



SARASOTA BAY
ESTUARY PROGRAM

Restoring Our Bays

Comprehensive Conservation & Management Plan

————— 2022 Update | Restoration & Resilience —————



Dedication

John Stevely was the UF/IFAS Sea Grant agent for Manatee and Sarasota Counties, and served as the chair of the SBEP's Technical Advisory Committee for over 20 years. John was instrumental in developing the artificial reef program for the greater Sarasota Bay region and played a key role in the formation of the Cortez Fishing Festival and the Florida Institute for Saltwater Heritage (FISH). The progress made to protect and restore Sarasota Bay is due in large part to John's presence in our community.

Maite Rodriguez was only nine years old when she was killed in the school shooting massacre in Uvalde, Texas. She dreamed of becoming a marine biologist and had already discussed with her parents the college she wanted to attend to fulfill that goal. Her passion and intelligence would most likely have led to her being successful in that dream, and so this document is dedicated to her memory.



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Acknowledgements

The Sarasota Bay Estuary Program (SBEP) Comprehensive Conservation and Management Plan (CCMP) was first adopted in 1995, then updated in 2010 and 2014. It was developed in part with funds provided by the US Environmental Protection Agency, Region 4 through a cooperative agreement.

This 2022–2027 CCMP Update was developed under the direction of Darcy Young by SBEP staff, including Dr. David Tomasko, Mark Alderson, Dr. Jay Leverone, Michael Dexter, Christine Quigley, Cheryl Dexter, Heather Moody and Megan Barry, as well as the Management Conference. Strategic planning support, facilitation, research, writing, and mapping were provided by Shafer Consulting. Graphic design and document production were provided by Cross Ink. SBEP staff and members of SBEP’s Technical Advisory Committee, Citizens Advisory Committee, Management Board, and Policy Board provided critical input and review. This Update greatly benefited from guidance and review by Felicia Burks, SBEP’s Program Manager in EPA Region IV, Noemi Mercado, EPA Headquarters, Washington DC, and their colleagues. This Update was approved by SBEP’s Policy Board in September 2021 and was recognized as final by EPA in March 2022.

About the Sarasota Bay Estuary Program

The Sarasota Bay Estuary Program is dedicated to restoring our area's greatest and most important natural asset – Sarasota Bay. We strive to improve water quality, increase wildlife habitat, and enhance the natural resources of the area for use and enjoyment by the public. Sarasota Bay was named an “estuary of national significance” by the U.S. Congress in 1989, laying the groundwork for the Sarasota Bay to join the National Estuary Program, now 28 strong.

SBEP is an intergovernmental partnership with a Management Conference that includes Manatee and Sarasota Counties, the Cities of Bradenton and Sarasota, the Town of Longboat

Key, the Southwest Florida Water Management District (SWFWMD), the Florida Department of Environmental Protection (FDEP), and the United States Environmental Protection Agency (US EPA). In 2004, the partners signed an Interlocal Agreement that established the Sarasota Bay Estuary Program as an Independent Special District of the state of Florida and committed the partners to carrying out the Comprehensive Conservation and Management Plan for Sarasota Bay.

SBEP is governed by a Policy Board that consists of elected and appointed officials representing each partner in the Interlocal Agreement. The

SBEP Management Board, consisting of upper-level administrators from each of the Interlocal Agreement partners and other regional agencies as well as the chairs of the Technical Advisory Committee and the Citizens Advisory Committee, makes recommendations to the Policy Board.

SBEP benefits from a Technical Advisory Committee of local scientists and managers and a Citizens Advisory Committee of local community stakeholders.

SBEP staff gratefully acknowledge the service of all current and past Management Conference Members.



Figure 1-1. Sarasota Bay Estuary Program Management Conference Structure.

Note from the Executive Director

Greetings! Joining the Sarasota Bay Estuary Program as the new Executive Director in 2020 was a sort of homecoming for me. Back in the early 1990s, I was the first scientist for the SBEP, after receiving the offer of employment from Mark Alderson, SBEP's Executive Director from 1989 to 2020. Sarasota Bay's initial recovery started under Mark's leadership, and we all owe him a debt of gratitude for his leadership and passion.

Sarasota Bay was, until fairly recently, a success story. Compared to conditions in the late 1980s, our nutrient loads were down about 50%, our water quality showed multiple signs of improvement, and we had gained about 50% more seagrass. However, our bays have suffered some recent setbacks that require us to re-examine our path forward. This CCMP update gives us the framework to do just that.

Over a five-year period between 2013 and 2018, there were ongoing effluent overflows from non-Advanced Wastewater Treatment plants to creeks that reach Roberts, Little Sarasota, and Blackburn Bays. During the same period, monitoring data showed increased nitrogen concentrations, increased phytoplankton, decreased water clarity, and an approximate 30% decline in seagrass coverage in those bay segments. These seagrass losses effectively reset the restoration clock in our lower bays.

Our northern bays fared better until a 2,000-acre reduction of seagrass meadows around Long Bar Pointe between 2018-2020, a decrease of approximately 20%. A strong and persistent red tide event in 2018 particularly impacted north Sarasota Bay and darkened the water column for months. These conditions likely caused seagrass meadows to contract. Wildlife populations, already devastated by the red tide, lost critical habitat. The seagrass meadows that were lost between 2018-2020 likely supported more than 30 million fish.

2021 brought unforeseen challenges for bay health. In April 2021, an emergency discharge of wastewater from a former phosphate processing plant, Piney Point, loaded an estimated 200 tons of nitrogen – equivalent to about ten years' worth of population growth – into Lower Tampa Bay over a ten-day period. While the discharge occurred outside of the SBEP watershed, modeling demonstrated that the discharge plume reached waters far afield. Conditions on the ground, including a large cyanobacteria bloom in Anna Maria Sound, indicated intense eutrophication. Adding fuel to the fire, a severe red tide event plagued Tampa Bay from June to July 2021. Sarasota Bay was not spared the impacts of this event. Dead fish piled up on beaches while sharks flocked to backwater canals to seek refuge.

We must act quickly and decisively to restore water quality in the bay with renewed focus on



nutrient management in the watershed. This will in turn require a coordinated and sustained effort to improve our stormwater and wastewater practices. SBEP's local government partners have committed to spending over \$600 million to upgrade wastewater and stormwater infrastructure in the next ten years, above and beyond planned maintenance spending. These government investments, alongside strong community and individual efforts, will go a long way toward protecting Sarasota Bay's water quality as the region continues to grow. The past thirty years of SBEP Management Conference leadership showed that Sarasota Bay's ecological health can recover with sufficient action, so let's get to it!

A handwritten signature in black ink, appearing to read "David Tomasko". The signature is fluid and cursive, written over a white background.

David Tomasko, Ph.D.
Executive Director

Milestones of Sarasota-Area Bays

1000s BCE-1700s

Indigenous peoples inhabit Florida. Historic shell middens still shape many Southwest Florida estuary shorelines today.

Late 1800s

Dredging of the Intracoastal Waterway began in Sarasota Bay, leading to the creation of many small dredge-spoil islands.



1972

EPA Clean Water Act adopted, establishing quality standards for surface waters and regulating pollutant discharges.

1982

Florida's statewide stormwater rule goes into effect, requiring municipal stormwater systems to manage nutrients.



1800s

Fishers from Cuba established fish camps, or ranchos, on the shores of Sarasota Bay, trading mainly in mullet and mullet roe.



Early to mid-1900s

Large-scale land reclamation projects drained thousands of acres of freshwater marsh across Florida and coastal development intensified.



1972

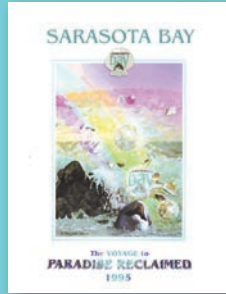
Florida's Wilson-Grizzle Act requires wastewater treatment plants discharging to southwest Florida estuaries, including Sarasota Bay, to upgrade to Advanced Wastewater Treatment (AWT) standards, or divert 100% to reclaimed use.

1989

EPA recognizes Sarasota Bay as an “estuary of national significance” and the Sarasota Bay National Estuary Program is established to develop a Comprehensive Conservation and Management Plan (CCMP).

1995

SBEP’s CCMP, approved by local partners, the Florida Governor, and the EPA Administrator, is published.



2004

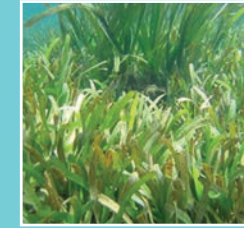
Federal, state, and local partners sign an Interlocal Agreement that establishes the Sarasota Bay Estuary Program as an Independent Special District of the state, institutes a funding schedule, and outlines priority issues and working groups.

2011

2011 – Estuarine Numeric Nutrient Criteria for SBEP-area bays established, setting regulatory limits to protect Sarasota-Manatee bays from nutrient over-enrichment.

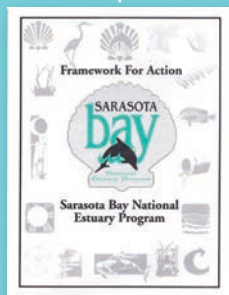
2014

Seagrass coverage baywide reaches 13,293 acres, a 53% increase from 1988.



1995

Sarasota Bay recognized as a Surface Water Improvement & Management (SWIM) Program priority water body by the Southwest Florida Water Management District.



1992

SBNEP’s Sarasota Bay: A Framework For Action, the first comprehensive technical study of Sarasota Bay, published.



2009

FWC Fisheries Independent Monitoring (FIM) Program begins fisheries sampling in SBEP bays.

2018

Last regular, permitted wastewater discharge to Sarasota Bay, the Siesta Key Water Reclamation Facility, is removed.

Estuaries are partially enclosed coastal waterbodies where saltwater from the ocean mixes with freshwater from rivers and creeks. The land over which water collects and flows into a waterbody is called a watershed. Estuarine habitats are among the most productive on earth, providing food and critical habitat for 80 percent of recreationally and commercially important species of finfish and shellfish. Together with their associated watershed habitats, estuaries provide important ecosystem services and support significant economic and recreational activities.



Roseate spoonbills. (Lou Newman)

Introduction

The Greater Sarasota Bay Estuarine System is a 50 square mile coastal lagoon located on the southwest coast of Florida. Its interconnected Gulf waters, bays, and tidal creeks link together a rich mosaic of bay habitats, including seagrass meadows, hardbottom, oyster reefs, beaches, and saltwater and freshwater wetlands. These iconic habitats are animated with a great diversity of fish and wildlife that underpin ecosystem integrity and function and provide the foundational environmental services that drive the cultural identity and economies of our coastal communities.

Historically, Sarasota Bay's alluring estuarine habitats teemed with abundant fish and wildlife, all dependent on a delicate balance of water quality and healthy interconnected habitats. The bay's iconic beauty, abundant fish and shellfish, and charismatic birds, dolphins, manatees, and sea turtles attracted and sustained residents from early indigenous peoples to Cuban fishers, to post-World War II couples. Increasing regional population size (Figure I-3) and associated development resulted in damage to and loss of natural habitats, which reduced their capacity to treat increasing pollutant loads. All of this change took a toll on water and habitat quality.

Human Population Growth in Sarasota and Manatee Counties

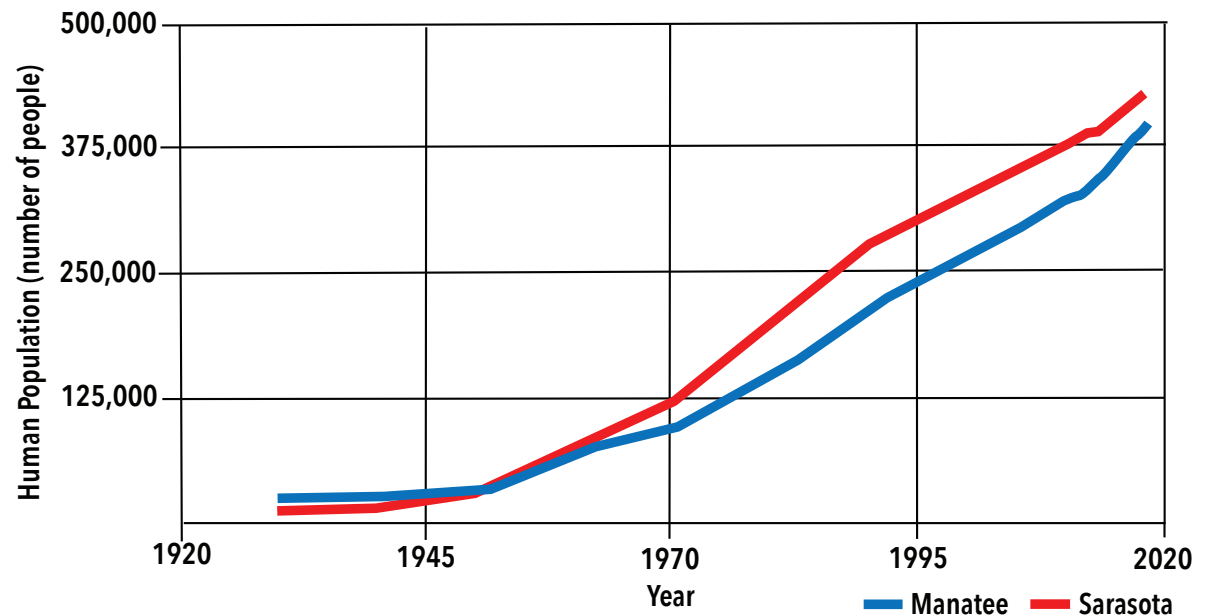
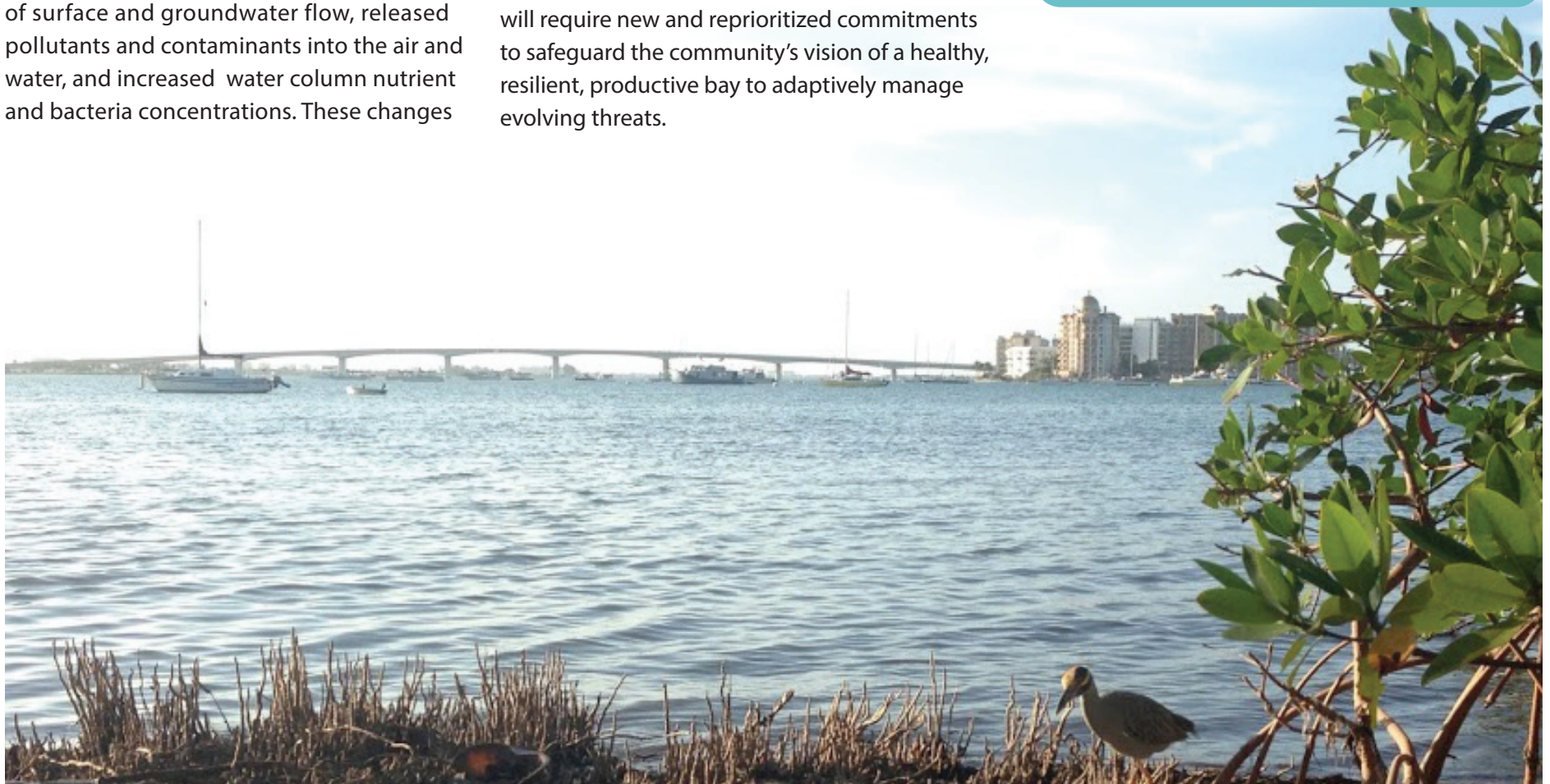


Figure I-3. Population growth in Sarasota and Manatee Counties, Florida. (US Census estimates)

Today, the majority of the Sarasota Bay watershed has been altered by urban and agricultural development, leaving isolated and compromised natural areas with limited ecosystem function and services necessary to reduce heavy pollutant loads. Alteration of natural landscapes by changing land uses has interrupted the natural infiltration and historical volume, location, and timing of surface and groundwater flow, released pollutants and contaminants into the air and water, and increased water column nutrient and bacteria concentrations. These changes

have negatively impacted aquatic systems and the services they provide. Increasing air and water temperatures, intensity of storms, and sea level rise associated with climate change will compound the negative effects of these stressors. SBEP and partners have made great progress over the years in restoring and protecting the Sarasota Bay Estuarine System, yet many challenges remain. Increasing population size and climate change will require new and reprioritized commitments to safeguard the community's vision of a healthy, resilient, productive bay to adaptively manage evolving threats.

SBEP envisions Sarasota Bay with abundant seagrass meadows teeming with fish and shellfish, oyster reefs filtering water and providing essential habitat for fish and birds, coastal wetlands and living urban shorelines filtering runoff and protecting the coast, a mosaic of uplands, freshwater wetlands, and tidal creeks supporting natural waterflow and habitat for fish and wildlife, and unimpeded vegetated dunes and sandy shorelines along Gulf beaches.



About the Sarasota Bay Estuary and Watersheds

The Sarasota Bay Estuarine System is formed by a necklace of barrier islands to the west, the mainland of Manatee and Sarasota counties to the east, Anna Maria Sound to the north, and the Venice Inlet to the South (Figure I-4). Circulation is primarily driven by tidal exchange with the Gulf of Mexico through inlets or passes, including Anna Maria Sound, Longboat Pass, New Pass, Big Sarasota Pass, and Venice Inlet. Big Sarasota Bay circulation is driven by the tides at Anna Maria Sound, Longboat Pass, New Pass, and Big Pass. Tidal circulation in Little Sarasota Bay is driven by tides at Venice Inlet and the Intracoastal Waterway running through the middle of the Bay. Numerous tidal creeks deliver freshwater to the eastern shoreline of the Bay, ranging in size from the largest (Phillippi Creek: drainage area of 36,417 acres) to the smallest (Palma Sola Creek: drainage area of 900 acres). The watershed is highly developed and consists of residential, commercial, light industrial, and agricultural land uses.

The Bay is comprised of one large bay segment (Sarasota Bay) and several smaller bay segments, including Palma Sola Bay to the north and Roberts Bay, Little Sarasota Bay, and Blackburn Bay to the south. Each bay segment is unique, differing in overall size, shape, water depth, habitat, sediment characterization, circulation, freshwater inputs, and pollutant delivery. SBEP and partners analyze and focus priority management actions for each bay independently, while recognizing their connectivity.



Figure I-4. Sarasota Bay Estuary Program watershed segments and creeks.

Palma Sola Bay

Palma Sola Bay is located in West Bradenton and opens up into Anna Maria Sound. It has a relatively stable seagrass coverage trend, but is connected to Perico Bayou, where substantial macroalgal blooms have been documented. Additional work is required to determine the nutrient sources responsible for these blooms. Palma Sola Bay has frequent exceedances of fecal coliform bacteria, for which it is currently impaired (FDEP 2020).

Sarasota Bay

Sarasota Bay is located between Longboat Key, Bradenton Beach, and Lido Key to the west, and Bradenton and Sarasota to the east. It is well flushed by Longboat Pass, New Pass, and Big Pass and is the largest and deepest bay between Tampa Bay and Charlotte Harbor. Freshwater runoff from highly urbanized watersheds via Whitaker Bayou, Hudson Bayou, and Bowlees Creek greatly exceeds historical freshwater input. Sarasota Bay is an Outstanding Florida Water and includes an area that is conditionally approved for shellfish harvesting, though it has been closed for decades due to elevated bacterial pollution, (FDEP 2020). Seagrass acreage declined significantly in Sarasota Bay between 2018–2020 and SBEP is assessing its capacity for recovery. Sarasota Bay suffered serious red tide impacts in 2018–2019, more so than any other bay segment. Potential for increased nutrient loading from ongoing shoreline and watershed development in Manatee County needs to be minimized or offset. Opportunities exist for canal restoration and wastewater treatment plant upgrades to improve water quality.

Roberts Bay

Roberts Bay is located between Siesta Key and mainland Sarasota County. It receives fresh water from the large, highly urbanized Phillippi Creek watershed and salt water from the Gulf of Mexico through Big Pass. Roberts Bay is impaired for total nitrogen (FDEP 2020) and experiences persistent impairments for chlorophyll-a. Drift macroalgae also appear to be increasing. There is an opportunity to document the benefit of planned upgrades to treatment, storage, and disposal of wastewater from the Bee Ridge Wastewater Treatment Plant and treatment upgrades related to septic to sewer conversions. Phillippi Creek is approximately seven miles of natural creek and over 100 miles of manmade canals. Many opportunities exist to reduce nutrient loading to Roberts Bay and increase fish and wildlife habitat by naturalizing these canals.

Little Sarasota Bay

Little Sarasota Bay receives freshwater from five tidal tributaries, including Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, and North Creek, as well as direct runoff from coastal areas. Midnight Pass, which once separated Siesta Key and Casey Key, historically connected Little Sarasota Bay to Gulf waters, but it closed in 1983. Little Sarasota Bay experienced significant seagrass loss between 2014–2018, but losses leveled off between 2018–2020. It has persistent impairments for chlorophyll-a and increasing occurrence of drift and attached macroalgae. The Little Sarasota Bay watershed has undergone significant development since the 2014 Sarasota Bay CCMP.

Blackburn Bay

Blackburn Bay is a long narrow bay between Casey Key and the mainland communities of Osprey, Laurel, and Nokomis. Blackburn Bay receives salt water through the Venice Inlet and fresh water from a canal and South Creek. Blackburn Bay is impaired for total nitrogen and South Creek is impaired for fecal coliform bacteria (FDEP 2020). Blackburn Bay suffered significant seagrass loss between 2014–2018, while 2020 data indicate a slight increase from 2018 levels. There is increasing drift and attached macroalgae in Blackburn Bay and there are persistent issues with high concentrations of chlorophyll-a.

Water tends to be clearer in Sarasota Bay than the smaller bay segments to the south. Bays with a higher ratio of watershed area to open water can have proportionally more freshwater inflow and pollutant loading than systems with lower ratios. Sarasota Bay has a 3:1 watershed-to-waterbody ratio compared to a 13:1 ratio for Roberts Bay, Little Sarasota Bay and Blackburn Bay (Tomasko and Raulerson 2007). Sarasota Bay also has significant saltwater flushing from the Gulf of Mexico. The closure of Midnight Pass in 1983 contributed to reduced flushing in southern bay segments.



History of the Sarasota Bay Estuary

Formation of the offshore keys that define the Gulf of Mexico boundary of modern Sarasota Bay occurred about 5,000 years ago, during a period when rates of sea level rise started to decline from higher values over the prior 10,000 years. (Estevez 1992). During the past few million years, sea level has fluctuated substantially. Geologically, sea level in the present-day Sarasota Bay area has ranged from as much as 330 feet below to perhaps as much as 100 feet above present levels. As recently as 17,000 years ago, the shoreline of the Gulf of Mexico was approximately 60 miles to the west.

Sarasota Bay served as a primary waterway for the Tocobaga, Timucuan, and Calusa, and other indigenous peoples during the 1500s. They created massive shell mounds, called middens, some of which are still visible today. Cuban fishers established fish camps, or rancheros, on the shore of the Bay from 1700 to the mid-1800s. Mullet and mullet roe were the principal products traded with Havana, although red drum, sea turtles and seatrout were also salted and shipped south. Seminole Indians, newly arrived in the Sarasota Bay area, also roamed the bay and coastal region hunting, fishing, and farming. European explorers used Sarasota Bay as a sheltered water link between Charlotte Harbor and Tampa Bay.

An early homesteader to the region was Josiah Gates, who arrived in the Manatee River area in 1842. A year later, William Whitaker sailed to the high yellow bluffs on the mainland further south and staked his claim to what is now much

of the northwest portion of the City of Sarasota. Beginning in 1920, large scale drainage projects were constructed to eventually drain 100,000 acres of freshwater sawgrass marsh. These marshes extended east of the coastal ridge to Myakka and from Tampa Bay to Charlotte Harbor. The marshes were initially drained for farming, which gave way to residential and commercial development. The slow trickle of settlers became a stream, and then a flood after World War II.

Although fewer than 100,000 people lived in the Sarasota Bay area 50 years ago, that early population has now swelled to more than 500,000, with continued growth projected (Figure I-3). Coastal and Bay development intensified from the late 1950s to 1970, as hundreds of acres of bay bottom were dredged to produce waterfront lots. Canals were dredged and the spoil was used to create subdivisions. The drained saltwater marshes were converted to residential neighborhoods.

Bird Key, located between the City of Sarasota mainland and St. Armands Key, was once the location of one of the largest seagrass beds in Sarasota Bay. The Bird Key development was bulkheaded with seawalls, dredges filled the area behind the seawalls with material from the bay bottom, and the newly expanded island was subdivided into single-family home sites. During this same development cycle, the Intracoastal Waterway was dredged to provide a deep, protected channel running the length of the bay and beyond. Dredge spoil islands were created throughout the bay during construction of the

Intracoastal Waterway, covering seagrass beds and permanently changing water circulation patterns. Natural bay shorelines were gradually replaced by seawalls to retain dredge-and fill material for homesites while natural landscapes were replaced by nonporous parking lots, roads, and rooftops. Seagrass coverage was reduced as water quality declined.

Sarasota Bay was a very different place in 1989, from what long-time residents remember. Seagrass beds had diminished, and remaining seagrass flats were scarred by the tracks of boat propellers. Scallop, oyster, and clam harvests were reduced, and anglers' catches were generally reduced as well. Miles of natural shoreline habitats had been replaced by seawalls, and once abundant mangrove wetlands were depleted. Intense residential and commercial development throughout the Bay area increased stormwater runoff, wastewater pollution, sediment, and chemical contaminants in the bay.

In 1989, a new vision was established by the communities surrounding Sarasota Bay to reclaim water quality and its biological integrity. This vision was brought into focus by the creation of the Sarasota Bay Estuary Program.



Whitaker Bayou, 1910. (*Sarasota Historical Society*)



Alphabetical Listing:

- ◆ **Palma Sola Bay Watershed Habitat Restoration**
 Neal Preserve - #3
 Palma Sola Scenic Highway - #4
 Perico Preserve - #2
 Robinson Preserve - #1
 Ungarelli Preserve - #5
- ◆ **Additional Habitat Restoration Projects**
 Honi Hanta Girl Scout Camp - #3
 Jiggs Landing - #4
 Pine Island - #2
 Wares Creek - #1
- ◆ **Sarasota Bay Watershed Habitat Restoration**
 6th Street Canal - #15
 Bowlees Creek Island - #10
 FISH Preserve - #3
 Grassy Point Preserve - #1
 Herb Dolan Living Shoreline Park - #2
 Joan M. Durante Park - #6
 Ken Thompson Park BayWalk - #8
 Leffis Key Park - #4
 New College of Florida Living Shoreline - #12
 North Water Tower Park - #13
 Pioneer Park & Hog Creek - #14
 Powel Crosley Estate - #11
 Quick Point Nature Preserve - #7
 Sarasota BayWalk - #9
 Sister Keys Preserve - #5
- ◆ **Artificial Reefs**
 888 Reef - #8
 Bayshore North Reef - #3
 Bayshore South Reef - #4
 Bradenton Beach Pier Reef - #1
 Hart Reef - #10
 Leffis Key Reef - #2
 Miller Reef - #11
 Pop Jantzen Reef - #9
 Sportfisherman Reef - #7
 Whale Reef - #5
 Walker Reef- #6
- ▲ **Oyster Habitat**
 34th Street Oyster Reef - #2
 Gladiola Fields Oyster Habitat - #3
 Perico Bayou Oyster Restoration - #1

LEGEND

- ◆ Palma Sola Bay Watershed
- ◆ Sarasota Bay Watershed
- ◆ Roberts Bay Watershed
- ◆ Little Sarasota Bay Watershed
- ◆ Blackburn Bay Watershed
- ◆ Additional Habitat Restoration Projects
- Artificial Reefs
- ▲ Oyster Habitat Enhancements
- Seagrass Habitat

Figure I-5a. Sarasota Bay Habitat Restoration Project Map, Page 1.

Northern Portion of SBEP Project Area Map

Southern Portion of SBEP Project Area Map shown on following page.



Figure I-5b. Sarasota Bay Habitat Restoration Project Map, Page 2.



Restoration project at Robinson Preserve, Manatee County. (SBEP)



Bayfront Park Living Shoreline, Sarasota County. (SBEP)

Alphabetical Listing:

- ◆ **Sarasota Bay Watershed Habitat Restoration**
 Bay Front Living Shoreline - #19
 Hudson Bayou In-Stream Restoration - #21
 Marie Selby Botanical Gardens Lagoon - #20
 North Lido Park - #16
 Otter Key - #17
 Sarasota BayWalk - #10
 South Lido Park - #18
- ◆ **Roberts Bay Watershed Habitat Restoration**
 Celery Fields - #4
 Pinecraft Living Shoreline Park - #1
 Red Bug Slough - #3
 Roberts Bay Bird Colony - #2
- ◆ **Little Sarasota Bay Watershed Habitat Restoration**
 Blackburn Point Park - #2
 Palmer Point Park - #1
- ◆ **Blackburn Bay Watershed Habitat Restoration**
 Oscar Scherer Pond - #1
- **ARTIFICIAL REEFS**
 Coker Reef - #12
 Evans Reef - #13
- ▲ **OYSTER HABITAT**
 Turtle Beach Oyster Habitat - #5
 White Beach Oyster Habitat - #4

Figure I-5c.
 Sarasota Bay Habitat Restoration Project Map, Page 3.

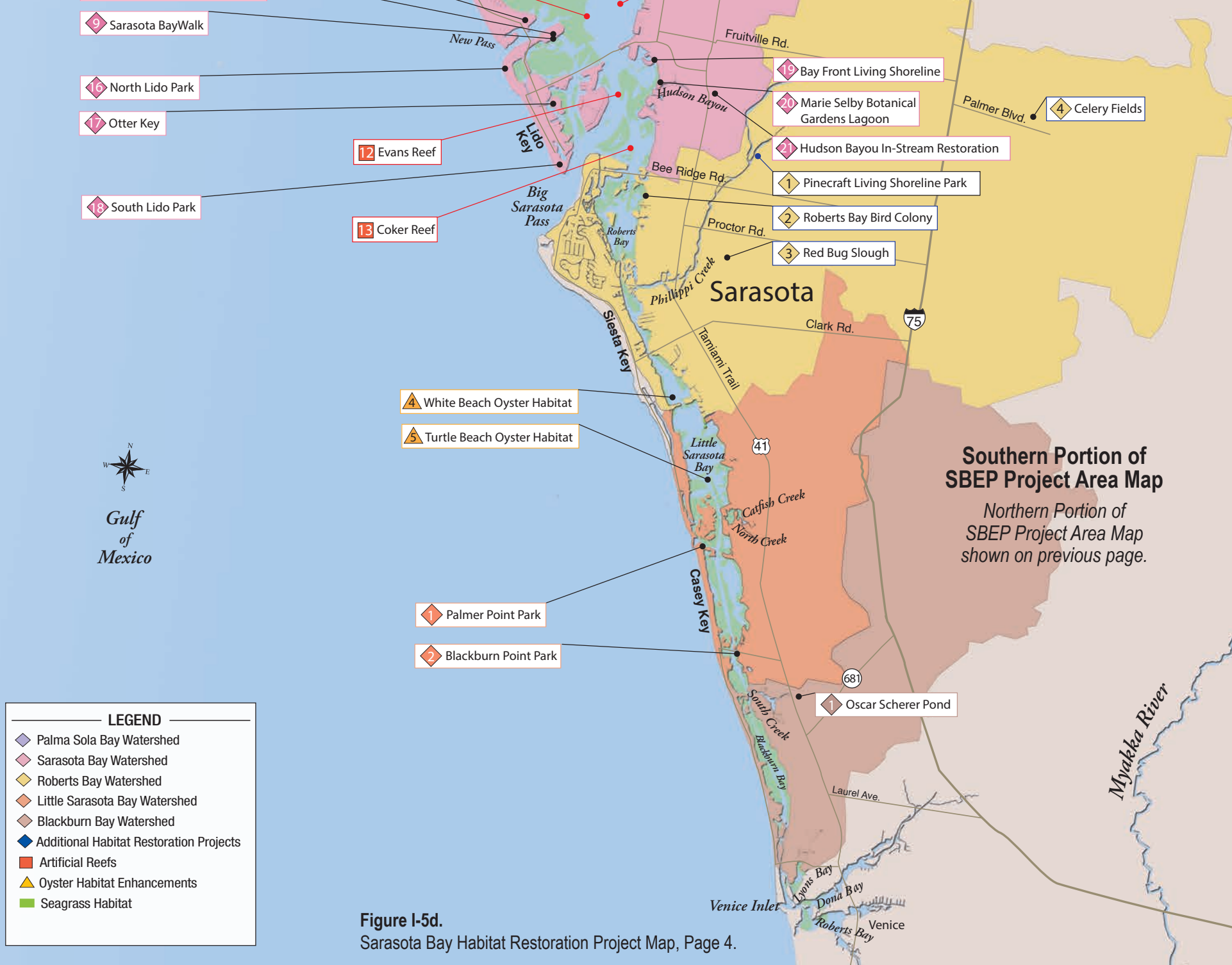


Figure I-5d.
Sarasota Bay Habitat Restoration Project Map, Page 4.

About This CCMP Update

Purpose and Focus of Update

This 2022 update to Sarasota Bay Estuary Program's 2014 Comprehensive Conservation and Management Plan (CCMP) is a science-based, community-driven strategic blueprint to advance progress in protecting and restoring the water quality and ecological integrity of Sarasota Bay. The CCMP is a living document that reflects the community's evolving understanding of the bay and its watersheds. It sets priorities, focuses resources, and ensures that SBEP staff, Management Conference members, protection and restoration partners, and other stakeholders are working

toward common goals and objectives through coordinated, collaborative planning and action.

This Update was developed over 28 months through a facilitated strategic planning process. Over 100 scientists, engineers, resource managers, resource users, volunteers, community members, and elected officials contributed knowledge, insights, and opinions during the Update process. Each Action Plan was developed sequentially and reviewed by SBEP's Technical Advisory Committee, Citizens Advisory Committee, and Management Board. The SBEP Policy Board, composed of

elected and appointed officials and high-level environmental administrators from SBEP partner governments and agencies, discussed and approved each Action Plan and formally adopted the full CCMP. Additional public input was solicited and collected during a three-month period when the draft CCMP was available for download and review from the SBEP website. Longstanding SBEP goals and objectives for protection and restoration of Sarasota Bay were reaffirmed and reenergized and new objectives and priorities emerged throughout this community-driven process.

Changes in the 2022 CCMP Update

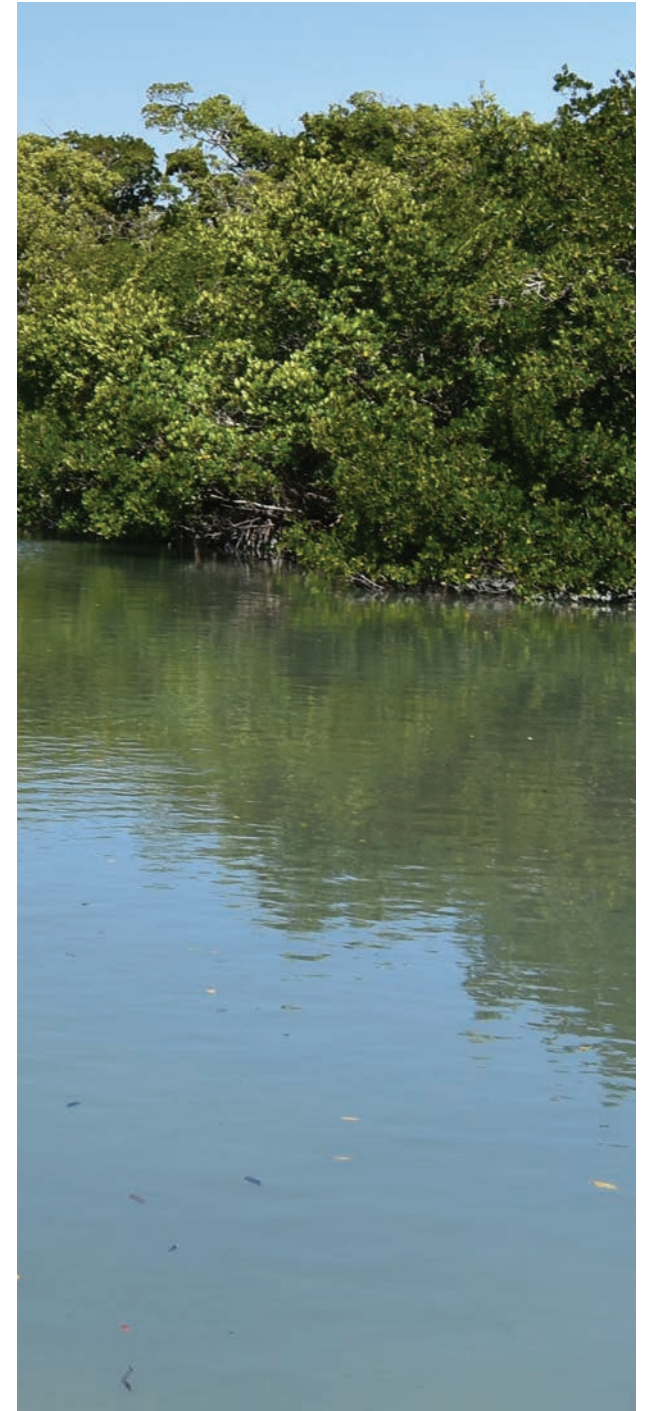
The seven chapters, 35 Objectives, and 104 Actions of the 2014 CCMP were updated, consolidated, moved, restated, or retired. The 2022 CCMP features four Action Plans with 21 Objectives and 57 Activities (See Appendix A: Action Plans at a Glance). The specific status of each Action in the 2014 CCMP has been cross-walked to the 2022 CCMP to illustrate continuity and progress (See Appendix B: 2014 to 2022 CCMP Crosswalk). The 2022 CCMP was reorganized under the framework of a more formal strategic plan to improve focus and decision-making, highlight priorities, and track progress (See Description of Action Plans at a Glance).



Members of SBEP Policy Board and staff, February 2022

Notable changes in the 2022 CCMP Update include:

- Support for comprehensive and coordinated surface water and groundwater quality monitoring, assessment, and reporting was prioritized as a new objective (See WQQ-1).
- Improving and managing hydrology for a more natural pattern of timing, quantity, and distribution of surface water flows was prioritized as its own objective (See WQQ-3).
- Encouragement for regular inspection and maintenance of septic systems, including installation of supplemental and advanced septic system technologies was identified to be an important activity in coastal areas with impaired waters (WQ-5.2).
- Evaluation and management of the impacts of reclaimed wastewater storage, distribution, and use on nutrient loading and hydrology was prioritized as an activity, due to increased use of reclaimed water for irrigation (WQQ-6.2).
- Encouragement of proactive inspection, maintenance, fats, oils, and grease avoidance, and replacement of failing or underperforming sewer infrastructure to prevent inflow and infiltration, overflows, and spills was identified to be an important activity (WQQ-6.3).
- Improving understandings of pollutant loading from atmospheric deposition was introduced as a priority knowledge gap (WQQ-7).
- Improving understanding, monitoring, reporting, and response to recover from, mitigate, and reduce harmful algal blooms was prioritized as a new objective (WQQ-8).
- Protecting, enhancing, and restoring beaches and dunes for wildlife and resiliency was prioritized as a new objective (WH-6).
- Monitoring and protecting threatened, endangered, and vulnerable wildlife with an emphasis on birds, dolphins, manatees, and sea turtles was prioritized as a new objective (FW-3).
- Outreach to new groups, especially those that have traditionally been underserved or underrepresented in SBEP's programming, has been prioritized to engage a broader, more diverse audience for protection, restoration, and education activities, and for expanding access and recreational opportunities to them (See Growing SBEP's Reach to Underserved and Underrepresented Stakeholders).
- Threats due to climate change and the importance of mitigation and adaption were addressed in each Action Plan (See Climate Ready Estuary).



Growing SBEP's Reach to Underserved and Underrepresented Stakeholders

SBEP strives for the fair and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development and implementation of environmental priorities, programs, and opportunities. SBEP recognizes the importance of local knowledge and cultural diversity when developing and implementing priorities to protect and restore the bay. SBEP seeks to broaden its services and base of public support for bay protection and restoration to groups that have been traditionally underserved or underrepresented in educational outreach and protection and restoration activities, including environmental justice communities. It also seeks to broaden bay access, recreational opportunities, field trips, and Bay Partners Grants to underrepresented groups and those disconnected from the bay for reasons of location, opportunity, and resources. Priority groups include African American and Hispanic/Latino residents, those with physical or mental disabilities, traditional waterfront workers like commercial fishers, and seasonal and older residents with time and interest in contributing to the community. Strategies to address inclusive and accessible programming are described in the SBEP Communications Plan (SBEP 2019).

Climate Ready Estuary

Climate change threatens Sarasota Bay's natural systems, already under stress from humans. United States Environmental Protection Agency (US EPA) set a goal for all National Estuary Programs to assess climate change vulnerabilities, develop and implement adaptation strategies, and engage and educate stakeholders. SBEP conducted a climate vulnerability analysis to assess impacts due to sea level rise, changes in precipitation, warmer air and water temperatures, and ocean acidification (SBEP and Shafer 2017). The analysis identified 54 threats that present a range of challenges to achieve CCMP goals, including impacts to water and habitat quality, fish and wildlife, and human use and enjoyment of the bay. Examples of potential impacts include:

- Changes in the growth rates and survival of algae, bacteria, and viruses
- Failure of low-lying wastewater infrastructure due to flooding or groundwater saturation
- Emergency releases of partially treated wastewater from treatment facilities overloaded by inflow and infiltration during intensifying storm events

- Increase or decrease in episodic volume and velocity of freshwater to tidal creeks and the bay
- Loss of shallow intertidal habitat, including mangroves, salt marsh, and beaches due to upland barriers to migration
- Changes in species composition and zonation and spread of invasive species
- Decreases in juvenile fish, shellfish, and bird feeding, breeding, and refuge habitat due to loss of coastal wetlands and natural shorelines
- Changes in seagrass cover and epiphytes due to changes in water clarity, temperature, depth, and pH
- Reduced or restricted public access to beaches, coastal parks, and natural areas

Results of the Climate Vulnerability Analysis were used to inform development of this 2022 CCMP Update.

