2021 Lake Worth Lagoon Management Plan

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lake worth LAGOON

LAKE WORTH LAGOON
MANAGEMENT PLAN

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Green sea turtle swimming in Lake Worth Lagoon (Photo credit: PBC-ERM)

Cover photo: Sunset view from Singer Island (Photo credit: Kim Seng)

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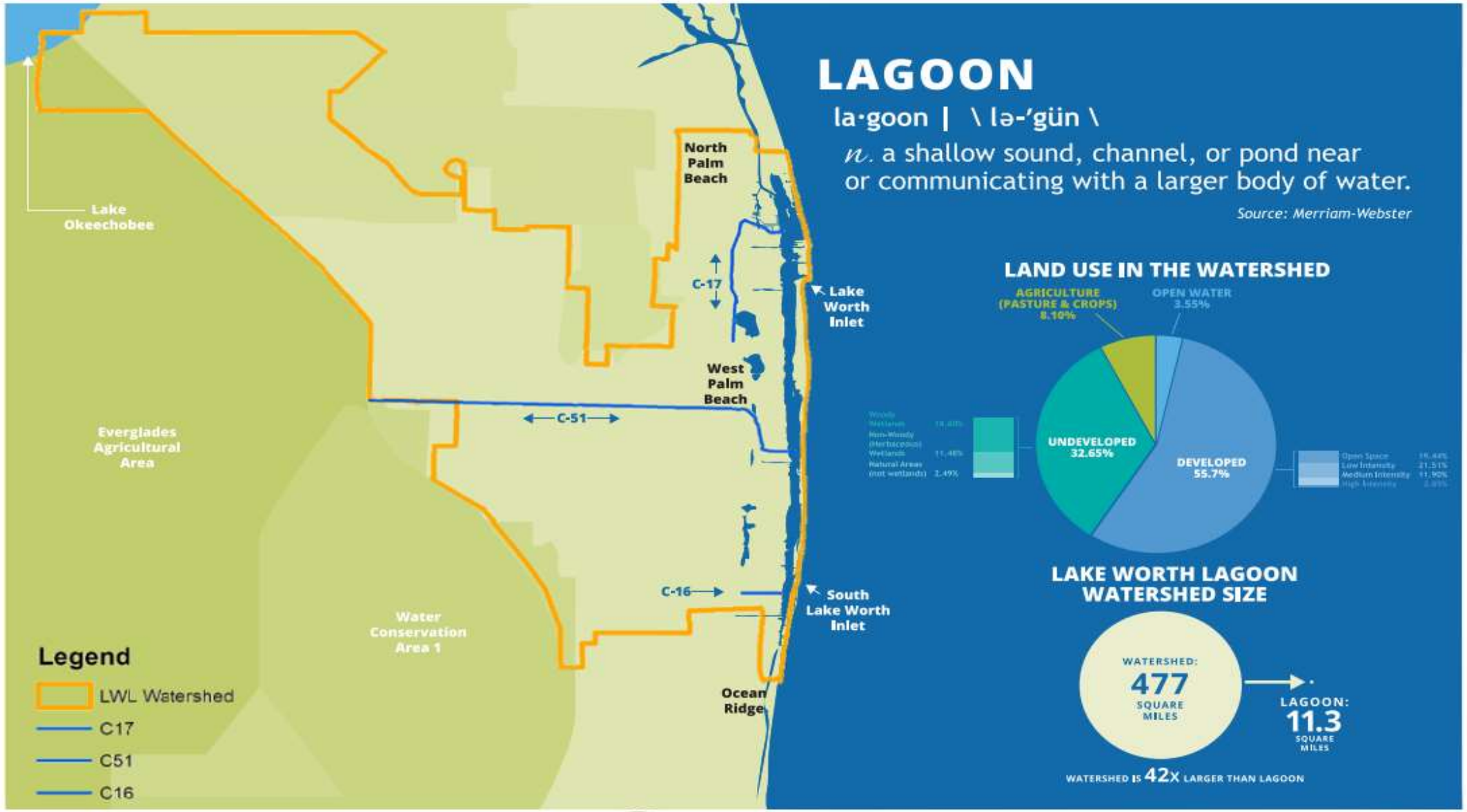
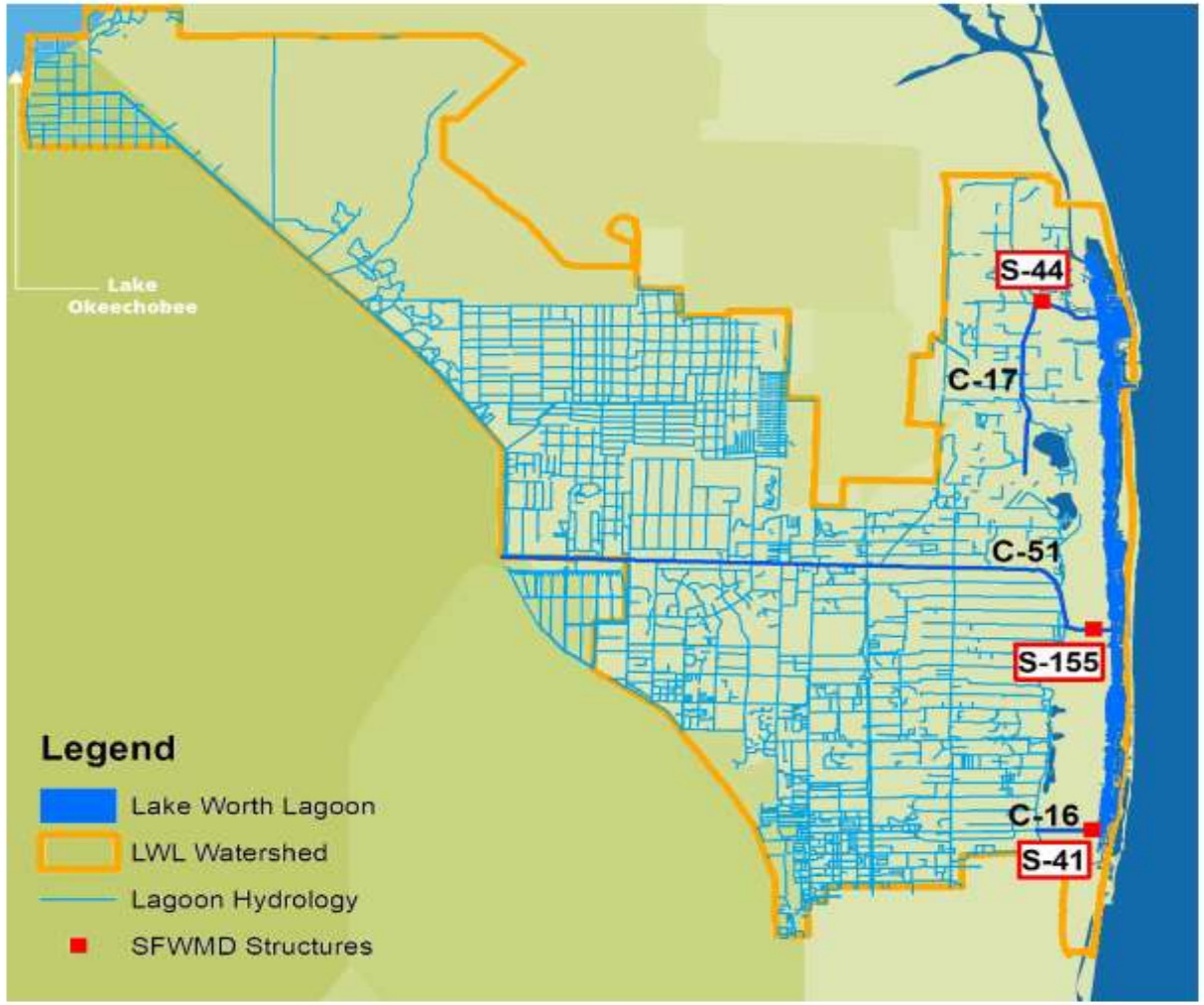
LAKE WORTH LAGOON WATERSHED MAP



