reduction in phosphorus and a 26% long-term reduction in nitrogen. In total, the project will create 162,520 acre-feet of new water storage including:

- 12,000 acres of aboveground storage
- 9,000 acres of man-made wetlands
- 90,000 acres of natural areas, including 53,000 acres of restored wetlands providing additional storage

The first component of the multi-billion-dollar IRL-S project is the C-44 Reservoir and STA. Scheduled to be completed by March 2021, the C-44 project is currently under construction and will include a 3,400-acre storage reservoir, 6,300-acre STA, and 3,600 acres of wetlands. Once completed, the reservoir will have a storage capacity of 50,600 acre-feet of water while the STA will be capable of treating 9,900 acre-feet of water. Together, these components will reduce the impacts of discharges from Lake Okeechobee by storing,

treating, and releasing the water at sustainable intervals. The project will also capture 65% of annual stormwater runoff in the C-44 basin. As a result, salinity and nutrient levels in the St. Lucie River and Indian River Lagoon are expected to improve. However, federal funding for the IRL–S project has lagged behind state spending (Figure 18).

FIGURE 18: STATE VS. FEDERAL SPENDING ON INDIAN RIVER LAGOON SOUTH (IRL-S) PROJECT (ACTUAL STATE VS FEDERAL CERP SPENDING $MILLIONS)



Source: South Florida Water Management District
https://www.sfwmd.gov/our-work/cerp-project-planning/cerp-implementation

5.5.2 LOXAHATCHEE RIVER WATERSHED RESTORATION PROJECT

The Loxahatchee River runs through the city of Jupiter in Palm Beach County and is part of the Everglades region. Areas on the river's watershed have been developed for urban and agricultural use, severing natural links to freshwater flows from the wider Everglades. As a result, native wildlife and vegetation are threatened by elevated salinity levels. The Loxahatchee River Watershed Restoration Project is intended to restore freshwater flows to the Loxahatchee River and Estuary.[60] However, there are no water treatment features included in the project plan. Given the presence of algal blooms in the river and broader concerns of spreading algal blooms through freshwater flows elsewhere around the state, consideration of nutrient levels in water to be sent to the Loxahatchee River may be warranted.

[60] "Loxahatchee River Watershed Restoration Project." *saj.USACE.mil*, U.S. Army Corps of Engineers. Web. https://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Loxahatchee-River-Watershed-Restoration-Project/

5.6 SENDING WATER SOUTH

5.6.1 EVERGLADES AGRICULTURAL AREAS (EAA) STORAGE RESERVOIR

With a planned capacity of at least 240,000 acre-feet of water, the EAA Storage Reservoir is the largest water storage project under CERP. The purpose of the project is to increase storage capacity south of Lake Okeechobee and reduce the need for discharges through the Caloosahatchee and St. Lucie rivers.[61] In January 2019, Florida Governor Ron DeSantis signed an executive order that instructed the South Florida Water Management District to expedite the design of the EAA storage reservoir and ensure that the project is approved by the Army Corps of Engineers according to schedule.[62] Acquiring the land to construct the reservoir has been a major obstacle to the project's completion. In 2008, then-Governor Charlie Christ planned to buy almost 200,000 acres of land from the U.S. Sugar Corporation at a cost of $1.75 billion, but the deal collapsed after the recession.

In October of 2019, Governor Ron DeSantis announced a new deal to pay $2.4 million to terminate a 1,234-acre lease of state-owned land.[63] Florida Crystals, the sugarcane producer occupying the land, enabled the deal by waiving a notice requirement that would have prevented the state from terminating the lease until at least three years after receiving a permit from the U.S. Army Corps of Engineers. The buyout is expected to save the state about $16 million in construction costs by expediting the project timeline.

Once completed, the project could significantly reduce discharges to the east and west from Lake Okeechobee. The EAA reservoir—in conjunction with other projects—will allow for a 63% reduction in the number of discharges to the northern estuaries and a 76% increase in the flow of water south to the Everglades and Florida Bay.[64] The project will also include water treatment features, but the planned 11% expansion of treatment

61 "Everglades Agricultural Area Storage Reservoir Project." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/cerp-project-planning/eaa-reservoir

62 "Governor Ron DeSantis Announces Major Water Policy Reforms." 10 Jan. 2019. Web. *FLGov.com*, Florida Governor Ron DeSantis. https://www.flgov.com/2019/01/10/governor-ron-desantis-announces-major-water-policy-reforms/

63 Turner, Jim. "State Approves Paying Sugar Grower To End Lease." *The News Service of Florida*. 22 Oct. 2019. Web. https://newsserviceflorida.com/app/post.cfm?postID=34414

64 Mitsch, William. J. "Restoring the Florida Everglades: Comments on the current reservoir plan for solving harmful algal blooms and restoring the Florida Everglades." *Ecological Engineering: X* 3 (2019) 1-5. Web. https://doi.org/10.1016/j.ecoena.2019.100009

wetlands is unlikely to be enough to provide adequate water treatment. If more water is to be sent south, it is critical that appropriate treatment occur to avoid spreading nutrient pollution and algal blooms south. Construction of the water treatment and storage features of the project are slated for completion in 2023 and 2028 respectively.

5.6.2 COMBINED OPERATIONAL PLAN (COP)

The Combined Operational Plan (COP) will be a comprehensive integrated water control plan to optimize water flows south of Lake Okeechobee. The plan is dependent on the completion of multiple projects to allow more water to flow south to Everglades National Park. These projects include: (1) Modified Deliveries to Everglades National Park and (2) C-111 South Dade. Once these projects are completed, the COP will send an annual average of approximately 210,000-acre feet of water south from Lake Okeechobee.[65]

5.7 MODIFIED DELIVERIES TO EVERGLADES NATIONAL PARK (FOUNDATION PROJECT)

The Modified Water Deliveries (MWD) project will alter the existing Central & South Florida Project to partially restore natural flows south of Lake Okeechobee. Additional flows south will also reduce the need to discharge water through the Caloosahatchee and St. Lucie rivers. The MWD will primarily increase flows into Shark River Slough, the main body of water in Everglades National Park (ENP), while maintaining the current level of flood protection for surrounding communities.[66] The project has four major components: Tamiami Trail Modifications, the 8.5 Square Mile Area (SMA) Flood Mitigation Plan, Conveyance and Seepage Control Features, and Project Implementation Support.