Scientific knowledge and understanding of climate change and how it may impact natural and built environments continues to grow, and so do conservation, restoration, mitigation, and adaptation management tools to address impacts. As both fields evolve, SBEP and partners will remain adaptive to new information and management tools to ensure continued success in protecting and restoring a resilient Sarasota Bay.

About the Action Plan Strategy

Definition of Terms

The CCMP strategy is composed of four Action Plans, including Water Quality and Quantity (WQQ), Watershed Habitats (WH), Fish and Wildlife (FW), and Community Engagement (CE). Each Action Plan has a high-level goal that is supported by quantifiable Objectives, that are elaborated on by specific Activities. Each Objective is assigned five-year performance metrics, benefits, and location. Each Activity is assigned a timeframe, list of collaborators, and estimated five-year costs and potential funding sources. These elements are presented within each Action Plan and all together in Appendix A: Action Plans at A Glance.

SBEP's role in implementing the CCMP is clearly defined for each Activity.

Key to Costs

Estimated five-year cost ranges for each CCMP activity are provided in the Action Plan Strategy using the following ranges:

\$	<\$25K
\$\$	\$25K–99K
\$\$\$	\$100K–499K
\$\$\$\$	\$500K–1 M
\$\$\$\$\$	>\$1 M

Supporting Documents

Specific strategies, tactics, and information for CCMP implementation are detailed in supporting documents, including:

- **Monitoring Strategy** (to be adopted by 2025) will outline strategies and methodologies for tracking CCMP performance measures.
- **Finance Strategy** (to be adopted by 2025) will outline the strategy for long-term financial support to implement the CCMP.
- **Communications Strategy** (2019, to be updated by 2025) describes principles and tactics for implementing the Public Engagement Action Plan (SBEP 2019).
- **Habitat Restoration Plan** (to be adopted by 2025) analyzes and makes recommendations for habitat restoration priorities, especially with regard to climate change stressors, to implement the Watershed Habitats Action Plan.
- **SBEP Climate Vulnerability Analysis** (2017) analyzes climate related risks to implementing the CCMP. Findings from this analysis helped guide development of this 2021–2026 CCMP Update (SBEP and Shafer 2017).

SBEP Role Definitions for CCMP Matrices

SBEP Actions	SBEP Engagement	SBEP (320) Funds
Support	Encourage actions that support CCMP implementation.	Staff time only
Coordinate	Convene partnering entities, ensure open communication, and maximize efficiencies.	Yes, for some meetings
Collaborate	Invest funding and staff time as a partner, but not as the lead agency.	Yes
Conduct	Invest funding and staff time as the lead agency.	Yes



Sunset over Longboat Key. (SBEP)

WATER QUALITY & QUANTITY *Action Plan*

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary

Introduction

Sarasota-Manatee area bays are celebrated for their alluring beauty, abundant fish and wildlife, recreational activities, and economic opportunities — all directly dependent on

a delicate balance of water temperature, nutrients, pH, oxygen, and clarity. Alteration of natural landscapes by residential, commercial, agricultural, and industrial land uses has interrupted the natural infiltration and historical volume, location, and timing of surface and groundwater flow, released pollutants and contaminants into the air and water, increased nutrient and bacteria concentrations, and reduced dissolved

oxygen concentrations in the early morning hours. These changes have negatively impacted aquatic systems and the services they provide to both natural and human populations.

SBEP and its partners have achieved many successes in protecting and restoring water

quality. As last quantified in 2014, nitrogen loading to SBEP Bays has been reduced 64% since 1989 due to considerable capital investments in wastewater and stormwater treatment infrastructure (SBEP 2014). These gains were achieved over a period of decades by conversion of septic systems to central sewer service, consolidation of small private wastewater treatment plants, improvements in the nutrient removal processes used by wastewater treatment plants, the elimination of direct wastewater discharge to the bays, and treatment of stormwater with regional stormwater treatment systems and innovative onsite treatment techniques. As population growth and development continue and climate change magnifies existing challenges, regional partnerships are even more critical for monitoring, evaluating, and responding to water quality threats. Multiple ongoing threats to water quality include excess nutrient loadings, harmful algal blooms, high bacteria counts, low dissolved oxygen concentrations, increased sediment loads from excess runoff, toxins, microplastics, and alteration of natural hydrology.

Threats to Water Quality

Excess Nutrients

Living things require nutrients to survive, grow, and reproduce. However, excess nutrients, including nitrogen and phosphorus, can feed harmful algal blooms, which can deplete dissolved oxygen, reduce water clarity, and create toxins harmful to aquatic life and human health. Nitrogen is the limiting nutrient for phytoplankton in SBEP waters. Excess nutrients in urban runoff from fertilizer, animal waste, septic systems (WQQ-5), wastewater spills and overflows (WQQ-6), reuse irrigation (WQQ-6), and atmospheric deposition (WQQ-7) are leading threats to water quality.

Bacteria

Bacterial contamination limits the Sarasota-Manatee community's ability to use water for recreation and shellfish harvesting.

Contamination comes from a variety of sources, but of most concern is fecal waste from humans and other animals. Sources of fecal bacteria include septic systems, centralized



wastewater collection system overflows, backups, and leaks, and wastes from pets, small hobby farms, ranchettes, and wildlife. In sub-tropical systems such as Southwest Florida, "fecal indicator bacteria" can also arise from non-fecal sources, such as decomposing seaweed and even grass clippings that are blown into stormwater conveyance systems. After heavy rainfalls, stormwater carries bacteria as well as nutrients from these sources to waterways and bays.

Low Dissolved Oxygen

Dissolved oxygen (DO) is an important indicator of water quality. Dissolved oxygen is generated during aquatic photosynthesis and wind-driven surface air mixing. Oxygen is consumed by animal, plant, and microbial respiration and decomposition. Low DO conditions can occur naturally in wetlands and tidal creeks, where organic decomposition occurs. Low DO can also occur in shallow estuarine waters during the rainy season when large volumes of freshwater runoff can create a freshwater lens that reduces mixing of oxygen into deeper water. Excess nutrients in runoff can cause algal blooms, which can deplete DO when algae die and decompose, and also in the early morning after hours with insufficient light for photosynthesis. Nutrient-stimulated algal growth and bacteria

can also stimulate oxygen demand, leading to low DO. Suspended sediments and other particulate matter can also limit the availability of sunlight, which can decrease oxygen production by photosynthetic organisms such as seagrass.

Sediment

Sediment and other particles in stormwater runoff can reduce water clarity and the penetration of sunlight, which limits photosynthesis and the area of suitable bottom habitat available to support seagrass. When suspended sediments settle, they can smother bay bottom habitats, which is especially harmful if the sediments carry bacteria and toxins from land-based sources.

Toxins

Aquatic environments are the ultimate reservoirs for many toxic manmade chemicals. Stormwater can carry oil, heavy metals, herbicides, pesticides, and chemical waste into waterbodies. Endocrine disrupting compounds are emerging pollutants of concern for environmental and human health and come from a variety of household products including flame retardants, plastics, personal care products, and pharmaceuticals. These constituents are linked to adverse



endocrine or reproductive effects in animals, whose tissues can accumulate toxins, making shellfish and fish harmful to humans. Toxins from pharmaceuticals and personal care products can pass through septic systems and wastewater treatment facilities and are present in treated wastewater discharges, including reuse.

Plastics

Microplastics, defined as plastics less than 5mm in diameter, are derived from the disintegration of larger plastic debris, manufactured microbeads from cleansers and cosmetics, and microfibers from laundering synthetic clothing. Microplastics can pass untreated through septic systems and wastewater treatment facilities and contaminate the environment. Microplastics are highly resistant to breaking down through decomposition. They can also absorb chemical contaminants and become incorporated into sediments and embedded in the tissue of living things.

Hydrologic Alteration

Human activities have substantially altered SBEP watersheds, waterways, and bays and profoundly impacted hydrology. Hydrologic alteration, defined as “the manmade or man-induced alteration of the chemical, physical, biological, and radiological integrity of water” (Clean Water Act Section 502(19)), is characterized as “pollution” under the Clean Water Act (Novak *et al.* 2016). The historical seasonally fluctuating volume, velocity, timing, and location of fresh surface water and groundwater flows have been redirected, impeded, or accelerated to drain water from the landscape (Wood 2019).



Wetlands have been drained and filled, creeks have been dammed, straightened, widened, deepened, and connected to hundreds of miles of new canals. Pervious natural habitats were replaced with impervious manmade surfaces. Isolated waterbodies were connected with canals and drained into different receiving waters, and bays were dredged deeper in some places and filled in others. Today, freshwater flows more quickly off the landscape, in much higher volumes, carrying pollutants, sediment, and other contaminants into creeks and bays.



Action Plan Strategy

This Action Plan encompasses the strategy of two Action Plans in the 2014 SBEP CCMP: the Wastewater Treatment and Reclamation and the Stormwater Treatment & Prevention Plans. From those original plans, two objectives have been completed since 2014. First, the objective to consider a regional program to reclaim treated wastewater has been completed; there are well-established programs to reclaim treated wastewater for irrigation in both Sarasota and Manatee Counties. Ongoing upgrades to local wastewater treatment plants will only increase the amount of treated wastewater that is reclaimed for alternative supply. Second, the objective to set water quality targets was met by establishing estuarine numeric nutrient criteria and, later, by establishing a Water Quality Report Card. Other 2014 objectives have been revised to better reflect current realities or merged into other objectives, in this Action Plan or in others, for clarity. Please refer to the CCMP Crosswalk in Appendix B for details. The 2022 CCMP, with a streamlined and holistic approach to water quality, is more approachable and straightforward to track, with better-defined performance metrics.

In this CCMP update, the SBEP Management Conference commits to eight major objectives for the goal of improving water quality and the timing, quantity, and distribution of freshwater flow to SBEP estuaries.

- **Objective 1:** Support comprehensive and coordinated surface water and groundwater quality monitoring, assessment, and reporting;
- **Objective 2:** Develop improvement plans to maintain, attain, or surpass state water quality standards;
- **Objective 3:** Improve and manage hydrology for a more natural pattern of timing, quantity, and distribution of surface water flows;
- **Objective 4:** Reduce pollutant loading from stormwater;
- **Objective 5:** Reduce pollutant loading from septic and other onsite sewage treatment and disposal systems;
- **Objective 6:** Reduce pollutant loading from centralized wastewater collection, treatment and disposal systems, including reuse;
- **Objective 7:** Improve understanding of pollutant loading from atmospheric nitrogen deposition;
- **Objective 8:** Support measures to better understand, monitor, report, respond to, recover from, and reduce harmful algal blooms.

Volunteers for the Perico Bayou Oyster Reef construction project in 2019. (SBEP)

Water Quality and Quantity Action Plan Objective 1:

Support comprehensive and coordinated surface water and groundwater quality monitoring, assessment, and reporting.

Activity WQQ-1.1

Continue support of long-term, coordinated, and timely collection, archiving, analysis, reporting, and quality assurance/quality control of water quality data. Support and enhance timely public communication of water quality monitoring data.

Activity WQQ-1.2

Review and evaluate monitoring programs, increase efficiencies, fill water and air quality monitoring gaps, reevaluate estuary circulation models, identify sources of pollution, and update pollutant sources in pollutant load models.

Background

Long-term standardized water quality monitoring of bays, tidal creeks, and beaches produces data to track water quality improvements or impairments over time (Figure WQQ-1). Data collection, quality assurance/quality control, archiving, analysis, and reporting support the development of management actions for continuously improving water quality.

The ongoing long-term standardized water quality monitoring of SBEP tidal creeks and estuaries is largely driven by the regulatory requirements of municipal stormwater permits required under the federal Clean Water Act and administered by the Florida Department of Environmental Protection (FDEP). National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) stormwater permits held by county and municipal governments require ongoing water quality monitoring to demonstrate that stormwater discharges do not contribute to the deterioration of the area's receiving water bodies.

Coordination among a variety of agencies conducting environmental water quality sampling in Southwest Florida estuaries occurs through the Regional Ambient Monitoring Program (RAMP) with standardized field sampling and laboratory analysis protocols that results in consistent data collection methods used by all parties (Table WQQ-1). This ensures that water quality data meet stringent state quality assurance standards before being submitted to the Watershed Information Network (WIN), a statewide public database maintained by FDEP.



Citizen scientists participate in a pilot water quality monitoring activity. (SBEP)

Status

Manatee County Parks and Natural Resources Department samples northern SBEP bays including Big Sarasota Bay from Anna Maria Sound south to the county line, and Palma Sola Bay. Each sampling area has 24 sampling stations. Eight of these stations are sampled monthly so that all 24 stations in an area are sampled each quarter¹.

Sarasota County Public Works monitors 30 sampling areas (polygons) across six SBEP estuary segments from Big Sarasota Bay to Blackburn Bay. Each area has 12 sampling stations. One station is sampled in each area each month so that all 12 stations are sampled each year².

The counties also collect monthly water quality samples at fixed stations in a dozen tidal creeks flowing into SBEP bays. Florida Department of Health also samples bi-weekly for bacteria and red tide at 12 Gulf beach locations plus the Palma Sola Bay Causeway and Bird Key Park. In addition, biological indicators of water quality such as seagrass, oysters, and scallops are routinely monitored by counties and other agencies (see WH-5).



Bay scallop. (SBEP)

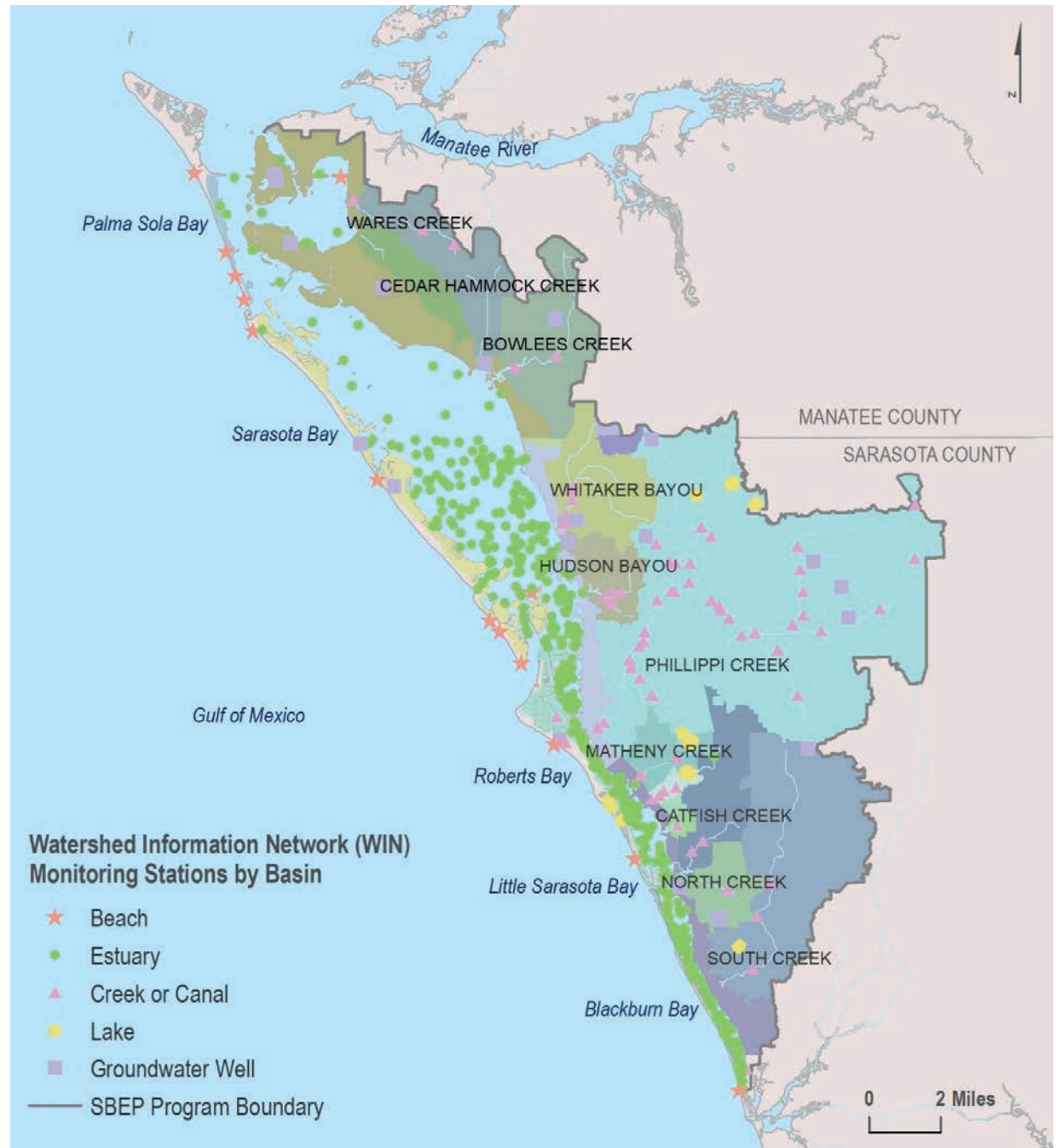


Figure WQQ-1. Water quality monitoring stations in the Sarasota Bay estuary and watersheds with sample data maintained in the Watershed Information Network. (WIN)

Table WQQ-1.

Field and laboratory estuary and tidal creek monitoring program parameters collected monthly by Manatee and Sarasota Counties.

PARAMETER	Estuaries		Tidal Creeks	
	Manatee	Sarasota	Manatee	Sarasota
Field				
Depth	X	X	X	X
pH	X	X	X	X
Temperature	X	X	X	X
Dissolved Oxygen (mg/l and % Sat)	X	X	X	X
Salinity	X	X	X	X
Conductivity	X	X	X	X
Transparency	X	X	X	X
Photometry (PAR)	X	X		
Total Dissolved Solids			X	
Laboratory				
Color	X	X	X	X
Turbidity	X	X	X	X
Total Suspended Solids	X		X	X
Biochemical Oxygen Demand		X		X
Chlorophyll-a	X	X	X	X
Pheophytin				X
Total Kjeldahl Nitrogen	X	X	X	X
Ammonia	X	X	X	X
Nitrite + Nitrate	X	X	X	X
Nitrate	X		X	
Total Phosphorous	X	X	X	X
Orthophosphate		X	X	X
Bacteria (Fecal Coliform and/or Enterococci)			X	X

¹ Manatee County: 24 areas x 24 stations/area = 576 stations; Stations sampled 1 x per quarter = 2304 samples annually

² Sarasota County: 6 segments x 5 areas/segment x 12 stations/area = 360 stations; Stations sampled 1 x per year = 360 samples annually

Other watershed data, such as stream flow and surface water and groundwater levels, are collected by a network of gauges maintained by SWFWMD in cooperation with USGS. High resolution rainfall data is collected throughout the region by automated monitoring gauges maintained by USGS, SWFWMD, and the counties.

Priorities

Analysis of water quality status and trends is essential to identify major sources of pollutants, provide accurate measures of pollutant load limits, develop a basis for management plans, and evaluate effectiveness of management practices (WQQ-2). Since its initiation in 1995, long-term coordinated water quality monitoring throughout the region has provided a quantitative basis for determining water quality impairments, estimates of water quality thresholds to maintain seagrass coverage, and identification of numeric nutrient criteria for evaluating estuarine water quality, among other uses.

SBEP will continue to support the long-term, coordinated and standardized collection, quality assurance/quality control, archiving, analysis, and reporting of water quality data. Further, SBEP will collaborate with partners to review and evaluate water and air quality monitoring programs for continuous improvement, especially to fill monitoring gaps. Additional data are needed about nutrient loading from atmospheric deposition, groundwater seepage, sediment flux, and reuse irrigation to update

pollutant loading models. Quantifying spatial and temporal macroalgae biomass trends in the bay is important for understanding the fate of nutrients and the implications of biological storage and release for bay water quality. Estuary circulation models should be reevaluated, especially for Gulf passes where beach replenishment operations occur and for the southern bays where water quality and seagrass do not meet targets. In addition, understanding the effects of climate change on estuary pH through ocean acidification and the mitigating role of seagrass requires further study. Monitoring carbonate chemistry parameters, including total alkalinity and dissolved inorganic carbon can help managers better understand coastal and estuarine acidification. As water temperatures continue to rise in Sarasota Bay, the impacts of increased temperatures, both direct and indirect, should be considered for additional study.



A genus of Red algae - *Gracilaria* spp. (SBEP)

Strategy

Activity WQQ-1.1: Continue support of long-term, coordinated, and timely collection, archiving, analysis, reporting, and quality assurance/quality control of water quality data. Support and enhance timely public communication of water quality monitoring data.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support); County and Municipal Governments (Leads), FDOH, FDEP, FWC, SWFWMD, USGS, USF

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320); County and Municipal Governments

Location: SBEP waterbodies and watersheds

Activity WQQ-1.2: Review and evaluate monitoring programs, increase efficiencies, fill water and air quality monitoring gaps, reevaluate estuary circulation models, identify sources of pollution, and update pollutant sources in pollutant load models.

Timeframe: Ongoing since 1995 CCMP; CCMP Monitoring Strategy complete by 2025

Collaborators: SBEP (Collaborate); Water Quality Consortium (Lead), County Governments, Mote Marine Laboratory, FDEP, FDOH, USF, USGS

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320); County and Municipal Governments; SWFWMD; FDEP

Location: SBEP bays and watersheds

Benefits

Long-term, standardized water quality data that is regularly analyzed and publicly accessible supports identification of waterbody improvements or impairments and management actions to improve water quality.

Five-Year Performance Metric Deliverables:

- (1) Completion of CCMP Monitoring Strategy,
- (2) Creation of a water quality status and trends communication piece.

Water Quality and Quantity Action Plan Objective 2:

Develop improvement plans to maintain, attain, or surpass state water quality standards.

Activity WQQ-2.1

Revise and implement watershed management plans and prioritized projects. Include hydrologic improvement planning in watershed management plans.

Activity WQQ-2.2

Convene a Sarasota Bay Water Quality Consortium and produce a report detailing water quality indicators and a pathway to remediation.

Background

SBEP and partners support the long-standing goal to improve and maintain environmental water quality necessary to support and sustain natural communities and human enjoyment of the bay. Efforts to improve water quality are carried out under the regulatory guidance of the federal Clean Water Act (CWA) cooperatively administered by the USEPA and FDEP. Under the CWA, FDEP classifies waters by degree of highest designated beneficial use — including Class 1 for drinking water, Class 2 for shellfish harvest, and Class 3 for fishing, recreation, and support of healthy fish and wildlife — and develops water quality standards supportive of each designated use. Most Florida and SBEP waters are designated Class 3. A large part of Big Sarasota Bay is designated Class 2 but has been closed to shellfish harvest since 2004 due to bacteria impairment. The Sarasota Bay Estuarine System from Anna Maria Island to Venice is designated by FDEP as an area of “Special Waters - Outstanding Florida Waters.” This designation recognizes the outstanding natural attributes of Sarasota Bay and affords it special protections. From a regulatory standpoint, this means that projects regulated by FDEP or SWFWMD that are proposed within the Sarasota Bay system must not lower water quality as determined at the time of designation, or the year prior to permit request, whichever water quality is better. Exceptions for projects deemed to be “clearly in the public interest” apply (FDEP 2017a).



Seagrass scarring may be avoided by using a pole to get through shallow water. (SBEP)

Water Quality Indicators

The State's numeric water quality standards set maximum thresholds for nutrient pollution in waterbodies, which if not exceeded support the designated waterbody use and protect aquatic life and human health. Recognizing that inland waters have different water chemistry and aquatic life than estuarine waters, the three Southwest Florida NEPs proactively developed estuary-specific numeric nutrient criteria (NNC) (Janicki Environmental, Inc 2010), which were subsequently approved by USEPA and adopted by FDEP (Table WQQ-2). Some of these NNC have recently been determined to be unreliable for Sarasota Bay, and a revised approach to develop NNC criteria was developed, resulting in a proposed new NNC criteria for total nitrogen (Janicki Environmental, Inc 2018). Although the revised criterion improves upon the original criteria, it is not normalized for salinity (rainfall), and may result in false positive conclusions of anthropogenic nutrient impairment in wetter than normal years and false negatives in drier than normal years (Tomasko and Keenan 2019). In addition, in Roberts, Little Sarasota, and Blackburn Bays, existing NNC for Total Nitrogen appear to be too high and are not aligned with other metrics of ecosystem health. Efforts are underway to reevaluate existing NNC criteria. The prime indicators of nutrient pollution in estuaries are excess nitrogen, phosphorous, and chlorophyll-a. The nutrient thresholds are intended to correlate with chlorophyll-a thresholds that meet water clarity targets

necessary to sustain seagrass at or above management targets (Janicki 2008) (WH-5).

To better understand, manage, and report water quality characteristics that produce water clarity supportive of seagrass targets, SBEP developed a water clarity conditions reporting tool (Dixon and Wessel 2017). Directly measuring the amount of light passing through water in shallow estuarine waters is difficult and error prone. Instead, the major contributors to water clarity (water color, chlorophyll, and turbidity) are easily and routinely measured and can be modeled to predict water clarity.

Actual concentrations of nutrients and chlorophyll measured at monitoring stations

(Figure WQQ-1) can vary substantially with annual rainfall and land use patterns in the watershed, so the NNC are defined as annual means for each bay with both recommended targets (an acceptable cautionary level) and regulatory thresholds (a level not to be exceeded). Because of the area's unique geology containing naturally occurring phosphorous in the soils, aquatic primary productivity is limited by and highly responsive to increases in nitrogen, but less so to phosphorous. However, the role of phosphorus in stimulating macroalgae needs to be assessed.

Tidal creeks are significant sources of freshwater to estuaries and provide critical fisheries habitat (WH-3) but have water chemistry different

Table WQQ-2.

Existing and potential updated numeric nutrient criteria (NNC) thresholds for SBEP estuary segments. Potential updates to NNC criteria are based on comparison to reference period (2006-2012) water quality conditions. The State of the Bay report card for Sarasota Bay does not include values for TP, as changes in laboratory techniques over time make comparisons problematic. The report card takes into account values for reference period averages, average values plus a standard deviation, and the highest value recorded for each bay segment during the reference period. Different management responses are required depending upon whether averages, average values plus a standard deviation, or highest values are exceeded.

ESTUARY SEGMENT	Existing Estuarine NNC			Reference Period Average	
	Total Phosphorous Threshold ¹	Total Nitrogen Threshold ¹	Chlorophyll a Threshold ²	Total N ¹	Chlorophyll a
Palma Sola Bay	0.26 mg/L	0.93 mg/L	11.8 µg/L	0.46 mg/L	6.9 µg/L
Big Sarasota Bay	0.19 mg/L	NA ³	6.1 µg/L	0.32 mg/L	3.8 µg/L
Roberts Bay	0.23 mg/L	0.54 mg/L	11.0 µg/L	0.42 mg/L	5.6 µg/L
Little Sarasota Bay	0.21 mg/L	0.60 mg/L	10.4 µg/L	0.48 mg/L	5.8 µg/L
Blackburn Bay	0.21 mg/L	0.43 mg/L	8.2 µg/L	0.31 mg/L	3.8 µg/L

¹ annual geometric mean not to be exceeded more than once in a three-year period

² annual arithmetic mean not to be exceeded more than once in a three-year period

³ annual geometric mean is calculated from monthly arithmetic mean of color by region and season

from estuaries. Early findings suggest that current FDEP narrative water quality criteria for tidal creeks based on dissolved oxygen (DO) and chlorophyll-a may be inaccurate and inadequate as indicators of the health of tidal creeks. Specifically, researchers observed no adverse effects on fish communities in creeks with low DO and high chlorophyll (Janicki and Mote 2016). Water quality in tidal creeks is often quite similar to that of wetlands, except nutrients can enter from both upstream land-based and downstream

estuarine sources. A tidal creeks nutrient Report Card (Figure WQQ-2) and additional indicators of creek condition have been developed to assist in efforts to identify and prioritize creeks for further evaluation and management response based on their nutrient conditions (Janicki and Mote 2019). Bioindicators such as macroalgal blooms, seagrass, and oysters also provide insight into

the health of the estuary and are an important part of the water quality monitoring strategy (WQQ-1, WH-5). Macroalgal blooms can indicate excess nutrient supply. Oysters can accumulate and concentrate trace metals over time and require specific ranges of salinity to survive. Because seagrasses require adequate light for photosynthesis, their presence or absence in a location can be used as an indicator of water clarity, which can be diminished by suspended sediments, particles, and nutrient fueled algal blooms.



Bowlees Creek Inlet, Whitfield Estates, Manatee County. (Marina.com)



Status

Water Quality Status

The Sarasota Bay Estuarine Nutrient Region (ENR) extends from the Manatee Avenue Bridge in Manatee County to the Siesta Key Bridge in Sarasota County and was used to develop NNC for Sarasota Bay. Annual geometric mean total nitrogen concentrations have increased in the Sarasota County portion of the ENR from about 0.2 mg/L in the late 1990s to about 0.4 mg/L in 2015, while chlorophyll concentrations have been relatively stable (Janicki Environmental, Inc. 2019). Over that time, annual geometric mean total nitrogen in the Manatee County portion of the ENR has decreased from about 0.7 mg/L to about 0.4 mg/L, while chlorophyll concentrations have slightly decreased.

In 2019, SBEP noted the likelihood of upcoming impairments in several Bay segments and commissioned a report to investigate whether increasing nitrogen concentrations in SBEP southern bay segments could be explained by changes in rainfall and stormwater runoff, or whether other drivers were responsible (Tomasko and Keenan 2019). Researchers found that increases in total nitrogen (TN) in northern Sarasota Bay areas from New Pass to Palma Sola Bay were consistent with those predicted from increased rainfall/runoff. In Bay segments south of New Pass, including areas east of New Pass and Big Pass, Roberts Bay, Little Sarasota Bay, and Blackburn Bay, increases in TN were found to be above and beyond those which can be explained by changes in rainfall and its effect on salinity and

nitrogen. This suggests for these bay segments, increased nutrient loads from sources with nitrogen concentrations higher than stormwater runoff, such as those associated with wastewater, may be responsible.

In 2021, SBEP completed two important technical products that are essential to bay management. The first of these was the completion of a Water Quality Report Card for the bay that evaluates water quality in each bay segment using four indicators: total nitrogen, chlorophyll-a, seagrass cover, and macroalgae cover. The scores include management recommendations to improve or sustain water quality. Following a peer review process, the Water Quality Report Card, the State of the Bay, was presented to the SBEP's Policy Board for their consideration on May 14, 2021. The Water Quality Report Card, which displays results from each bay segment for the years 2006 to 2021, is now available on the SBEP's website (<https://sarasotabay.org/our-estuaries/state-of-the-bay/>).

In addition to the Water Quality Report Card, SBEP completed the peer review process for a comprehensive pollutant loading model for Sarasota Bay. This latest pollutant loading model includes load estimates for both and Dissolved Inorganic Nitrogen (DIN). While TN refers to all forms of nitrogen loads, the term DIN represents nutrient forms that are immediately available for algal uptake, and thus the most problematic.

Sarasota Bay Estuary Program Ecosystem Health Report Card

Year	Palma Sola Bay	Big Sarasota Bay	Roberts Bay	Little Sarasota Bay	Blackburn Bay
2006	3.67	3.50	3.50	3.75	3.75
2007	3.00	3.25	4.00	3.75	3.75
2008	3.67	3.00	3.00	3.25	3.25
2009	3.67	3.25	3.25	3.50	3.00
2010	3.67	3.75	3.00	2.75	2.75
2011	4.00	3.50	3.00	2.75	2.50
2012	3.00	3.25	3.25	3.00	3.25
2013	3.67	3.00	2.50	2.25	2.25
2014	4.00	3.50	2.50	2.50	2.25
2015	3.67	3.25	2.00	2.25	2.00
2016	3.67	2.75	1.75	2.00	2.25
2017	3.67	2.50	2.00	2.25	2.00
2018	4.00	2.50	2.00	1.50	1.75
2019	3.67	3.00	3.25	1.75	1.75
2020	3.67	3.00	3.00	2.25	2.25
2021	3.75	3.75	3.75	2.75	3.00

Figure WQQ-2. Sarasota Bay Estuary Program Ecosystem Health Report Card, 2006-2021

Based on the pollutant loading model, it appears that DIN loads are approximately twelve tons higher as an annual average during the years 2013 to 2019 compared to the reference period of 2006 to 2012. Combined, these results suggest that DIN load reductions of twelve tons per year (a 20% decrease) would be a logical but preliminary nitrogen load reduction target that will be refined during the development of the Reasonable Assurance Plan for Sarasota Bay, to be initiated in 2022.

- A** All signs indicate healthy water quality; continue to monitor as usual
- B** Most signs indicate healthy water quality; monitor carefully
- C** One or more signs indicate concern; investigate stressors, check for compliance with wastewater and stormwater permits, and plan for management actions
- D** All signs indicate water quality degradation; take management actions

Figure WQQ-3. Sarasota Bay Estuary Program Water Quality Report Card Legend

Water Quality Impairments and Improvement Plans

Under the CWA, FDEP evaluates all waterbodies in Florida on a rotating basis every 5 years and reviews water quality standards every three years. The most recent FDEP assessment of SBEP waterbodies was completed in August 2020. Waterbodies that do not meet water quality standards and have no reasonable plan for improvement are verified and listed as “impaired” for the particular pollutants of concern. FDEP then prioritizes verified impaired waters for Total Maximum Daily Load (TMDL) development. TMDL is a scientific determination of the maximum amount of a pollutant a waterbody can assimilate from all sources and still meet water quality standards. It is a restoration target that allocates “allowable” pollutant loads from the TMDL budget to particular sources of pollution discharging into waterbodies. Once the TMDL is established, specific activities to eliminate “non-allowable” pollutant loads must be implemented.

There are over 1,700 FDEP verified impairments to Florida waterbodies. High priority for TMDL development is given to waters with impairments affecting drinking water sources, human health, and threatened or endangered species — about 10% of the total. SBEP waterbodies have 32 FDEP verified listed impairments for bacteria, nutrients, DO, and metals in 16 creeks and bays (Figure WQQ-4, Table WQQ-3). US EPA approved TMDLs have already been developed for six tidal creeks flowing into the southern bay segments, including Phillippi Creek, Sarasota’s largest

source of freshwater flow. No TMDL development has been required for SBEP bays. The 2006 TMDLs for eleven Sarasota Bay tidal creeks include TN load reduction targets that range from 2 to 63 percent, with an average of 36 percent. These TN load reduction targets do not include estimates of nutrient loads from atmospheric deposition, which results in higher load reduction targets due to not including a fairly sizable source of nutrient loads to the bay.

Basin Management Action Plans (BMAPs) are enforceable comprehensive pollutant cleanup plans developed by FDEP to implement TMDLs that coordinate stakeholders and consolidate efforts, setting a course for restoration of water quality. In a similar process, community stakeholders can voluntarily develop a Reasonable Assurance Plan (“4B Plan”) for water bodies not meeting water quality standards, and thereby pre-empt FDEP’s regulatory steps to list the waterbody as impaired and develop a TMDL and BMAP.

Priorities

Sarasota County has developed watershed management plans for Sarasota Bay (JEA 2012a), Little Sarasota Bay (JEA 2012b) and Roberts Bay (JEA 2010) to evaluate existing water quality characteristics as compared to regulatory thresholds and management targets, estimate current and future pollutant loading, and identify activities and projects for water quality improvement and protection. More than 80 water quality improvement projects are identified for SBEP waterbodies. In June of 2022, Sarasota County updated the Watershed Management Plan for that portion of the Sarasota

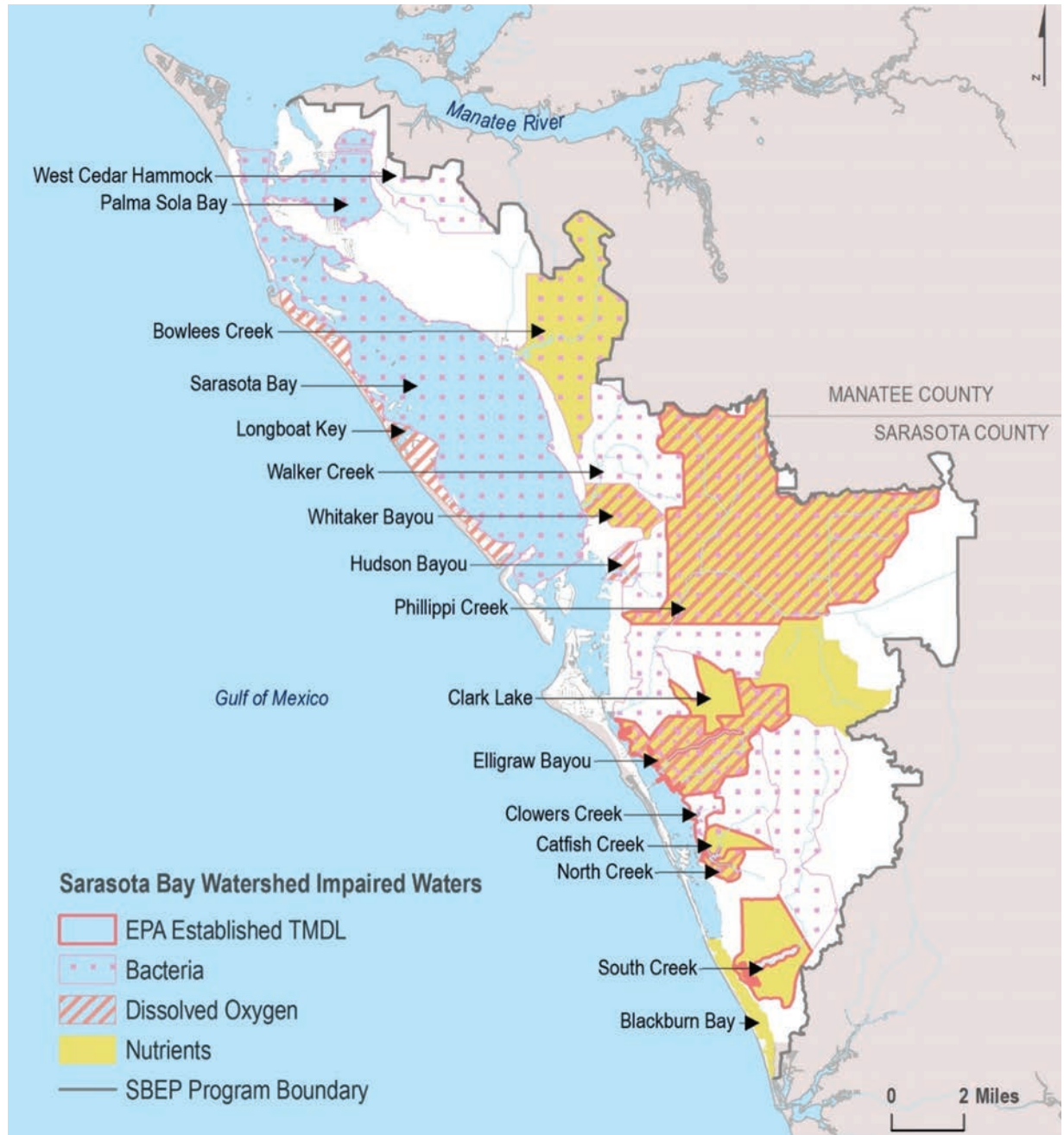


Figure WQQ-4.

Bays and creeks verified impaired for water quality by FDEP using data collected up to 2015. (Source: FDEP Verified Impaired List published August 2020.)

Table WQQ-3. FDEP verified list of impaired waters in SBEP bays and watersheds using monitoring data up to 2015. (FDEP Verified Impaired List published August 2020.)

Water Segment Name	WBID	County	Water-body Class ¹	Parameters Assessed Using the Impaired Waters Rule (IWR)	Dissolved Oxygen/Pollutant of Concern	FDEP Priority for TMDL Development ²
Blackburn Bay	1968F	Sarasota	3M	Nutrients (Total Nitrogen)		Medium
Bowlees Creek	1896	Manatee	3M	Fecal Coliform		Medium
Bowlees Creek	1896	Manatee	3M	Nutrients (Chlorophyll-a)		Medium
Catfish Creek	1984AA	Sarasota	3F	Fecal Coliform		Low
Catfish Creek (Tidal)	1984	Sarasota	3M	Fecal Coliform		Low
Clower Creek Estuary	1975A	Sarasota	3M	Fecal Coliform		High
Clower Creek Estuary	1975A	Sarasota	3M	Copper		Medium
Clower Creek Estuary	1975A	Sarasota	3M	Iron		Medium
Hudson Bayou Drain	1953A	Sarasota	3F	Fecal Coliform		Low
Elligraw Bayou	1975	Sarasota	3M	Fecal Coliform		Low
Elligraw Bayou	1975	Sarasota	3M	Nutrients (Chlorophyll-a)		Medium
Hudson Bayou Tidal	1953	Sarasota	3M	Dissolved Oxygen	Biochemical Oxygen Demand	Medium
Hudson Bayou Tidal	1953	Sarasota	3M	Fecal Coliform		Low
Longboat Key	1916	Manatee, Sarasota	3M	Dissolved Oxygen	Biochemical Oxygen Demand	Medium
Matheny Creek	1975B	Sarasota	3F	Fecal Coliform		Low
North Creek (Tidal)	1984A	Sarasota	3M	Dissolved Oxygen	Total Nitrogen, Total Phosphorus, Biochemical Oxygen Demand	Medium
North Creek (Tidal)	1984A	Sarasota	3M	Iron		Medium
North Creek (Tidal)	1984A	Sarasota	3M	Nutrients (Chlorophyll-a)		High
North Creek (Tidal)	1984A	Sarasota	3M	Fecal Coliform		Low
Palma Sola Bay	1883	Manatee	2	Fecal Coliform		Low
Palma Sola North	1883B	Manatee	3M	Bacteria (Beach Advisories)		Medium
Palma Sola South	1883C	Manatee	3M	Bacteria (Beach Advisories)		Medium
Philippi Creek Tributary	1966	Sarasota	3F	Nutrients (Macrophytes)		Medium
Philippi Creek	1937	Sarasota	3F	Fecal Coliform		Medium
Philippi Creek (Tidal)	1947	Sarasota	3M	Fecal Coliform		Low
Sarasota Bay	1968B	Manatee, Sarasota	2	Bacteria (in Shellfish)		Low
South Creek	1982	Sarasota	3F	Fecal Coliform		Low
Walker Creek	1936A	Manatee, Sarasota	3F	Fecal Coliform		Low
West Cedar Hammock	1885A	Manatee	3M	Fecal Coliform		Low
Whitaker Bayou (Tidal)	1936	Sarasota	3M	Dissolved Oxygen	Total Nitrogen, Total Phosphorus, Biochemical Oxygen Demand	High
Whitaker Bayou (Tidal)	1936	Sarasota	3M	Fecal Coliform		Low
Whitaker Bayou (Tidal)	1936	Sarasota	3M	Nutrients (Chlorophyll-a)		High

¹ Florida's has five waterbody classifications, including Class 2 – shellfish propagation or harvesting and class 3 – recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in (M) marine or (F) freshwater.

² Where a parameter was identified as impaired under the Impaired Waters Rule, a priority of “medium” was assigned by FDEP. Exceptions are waters where the impairment poses a threat to potable water or human health, which have been assigned a “high” priority, and fecal coliform impairments, which have been assigned a “low” priority. All other listings are prioritized by FDEP based on the following: listings with a “High” priority should be addressed within the next 5 years, listings with a “Medium” priority should be addressed within 5-10 years as resources allow, and listings with a “Low” priority should be addressed within the next 10 years.

Bay watershed within Sarasota County. That plan included an updated pollutant loading model and a list of recommended stormwater retrofit projects.