Click to toggle between Lake Worth Lagoon watershed map and LWL hydrology map.

LAKE WORTH LAGOON WATERSHED MAP



Click to toggle between Lake Worth Lagoon watershed map and LWL hydrology map.

MILESTONES IN LAGOON MANAGEMENT

1877
Pioneer Augustus Lang creates the first inlet to the sea in Lake Worth

1912
Construction of Intracoastal Waterway in Palm Beach County is completed

1915
Lake Worth Inlet is excavated; dredge material used to create Peanut Island

1917
South Lake Worth Inlet (Boynton Inlet) is created, completing Lake Worth's transition from a freshwater lake to the Lake Worth Lagoon estuary

1925
West Palm Beach Canal is dredged; freshwater from Lake Okeechobee sent to Lake Worth

1972
With population surging to 400,000 Palm Beach County adopts its first Land Use Plan

1990
LWL Natural Resources Inventory and Resource Enhancement Study completed

1992
Florida Estuarine Natural Resources Inventory and Resource Enhancement Study completed

1998
First Lake Worth Lagoon Management Plan approved

2008
LWL Management Plan Updated; Lake Worth Lagoon Initiative established to coordinate management

2013
LWL Management Plan updated, First Lake Worth Lagoon Science Symposium held

2021
LWL Management Plan updated

Palm Beach Shores in Northern Lagoon, 1945

Photos courtesy of Historical Society of Palm Beach County

Peanut Island and Lake Worth Inlet ca. 1947

Dredging the Lake Worth Inlet ca. 1918

Cocoanut Grove House front dock ca. 1880-1893

Lake Worth Inlet, Peanut Island and Port of Palm Beach ca. 1918

The spotted eagle ray is an iconic symbol of the Lake Worth Lagoon. (Photo Credit: PBC-ERM)

EXECUTIVE SUMMARY

For the first time, the 2021 Lake Worth Lagoon Management Plan strategically embraces watershed management as a central theme, acknowledging that the health of the Lagoon is inextricably connected to the activities and inputs occurring across a voluminous watershed that is 42 times the size of the Lagoon itself.

This approach elevates the importance of expanded monitoring to better understand and respond to the myriad factors that influence Lagoon health. The County and LWLI partners have initiated long-term biological monitoring for oysters, seagrass, fisheries, birds and turtles, all linked to assessing the health and productivity of the Lagoon. Additional monitoring includes water quality parameters (nutrients and salinity) as well as success of intertidal vegetation (mangroves/cordgrass) at restoration projects and throughout the Lagoon. Where possible, future monitoring should be consistent with existing regional or statewide monitoring protocols so that meaningful comparisons can be made, and data on the Lagoon can contribute to statewide knowledge of estuarine systems.

Despite unexpected challenges from the Covid-19 pandemic, Palm Beach County's Environmental Resources Management (ERM) staff adjusted monitoring, management and outreach activities to sustain progress. Contracted monitoring programs experienced minor interruptions. The long-term economic reverberations from the Covid-19 crisis may result in diminished funding in the near term for many government services, including environmental initiatives. However, funding already is secured for the Tarpon Cove Phase II, Bonefish Cove, and Monceaux Park Living Shoreline restoration projects, supported by state, federal and local matching funds.

Overall, significant progress has been made in improving scientific understanding and management of the Lagoon. Following are key accomplishments in Lagoon research, restoration and public outreach since 2013:

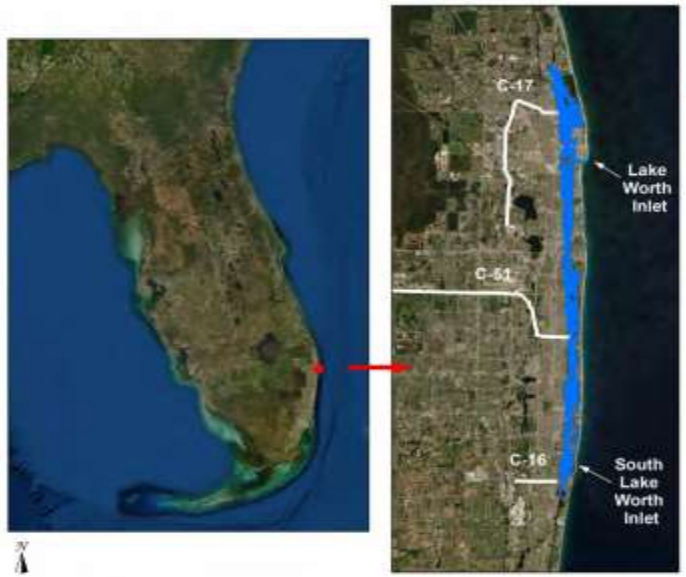
WATER AND SEDIMENT QUALITY

- Two high-frequency salinity sondes were deployed and maintained in partnership with the South Florida Water Management District (SFWMD) in November 2019 to augment monitoring and document salinity in the Central Lagoon. The stations are located to the north and south of the C-51 canal. The County maintains its own salinity probes at John's Island Natural Area across from the C-51 canal, and at Munyon Cove.
- A nutrient autosampler installed in 2019 at the S-155 structure enables analysis for total nitrogen and phosphorus discharged from the C-51 canal into the Lagoon and calculations of nutrient loading into the Lagoon. Water quality analysis is completed by the SFWMD in addition to maintaining and servicing the equipment.
- An assessment of the sediment trap excavated on C-51 to prevent sediments from entering the Lagoon indicates the trap's efficiency decreases as flow increases, particularly for flows higher than 850 cfs at S-155. The range of sediment

A hermit crab peers out from the safety of his shell sanctuary (Photo credit: PBC-ERM)

STATE OF THE LAGOON

Highly urbanized and altered by more than a century of human activities to facilitate navigation, flood control and development, the Lake Worth Lagoon is an underappreciated asset. Asked to suggest adjectives that best describe it, participants in a 2020 Lagoon Perceptions and Priorities survey offered words like "forgotten," "misunderstood," and "taken for granted." In a nod to its inherent value, they also noted the Lagoon is "stunning," "accessible" and "a treasure."