The Tamiami Trail is a 264-mile roadway constructed in the 1920s that connects the cities of Tampa and Miami. A portion of the road runs along the northern boundary of Everglades National Park, creating a 25-mile barrier to natural surface water flows.[67] Reduced flows

65 "Southern Everglades Ecosystem: Restoring America's Everglades." U.S. Army Corps of Engineers. Web. https://www.saj.usace.army.mil/Portals/44/docs/Environmental/C-111%20South%20Dade/SouthernEvergladesOverview_web.pdf

66 "Everglades Restoration Projects Clear Another Hurdle." Florida Department of Environmental Protection. 29 July 2016. Press Release. Available at: https://content.govdelivery.com/accounts/FLDEP/bulletins/1596179

67 "Tamiami Trail: Next Steps." *NPS.gov*, National Parks Service. 4 Nov. 2018. Web. https://www.nps.gov/articles/tamiami-trial-next-steps.htm Accessed 24 Feb. 2020

south of the lake have dried out historical wetlands and contribute to discharges to the Caloosahatchee and St. Lucie estuaries. As part of the MWD project, Congress authorized a one-mile bridge and 9.7 miles of roadway reinforcements in 2009 to allow more water to reach the Park. Construction of the bridge and reinforcements was completed in 2013 at a cost of $81 million. However, these modifications were determined to be insufficient, and additional modifications—known as Tamiami Trail Modifications: Next Steps—were planned. In 2016, Governor Rick Scott granted $97 million from the Florida Department of Transportation to complete Phase I of the additional modifications, which included 2.6 miles of bridging completed in January 2019. Governor Ron DeSantis announced in June 2019 that Phase II was fully funded by a $60 million grant from the U.S. Department of Transportation to match a $40 million commitment from the state.[68] Phase II of the Tamiami Trail Modifications project will include a bridge to raise a 6.5-mile section of the road. Construction of Phase II is expected to be completed in December 2022.[69]

As a result of increased flows south, an 8.5 square-mile residential area in south Miami-Dade County along the north east edge of Everglades National Park will have an increased risk of flooding. The area was developed in the absence of flood control measures and has frequently experienced flood threats. For many years, the 8.5 Square Mile Area was a source of contention and a hindrance to Everglades restoration efforts. The current plan includes a pump station, a detention area, a control structure, levees, and seepage canals to provide flood mitigation for the 8.5 Square Mile Area, requiring about 4,320 acres of land to be acquired.[70] Overcoming these challenges is important because the MWD project is considered a foundational project and its completion is required for the implementation of CERP.

Conveyance and Seepage Control Features (pumps and modifications to levees and canals) will allow for additional flows to Everglades National Park while controlling seepage into urban areas to the east. Project Implementation and Support includes monitoring, testing, and planning required to implement the MWD project in conjunction with other projects to restore natural conditions in the Everglades system.[71]

68 "Governor DeSantis Announces Full Funding Now in Place for Critical Tamiami Trail Project." *FLGov.com*, Governor Ron DeSantis. 3 June 2019. Press Release. Available at: https://www.flgov.com/2019/06/03/governor-desantis-announces-full-funding-now-in-place-for-critical-tamiami-trail-project/

69 "Advancing Key Priority Projects." *SFWMD.gov*, South Florida Water Management District.

70 "Modified Water Deliveries | Everglades National Park: Facts and Information." U.S. Army Corps of Engineers. Jan. 2019. Web. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/3149

71 Ibid.

5.8 CANAL 111 (C-111) SOUTH DADE PROJECT (FOUNDATION PROJECT)

The C-111 South Dade is another foundation project that will work in coordination with MWD infrastructure to restore natural hydrologic conditions in Taylor Slough and surrounding areas within Everglades National Park. The primary function of the project is to prevent seepage out of the Park resulting from increased water flows. This will provide flood protection in agricultural areas east of Everglades National Park while allowing increased water flow into the Park and Florida Bay.[72] The C-111 project was originally authorized as part of the Central & South Florida project in 1962, but environmental concerns caused construction to be discontinued before the project was complete. Project modifications were approved in 1994 and construction was recently completed. However, the Army Corps of Engineers is currently making repairs to detention areas that are part of the project. The repairs are expected to be completed in December 2021.[73] Sending more water south is a key component of addressing algal blooms, but developed areas in south Florida must be protected from flooding.

5.9 NORTHERN EVERGLADES AND ESTUARIES PROTECTION PROGRAM

The Northern Everglades and Estuaries Protection Program (NEEPP) is a joint effort by the South Florida Water Management District, Florida Department of Environmental Protection (FDEP), and the Florida Department of Agriculture and Consumer Services (FDACS) to improve the quantity and quality of water in the Lake Okeechobee, Caloosahatchee River, and St. Lucie River watersheds. The NEEPP originated in 2000 with the Lake Okeechobee Protection Act, which expanded in 2007 to include the Caloosahatchee and St. Lucie rivers and estuaries. The NEEPP includes the Lake Okeechobee, Caloosahatchee River, and St. Lucie River Watershed Protection Programs. Each Protection Program encompasses (1) Construction Projects, (2) a Research and Water Quality Monitoring Program, and (3) a

[72] "C-111 | South Dade Project: Facts and Information." U.S. Army Corps of Engineers. July 2018. Web. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/2573

[73] "Advancing Key Priority Projects." *SFWMD.gov*, South Florida Water Management District.

Pollutant Control Program.[74] Considering that much of the freshwater reaching the coastal estuaries originates in the local basins of the Caloosahatchee and St. Lucie rivers, these projects are particularly important to addressing water quality issues in those water bodies. The objectives of NEEPP and CERP have considerable overlap and many projects under each complement the other. Construction projects under CERP including ASR wells north of Lake Okeechobee, the C-43 reservoir, and the IRL-S project will significantly support the implementation of NEEPP.

5.9.1 BASIN MANAGEMENT ACTION PLANS (BMAPS)

Basin Management Action Plans (BMAPs) have also been developed for each watershed as a means to achieve water quality standards. A BMAP is a "blueprint" for reducing pollutants and includes efforts ranging from major construction projects to public education programs to achieve water quality goals in the form of Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of a pollutant (such as nitrogen or phosphorus) that can exist in a body of water while still meeting state water quality standards. BMAPs are required to include 5-, 10-, and 15-year measurable milestones with a 20-year deadline to achieve established TMDLs, but the deadline may be extended without any significant repercussions. As noted by the Blue-Green Algae Task Force, there is insufficient monitoring in place to determine overall progress or the relative value of individual projects under BMAPs.[75] The Task Force will, in part, identify strategies to improve monitoring and prioritization of BMAP projects. As of December 31, 2018, 24 BMAPs have been adopted for water bodies around the state.