Manatee County is working with SWFWMD to leverage RESTORE Act funds to develop watershed management plans for priority tidal tributaries, including Bowlees Creek and Cedar Hammock Drain. These creeks flow from watersheds characterized by older development lacking modern stormwater management systems and have verified listed impairments. The completed watershed plans will include hydrologic/hydraulic modeling, an inventory of existing stormwater infrastructure, and prioritized projects to address water quality and flooding

problems using green infrastructure solutions (see WQQ-4) where possible.

The Southwest Florida Water Management District (SWFWMD) classifies Sarasota Bay as a priority water body for protection and restoration through its Surface Water Improvement and Management (SWIM) program, which develops watershed management plans to evaluate priority waterbodies and identify improvement projects. SWFWMD works with SBEP, FDEP, and local governments to implement projects from the Sarasota Bay SWIM Plan (SWFWMD 2002) that improve coastal and wetland habitat quality and reduce water pollution through installation of stormwater BMPs.

An update to the SWIM Plan is expected after the completion of this CCMP update.

There is an urgent need to reduce pollutants and contaminants, avoid impairments, and increase estuary resilience to unpredictable stressors such as hurricanes, HABs, and climate change. SBEP will continue to participate in developing and updating water quality management plans and implement water quality and habitat improvement projects (see WH-1), especially for older developments in coastal areas lacking modern stormwater management systems. There is also a need to develop or reevaluate water quality indicators and targets, fill data gaps (see WQQ-1), and update pollutant loading models to achieve a more holistic and robust assessment of impairments, and the required actions to restore water quality to degraded waters.

In 2021, SBEP convened a Water Quality Consortium of a broad group of stakeholders in response to several Bays receiving impairments (Table WQQ-3). The Water Quality Consortium was established in the 2004 SBEP Interlocal Agreement with the mandate to “develop an Action Plan [...] to address the goals for cumulative water quality improvement in bay segments verified by FDEP as impaired.” During the meeting, SBEP’s local government partners presented their commitments to spend over \$600 million to reduce nutrient loads to SBEP bays via upgrades to wastewater and stormwater infrastructure. These planned investments will be included in the upcoming Reasonable Assurance Plan for SBEP bays.



Strategy

Activity WQQ-2.1: Revise and implement watershed management plans and prioritized projects. Include hydrologic improvement planning in watershed management plans.

Timeframe: Ongoing since 2014 CCMP; Update Sarasota Bay Watershed Management Plan by 2022

Collaborators: Collaborate), County and Municipal Governments (Leads), SWFWMD SBEP

Projected Five-Year Costs and Funding Sources: \$\$\$\$\$/County and Municipal Governments, SWFWMD

Location: SBEP waterbodies and watersheds

Activity WQQ-2.2: Convene a Sarasota Bay Water Quality Consortium and produce a report detailing water quality indicators and a pathway to remediation.

Timeframe: New activity; Convene Water Quality Consortium in 2021; Reasonable Assurance Plan complete by 2026

Collaborators: SBEP (Conduct/Lead), County & Municipal Governments, FDEP

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (CWA 320), Sarasota County, Manatee County, Town of Longboat Key, City of Bradenton, FDEP, SWFWMD

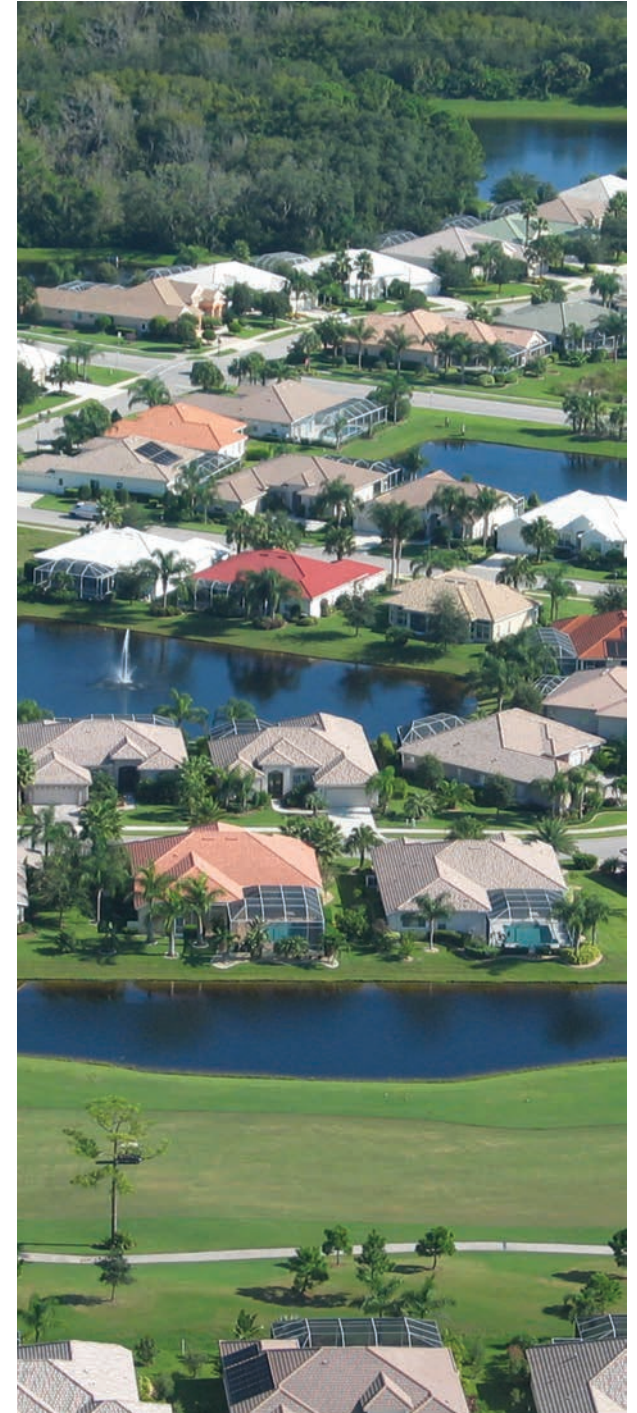
Location: SBEP waterbodies and watersheds

Benefits

Watershed management plans and projects developed from accurate nutrient pollutant loading models and science-based criteria for water quality indicators, targets, and thresholds result in measurable water quality improvements.

Five-Year Performance Metric Deliverables:

- (1) establishment of a Water Quality Consortium,
- (2) report detailing water quality indicators and a pathway to remediation,
- (3) prioritized list of water quality projects.



Water Quality and Quantity Action Plan Objective 3:

Improve and manage hydrology for a more natural pattern of timing, quantity, and distribution of surface water flows.

Activity WQQ-3.1

Understand historic, current, and projected hydrologic regimes, accounting for projected climate change and the role of beneficial reuse; identify and prioritize hydrologic improvement projects.

Activity WQQ-3.2

Support floodplain management that benefits resiliency to flooding and climate change, stormwater quality and quantity improvement, nutrient reduction, and flowway and floodplain restoration to mimic natural system function.



Ken Thompson Park and Longboat Key.
(Mote Marine Laboratory)

Background

Human activities have profoundly altered the natural hydrology of all SBEP watersheds. Historically, the slow-draining Southwest Florida landscape was dotted with chains of wetlands, linked by shallow, meandering creeks. Beginning in the 1920s, spasms of development, systematically reengineered water flow through watersheds. Natural areas were hardened with rooftops and roads, natural creeks were channelized straighter and deeper, wetlands were ditched, and floodplains were connected via canals and pipes into large drainage networks. Freshwater flows, volumes, and timing were redirected, impeded, or accelerated, vastly increasing the rate and volume of freshwater reaching the estuary, bringing with it high levels of contaminated and polluted runoff.

Variability in the timing, volume, velocity, and location of freshwater flows can regulate the suitability of a habitat to sustain salinity-sensitive biological communities (Estevez 1991, Morrison and Greening 2011). When streamflow volume is chronically reduced so that tidal saltwater replaces the historical freshwater regime, freshwater biological communities may be displaced. Similarly, if too much freshwater chronically floods a traditionally high-salinity habitat, biological communities requiring saline waters may be displaced. Some species can tolerate physiological stress related to suboptimum salinity regimes for limited durations; however, if the alteration becomes chronic or permanent, they too will be displaced.

Climate change is expected to impact natural hydrology in SBEP waterbodies and watersheds due to rising seas and changing precipitation patterns (SBEP and Shafer 2017). Rainfall intensities are projected to increase during the wet season and more days without rain are expected during the dry season (Easterling 2017). Increased flooding during more intense rainfall events may flood natural areas and overwhelm infrastructure designed to manage stormwater. Changes in freshwater input into creeks and bays will likely alter their chemical, physical, and ecological characteristics, further disrupting salinity regimes that are important in their role as nursery and forage areas for aquatic life.

Climate change impacts will be compounded by continued development pressure and increased demands for further alteration and drainage to reduce impacts of increased flooding (Twilley 2001). The community's priority response to these changes may be to build more protective structures and barriers to prevent flooding and water intrusion into built environments, while abandoning infrastructure that becomes obsolete. Remaining natural floodplains and flowways require attention in order to remain unaltered by future development projects. Retrofitting and restoring important ecosystem services lost due to development can be costly. It is more cost-effective to protect natural areas during development planning than to try to restore them post-impact, which is one reason why

Status

the conservation of natural floodplains and flowways is an ongoing SBEP priority (see WH-2 and WH-4).

Hydrologic restoration considers the complex interaction of surface water and groundwater flow in order to integrate and balance natural system preservation, water supply, water quality, and flood protection under different climatic and hydrologic conditions. Effective planning determines how much water an ecosystem needs, where water is located, how it can be safely distributed to those areas of need, and how water quality can be protected and improved in the process.

The largest hydrologic restoration project in SBEP watersheds is the Celery Fields Regional Stormwater Facility. Its 440 acres of created wetlands and ponds store stormwater and release it slowly to Phillippi Creek, preventing flooding in downstream neighborhoods. The project was so successful in restoring wetlands that the Celery Fields have become a world-renowned birding and recreation area. Further downstream, the Pinecraft levee project helps manage flow volume to prevent flooding. Phillippi Creek, which drains SBEP's largest watershed, is a highly altered network of over 100 miles of manmade canals flowing into seven miles of tidal creek. Large-scale canal construction began in the 1920s and expanded the size of the Phillippi Creek watershed from 28 to 56 square miles.

In natural meandering creeks, sediments are often shaped into point bars and natural levees, increasing the creek's geomorphic and biological diversity (Wood 2019). Pools, pockets of vegetation, wood substrates, and leaf packs in natural creeks increase the diversity and abundance of creek life. In contrast, deep straight canals provide little water quality improvement and habitat value. They also require frequent and costly maintenance, including mowing, application of herbicides, removal of debris, dredging, and repairing eroded banks. In 2015, Sarasota County spent \$6.6 million maintaining Phillippi Creek canals, with some canals requiring significantly more maintenance than others. For example, from 2008–2015, less than 30% of the canals were responsible for 90% of the costs — with just 14 canals responsible for half the costs.



The largest hydrologic restoration project in SBEP watersheds is the Celery Fields Regional Stormwater Facility. (WUSF Public Media, Tom Matrullo)



Phillippi Creek (upper right) as it enters Roberts Bay, Sarasota. (SBEP)

Priorities

Sarasota County is developing a Phillippi Creek restoration strategy that involves retrofitting man-made canals to mimic the natural function of the original creek (Wood 2019). Canals can be reengineered to incorporate shallow, broad, vegetated, and serpentine stream-like components that create variable patterns of flows and eddies. This nature-based design improves water quality and creates fish habitat and can be done without compromising flood protection. Wood (2019) prioritized areas within the Phillippi Creek drainage network that were most subject to erosion and repetitive high maintenance costs.

The partial dam on Phillippi Creek near the Southgate Community Center no longer serves a functional purpose and has been evaluated for removal. With removal of obsolete dams, waterways can realize significant gains in water quality, flood control, recreational opportunities, habitat improvement, and public safety (USEPA 2016b).

In many areas of the developed watershed, it is not feasible to return altered waterways to their original state. Nevertheless, there are many opportunities for hydrologic improvements that provide multiple benefits of flood protection, wetland restoration, increased recreational opportunities, and improved water quality. Over 80 such projects are detailed in watershed management plans for Sarasota Bay (JEA 2012a, to be updated in 2021), Little Sarasota Bay (JEA 2012b), Roberts Bay (JEA 2010), and Bowlees Creek (to be completed 2021) as well as the County Floodplain Management Plans and SWFWMD's Sarasota Bay Surface Water Improvement Management Plan (SWFWMD 2002). SBEP continues to prioritize hydrologic protection and restoration by reestablishing landscape scale floodplains, protecting wetlands, and protecting tidal tributary isohaline zones to support critical habitat migration and improve resilience of natural systems (see Watershed Habitats Action Plan). Projects in the

SBEP Five-Year Habitat Restoration Plan (see WH-1) are scored for their potential to restore natural floodplain function. Projects with significant potential to retain or slow stormwater flow are awarded more points than projects without hydrologic restoration potential.

In 2021, SBEP and Manatee County completed 60% plans and applied for construction permits for a priority creek restoration project at GT Bray Park in Bradenton. The project will restore tidal creek habitat in a heavily altered system and provide educational opportunities for park visitors.

Ongoing and future comprehensive watershed management planning and project design must consider projected climate change impacts on water availability and flow regimes. They should also consider the cost-benefits of capture and beneficial reuse of stormwater (APA 2010), both as a water conservation measure and to reduce excess flow to the estuary.

Strategy

Activity WQQ-3.1: Understand historic, current, and projected hydrologic regimes, accounting for projected climate change and the role of beneficial reuse. Identify and prioritize hydrologic improvement projects.

Timeframe: New activity; Update Sarasota Bay Watershed Management Plan by 2022.

Collaborators: SBEP (Collaborate), County and Municipal Governments (Leads), SWFWMD, USGS

Projected Five-Year Costs and Funding Sources: \$\$\$/County and Municipal Governments; SWFWMD

Location: SBEP priority hydrologic alteration areas.

Activity WQQ-3.2: Support floodplain management that benefits resiliency to flooding and climate change, stormwater quality and quantity improvement, nutrient reduction, and flowway and floodplain restoration to mimic natural system function.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SSBEP (Coordinate), County and Municipal Governments (Co-leads), SWFWMD (Co-lead), FEMA (Co-lead)

Projected Five-Year Costs and Funding Sources: \$\$\$\$\$/County and Municipal Governments; SWFWMD

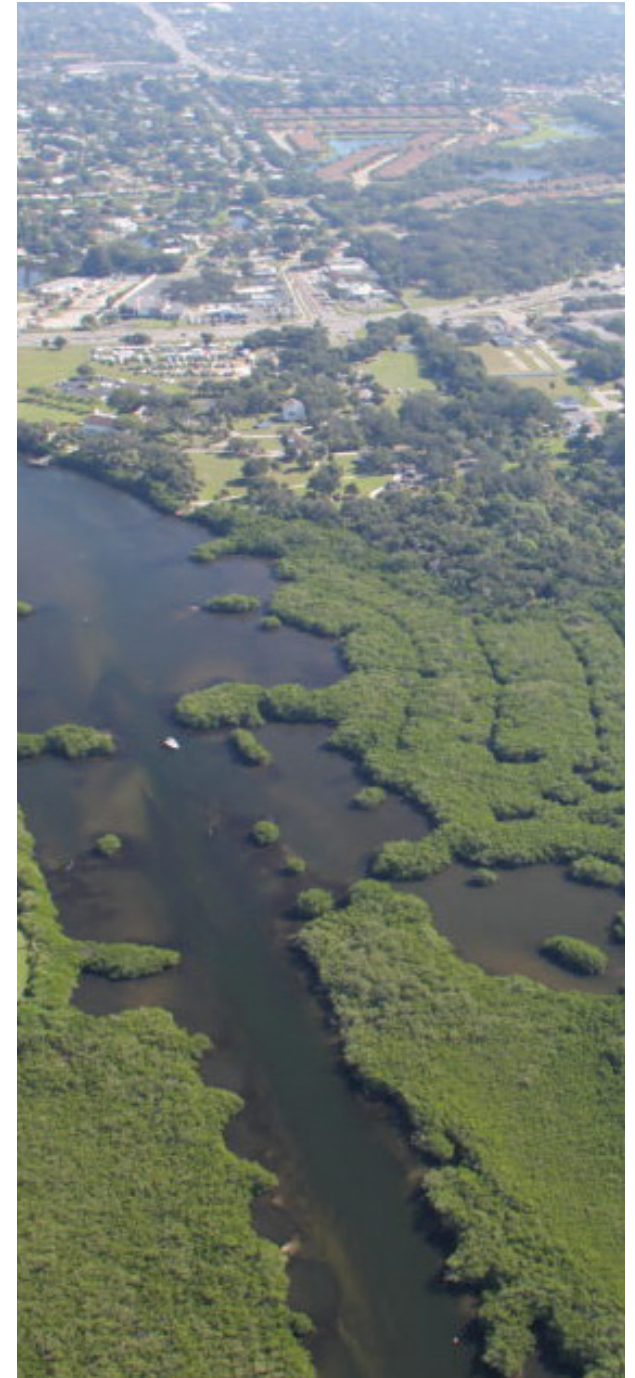
Location: SBEP priority hydrologic alteration areas.

Benefits

Improving hydrology to a more natural state provides multiple benefits for water quality, recreation, habitat, and flood protection.

Five-Year Performance Metric Deliverable:

Completion of an inventory of prioritized (funded) projects for hydrologic restoration.



Phillippi Creek, Sarasota. (SBEP)

Water Quality and Quantity Action Plan Objective 4:

Reduce pollutant loading from stormwater.

Activity WQQ-4.1

Support development and adoption of green infrastructure and smart growth standards in comprehensive land-use plans and land development regulations, including stormwater rules and design manuals, to reduce stormwater quantity and pollutant loading.

Activity WQQ-4.2

Install green infrastructure projects to improve stormwater management for efficient pollution reduction and flood control.

Activity WQQ-4.3

Establish the fee structure for the Manatee County stormwater utility and consider utilizing stormwater utility funding for water quality improvement projects, especially green infrastructure.

Activity WQQ-4.4

Evaluate nutrient removal performance and cost-benefits of nutrient removal BMPs. Support development of a homeowner/HOA BMP manual and a model vendor contract supportive of water quality.

Background

One of Florida's most abundant natural resources is rainwater. SBEP watersheds typically receive 45 inches or more of rainfall on an annual basis. In natural areas, rainfall is intercepted by tree canopies, evaporates, filters into soil, and/or flows slowly over land to collect in waterbodies, nourishing wetlands and wildlife. Development to support human population growth commonly converts pervious natural habitats to impervious rooftops, roads, and parking lots, causing rainfall to accumulate into increased quantities of stormwater runoff. Historically, stormwater management in Florida focused on collecting and rapidly moving stormwater away from development for flood protection. As it flows across developed land, stormwater accumulates pollutants and contaminants from human activities, causing water quality problems for collecting waterbodies. Urban stormwater is the primary pathway of pollutant loading to SBEP waters.

Stormwater management in SBEP watersheds will become more challenging with projected changes in rainfall patterns due to climate change (SBEP and Shafer 2017). Increased water vapor due to warming air and water temperatures is expected to increase the frequency and intensity of precipitation extremes (Easterling 2017). Stormwater created by the first rain after prolonged dry periods will likely have higher concentrations of nutrients and possibly bacteria, and increased storm intensity



Downtown Sarasota. (Patti Cross)

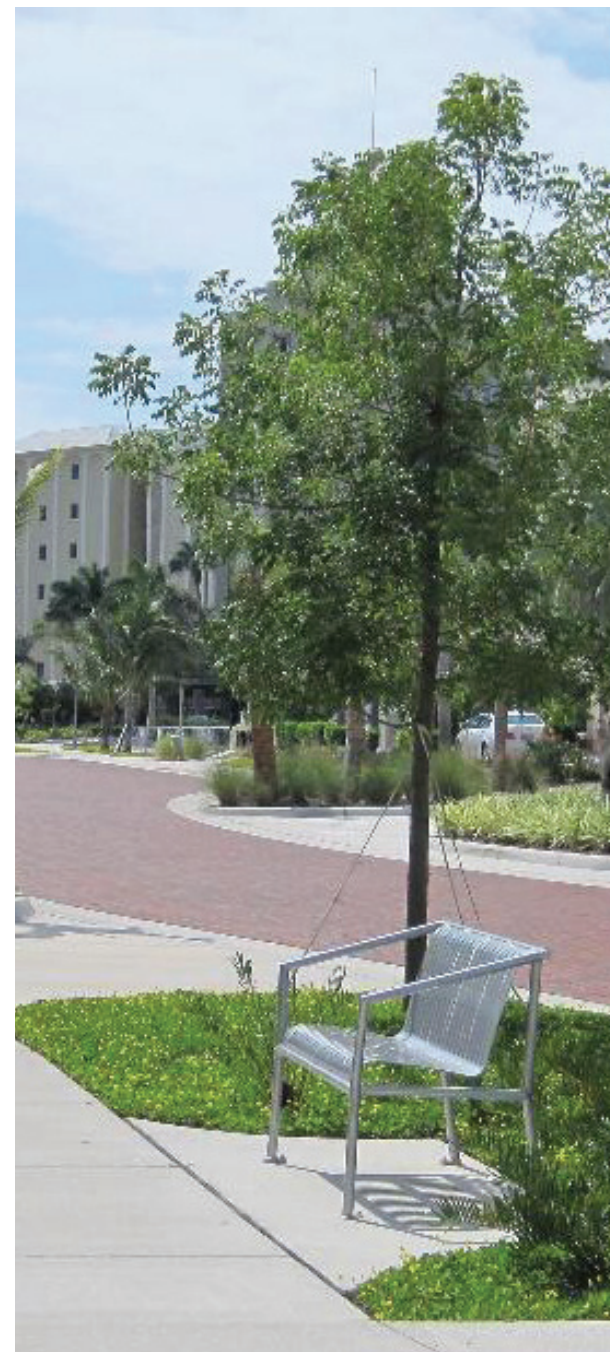
will likely increase erosion and sediment loads in stormwater. Heavier rain events or longer droughts with warmer temperatures may affect the biological and mechanical functions of stormwater treatment systems such as vegetated swales and stormwater detention ponds, which could compromise their ability to filter sediment, toxins, trash, and nutrients from stormwater and to modulate the flow of freshwater to the estuary. Rising sea levels will interfere with the function of gravity-fed pipes and outfall systems in areas directly along the coastline, creating more nuisance flooding. Impacts will be more severe in older coastal neighborhoods where little or no stormwater treatment infrastructure exists and where stormwater flows untreated directly into natural waterbodies.

Sources of nutrient pollution to stormwater include excessive application of fertilizers, animal waste, septic systems (WQQ-5), wastewater spills and overflows (WQQ-6), reuse irrigation (WQQ-6), and atmospheric emissions from engines and powerplants that fall back to the watershed through both wet and dry deposition (WQQ-7). The type and concentration of stormwater pollution varies based on amount of rainfall and land use. Typical urban stormwater runoff contains about 2.0–2.4 mg/L total nitrogen and 0.3–0.5 mg/L total phosphorous, values that are substantially higher than state guidance for ambient water quality in estuaries.(WQQ-2) (Sarasota County 2015).

Status

The most effective way to reduce polluted stormwater runoff is to reduce the availability of pollutants and contaminants to stormwater. Fertilizer ordinances prohibiting nitrogen and phosphorus-based application in the summer wet season continue to be implemented in all jurisdictions throughout SBEP watersheds. SBEP participates in fertilizer and pet waste education and supports UF IFAS's Florida Friendly Landscaping™ program. Street sweeping is also an effective strategy to reduce pollutant and contaminant availability. For example, in 2018 the City of Sarasota swept 8,208 miles of streets to remove 1,547 tons of sediment, 66.67 tons of litter, 1,742 pounds of nitrogen, and 1,117 pounds of phosphorous.

Modern stormwater management systems work to replicate the function of natural systems, allowing pollutants and contaminants to be removed by soils and plants, and water to percolate into the ground. Stormwater treatment projects identified in regional water quality management plans have been constructed in Phillippi Creek, Hudson Bayou, and Catfish Creek watersheds and initiated in the Whitaker Bayou watershed. Manatee County is developing projects for Bowlees Creek and aims to establish a county-wide stormwater utility to fund more water quality projects. Coastal stormwater treatment retrofits were installed in the City of Bradenton Beach and City of Sarasota. Various treatment techniques are strategically designed and located to work together to treat urban stormwater drainage over hundreds of acres.



Low Impact Design (LID). A Green Streets project, downtown Sarasota. (SBEP)

Techniques employed in SBEP watersheds include bioswale enhancement, exotic plant removal, bay friendly plantings, sediment removal, wetland creation, stream bank re-sloping and restoration, baffle boxes, infiltration basins, weirs, and erosion control matting.

Priorities

In the urbanized SBEP watershed, especially in older developments where large projects are impractical or too expensive, a series of smaller green infrastructure practices can be linked together to form an effective treatment train. Green infrastructure practices, also known as Low Impact Development or Low Impact Design (LID), work with natural elements to reduce and treat stormwater at its source, minimizing the

volume of water and pollution emanating from the constructed environment.

Examples of green infrastructure practices include:

- Canopy trees and green roofs to intercept rainfall before it hits the ground
- Rainwater harvesting systems, such as rain barrels and cisterns, to capture rainfall and store it for later use
- Vegetative buffers and littoral zones around shorelines, ponds, and waterways to filter pollutants and litter from runoff before it enters a waterbody
- Pervious surfaces for parking areas, walkways, and drives — like pavers, bricks, or gravel, to reduce runoff after light rainfalls, allowing gradual infiltration of rainfall into underlying soils

- Rain gardens, vegetated swales, and recessed tree islands to capture runoff and allow it to evaporate, percolate into the ground, or be used by vegetation
- Stormwater parks to combine recreational opportunities, public amenities, wildlife habitat, flood protection, and stormwater storage and treatment into one area

Most stormwater treatment opportunities are on privately owned property. Barriers to implementing green infrastructure include limited education and training opportunities, Homeowner Association rules and deed restrictions, and conflicting language in comprehensive plans and development codes. A widely distributed comprehensive guide for homeowners, analogous to the detailed guidance provided to farmers and



Example of grassy swale (left) and same swale with native plants (right) to increase evaporation of water and increase pollutant removal. (SBEP)

golf course managers, would improve the public's understanding and capacity to identify and reduce their nutrient pollution footprint through recommended practices and do-it-yourself DIY green infrastructure projects around the home and neighborhood.

Sarasota County's Low Impact Development (LID) Guidance Document provides technical support to professionals seeking to implement LID-integrated stormwater management practices in their project (Sarasota County 2015). The document provides county-specific technical guidance and design specifications on the design, construction, operations, and maintenance specifications for LID practices, including shallow bioretention, pervious pavements, stormwater harvesting, green roof stormwater treatment systems, rainwater harvesting, and detention with biofiltration. It also provides permitting guidance for meeting Environmental Resource Permit Basis for Review and Sarasota County Land Development Regulation. Increased outreach and education to professionals engaged in planning, designing, constructing, operating, and maintaining building and development projects in Sarasota County about LID and how to use the Guidance Document may expand the use of LID in SBEP watersheds. SBEP supports development and adoption of green infrastructure and smart growth standards in comprehensive land-use plans and land development regulations.





Green roof. (SBEP)

Strategy

Activity WQQ-4.1: Support development and adoption of green infrastructure and smart growth standards in comprehensive land-use plans and land development regulations, including stormwater rules and design manuals, to reduce stormwater quantity and pollutant loading.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), County and Municipal Governments (Leads)

Projected Five-Year Costs and Funding Sources:

\$/County and Municipal Governments, Sarasota-Manatee Metropolitan Planning Organization (MPO)

Location: SBEP watersheds

Activity WQQ-4.2: Install green infrastructure projects to improve stormwater management for efficient pollution reduction and flood control.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Coordinate/ Collaborate); County & Municipal Governments; SWFWMD; FDEP; FDOT

Projected Five-Year Costs and Funding Sources:

\$\$\$\$/SWFWMD; FDEP; County and Municipal Governments; FDOT; MPO

Location: SBEP watersheds

Activity WQQ-4.3: Establish the fee schedule for the Manatee County stormwater utility and consider utilizing stormwater utility funding for water quality improvement projects, especially green infrastructure.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), Manatee County (Lead)

Projected Five-Year Costs and Funding Sources:

\$/Manatee County

Location: Manatee County

Activity WQQ-4.4: Evaluate nutrient removal performance and cost-benefits of nutrient removal BMPs. Support development of a homeowner/HOA BMP manual and a model vendor contract supportive of water quality.

Timeframe: New activity; BMP manual development began in 2021

Collaborators: SBEP (Collaborate), UF/IFAS Extension (Lead), Sarasota County, FDEP

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320); UF/IFAS Extension; US EPA

Location: SBEP watersheds

Benefits

Reduced pollutant loading from stormwater improves water quality necessary for human uses and healthy aquatic systems.

Five-Year Performance Metric Deliverable:

Creation of an HOA/homeowner BMP manual for residential LID practices.



Water Quality and Quantity Action Plan Objective 5:

Reduce pollutant loading from septic and other onsite sewage treatment and disposal systems.

Activity WQQ-5.1

Continue conversion of septic systems to centralized sewer systems and consolidation of small wastewater treatment plants, prioritized in coastal areas.

Activity WQQ-5.2

Encourage regular inspection and maintenance of septic systems and installation of supplemental and advanced septic system technologies, prioritized in coastal areas and basins with impaired waters.

Activity WQQ-5.3

Improve inventory and mapping of septic and other onsite sewage treatment and disposal systems and increase understanding about septic system capacity to treat nutrient pollution and pathogens under different site conditions, including climate change.

Background

Untreated or partially treated sewage contains nutrients, bacteria, chemicals, microplastics, and pharmaceuticals harmful to the environment and public health. Commercial and residential properties not serviced by modern wastewater treatment facilities commonly use onsite sewage treatment and disposal systems (OSTDS) like septic systems to treat sewage on their property. Conventional septic systems are primarily designed to treat bacteria and other pathogens, though they do provide some nutrient treatment. They provide little to no treatment of pharmaceuticals and no treatment of microplastics.

In some areas, septic systems can be a significant source of pollution in Florida surface and groundwaters. For example, high concentrations of nitrogen and bacteria were found down gradient from septic systems in Charlotte Harbor (Lapointe 2016). There is a need to better understand nutrient and bacteria loading from septic systems in SBEP watersheds, especially near priority and impaired waterbodies.

From a water quality management perspective, nitrogen is the primary nutrient pollutant of concern in sewage. Even when properly sited, operated, and maintained, conventional septic tanks and drainfields only remove 30 to 40% of nitrogen (Toor 2011). However, substantial reductions of nitrogen can also occur via denitrification in soils when conditions are favorable. When septic systems are improperly sited, operated, or maintained, they can be

even less effective. For example, drainfields sited in areas with poor soil types and shallow water tables or in areas prone to saturation during rainstorms will have diminished treatment capacity.

Safeguarding adequate depth between the bottom of the drainfield and groundwater is important to reducing nitrogen loading to waterbodies. Since 1983, Florida has required at least a two-foot separation between the bottom of the drainfield and the seasonal high-water table. Both Manatee County and Sarasota County Governments require a three-foot separation. Before 1983, only one foot was required. Because many coastal areas in SBEP watersheds were developed before 1983, protective distances between drainfields and groundwater may not occur in older neighborhoods with pre-1983 septic systems. Climate change is expected to increase rainfall intensity and sea levels in SBEP waters and watersheds (SBEP and Shafer 2017).

These stressors may increase flooding and soil saturation, raise groundwater levels, and further reduce the treatment effectiveness of septic system drainfields, if those systems are not elevated in some manner (Cooper 2016, M-DCDR&ER 2018).

Ensuring adequate distance between the drainfield and surface waters is also important for preventing nitrogen loading to waterbodies. Florida requires a minimum 75-foot setback

between a septic drainfield and bays, rivers, streams, canals, lakes, or ponds. Since June 15, 1983, Sarasota County Government requires a 100-foot minimum setback. On lots platted before June 15, 1983, Sarasota County requires a 50-foot minimum setback. Manatee County requires a 75-foot minimum setback or a 50-foot setback on lots platted before January 1, 1972.

Improper use and maintenance of septic systems can also lead to reduced treatment performance or failure. Tanks and drainfields of septic systems deteriorate over time. Although conventional systems have a functional lifespan of about 25 years, many systems in SBEP watersheds are older. Solids and scum that cannot be digested in the tank accumulate and must be physically removed every 3–5 years to avoid backups

or damage to the drainfield. Soils can be compacted over drainfields or roots of shrubs and trees can interfere with proper drainfield operation. Disposing harmful chemicals or undigestible items into septic systems reduces the effectiveness of bacteria and can clog and damage systems.

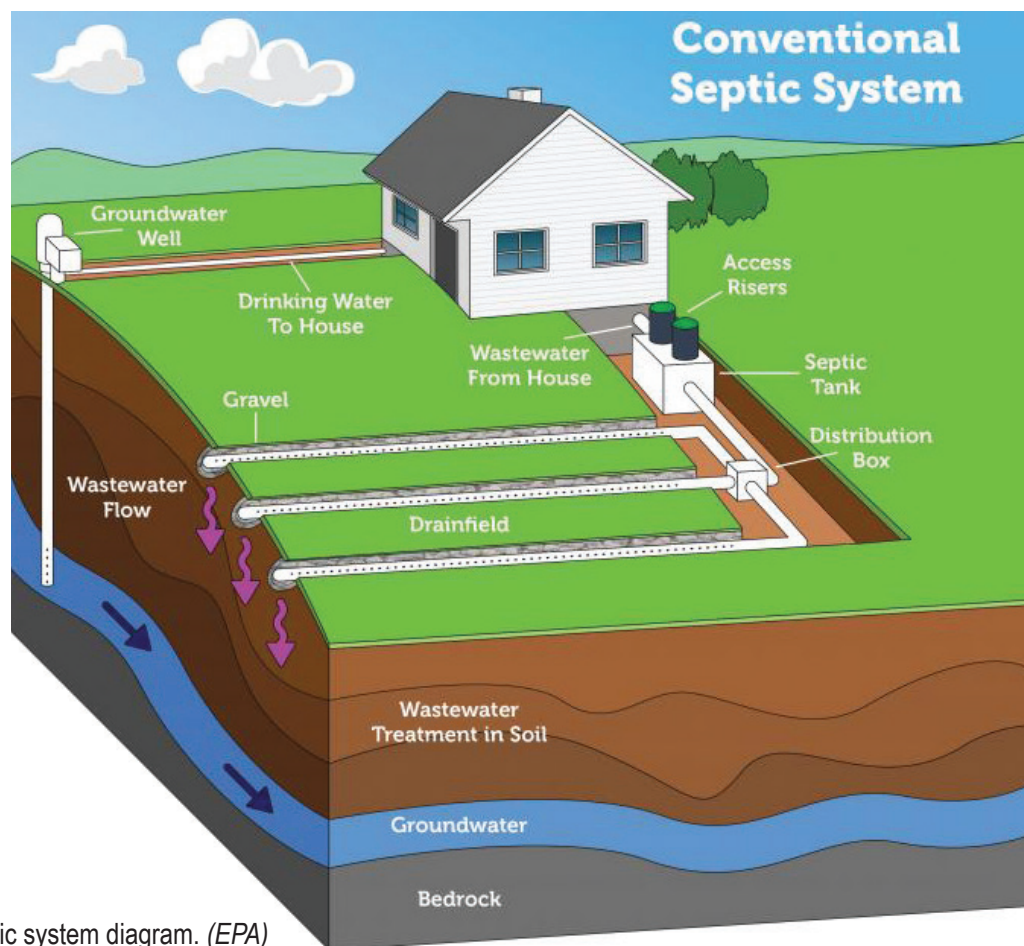
Status

Management of pollutant loading from septic systems in SBEP watersheds has focused on research to inventory the location of septic systems, outreach and education to encourage owners to properly use and maintain systems, and capital projects to convert septic systems to central sewer service in priority areas.

Inventory and Status

Understanding the location and status of septic systems operating in SBEP watersheds is fundamental to assessing and managing their environmental impacts. Currently, the inventory of septic systems in SBEP watersheds is unverified, inaccurate, and missing key data on system build and status.

FDOH's statewide Florida Water Management Inventory (FLWMI, FDOH 2016) estimates that there are 26,646 "known", "likely", or "somewhat likely" parcels using septic systems in SBEP watersheds (Table WQQ-4). Most exist in older coastal communities, including Anna Maria, Holmes Beach, Palma Sola Bay, Bayshore Gardens,



Septic system diagram. (EPA)

Whitfield, Vamo, Casey Key, neighborhoods adjacent to Dona Bay, South Venice, and Manasota Key.

Sarasota County Government conducted its own septic system inventory in 2019, finding 13,342 parcels either “known” or “likely” to use septic systems in the Sarasota County portion of SBEP watersheds — 5,251 parcels more than the FLWMI estimate (Table WQQ-4).

Many data on septic system locations are unverified and there are significant inconsistencies between FDOH and Sarasota County data. To address these shortcomings, local legislators filed bills in the State House and Senate in 2019 (HB 85 and SB 214) requiring FDOH to identify and map all septic systems in the state. Both bills failed to make it out of committee.

Use and Maintenance

There are no operation or maintenance requirements for septic systems in SBEP watersheds and no data exist to quantify how many systems are properly used and maintained. The only management tool currently available to encourage best practices

is outreach and education. SBEP, Science and Environment Council, Sarasota County Government, University of Florida Institute of Food and Agricultural Science (UF/IFAS), and the USEPA provide limited outreach and education about septic system use and maintenance (see Community Engagement Action Plan).

In 2010, Florida recognized that voluntary maintenance of septic systems was not enough to ensure septic systems were operating in ways that protected public health and the environment. In response, the state adopted a statewide mandatory septic system evaluation and maintenance requirement. However, the state legislature repealed the law in 2012. In 2019, following severe episodes of blue-green algal blooms, macroalgal blooms, and red tide, local legislators introduced State House Bill 85 and Senate Bill 214 to require statewide septic system maintenance every five years, but both bills failed to make it out of committee. Later in the year, the State’s Blue-Green Algae Task Force recommended that Florida develop and implement a septic

system inspection and monitoring program to identify improperly functioning or failing systems (BGATF 2019).

Advanced Septic Systems and Conversion of Septic to Central Sewer Service

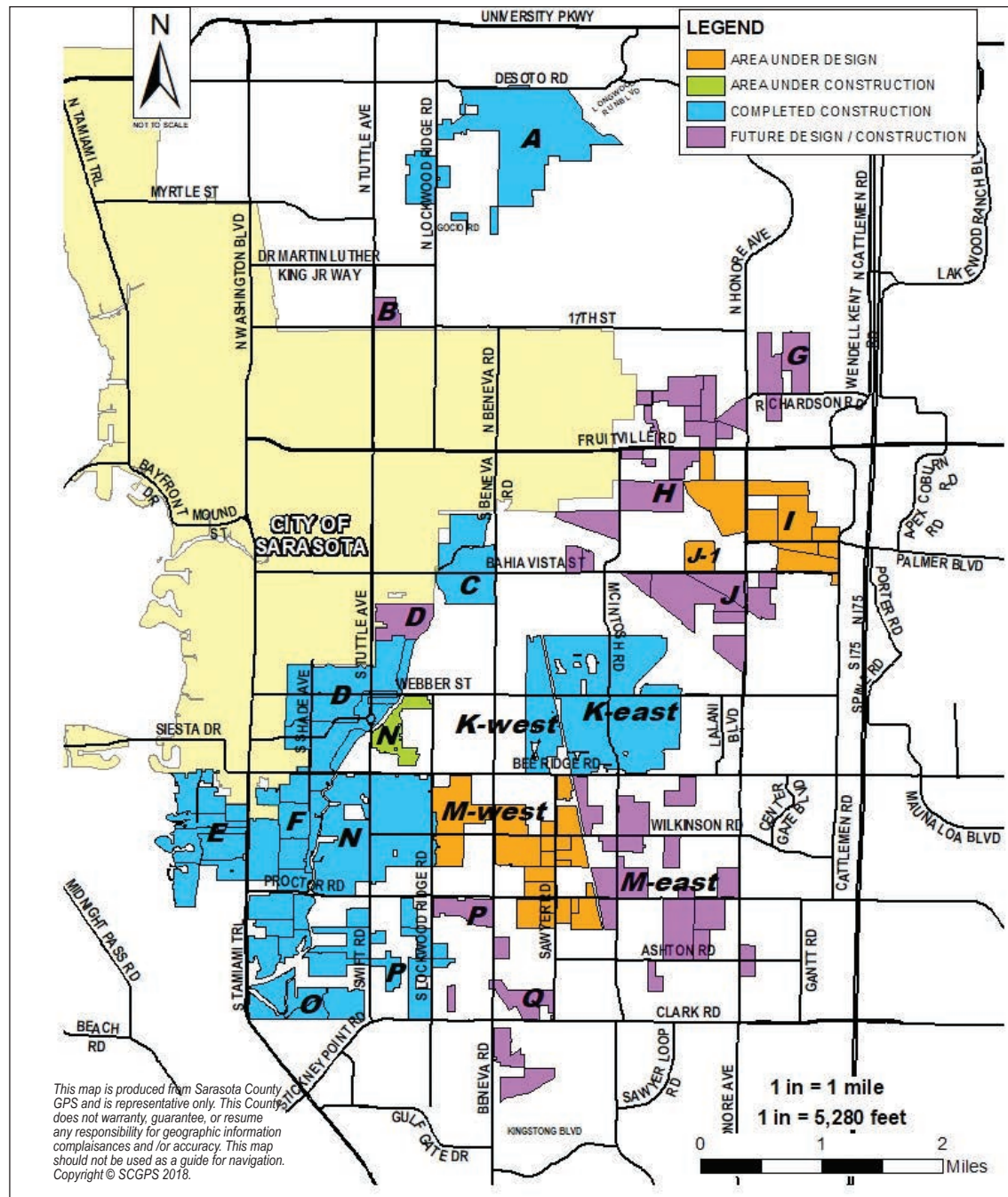
In areas near priority waterbodies or where groundwater levels no longer support proper drainfield treatment, septic systems can be upgraded with advanced nutrient-removal technologies or converted to central sewer service.

Advanced nutrient treatment technologies are now available for new system installations or retrofits of older systems. Technologies approved for use in Florida include in-ground nitrogen-reducing biofilters, nitrogen-reducing aerobic treatment units, or nitrogen-reducing Performance-Based Treatment Systems (FDOH May 2019). Florida now prohibits installation of new septic systems on lots of one acre or less in priority focus areas within Outstanding Florida Springs watersheds, unless they include advanced nutrient treatment. Although SBEP watersheds do not have Outstanding Florida Springs, SBEP Bays from Anna Maria Island to the Venice Inlet are classified as Special Outstanding Florida Waters. In 2019, Florida’s Blue-Green Algae Task Force recommended extending the springs rule to include other vulnerable areas across the state. Until Outstanding Florida Waters are afforded the same protections as Outstanding Florida Springs, advanced nutrient-treatment

Table WQQ-4.

Number of parcels using septic systems in SBEP watersheds in Sarasota and Manatee Counties from the Florida Department of Health’s Florida Water Management Inventory (FLWMI), including known, likely, and somewhat likely identifications and an independent inventory of known and likely parcels using septic systems conducted by Sarasota County (2019).

SBEP Watershed Areas by County	FDOH Estimate				County Estimate
	Known	Likely	SW Likely	TOTAL	Known and Likely
Sarasota	2,356	5,000	735	8,091	13,342
Manatee	81	18,473	1	18,555	N/A
Total	2,437	23,473	736	26,646	



upgrades to conventional septic systems in SBEP watershed remain voluntary. Outreach and education are important tools to promote these opportunities to property owners in areas where septic systems are underperforming or failing and where future central sewer service is unplanned (see Community Engagement Action Plan).