INTRODUCTION

Just 20 miles long, the Lagoon punches above its weight in ecological and economic value. A 2019 Economic Valuation study estimated the value of recreational uses and business activities related to the Lagoon at $813.9 million per year. The total value of tangible and intangible benefits associated with the Lagoon is estimated at $5.37 billion.[1]

The Lagoon is an aquatic playground for fishing, diving, paddle sports and birdwatching enthusiasts, with a world-renowned SCUBA destination, the Phil Foster Park Snorkel Trail, just steps from shore. It is a nursery and foraging area for threatened and endangered fish and wildlife as diverse as sea turtles, goliath groupers, American oystercatchers and manatees. And it is home to the bustling Port of Palm Beach, ranked among the state's top five ports in cargo value. The successful co-existence of these distinctly differing personalities in a compact estuary of just 11.3 square miles is a testament to the Lagoon's resilience.

Originally a freshwater lake, early pioneers followed by colonists transformed Lake Worth into an estuary. Saltwater from the Atlantic Ocean enters through the Lake Worth and South Lake Worth Inlets. Freshwater is funneled to the Lagoon from three major drainage canals (C-17, C-51, and C-16), which together collect runoff from more than 305,000 acres of land. The C-51 canal alone delivers nearly 60% of the Lagoon's freshwater flows.[2] In addition, the Atlantic Intracoastal Waterway carves a nautical highway through the entire length of the Lagoon as it traverses the East Coast.

These features have in effect created three sub-Lagoons. The highest ecological diversity and most intense recreational usage occurs in the Northern Lagoon, where the Lake Worth Inlet brings salty and cleansing tides that support large seagrass beds. The Southern Lagoon also benefits from proximity to the ocean, albeit through a smaller, more constricted inlet. Markedly diminished water quality, biodiversity and recreational activities characterize the Central Lagoon, located farthest away from tidal flushing and on the receiving end of most canal freshwater discharges.

The sprawling watershed - 42 times the size of the Lagoon itself, with a 2020 population estimated at more than 1 million - has an enormous impact on the Lagoon's health, and complicates efforts to manage it holistically. The presence of 30 local municipalities, a large unincorporated area, and multiple federal, state and local water management districts, all contributing runoff to the Lagoon, compound the enormous challenges confronting Lagoon managers.

For decades, water management of the Lagoon watershed has largely focused on its role in flood control rather than its intrinsic ecological value. Dramatic fluctuations in the timing and volume of freshwater discharges result in water that is too salty for some living resources, and not salty enough for

LAKE WORTH LAGOON
BY THE NUMBERS

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LAKE WORTH LAGOON
BY THE NUMBERS

INDEX OF ACTIONS AND ACTION PLANS

WATER AND SEDIMENT QUALITY

WATER QUALITY

WQ-1 Expand Water Quality Monitoring **Renamed from 2013 Plan*

WQ-2 Develop a Watershed-Based Modeling Program **NEW*

WQ-3 Implement Best Management Practices for Drainage Canals **NEW*

WQ-4 Monitor and Assess Ways to Reduce Bacterial Contamination and Harmful Algal Blooms **NEW*

WQ-5 Identify and Assess the Impacts of Emerging Contaminants **NEW*

WQ-6 Manage Freshwater Inflows to Optimize Environmental Benefits **NEW*

WASTEWATER

WW-1 Assess and Reduce Occurrence of Sewer Overflows **Renamed from 2013 Plan*

WW-2 Identify Priority Areas for Conversion of Septic Systems to Central Sewer **Renamed from 2013 Plan*

STORMWATER

SW-1 Reduce Stormwater Runoff from Urban Landscapes **NEW*

SW-2 Expand Use of Green Infrastructure and Low Impact Development Practices **Renamed from 2013 Plan*

SEDIMENT MANAGEMENT

SE-1 Assess and Manage Sediment Loading **Renamed from 2013 Plan*

HABITAT ENHANCEMENT AND PROTECTION

HE-1 Create, Protect and Monitor Hardbottom Habitats **NEW*

HE-2 Restore, Create and Protect Intertidal Habitats **Renamed from 2013 Plan*

HE-3 Maintain and Expand Seagrass Habitats **Renamed from 2013 Plan*

HE-4 Acquire Ecologically Significant Submerged and Intertidal Lands **Renamed from 2013 Plan*