5.10 CALOOSAHATCHEE ESTUARY BASIN MANAGEMENT ACTION PLAN

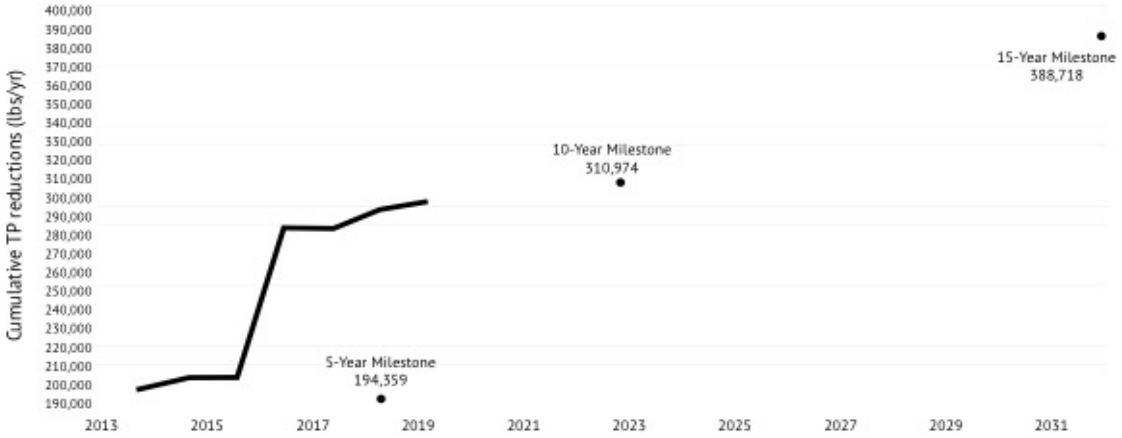
In 2009, the Florida Department of Environmental Protection (FDEP) adopted a TMDL for the Caloosahatchee Estuary that established a target for total nitrogen reduction and adopted the Caloosahatchee Estuary BMAP in 2012 to implement the established TMDL. No TMDL was established for phosphorus in the Caloosahatchee Estuary. A total of 99 projects have been completed under the Caloosahatchee Estuary BMAP as of December 31, 2018

[74] "Northern Everglades and Estuaries Protection Program." *SFWMD.gov*, South Florida Water Management District. Web. https://www.sfwmd.gov/our-work/northern-everglades Accessed 24 Feb. 2020

[75] "Blue-Green Algae Taskforce Consensus Document #1." Florida Department of Environmental Protection. *FloridaDEP.gov*.

with 20 additional projects planned or underway. Modeling by FDEP suggests that the completed projects under the Caloosahatchee Estuary BMAP will achieve 77% of the total nitrogen reductions required under the TMDL.[76] However, the models used by FDEP rely on several assumptions that overstate the impact of these projects.

FIGURE 19: CALOOSAHATCHEE ESTUARY BMAP TOTAL NITROGEN (TN) REDUCTIONS



Source: Florida Department of Environmental Protection
https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report

The South Florida Water Management District collects water quality data from monitoring stations throughout the Caloosahatchee River watershed. The district provides summaries of these data in annual South Florida Environmental Reports. These summaries include data from areas outside of the Caloosahatchee BMAP and are presented by Water Year (WY). By contrast, FDEP reports Total Nitrogen reductions by calendar year. The FDEP numbers also only include areas of the watershed covered by the BMAP, even though conditions in the estuary depend on nutrient flows throughout the watershed. While FDEP claims to have achieved significant cumulative reductions in Total Nitrogen, data from the South Florida Water Management District suggest little or no improvement between WY1997 and WY2018.

[76] "2018 Statewide Annual Report on Total Maximum Daily Loads, Basin Management Action Plans, Minimum Flows or Minimum Water Levels, and Recovery or Prevention Strategies." *FloridaDEP.gov*, Florida Department of Environmental Protection. 3 Oct. 2019. Web. https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report

FIGURE 20: TOTAL NITROGEN AND PHOSPHORUS LOADS TO THE CALOOSAHATCHEE RIVER ESTUARY WY1997-WY2018

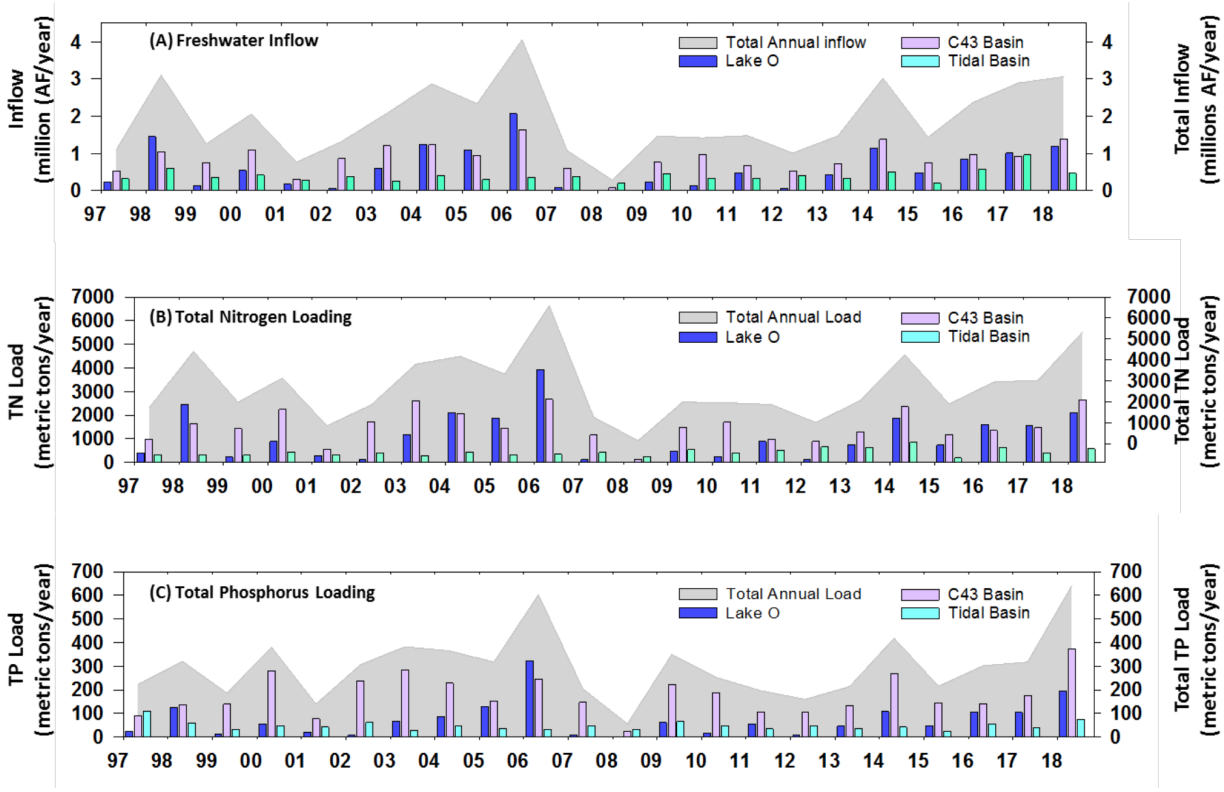


Figure 8C-17. Time series of (a) annual freshwater inflow in million acre-foot per year (million AF/year) and (b) TN loads and (c) TP loads in metric tons per year (metric tons/year) into the CRE for WY1997–WY2018.