Converting underperforming or failing septic systems to central sewer is an effective strategy to reduce nutrient pollution from septic systems. In 2001, Sarasota County began the phased conversion of septic to sewer service for about 14,000 parcels in the Phillippi Creek Watershed (Figure WQQ-5). Phillippi Creek is the largest tidal creek entering SBEP Bays – with seven miles of creek and over 100 miles of canals draining mostly residential and commercial development. As of October 2021, connections to central wastewater service have been made available to 10,232 parcels out of the planned 14,000, or about 73%. In 2019, Florida’s Blue-Green Algae Task Force recommended legislation and funding for cost-effective septic to sewer programs (BGATF 2019). One caveat to septic to central sewer conversion is that if Advanced Wastewater Treatment is not used, the fate and impacts of high-nutrient reuse water must be considered.

Figure WQQ-5. Phillippi Creek Septic Replacement Program is converting 14,000 parcels in the Phillippi Creek Watershed from septic to sewer service. (Sarasota County)

Priorities

SBEP and partners recognize that conventional septic systems can be a source of nutrient pollution in coastal areas. We need to improve our understanding about the capacity of septic systems to treat nutrient pollution and pathogens under different site conditions, including potential impacts due to climate change. Existing septic systems should be inventoried and mapped. Regular inspection and maintenance of septic systems should be encouraged and those found to be underperforming or failing should be repaired or replaced. In priority areas, especially near SBEP Outstanding Florida Waters, septic systems should be converted to centralized sewer systems and small wastewater treatment plants should be consolidated. Where central sewer is unlikely to become available, conventional systems can be upgraded with advanced nutrient removal technologies.



Installation of sewer main, Lockwood Ridge Road, Sarasota County. (Hazen & Sawyer Environmental Engineers)

Strategy

Activity WQQ-5.1: Continue conversion of septic systems to centralized sewer systems and consolidation of small wastewater treatment plants, prioritized in coastal areas.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), County and Municipal Governments (Leads), private utilities

Projected Five-Year Costs and Funding Sources: \$\$\$\$ /County and Municipal Governments

Location: SBEP priority watersheds and coastal areas

Activity WQQ-5.2: Encourage regular inspection and maintenance of septic systems and installation of supplemental and advanced septic system technologies, prioritized in coastal areas and basins with impaired waters.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), FDOH (Co-lead), FDEP (Co-lead)

Projected Five-Year Costs and Funding Sources: \$/SBEP (320)

Location: SBEP priority watersheds and coastal areas

Activity WQQ-5.3: Improve inventory and mapping of septic and other on site sewage treatment and disposal systems and increase understanding about septic system capacity to treat nutrient pollution and pathogens under different site conditions, including climate change.

Timeframe: Ongoing since 1995 CCMP; CCMP Monitoring Strategy complete by 2025

Collaborators: SBEP (Collaborate), FDOH (Co-lead), County & Municipal Governments (Co-lead)

Projected 5-Year Costs and Funding Sources: \$/County and Municipal Governments

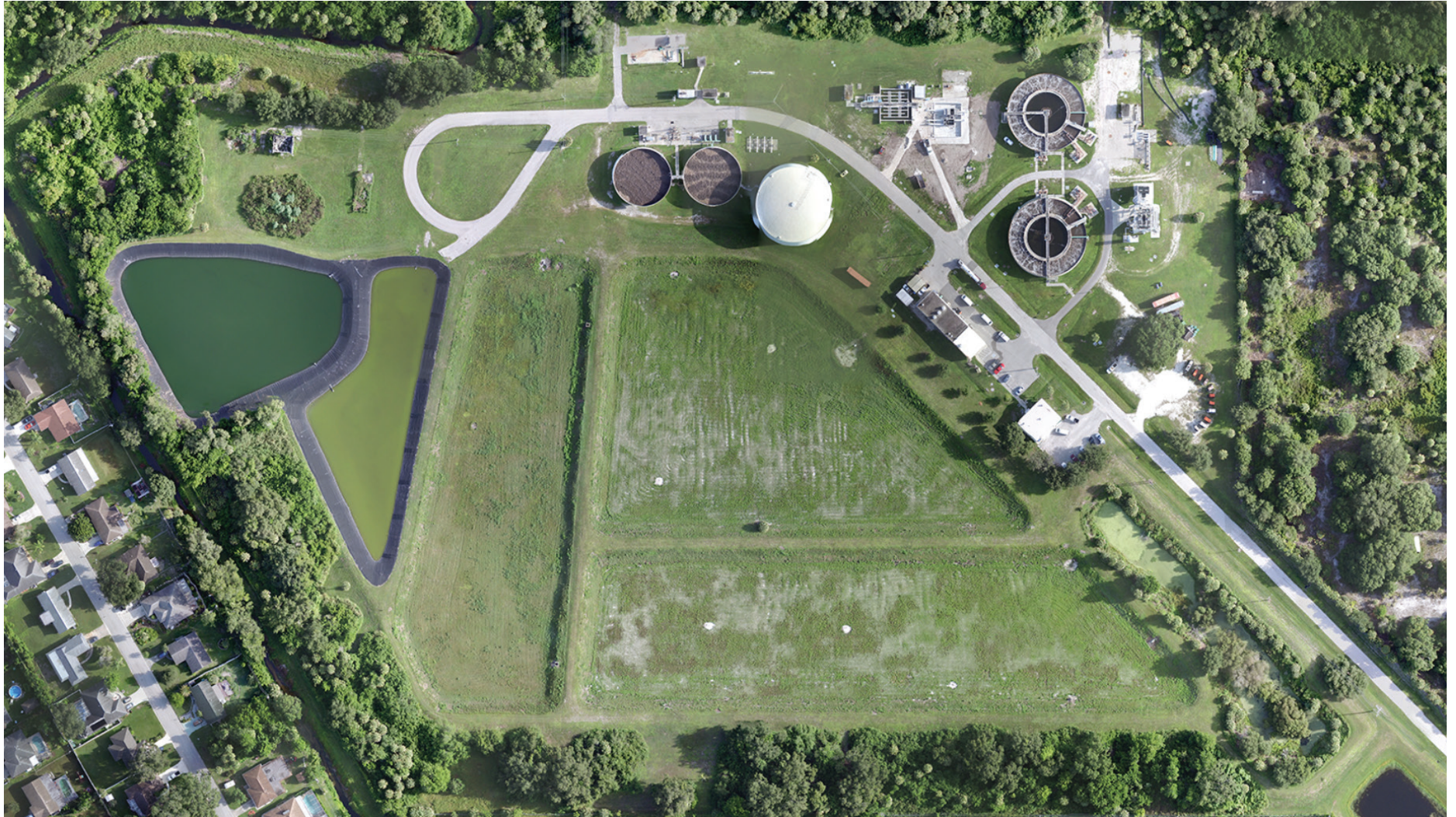
Location: SBEP priority watersheds and coastal areas

Benefits

Improving understanding and management of pollutant loading from septic systems and converting parcels from septic to sewer service will reduce pollutant loading from septic systems.

Five-Year Performance Metric Deliverables:

- (1) Improved inventory of onsite sewage treatment and disposal systems,
- (2) Creation of a prioritized list of future septic to sewer service conversions.



Venice Gardens Water Reclamation Facility. (Sarasota County)



Bee Ridge Water Reclamation Facility, Sarasota County. (Sarasota County)

Water Quality and Quantity Action Plan Objective 6:

Reduce pollutant loading from centralized wastewater collection, treatment, and disposal systems, including reuse.

Activity WQQ-6.1

Support advanced wastewater treatment or better throughout SBEP watersheds, considering population growth, climate change, and opportunities for beneficial reuse. Improve public understanding of the value of AWT.

Activity WQQ-6.2

Evaluate and manage impact of reuse storage and distribution on nutrient loading and hydrology, including reuse irrigation in population growth centers and siting of reuse ponds relative to bays and creeks. Develop management plans and BMPs to avoid overflows, releases, and excess nutrient loading.

Activity WQQ-6.3

Encourage proactive inspection, maintenance, and replacement of failing or underperforming sanitary sewer infrastructure to prevent inflow and infiltration, overflows, and spills. Support improved quantitative public reporting requirements for accidental and emergency sewage discharges.

Background

Effective wastewater treatment is critical to ensure area waters meet their designated uses. In centralized wastewater treatment systems, wastewater is collected at its source and conveyed to a wastewater treatment facility (WWTF), treated, then disposed. Failure during any stage can release untreated or partially treated sewage into the environment.

Wastewater Collection

Sanitary sewer systems collect sewage from its source and transport it through a series of gravity-fed pipelines, electrical lift stations, and force mains to a WWTF. Backups, spills, and overflows of untreated sewage can result from a variety of causes:

- Incursions of tree roots and disposal of improper items into drains or toilets, like diapers, wipes, dental floss, fats, oils, and grease can clog pipes and cause overflows.
- Rapid population growth, septic to sewer service conversion, or closing WWTFs and transporting wastewater to another WWTF can exceed original system capacity to treat and/or dispose of wastewater.
- Aging infrastructure deteriorates and eventually fails, resulting in spills and overflows.
- Construction activities can break or dislodge pipes, leading to spills.
- Groundwater and stormwater can enter the system by infiltration through defective, permeable, or broken pipes or by inflow through unauthorized

connections. This excess volume can overwhelm system capacity and cause backups, overflows, and emergency discharges, especially during heavy rainfall events.

- Storms and flooding can cause electrical failures at lift stations unequipped with battery backup devices, resulting in overflows.

Wastewater Treatment

WWTFs can utilize several treatment levels.

- **Primary Treatment** mechanically removes solids, grease, and oils.
- **Secondary Treatment** uses microbes to reduce soluble organic matter, then disinfects the remaining water.
- **Tertiary, or Advanced Wastewater Treatment (AWT)** further reduces impurities, including nutrients like nitrogen and phosphorus. AWT treatment techniques can include biological treatment, filtration, carbon absorption, distillation, and reverse osmosis.

Additional technologies are being developed elsewhere to remove pharmaceuticals, endocrine disruptors, or other harmful chemicals that can survive primary, secondary, and advanced treatment. The suitability of these technologies should be evaluated for WWTFs operating in or providing reuse water to SBEP watersheds.

Nutrient concentrations in treated wastewater are regulated by the state according to treatment level (Table WQQ-5). Florida requires a minimum of secondary treatment before disposal. To protect

Table WQQ-5.

State of Florida standards for total nitrogen (TN), total phosphorus (TP), biological oxygen demand (BOD), and total suspended solids (TSS) in treated wastewater effluent, according to treatment level. Standards are annual averages and are regulated by Florida Statute F.S. 403-086. (<https://www.flsenate.gov/laws/statutes/2012/403.086>)

Contaminant	Wastewater Treatment Level	
	Advanced	Secondary
TN	3 mg/L	N/A
TP	1 mg/L	N/A
BOD	5 mg/L	20 mg/L
TSS	5 mg/L	20 mg/L

select waterbodies, Florida requires wastewater to be treated to AWT standards before it can be discharged into Sarasota Bay, Little Sarasota Bay, Roberts Bay, or "...into any river, stream, channel, canal, bay, bayou, sound, or other water tributary thereto..." as well as other waterbodies in Southwest Florida (Grizzle-Figg Act 1987, F.S. 403.086). Further, the Act requires that discharges, even of AWT effluent, will not cause considerable impacts to Outstanding Florida Waters or to other waters, substantially impact an approved shellfish harvesting area or water used as a domestic water supply, or seriously alter the natural fresh-salt water balance of the receiving water after reasonable opportunity for mixing.

Disposal of Treated Biosolids and Wastewater

End products of wastewater treatment include treated biosolids and wastewater effluent. Subject to regulation, biosolids can be used as a fertilizer or soil amendment on farms and ranches, forest lands, public parks, or land reclamation projects, though none are applied to lands in SBEP watersheds. Depending on treatment level, effluent can be discharged into surface waters,

injected into underground wells and aquifers, released to infiltration basins and spray fields, or reclaimed for beneficial reuse.

Emerging Contaminants and Pollutants of Concern

Endocrine disruptors, pharmaceuticals, and microplastics can negatively impact living things. Many of these contaminants and pollutants persist through treatment in WWTFs and pollute the environment following disposal (Murphy 2016, Kostich 2013, Sunn 2019, Conley 2019, Estahbanati and Fahrenfeld 2016). More research is needed to improve detection and treatment methods for these emerging contaminants and pollutants, and to better understand their environmental and human impacts (Barber 2012).

Climate Change Vulnerabilities

SBEP completed a climate vulnerability analysis of its CCMP goals in 2017, concluding that climate stressors will further strain wastewater infrastructure in SBEP watersheds (SBEP and

Shafer 2017). Projected increases in storm intensity will likely increase capacity challenges for sanitary sewer infrastructure, resulting in additional backups, overflows of untreated or partially treated wastewater, or emergency discharges at WWTFs. More intense rainfall events will present further challenges to reuse storage

ponds that already regularly exceed capacity during the summer rainy season. Rising sea levels will likely elevate groundwater levels and increase infiltration into wastewater conveyance pipes, corrode infrastructure, and alter the effectiveness of wastewater treatment. Impacts due to increased loading of harmful nutrients, bacteria, and viruses

in wastewater will be compounded by warmer temperatures (Lovett 2010). Due to these vulnerabilities and others, climate stressors must be considered when planning new or retrofitting existing wastewater infrastructure.

Wastewater Treatment and Storage Upgrades in SBEP Watersheds

- Sarasota County is currently converting its Bee Ridge WWTF to AWT, with an expected completion in 2025. In 2021, the Sarasota County Commission announced plans to spend a total of \$500 million to upgrade its Bee Ridge, Venice Gardens, and Central County facilities to provide AWT levels of treatment.
- Sarasota County, with matching funding from SWFWMD, built supporting infrastructure for an Aquifer Storage and Recovery (ASR) well at the Central County Water Reclamation Facility, which allows for underground storage of reuse water during periods of wet weather when irrigation demand is low.
- Sarasota County eliminated its last regular surface water discharge of treated wastewater in 2018 when it decommissioned the Siesta Key advanced WWTF. Collection infrastructure, including eight miles of force main, a master pump station, and a booster pump station, was built to transfer wastewater from the island to the larger Bee Ridge advanced-secondary WWTF on the mainland.
- Manatee County upgraded its advanced-secondary treatment Southwest Regional Water Reclamation Facility (SWRWRF) in 2017 to include a modified process that reduces TN levels below an average 8.5 mg/l – about a 40% reduction. The process removes biological oxygen demand, ammonia, and nitrate plus nitrite.
- Manatee County completed construction of a 15-million-gallon recharge well at SWRWRF that provides additional wet weather disposal capacity in the reuse system.
- Manatee County added another 10-million-gallon reuse water storage tank and a high service pump station in support of the Manatee County Agricultural Reuse System (MARS). The system connects the County's three regional WWTFs and is designed to supply up to 30 million gallons per day of reuse water for agricultural, residential, and residential users.
- The City of Sarasota improved treatment performance at its AWT WWTP to achieve 1.65 mg/L total nitrogen and 0.42 mg/L total phosphorus in its reuse water, exceeding requirements for AWT and meeting Florida's

numeric nutrient criteria for freshwater streams. The City of Sarasota eliminated regular surface water discharges of treated wastewater into Whitaker Bayou, resulting in about a 20% reduction in TN loading to Big Sarasota Bay. The City is also constructing a large lift station in Lukewood Park to service one third of the city's wastewater.



Status

Under Florida's Public Notice of Pollution Act (effective July 1, 2017) all reportable pollution release events require public notice within 24-hours of the incident. Between July 1, 2017 and November 11, 2019, 292 releases were reported in Sarasota and Manatee Counties — more than one every three days. The public notice database can be improved by creating specific fields for details like number of gallons spilled and recovered, spill quality (raw, partially treated, or reuse quality), and estimates of the unrecovered pollution load of bacteria, nitrogen, and phosphorus.

SBEP partners have adopted deep-well injection, along with increased wet weather storage ponds, as a strategy for eliminating discharges of treated wastewater to surface waterbodies. This technology uses injection wells to transfer treated wastewater effluent into deep geologic formations that are confined vertically by impermeable layers. The impermeable layers prevent migration of pollutants or contaminants into potable water supplies. For example, in 2015, the City of Sarasota built a \$6 million deep-well injection facility to divert regular surface water discharges of treated wastewater into Hog Creek and Whitaker Bayou.

Priorities

Addressing causes of wastewater spills and overflows through regular inspection and maintenance, capital improvement projects,

education, and enforcement are management priorities in SBEP watersheds.

The City of Sarasota adopted a Climate Vulnerability Analysis of 34 city-owned wastewater assets and identified seven as being most vulnerable to future climate conditions. The plan, which is the first climate vulnerability assessment of infrastructure in SBEP watersheds, identified high-level strategies for protecting and preserving those assets. SBEP supports conducting similar climate vulnerability analyses for all wastewater assets in Sarasota and Manatee County that are potentially vulnerable to future climate conditions.

From 2013 - 2021, Sarasota County's Bee Ridge WWTF periodically discharged treated wastewater containing up to 20 mg/L of TN into Phillippi Creek, a protected tributary of Roberts Bay. These discharges exceeded 760 million gallons of non-AWT effluent (Stantec 2019). The County has committed to upgrading the facility to AWT by 2025, which will improve options for treated wastewater disposal, decrease nitrogen loading in watersheds where reuse is applied, and reduce loading to Phillippi Creek in the event emergency discharges are required. In the short term, the County has constructed two 18-million-gallon per day aquifer recharge wells at the site, which will enable the County to prevent further emergency discharges from the facility.

Because beneficial reuse of treated wastewater for irrigation can reduce demand on surface water and groundwater sources, SWFWMD, Sarasota and Manatee Counties, and local municipalities promote reuse for water conservation. However, since most WWTFs that affect SBEP watersheds only accomplish secondary treatment, there is a need to assess the quantity and fate of nutrients in non-AWT reuse

irrigation water and their consequences for water quality. For example, residents are generally unaware of the need to offset their fertilizer use with the nutrient content of reuse water irrigation. Moreover, use of non-AWT reuse water for irrigation during the summer may diminish the effectiveness of local fertilizer ordinances, which prohibit the summer application of fertilizers containing nitrogen and phosphorus. During periods of heavy rainfall, demand for reuse water declines, causing storage challenges at wastewater reclamation facilities and emergency releases of high nutrient reuse water (especially from non-AWT WWTFs).

Whether direct from emergency release and overflows or indirect from irrigation, non-AWT reuse water can result in significant nutrient loading to waterbodies. One solution is to upgrade all WWTFs to AWT. WWTFs operating both inside and outside of SBEP watershed boundaries can impact SBEP bays if they are connected to reuse water distribution systems that cross watershed boundaries. The largest WWTFs that can supply reuse water to SBEP watersheds by local or regional reuse distribution systems include the Manatee SW, Manatee County SE, City of Bradenton, City of Sarasota, Bee Ridge, and Sarasota County Central WWTFs. Of these, only the City of Sarasota and City of Bradenton WWTFs produce reuse water equal to or better than AWT as of 2021.

Since its first CCMP, SBEP has asserted that all wastewater in Sarasota Bay watersheds should be treated to AWT standards before effluent reaches bays or tributaries (SBEP 1995), consistent with the intent of the Grizzle-Figg Act (FS 403.086). This remains a top management priority.



Fruitville Water Reclamation Facility. (Sarasota County)

Strategy

Activity WQQ-6.1: Support advanced wastewater treatment or better throughout SBEP watersheds, considering population growth, climate change, and opportunities for beneficial reuse. Improve public understanding of the value of AWT.

Timeframe: Ongoing since 1995 CCMP; Sarasota County Bee Ridge Water Reclamation Facility will be upgraded to AWT by 2025.

Collaborators: SBEP (Support), County and Municipal Governments (Leads)

Projected Five-Year Costs and Funding Sources: \$/SBEP (320); \$\$\$\$\$/County and Municipal Governments

Location: SBEP watersheds

Activity WQQ-6.2: Evaluate and manage impact of reuse storage and distribution on nutrient loading and hydrology, including reuse irrigation in population growth centers and siting of reuse ponds relative to bays and creeks. Develop management plans and BMPs to avoid overflows, releases, and excess nutrient loading.

Timeframe: New activity; development of BMP guides for reuse irrigation began in 2021

Collaborators: SBEP (Collaborate), County and Municipal Governments, UF/IFAS Extension (Lead), FDEP

Projected Five-Year Costs and Funding Sources: \$\$\$/County and Municipal Governments; FDEP

Location: SBEP watersheds

Activity WQQ-6.3: Encourage proactive inspection, maintenance, and replacement of failing or under performing sanitary sewer infrastructure to prevent inflow and infiltration, overflows, and spills. Support improved quantitative public reporting requirements for accidental and emergency sewage discharges.

Timeframe: Ongoing since 1995 CCMP; local government partners plan to invest over \$500 million to construct new or maintain existing sanitary sewer infrastructure between 2021-2031.

Collaborators: SBEP (Support), County and Municipal Governments (Leads), FDOH, FDEP

Projected Five-Year Costs and Funding Sources: \$/SBEP (320); \$\$\$/County and Municipal Governments; FDOH; FDEP

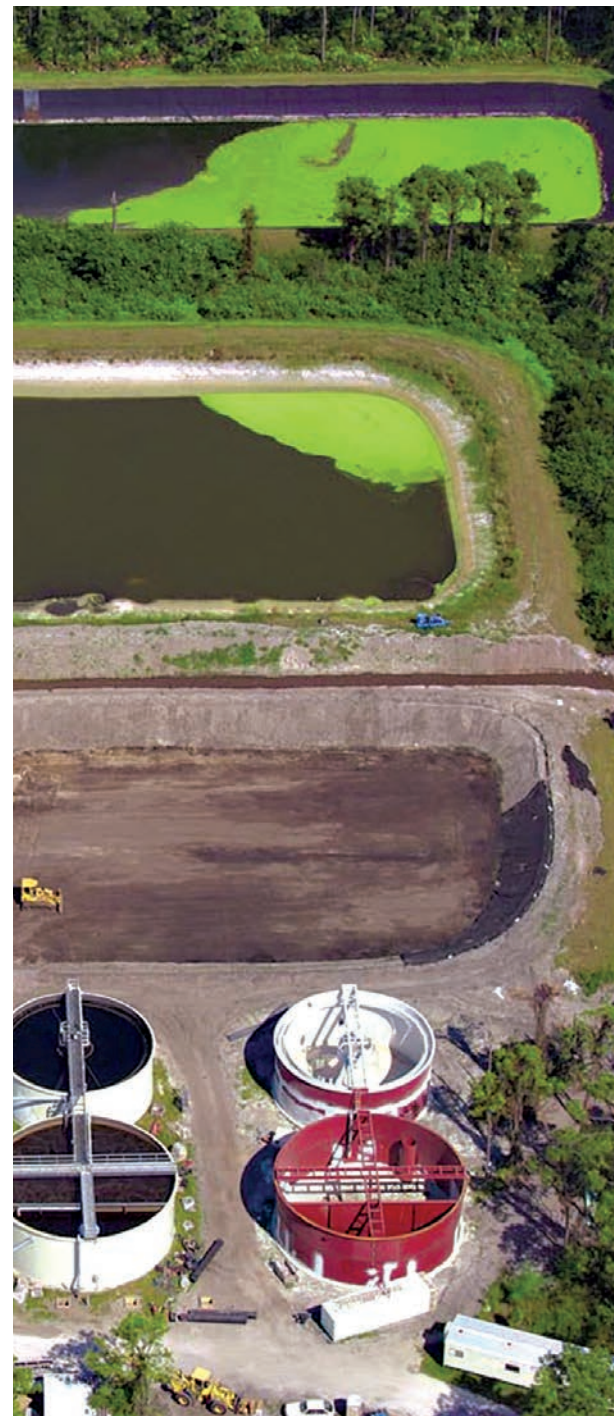
Location: SBEP watersheds

Benefits

Reducing spills and overflows from failing or underperforming centralized wastewater infrastructure and converting WWTPs to advanced treatment will reduce pollutant loading from centralized wastewater collection, treatment, and disposal systems, including reuse.

Five-Year Performance Metric Deliverables:

- (1) Updated pollutant loading model for SBEP bays,
- (2) Sarasota County Bee Ridge Water Reclamation Facility will be upgraded to AWT by 2025.



Water Quality and Quantity Action Plan Objective 7:

Improve understanding of pollutant loading from atmospheric nitrogen deposition.

Activity WQQ-7.1

Evaluate air quality monitoring network and programs to quantify sources, pathways, and contribution of direct and indirect atmospheric deposition to area waters.

Activity WQQ-7.2

Support initiatives to reduce emissions from vehicles, landscape maintenance equipment, and other mobile sources.

Background

Airborne nitrogen compounds in the form of nitrogen oxides and ammonia are a significant source of nutrient pollution to watersheds and bays. Atmospheric nitrogen can be deposited directly onto waterbodies or indirectly by deposition on the watershed and conveyed to waterbodies by stormwater or groundwater. It can be deposited as gas and dust (dry deposition) or rain (wet deposition). Natural sources of reactive atmospheric nitrogen include emissions from wild animal waste, lightning, forest fires, and soils; anthropogenic sources include emissions from fertilizer application, human and livestock waste, and fossil fuel combustion by power plants, vehicles, and outdoor power equipment. Mobile sources of nitrogen oxides like cars and landscape machinery create emissions close to the ground, which can contribute four times more nitrogen deposition to the local watershed than regional power plants that release nitrogen from tall stacks (Poor 2013b).

Total CO₂ emissions from driving in the Sarasota-Bradenton metro area are up 61% since 1990 (Gately 2019). Boat engines and gas-powered outdoor equipment emit even more pollution per use than automobiles. For example, operating a gas-powered leaf blower for thirty minutes creates the equivalent nitrogen emission of driving a Ford F-150 truck more than 68 miles (Kavanagh 2011). Florida has the highest per capita emissions from gas-powered outdoor equipment compared to California, Illinois, New



Gas-powered landscaping equipment emits significant levels of nitrogen pollution.

York, and Texas (Banks 2015). Moreover, Florida has been called the “boating capital” of the United States, with 44,000 registered vessels in Manatee and Sarasota Counties generating emissions at the water’s surface.

The proportion of nitrogen loading due to atmospheric deposition varies widely among locales, with estimates as high as 75% of total nitrogen loading for bays in the northeastern US (Howarth 2008) although estimates from Tampa Bay are that atmospheric deposition comprises between 20 to 32% of nitrogen loads to that well-studied system (TBEP 2003). Although mobile sources of atmospheric nitrogen loads have increased over time, atmospheric deposition to Tampa Bay appears to have decreased over time, likely due to changes in fossil fuel uses at regional power plants. In addition, although the monitoring locations are not ideally situated, it also appears that atmospheric loads to Sarasota Bay might also be decreasing.

Status

Monitoring atmospheric nitrogen deposition is fundamental to estimating atmospheric nitrogen loading to area waters. The existing air quality monitoring network in Sarasota and Manatee Counties was predominately designed to monitor air quality for protecting human health. As a result, existing monitoring stations are not optimally sited for monitoring nitrogen deposition on watersheds of priority waterbodies or deposition directly on the waterbodies themselves.

Figure WQQ-6.

Annual weighted mean atmospheric nitrate concentration at the Verna Wellfields station in Northeast Sarasota County. Trend line represents a three-year moving average with a one-year time step.

(Graph source: <http://nadp.slh.wisc.edu/data/ntn/plots/ntntrends.html?siteID=FL41>)

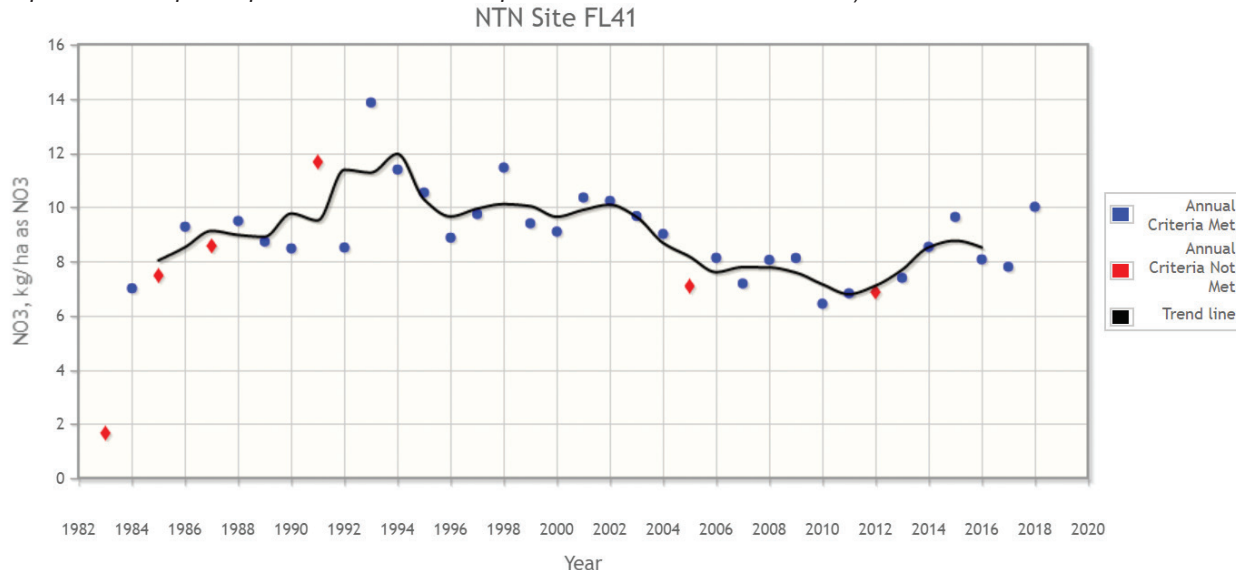
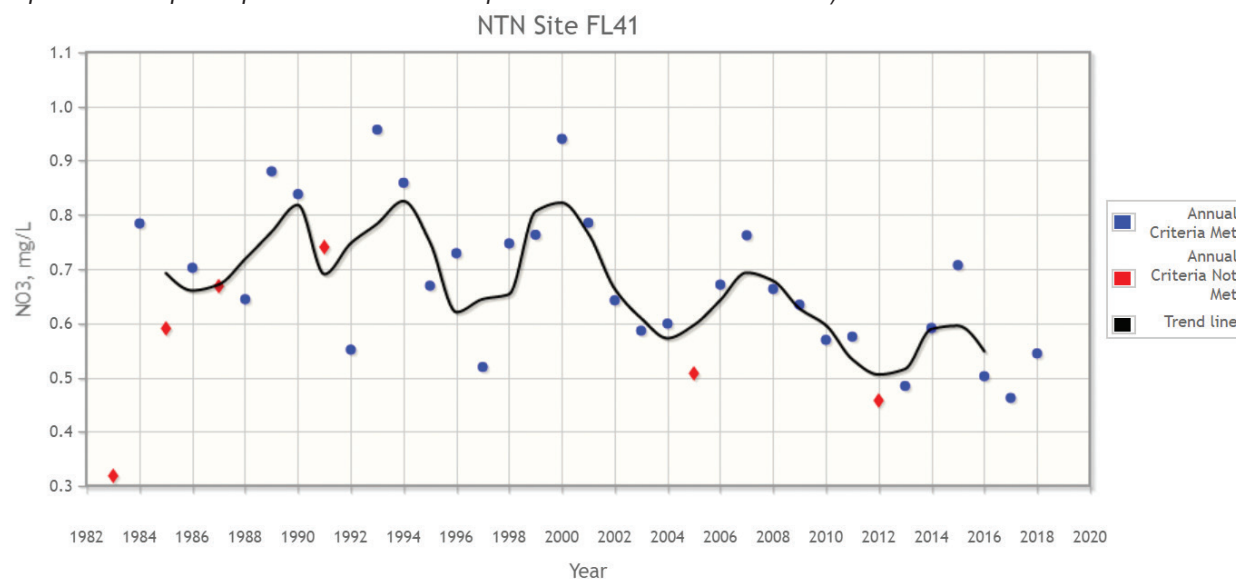


Figure WQQ-7.

Annual weighted mean atmospheric nitrate deposition at the Verna Wellfields in Northeast Sarasota County. Trend line represents a three-year moving average with a one-year time step.

(Graph source: <http://nadp.slh.wisc.edu/data/ntn/plots/ntntrends.html?siteID=FL41>)



Two monitoring networks have air quality monitoring stations in Sarasota and Manatee Counties. The *National Atmospheric Deposition Program* is a cooperative among federal, tribal, state, and local government agencies, educational institutions, private sector, and non-governmental agencies that monitors rainfall chemistry. The Program includes one station located at the Verna Wellfields in northeastern Sarasota County, where records of nitrate concentration, equivalents, wet deposition, and other pollutants have been maintained since 1983. The station is located in a remote area of the County away from heavy traffic, where data indicate that annual weighted mean atmospheric nitrate concentration has been generally declining since the 1980s (Figure WQQ-6). Wet nitrogen deposition peaked during the early to mid-90s, declined until 2012, then began rising again (Figure WQQ-7), perhaps due to the finding that precipitation at the station has increased since around 2006. Because Verna Wellfields is located in a remote area of the County away from heavy urbanization and outside of SBEP watersheds, it is not an ideal indicator of atmospheric deposition onto SBEP watersheds or bays.

Florida's Ambient Air Quality Monitoring Program is coordinated by FDEP. The Program includes 100 monitoring sites across the state to assess progress in maintaining and improving air quality, understand temporal variations in air pollutants, and evaluate pollution exposure by individuals and the environment (FDEP 2019). The Program includes four air quality stations in Sarasota County and four in Manatee County. None currently monitor nitrogen oxide concentrations or deposition.

Understanding atmospheric nitrogen loading to SBEP bays is limited by lack of an air quality monitoring program dedicated to that goal. Janicki (2010) calculated direct wet and dry nitrogen deposition onto SBEP bay segments using atmospheric nitrogen wet deposition data from Verna Wellfields, together with a dry:wet ratio calculated for Tampa Bay (Poor 2000, Pribble 2001) and local rainfall estimates. The relative contribution of direct atmospheric nitrogen deposition, compared to other sources

or conveyances, varied significantly among SBEP bay segments (Table WQQ-6). The relative contributions of direct and indirect deposition on bays are dependent, in part, on the proportional surface area of the bay compared to its watershed. For Big Sarasota Bay, direct nitrogen deposition to the bay accounted for almost 11% of nitrogen loading. This analysis underestimates nitrogen loading due to total atmospheric deposition because it only measures direct deposition and excludes

Table WQQ-6.

Relative contribution (%) of total nitrogen load types to each SBEP bay segment, 2015-2019.

LOAD TYPE (Total Nitrogen)	Blackburn Bay	Little Sarasota Bay	Palma Sola Bay	Roberts Bay	Big Sarasota Bay
Atmospheric Deposition	1	3	7	0	11
Base Flow	20	21	16	21	15
Direct Runoff	72	63	65	62	62
Reclaimed Water	4	5	9	2	8
Septic	3	8	2	8	2
Point Source	0	0	0	3	1
Spills	0	0	0	3	0

Table WQQ-7.

Relative contribution (%) of dissolved inorganic nitrogen (DIN) load types to each SBEP bay segment, 2015-2019.

LOAD TYPE (Dissolved Inorganic Nitrogen)	Blackburn Bay	Little Sarasota Bay	Palma Sola Bay	Roberts Bay	Big Sarasota Bay
Atmospheric Deposition	3	9	16	1	24
Base Flow	11	11	7	12	6
Direct Runoff	69	47	55	52	49
Reclaimed Water	9	12	17	5	16
Septic	8	20	5	23	4
Point Source	0	0	0	4	0
Spills	0	0	0	3	0

measures of indirect deposition, where nitrogen is deposited onto the watershed and conveyed to bays via stormwater. In the analysis, indirect atmospheric nitrogen deposition is aggregated with other sources of nitrogen loading measured as direct runoff. Considering this, total contributions of atmospheric nitrogen deposition to SBEP bays can be significant.

Priorities

Establishing an air quality monitoring program to track nitrogen deposition in SBEP watersheds and bays would be an important investment for understanding and monitoring the contribution of nitrogen loading in SBEP waters.

SBEP supports initiatives to reduce emissions from vehicles, landscape maintenance equipment, and other mobile sources to reduce atmospheric nitrogen deposition on its watersheds and bays. Education and outreach about the relationship between fossil fuel combustion and water quality would be an important tool for reducing locally generated nitrogen emissions from mobile sources. There are also co-benefits to reducing fossil fuel emissions for public health, especially around vulnerable populations, and for climate change mitigation.

Strategy

Activity WQQ-7.1: Evaluate air quality monitoring network and programs to quantify sources, pathways, and contribution of direct and indirect atmospheric deposition to area waters.

Timeframe: New activity; CCMP Monitoring Strategy by 2025

Collaborators: SBEP (Coordinate), County and Municipal Governments, FDOH (Lead), FDEP

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320); FDEP

Location: SBEP waterbodies and watersheds

Activity WQQ-7.2: Support initiatives to reduce emissions from vehicles, landscape maintenance equipment, and other mobile sources.

Timeframe: New activity; began communication initiative in 2022

Collaborators: SBEP (Support), County and Municipal Governments, UF/IFAS Extension (Lead), FDEP

Projected Five-Year Costs and Funding Sources: \$/SBEP (320); County and Municipal Governments; FDEP

Location: SBEP waterbodies and watersheds

Benefits

Improving understanding of pollutant loading from atmospheric deposition will improve management of water quality in SBEP watersheds and bays.

Five-Year Performance Metric Deliverables:

- (1) Literature review of local atmospheric nitrogen deposition,
- (2) communication piece linking air quality to water quality to encourage emissions reductions.

Water Quality and Quantity Action Plan Objective 8:

Support measures to better understand, monitor, report, respond to, recover from, mitigate, and reduce harmful algal blooms.

Activity WQQ-8.1

Support development of coordinated, standardized tools for monitoring and reporting on HABs, evaluating their impact on the environment, economy, and human health, and improving capacity to prepare for, respond to, and recover from them.

Activity WQQ-8.2

Support research and monitoring to better understand the taxonomic composition, toxicity, severity, extent, and duration of HABs, and the role nutrient sources and climate change play in bloom initiation, growth, maintenance, and termination.

Background

Algae are a critical part of the estuarine food web that produce oxygen and provide habitat and forage area for numerous organisms. Under favorable conditions, including high temperature, light, pH, and availability of nutrients like nitrogen and phosphorus, algae can multiply quickly and form blooms. Harmful algal blooms (HABs), defined as those algal blooms with measurably detrimental effects to humans and ecosystems, can reduce available sunlight for seagrasses, smother aquatic vegetation and hardbottom habitats, degrade water quality, and kill aquatic invertebrates, fish, seabirds, turtles, and marine mammals (Zanchett and Oliveira-Fiho 2013). When blooms die and decay, oxygen can be depleted in surrounding waters, causing additional mortality and adding nutrients to sustain the bloom. In addition to environmental impacts, HABs can impact human recreation, economic activity, and health. These impacts threaten coastal ecosystems and communities throughout Southwest Florida.

HABs have increased in frequency, extent, and duration throughout the world's waters, often in response to increased temperatures due to climate change and anthropogenic (human-caused) nutrient pollution (Gilbert 2020). Climate change is expected to further increase their impacts due to reduced oxygen solubility, increased water column

stratification, variable salinity, increased acidity, and more intense precipitation events washing nutrients into waterways (O'Brien 2016, SBEP and Shafer 2017).

SBEP waterbodies are impacted by red tide and blooms of cyanobacteria and macroalgae.

Red Tide

Florida red tide, formed by the dinoflagellate *Karenia brevis*, is a common saltwater HAB in Southwest Florida. *K. brevis* typically exists in low concentrations throughout the Gulf of Mexico, grows slowly, and can utilize low concentrations

of a broad range of organic and inorganic nutrients (Geesey and Tester 1993). *K. brevis* blooms are believed to initiate in low-nutrient deep-water environments 10–40 miles offshore, where blooms can be sustained by recycling or regenerating nutrients. Blooms can be transported inshore by currents and winds and maintained or intensified by nutrients, including those from land-based runoff and decomposing marine life. *K. brevis* produces neurotoxins called *brevetoxins* that can bioaccumulate and kill fish, seabirds, turtles, and marine mammals. In humans, aerosols of the toxin can cause eye, nose, and throat irritation and more serious consequences for people with

existing respiratory issues, like asthma (Kirkpatrick 2004). Eating shellfish impacted by *K. brevis* can also result in neurotoxic shellfish poisoning. The 2017–2019 west Florida red tide bloom lasted 15 months and decimated marine life. By January 2019, Manatee and Sarasota Counties had removed a total of 571 tons of dead sea life from their beaches and waterways. Throughout West Florida, FWC and NOAA reported that over 589 sea turtles, 213 manatees, and 127 bottlenose dolphins were killed during the bloom. Impacts to beachgoers, boaters, charters, and fishers were significant with Visit Sarasota County reporting declines in hotel occupancy of 11 percent during the last three months of 2018 — the largest decline during that period since the September 11, 2001 terrorist attacks. Photographs and reports of dead and rotting sea life from SBEP bays were featured in national news.

Complex bloom dynamics, multiple nutrient sources, and the importance of regenerated nitrogen in supporting red tide prevent isolating a single cause of any one bloom (Heil 2014). Current understanding of red tide suggests that it may be impossible to altogether eliminate its periodic recurrence in Southwest Florida, though successful nutrient management efforts could potentially decrease the intensity and duration of blooms once they start by reducing the availability of anthropogenic nutrient pollution in nearshore waters (*i.e.*, Medina 2020 and 2022, Alcock 2007, Paerl 2008, Heil 2014).



Red tide. (Dr. David Tomasko)



A sign on Longboat Key beach warns visitors of red tide. (Bronte Wittpenn, Tampa Bay Times)

Cyanobacteria Blooms

Both freshwater and saltwater species of cyanobacteria (blue-green algae) generate HABs in Florida and about 20 species in the genera *Microcystis*, *Cylindrospermopsis*, *Anabaena*, *Aphanizomenon*, *Dapis pleousa*, and *Planktothrix* can produce toxins (Rastogi 2015).

Dapis pleousa, previously known as *Lyngbya majuscula*, is a common saltwater filamentous cyanobacteria in SBEP bays that can create dense mats along the bay bottom, smothering oyster reefs and seagrasses. Sometimes mats can produce so much oxygen during photosynthesis that they dislodge, float to the surface, and wash ashore. Rotting *Dapis pleousa* blooms degrade water and shoreline habitat quality, diminish dissolved oxygen, and impact human shoreline uses. Impacts to human health include dermatitis and respiratory distress. *Dapis pleousa* blooms usually occur in spring and summer in SBEP bays when waters are warmer, light input is more intense, and rains wash nutrient pollution off the watershed into the bay. Blooms of *Dapis pleousa* may be increasing in Florida (Paerl 2008, Arthur 2009). A prominent *Dapis pleousa* HAB in the spring of 2019 garnered significant attention by the community.

Dapis pleousa blooms are stimulated by over-enrichment of nitrogen and phosphorus, and in the presence of iron can also convert inert atmospheric nitrogen into a bioavailable form (Arthur 2009, Paerl 2008). Reducing the availability of inshore anthropogenic nutrient pollution is likely the best strategy for reducing *Dapis pleousa* HABs in SBEP bays (Paerl 2008).

Microcystis is a genus of freshwater cyanobacteria, on the rise in estuarine and marine environments (Preece 2017), that release toxins called microcystins. Released upon cell death, these toxins can persist in the water for weeks to months and negatively impact all aquatic trophic levels. The toxins can also bioaccumulate in animals and be transferred to humans (Smith and Haney 2006, Zanchett and Oliveira-Filho 2013). Pathways of human exposure include consuming fish and shellfish with high concentrations of microcystin in tissues, swallowing, skin contact, and inhalation of contaminated water. Microcystins can cause acute abdominal pain, headache, nausea, and vomiting and serious damage to liver, intestines, brain, kidney, lung, heart, and reproductive tissues (Massey 2018). Microcystins are listed on the USEPA's third drinking water Candidate Contaminant list (USEPA 2014). The International Agency for Research on Cancer has classified Microcystin-LR as a possible human carcinogen.