FISH AND WILDLIFE MONITORING AND PROTECTION

FW-1 Continue Implementing Palm Beach County's Manatee Protection Plan **Renamed from 2013 Plan*

FW-2 Continue Sea Turtle Monitoring **Renamed from 2013 Plan*

FW-3 Continue Fisheries Monitoring **Renamed from 2013 Plan*

FW-4 Manage and Monitor Shorebird Habitat **Renamed from 2013 Plan*

FW-5 Implement Remote Tracking Technologies for Fish and Wildlife Monitoring **NEW*

CLIMATE CHANGE AND SEA LEVEL RISE

CC-1 Conduct a Vulnerability Analysis of Resources at Risk from Climate Change **NEW*

CC-2 Improve Resiliency of Critical Habitats to Climate Change and SLR **NEW*

PUBLIC OUTREACH AND ENGAGEMENT

PO-1 Foster Public Awareness and Engagement **NEW*

PO-2 Promote Youth Education and Engagement **NEW*

PUBLIC USES OF THE LAGOON

PU-1 Ensure Adequate and Appropriate Public Access to the Lagoon **NEW*

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WATER AND SEDIMENT QUALITY ACCOMPLISHMENTS AT A GLANCE

Two sampling units were installed in 2019 in the Central Lagoon near the C-51 Canal to **transmit near-continuous data about salinity and other water quality parameters.**

SEE ACTION WQ-1

A nutrient autosampler installed in 2019 at the S-155 structure will **facilitate calculations of nutrient loading** from the C-51 canal into the Lagoon.

SEE ACTION WQ-1

Health advisories due to bacterial contamination were posted at Phil Foster Park 16 times from 2016-2020—9.9% of the time that samples were taken.

SEE ACTION WQ-4

A 2020 study by a Palm Beach Atlantic University student on the abundance and variation of microplastics in surface waters of the Lagoon found **an average of 8.6 microplastic pieces per liter.**

SEE ACTION WQ-5

Initial mapping of areas with **high density septic systems** throughout the County was conducted in 2019.

SEE ACTION WW-2

21 projects incorporating **Green Infrastructure design elements** were completed or underway in Palm Beach County as of 2020.

SEE ACTION SW-2

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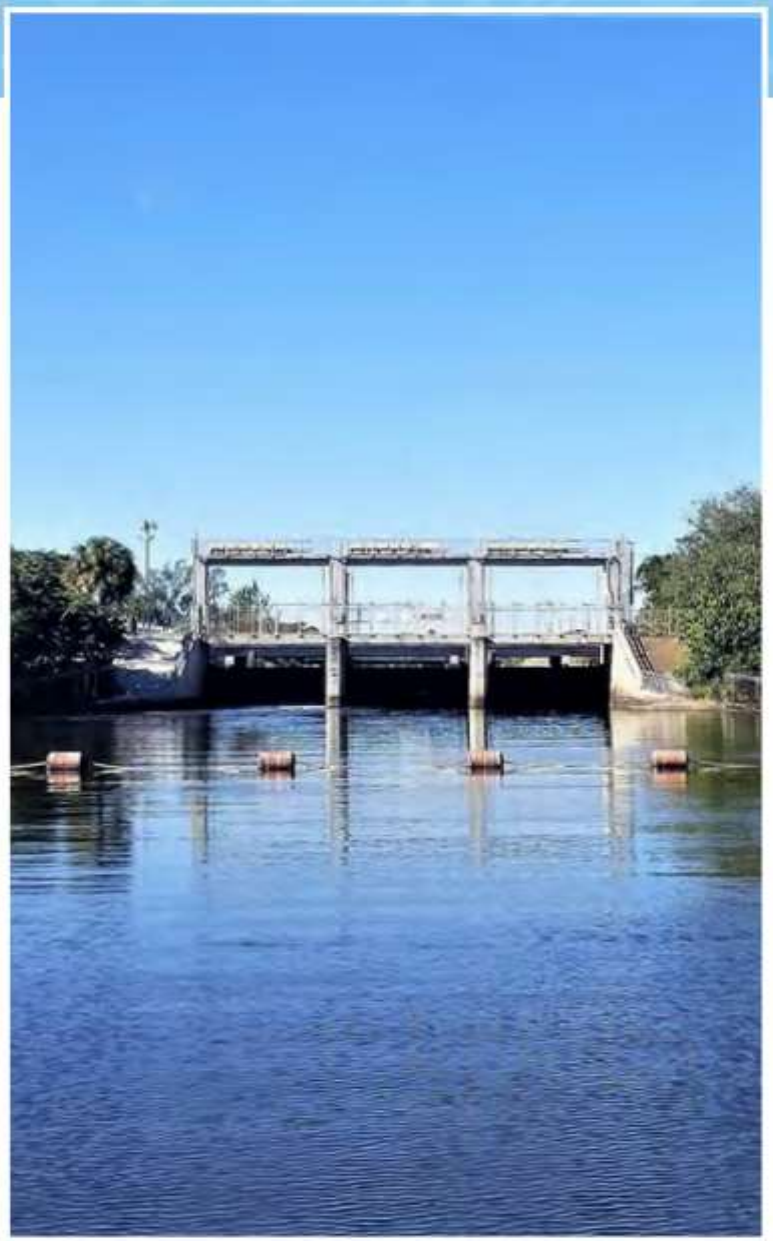
WQ-6 MANAGE FRESHWATER INFLOWS TO OPTIMIZE ENVIRONMENTAL BENEFITS