Source: South Florida Water Management District
https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/v1/chapters/v1_ch8c.pdf

5.11

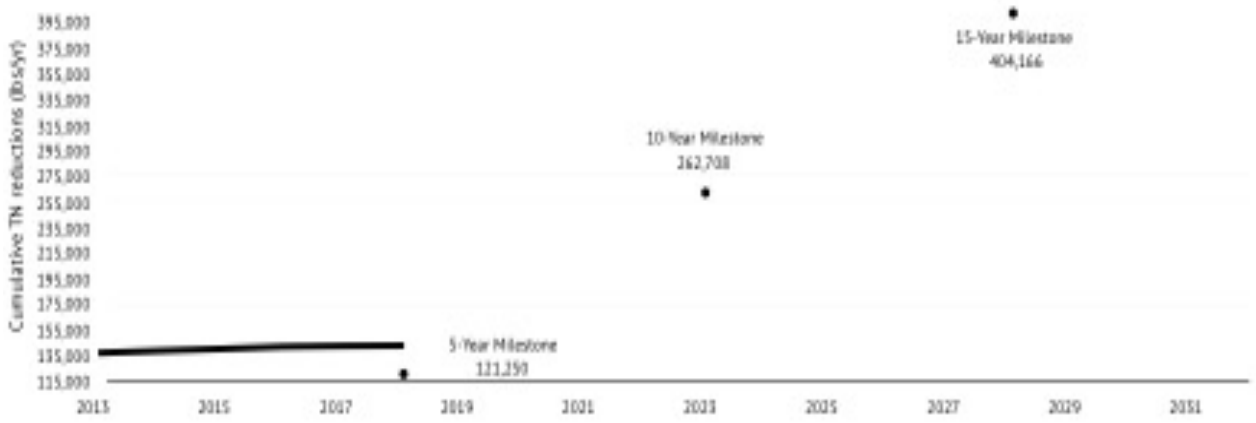
ST. LUCIE BASIN MANAGEMENT ACTION PLAN

The Florida Department of Environmental Protection (FDEP) identified the St. Lucie River and Estuary as impaired for both total nitrogen and total phosphorus and adopted a TMDL for both nutrients in 2013. A total of 224 projects were completed under the St. Lucie BMAP as of December 31, 2018. An additional 29 projects were planned or underway. Completed projects are estimated to achieve 52% and 35% of the total nitrogen and phosphorus reductions needed to meet the respective established TMDLs.[77] As with the Caloosahatchee Estuary BMAP, these estimates are based on overly optimistic modeling. Data from the South

[77] Ibid.

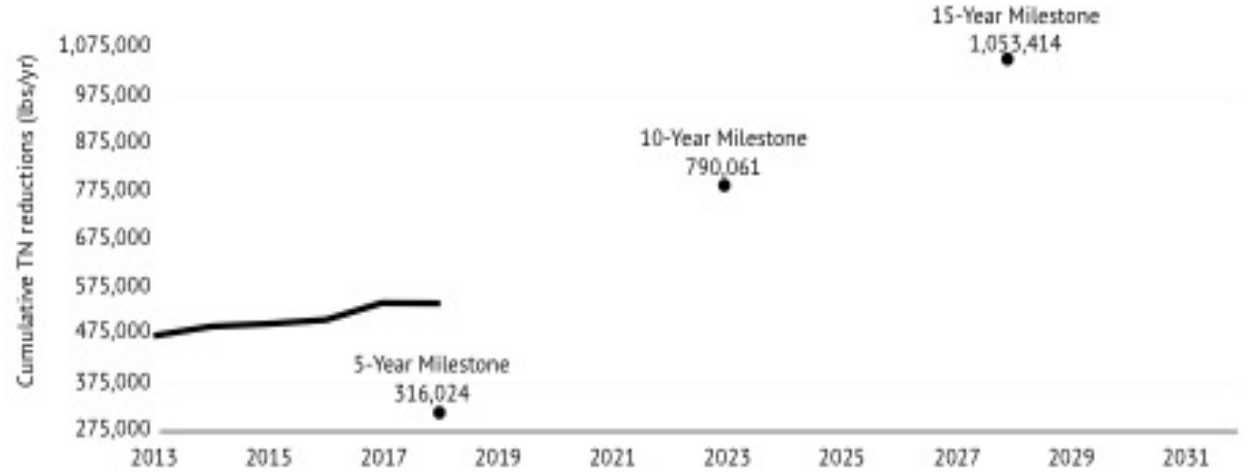
Florida Water Management District suggest little or no improvement in Total Nitrogen and Total Phosphorus flows to the St. Lucie Estuary between WY1997 and WY2018.

FIGURE 21: ST. LUCIE BMAP TOTAL PHOSPHORUS (TP) REDUCTIONS



Source: Florida Department of Environmental Protection
https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report

FIGURE 22: ST. LUCIE TOTAL NITROGEN (TN) PROJECT REDUCTIONS



Source: Florida Department of Environmental Protection
https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report