Macroalgae Blooms

Nuisance blooms of macroalgae impact aquatic ecosystems by diminishing sunlight to seagrasses, depleting dissolved oxygen when they die and decompose, and smothering benthic habitat. Macroalgae also contributes to beach wrack, which in excessive amounts can decay and increase bacteria loads in nearby waters. Nutrient pollution is a primary cause for macroalgal blooms in SBEP Bays.

SBEP commissioned a study of macroalgae at 11 sites in SBEP bays between 2009-2011 (LaPointe 2012). Benthic macroalgae were analyzed for nitrogen isotopes and carbon to nitrogen ratios to identify potential nitrogen sources feeding blooms. Study results pointed to sewage-derived nitrogen and rainfall as drivers of development of blooms of two common genera of macroalgae, *Gracilaria* and *Ulva*.

Seagrass Epiphytes

A multitude of sessile species settle and live on seagrass blades. Seagrass epiphytes include algae, bacteria, sponges, bryozoans, tunicates, crustaceans, and mollusks. Increased nutrient availability has been shown to increase epiphyte loading on seagrass (Jensen and Gibson 1986, Tomasko and Lapointe 1991, Nelson 2017), which can reduce light availability for photosynthesis and degrade seagrass health. Epiphyte loads in Sarasota Bay appear to be increasing since 2013 (Figure WQQ-9).

Status

Monitoring

Florida's DEP tracks cyanobacteria blooms, reviews citizen reports of algal blooms, and coordinates sampling among other agencies. FWC tracks red tide events, provides status reports, and coordinates routine and event-response monitoring with state agencies, local governments, Mote Marine Laboratory, and private citizens.

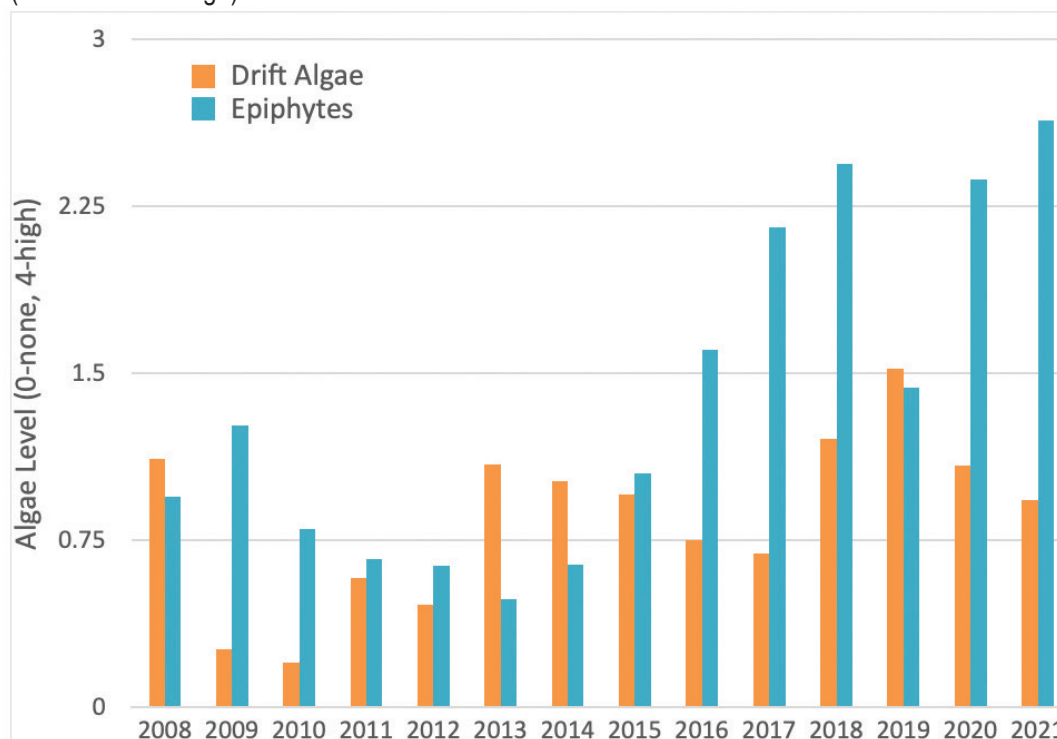
Complementary efforts include:

- **Collaboration for Prediction of Red Tides:** FWC provides red tide data to the USF College of Marine Sciences, which forecasts red tide movement using the West Florida Shelf Regional Ocean Modeling System.
- **USF Optical Oceanography Laboratory:** USF processes NASA and NOAA data to provide bloom maps to FWC to assist them in directing sampling efforts and bloom assessments.
- **Harmful Algal Bloom Observing System (HABSOS):** FWC provides data to NOAA's HABSOS, a system used to visualize blooms and changes in environmental conditions.

- **Beach Conditions Reporting System:** Mote Marine Laboratory reports information about red tide-related respiratory irritation and dead fish at local beaches.
- **Harmful Algal Bloom Operational Forecast System:** FWC provides data to NOAA's Harmful Algal Blooms Operational Forecast System (HAB-OFS), which publishes information bulletins.

In 2021, SBEP extended the community science-driven Eyes on Seagrass project, originally launched by Florida Sea Grant in Charlotte Harbor, to monitor macroalgae coverage in SBEP bays.

Figure WQQ-9. The level of epiphytic and drift algae coverage for Sarasota Bay from 2008–2021. Algae levels are 0=not present, 1=light (1–25% coverage), 2=moderate (26–50% coverage), 3=heavy (51–75% coverage), and 4=extreme (76–100% coverage).



Policy Initiatives

The 2016–2019 occurrence of prolonged and highly destructive blue-green HABs and red tide throughout Florida sparked public concern and support for improved nutrient management throughout the state. In response, Florida Governor Ron DeSantis issued Executive Order 12-12 in January of 2019 calling for expedited action to protect and restore waterbodies of the state. The governor's new budget prioritized increased research and a focus on science. The State created the Blue-Green Algae Task Force to provide guidance and science-based recommendations for improving and restoring Florida's water bodies that have been adversely affected by blue-green HABs and reactivated the state's Harmful Algal Bloom/Red Tide Task Force, which will help determine strategies to research, monitor, control, and mitigate red tide and other HABs in Florida waters. The governor also signed SB 1552 launching the Florida Red Tide Mitigation and Technology Development Initiative as a partnership between FWC and Mote Marine Laboratory to develop technologies and approaches to control and mitigate red tide and its impacts.

The 2021 Florida Macroalgae Workshop, an initiative of the Florida Estuaries Alliance, the Southwest Florida Water Management District, Florida Sea Grant, the St. Johns River Water Management District, and Harbor Branch Oceanographic Institute, convened stakeholders in March and April 2021 to discuss the state of current knowledge about macroalgae blooms in Florida estuaries. The workshop enhanced understanding of data gaps and research/

monitoring needs. The breakout sessions connected practitioners, researchers, and managers within and across estuary systems. Presenters raised awareness of the importance of macroalgae in nutrient cycling and other ecosystem processes. There was consensus among presenters that macroalgae must be included in the resource management framework of all Florida estuaries.

Priorities

SBEP will continue to work with partners to reduce HAB impacts by reducing nutrient pollution in its watersheds (see WQQ Objectives 4–6) and delivering educational information about HABs through its website and other outreach efforts (see Community Engagement Action Plan). SBEP supports research and monitoring to better understand the species composition of blooms and to better track and forecast their severity, extent, and duration. In addition, SBEP recognizes the need to understand the role that various nutrient sources play through time and space in bloom initiation, growth, maintenance, and termination, especially for red tide.

There is a critical need to continue monitoring macroalgae in SBEP bays to track species population dynamics and to quantify the nutrient load expressed in macroalgae biomass. There is also a need to monitor marine cyanobacteria in priority SBEP waters.

In 2020, a Community Red Tide Impact and Response Assessment study was completed to improve understanding of red tide impacts and responses to future impacts (Shafer 2020a and Shafer 2020b). The study, conducted by the Science and Environment Council, developed a regionally-standardized Red Tide Community Impact Assessment Framework, identified data gaps, and applied that tool to document and report on select environmental, social, and economic impacts of the historic 2017–2019 Florida red tide event in TBEP and SBEP waterbodies and watersheds. The study also examined red tide response efforts by County and Municipal Governments and other agencies and organizations, identified gaps and opportunities, and generated recommendations for regionally coordinated responses to red tide.

Strategy

Activity WQQ-8.1: Support development of coordinated, standardized tools for monitoring and reporting on HABs, evaluating their impact on the environment, economy, and human health, and improving capacity to prepare for, respond to, and recover from them.

Timeframe: Ongoing since 2014 CCMP; CCMP Monitoring Strategy complete by 2025

Collaborators: SBEP (Support), FWC (Co-lead), FDOH (Co-lead), FDEP (Co-lead), Florida Sea Grant, NOAA, Colleges & Universities, County and Municipal Governments, Mote Marine Laboratory, SWFWMD, TBEP, Science and Environment Council

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (320); FWC; FDOH; FDEP; Florida Sea Grant; USF and UF; NOAA; Mote Marine Laboratory; SWFWMD; GCOOS; GOMA; FWC; TBEP

Location: SBEP waterbodies

Activity WQQ-8.2: Support research and monitoring to better understand the taxonomic composition, toxicity, severity, extent, and duration of HABs, and the role nutrient sources and climate change play in bloom initiation, growth, maintenance, and termination.

Timeframe: Ongoing since 2014 CCMP; CCMP Monitoring Strategy complete by 2025

Collaborators: SBEP (Support), FWC (Co-lead), Florida Sea Grant (Co-lead), USF, Colleges & Universities, County and Municipal Governments, Mote Marine Laboratory, NOAA, GCOOS, FDEP

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (320); FWC; NOAA; FDEP; Florida Sea Grant; Colleges & Universities; Mote Marine Laboratory; SWFWMD; USACE

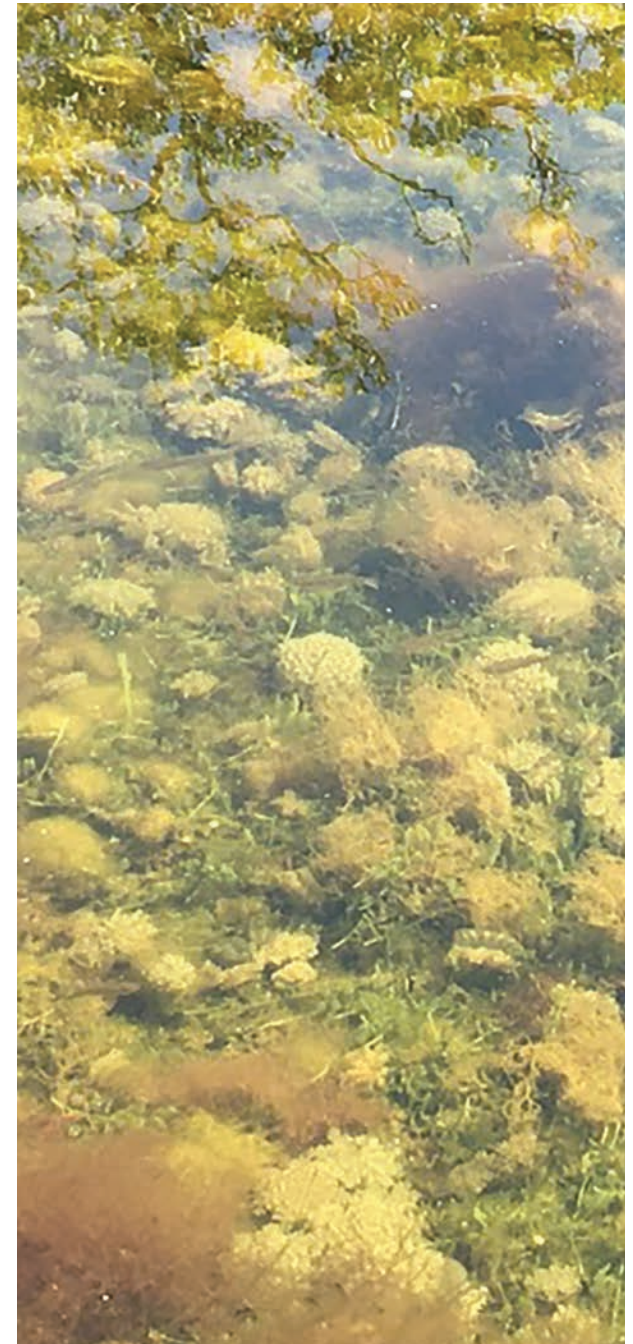
Location: SBEP waterbodies

Benefits

Improved knowledge about HABs and their impacts on environment, economy, and human health and improved capacity to prepare for, respond to, and recover from them will build public support for water quality improvement and habitat restoration and will increase human and ecosystem resilience to impacts from HABs.

Five-Year Performance Metrics

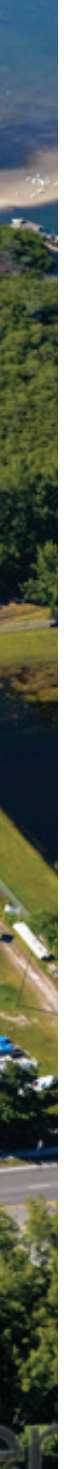
- (1) Improved coordination on HAB monitoring, reporting, and response,
- (2) Improved HAB communication tools.



Collection of macroalgae and upside-down jelly fish (*Cassiopea xamachana*) and seagrass in a shallow lagoon in southern Longboat Key



FISH Preserve Habitat Restoration project in progress. (SBEP)



WATERSHED HABITATS *Action Plan*

GOAL: Restore shoreline, wetland, and bay habitats and eliminate future losses

Introduction

The majority of the Greater Sarasota Bay Watershed has been altered by urban and agricultural development, leaving isolated natural and conservation areas with limited ecosystem function and services necessary for a healthy estuary and thriving fish and wildlife. The community vision for Sarasota Bay is abundant seagrass meadows teeming with fish and shellfish, well-developed oyster reefs filtering water and providing essential habitat for fish and birds, living vegetated coastal wetlands and shorelines filtering runoff and protecting the coast, a mosaic of uplands, freshwater wetlands, and tidal creeks supporting natural waterflow and habitat for fish and wildlife, and unimpeded vegetated dunes and sandy shorelines along Gulf beaches.

SBEP and partners are making significant progress towards this vision of protecting and restoring the Sarasota Bay area's iconic ecosystems. Through water quality improvements (see Water Quality and Quantity Action Plan). By 2016, seagrass coverage had increased by over 50%, compared to the late 1980s. However, coverage in 2020 was down by more than 20%, compared to 2016, although 2020 levels were still 20% higher than in the late 1980s. In addition, live oysters appear

to be increasing in the tidal creeks, at least in the southern portion of the watershed (Meaux *et al.* 2016). Through protection and restoration, total coastal wetland acreage is stable (SWFWMD). From 2014–2018, SBEP leveraged \$12.6 million in public and private funds for 66 habitat restoration projects on over, 1100 acres and 900 linear feet of shoreline (Table WH-1). Projects included beach and dune restoration, bird island habitat enhancement, oyster reef and artificial reef construction, coastal wetland restoration, exotic vegetation removal and native planting, prescribed burns, and land conservation. Every priority habitat type was improved, and eight projects from the most recent Habitat Restoration Plan (2016) have been initiated or completed.



Volunteer plants cordgrass in Whitaker Bayou. (SBEP)

Table WH-1. Habitat restoration projects completed 2014–2021.

Project Name	Habitat Type	Acres	Feet
Beach and Dune Restoration			
Coquina Beach Dune Restoration	Beach & Dune	20	0
Bird Island Habitat Enhancement			
Oscar Scherer Park Habitat Restoration: Phase 3	Freshwater Shoreline	5	0
Perico Bird Rookery Island	Coastal Shoreline	16	0
Invasives Control/Removal - Vegetation			
Arlington Park Exotic Vegetation Removal	Upland	2	0
FISH Preserve Habitat Restoration	Coastal Wetland	25	0
G.T. Bray Park Exotic Removal	Upland	1	0
Leffis Key Exotic Vegetation Removal	Beach & Dune	2	0
Johnson Preserve Invasive Plant Control	Forested Woodlands	30	0
Jordyn Parcel Habitat Restoration	Upland	0	0
Leffis Key Preserve Exotic Species Management	Coastal Wetland	2	0
Manatee County Parks	Coastal Wetland	150	0
Neal Preserve Exotic Species Management	Coastal Wetland	10	0
Neal Preserve Exotic Species Removal	Upland	10	0
New College Native Plant Showcase	Upland	0.5	0
North Lido Preserve Australian Pine Removal	Beach & Dune	2	0
North Water Tower Park Exotic Removal	Upland	6	0
Orchid Oaks Environmental Enhancement	Freshwater Shoreline	5	0
Oscar Scherer Park Habitat Restoration: Phase 2	Freshwater Shoreline	3	0
Palma Sola Scenic Highway Restoration	Coastal Shoreline	5	0
Palmer Point Exotic Vegetation Treatment	Coastal Shoreline	20	0
Perico Perimeter Berm Preserve Exotics Treatment	Upland	5	0
Perico Preserve Exotic Species Management	Coastal Wetland	40	0
Phillippi Estate Park Exotic Removal	Coastal Wetland	1	0
Pine Island Preserve	Coastal Wetland	14	0
Plymouth Harbor Peninsula Restoration Project	Coastal Wetland	0.3	0
Red Bug Slough Preserve Exotic Vegetation Removal	Upland	1	0
Robinson Preserve Exotic Species Maintenance	Coastal Wetland	225	0
Robinson Preserve Expansion Exotics Removal	Upland	20	0

Table WH-1. Habitat restoration projects completed 2014–2021.

(continued)

Project Name	Habitat Type	Acres	Feet
Sarasota Bay Watershed Exotic Management	Coastal Wetland	80	0
Save Our Seabirds Native Planting Project	Upland	0.2	0
Siesta Beach Exotic Treatment	Beach & Dune	20	0
South Gate Community Association Planting	Freshwater Shoreline	1	0
South Lido Beach Exotic Vegetation Removal	Upland	2	0
Tidy Island Habitat Restoration	Coastal Wetland	13	0
Tom Bennett Park Exotic Species Control	Upland	55	0
Ungarelli Preserve Exotic Species Management	Coastal Wetland	2.5	0
Ungarelli Preserve Exotic Species Removal	Upland	8.5	0
Land Acquisition and Easements			
Johnson Preserve on the Braden River	Forested Woodlands	43.82	0
Siesta Key Tax Deed Lots Acquisition	Beach & Dune	1.08	0
Thaxton Preserve	Upland	287	0
555 Verna Road Land Acquisition	Upland	20.4	0
129 Bayview Lane Acquisition	Coastal Shoreline	1.15	0
Robinson/Perico Connector Property Acquisition	Coastal Shoreline	15.52	0
Sarasota County Parkland Acquisition	Riparian	2.8	0
Webber Street Trailhead Acquisition	Forested Woodlands	1.8	0
Planting			
Bowlees Island Native Planting	Island	1	0
Emerson Point Preserve Native Planting	Coastal Shoreline	1.5	0
Honi Hanta Pollinator Garden	Forested Wetlands	0.2	0
Jiggs Landing Native Vegetation Planting	Upland	0.2	2
New College of Florida Native Plantings	Coastal Shoreline	0.5	0
Red Bug Slough	Forested Wetlands	6.2	0
Sarasota Audubon Center Bioswale	Upland	0	75
Sherwood Forest HOA Planting	Freshwater Wetland	0.4	0
North Water Park Addition	Upland	6.2	0
Perico Preserve Native Planting	Coastal Wetland	40	1540
Robinson Preserve Expansion Phase II-A	Coastal Shoreline	20	0
Sarasota Audubon Society Bioswale	Upland	0	100



FISH Preserve Habitat Restoration project in progress. (SBEP)



Balm Boyste Stream Restoration. (SBEP)

Table WH-1. Habitat restoration projects completed 2014–2021. (continued)

Project Name	Habitat Type	Acres	Feet
Planting (continued)			
Sherwood Forest HOA Planting	Freshwater Wetland	0.4	0
North Water Park Addition	Upland	6.2	0
Perico Preserve Native Planting	Coastal Wetland	40	1540
Robinson Preserve Expansion Phase II-A	Coastal Wetland	20	0
Sarasota Audubon Society Bioswale	Upland	0	100
Prescribed Burn			
Robinson Preserve Prescribed Fire Application	Upland	15	0
Sarasota Bay Watershed Prescribed Burning	Upland	25	0
Johnson Preserve Prescribed Fire Application	Upland	15	
Reef Construction - Artificial Materials			
Bridge Street Artificial Reef	Artificial Reef	3	0
Manatee County Artificial Reef Deployments	Artificial Reef	2	0
Reef Construction - Natural Materials			
Perico Bayou Oyster Reef Creation	Oyster	0.7	300
Robinson Preserve Oyster Habitat Creation	Oyster	3	2
Sarasota Bay 34th Street Oyster Habitat Creation	Oyster	1	0
Shoreline Stabilization/Enhancement			
Blackburn Point Living Shoreline Enhancement	Coastal Shoreline	0.25	150
Boulevard of the Arts Shoreline	Coastal Shoreline	0	3
Hudson Bayou In-Stream and Water Quality Improvements	In-Stream	15	0
Oscar Scherer Park Habitat Restoration: Phase 1	Freshwater Shoreline	0	250
Riverview High School shoreline restoration	Coastal Shoreline	0	200
Phillippi Creek Shoreline Demonstration Project	Freshwater Shoreline	0	75
Grand Total		1333	2697

Action Plan Strategy

This Action Plan encompasses the strategies of two Action Plans in the 2014 SBEP CCMP: the Freshwater & Saltwater Wetlands and the Fisheries & Other Living Resources Action Plans. From those original plans, all objectives are still ongoing. We have significantly organized and streamlined the objectives to improve the ease of tracking progress. Therefore, nearly all of the 2014 objectives have been significantly revised or merged into compound objectives. Please refer to the CCMP Crosswalk in Appendix B for details. This action plan also contains a new objective of beach and dune restoration that has not been addressed since the original 1995

SBEP CCMP. The SBEP Management Conference has recognized the importance of the area's iconic beaches in the overall habitat mosaic of the greater Sarasota Bay watershed and opted to include them as a habitat restoration priority once more.

In this CCMP update, the SBEP Management Conference commits to six major objectives for the goal of restoring shoreline, wetland, and bay habitats and eliminating future losses.

- **Objective 1:** Update and implement the SBEP Five-Year Habitat Restoration Plan;
- **Objective 2:** Protect, enhance, and restore uplands and freshwater wetlands;
- **Objective 3:** Improve tributary habitats with a special emphasis on fisheries;
- **Objective 4:** Protect, enhance, and restore coastal wetlands and improve shoreline resiliency;
- **Objective 5:** Protect, enhance, and restore hard bottom and seagrass habitats; and
- **Objective 6:** Protect, enhance, and restore beaches and dunes for wildlife and resiliency.



Marie Selby Botanical Gardens bayfront. (SBEP)

Watershed Habitats Objective 1: Update and implement the SBEP Five-Year Habitat Restoration Plan.

Activity WH-1

Update the five-year Habitat Restoration Plan with consideration of local watershed management plan priority projects and resiliency strategies. Coordinate, track, and report progress metrics for habitat restoration.



Great Blue Heron. (Patti Cross)

Background

SBEP developed the first five-Year Habitat Restoration Plan (HRP) in 2004 to guide efforts of SBEP and its partners to identify, prioritize, and implement restoration projects throughout the bay and its watersheds. In general, the site selection approach of the HRP recognizes that a watershed level habitat mosaic, in appropriate proportions, is necessary to maintain ecological health. Revisions to the original 2004 ranking criteria were made in successive five-year plans (2010 and 2016) to encompass new regulatory and ecosystem management priorities, while providing flexibility to prioritize selected projects when funding opportunities arise. Fourteen site-scoring criteria cover logistical considerations and habitat balance considerations, and support the following restoration objectives: 1) essential habitat restoration and/or creation, 2) water retention and water quality improvements, and 3) historic habitat restoration and/or preservation.

The site selection approach prioritizes sites where essential habitat, defined as habitat with physical and biological features that are vital to a species' existence, can be protected, restored, or enhanced. For example, low-salinity zones in creeks or complex prop root structure of mangroves are essential for the juvenile stages of many fish.

Sites with potential for improving estuarine water quality and hydrology are preferred. Restored upland vegetation and wetlands filter nutrients,

sediment, and toxics from stormwater before reaching waterways. In addition to natural habitat creation, sites which can support green infrastructure projects to retain runoff and filter pollutants are also preferred.

Focusing on both terrestrial and aquatic areas and restoring or enhancing processes and corridors that connect them within watersheds is essential. Restoring native vegetation, managing invasive plants, and removing development from the riparian and floodplain area also increase connectivity between stream corridors and their associated uplands. Sites with opportunities to restore and create freshwater wetlands within the drainage basin of tidal creeks are preferred, even if not directly congruous with the bay. To promote living shorelines (see WH-4), locations with potential for demonstration living shoreline installations are ranked higher. Restoration plans incorporate climate-resilient designs where appropriate. For example, designs for coastal sites subject to sea level rise include more high marsh and upland areas, which will allow restored plant communities to naturally migrate inland as sea level rises.

Potential sites are identified through extensive coordination with regional experts and SBEP partners. Almost 70 projects have been identified and ranked in the HRP over the last 15 years, and more than 35 projects, including some with multiple phases, have

been completed (Figure I-5). Eight projects from the latest FY2016–2020 Plan have been initiated:

- North Lido (partial completion 2016);
- South Lido (partial construction 2017);
- Tidy Island (plans and permits 2018, exotic pest plant removal 2021);
- Dit-Dot-Dash Bird Islands (plans and permits 2018);
- Jim Neville Preserve (plans 2018);
- 34th Street Oyster Restoration (completed 2017, monitoring and shell replenishment ongoing);
- FISH Preserve (partial construction 2019, additional exotic pest plant removal 2021); and
- Perico Bayou Oyster restoration (plans and permits 2019, completed 2020).

Habitat restoration accomplishments are tracked and reported annually to USEPA in the National Estuary Program On-line Reporting Tool (NEPORT) database. Metrics include acres or linear feet restored or enhanced. In addition, planting success and oyster recruitment and size distribution are monitored. There is a need to better coordinate reporting among partners and to standardize project reporting categories and metrics for restoration, monitoring, and management activities (see Community Engagement Action Plan Objective CE-4).

Continued funding support is necessary to complete projects identified in the HRP. This requires close coordination with priorities and funding opportunities of Program partners, especially the Southwest Florida Water Management District (SWFWMD), Manatee County, and Sarasota County.

The next update to the HRP should continue to coordinate with priorities of the Sarasota Bay (JEA 2012a), Little Sarasota Bay (JEA 2012b) and Roberts Bay (JEA 2010) Water Quality

Management Plans, the SWFWMD Surface Water Improvement and Management Plan (SWIM) for Sarasota Bay (SWFWMD 2002), and the Audubon Gulf of Mexico restoration strategy (NAS 2019). As sea level rise and increased storm intensity threaten to drown coastal wetlands squeezed by upland development, there is a need to analyze projected changes in coastal wetlands and prioritize remaining coastal wetland restoration opportunities (see Watershed Habitat Action Plan Objective WH-4).



Volunteers load recycled oyster shells onto barges to build new reefs in Perico Bayou. (SBEP)

Strategy

Activity WH-1.1: Update the five-year Habitat Restoration Plan with consideration of resiliency strategies; and coordinate, track, and report progress metrics for habitat restoration.

Timeframe: Ongoing since 2004; Complete update by 2024

Collaborators: SBEP (Conduct/Lead), SWFWMD (except beach and dune projects), FDEP, FWC, FDOT, Audubon, County and Municipal governments

Projected Five-Year Costs and Funding Sources: \$/SBEP (CWA 320)

Location: SBEP watersheds

Benefits

SBEP (Conduct/Lead), SWFWMD (except beach and dune projects), FDEP, FWC, FDOT, Audubon, County and Municipal governments

Five-Year Performance Metrics Deliverable:

Updated Habitat Restoration Plan by 2025

Watershed Habitats Objective 2:

Protect, enhance, and restore uplands and freshwater wetlands.

Activity WH-2.1

Encourage and support the permanent conservation of natural lands through acquisition and conservation easements, including freshwater wetlands and flowways, corridors, and uplands adjacent to coastal habitats necessary for habitat resilience and migration.

Activity WH-2.1

Restore and manage natural lands through prescribed fire, eradication of invasive exotic plants and animals, hydrologic improvement, and reestablishment of threatened and endangered plants.



Great blue heron. (Patti Cross).

Benefits and Priority Concerns

Healthy bay water quality and wildlife require a diversity of interconnected habitats in the watershed — including upland forests and freshwater wetlands — that support the full suite of natural processes necessary to sustain life. Even though these inland habitats may not be confluent with the bay, they influence the health of the bay through hydrologic connectivity that affects bay water quality and habitat connectivity that supports fish and bay wildlife (see Water Quality & Quantity Action Plan and Fish & Wildlife Action Plan).

Important upland habitats include pine prairies (pine flatwoods and dry prairie), oak hammocks, and scrub (sand pine scrub and scrubby flatwoods). All provide habitat value for a variety of birds, reptiles, and small mammals. Forested areas capture rainwater, allowing it to slowly evaporate from the canopy or seep into the ground. Upland habitats are threatened by development, lack of fire management, and invasion by exotic vegetation.

Wetlands are highly productive habitats, providing food and shelter for a large variety of wildlife. Many of the bay's colonial nesting birds forage in freshwater wetlands, and some commercially and recreationally important fishes use freshwater wetlands during their juvenile life stages. Wetlands are also critical for cycling nutrients and filtering and storing water, thus providing water quality and flood protection benefits (see Water Quality & Quantity Action Plan).

Contiguous wetlands, such as forested swamps, grassy marshes, and sloughs, are periodically flooded by adjacent waterways. Isolated wetlands are fed by rainwater and runoff from surrounding uplands. Wetlands typically form where the water table is at or above the surface of the ground and remain inundated for most of the year. They contribute to the hydrologic cycle through high rates of evaporation and evapotranspiration, as well as recharge groundwater and aquifers in some areas.

Wetlands are threatened by development that changes local hydrology, resulting in fragmentation, too little or too much water, and pollution. Changes in precipitation and warming temperatures from climate change also threaten wetlands by affecting water balance and soil characteristics (Twilley 2007). Increased flooding and prolonged drought may make wetland communities more susceptible to sedimentation and erosion, pollutants, pests and disease, and competition from exotic species leading to local extirpation (SBEP and Shafer 2017). Loss of habitats and changes in wetland community structure are expected with climate change (Root 2003). These changes have important implications for restoration efforts.

Monitoring and Status

Since the 1950's, urban development and agriculture have degraded, fragmented, and replaced upland forest and freshwater wetland habitats. The Sarasota Bay watershed is highly urbanized; natural areas are fragmented and isolated as relatively small public parks and preserves, golf courses, water bodies, and subdivision easements. The SBEP area has 5,678 acres of freshwater wetlands and 4,899 acres of forested uplands remaining. Due to regulatory protection and restoration of wetlands, wetland area has remained relatively stable over the last 30 years, but upland forests have declined (Water Atlas, SWFWMD 2014).

Regionally, 20% of the total land area of Manatee and Sarasota Counties is conservation lands in public and private ownership (Table WH-2). Sarasota County has a conservation land acquisition program approved by voter referendum and financed through dedicated ad valorem property tax revenue and other sources. Manatee County successfully identifies and acquires conservation lands through general funds, grants, and innovative public-private partnerships. In addition to public acquisitions, the Conservation Foundation of the Gulf Coast provides leadership and initiates conservation land acquisitions on private lands and through public-private partnerships.

Table WH-2. Managed conservation lands (acres) in Sarasota and Manatee counties include public and some privately-owned lands. (Florida Natural Areas Inventory. Florida Conservation Lands, updated March 2019)

County	Local	State	Federal	Private	Total	County Area	% Conserved
Manatee	26,040	32,910	1,090	1,660	61,700	474,240	13%
Sarasota	47,710	60,590	10	880	109,190	366,080	30%
TOTAL	73,750	32,910	1,100	2,540	170,890	840,320	20%

Often, private lands are protected through purchase of conservation easements, a legal agreement between a property owner and a qualified conservation organization, such as a land trust or government agency. The easement usually contains permanent restrictions on the use or development of land in order to protect its conservation values.

SBEP supports and promotes existing federal, state, water management district, and local conservation land acquisition programs, including:

- Florida Department of Environmental Protection Florida Forever;
- Florida Forest Service Rural and Family Land Protection Program and Forest Legacy Program;
- U.S. Department of Agriculture National Resources Conservation Service; and
- Southwest Florida Water Management District.

Wetlands are protected from dredging and filling under the Federal Clean Water Act through the US Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP). Florida provides further protection by also regulating the alteration of uplands that may affect surface flows to isolated wetlands not falling under federal jurisdiction. Sarasota County land development regulations include open space requirements and protections for certain sensitive and rare native habitats, including wetlands, grassy dry prairies, and scrub. Protection and restoration of uplands and freshwater wetlands in the floodplain also contributes to flood plain management, potentially lowering a community's flood insurance rates (FEMA 2015).

Accomplishments and Priorities

Within the SBEP area, Oscar Scherer State Park and many County and City parks and preserves are actively managed for their upland and freshwater wetland habitat. From 2014-2018, SBEP and its many partners and volunteers supported 23 upland restoration projects on over 150 acres involving prescribed fire, removal of exotic plants, native planting, and creation of 175 feet of vegetated bioswale. In addition, 314 acres of upland were purchased for conservation, including the 287-acre Thaxton Preserve adjacent to Oscar Scherer State Park. Wetland restoration projects during this period included removing exotics and planting native species on 13 acres plus shoreline enhancement along 325 feet of creeks and lakes.

SBEP will continue to monitor habitat gains or losses and identify opportunities for upland and freshwater wetland acquisition and restoration in the Habitat Restoration Plan. By partnering with public and private landowners to provide technical and funding guidance for priority projects, SBEP can facilitate and accelerate progress in protecting the remaining vulnerable natural forests and freshwater wetlands in the area. SBEP also has an important role in educating the community about the benefits of upland and freshwater wetland habitat protection and restoration for floodplain management, groundwater recharge, and wildlife protection.

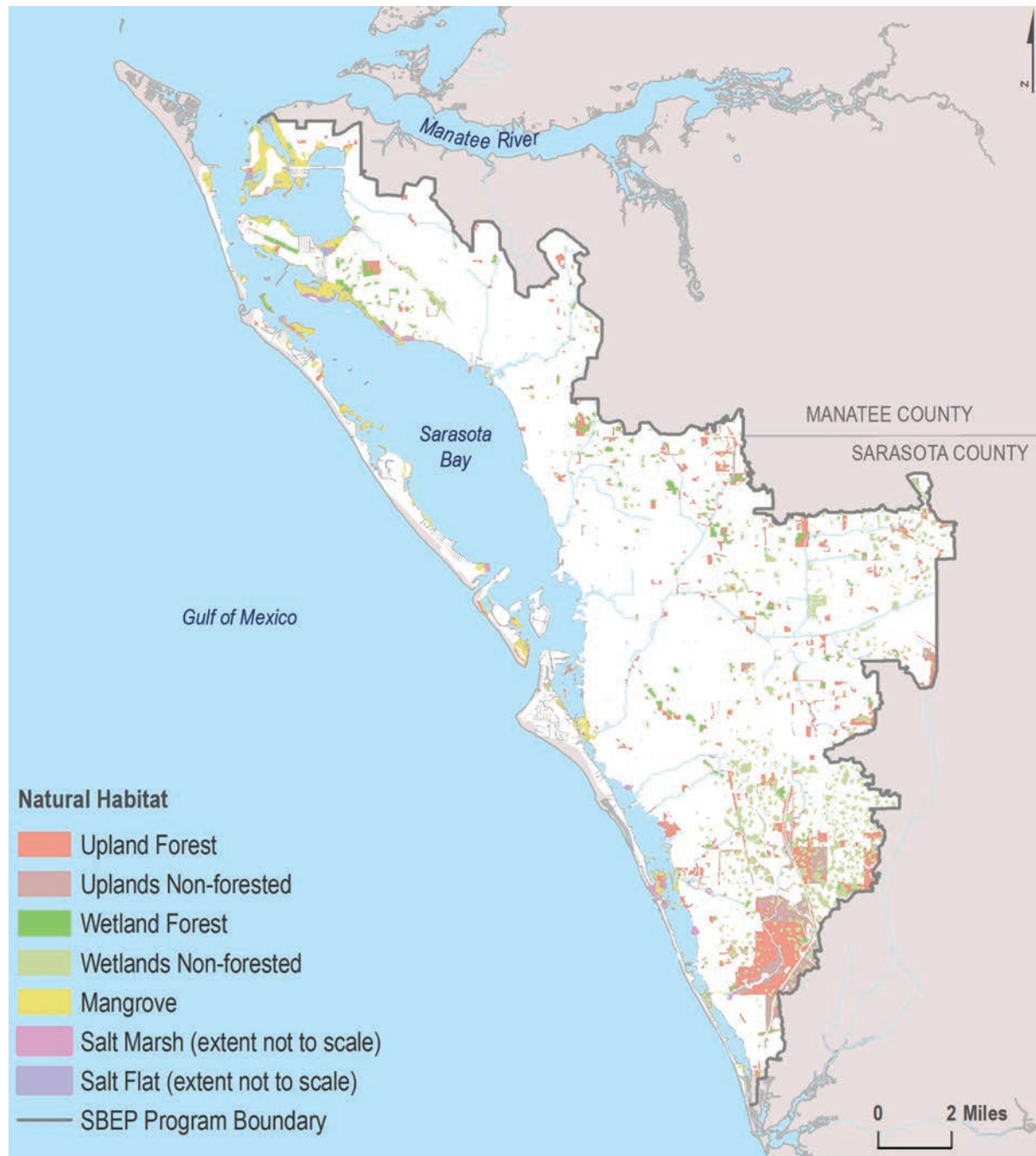


Figure WH-1. Figure WH-1. Natural habitat in the watersheds of Sarasota Bay estuary, including upland forests and freshwater wetlands.



Black mangrove pneumatophores. (SBEP)

Strategy

Activity WH-2.1: Encourage and support the permanent conservation of natural lands through acquisition and conservation easements, including freshwater wetlands and flowways, corridors, and uplands adjacent to coastal habitats necessary for habitat resilience and migration.

Timeframe: Ongoing since 2014 CCMP

Collaborators: SBEP (support), FWC, SWFWMD (Co-lead), FDEP (Co-lead), FDACS, County and Municipal Governments (Co-lead), NOAA, Conservation Foundation of the Gulf Coast (Co-lead)

Projected Five-Year Costs and Funding Sources: \$\$\$\$\$/County and Municipal Governments, Conservation Foundation of the Gulf Coast, Landowners, SWFWMD, USDA-NRCS

Location: SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts

Activity WH-2.2: Restore and manage natural lands through prescribed fire, eradication of invasive exotic plants and animals, hydrologic improvement, and reestablishment of threatened and endangered plants.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (support/Co-lead), FWC (Co-lead), SWFWMD (Co-lead), FDEP (Co-lead), FDACS, County & Municipal Governments (Co-lead), NOAA, Audubon Florida (Co-lead), US EPA

Projected Five-Year Costs and Funding Sources: \$\$\$\$\$/SBEP (CWA 320), County and Municipal Governments, SWFWMD, FWC, FDEP, NOAA, USDA-NRCS, USFWS, US EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts

Benefits

Healthy and interconnected, upland and freshwater wetland habitats support the natural processes necessary for a healthy bay.

Five-Year Performance Metrics Deliverable:

Increased acreage of conserved, restored, or managed habitat.

Watershed Habitats Objective 3: Improve tributary habitats with a special emphasis on fisheries.

Activity WH-3.1

Create and implement a strategy for restoring habitat in tributaries to:

- characterize, delineate, and quantify tributary shoreline and habitat features supportive of fisheries;
- prioritize habitat restoration projects that increase critical juvenile fish habitat; and
- design restorations of urban creek, canal, and stormwater flowways to mimic natural stream function, including elimination of barriers and hardened shorelines.

Benefits and Priority Concerns

Tidal creeks are relatively small coastal tributaries, either natural or manmade, that fluctuate in salinity due to exchanges of fresh and estuarine waters (Janicki and Mote 2016). Although tidal creeks provide an important connection between freshwater and estuarine systems, they possess water quality characteristics that differ from either system. In particular, they can have relatively high nutrient and chlorophyll concentrations and low dissolved oxygen levels relative to downstream estuaries.

Tidal creeks provide food and habitat for crustaceans, wading birds, alligators, and small bodied and larger piscivorous fishes and provide nursery areas for crustaceans and fishes of high ecological and economic value. They also provide many beneficial hydrologic services including water retention, groundwater recharge, and flood prevention.

Historically, wetlands adjacent to tidal creeks were drained for agriculture and creeks were dammed to prevent salinity from reaching farmland. Other harms include ditching, channelizing, and shoreline hardening. Road crossings and culverts impact natural flow and nutrient pollution from stormwater and wastewater, bacterial pollution, and sedimentation degrade water quality. Climate change will further magnify stresses to SBEP area tidal creeks (SBEP and Shafer 2017), including warmer water temperatures, increased intensities of rainfall and storms, prolonged winter droughts,



Paddler in Wares Creek. (SBEP)

and rising sea levels. These stresses will impact water quality and hydrology, affecting plant and animal communities along the full extent of creeks (Jassby 1995).

Monitoring and Status

Currently, the only approved guidance for evaluating tidal creek biological integrity (e.g., Karr 1986) is narrative criteria based on State of Florida dissolved oxygen (DO) and chlorophyll-a threshold values alone. To improve upon this standard, SBEP led a collaborative study, supported by two EPA Wetlands Development Grants, of all three Florida Gulf Coast NEPs to develop numeric nutrient criteria (NNC) for tidal creeks.

Researchers found that creek segments with low dissolved oxygen and high chlorophyll levels could still support high densities of juvenile fishes and baitfish (Janicki and Mote 2016), suggesting that current narrative-based criteria

for water quality in tidal creeks based on DO and chlorophyll may be ineffective and misleading as indicators of the biological integrity of tidal creeks. Large differences among creeks suggested that no single optimum water quality criterion may be appropriate for setting nutrient targets and thresholds to maintain ecological health for all creeks. Instead, the status of juvenile fishes using the creeks might be a more reliable indicator of ecological health. Wessel (2022) recently published work with the three southwest Florida NEPs and six coastal counties that presents a water quality assessment framework for the region's tidal creeks, including a report card to build capacity for future research to identify and refine management tools for these creeks.

In order to better understand how tidal creek habitat quality affects creeks' effectiveness as a nursery habitat for fish, researchers from the Bonefish and Tarpon Trust and FWC analyzed statewide maps of juvenile snook and tarpon locations and assembled a list of habitat characteristics common to successful nursery

habitats (Wilson 2017). Locally, Mote Marine Laboratory scientists conducted a study to determine the status of juvenile fishes in canal systems. Results suggest that creek segments with secondary stage habitat — such as curved channels, wetland plants, or slower moving waters — tend to have increased fish diversity and support proportionally more recreationally important species (Locascio 2017). This is likely due to these sections better resembling natural creeks. In addition, Mote researchers have ongoing studies examining shoreline habitat use of snook and mullet in Sarasota County tidal creeks. Data gathered to date suggest that fish associated with stretches of creek with hardened shorelines spend less time along seawalls. However, if the hardened shorelines have vegetation associated with them, then fish use them as much as nearby natural shorelines (R. Schloesser, Mote Marine Laboratory, personal communication).