ACTION: Evaluate and implement strategies to balance freshwater flows to achieve optimal salinities for oysters and seagrasses, and decrease nutrients and sediments entering the Lagoon.



Water control structure on the C-51 Canal (Photo credit: PBC-ERM)

IMPORTANCE:

The delivery and timing of freshwater to the Lagoon is critical to maintaining the health of the Lagoon's living resources and to boosting their resiliency to climate change and sea level rise.

RELATED ACTIONS:

WQ-1, WQ-2

BACKGROUND:

Almost all of the freshwater entering the Lake Worth Lagoon is transported via three major drainage canals - the C-51, C-16 and C-17 *(see Figure 1.1)*. They receive water from more than 850 miles of smaller canals that, combined, drain a watershed 42 times the size of the Lagoon itself. Responsibility for management of this vast network is shared by the South Florida Water Management District (SFWMD), eight additional water improvement agencies and water control districts, Palm Beach County and 30 municipalities within the watershed.

The C-51, C-16 and C-17 canals and associated water control structures are managed by the South Florida Water Management District for the primary purpose of flood control. They are not as a matter of principle or practice operated to deliver freshwater in volumes or on schedules that meet the ecological needs of the Lagoon's key indicators of ecosystem health: the American oyster (*Crassostrea virginica*) and three species of seagrass: paddle grass (*Halophila decipiens*), shoal grass (*Halodule wrightii*) and Johnson's seagrass (*Halophila johnsonii*), a federally threatened species.

The optimal salinity range for oysters in the Lake Worth Lagoon is 12-20 parts per thousand (ppt).[2,3] The optimal

FIGURE 1.1 WATERSHED MAP

CLICK IMAGE TO ZOOM IN. CLICK AGAIN TO ZOOM OUT.

SOURCE: PBC-ERM

salinity range for seagrasses is 22-35 ppt.[5] Current operational protocols for the canal network mean that Lagoon oysters are exposed to higher salinities than they prefer during the dry winter months, while seagrasses, especially within the Central Lagoon, are often subjected to lower salinities than optimal for sustained growth and/or survival.

Nine years of data collected from a salinity sonde at John's Island, located directly east of the C-51 canal, show that salinity fell below 10 ppt on 180 of 620 days recorded, or 30% of the time *(see Table 1.1)*. Adverse effects to paddle, shoal and Johnson's seagrass can occur when salinity falls below 15 ppt for prolonged periods[1] *(see Action HE-3)*. Additionally, oyster reproduction is impaired at salinity levels below 8 ppt[5] *(see Action HE-1)*.

Conversely, oysters experience higher prevalence of predation and disease at salinities greater than 32 ppt.[5] Average salinities for the Lagoon from 2005 to April 2019 exceeded the optimal range for oysters 70% of the sampled months and were in the optimal range only 26% of the time sampled.[2]

Freshwater flows to the Lagoon are frequently characterized by extreme highs and lows which subsequently impact salinity. The most recent oyster monitoring report from the Florida Fish and Wildlife Conservation Commission shows that salinity varied significantly month to month (from a low of 8 ppt to a high of 36 ppt), corresponding with variable flows from the C-51 Canal *(see Figure 1.2)*. The lowest flow rates were measured in March 2020 when the monthly mean was 0 cubic feet per second. Highest flows were in March 2019, at 743 cfs.[3] Additionally, analysis of high frequency salinity data recorded in the Central Lagoon at John's Island revealed several distinct events, both in duration and severity (low salinity), that could severely stress seagrass species.[6] These extended periods of no flows and extremely high flows are the main culprit in salinity fluctuations that are damaging to oysters and seagrass.

This action seeks to modulate freshwater inflows to maximize environmental benefits, especially in the Central Lagoon. This segment is a priority because it receives a disproportionate amount of freshwater via the C-51 Canal, it has the largest population of oysters, and the longest water residence time (up to 13 days).[4] The desired salinity envelope within the Central Lagoon is 12-20 ppt.