FIGURE 23 FRESHWATER INFLOW, TOTAL PHOSPHORUS LOADS, AND TOTAL NITROGEN LOADS TO THE ST. LUCIE ESTUARY WY1997-WY2018

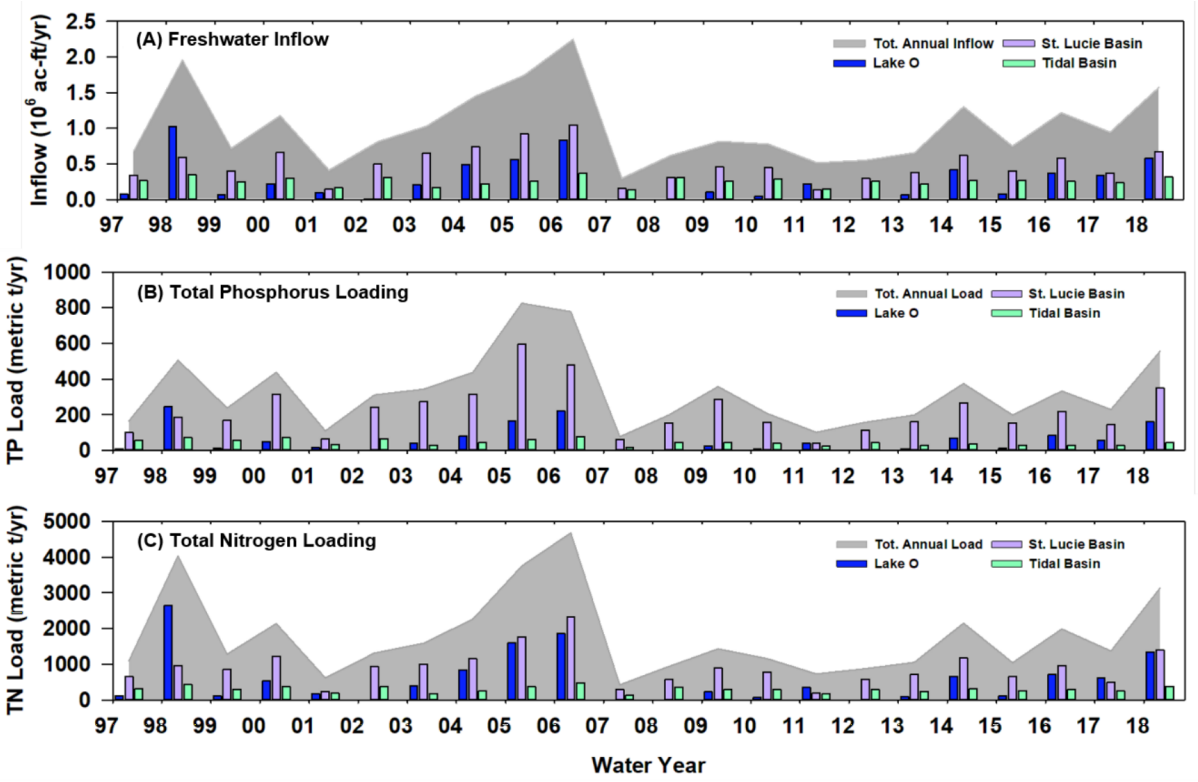


Figure 8C-7 Time series of (a) annual freshwater inflow in million acre-feet per year (10^6 ac-ft/yr or 1.233×10^9 cubic meters [m^3]) and (b) TP load, and (c) TN load in metric tons per year (t/yr) into the SLE from different sources between WY1997–WY2018.

Source: South Florida Water Management District
https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/v1/chapters/v1_ch8c.pdf

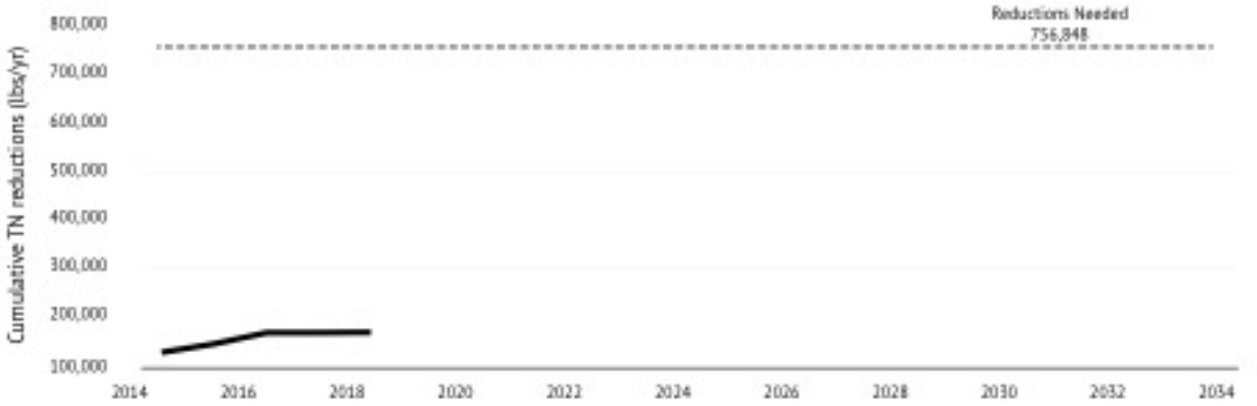
5.12 LAKE OKEECHOBEE BASIN MANAGEMENT ACTION PLAN

In 2001, the Florida Department of Environmental Protection adopted a TMDL for total phosphorus in Lake Okeechobee. Of the maximum 140 metric tons per year (308,647 lb./yr.) of total phosphorus established by the TMDL, 35 mt./yr. (77,162 lb./yr.) fall directly onto the lake through atmospheric decomposition. The Lake Okeechobee BMAP was adopted in 2014 and allocated the remaining 105 mt./yr. (231,485 lb./yr.) to the entire Lake Okeechobee Watershed.[78] As of December 31, 2018, 181 projects were completed with an additional 47 projects planned or underway. Completed projects are estimated to have

[78] "Lake Okeechobee Basin Management Action Plan (BMAP) Story Map." Florida Department of Environmental Protection. Web. https://fdep.maps.arcgis.com/apps/MapSeries/index.html?appid=ac355a2b17224f7baae353bfa234cbac

achieved only 22% of the phosphorus reductions required under the TMDL. Data from the South Florida Water Management District also suggests that Total Phosphorus flows to Lake Okeechobee have not significantly improved between WY1974 and WY2018. A major concern regarding the effectiveness of projects under the Lake Okeechobee BMAP is legacy phosphorus stored in soils within the watershed and the lake itself (Figures 24-26).

FIGURE 24: LAKE OKEECHOBEE BMAP TOTAL PHOSPHORUS (TP) REDUCTIONS



Source: Florida Department of Environmental Protection
https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report