Upper Manatee River, Manatee County. (SBEP)



Sea grape
Coccoloba uvifera. (SBEP)

Phillippi Creek

Phillippi Creek, the largest freshwater creek in the SBEP area creek assemblage, has about seven miles of creek and over 100 miles of manmade canals and channels. The creek drains a highly urbanized watershed and regularly exceeds its total maximum daily load limits for bacteria pollution. Phillippi

Creek collects stormwater from many older neighborhoods developed without central sewer or stormwater treatment and is subject to overflows of treated wastewater high in nitrogen from the Bee Ridge Wastewater Treatment Plant. Sarasota County has focused its attention

on improving Phillippi Creek through purchase of the Celery Fields stormwater treatment area, construction of sediment catchment systems, converting 10,000 septic systems to sewer, and extensive outreach and education to community members about fertilizer use, pet waste, and proper maintenance of septic systems and sewer laterals. Sarasota County will upgrade its Bee Ridge Wastewater Treatment Plant from Secondary to Advanced Wastewater Treatment by 2025, which will greatly reduce the amount of nitrogen input into the creek during overflows. Restoration of habitats along Phillippi Creek is an ongoing SBEP priority that local creek-adjacent communities support through volunteer cleanups with the Sarasota Bay Guardians and demonstration restoration projects. Over the past five years, SBEP has supported or managed projects to replace exotic plants with native vegetation along shorelines facing Orchid Oaks Condominium, South Gate Community Association, and Riverview High School.



Phillippi Creek. (Mote Marine Laboratory and Sarasota County West Coast Inland Navigation District Waterway Development Grant Program)

Green tree frog
Hyla cinerea. (Brad Weinert)



Sand fiddler crab
Uca pugilator. (SBEP)





South Creek, Sarasota County. (SBEP)

Strategy

Activity WH-3.1:

Create and implement a strategy for restoring habitat in tributaries to:

- characterize, delineate, and quantify tributary shoreline and habitat features supportive of fisheries;
- prioritize habitat restoration projects that increase critical juvenile fish habitat; and
- design restorations of urban creek, canal, and stormwater flowways to mimic natural stream function, including elimination of barriers and hardened shorelines.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (collaborate/Co-lead), Mote Marine Laboratory (Co-lead), County and Municipal Governments (Co-lead), SWFWMD, FWC (Co-lead), FDEP

Projected Five-Year Costs and Funding Sources: \$\$\$\$\$/SBEP (CWA 320), FDEP, County and Municipal Governments, SWFWMD, FWC, NFWF, Colleges and Universities, NOAA, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

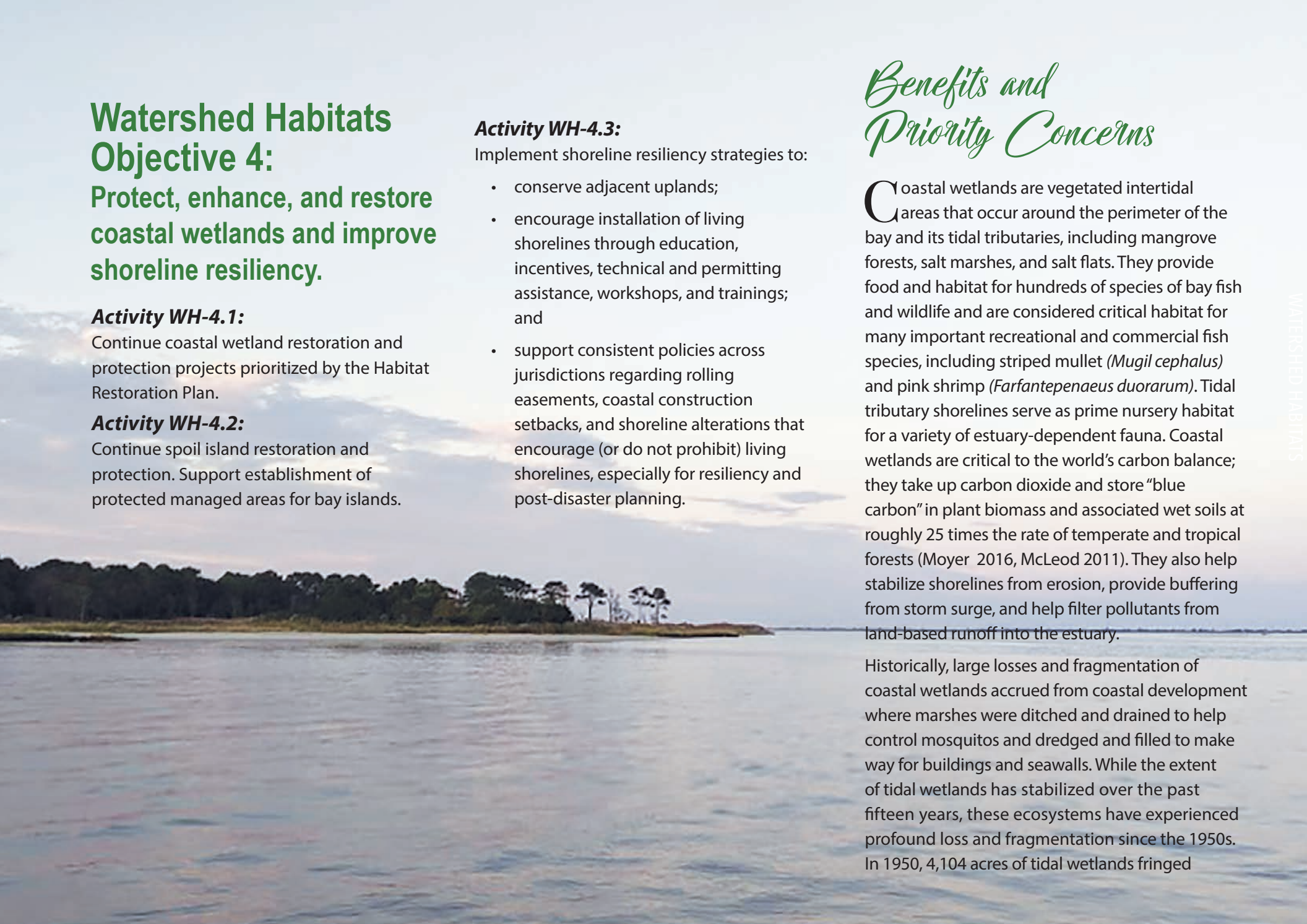
Location: SBEP tributaries

Benefits

Improvements to the habitat quality and connectivity of tributaries support water quality and fish populations, while providing flood control and increasing property values.

Five-Year Performance Metrics Deliverable:

Increased acreage and linear feet of improved shorelines and tributary habitats.



Watershed Habitats Objective 4: Protect, enhance, and restore coastal wetlands and improve shoreline resiliency.

Activity WH-4.1:

Continue coastal wetland restoration and protection projects prioritized by the Habitat Restoration Plan.

Activity WH-4.2:

Continue spoil island restoration and protection. Support establishment of protected managed areas for bay islands.

Activity WH-4.3:

Implement shoreline resiliency strategies to:

- conserve adjacent uplands;
- encourage installation of living shorelines through education, incentives, technical and permitting assistance, workshops, and trainings; and
- support consistent policies across jurisdictions regarding rolling easements, coastal construction setbacks, and shoreline alterations that encourage (or do not prohibit) living shorelines, especially for resiliency and post-disaster planning.

Benefits and Priority Concerns

Coastal wetlands are vegetated intertidal areas that occur around the perimeter of the bay and its tidal tributaries, including mangrove forests, salt marshes, and salt flats. They provide food and habitat for hundreds of species of bay fish and wildlife and are considered critical habitat for many important recreational and commercial fish species, including striped mullet (*Mugil cephalus*) and pink shrimp (*Farfantepenaeus duorarum*). Tidal tributary shorelines serve as prime nursery habitat for a variety of estuary-dependent fauna. Coastal wetlands are critical to the world's carbon balance; they take up carbon dioxide and store "blue carbon" in plant biomass and associated wet soils at roughly 25 times the rate of temperate and tropical forests (Moyer 2016, McLeod 2011). They also help stabilize shorelines from erosion, provide buffering from storm surge, and help filter pollutants from land-based runoff into the estuary.

Historically, large losses and fragmentation of coastal wetlands accrued from coastal development where marshes were ditched and drained to help control mosquitos and dredged and filled to make way for buildings and seawalls. While the extent of tidal wetlands has stabilized over the past fifteen years, these ecosystems have experienced profound loss and fragmentation since the 1950s. In 1950, 4,104 acres of tidal wetlands fringed

Sarasota Bay, and the average size of wetlands was about 22 acres. About 40 acres were lost annually between 1950 and 1975, followed by losses of about 20 acres per year through 1990, while the average size of wetlands decreased to 5.6 acres during this period (SBEP 1992). The most recent bay-wide shoreline habitat survey shows 55% of the 410 miles of shoreline of Greater Sarasota Bay, including upland-cut canal systems, are hardened by bulkheads and riprap (Serviss and Sauers 2003).

Although State and County regulations now protect coastal wetlands from being cleared for development, impacts still occur. For example, boat wakes can accelerate erosion along stressed shorelines. Moreover, shoreline development reduces ability for salt marshes and mangroves to migrate inland as sea level rises, eventually causing coastal wetlands to be squeezed and drown in place.

Mangrove trimming is common practice for many waterfront properties in Sarasota County; in the unincorporated area, 54% of coastal parcels with mangroves are trimmed, and 18% of those are trimmed to less than 6 feet in height in violation of State and County regulations (Sarasota County 2016). Excessively trimmed mangroves lose productivity, longevity, and habitat value. Invasive vegetation, particularly Brazilian pepper (*Schinus terebinthifolius*), and Australian pines (*Casuarina spp.*) encroach on the boundaries of coastal wetlands and can outcompete native species in impacted areas.

Altered upland hydrology, where natural sheet flow of freshwater has been replaced by highly variable flow through stormwater control

structures, causes rapid changes in salinity of coastal wetlands and shorelines. Too much freshwater flow can increase erosion and polluted runoff. Too little flow can cause stress from stagnation, anoxia, or hypersalinity, and lead to collapse of marsh root structure, making it more difficult for coastal wetlands to accrete substrate and maintain elevation with rising sea level.

Monitoring and Status

Mapping and monitoring of coastal wetlands is achieved by remote mapping and field surveys. Regional land use and land cover mapping by photointerpretation of aerial imagery is conducted by the Southwest Florida Water Management District (SWFWMD) every three years. Field-based shoreline morphology and vegetation surveys focus on juvenile fisheries habitat (Serviss and Sauers 2003), tidal creek

assessment (Eilers 2013, Eilers 2014, and SBEP 2016), and mangrove trimming (Sarasota County 2016). A new monitoring method can identify stressed mangroves via remote sensing and can inform management strategies to prevent mangrove mortality (Beever 2016). SBEP supports continuing regular mapping and surveying efforts.

Wetlands make up 37% of shorelines, while beach and upland shoreline total 8% (Serviss and Sauers 2003). As a percentage of total shoreline, Little Sarasota Bay has the most coastal wetlands (65%), while Sarasota Bay has the least (31%) (Table WH-3).

Mangroves make up 96% of the coastal wetlands in Sarasota Bay (Table WH-4). Since 1999, areal extent of mangroves has increased as a result of mangrove restoration efforts and natural succession of salt marsh to mangrove

Table WH-3. Sarasota Bay shoreline type (in linear feet) by bay segment. (Serviss and Sauers 2003)

BAY SEGMENT	Hardened	%	Wetland	%	BEACH/ UPLAND	%	TOTAL
Anna Maria	127,199	86%	18,704	13%	1,819	1%	147,722
Palma Sola	155,266	45%	173,883	50%	18,959	5%	348,108
Sarasota Bay	531,122	62%	262,599	31%	63,246	7%	856,967
Roberts Bay	245,509	55%	139,913	31%	60,186	14%	445,608
Little Sarasota Bay	51,454	26%	129,066	65%	17,049	9%	197,569
Blackburn Bay	73,659	43%	82,442	48%	14,415	8%	170,516
TOTAL	1,184,209	55%	806,607	37%	175,674	8%	2,166,490

Table WH-4. 2017 acreages for emergent wetlands and tidal flats in Sarasota Bay. (SSFWMD 2017)

	Mangroves	Salt Flats	Salt Marsh	Total
TOTAL	2186	38	52	2280

(Leverone 2017). This trend is expected to continue due to climate change and sea-level rise, which favor mangrove expansion at the expense of other estuarine habitats (Sherwood and Greening 2012, 2014). Only 56 acres of salt marsh habitat remain, with most located around Jim Neville Preserve in Little Sarasota Bay and upstream in tidal creeks. Manatee County's extensive coastal preserves, including Robinson, Perico, and Neal Preserves, are major highlights in showcasing the region's efforts to protect and restore coastal wetlands (especially rare salt flats), oyster reefs, and coastal uplands (See Figure WH-1).

Accomplishments and Priorities

Between 2014-2018, twenty-one projects on about 500 acres were completed to protect, enhance or restore coastal wetlands and shorelines. Activities included removing exotic vegetation, planting native vegetation, creating new habitat, and acquiring coastal properties. Most of these efforts focused on coastal preserves in Manatee County, including Robinson Preserve and Robinson Preserve Expansion, Perico Preserve, and FISH Preserve. Many of these projects were supported by local volunteers organized through the Bay Guardians Program (See Community Action Plan) and Bay Partners Grants.



Perico Preserve Restoration



Manatee County's extensive coastal preserves, including Robinson, Perico, and Neal Preserves, are major highlights in showcasing the region's efforts to protect and restore coastal wetlands, oyster reefs, and coastal uplands. In 2007, Manatee County purchased 176 acres of highly disturbed fallow farmland slated for high intensity development in western Manatee County. The Manatee County Parks and Natural Resource Department and partners restored the property to a mosaic of ecologically valuable habitats that improve ecological values, water quality, and passive recreational opportunities. Hundreds of volunteers assisted in the restoration effort, including Sarasota

Bay Estuary Program Bay Guardians. Perico Preserve's proximity and accessibility to the public makes it an ideal location for education

and outreach about the importance of protecting and restoring Sarasota Bay area natural habitats.



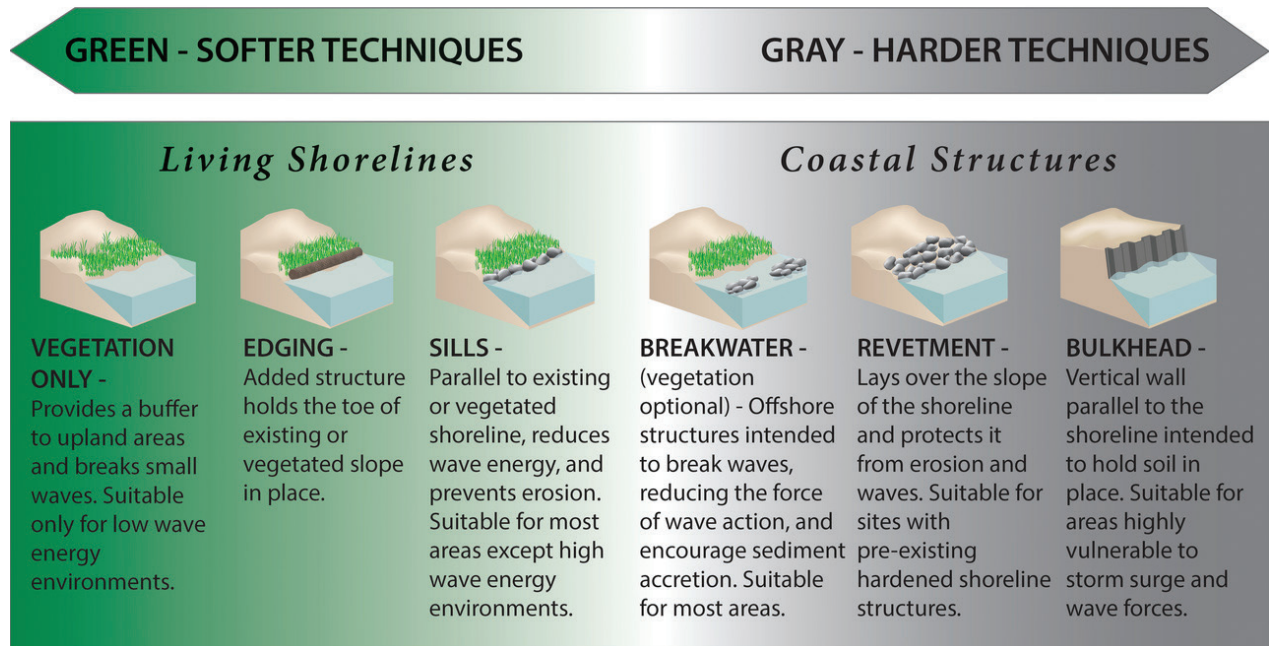
Volunteers built habitat for a new oyster reef in the Perico Preserve basin in 2019. (SBEP)

Improving coastal shoreline resilience through the installation of living shorelines is a SBEP priority. Living shorelines can reverse the negative effects of hardened shorelines in many SBEP area locations. Over 50 public waterfront parcels have been identified as candidates for living shoreline projects (ESA Scheda 2018), and a majority of Sarasota County shorelines may be candidates for hybrid living shorelines, composed of natural and structural elements (Dobbs 2017).

A continuum of shoreline stabilization techniques is available for different wave energy and infrastructure conditions that vary from tidal creek to canal to bayfront locations. Where existing seawalls cannot be removed, seawall enhancement projects can create habitat in front of the seawall. SBEP will continue to implement living shoreline demonstration projects and encourage consistent policies across jurisdictions for permitting and design. There is a need for broader education on the benefits and efficacy of living shorelines along with technical and permitting assistance for the marine construction industry and shoreline property owners.

Bay islands feature some of the last remaining undeveloped shorelines. Although some islands have natural origins, most were created from dredge material produced during creation of the Intracoastal Waterway and other coastal development. Many serve as important colonial bird rookeries, hosting threatened and endangered species such as the roseate spoonbill (*Platalea ajaja*) and reddish egret

HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?



WH-2: A continuum of green (soft) to grey (hard) shoreline stabilization techniques. (NOAA (2015)

(*Egretta rufescens*). SBEP has identified projects to enhance spoil island hydrology, native coastal habitats, and shorelines to improve their ecological function. While spoil island restoration projects generally rank lower in SBEP's Habitat Restoration Plan than those associated with water quality improvements in the watershed (SBEP 2016), there are important opportunities in Braden River, north Sarasota Bay, and Roberts Bay.

SBEP is committed to supporting coastal wetland and shoreline protection, enhancement, and restoration projects prioritized in the Habitat Restoration Plan (see Bay Habitats Objective 1). Consistent effort and vigilance are needed to prevent further spread of invasive vegetation and recognize new invasive species. Early identification

of coastal wetland stressors such as erosion, illicit trimming, pollution, and altered hydrology can be used to help prioritize intervention projects. Opportunities for establishing and maintaining wetland habitat connectivity and buffer zones for landward migration of coastal wetlands should also be prioritized. Coordinating projects and funding opportunities among SBEP partners will enhance success and may create opportunities for aggregated blue carbon offset financing for coastal wetland restoration (Herr 2015).



Bayfront Park, City of Sarasota. (SBEP)

Strategy

Activity WH-4.1: Continue coastal wetland restoration and protection projects prioritized by the Habitat Restoration Plan.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Conduct/Co-lead), SWFWMD (Co-lead), FDEP, FWC, USACE, County and Municipal Governments (Co-leads)

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (CWA 320), County and Municipal Governments, Landowners, SWFWMD, FWC, FDEP, NOAA, Florida Sea Grant, USACE, WCIND, NFWF, NOAA, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts

Activity WH-4.2: Continue spoil island restoration and protection. Support establishment of protected managed areas for bay islands.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Collaborators: SBEP (conduct/Co-lead), County and Municipal Governments (Co-lead), FWC, USACE, Audubon Florida (Co-lead), FDEP

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (CWA 320), FWC, USACE, WCIND, NFWF, NOAA, FDEP, RESTORE, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts

Activity WH-4.3: Implement shoreline resiliency strategies to:

- conserve adjacent uplands;
- encourage installation of living shorelines through education, incentives, technical and permitting assistance, workshops, and trainings; and
- support consistent policies across jurisdictions regarding rolling easements, coastal construction setbacks, and shoreline alterations that encourage (or do not prohibit) living shorelines, especially for resiliency and post-disaster planning.

Timeframe: Ongoing since 2014 CCMP

Activity WH-4.3: (continued)

Collaborators: SBEP (Conduct/Co-lead), Co-leads: FWC, NOAA, Florida Sea Grant, USACE, County and Municipal Governments, FDEP

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (CWA 320), County and Municipal Governments, Landowners, NOAA, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, under-served communities, and areas specifically vulnerable to climate change impacts

Benefits

Expanded use of softened shorelines in bay and tidal tributary locations improves wildlife habitat, water quality, and resilience to storms and sea level rise. Expanded ecosystem services and non-habitat related benefits.

Five-Year Performance Metrics Deliverables:

- (1) Increased acreage and linear feet of created or restored coastal habitat,
- (2) Ten workshops or consultations with government, waterfront property owners, or marine contractor representatives.



Watershed Habitats Objective 5:

Protect, enhance, and restore hard bottom and seagrass habitats.

Activity WH-5.1:

Monitor artificial and oyster reef habitat quality, explore optimal placement of new reefs, and establish/enhance oyster and artificial reefs in Sarasota Bay.

Activity WH-5.2:

Participate in inventories of benthic and living hard-bottom habitat in Sarasota Bay and nearshore Gulf water and passes.

Activity WH-5.3:

Reevaluate seagrass indicators and targets in bay segments. Implement water quality improvement strategies to increase productive and resilient seagrass habitat.

Activity WH-5.3:

Continue seagrass mapping and monitoring and expand seagrass monitoring transects to Manatee County.

The Sarasota Bay Estuary spans approximately 52 square miles of open water in Manatee and Sarasota Counties. As a shallow lagoonal estuary, the bay bottom is primarily composed of soft sediments ranging from mud to sand to shell that provide habitat to hundreds of species of small benthic invertebrates. In impacted dredged areas, soft sediments are a sink for nutrients and toxic substances. Hard-bottom habitat is relatively rare and consists of oyster reefs along shoreline fringes, sporadic rock outcrops, and strategically located artificial reefs. About a third of the bay bottom is covered in seagrass meadows. The hard-bottom habitats and seagrass meadows are priority habitats for protection, enhancement, and restoration.

Hard-Bottom Habitats

Natural Rock Outcroppings

Isolated and sporadic occurrences of natural rock occur in the nearshore waters of the Gulf of Mexico and bays. The limestone or dolomite sedimentary rock (also known as coquina rock) is composed of consolidated shells of marine animals formed over millions of years. In some places, such as Point of Rocks on Siesta Key, the rock forms outcroppings with relief of 2–3 meters, but in most natural hard-bottom areas it takes the form of low relief bedrock covered with a thin veneer of sand or shell. These natural hard-bottom areas provide habitat for distinct communities of plants, fish and invertebrates, and in turn provide recreational opportunities for fishers and snorkelers. The full extent of rocky hard-bottom habitat has never



been comprehensively mapped in Sarasota Bay, although various benthic habitat assessments have contributed piecemeal information over time. The Florida Coastal Mapping Program (FCMaP), an initiative between Federal and Florida State agencies and institutions, has aggregated many of the available benthic habitat maps for the state's coastal and marine waters to identify gaps in coverage, develop a multi-year plan for filling those gaps, and complete a high-resolution map for all of Florida's waters. A comprehensive inventory could be achieved by underwater visual surveys, aerial image interpretation, or vessel-based side-scan sonar or acoustic sounders. These rare habitat locations may warrant special protection, similar to Sarasota County's Point of Rocks Protection ordinance prohibiting damage, destruction, or taking of rock at that location.

Artificial Reefs

Artificial reefs are man-made structures designed to mimic the habitat characteristics of natural hard-bottom reefs. They provide suitable substrate for colonization by encrusting organisms, invertebrates, and fish on sandy bay bottom otherwise only inhabited by small benthic invertebrates. Artificial reefs can help compensate for historical losses of hard bottom habitat due to dredge and fill operations in the bay. Artificial reefs can also provide substrate for oyster recruitment and reef generation and can enhance shoreline protection. Artificial reefs can be constructed of a variety of materials, including concrete rubble, reef balls, and limestone boulders. Artificial reefs with greater complexity and constructed from a variety of materials tend to host a wider variety of species (Serviss and Sauers 2003).



Artificial reef ball. (SBEP)

A study to monitor the colonization of artificial reef habitats in Sarasota Bay and Tampa Bay showed that artificial reefs were important seasonal habitats in these systems for both finfish and invertebrates (Blackburn 2008). Reefs appeared to benefit both recruitment and retention of organisms and abundance on reefs was positively correlated to reef size.

The Florida Fish and Wildlife Conservation Commission (FWC) Division of Marine Fisheries Management administers the statewide artificial reef deployment program in partnership with Counties. SBEP's reef restoration efforts focus on enhancing and

monitoring artificial reefs in Greater Sarasota Bay (Figure WH-4), although there are dozens more located in the nearshore gulf. Between 2014 and 2018, two acres of artificial reefs were deployed in Manatee County waters and two new sites were permitted by FWC.

SBEP will continue working with Sarasota County, Manatee County, and FWC to design, permit, and deploy artificial reef modules to designated sites in the bay. Continued monitoring of fish habitat usage is important in order to maximize reef array design and placement for maximum fishery habitat benefit.

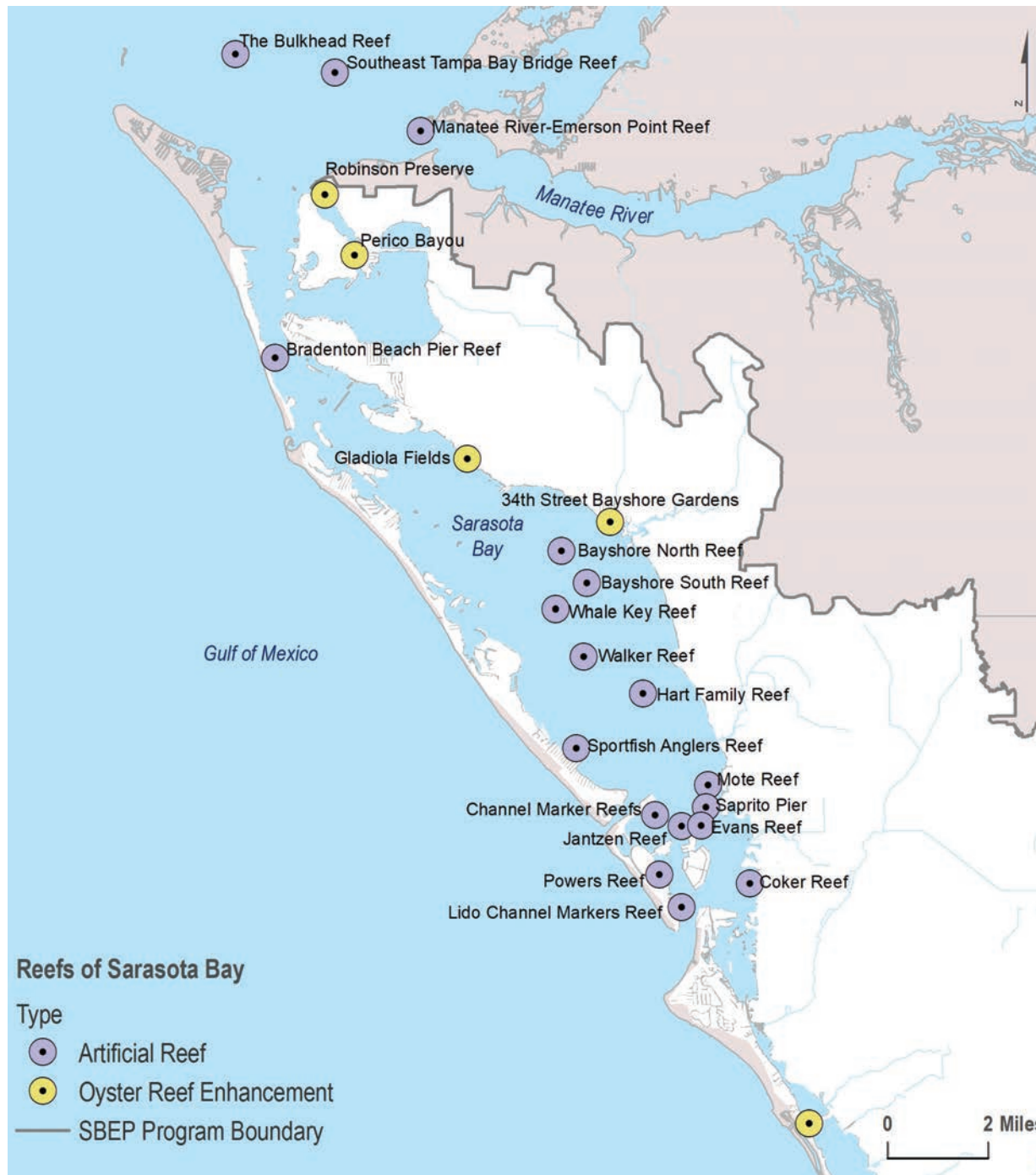


Figure WH-3. Artificial and oyster reefs in Sarasota Bay.

Oyster Reefs

Oyster reefs are a critical component of estuarine ecosystems. They provide habitat and food for other invertebrates, fish, and birds, provide shoreline protection from wave energy, and improve water quality by capturing pollutants as they filter feed. One acre of restored oyster reef has been shown to remove up to 543 pounds of nitrogen pollution per year (Kellogg 2013). Oyster reefs are protected under Federal and State law; they are considered Essential Fish Habitat and afforded federal protection under the Magnuson-Stevens Fisheries Conservation and Management Act.

Eastern oysters (*Crassostrea virginica*) live in particular estuary mixing zones, where they receive regular tidal inundation and freshwater input that creates an optimal salinity regime. In Sarasota Bay, oysters form reefs along the coastal fringe, often flanking mangroves. They also recruit to the vertical surface of seawalls and form clumps around mangrove roots.

Sarasota County conducts annual oyster surveys in 14 bay and tidal creek locations. Of the 55 acres of oysters found in the Sarasota County bays and creeks of the SBEP, 20% are found in creeks, with half in Phillippi Creek and about 30% in Little Sarasota Bay (Meaux 2016). Aerial oyster habitat mapping is conducted by Southwest Florida Water Management District (SWFWMD) every two years in conjunction with seagrass mapping but without ground-truthing; 2016 maps

show 78 acres of oyster habitat in the SBEP area with recent increases over all bay segments. SBEP participates in the Oyster Integrated Mapping and Monitoring Program (OIMMP) coordinated by FWC to create a publicly available mapping layer and statewide report on mapping and monitoring methods, data gaps, and priorities.

Oyster reefs are expected to grow in elevation at pace with sea level rise in some locations, but they face other climate stressors including ocean acidification, eutrophication, algal blooms, disease, and parasites (Rodriguez 2014). Oyster reefs located at the mouths of tidal creeks will likely migrate upstream with sea level rise but may encounter limited substrate availability in narrower creek beds. Continued annual monitoring of live oysters in Sarasota County tidal creeks will help track watershed health and evaluate watershed management programs, especially hydrologic restoration of natural freshwater flows to the bay and reduction of stormwater pollutants.

Oyster habitat creation and enhancement continues to be a priority activity for SBEP in order to support essential fish habitat and water quality goals. Habitat Restoration Plan projects with potential for oyster habitat restoration, such as the Cortez Key and Dot Dash Dit Bird Sanctuaries, are ranked higher for their fisheries, shoreline enhancement, and water quality benefits. In 2017, four 20-foot diameter reefs were installed in northern Sarasota Bay at the 34th Street Canal in Bayshore Gardens, creating one

acre of new oyster habitat. From 2017–2019, hundreds of feet of shoreline were enhanced with recycled oyster shell at Robinson Preserve and Perico Preserve through the unique local partnership of the Gulf Coast Oyster Recycling and Renewal program (GCORR). With the help of community volunteers who bag and deploy the oyster shells, GCORR coordinates the use of live oyster shell discards, collected and cleaned by eleven participating restaurants, for oyster habitat restoration. This operation reduces impacts from shell mining and eliminates an estimated 80 tons of restaurant waste going to the landfill. Monitoring shows that oyster reefs created with live shell produce 23% more new oyster growth than those built with fossil shell. Manatee County is also planning large scale oyster habitat restoration on the shallow banks of the Manatee River, where oyster beds were once very abundant.

Seagrass Habitats

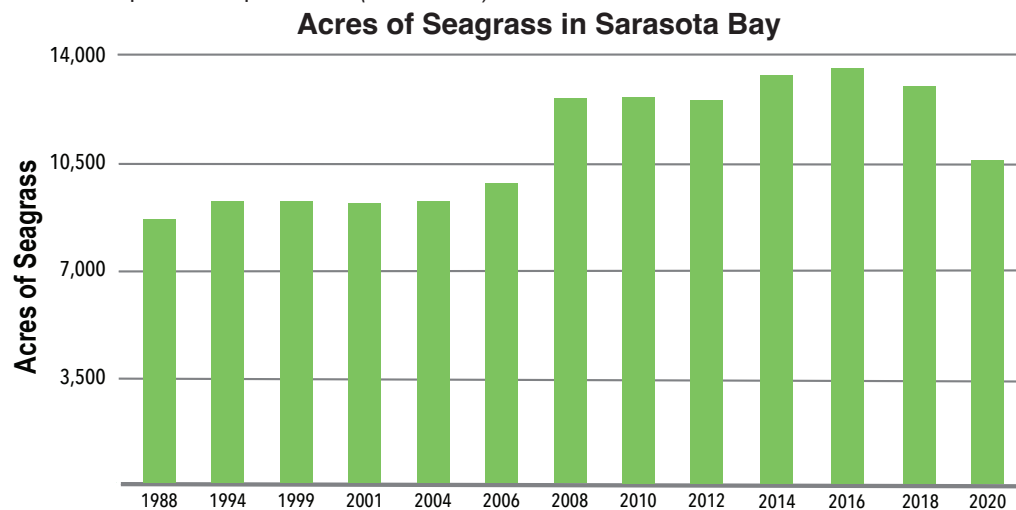
Expansive seagrass meadows are one of Sarasota Bay's signature features. Seagrass meadows provide essential food and habitat for juvenile and adult finfish and shellfish, hosting about 70 percent of commercially and recreational important species during some portion of their life cycle. Seagrasses also play an important role in cycling nitrogen and carbon. Their extensive root and rhizome systems also stabilize sediments and reduce coastal erosion and wave action.

Climate change may impact the growth and distribution of seagrass. Seagrass could be inhibited by increased turbidity from more intense storms



Table WH-4. Seagrass acreage by bay segment by year. (SWFWMD)

	BAY SEGMENT					TOTAL
	Palma Sola	Sarasota	Roberts	Little Sarasota	Blackburn	
YEAR						
1988	1,111	6,323	334	533	411	8,712
1994	1,089	6,910	347	592	411	9,349
1999	1,025	6,750	332	770	374	9,251
2001	1,046	6,862	273	699	301	9,181
2004	1,002	6,646	371	763	468	9,250
2006	1,028	7,436	325	640	425	9,854
2008	1,164	9,997	302	837	346	12,646
2010	1,177	9,917	329	891	382	12,696
2012	1,185	9,798	307	902	399	12,591
2014	1,238	10,378	326	929	422	13,293
2016	1,258	10,659	361	806	390	13,473
2018	1,278	10,326	349	610	295	12,857
2020	1,216	8,075	332	607	307	10,539

Figure WH-4. Acres of seagrass in Sarasota Bay 1988-2020 as measured by aerial surveillance and photointerpretation. (SWFWMD)

and increased algal growth with rising water temperature. Alternatively, elevated carbon dioxide and water temperature may make seagrass grow faster, taking up excess carbon dioxide from the water and creating localized micro-refugia from ocean acidification (Manzello 2012).

Boat propellers that run aground in seagrass beds can tear root systems and dislodge seagrass, which can lead to further substrate erosion and collapse. Seagrass propeller scarring appears to be more prevalent in Sarasota Bay where boat traffic is not as constrained by the intracoastal waterway channel (Ali 2013). There is a need to update propeller scarring maps and evaluate the rate of scar recovery, as well as improve boater education and awareness of seagrass beds to reduce scarring (see Community Action Plan).

Seagrasses need adequate water clarity for sunlight to penetrate to depth. Reduced water clarity from sedimentation, color changes, and excessive algal growth due to nutrient pollution can impact the health of seagrass meadows, making them a good biological indicator of water quality and efforts to reduce watershed pollutant loads.

Aerial seagrass mapping is completed biennially by SWFWMD, with some mapping beginning as early as 1988 (Figures WH-5 and WH-6). FDEP has monitored seagrass annually in Sarasota Bay since 1999 at seven permanent transects. Since 2006, Sarasota County has conducted semi-annual field surveys of



Figure WH-5. Seagrass meadows in Sarasota Bay, including continuous and patchy seagrass beds. (SWFWMD 2020)

bay seagrass to characterize density, species composition, and occurrence of epiphytic and drift algae (Figure WQQ-9).

There was an increase in frequency of drift algae and a decrease in frequency of shoal grass (*Halodule wrightii*) across all segments from 2010–2015 (Christman 2015). Seagrass recovery in Sarasota Bay tracked bay-wide nutrient load reductions implemented between the 1980s and 2016 (Tomasko 2018). Recent declines in seagrass coverage (Table WH-5) may be attributable to complex factors, from anthropogenic eutrophication in southern bay systems to episodic red tide impacts in the northern bays.

Long-term seagrass monitoring should be continued and augmented with a monitoring framework to detect the effects of climate change and ocean acidification on seagrass and other estuarine habitats. Efforts should be undertaken to better translate the significance of changes in seagrass coverage to policymakers, managers, and the general public. In addition, measures of ecosystem services provided by seagrass, such as suitability for fishery habitat and water quality improvement, should be considered alongside conventional measures of areal extent.



Natural oyster reef offshore of Marie Selby Botanical Gardens. (SBEP)

Strategy

Activity WH-5.1: Monitor artificial and oyster reef habitat quality, explore optimal placement of new reefs, and establish/enhance oyster and artificial reefs in Sarasota Bay.

Timeframe: Ongoing since 1995 CCMP

Collaborators: (Conduct/Co-lead), County Governments (Co-leads), FWC (Co-lead), FDEP, Florida Sea Grant, Mote Marine Laboratory, USACE

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320), SWFWMD, County Governments, FWC, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP bays

Activity WH-5.2: Participate in inventory of benthic and living hard-bottom habitat in Sarasota Bay and nearshore Gulf water and passes.

Timeframe: New activity; Begin coordination in 2022

Collaborators: SBEP (collaborate), USGS, Florida Coastal Mapping Program (lead)

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320), FIO, USF, SWFWMD, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP bays

Activity WH-5.3: Reevaluate seagrass indicators and targets in bay segments. Implement water quality improvement strategies to increase seagrass habitat.

Timeframe: Ongoing since 1995 CCMP; target re-evaluation began in 2021, strategy implementation will be ongoing (see Water Quality and Quantity Action Plan)

Collaborators: SBEP (Conduct/Co-lead), County and Municipal Governments (Co-lead), FDEP (Co-lead), SWFWMD (Co-lead)

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320), County and Municipal Governments, SWFWMD, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding

Location: SBEP bays

Activity WH-5.4: Continue seagrass mapping and monitoring and expand seagrass monitoring transects to Manatee County.

Timeframe: Ongoing since 1988; biennial

Collaborators: SBEP (support); SWFWMD (lead), County Governments

Projected Five-Year Costs and Funding Sources: \$\$\$/SWFWMD, County Governments

Location: SBEP bays

Benefits

Mapping, monitoring, and enhancing hard bottom and seagrass habitats supports fish and shellfish populations and improves water quality.

Five-Year Performance Metrics Deliverables:

- (1) Reporting of acres of extant seagrass and hard-bottom habitats,
- (2) Net area of hard-bottom habitat created or restored



Turtle grass.

Watershed Habitats Objective 6

Protect, enhance, and restore beaches and dunes for wildlife and resiliency.

Activity WH-6.1:

Restore coastal dunes and encourage protection of beach wrack communities.

Activity WH-6.2:

Curate scientific knowledge of habitat impacts of sand replenishment and movement.

Activity WH-6.3:

Explore SBEP's role in regional sediment management planning, including coordination with USACE.

Benefits and Priority Concerns

SBEP area Gulf Coast barrier island beaches provide critical habitat for fish and wildlife and significant ecosystem services to Sarasota Bay. Many fish and wildlife species commonly associated with Sarasota Bay utilize beaches, dunes, and surf zone environments during various life stages. For instance, during May–October, loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) use area beaches for nesting. Resident and migratory shorebirds depend on beaches and dunes for resting, foraging, and nesting. A community of small invertebrates live among the beach wrack that washes up on beaches. Beach wrack is the primary source of nutrients for beach communities, particularly for shorebirds (Dugan *et al.* 2003). Small animals living in wrack and nutrients from decomposing wrack regularly wash into the surf zone, making it an important nursery area for ecologically and economically important bay-associated fishes like snook, redfish, spotted seatrout, and sheepshead. Barrier island beaches and dunes also provide protection to relatively fragile bay habitats like seagrass meadows, salt marshes, and mangrove forests by reducing the impact of high energy waves and storms.

In addition to their environmental importance, Florida's beaches are the state's primary tourist attraction (EDR 2015). Area beaches extend 47 miles along the Gulf barrier islands from Anna Maria Island in Manatee County to Manasota

Key in Sarasota County with five passes opening to the bays between Tampa Bay and Charlotte Harbor. Passes provide important habitat for fish and wildlife and their dynamic geomorphology affects tidal mixing and flushing of bay waters.

Beaches are naturally dynamic systems that include both onshore terrestrial and offshore submerged components. The interaction of winds, waves, tides, and currents constantly reshapes beaches and dunes. High energy storm waves reposition sand from the upper beach and dunes to offshore sandbars. Between storms, lower energy waves return sand to the beach, where wind can blow it inland to rebuild dunes. Beaches are further shaped by natural inlet dynamics and variable patterns of onshore-offshore and longshore sand transport. Adequate sediment availability

also plays a role in beach accretion and erosion. Priority management concerns include erosion, invasive species, recreational impacts, beach grooming, and pollution from infrastructure failures.

Erosion

Beach erosion is a natural process of barrier island movement. It becomes a management concern when it threatens coastal development or infrastructure. Beach erosion in the SBEP area is caused by sea level rise, tropical storms and hurricanes, winter frontal systems, and the effects of development, coastal armoring, and passes on adjacent beaches.

Of the 21.4 miles of beaches in FDEP's Sarasota Barriers North Reach subregion, which extends from the Southwest Channel entrance to Tampa Bay in Manatee County to the northwest end of Siesta Key in Sarasota County, 21.2 miles are designated

as critically eroded. A total of 16.4 miles have been restored and maintained (FDEP 2018b). Of the 18.9 miles of beaches in the Sarasota Barriers South Reach subregion, which extends from the northwest end of Siesta Key to the north end of Manasota Key, 10.8 miles are designated as critically eroded. A total of 5.4 miles have been restored (FDEP 2018b).

Climate change is expected to drive warmer air and water temperatures, higher sea levels, more acidic ocean waters, and increased intensity of storms (SBEP and Shafer 2017). These pressures will negatively impact beaches and dunes and the flora and fauna that depend on them. Sea level rise will increase erosion and reduce the size of beaches or eliminate them altogether where beaches have lost the capacity to retreat due to coastal construction or armoring. More extreme storms will exacerbate ongoing beach erosion and create new problems for previously stable beach and dune systems.