Progress in addressing freshwater inflows has been hampered by the exclusion of the Lagoon from the Northern Estuaries management area of the Comprehensive Everglades Restoration Plan since 2007. However, a pending update of the Lake Okeechobee Standard Operating Manual (LOSOM) has provided an opportunity for Palm Beach County to request that salinity standards, or Performance Indicators, be established for discharges from Lake Okeechobee to the Lagoon.

Although discharges from the Lake are historically a small fraction of the total freshwater coming from the Lagoon watershed, development of Performance Indicators would facilitate use of a predictive model to evaluate ways to maintain optimal salinities for oysters and seagrasses. The model could serve as a pilot for subsequent adaptation and expansion to address the timing and quantity of freshwater runoff from the entire Lagoon drainage basin *(see Action WQ-2)*. In addition to seagrasses and oysters, Lagoon fisheries also would benefit from more dependable and consistent freshwater flows, as several species require predictable salinities, especially in juvenile and sub-adult life stages *(see Action FW-3)*.

Deployment of the model would also help system operators and Lagoon managers evaluate options for achieving optimal salinities, among them:

- Modifications to existing Stormwater Treatment Areas (STAs) to increase capacity and reduce nutrient and sediment loads to the Lake Worth Lagoon.
- Identification of new STAs and alternate water storage options, potentially within urban stormwater systems.
- Modifications to water control structures to release water from the top rather than the bottom of floodgates and weirs, to slow water movement. This option would require ongoing removal of sediments that build up behind the structures.

APPROACH:

STEP 1 Evaluate and implement modifications to operational protocols for drainage canals and water control structures to reduce damaging freshwater pulses and velocities, as well as nutrient and sediment loading *(See Action WQ-3)*.

STEP 2 Evaluate and implement improvements to canal operations to reduce dramatic fluctuations in freshwater flows that contribute to salinity extremes.

TABLE 1.1 ACTUAL VS. OPTIMAL SALINITY FOR CENTRAL LAGOON (JOHN'S ISLAND SONDE)

	Minimum Salinity Target (ppt)	Optimal Salinity	Central LWL Salinity (ppt)	References for Optimal Salinity
Oyster Tolerance (Adult)	15	10-28	22.7	Loosanoff, 1965 in Rudolph 1998
Oyster Growth (Adult)	15	8-22	22.75	Mote Marine Laboratory, 1990 in Rudolph, 1998
Oyster Growth (Spat)	15	15-22	22.7	Sellers and Stanley, 1984
Oyster Spawning	15	>7.5	22.7	Sellers and Stanley, 1984
Seagrass Growth *(Halodule wrightii)*	20	23-37	22.7	McMahan, 1968 in Rudolph 1998
Seagrass Flowering *(Halodule wrightii)*	20	26-36	22.7	McMahan, 1968 in Rudolph 1998

Optimum target range: WITHIN ABOVE BELOW

Salinity ranges contained in the Northern Estuaries Performance Measure Salinity Envelopes.[2]

SOURCE: PBC-ERM

Develop a long-term water management plan to maintain optimal salinity ranges for oysters and seagrasses.

STEP 3 Support modifications to existing STAs to improve storage capacity, nutrient reduction and sediment containment.

STEP 4 Identify potential new Stormwater Treatment and Water Conservation Areas in the western C-51 basin to capture, treat and gradually release freshwater downstream. Identify potential STAs in the eastern C-51 basin, including small-scale sites of 1 acre or more within neighborhoods and golf courses.

TIMEFRAME:

STEP 1 can begin in 2021 with initial consideration of operational modifications, and development of a framework for hydrodynamic modeling. Development of the model itself is dependent upon funding through grants or other mechanisms.

STEPS 2, 3 and 4 can begin in FY 2021, with evaluation of effectiveness of techniques in FY 2022-2023 and beyond.

COST ESTIMATE:

$$-$$$$$

EVALUATING PROGRESS:

Water quality monitoring combined with data from salinity sondes will document salinities in relation to flows from C-51, rainfall, and other parameters.