FIGURE 25: LAKE OKEECHOBEE TOTAL PHOSPHORUS LOAD AND INFLOW WY1974-WY2018

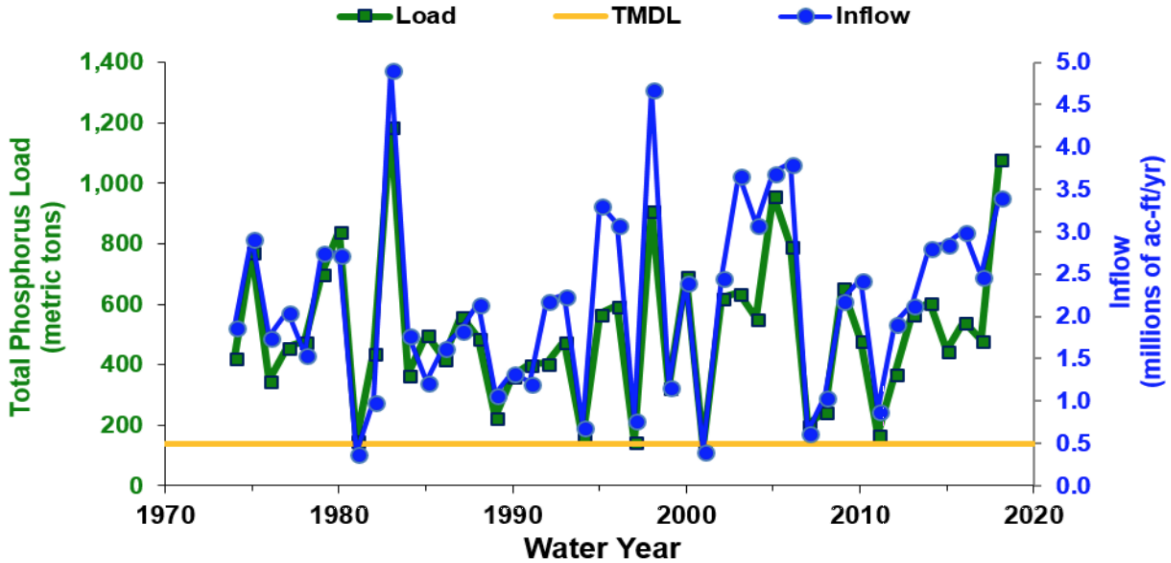
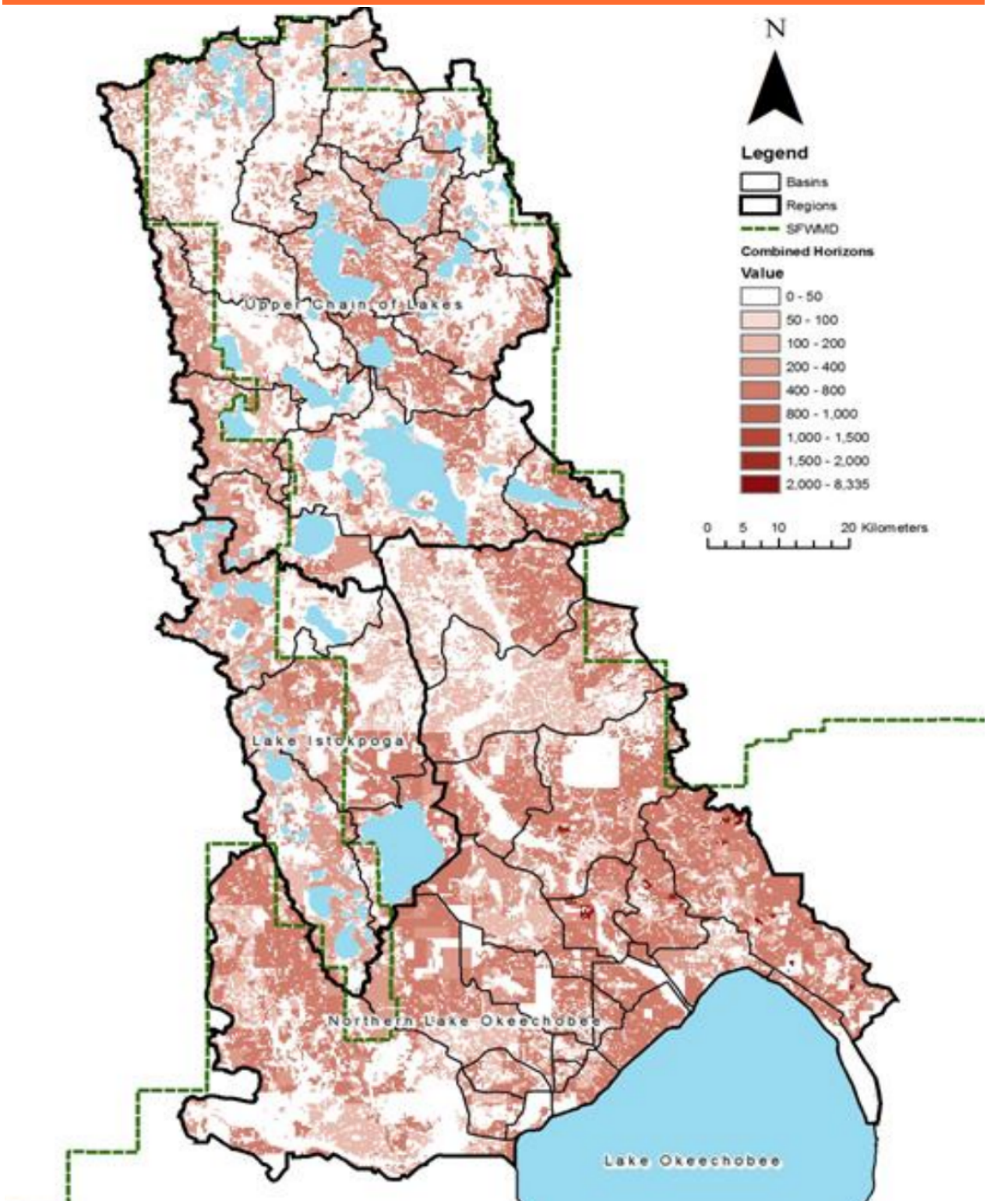


Figure 8B-20. Timelines of May–April water year TP load and inflow entering Lake Okeechobee from its tributaries calculated from the P budget of Lake Okeechobee.

FIGURE 26: LEGACY PHOSPHORUS CONCENTRATIONS IN THE LAKE OKEECHOBEE WATERSHED



Source: South Florida Water Management District
https://www.sfwmd.gov/sites/default/files/documents/legacypprojoverview.pdf

Estimates indicate that as much as 80% of net phosphorus imports in the Lake Okeechobee Watershed are stored in soils and sediments.[79] This has limited the effectiveness of projects under the Lake Okeechobee BMAP. Assuming that imports and exports were balanced, it would take about 350 years to wash away existing legacy phosphorus according to the South Florida Water Management District.[80]

5.12.1 LAKE OKEECHOBEE WATERSHED PROTECTION PROGRAM

The objective of the Lake Okeechobee Watershed Protection Program is to improve the hydrology and water quality in Lake Okeechobee. Specifically, the program focuses on reducing phosphorus loads in the Lake Okeechobee Watershed. Part of the program, known as the Lake Okeechobee Watershed Construction Project (LOWCP), is a two-phased approach to reducing phosphorus. Phase I of the LOWCP included the construction of water treatment infrastructure and wetland restoration projects.[81] In partnership with the federal government, two STAs were constructed north of Lake Okeechobee. The Taylor Creek and Nubbin Slough STAs reduce the amount of phosphorus entering Lake Okeechobee by treating and storing water before it reaches the lake.[82] The STAs can also prevent the lake's water level from rising too rapidly during storm events. In conjunction with other projects, the STAs will help avoid large-volume discharges to the estuaries and mitigate algal blooms in Lake Okeechobee. However, problems with the Nubbin Slough STA were detected soon after construction was completed. Levee defects and undersized pumps prevent the STA from operating at its maximum capacity.[83] Repairs to the STA are currently in the planning phase. According to the South Florida Water Management District, the multi-phased LOWCP includes:

79 "Lake Okeechobee Northern Watershed Evaluation of Legacy Phosphorus South Florida Water Management District." Web. https://www.sfwmd.gov/sites/default/files/documents/legacypprojoverview.pdf Accessed 24 Feb. 2020

80 Ibid.

81 Olexa, M. T., T. Borisova and J. Davis. "Handbook of Florida Water Regulation: Northern Everglades and Estuaries Protection Program." Publication #FE580. *Food and Resource Economics Department, University of Florida Institute for Food and Agricultural Sciences Extension*. Revised June 2017. Web. https://edis.ifas.ufl.edu/fe610

82 "Lake Okeechobee Phosphorus Removal | Taylor Creek and Nubbin Slough: Facts and Information." U.S. Army Corps of Engineers. Feb. 2015. Web. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/2699

83 "Advancing Key Priority Projects." *SFWMD.gov*, South Florida Water Management District.