Erosion alongside gulf shoreline, Casey Key. (Patti Cross)

Recent Storms

Causing the most beach erosion
in the SBEP area

1982	No-Name Storm
1985	Hurricane Elena and Tropical Storms Bob and Juan
1996	Tropical Storm Josephine
2004	Hurricanes Frances, Ivan and Jeanne
2005	Hurricane Wilma
2008	Tropical Storm Fay
2012	Tropical Storm Debby
2016	Tropical Storm Colin and Hurricane Hermine
2017	Hurricane Irma
2020	Tropical Storm Eta
2021	Tropical Storm Elsa



Hurricane Season. (Sarasota Herald Tribune)

Development, Sand Replenishment, and Coastal Armoring

When dynamic, moving beaches interact with fixed coastal construction, they can erode and be lost. When beaches erode, communities often respond with engineered solutions ranging from sand replenishment to coastal armoring (Doyle 1984), the latter often leading to loss of beach (Doyle *et al.* 1984, Kaufman and Pilkey 1984). Sand replenishment projects are costly and tend to be temporary and repetitive. For example, between 1964 and March 2015, Lido Key Beach underwent 13 sand replenishment projects, adding a total of almost 3.3 million cubic yards of sand to the beach (FDEP 2018b).

Environmental impacts of sand replenishment projects can include:

- Burial of existing flora and fauna living on and in the sand, including invertebrates that are important food sources for surf-feeding fish, crabs, and shorebirds;
- Increased turbidity, which can negatively affect surrounding inlets and their bays;
- Mismatches between natural and dredged sand size and composition, which can negatively affect organisms that live in the sand and wildlife's ability to dig through it for nesting (Mallach and Leberg 1999); and mismatches in sand color, which can change the temperature of the beach surface by differential absorption of solar

energy and affect reproductive habits, sex determination, and development of young sea turtles (Standora and Spotila 1985); and

- Disturbances to wildlife due to operation of heavy machinery on the beach.

The Sarasota Bay area lacks a comprehensive understanding of the effects of turbidity on surrounding areas during dredge and fill operations, the importance of dredge material quality on habitat suitability, and the recovery of flora and fauna in and on beaches following replenishment activities.

Invasive Exotic Species

Invasive exotic plants can outcompete and exclude native beach and dune vegetation, creating diet and shelter mismatches with native fauna and building less-effective vegetative mats for dune stabilization.

Recreational Use Impacts and Beach Grooming

Recreational impacts to beaches include marine debris and litter, diminished water quality, disturbance and trampling of nests, exacerbation of erosion, and impacts from domesticated animals. Domestic animals like dogs and cats can disturb and kill shorebirds, beach nesting birds, and sea turtle hatchlings, and reduce the suitability of beach habitat for their use. Recreational impacts also include beach maintenance practices like grooming that eliminates beach wrack. Beaches without wrack have lower species richness, abundance, and biomass of invertebrates, many of which are

important prey species for shorebirds (Dugan 2003, Defeo 2009, Gilburn 2012). Removing wrack also interferes with sand retention and dune building (Dugan and Hubbard 2010, Nordstrom 2012). FWC recommends that best beach management practices should avoid beach grooming, but if used, it should be done sparingly and should minimize impacts to wildlife and natural beach habitat succession (FWC 2017).

Infrastructure Failures

Habitat quality at beaches can be degraded by impacts from human infrastructure failures, including wastewater overflows and spills, stormwater pollution, and oil spills. Bacteria pollution from stormwater and human sewage can contaminate coastal waters — impacting fish and wildlife and closing beaches

for recreation. Florida's Department of Health manages the Florida Healthy Beaches Program, which provides information on high fecal indicator levels in water samples collected at beaches and informs the public about beach closures. Excess nutrient pollution in coastal waters from wastewater, stormwater, and a variety of other sources can fuel harmful algal blooms (HABs) like Florida red tide. Such blooms can reduce water and air quality, killing fish and beach-dependent animals that can further foul the beach and dune habitat. Oil spills can impact beaches and the wildlife that use them by contaminating habitat and sources of food.

Management Status and Regional Sand Management Planning

Beach and inlet management practices in Florida are governed by the Florida Beach and Shore

Preservation Act (Chapter 161, F.S.). Under the Act, FDEP identifies critically eroding beaches each year in their Critically Eroded Beaches Report (*e.g.*, FDEP 2018a, 2019) and develops, updates, and implements a Strategic Beach Management Plan (FDEP 2018b) that guides beach preservation and restoration. The Plan also overviews FDEP's beach management programs, permitting, coastal barrier inlets, beach restoration projects, and sand resources.

In the SBEP area, beaches are naturally replenished with sand by onshore-offshore and longshore sand transport, whereby sand generally moves in a southerly direction along the shore. For example, sand from Lido Key naturally travels southward to replenish beaches on Siesta Key.

Artificially adding or removing sand from any part of the coastline can ultimately affect beaches downstream. As a result, longshore



Living shoreline. (SBEP)

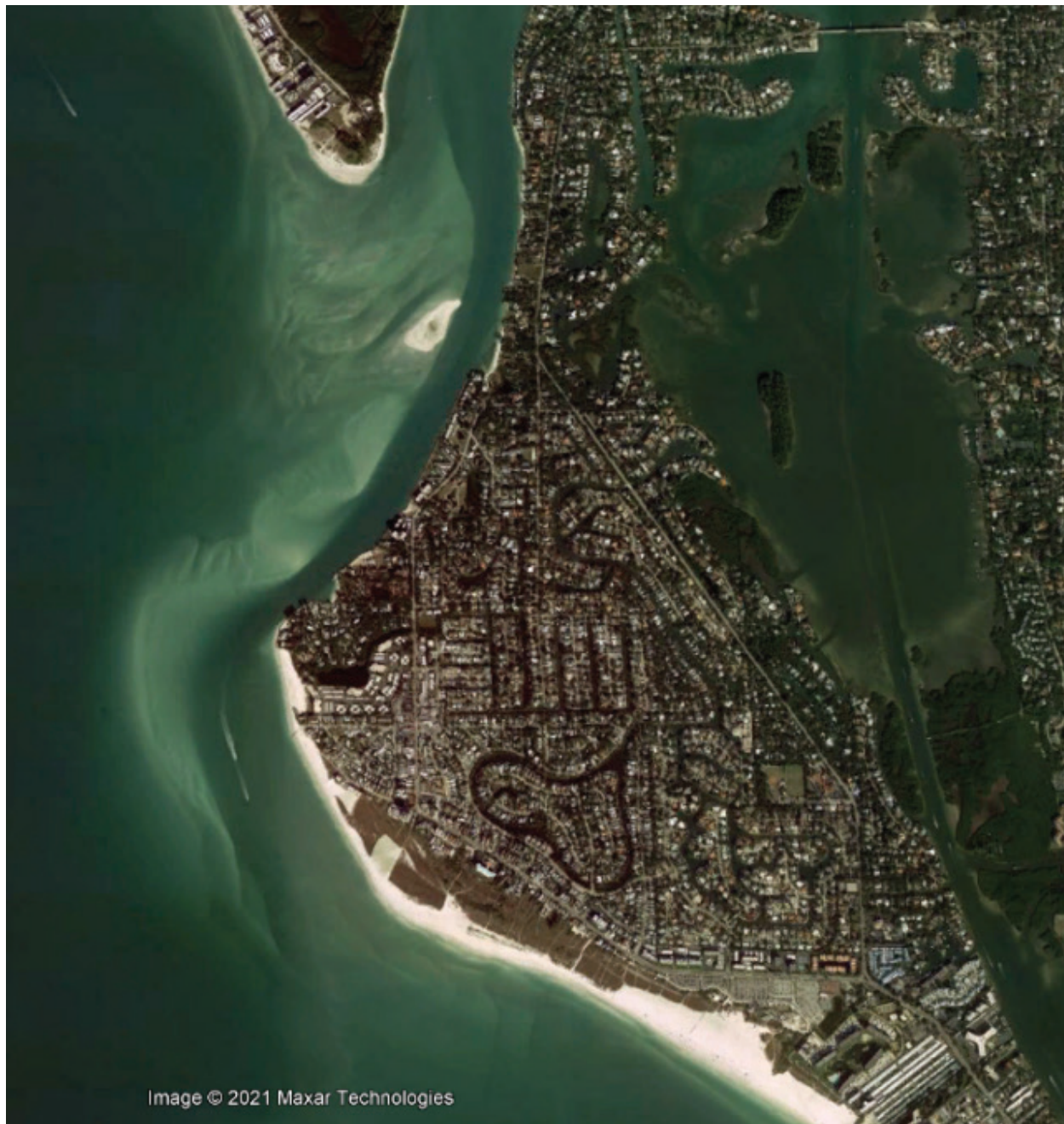


Figure WH-6: Sand transport from Lido Key to Siesta Key. (Courtesy of Google Earth Pro 7.3.4.8248. (December 16, 2017). Sarasota, Florida. 27° 18' 09.29"N, 82° 33' 32.20"W, Eye alt 27036 ft. SIO, NOAA, U.S. Navy, NGA, GEBCO. (Accessed August 16, 2021)

sand transport must be considered as a regional system that requires regional management coordination. The SBEP area lacks a comprehensive regional sand management planning process. Exploring regional sand management may provide collaborative and cost-effective solutions to sand management across municipal, county, state, and federal jurisdictions. It may also result in strategies for conservation and restoration uses for dredged materials other than for beach replenishment (e.g., the Regional Sediment Management initiative in the Tampa Bay area). SBEP's trusted reputation as a science-based convener together with its established partnerships makes it well-positioned to assist in such planning processes.

Accomplishments and Priorities

Over the past five years, SBEP has led and participated in a variety of beach and dune restoration projects. In 2014, SBEP participated in replacing invasive exotic Australian pine trees on Siesta Beach with more than 400 native plants. A 2018 Bay Partners Grant funded the purchase of signs to encourage beachgoers use established paths rather than trampling dunes on Anna Maria Island. SBEP also removed exotic vegetation on Leffis Key in 2017 and removed Australian pines from coastal upland habitat on North Lido Key. Over the next five years, SBEP will continue to prioritize projects to remove exotic species and restore beach and dune communities.

Strategy

Activity WH-6.1: Restore coastal dunes and encourage protection of beach wrack communities.

Timeframe: New activity

Collaborators: SBEP (collaborate), County and Municipal Governments (Leads), Audubon, FWC, Mote Marine Laboratory, USACE, DEP, Audubon

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (CWA 320), FWC, WCIND, USACE

Location: SBEP beaches

Activity WH-6.2: Curate scientific knowledge of habitat impacts of sand replenishment and movement.

Timeframe: New activity; Begin in 2023

Collaborators: SBEP (conduct); Mote Marine Laboratory, Florida Audubon, FWC, FDEP, NOAA

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (CWA 320)

Location: SBEP beaches

Activity WH-6.3: Explore the role of SBEP in regional sediment management planning and monitoring, including coordination with USACE.

Timeframe: New activity; Begin in 2023

Collaborators: SBEP (conduct/Lead), County and Municipal Governments, USACE, FDEP

Projected Five-Year Costs and Funding Sources: \$/SBEP (CWA 320)

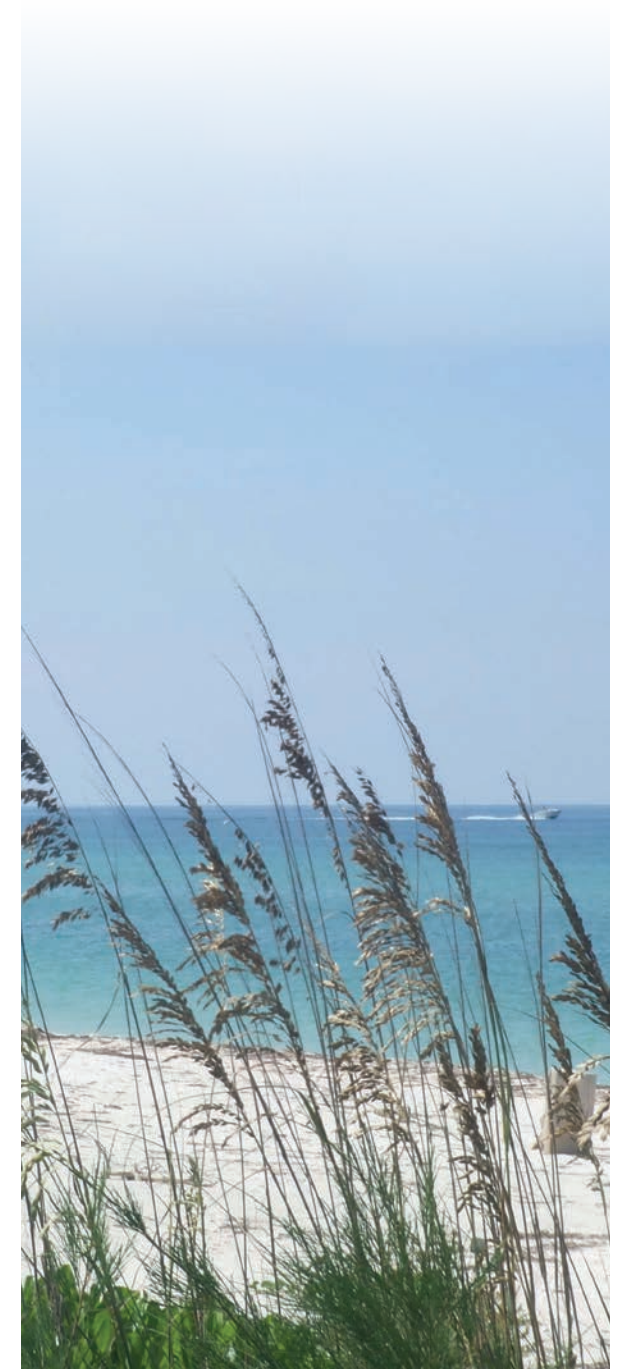
Location: SBEP beaches

Benefits

Better understanding of impacts of dredge and fill activities on beach and dune habitat improves comprehensive planning and protection of sensitive fish, birds, turtles, and invertebrates.

Five-Year Performance Metrics Deliverables:

- (1) Increased acreage of restored dunes,
- (2) Technical report on impacts of dredge and fill activities on beach and bay habitats



Sea oats. (Sarasota County)



Tricolor heron. (SBEP)

FISH & WILDLIFE *Action Plan*

GOAL: Protect, restore, and enhance fish and wildlife populations in SBEP bays and watersheds.

Introduction

The Sarasota Bay Estuary supports a rich diversity of fish and wildlife. From cryptic to charismatic, these species are foundational to marine, estuarine, and freshwater ecosystem integrity, function, and services and are drivers of the cultural identity and economies of local communities. Fish and wildlife have attracted and sustained human populations on Sarasota Bay for the past ten thousand years. Historical and sustained impacts associated with human population growth, especially during the 20th century, threaten the health and sustainability of fish and wildlife in SBEP bays and watersheds.

To address the threats of human population growth and associated development, a suite of integrated management activities is ongoing across multiple agencies, organizations, and partnerships to protect, restore, and enhance fish and wildlife, including species monitoring and assessment, fishing and hunting regulations, law enforcement, imperiled and invasive species management, public education, best management practices, incentives, and habitat protection and restoration. The SBEP Fish and Wildlife Action Plan supports these ongoing efforts.

The goal of the Fish and Wildlife Action Plan, to protect, restore, and enhance fish and wildlife populations in SBEP bays and watersheds, and the goals of the three other CCMP Action Plans are interdependent. Healthy populations of fish and wildlife depend on clean water (see Water Quality and Quantity Action Plan) and a mosaic of resilient, interconnected habitats ranging from freshwater wetlands, ponds, and creeks to brackish tidal creeks and estuaries, to marine waters of the Gulf of Mexico (see Watershed Habitats Action Plan). They also benefit from an informed public that supports protection and restoration and reduces harmful interactions, unsustainable harvest, littering, and other negative impacts (see Community Engagement Action Plan).



Wood stork. (SBEP)

Action Plan Strategy

This Fish and Wildlife Action Plan builds upon goals of the 2014 CCMP to protect fish and shellfish populations and introduces new actions addressing other bay-associated wildlife. It encompasses the goal of the 2014 Fisheries and Other Living Resources and Recreational Use Action Plans while adding several brand new objectives to support wildlife protection and monitoring. The SBEP Management Conference recommended this change to reflect the importance of protecting the diverse array of threatened and iconic wildlife in the Sarasota Bay area. From an economic perspective, wildlife watching and sportfishing are two of the most popular activities among tourists visiting the region. The increasing popularity of these activities increases the public appetite to protect wildlife, yet it also puts direct pressure on wildlife populations. This Action Plan aims to provide support for the many local organizations addressing these challenges by highlighting the importance of fish and wildlife to a healthy Sarasota Bay.

With this Plan, the SBEP Management Conference commits to three major objectives with the goal to protect, restore, and enhance fish and wildlife in SBEP waters and watersheds.

- **Objective 1:** Protect, restore, and enhance the diversity and abundance of native fish
- **Objective 2:** Protect, restore, and enhance the diversity and abundance of native shellfish
- **Objective 3:** Monitor and protect threatened, endangered, and vulnerable wildlife

Fish & Wildlife Action Plan Objective 1:

Protect, restore, and enhance the diversity and abundance of native fish.

Activity FW-1.1

Continue fish population monitoring programs to support fisheries management, monitor invasive species, and understand habitat usage through all life stages. Explore opportunities to expand monitoring programs to include a greater diversity of species, tidal creeks and canals, and use of innovative monitoring technologies.

Activity FW-1.2

Support research to fill fisheries data gaps, including habitat connectivity between tidal tributaries, bays, and the Gulf of Mexico; migration barriers; HAB response and recovery; and projected climate change impacts.

Activity FW-1.3

Explore capacity and potential effectiveness of protected managed areas, enhanced fishery management actions, and stock enhancement to protect and restore fish diversity, abundance, and resilience.

Activity FW-1.4

Promote ethical angling practices that increase conservation and prevent marine debris.

Atlantic tarpon (*Megalops atlanticus*)

A highly prized saltwater gamefish in Florida. They are powerful, acrobatic fighters with great stamina. They are almost exclusively a catch and release fishery, as their flesh has poor seafood value. Florida fishing regulations require a special tarpon tag if fishers intend to keep a tarpon, and then only if it is intended to be kept in pursuit of a Florida state record.

Tarpon utilize saltwater, brackish, and freshwater habitats during different stages of their life history. Adults spawn in offshore waters in late spring to early summer, where larvae begin to grow and develop. Larvae later move inshore to salt marshes, creeks,

and rivers where they become juveniles. As they transition into adulthood, they move back into offshore waters, though many can remain in freshwater habitats. They can survive in low oxygen waters due to their abilities to gulp air at the surface and attain oxygen from their swim bladder, which they also use for buoyancy. Juveniles feed on insects, fish, crabs, and shrimp, whereas adults typically feed on midwater prey species. Juveniles are preyed upon by fishes and birds, especially when they come to the surface for air. Adults are preyed upon by sharks, dolphins, and alligators.



Background

SBEP bays and tributaries support a diversity of marine, estuarine, and freshwater fishes. They are critical components of bay ecosystem integrity, function, and services and are important to the cultural identity and economy of Sarasota and Manatee Counties.

For thousands of years, fish have been caught and used as an important source of dietary protein to human inhabitants of Sarasota Bay. The village of Cortez, which was founded in the 1880s, contains the last stretch of shoreline with a significant commercial fishing presence. The native striped mullet is still harvested by small local fishing boats. The mullet roe is collected, processed, and exported to Europe as exclusive Gulf Coast caviar, also known as bottarga.

Commercial fishing occurs throughout SBEP bays and coastal waters, with most fish landed in Manatee County (Table FW-1). According to the Florida Fish and Wildlife Conservation Commission (FWC), from 2014 to 2018, over 31.6 million pounds of finfish worth over \$25.6 million were commercially landed in Manatee County and 616,000 pounds of finfish worth \$943,000 were commercially landed in Sarasota County. Commercial finfish landings are dominated by striped mullet (*Mugil cephalus*), thread herring (*Opisthonema oglinum*), small miscellaneous bait fish, ladyfish (*Elops saurus*), and red grouper (*Epinephelus morio*).

Florida is popularly called the “Fishing Capital of the World” based on the number of anglers, time spent fishing, economic impact, diversity of

recreational fishery species, international fishing records, and popularity of fishing tourism. In 2016, more than 3.7 million recreational anglers made over 13.2 million trips in Florida and spent over \$5.9 billion on trip and durable goods expenditures (NMFS 2018). The most popular catch and release species are spotted seatrout (*Cynoscion nebulosus*), gray snapper (*Lutjanus griseus*), red drum (*Sciaenops ocellatus*), and common snook (*Centropomus undecimalis*). Recreational fishing occurs throughout SBEP bays and tributaries. In 2020, over 65,000 valid freshwater and saltwater state fishing licenses were held by recreational fishers in Manatee and Sarasota Counties (Table FW-2). Many fishes species depend on estuaries during all or part of their life cycle (Hollweg *et al.* 2019). In fact, more than 95% of US commercial fishery landings by weight in the Gulf of Mexico are estuary-dependent species (Chambers 1992, Lellis-Dibble 2008). Some species, like common snook, striped mullet, and spotted seatrout typically complete their entire life cycle in estuarine environments. Other species reproduce in the Gulf of Mexico but complete part of their life cycle in estuaries. For example, gray snapper and gag grouper (*Mycteroperca microlepis*) spend their first 12–18 months in estuaries while red drum and goliath grouper (*Epinephelus itajara*) spend their first few years in estuaries.

Threats to local fish populations include degradation and loss of critical habitats, loss of corridors linking those habitats, altered hydrology, degraded water quality, harmful algal blooms, and overfishing.

Table FW-1. Top ten commercially landed fish in Manatee and Sarasota Counties by weight for combined years 2014–2018. (FWC)

Manatee County Total Catch 2014-2018

Fish	Pounds
striped mullet (<i>Mugil cephalus</i>)	9,881,783
thread herring (<i>Opisthonema oglinum</i>)	9,214,328
miscellaneous bait fish	2,931,205
ladyfish (<i>Elops saurus</i>)	2,583,114
red grouper (<i>Epinephelus morio</i>)	2,468,531
miscellaneous industrial fish	1,395,885
crevalle jack (<i>Caranx hippos</i>)	509,797
Spanish sardine (<i>Sardinella aurita</i>)	440,257
yellowedge grouper (<i>Hyporthodus flavolimbatus</i>)	244,225
Spanish mackerel (<i>Scomberomorus maculatus</i>)	230,295

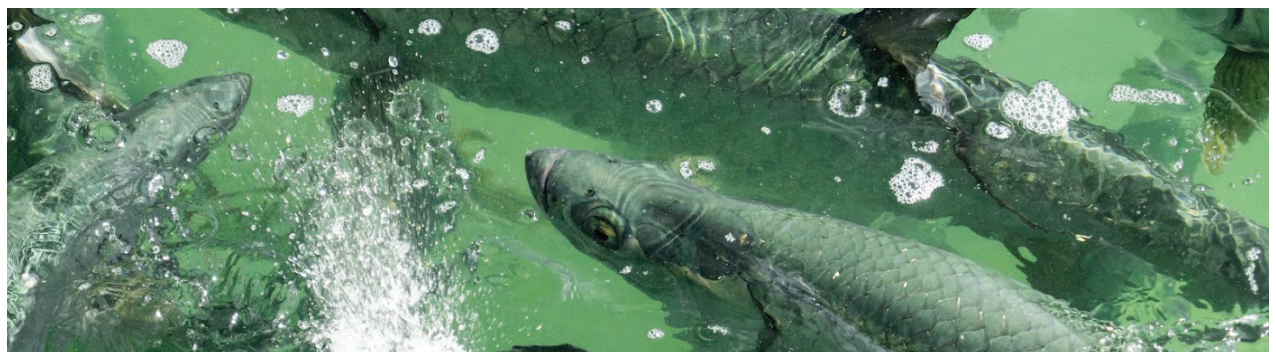
Sarasota County Total Catch 2014-2018

Fish	Pounds
striped mullet (<i>Mugil cephalus</i>)	375,911
red grouper (<i>Epinephelus morio</i>)	163,138
sheepshead (<i>Archosargus probatocephalus</i>)	11,458
striped mojarra (<i>Eugerres plumieri</i>)	9,716
Florida pompano (<i>Trachinotus carolinus</i>)	9,316
gray snapper (<i>Lutjanus griseus</i>)	7,390
tilapia/nile perch (<i>Oreochromis spp.</i>)	6,879
red snapper (<i>Lutjanus campechanus</i>)	6,038
lane snapper (<i>Lutjanus synagris</i>)	4,010
miscellaneous jacks	3,278

Finfish are managed by an integrated complement of laws, regulations, and activities coordinated across federal and state agencies, including the NOAA National Marine Fisheries Service (NMFS), the Gulf of Mexico Fishery Management Council, the US Fish and Wildlife Service (USFWS), and the Florida Fish and Wildlife Conservation Commission (FWC). State waters extend nine nautical miles into the Gulf of Mexico, where federal waters begin and extend to 200 miles offshore.

Table FW-2. Number of valid fishing licenses in Manatee and Sarasota Counties. Numbers of valid licenses do not necessarily reflect the number of unique fishers, as a fisher could be counted in both saltwater and freshwater license categories due to combination licenses. (FWC, 19 March 2020)

	Manatee	Sarasota	Total
Saltwater	22,466	24,054	46,520
Freshwater	9,061	9,866	18,927
Total	31,527	33,920	65,447



Tarpon. (SBEP)



Mangrove snappers. (Johnny White)

Status

Protecting, restoring, and enhancing the diversity and abundance of native fish populations is a long-standing management priority for SBEP (SBEP 1995). A variety of management activities are ongoing or proposed to accomplish this objective, including research and monitoring, protected areas, stock enhancement, habitat protection and restoration, and outreach and education.

Research and Monitoring

Understanding the life history, ecology, and population dynamics of fishes in SBEP bays and tributaries through research and monitoring is fundamental for informed management of estuarine ecosystems, commercial and recreational fisheries, water quality, and habitat protection and restoration. A variety of programs monitor fishes in SBEP bays and tributaries.

FWRI Fisheries Independent Monitoring (FIM)

Program provides timely, fisheries-independent data and analysis to help conserve and protect Florida's fisheries. The program aims to detect changes in relative abundance of fishes and select invertebrates, improve knowledge of species life history, habitat utilization, and recruitment dynamics, and describe baseline conditions and document changes in the biological condition of Florida's estuaries.

FIM has conducted routine bimonthly fish surveys in SBEP bays since 2009, using three gear types to sample juvenile, subadult, and adult life history stages in multiple estuarine habitats (Jones 2019, FWC-FWRI 2018). FIM records species, size, sex, number caught, habitat features (type and quantity of submerged and shoreline vegetations and the presence of seawalls or oyster beds), and water quality data (temperature, pH, salinity, and dissolved oxygen). In 2018, 106,892 fishes from

92 taxa were collected. FIM monitoring is an important tool for understanding changes in species diversity and abundance as impacted by stressors such as red tide, climate change, and fishing pressure.

New College of Florida (NCF) has conducted monthly fish surveys from April to October in Big Sarasota Bay since 2016 (Moncrief-Cox 2020). They monitor relative abundance, size distributions, and habitat characteristics and assess long-term trends and the impacts of acute perturbations, such as harmful algal blooms. The NCF survey, conducted in conjunction with NOAA's Gulf of Mexico Shark Pupping and Nursery (GULFSPAN) survey, uses gillnets to capture a variety of fish, primarily upper trophic level species. Data including species, size, number caught, habitat type, and water quality (temperature, salinity, dissolved oxygen, and turbidity) are collected. For sharks and rays, sex and life stage are also recorded, and animals are tagged to facilitate identification in the event of recapture. From 2016–2019, 2,410 fish representing 50 taxa were collected.

The Chicago Zoological Society's Sarasota Dolphin Research Program (CZS-SDRP)

conducts seasonal multi-species fish surveys to explore relationships between resident dolphins in Sarasota Bay and their prey. SDRP monitors abundance, distribution, and body size of fishes in seagrass habitats during winter (January – March) and summer (June – September) months. In the winter of 2016, SDRP sampled 31,681 fish from 59 species

(Berens McCabe and Brennerman 2017). SDRP seasonal surveys can be an important tool for understanding red tide impacts to fishes and dolphins. During the 2017–2018 red tide, surveys detected an 88% decline in primary dolphin prey fish species from September 2017 to September 2018 (Wells and McCabe 2020).

Sarasota Coast Acoustic Network (SCAN) is operated collaboratively by Mote Marine Laboratory, SDRP, New College of Florida, Florida Atlantic University, and Loggerhead Instruments. SCAN researchers tag fish with transmitters that send signals to strategically-placed listening stations as fish swim near them. SCAN can track predator and prey movements and how they respond to stressors like cold snaps, storms, pollution, and Florida red tide. To date, tracking efforts have focused on bull sharks (*Carcharhinus leucas*), great hammerheads (*Sphyrna mokarran*), spotted eagle rays (*Aetobatus narinari*), and common snook (*Centropomus undecimalis*). Mote researchers have installed acoustic receivers in six tidal creeks around Sarasota Bay and in passes connecting the bay to the Gulf of Mexico in order to track acoustic-tagged snook between areas used for shelter and reproduction. New College of Florida tracks young blacktip sharks (*Carcharhinus limbatus*) to determine resident or migrant status. Presence of newborn blacktips suggests that Sarasota Bay may host a primary nursery area for them. Blacktips may return to the bay from time to time and have been shown to flee shallow bays in response to tropical storms.

The Passive Acoustic Listening Station (PALS) Network is a collaborative network of passive underwater listening stations operated by CZS-SDRP, New College of Florida, Loggerhead Instruments, and citizen scientists in Sarasota Bay. Researchers use hydrophones connected to land-based stations to listen to underwater sounds emitted by a variety of animals to learn more about their biology and how they respond to disturbances. Compared to light, sound can travel considerable distances underwater. Many animals have evolved to use sounds for hunting, mating, territorial defense, and other social communication. During the 2018–2019 red tide event, listening stations on Longboat Key and Palma Sola documented a more than 90% decline in biological sound levels.

The **Sarasota Bay Artificial Reef Monitoring Project** documented the ecological use and fish diversity

of three artificial reefs (Hart’s Family Reef, originally created in 1987; Walker’s Reef, originally created in 1999; and Sportfish Angler’s Club Reef, originally created in 1998) in Big Sarasota Bay. Side-scan sonar imagery produced maps of the entire permitted reef area showing the location of reef materials deployed since the reefs were created. Reef fish censuses were conducted using three techniques: roving divers, stationary divers, and baited underwater video recordings. A new reef module, called the “deep cover,” showed great promise as a habitat for juvenile gag grouper (*Mycteroperca microlepis*), which use bays and estuaries before migrating to the offshore fishery. Results will help reef managers evaluate the ecological and economic benefits of artificial reefs in Sarasota Bay and inform future artificial reef planning and development.



Artificial reefs in Sarasota Bay. (SBEP)

Sister Keys

The Sister Keys are the largest group of undeveloped protected islands in Sarasota Bay. The Sister Keys Conservatory, formed by a group of concerned citizens, worked for four years to protect the islands from development. In 1992, the Town of Longboat Key purchased the islands for protection and in 2007, the town embarked on a \$1 million mitigation project to remove invasive species, plant native species, and restore wetlands. Today, the Sister Keys host a diverse assemblage of wildlife. Sarasota Bay Watch works to maintain the restored islands with an annual cleanup. Seagrass adjacent to the islands provides nursery areas for snook, redfish, sea trout, and flounder and habitat for crabs, oysters, scallops, and manatees. Enhanced fishing regulations in a fringing buffer around the islands could provide critical protections for these species and others, including species using the restored terrestrial and intertidal habitats of the protected islands. SBEP's first CCMP adopted an Action to

establish a conservation area near Sister Keys with limited access or activity (Action 2.1, SBEP 1995). Increased human population size, development, and fishing pressure around

Sarasota Bay, in addition to impacts of episodic red tides, makes this uncompleted Action even more relevant today for restoring fish diversity, abundance, and resilience.



Marine Protected Areas

Marine protected areas (MPAs) can provide ecological, cultural, and economic benefits, including enhancements to biodiversity, fishery populations, resilience, and ecosystem services. They can also serve as a local benchmark for environmental health and a laboratory for education and science. MPAs can help recover declining fish populations by restricting fishing methods, seasons, or catch limits, or by restricting fishing altogether.

Reduced fishing pressure provides refuge for spawning stocks and increases abundance within the MPA, creating spillover into nearby unprotected areas (Rolim 2019, Christie 2020). A network of MPAs can be especially valuable for repopulating adjacent areas impacted by episodic events like red tide or for mitigating and promoting adaptation to long-term stressors like climate change (Roberts 2017).

Stock Enhancement

Stock enhancement involves raising fish in a hatchery and releasing them at an optimal time and place to supplement existing populations. It is an important tool for recovering depleted populations impacted by overfishing, cold shocks, red tide, or other pressures. Stock enhancement typically focuses on commercially or recreationally important species but can also be used to restore populations of threatened, endangered, or vulnerable species. Some

residential communities in the Sarasota Bay area are experimenting with stocking fish in private stormwater ponds to reduce algal blooms and to mimic a more natural aquatic ecosystem. The success of stock enhancement can often be improved when coupled with appropriate habitat protection and restoration to support enhanced populations. For example, released fish can quickly fall prey to predators if they cannot access suitable refuge habitats.

Research is underway on Florida's west coast to understand how stock enhancement can be used in conjunction with habitat restoration and fishing regulations to restore and enhance fish populations. For example, FWC is experimenting with rearing red drum (*Sciaenops ocellatus*) to enhance wild populations and support the recreational fishery in Tampa Bay. Mote Marine Laboratory in partnership with FWC is studying optimal hatchery conditioning and release sites, times, and protocols for responsible common snook stock enhancement in the Sarasota Bay system. A recent study that released 1,920 juvenile snook into Phillippi Creek reported the highest survival among individuals released in the lower reaches of the tidal creek in the spring (Schloesser 2019). The authors also found that exposing hatchery snook to live prey could improve post-release feeding performance and survival (Caldeney 2019).

Habitat Protection and Restoration

SBEP and partners support, coordinate, and conduct efforts to protect, restore, and promote

recovery of critical fish habitats, especially wetlands, oyster reefs, and seagrass meadows (see Watershed Habitats Action Plan). A review of publications documenting habitat restoration projects in the northern Gulf of Mexico found that nekton colonization can be relatively rapid following seagrass and oyster reef restoration, with densities and assemblages matching reference sites within five years for seagrass and 1–2 years for oyster reefs (Hollweg 2019). For restored marshes, fishes can recover to reference densities and assemblages about three years after restoration, but crustaceans can take longer than a decade to achieve reference densities and assemblages. SBEP's strategy for water quality improvement through nutrient management also improves fish habitat by promoting seagrass recovery (see Water Quality and Quantity Action Plan).

Outreach and Education

SBEP and partners promote ethical angling practices to fishers through a variety of outreach and education formats. Ethical angling includes behaviors that conserve fishery stocks and reduce impacts to water and habitat quality and to non-targeted species of fish and wildlife. Education focuses on increasing knowledge about fish and support for their conservation, fishing rules and regulations, prevention of marine debris, proper disposal or recycling of monofilament line and other fishing gear, catch and release, and reducing impacts to birds, turtles, and marine mammals. Public engagement focuses on fishing skills, ethical practices, and marine debris and monofilament line cleanups. Partners include FWC, FDEP, Mote Marine Laboratory, Sarasota Bay Watch, NOAA, Florida Sea Grant, and Audubon Florida.

Priorities

SBEP and partners will continue to protect and restore water quality (see Water Quality and Quantity Action Plan) and the full mosaic of interconnected aquatic habitats necessary to support fish populations, including seagrasses, mangrove shorelines, tidal creeks, and oyster reefs, and other hardbottom habitats (see Watershed Habitats Action Plan). SBEP will continue to increase knowledge about fish life history and population dynamics in tidal tributaries, bays, and Gulf of Mexico. Priorities include understanding habitat usage by all life stages and connectivity among those habitats, response and recovery to harmful algal blooms, impacts of invasive species, and projected climate change impacts. Fish monitoring programs will continue to advance these understandings, support adaptive fishery management, and provide important feedback on the effectiveness of water and habitat quality improvement strategies. If monitoring leads to the recognition of a problem, for example, the rapid population growth of an invasive species, SBEP will collaborate with partners to develop adaptive management strategies.

SBEP and partners will continue to promote research and use of enhanced fishery management tools and programs like artificial reefs, marine protected areas, and stock enhancement to protect, restore, and enhance fish populations in SBEP waters. We will continue to support and conduct outreach and education to promote ethical angling practices that increase conservation and prevent marine debris.



Sea star. (SBEP)

Strategy

Activity FW-1.1:

Continue fish population monitoring programs to support fisheries management, monitor invasive species, and understand habitat usage through all life stages. Explore opportunities to expand monitoring programs to include a greater diversity of species, tidal creeks and canals, and use of innovative monitoring technologies.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Collaborate), FWC (Co-lead), CZS-SDRP (Co-lead), NCF (Co-lead), SCAN, Florida Sea Grant, NOAA, Mote Marine Laboratory

Projected Five-Year Costs and Funding Sources: \$\$\$/SBEP (320), FWC, County and Municipal Governments, NOAA

Location: SBEP bays and tributaries

Activity FW-1.2:

Support research to fill fisheries data gaps, including habitat connectivity between tidal tributaries, bays, and the Gulf of Mexico; migration barriers; HAB response and recovery; and projected climate change impacts.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Collaborate), Co-leads: Mote Marine Laboratory, FWC, NCF, Florida Sea Grant, NOAA

Projected 5-Year Costs and Funding Sources: \$\$\$/SBEP (320), Grants

Location: SBEP bays and watersheds

Activity FW-1.3:

Explore capacity and potential effectiveness of protected managed areas, enhanced fishery management actions, and stock enhancement to protect and restore fish diversity, abundance, and resilience.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), FDEP, FWC, Mote Marine Laboratory

Projected Five-Year Costs and Funding Sources: \$\$\$/Grants

Location: SBEP bays and tributaries

Activity FW-1.4: Promote ethical angling practices that increase conservation and prevent marine debris.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Collaborate), FDEP, Florida Sea Grant (Co-lead), Sarasota Bay Watch, Mote Marine Laboratory (Co-lead), CZS-SDRP (Co-lead), FWC (Co-lead), Audubon Florida (Co-lead), Save Our Seabirds, fishing enthusiast organizations

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320), Grants

Location: SBEP bays and tributaries

Benefits

Native fish are critical components of the ecological integrity of SBEP bays and tributaries.

Five-Year Performance Metric Deliverables:

Continued bimonthly fish population monitoring in priority SBEP estuary segments



Fish & Wildlife

Action Plan Objective 2: Protect, restore, and enhance the diversity and abundance of native shellfish.

Activity FW- 2.1

Monitor native bivalve populations and protect, restore, and enhance their habitats.

Activity FW-2.2

Support research to understand native shellfish recruitment, habitat needs, and vulnerabilities to climate change impacts.

Activity FW-2.3

Support research to understand the benefits of native bivalve stock enhancement for improvements to water quality, habitat, and native populations.



Volunteers helping in oyster reef restoration project. (SBEP)

Background

The term “shellfish” is casually applied to aquatic invertebrates with shells and exoskeletons that are commonly consumed as seafood. SBEP waters support diverse assemblages of shellfish, including oysters, clams, scallops, crabs, shrimp, and lobsters. These species are important components of the integrity and function of SBEP bays and tidal tributaries and provide a wide range of beneficial ecosystem services. They are also valuable to the culture and economy of Sarasota Bay communities.

Gastropods

Gastropods are a large and diverse taxonomic class of mollusks that include terrestrial, freshwater, and marine snails and slugs. Examples include conchs, whelks, sea hares, and nudibranchs. They serve a variety of roles in Sarasota Bay’s food web. For example, herbivorous gastropods are important for reducing algae and dead matter in benthic environments. Many are an important source of food for fish, crabs, birds, and other gastropods. Some are harvested in Florida as seafood. Their discarded shells can provide habitat and protection for other animals and are highly prized by seashell collectors.

Crustaceans

Crustaceans play an important role in Sarasota Bay’s benthic food web and many are commercially important fishery species. From 2014–2018, over 623,271 pounds of crabs, shrimp, and lobster were commercially landed in Manatee and Sarasota Counties, worth over

\$5.4 million (Table FW-3). Fresh stone crab claws are a classic staple of Florida culinary culture, available only during stone crab season between mid-October and mid-May (Mink 2006). The stone crab fishery is unique in that fishers break one or two claws from the crab, then return the animal to the water to molt and regenerate missing claws. Taking only one claw is a local tradition and can lead to a more sustainable fishery, as regenerated claws continue to grow throughout subsequent molts, eventually regaining up to 95% of their original size.

Bivalves: Oysters, Clams, and Scallops

Bivalves are important to the ecosystem integrity, function, and services of Sarasota Bay and its tributaries and serve as important biological indicators of environmental health. They reduce erosion, stabilize shorelines, and provide habitat and food to invertebrates, fish, and birds (see Watershed Habitats Action Plan). Bivalves filter suspended particulates as they feed, including microalgae and suspended sediments. Transferring waterborne nutrients into shell and benthic sediments can reduce nitrogen and phosphorus in the water, improve water clarity, and sequester carbon. Harvesting wild and aquaculture bivalves can more permanently remove nutrients and carbon from the system.

Native Americans harvested oysters, clams, scallops, and other bivalves for food, and created large mounds of discarded shell, called middens, along the coast. Many middens were destroyed

Table FW-3. Top commercially landed decapod crustaceans in Manatee and Sarasota Counties by weight for combined years 2014–2018. (FWC)

Manatee County Total Catch 2014-2018

Crustacean	Pounds
stone crab (<i>Menippe mercenaria</i>)	211,975
blue crab (<i>Callinectes sapidus</i>)	128,898
bait shrimp	80,070
pink shrimp (<i>Farfantepenaeus duorarum</i>)	34,955
miscellaneous invertebrates	6,091
rock shrimp (<i>Sicyonia brevirostris</i>)	488
Spanish lobster (<i>Panulirus guttatus</i>)	109
Grand Total	462,586

Sarasota County Total Catch 2014-2018

Crustacean	Pounds
stone crab (<i>Menippe mercenaria</i>)	123,919
blue crab (<i>Callinectes sapidus</i>)	36,516
bait shrimp	112
Spanish lobster (<i>Panulirus guttatus</i>)	73
spiny lobster (<i>Panulirus argus</i>)	65
Grand Total	160,685

to support coastal development, but some are preserved and offer a retrospective natural history of shellfish abundance in Sarasota Bay. People collected and consumed bivalves from Sarasota Bay and its tributaries from prehistory up until around the 1970s, when hydrological alterations, habitat destruction, and diminished water quality reduced population sizes and bacterial pollution made them unsafe to eat.



SBEP staff monitoring oyster beds in Sarasota Bay. (SBEP)

Oysters

The Eastern oyster (*Crassostrea virginica*) is the only reef-building oyster in Florida and predominantly grows in shallow estuarine areas near freshwater inputs. Oysters form subtidal and intertidal reefs by the cumulative buildup of successive generations of oyster shells and can colonize most natural and artificial hard structures, including mangrove roots and seawalls.

An estimated 80–90 percent of historical oyster reefs in Florida have been lost due to human impacts (Radabaugh 2019). Many oyster reefs were historically dredged for navigation, mined for construction material, or by fill during shoreline expansion projects. By the late 1980s, nearly 3,500 acres of benthic habitats in Sarasota Bay were covered by dredge material (SBEP 2006). Oysters have also declined due to increased water pollution, sedimentation, and low oxygen conditions (VanderKooy 2012). Careless boating behaviors, including large boat wakes, groundings, and anchoring (TBEP 2017) can further stress populations.