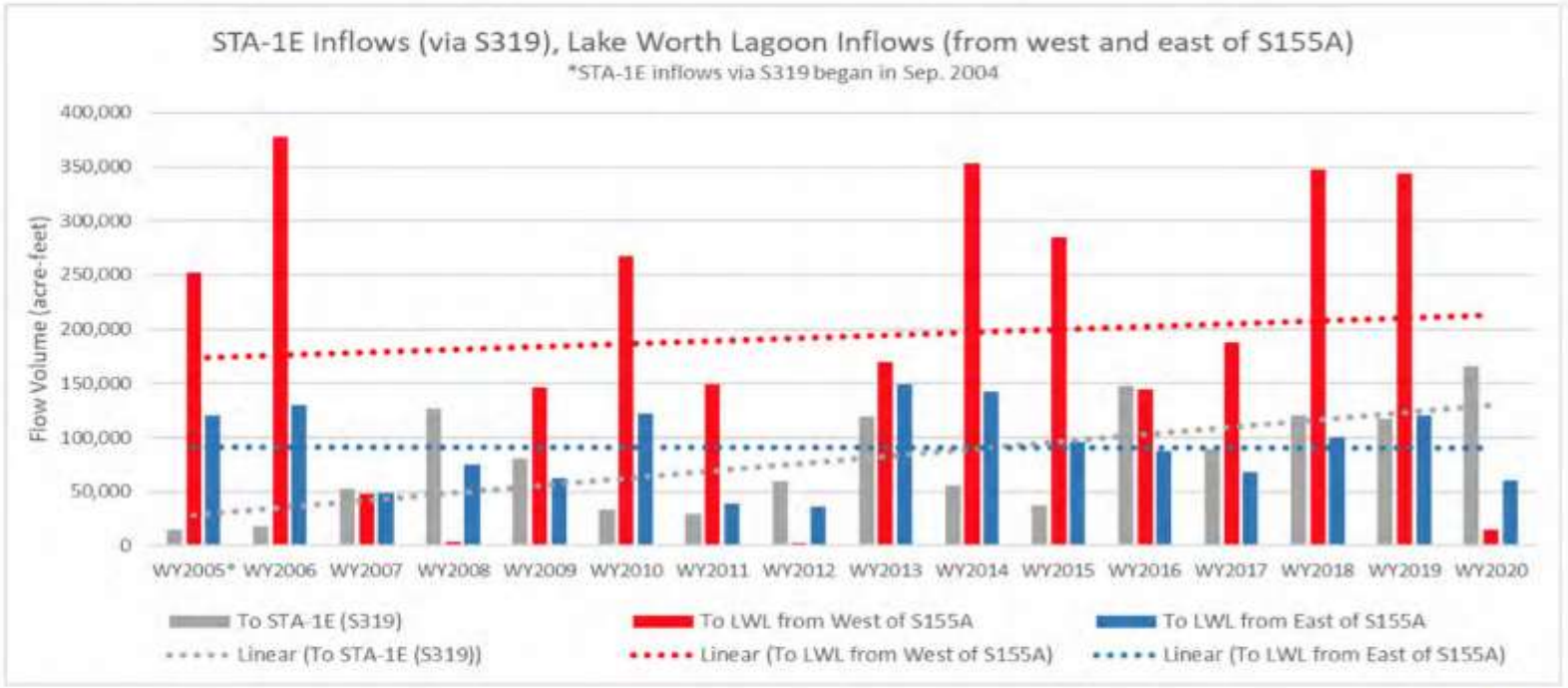
REGULATORY NEEDS:

None

FUNDING:

To be determined, depending on management steps to be implemented and land acquisition needs identified.

FIGURE 1.2 FRESHWATER FLOWS TO LAKE WORTH LAGOON FROM EAST AND WEST OF S155A 2005-2020



SOURCE: PBC

POTENTIAL PARTNERS:*

ERM, SFWMD, USACOE, Local Municipalities

**Listed Agencies have not committed funds and are subject to Agencies' budget approvals*

[1] Northern Estuaries Performance Measure Salinity Envelopes. CERP System-Wide Performance Measure Documentation Sheet. 2007 and 2020.

[2] LWL Oyster Monitoring Program Summary. Parker, M. Florida Fish and Wildlife Conservation Commission. 2020.

[3] Oyster monitoring in Lake Worth Lagoon Final Report April 2019 - June 2020. Geiger, S and Maloney, N. Florida Fish and Wildlife Conservation Commission. 2020.

[4] Assessment of Freshwater Inflow and Water Quality for an Urbanized, Subtropical Estuary (Lake Worth Lagoon, Florida, USA). Buzzelli, C., et al. Marine Technology Society Journal. 2018.

[5] LOSOM Performance Measure Documentation Sheet. 2020.

[6] 2020 Lake Worth Lagoon Fixed Transect Seagrass Monitoring. CSA Ocean Sciences Inc. 2021.

Resource managers and citizens who took a 2020 online survey about Lagoon perceptions and management priorities were asked to list adjectives that best describe the Lagoon. This Word Cloud shows the words they submitted, in the form of a spotted eagle ray—the mascot of the Lake Worth Lagoon Initiative.

ACCESS 2021 PLAN @ LWLI.ORG

Questions

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