- Implementing agricultural management practices on more than 1.7 million acres of farmland
- Adopting new regulations that will reduce the impacts of development on water quality and flow
- Building treatment wetlands to clean water flowing into the lake
- Using other innovative "green" nutrient control technologies to reduce phosphorus loads from the watershed
- Creating between 900,000 and 1.3 million acre-feet of water storage north of the lake through a combination of above-ground reservoirs, underground storage, and alternative water storage projects on public and private lands[84]

5.12.2 WATER FARMING

Alternative water storage projects under NEEPP include water farms on privately owned lands. Water farming is a relatively new practice in the South Florida Water Management District's Dispersed Water Management (DWM) Program for water storage and nutrient reduction. Water farms can be constructed on public or private lands, but existing water farm projects primarily exist on private lands through public-private partnerships. Rainfall and inflows from drainage canals are collected and retained over large areas. Because water farms retain water, nutrients like nitrogen and phosphorus also remain onsite. Three pilot tests launched between February 2014 and May 2015, funded ($3,422,989) by a Nonpoint Source Management Implementation Grant from the U.S. Environmental Protection Agency. The results of the pilot program were highly successful and exceeded the project goals. In total, the three water farms stored 46,491.84 acre-feet of water—more than twice the original goal of 22,570. Annual average reductions in nitrogen and phosphorus also exceeded the pilot project goals by 152.61% and 72.62% respectively. Water farms are highly cost efficient relative to other water management projects. According to the South Florida Water Management District, "the average unit cost of nutrient reductions on the water farms was found to be less than one percent of the average unit cost of nutrient reductions provided by 50 non-agricultural projects" in the St. Lucie River and Estuary BMAP.[85] The success of the pilot program suggests that water farms

[84] "Northern Everglades and Estuaries Protection Program." *SFWMD.gov*, South Florida Water Management District.

[85] "Water Farming Pilot Projects: An Evaluation of Water Farming as a Means for Providing Water Storage/ Retention and Improving Water Quality in the Indian River Lagoon/ St. Lucie Watershed." *SFWMD.gov*,

could be a highly cost-effective tool for water storage and treatment. In 2016, the Florida Legislature allocated over $47,000,000 to implement NEEPP through public-private partnerships including water farms.

South Florida Water Management District. 17 Aug. 2018. Web. https://www.sfwmd.gov/sites/default/files/documents/Water_Farming_Pilot_Projects.pdf

PART 6

POLICY RECOMMENDATIONS

Improved water management and algal bloom mitigation are necessary to sustaining Florida's growth. Economic growth, public health, and quality of life in Florida depend on the quality, quantity, timing, and distribution of water resources. Addressing blue-green algal blooms in Florida requires action at the private, municipal, state, and federal levels.

6.1 PRIVATE

Tremendous urban growth across the state has contributed to economic growth in Florida but has also come with substantial environmental costs. Runoff from urban areas is among the largest sources of nutrient pollution in the lakes, rivers, and streams that dot the Sunshine State. Rapid development over recent decades has left large swaths of the population dependent on septic systems that are not well-suited to Florida's topography—particularly in coastal areas. Households can reduce the environmental impact of septic systems through proper routine maintenance and inspection. As more developments transition off of septic and connect to public sewer systems, the risk associated with sewage spills will only increase. Responsible disposal of greases and fats can reduce the risk of blockages and system failures. Households can also address nutrient pollution by voluntarily limiting fertilizer use and avoiding excessive landscaping. While these practices are rather insignificant at the individual level, they could have a real impact if adopted by

the millions of households that call Florida home. Individual action in communities north of Lake Okeechobee and in close proximity to vulnerable water bodies like the Caloosahatchee, St. Lucie, St. Johns, and Loxahatchee rivers is particularly important to addressing nutrient pollution.

6.2 MUNICIPAL

Reducing the amount of nutrients like nitrogen and phosphorus reaching water bodies is significantly less expensive than developing treatment mechanisms after the fact. In some cases, limited municipal ordinances may be necessary to control fertilizer runoff in areas near water bodies at risk for algal blooms. Thirty-two counties in Florida have adopted some form of restrictions on fertilizer applications, while only 12 counties have county-wide ordinances.[86] Generally, restrictions include a prohibited application period and ban applications when major storms are likely to occur or when soils are water-saturated. The Florida Department of Environmental Protection (FDEP) has developed model ordinances for adoption by city and county governments.[87] Agricultural producers do not generally have to comply with municipal fertilizer ordinances but must instead comply with Best Management Practices (BMPs). Limiting residential fertilizer runoff through ordinances could be an effective way to combat algal blooms by addressing nutrient pollution at the source.

Local governments can also reduce nutrient pollution by preventing the spread of septic systems. Possible policy measures include requiring sewer connections for new developments where feasible. The initial construction of wastewater treatment is relatively expensive but connecting developments to existing infrastructure is far more affordable. Moreover, conversion of existing septic systems is extremely expensive and often borne by households. Conversion to sewer systems may not be feasible in some rural areas, but many lower-cost alternatives to conventional septic systems exist. Underlying drain fields with wood chips or ground-up tires has proven effective at reducing nutrient leaching in preliminary testing.[88] However, the state regulators place stringent restrictions on

86 "Florida Fertilizer Ordinances." University of Florida Institute for Food and Agricultural Science. 6 June 2019. Web. https://ffl.ifas.ufl.edu/pdf/FloridaFertilizerOrdinances.pdf?v=20190606

87 "Florida-Friendly Landscape Guidance Models for Ordinances, Covenants, and Restrictions." Florida Department of Environmental Protection and the University of Florida. Jan. 2009. Web. https://ffl.ifas.ufl.edu/pdf/ffl-mo-ccr-1-09.pdf

88 Peterson, Dan. "Remediating Nitrogen from Septic Systems." *CPR-FL.org*, The Coalition for Property Rights-FL. 27 June 2019. Web. http://www.cpr-fl.org/remediating-nitrogen-from-septic-systems/

alternative systems, limiting the potential for innovative solutions. If testing indicates effective sanitation and removal of nutrients, regulations on alternative systems should be relaxed to allow for further innovation and cost reduction.

Sustainable development requires a forward-looking approach to wastewater management. To that end, aging wastewater infrastructure must improve to accommodate growing populations in urban areas. Florida's population is expected to grow by as much as six million by 2030 with half of that growth concentrated in just 10 counties.[89] This rapid, concentrated growth will place additional strain on municipal sewer systems and budgets. Public-private partnerships (PPPs) could alleviate some of the financial burden associated with wastewater infrastructure improvements. PPPs could be particularly beneficial in growing communities outside of Urban Service Areas which would otherwise likely rely on septic systems. Many municipal governments across the United States—including Tampa Bay and West Melbourne, Florida—have privatized water and wastewater services through long-term contracting to achieve considerable cost savings.[90] In addition to financial benefits, PPPs have also been shown to increase compliance with environmental and health standards—often more effectively than publicly owned utilities.[91] In fact, the U.S. Environmental Protection Agency has stated that:

[Privatization case studies] provide concrete examples to local officials of how successful partnerships and other models can be used by communities to provide needed environmental services more efficiently. They also show how public-private partnerships can be used as a way to provide substantial benefits to both the public and private sectors, creating the classic 'win-win' situation.[92]

Potential PPPs could include several aspects of infrastructure delivery including project design, construction, financing, operation, and maintenance. The division of responsibility

89 Roberts, Melissa. "Did You Know that Florida's Population Could Increase to Nearly 26 Million by 2030?" *FLChamber.com*, Florida Chamber of Commerce. Web. https://www.flchamber.com/did-you-know-that-floridas-population-could-increase-to-nearly-26-million-by-2030/

90 Johnson, Robin A., John McCormally, and Adrian T. Moore. "Long-Term Contracts for Water and Wastewater Services." Reason Foundation, 2002. Web. https://reason.org/wp-content/uploads/files/5a63382124e59656385c428741ef3278.pdf

91 Segal, Geoffrey F. and Adrian T. Moore. "Frequently Asked Questions About Water/Wastewater Privatization." Reason Foundation, 2003. Web. https://reason.org/wp-content/uploads/files/db5c3e3e5365eb334855d7d818ef53d9.pdf

92 "A Guidebook of Financial Tools Section 4B: Public-Private Partnerships and Optimization Case Studies." U.S. Environmental Protection Agency, Environmental Finance Program. 1999.

between public and private sectors will depend on the context of each project, but transferring some responsibility to the private sector through PPPs could be a major boon to local governments as the need to improve water and wastewater infrastructure grows.

6.3 STATE AND FEDERAL

Completion of CERP projects is essential to addressing Florida's water problems. Political and financial factors have delayed implementation of CERP over the nearly 20 years since the program was authorized, leading to increased costs and continued economic and environmental harm. Planning and funding should be expedited at the state and federal levels. Florida Governor Ron DeSantis' executive order was a strong step in the right direction, but it is vital that a sense of urgency continues going forward. The federal government must also follow through with its financial obligations under CERP to ensure that essential projects are completed on schedule. Moreover, CERP projects that reduce the harmful freshwater discharges to the Caloosahatchee and St. Lucie estuaries should be given the highest priority. While projects should be completed in a timely manner, it is also important to plan for the future and consider the potential impacts of climate change and sea-level rise.

Sending more water south is the best option for reducing discharges, but appropriate treatment is essential to avoid spreading algal blooms around the state. To that end, capturing and treating water before it reaches Lake Okeechobee is likely the most effective strategy for reducing the risk of algal blooms in the lake and estuaries resulting from nutrient runoff. The Lake Okeechobee Watershed Restoration Project (LOWRP) will provide a significant amount of storage and treatment capacity north of the lake. Public-private partnerships for projects, including water farms, have proven to be highly cost-effective. Testing of water farms indicates that they could be enormously valuable tools for water storage and nutrient removal—at a fraction of the cost associated with the large-scale storage reservoirs being constructed under CERP. The LOWRP and additional water farms are viable options for addressing nutrient runoff before it reaches Lake Okeechobee. Strategies should also be developed to address legacy phosphorus in Lake Okeechobee and the surrounding areas.

Once CERP projects are completed, they will need to be operated and maintained—at the cost of taxpayers in Florida and at the federal level. While the federal government has been involved in Florida's water management since the drain-and-farm policies of the 1800s, there is little justification for continued involvement. Taxpayers in other states should not

finance water management in Florida beyond the existing arrangements to construct infrastructure under CERP. Once these projects are completed, responsibility for their operation and maintenance should be turned over to the state of Florida. PPPs could then divide responsibility for operation and maintenance between the public and private sector.

The state's Basin Management Action Plans (BMAPs) are not achieving significant nutrient reductions and could be improved in a number of ways. Most importantly, FDEP should report nutrient loads based on actual water quality data provided by the South Florida Water rather than highly optimistic modeling that assumes "best-case-scenarios." These reports should be presented by water year rather than calendar year to better reflect the hydrological cycles of the regions and to be consistent with reporting by the South Florida Water Management District. BMAPs and associated progress reports should also cover the entire watersheds of Lake Okeechobee, the St. Lucie Estuary, and the Caloosahatchee River Estuary. Finally, agricultural producers must be held accountable for implementing BMPs. The new inspection requirements will help ensure practices are implemented properly, but additional water quality data and monitoring will be necessary to confirm that practices are achieving sufficient nutrient reductions.

Tax mechanisms could be designed such that the bulk of water management costs falls on the sources of nutrient pollution. Further analysis by state entities including the South Florida Water Management District, FDACS, and FDEP could better identify the sources of nutrient pollution to aid in designing appropriate funding mechanisms. Existing analyses by the South Florida Water Management District can determine the primary sources of nutrient pollution by geographic location and land-use, but those figures were last updated in 2011. Recurring analyses of this type could be used to ensure that the costs of mitigation are borne primarily by those responsible for nutrient pollution. Shifting the burden of mitigation to the primary contributors of nutrient pollution will create better incentive structures and encourage polluters to reduce nutrient runoff. Analysis and methods for water-quality monitoring by the District should also be improved to rely less on modeling, which can result in overly optimistic results and lead to skepticism among environmental groups. Improved monitoring would also address problems with BMAP implementation to reach TMDLs in a more efficient manner.

Nutrient levels should be reduced before water reaches coastal areas. State efforts like BMPs to reduce nutrient pollution from agricultural areas have been largely effective, but agricultural producers continue to receive special treatment under state and federal policies. Sugar subsidies protect the sugar industry at the expense of taxpayers and

consumers—to the tune of $2.4 billion to $4 billion a year.[93] The U.S. sugar policy includes a number of harmful interventions that effectively set a minimum price for sugar, making the domestic price significantly higher than in the world market. Limits on domestic production and imports artificially restrict the supply of sugar and raise prices for American consumers and businesses. If that deal isn't sweet enough for sugar producers, the U.S. government is required to buy sugar in times of surplus and resell it at a loss to ethanol producers.[94] In 2013 alone, government purchases of surplus sugar cost taxpayers $259 million.[95] These policies have propped up the U.S. sugar industry and made land in the EAA more valuable than would otherwise be the case. Meanwhile, state and federal projects have cost billions of taxpayer dollars to clean up after agricultural producers. When these projects require the acquisition of land in the EAA, bad sugar policy means that governments pay more for the land. Regardless of the environmental impacts of sugarcane production, these protective policies should be eliminated.

93 Beghin, John C.and Amani Elobeid. "Analysis of the US sugar program." American Enterprise Institute. 6 Nov. 2017. Web. https://www.aei.org/research-products/report/analysis-of-the-us-sugar-program/

94 "Sugar Policy 101: An Overview of the U.S. Sugar Program and the Need for Reform." Alliance for Fair Sugar Policy. Web. http://fairsugarpolicy.org/wordpress/wp-content/uploads/2018/04/Sugar-Policy-101-1.pdf

95 Boudreau, Catherine. "How Sugar Policy Could Kill the Farm Bill." *Politico*. 17 May 2018. Web. https://www.politico.com/story/2018/05/17/how-sugar-policy-could-kill-the-farm-bill-549052

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