Changes in salinity regimes due to human-caused alterations to the historical timing, amount, and location of freshwater flow (see Water Quality and Quantity Action Plan) have been especially damaging to oysters. Eastern oysters have an optimum salinity range of 14–18, though they can temporarily tolerate extremes between 5–40 (Radabaugh 2019). Low salinity conditions cause oyster growth and reproduction to decline, resulting in high mortality in freshwater conditions. Although oysters can tolerate high salinity better than low, the resulting stress can

increase susceptibility to disease, parasites, and predation. Increased temperature, like that expected from climate change, will reduce tolerances to salinity extremes. Salinity regimes are expected to be further altered by climate change due to sea level rise, prolonged droughts, and more intense episodic rainfall (Tolley 2010, SBEP and Shafer 2017). Climate change is also expected to impact oyster shell formation due to ocean acidification (Hofmann 2010).

Bivalves can concentrate water-borne pollutants like bacteria, viruses, toxins, and chemicals in their tissues during filter-feeding, which can cause serious and sometimes fatal human illnesses if consumed from areas with polluted waters. The Florida Department of Agriculture and Consumer Services (FDACS) manages shellfish harvesting within designated harvesting areas in the state. In Sarasota Bay, FDACS conditionally approves harvest of oysters and clams in an area stretching from the SR 684 bridge to Anna Maria Island southward to the north shoreline of Phillippi Creek (Area 54). Between 1951–2019, only four commercial oyster harvests were recorded in Sarasota Bay (Radabaugh 2019). Area 54 has been closed for shellfish harvest since September 2004 due to exceedances of waterborne bacteria. Sarasota County Government monitors bacteria pollution in tidal creeks, but not in the bay (see Water Quality Action Plan). Monitoring bacteria pollution in Area 54 may be an important management tool in the future to provide feedback on water quality improvement efforts for bacteria-impaired waters, like nearby Phillippi Creek.

Scallops

Bay scallops (*Argopecten irradians*) live predominately in seagrass meadows in shallow nearshore waters along Florida's Gulf Coast. Though once common in Sarasota Bay, they have nearly disappeared. Commercial and recreational harvest of scallops in Sarasota Bay is prohibited.

Clams

Clams generally live in sandy coastal habitats with sufficient water circulation to bring food and oxygen and flush wastes. They are often found in association with seagrass and sometimes oyster reefs. While research shows that hard clams can improve water quality through filtering particulate material from the water column (Peterson and Heck 2001a) a large study carried out in Tampa Bay did not find similar evidence (Gulf Shellfish Institute 2019). Environmental stressors to clams include habitat loss, sedimentation, disease, and hydrological changes. Little is known about the abundance of clams in Sarasota Bay today compared to historical levels.

The non-commercial Florida cross barred Venus clam (*Chione elevata*) is probably the most abundant clam in Sarasota Bay. Smaller numbers of commercially important clams are commonly present, including the indigenous southern hard clam (*Mercenaria campechiensis*), introduced northern hard clam (*Mercenaria mercenaria*), and sunray Venus clam (*Macrocallista nimbosa*). Only one area on the bay side of Longboat Key is conditionally approved for clam harvest in

Sarasota Bay, and it has been closed since September 2004 due to bacteria pollution.

The invasive Asian Green Mussel (*Perna viridis*) lacks native predators and can outcompete native bivalves for space and food (Yuan 2016). Originally from the Indian and Pacific Oceans, Asian Green Mussels were likely introduced into the Gulf of Mexico in the 1990s through the release of ship ballast water (Baker 2007). They were first discovered in Tampa Bay in 1999, which is their northern geographical limit due to temperature. New recruits of green mussels have been found in Sarasota Bay, but they do not appear to have established significant populations.

Status

Research and Monitoring

SBEP participates in the Oyster Integrated Mapping and Monitoring Program, which utilizes a collaborative network of experts to collect and synthesize mapping and monitoring data in Florida to characterize the status and trends of oysters and their habitats and to identify management priorities (Radabaugh 2019).

The Southwest Florida Water Management District (SWFWMD) conducts aerial oyster mapping every two years ancillary to seagrass mapping efforts and without ground-truthing. In 2016, they mapped 76.74 acres of oysters in SBEP bays and tributaries, providing baseline information of habitat extent in the region (Table FW-4). Sarasota County Government produced maps of oyster assemblages in Sarasota County bays, estuaries, and tidal creeks from 2008–2012 to document baseline conditions and identify restoration opportunities (Meaux 2016).

They used a rapid assessment technique based on FWC protocols (Meaux 2011) to estimate oyster cover, characterize oysters as reef, seawall, rip rap, mangrove apron, mangrove root, piling, clumps, or shell, and demarcate their upstream extent in creeks. Most oysters in SBEP bays are part of natural reef formations, with smaller populations growing on seawalls, rip rap, mangrove roots, and pilings. For SBEP bays located in Sarasota County, Little Sarasota Bay followed by Sarasota Bay and Roberts Bay host the highest oyster acreages (Figure FW-1). Work by Sarasota County has found that oysters favored seawalls over riprap and were absent from metal seawalls and bulkheads and from high density polyethylene pile wraps. These findings have

Table FW-4. Oyster area in SBEP bays as recently mapped by Sarasota County's rapid assessment and SWFWMD aerial photointerpretation methodologies. Mapping areas and times differ between the assessments. Adapted from Raulerson 2019 with data from Sarasota County (Meaux 2016) and SWFWMD (SWFWMD 2016).

Bay Segment	Oyster Area (acres)	
	Sarasota Co.	SWFWMD
Palma Sola Bay		6.91
Big Sarasota Bay	7.29*	23.83
Little Sarasota Bay	17.38	23.26
Roberts Bay	9.23	21.33
Dryman Bay	2.55	
Blackburn Bay	2.11	1.41
Lyons Bay	2.85	
Dona Bay	1.35	
Roberts Bay, Venice	1.49	

* Sarasota County only mapped oysters in their portion of Sarasota Bay, whereas SWFWMD mapped both Sarasota and Manatee County portions.



Figure FW-1. Oyster reefs and oyster reef restoration project locations.

important implications for designing seawalls that can better accommodate oysters. Seawalls have replaced coastal wetlands in 62% percent of Big Sarasota Bay shorelines (Serviss and Sauers 2003). Sarasota County began regular annual monitoring of oysters in 2006 to gauge effects of freshwater flow on oyster condition (Jones 2006). Staff monitor oysters in the Hudson Bayou and Phillippi Creek tributaries of Sarasota Bay and North and South creek tributaries of Little Sarasota Bay.

Sarasota County monitors bay scallop populations to evaluate the effectiveness of water quality improvement efforts. The program conducts surveys of new scallop recruits (spat) and adults and monitors survival of caged adults. Monitoring began in 2008 and is conducted in partnership with FWC's Fish and Wildlife Research Institute (FWC-FWRI), Mote Marine Laboratory, and Sarasota Bay Watch. Results from 2019 monitoring suggested a low recruitment year with a temporal shift in recruitment from spring (April) to summer (July) and winter (November–December), possibly due to the 2018–2019 red tide bloom (Janneman 2019).

Since 2008, Sarasota Bay Watch has hosted the annual Great Scallop Search, when volunteers from Sarasota and Manatee Counties head out in boats and kayaks to snorkel in seagrass meadows and count scallops. The event provides educational opportunities for citizens to discover Sarasota Bay's seagrass meadows, learn how water quality is connected to habitat quality and scallops, and if they are lucky, to encounter live scallops in the wild.

Reef Restoration and Stock Enhancement

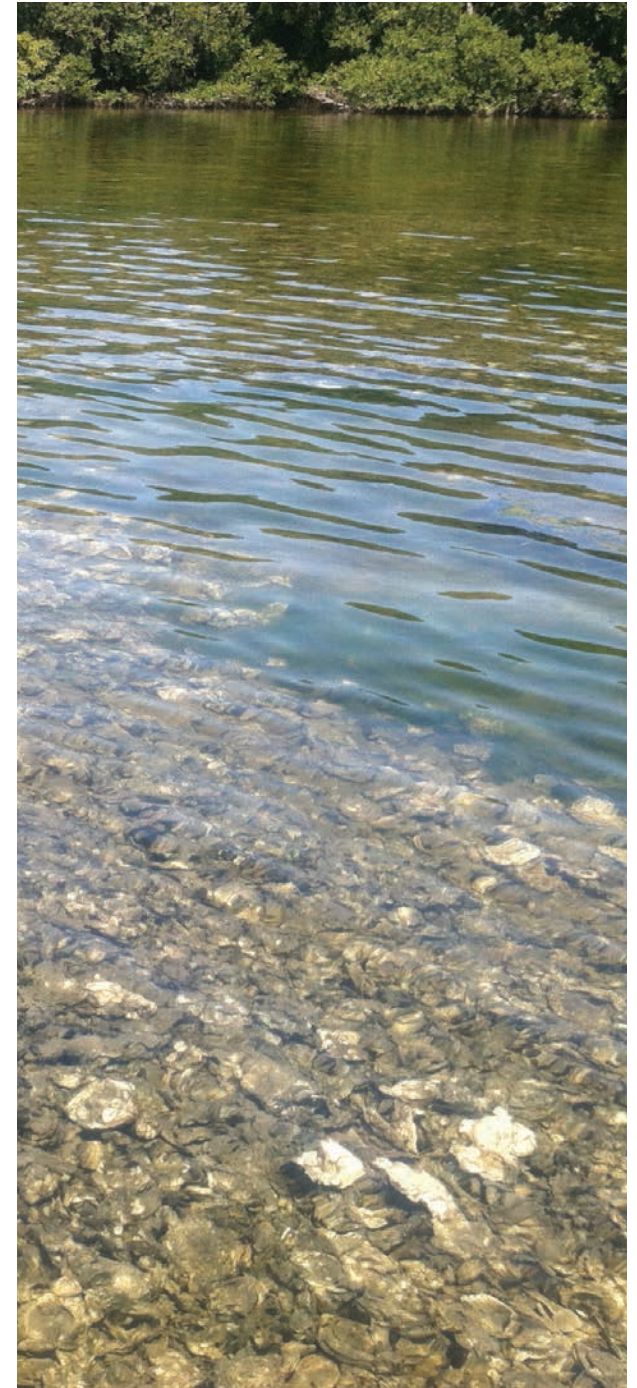
Habitat restoration and stock enhancement efforts are underway in Sarasota Bay to restore and enhance populations of oysters, clams, and scallops.

For nearly two decades, SBEP has led oyster restoration efforts in SBEP bays. Oysters can be restored in areas if appropriate environmental conditions are restored, including availability of suitable hard substrate and salinity regimes. SBEP reviews historical oyster reefs, current water conditions, and potential oyster recruitment to identify optimum oyster restoration sites. In 2005, new reefs were created at White Beach and Turtle Beach in Sarasota County and in 2010 new reefs were created offshore the Gladiola Fields in Manatee County. Starting in 2017, 1.2 acres of new oyster reef was created at the 34th Street Canal in Bayshore Gardens and hundreds of feet of oyster habitat was enhanced at Robinson and Perico Preserves. Oyster restoration has recently received a boost from the Gulf Coast Oyster Recycling and Renewal Program (GCORR), a local partnership of community volunteers who bag and deploy oyster shells donated by eleven participating seafood restaurants. The GCORR program reduces impacts of shell mining and has eliminated approximately 80 tons of restaurant shell waste going to landfills. Manatee County is planning an ambitious program of over 100 acres of oyster restoration on the banks of the Manatee River, once called the Oyster River

because of the historical abundance of oysters. Oyster reef restoration is discussed further in the Watershed Habitats Chapter.

Sarasota Bay Watch formed a community-based partnership in 2011 with citizens, businesses, and local organizations to restore scallops in Sarasota Bay with guidance from SBEP, FWC-FWRI, SBEP, Mote Marine Laboratory, and the Bay Shellfish Company. From 2011–2018, SBW released 105 million larval and 110,000 juvenile scallops at strategically selected locations in Sarasota Bay, utilizing a variety of approaches including free releases and boom-contained releases to reduce predation. From 2015–2017, SBW, Sarasota County, and Mote Marine Laboratory deployed 1,640 maturing adult scallops in protective cages to create natural spawning pulses to repopulate the bay. Despite these efforts, scallop populations in Sarasota Bay remain small. A relatively short 12 to 18-month lifespan makes scallops vulnerable to episodic salinity or temperature shocks, predator population dynamics, and red tide. Their short two-week larval stage limits the dispersal potential of remote populations to restore nearby impacted populations through new recruitment. Combined, these life history characteristics make restoration and enhancement of scallop populations in Sarasota Bay difficult.

In an effort to restore once abundant populations of southern hard clam in Sarasota Bay, SBW launched a stock enhancement program in 2016. To date, they have released a total of 380,221 southern hard clams into Sarasota Bay. Mote Marine Laboratory is conducting monitoring at release sites. Compared to bay scallops, southern hard clams are relatively tolerant of red tide.



Oyster beds in Sarasota Bay. (SBEP)



Clams. (SBEP)

Priorities

Achieving healthy and resilient shellfish populations is an important benchmark of ecosystem health for Sarasota Bay and its tributaries. SBEP and partners will continue to advance understanding, monitoring, protection, restoration, and enhancement of priority shellfish populations. Priority research needs include native shellfish recruitment dynamics, water and habitat quality needs, and shellfish vulnerabilities to anthropogenic and climate change impacts. Continued monitoring will provide timely feedback to fisheries and ecosystem managers to assess ongoing

and new threats and to evaluate benefits of improving water and habitat quality. SBEP and partners are committed to continuous improvement of water quality and hydrological conditions that mimic natural flow and reduce rapid changes in salinity and salinity extremes (see Water Quality and Quantity Action Plan). SBEP will continue to participate in the Oyster Integrated Mapping and Monitoring Program and support key recommendations for research, mapping, and managing shellfish that are appropriate for Sarasota Bay (Radabaugh 2019). SBEP will support SWFWMD and Sarasota County

shellfish mapping and monitoring programs. Improved understanding of the benefits of native bivalve stock enhancement for water and habitat quality and for building healthy, resilient populations of target shellfish is an important priority for SBEP and partners. SBEP will continue to coordinate and support restoration and enhancement of oyster reefs in priority locations throughout the bay. SBEP will also continue to monitor and provide scientific assistance to ongoing community-driven efforts to restore bay scallops and southern hard clams in the bay.

Strategy

- Activity FW-2.1:** Monitor native bivalve populations and protect, restore, and enhance their habitats.
- Timeframe:** Ongoing since 1995 CCMP
- Collaborators:** (Conduct/Co-lead), County Governments (Co-leads), Sarasota Bay Watch (Co-lead), Mote Marine Laboratory (Co-lead), FWC
- Projected Five-Year Costs and Funding Sources:** \$\$\$/SBEP (320), County Governments, FWC, Sarasota Bay Watch, Mote Marine Laboratory, RESTORE
- Location:** SBEP bays and tributaries
- Activity FW-2.2:** Support research to understand native shellfish recruitment, habitat needs, and vulnerabilities to climate change impacts.
- Timeframe:** New activity, conduct 2022-2026 as opportunities arise.
- Collaborators:** SBEP (Coordinate), Florida Sea Grant, Gulf Shellfish Institute, Mote Marine Laboratory, FWC
- Projected Five-Year Costs and Funding Sources:** \$\$/SBEP (320), Grants, FWC
- Location:** SBEP bays and tributaries
- Activity FW-2.3:** Support research to understand the benefits of native bivalve stock enhancement for improvements to water quality, habitat, and native populations.
- Timeframe:** New activity, conduct 2022-2026 as opportunities arise.
- Collaborators:** SBEP (Coordinate), Florida Sea Grant (Co-lead), Gulf Shellfish Institute (Co-lead), FWC, County Governments
- Projected Five-Year Costs and Funding Sources:** \$\$/SBEP (320), Grants, FWC
- Location:** SBEP bays and tributaries

Benefits

Native fish are critical components of the ecological integrity of SBEP bays and tributaries.

Five-Year Performance Metric Deliverables:

10 acres of oyster reef created or enhanced



Brown pelicans. (Johnny White)

Fish & Wildlife

Action Plan Objective 3: Monitor and protect threatened, endangered, and vulnerable wildlife.

Activity FW-3.1

Support monitoring of threatened, endangered, and vulnerable wildlife.

Activity FW-3.2

Support protection of threatened, endangered, and vulnerable wildlife, including outreach and education to minimize adverse human-wildlife interactions.

Background

Sarasota Bay is well-known for its charismatic wildlife, many of which are afforded special federal, state, and local protections due to being threatened, endangered, or vulnerable to human impacts.

The federal Endangered Species Act of 1973, as amended, protects and recovers species from extinction and protects and restores their associated ecosystems. The Act is administered by NMFS for marine species and by USFWS for freshwater and all other species. Species that occur in both habitats are jointly managed.

The Florida Endangered and Threatened Species Act of 1977, administered by FWC, requires conservation and special management of imperiled species considered endangered or threatened by either federal or state designations. Florida's Imperiled Species Management Plan of 2016, as amended, focuses on conserving 57 imperiled fish and wildlife species by reducing extinction risks, maintaining essential habitat, and improving public and partner support. The Plan combines targeted individual species Action Plans with integrated Conservation Strategies that protect multiple species in shared habitats (FWC 2016).

Florida's State Wildlife Action Plan uses an ecosystem-based approach to benefit species and their habitats, including Species of Greatest Conservation Need (SGCN), federally and state listed species, and priority species





Bottlenose dolphin in Sarasota Bay. (SBEP)

in decline (FWC 2019). The Plan's SGCN list focuses on species at greatest risk of becoming imperiled and the actions necessary to prevent their decline. The Plan serves as an overarching resource for developing local and conservation plans produced by other agencies and integrating them into a comprehensive wildlife conservation strategy.

Marine mammals

The federal Marine Mammal Protection Act of 1972, as amended, prohibits hunting, killing, capture, and/or harassment of marine mammals. Three federal agencies protect marine mammals under the Act, including dolphins (NOAA Fisheries) and manatees (US Fish and Wildlife Service). The Marine Mammal

Commission provides independent science-based oversight of the policies and actions of NOAA and USFWS to prevent human impacts on marine mammals and their ecosystems.

Sarasota Bay has a resident population of approximately 160 common bottlenose dolphins (*Tursiops truncatus*). Major stressors and threats include predation by sharks on juveniles, water and habitat quality degradation, disease, red tide, and adverse human interactions, especially boat collisions, illegal feeding, harassment, and entanglement or ingestion of fishing gear. As top predators, dolphins can bioaccumulate contaminants in the environment, especially mercury and organohalogen contaminants (POCs) used in industry, agriculture, and domestic settings.

The Florida manatee (*Trichechus manatus latirostris*) is a cherished occupant of Sarasota Bay and its tidal creeks. It feeds on submerged, emergent, and floating freshwater and marine vegetation and is commonly found grazing in seagrass. Manatees require access to freshwater for drinking. During winter, they concentrate in peninsular Florida, relying on warm water from natural springs and power plant outfalls as a refuge from colder temperatures. Many return to the same winter sites year after year.

Manatee habitat degradation, fragmentation, and loss combined with historical overfishing caused populations to decline to a few hundred individuals around 1967. Significant efforts by federal, state, private, and nonprofit organizations to protect and restore the West Indian manatee (*T. manatus*), of which the Florida manatee is a subspecies, have improved critical manatee habitats and increased the Florida population to 6,620 individuals. In 2017, USFWS downlisted the



Manatee calf and mother. (Johnny White)

West Indian Manatee from Endangered to Threatened (USFWS 2017). However, in 2021, over 1,100 manatees died in Florida, the worst year on record. The epicenter of this die-off was the Indian River Lagoon, where seagrass resources have collapsed due to inadequate water quality. As of June of 2022 an additional 600 manatees had died in 2022, with most deaths occurring - again - on Florida's east coast. Combined, those 18 months (2021 and half of 2022) represent a loss of perhaps a third of the population of manatees on Florida's east coast. Threats to manatees include cold snaps, red tide, harassment, boat collisions, entanglement with and ingestion of fishing gear, and degradation and loss of habitat, especially warm water refuges. From 1993–2012, over 25 percent of manatee rescues in Florida were related to entanglement or ingestion of fishing gear (Reinert 2017).

Sea turtles

Sea turtles have swum the world's oceans for the past 110 million years. Today, all species are federally listed as threatened or endangered. Three sea turtle species generally occur in SBEP waters, including loggerheads (*Caretta caretta*), green sea turtles (*Chelonia mydas*), and leatherbacks (*Dermochelys coriacea*).

Sea turtles are relatively slow-growing and can live between 50–100 years. Every two to three years, females mate offshore then crawl onshore to dig nests, deposit eggs, and bury them before returning to the ocean. Nesting season on SBEP beaches is May 1–October 31. Eggs incubate for a couple of months, after which hatchlings emerge and scramble to the Gulf.



Loggerhead sea turtle. (Mote Marine Laboratory & Aquarium)

Sea turtles suffer high mortality during early life history. Turtle eggs and hatchlings face predation from terrestrial predators, including raccoons and birds. Light pollution from beach development can disorient hatchlings, causing them to crawl away from the water and perish. Hatchlings that make it safely to the ocean can be preyed upon by seabirds, fish, and other marine predators. Predation by sharks threatens larger adults. Other human threats include entanglement and drowning in fishing gear, collisions with watercraft, and red tide. Marine debris, especially plastic bags that can be mistaken for jellyfish and ingested, can cause death by choking or intestinal blockage. Synthetic particles, including microplastics, can also be a problem if they carry chemical contaminants, bacteria, or viruses. A recent study found synthetic particles in 100% of the guts of

individuals from all seven species of sea turtles examined (Duncan 2018).

Degradation and loss of beach due to waterfront development and armored shorelines threaten the availability or suitability of nesting habitat. A false crawl occurs when a female sea turtle emerges from the water to build a nest but returns to the water without laying eggs. False crawls can result from encountering obstructions on the beach like beach chairs or holes or being disturbed by light, people, or loud noises.

Sand replenishment activities conducted during nesting season (May 1–October 31) can also disturb nesting activities. If mismatched grain size or color is used, replenished sand can thwart nest building or alter temperature. Sea turtle sex is determined by nest

temperatures during incubation, with cooler temperatures producing males and warmer temperatures producing females (Janzen 1994). A recent study on the Great Barrier Reef in Australia found that warmer northern green turtle rookeries have been producing primarily females for more than two decades (Jensen *et al.* 2018). This finding has implications for understanding future effects of climate change on sea turtle populations.

Sea turtles are protected under the federal Endangered Species Act of 1973, as amended, Florida's Marine turtle Protection Act (379.2431 F.S.), and Florida's Endangered and Threatened Species Rule (68A-27 F.A.C.). Green and leatherback sea turtles are federally listed as Endangered and the loggerhead sea turtle is federally listed as Threatened. The Florida statute restricts the take, possession, disturbance, mutilation, destruction, selling, transference, molestation, and harassment of marine turtles, nets, or eggs. FDEP and FWC review coastal construction permits that affect sea turtles. Florida created the Model Lighting Ordinance for Marine Turtle Protection Rule (62B-55 F.A.C.) to provide guidance to county and municipal governments to develop ordinances for preventing light from reaching the beach. As of March 2020, Anna Maria Island, Bradenton Beach, Holmes Beach, Sarasota County, City of Sarasota, Town of Longboat Key, and City of Venice have lighting ordinances to protect sea turtle hatchlings (FWC 2020).

Birds

Birds contribute to the ecological integrity, function, and services of bay ecosystems. Together with their associated habitats, they are emblematic of Florida's wild heritage and culture and are a growing economic asset for tourism. Wildlife viewing, mostly of birds, is the second most popular activity in Florida, second only to beach recreation. In 2011, 4.3 million residents and nonresidents participated in wildlife viewing, with a total economic effect of \$4.93 billion (Southwick Associates 2013).

Since the 1970s, North America has lost nearly 3 billion birds, or about 29% of their prior numbers

(Rosenberg 2019). For coastal and estuary-dependent birds, net trends are variable. Gulls, terns, herons, and plovers have declined, while ibises, spoonbills, cormorants, and pelicans have increased over their 1970s abundance. Radar data also suggests a decline in the biomass of migrating birds in North America over the past ten years (Rosenberg 2019).

Colonial-nesting water birds, like herons, egrets, and spoonbills nest in large multi-species assemblages, often on islands that offer some protection from terrestrial predators. Fourteen islands in SBEP bays



Pelican rookery. (SBEP)

support 18 colonial-nesting species, with the largest colonies at Roberts Bay and Cortez Key (Figure FW-2). Threats to colonial-nesting bird island habitats include erosion from boat wakes, storms, and sea level rise and mortality due to entanglement and ingestion of fishing gear. Monofilament line can be picked up by birds near heavily fished areas and brought back to nesting areas, where it continues to entangle and kill birds until it is removed. Birds can become hooked when anglers reel their catch up from tall structures like piers or bridges. When fishers clean their catch near where they fish, they can attract birds to where gear is deployed. Additionally, the practice of throwing fish carcasses back into the water after cleaning can result in birds swallowing bones much larger than those of their typical prey, resulting in digestive tract punctures, obstructions, and death. Human disturbance, including approaching colonies too closely, can cause birds to temporarily abandon nests, and expose eggs and young to temperature extremes and predators. Frequent disturbance can cause adults to abandon eggs and young permanently, leading to failure of the colony.

Beach-nesting birds like terns, plovers, and black skimmers nest, lay eggs, and raise young on beaches. Breeding season for SBEP beach-nesting birds is February 15–September 1. Disturbance by beachgoers can flush beach-nesting birds from their nests, exposing eggs and young to temperature extremes and predators or they can inadvertently trample eggs and young. Human presence can also artificially

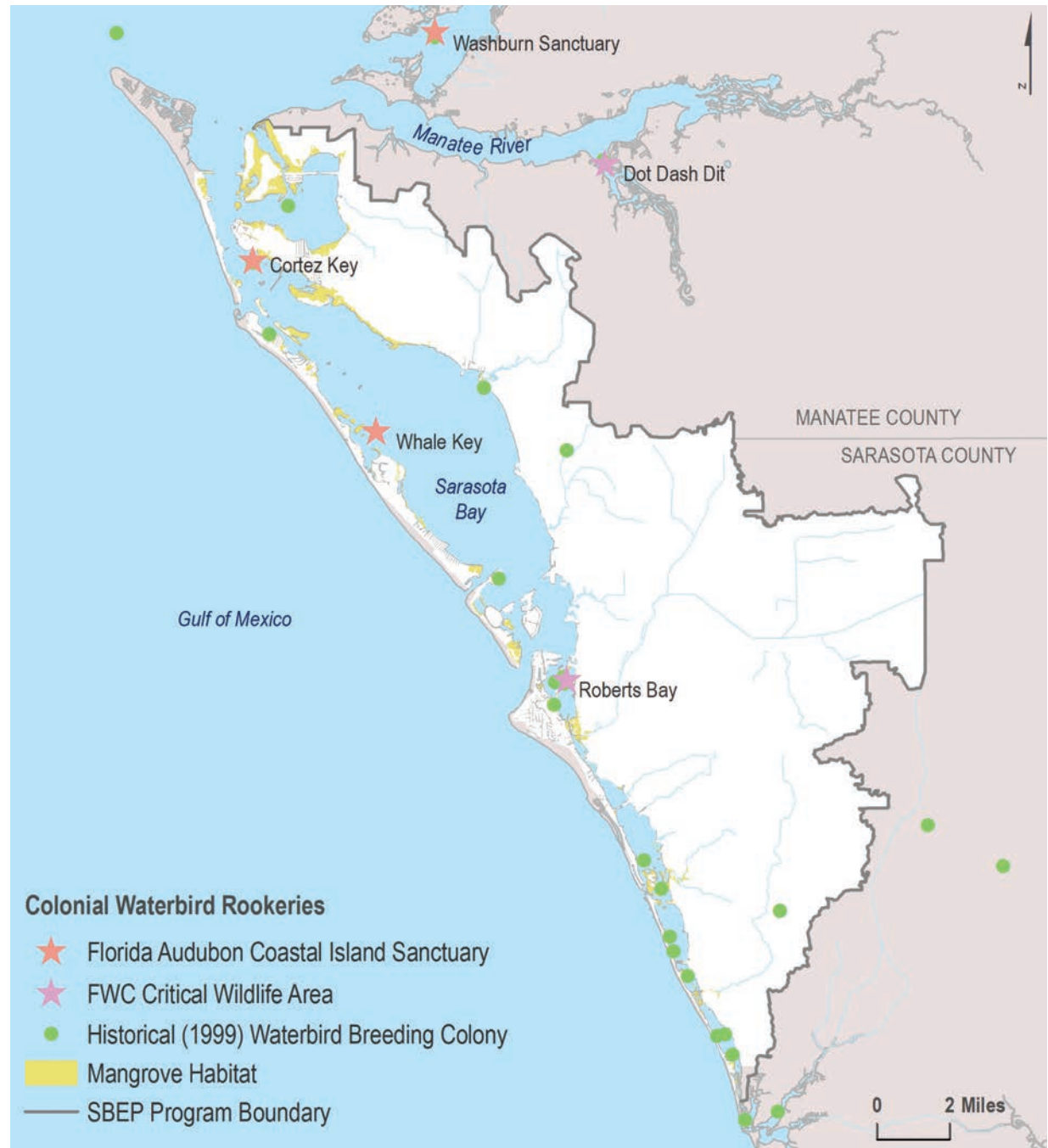


Figure FW-2. Sarasota Bay managed and protected bird rookery islands and known historical waterbird breeding colonies.

increase predator densities, especially raccoons, dogs, and cats. Maintenance practices that remove beach wrack from recreational beaches also remove important shorebird prey species living in the wrack. Red tide and other harmful algal blooms can also significantly reduce prey availability and impact birds directly through toxins. Beach-nesting bird habitat can be degraded, eroded, or lost due to coastal development, shoreline hardening, beach replenishment activities, sea level rise, and other climate stressors (see WH-6).

Declining nesting habitat and increased disturbance of existing habitat has caused some shorebirds to use alternative nesting habitat on gravel roofs, which can have many of the same qualities as beaches but are generally free from human and pet disturbance. Least terns are the most commonly encountered rooftop nesting species in Florida. New government-issued hurricane damage prevention guidelines for roofing materials prevent the use of gravel roofs, resulting in fewer and fewer roofs available for this alternative survival strategy.

A variety of migratory birds fly hundreds to thousands of miles to overwinter on SBEP coastlines, including the red knot, spotted sandpiper, and American white pelican. Others, like black terns, stop along the coasts during spring and fall migrations to rest and feed before continuing their travels. These long-distance travelers are often exhausted, hungry, and pushed to their physical limits when they arrive. Disturbances that reduce or prevent their ability to rest and feed can lead to significant mortality.

Reduction of prey abundance due to overharvesting and habitat degradation and loss has increased bird mortality. For example, mismanaging algae in stormwater ponds using copper sulfate can kill resident fish and result in a sterile pond. Many of these ponds also have mismanaged shorelines where grass is planted, fertilized, and mowed to their edge – creating no natural littoral shelf for invertebrates and fish to live. The federal Migratory Bird Treaty Act of 1918, as amended, protects migratory birds including their eggs, nests, and body parts. USFWS recently revised the list of migratory birds protected by the Act (USFWS 2020).

Horseshoe Crabs

The American horseshoe crab (*Limulus polyphemus*) is commonly found in shallow coastal waters, but mates and lays eggs on sandy beaches, especially during full and new moons in spring and fall. Closely related to spiders and scorpions, horseshoe crabs first appeared in the fossil record about 445 million years ago. Today, their numbers are declining, in part due to degradation and loss of beach habitat, including the proliferation of seawalls.



Least terns. (Lou Newman)



Scrub jay. (Martinlli)

Status

SBEP waters and watersheds support at least 26 species listed as Endangered or Threatened by the United States Fish and Wildlife Service (USFWS) or listed as Threatened by FWC (Table FW-5). Management activities include protection and restoration of critical habitats and corridors, population assessment and monitoring, law enforcement, and education.

Table FW-5. Partial listing of Endangered and Threatened species that can occur in SBEP waters and watersheds. Data from Florida Natural Areas Tracking List February 2022 and FWC June 2021.

	Common Name	Scientific name	Status
Birds	American oystercatcher	Haematopus palliatus	ST
	black skimmer	Rynchops niger	ST
	Florida scrub jay	Aphelocoma coerulescens	FT
	least tern	Sternula antillarum	ST
	little blue heron	Egretta caerulea	ST
	piping plover	Charadrius melodus	FT
	red knot	Calidris canutus rufa	FT
	reddish egret	Egretta rufescens	ST
	roseate spoonbill	Platalea ajaja	ST
	snowy plover	Charadrius nivosus	ST
	crested caracara	Caracara cheriway	FT
	wood stork	Mycteria americana	FT
	Florida sandhill crane	Antigone canadensis pratensis	ST
	Florida burrowing owl	Athene cunicularia floridana	ST
	tricolored heron	Egretta tricolor	ST
roseate tern	Sterna dougallii	FT	
Southeastern American kestrel	Falco sparverius paulus	ST	
Reptiles	eastern indigo snake	Drymarchon corais	FT
	American alligator	Alligator mississippiensis	FT
	loggerhead sea turtle	Caretta caretta	FT
	green sea turtle	Chelonia mydas	FT
	leatherback sea turtle	Dermochelys coriacea	FE
	Kemp's ridley sea turtle	Lepidochelys kempii	FE
Mammals	Florida panther	Puma concolor coryi	FE
	Florida manatee	Trichechus manatus latirostris	FT

FT = Federally Listed Threatened

FE = Federally Listed Endangered

ST=State Listed Threatened

Manatees

Protecting and restoring the Florida Manatee is guided by the Florida Manatee Recovery Plan (USFWS 2001).

FWC surveys manatees by two methods. The Synoptic Survey is a winter aerial survey that targets specific wintering habitats on a particular date. The more comprehensive Abundance Survey takes place over a week or more during a time of year when manatees are spread out instead of congregated in wintering spots. The 2015 estimate for Florida's west coast was 4,810 manatees with a 95% confidence interval of 3,820–6,010 (Hostetler 2018).

In 2018, FWC attributed 60 manatee deaths to red tide and seven to boat collisions in Manatee and Sarasota Counties (FWC Red Tide Manatee Mortalities and Mortality Database). To reduce mortality due to red tide, SBEP and partners have prioritized improving water quality to reduce the duration and severity of red tides and to recover seagrass meadows to levels that can support resilient manatee populations (see Water Quality Action Plan). In known manatee habitats and travel corridors, watercraft slow speed zones are established and enforced to reduce collisions with manatees (Calleson and Frohlich 2007). Pansy Bayou, a watercraft no-entry zone on Lido Key, is an important refuge for manatees. Larger restricted or no-entry sanctuaries are established to the north and south of SBEP bays, including National Wildlife Refuges at

Pinellas, Egmont Key, and Passage Key to the north and Island Bay, Pine Island, and J.N. 'Ding' Darling to the south.

2021 was the most deadly year on record for Florida manatees, with preliminary FWC reports of 1,100 deaths. Most deaths have occurred on Florida's east coast, where seagrass losses have left little forage area for manatees. Activists are igniting efforts to re-list the Florida manatee as federally endangered; in 2017, the manatee was delisted as endangered due to rebounding populations.

Recent local seagrass losses in SBEP bays raises similar cause for concern. While manatee deaths have not risen in the SBEP area, it is critical to accelerate water quality and seagrass restoration to ensure that SBEP bays can support manatees into the future.

Bottlenose dolphins

The Chicago Zoological Society's Sarasota Dolphin Research Program (SDRP) is the longest-running study of a wild dolphin population in the world. For 50 years, they have studied Sarasota Bay's 160 resident bottlenose dolphins focusing on population dynamics, health, behavior, genetics, and impacts due to adverse human interactions, red tide, and climate change. In addition to research, SDRP mitigates threats to dolphins through education and direct intervention, including rescues of entangled or injured animals. The 2018–2019 Florida red tide impacted dolphins directly through the lethal effects of *K. brevis* neurotoxins and indirectly through reduced prey availability. During the event, five Sarasota Bay

dolphins died, eight calves born in 2018 and 2019 disappeared from the bay, and survivors suffered reduced weights due to an 88% drop in prey species abundance between August/September 2017 – August/September 2018 (Wells and McCabe 2020). A common indirect effect of prey depletion is increased dolphin mortality due to hunger-driven adverse human interactions. For example, following the previous 2005–2006 red tide, SDRP recorded increased dolphin mortality due to ingestion of recreational fishing gear. To prevent a similar outcome following the 2018–2019 red tide, SDRP conducted extensive outreach to fishers. As of spring 2020, SDRP has not detected significant increases in adverse human-dolphin interactions (Wells and McCabe 2020, McHugh 2020). A faster rebound in prey fish populations from the 2018–2019 than the 2005–2006 events may also have contributed to this result.

SDRP also monitors dolphins using listening stations installed at Mote Marine Laboratory, Longboat Key, and Cortez/Palma Sola to identify the presence of specific dolphins by their unique whistles and the occurrence of hunting behavior by the presence of echolocation clicks (Rutger 2018). This innovative monitoring program is also being used to understand how human noises like boat motors might mask dolphin communications or sounds necessary for them to identify and locate prey.

Sea turtles

Monitoring sea turtle nesting activity is important for understanding population status and trends and to minimize impacts to turtles and their habitats. Monitoring can also help identify important areas for enhanced protection

or restoration. FWC-FWRI coordinates the Statewide Nesting Beach Survey (SNBS) and Index Nesting Beach Survey (INBS) through a network of surveyors, including federal, state, and local personnel, members of conservation organizations, researchers, and private citizens. Mote Marine Laboratory and Longboat Key

Turtle Watch are important partners for SBEP beaches. FWC trains surveyors and coordinates data collection, compilation, and distribution to researchers, managers, and the public. The SNBS monitors the total distribution, seasonality, and abundance of nesting, covering about 825 miles of coastline on 215 beaches annually. The INBS employs more standardized methodology, including consistent effort by location, fixed dates, and highly trained personnel to survey a subset of 36 SNBS, representing 275 miles of coastline.

Loggerheads are the most common sea turtle found on SBEP beaches, followed by green sea turtles and, on rare occasions, leatherbacks (Table FW-6). According to FWC, the 2018–2019 red tide killed 589 sea turtles on Florida’s west coast while the 2021 red tide killed 472 in the same region. Nesting also declined in 2018. Nesting data are not yet available for 2022.



Loggerhead turtle.

Table FW-6. Sea turtle nesting and false crawls on SBEP area beaches in 2019. Source: FWC.

Key	Loggerhead		Green		Leatherback	
	Nests	False Crawls	Nests	False Crawls	Nests	False Crawls
Longboat Key – Manatee Co.	623	660	8	11	0	0
Longboat Key – Sarasota Co.	686	840	25	7	0	0
Lido Key	96	192	2	0	0	0
Siesta Key	699	1144	10	14	2	0
Casey Key	2178	2813	135	169	1	3
Venice	644*	1133	2	4	1	0
Total	4926	6782	182	205	4	3

*includes 1 potential Kemp’s ridley pending genetic confirmation

Birds

Eighteen coastal and estuary-dependent birds in SBEP watersheds are state or federally listed Threatened species (Table FW-5). Efforts to reverse declines and stabilize populations of these and other birds include critical habitat protection and restoration, surveys and monitoring, and outreach and education.

Audubon’s Florida Coastal Islands Sanctuaries program manages colonial-nesting bird islands in SBEP bays and conducts annual bird surveys, field trips for protection partners, invasive vegetation and erosion control,

predator removal, monofilament line cleanup, and posts protective signage (Table FW-7).

In 2016, FWC designated the Roberts Bay Bird Colony Islands a Critical Wildlife Area (CWA) (Figure FW-2). The designation prevents entry to the islands year-round, and protects hundreds of nesting and young roseate spoonbills, reddish egrets, tricolored herons, great egrets, great blue herons, brown pelicans, and double-crested cormorants. From 2007–2008 Sarasota County installed a breakwater between the Intracoastal Waterway and the islands to prevent erosion from boat wakes. Boat traffic on the mainland side of the islands, including that by ecotour companies and wildlife photographers, continues to be a challenge.

The Town of Longboat Key donated Whale Key and the Town Islands to the National Audubon Society to provide for their long-term conservation. Audubon Florida posts these islands “no trespassing”. The healthy mangrove forests and shallow bay grass meadows surrounding them are important habitats for roosting birds, neotropical migrants, and fish. Education and outreach are important tools for reducing human impacts on bird populations. Multiple agencies, organizations, and partnerships conduct education and outreach in SBEP watersheds and beaches. Messaging includes best practices for reducing disturbances including safe distances, avoidance of habitats during nesting seasons, and leashing pets.

Table FW-7. Number of nesting pairs of colonial-nesting water birds on nesting islands in SBEP bays from 2015–2019. Source: Audubon Florida.

SPECIES	YEAR				
	2015	2016	2017	2018	2019
anhinga (<i>Anhinga anhinga</i>)	7	37	13	30	9
double-crested cormorant (<i>Phalacrocorax auritus</i>)	250	201	137	206	218
brown pelican (<i>Pelecanus occidentalis</i>)	162	214	152	74	165
great blue heron (<i>Ardea herodias</i>)	80	65	51	31	97
great egret (<i>Ardea alba</i>)	249	326	135	220	242
snowy egret (<i>Egretta thula</i>)	95	86	81	29	70
little blue heron (<i>Egretta caerulea</i>)	65	20	27	11	15
tricolored heron (<i>Egretta tricolor</i>)	47	26	25	30	23
reddish egret (<i>Egretta rufescens</i>)	8	9	5	1	0
cattle egret (<i>Bubulcus ibis</i>)	75	21	37	7	14
green heron (<i>Butorides virescens</i>)	4	4	4	3	3
black-crowned night heron (<i>Nycticorax nycticorax</i>)	15	14	7	4	17
yellow-crowned night heron (<i>Nyctanassa violacea</i>)	3	1	0	0	0
white ibis (<i>Eudocimus albus</i>)	120	0	10	0	0
glossy ibis (<i>Plegadis falcinellus</i>)	0	0	0	0	0
roseate spoonbill (<i>Platalea ajaja</i>)	58	37	38	6	21
wood stork (<i>Mycteria americana</i>)	0	0	0	0	70
American oystercatcher (<i>Haematopus palliatus</i>)	1	0	0	0	0
Total nests	1,239	1,061	722	652	964

- **The Florida Bird Conservation Initiative** is a public-private partnership that promotes sustainability of Florida birds and their habitats through conservation planning, programs, monitoring, education and outreach, and policy.
- **The Florida Shorebird Alliance** is a statewide network of conservation partners advancing shorebird and seabird conservation. They collaborate to address research, education, outreach, and public policy.
- **The National Audubon Society** coordinates the Christmas Bird Count, a citizen science bird census. It is the longest-running citizen science survey in the world.
- **Audubon Florida** maintains an educational website and partners with local organizations to provide outreach, especially during monofilament cleanup events. Audubon Florida works with property owners to protect roof nesting birds. Their bird steward network



Wood storks. (Lou Newman)

consists of dedicated volunteers who monitor vulnerable colonial-nesting and beach-nesting bird sites and provide education and outreach about best practices for reducing human disturbance.

- **FWC** provides education through their website featuring facts about common species and best practices for avoiding adverse interactions with them.
- **Save Our Seabirds** is a non-profit wildlife conservation and education organization that rescues, rehabilitates, and releases treated birds back into the wild. They respond to over 4,000 bird rescue calls per year and maintain a three-acre rehabilitation, education, and research center on Sarasota Bay.

- **Sarasota Audubon** built a Visitor and Nature Center at the Celery Fields Regional Stormwater Complex in 2015 to educate the public about birds, their habitats, and conservation. Over 215 species of birds use the Celery Fields for shelter, foraging, and breeding, making it a popular birdwatching hotspot and is featured on the Great Florida Birding Trail.
- **Sarasota Bay Watch** partners with Audubon Florida, Save Our Seabirds, Mote, and FWC to conduct volunteer monofilament cleanups that remove fishing line from bird nesting habitats each fall. Participants learn about the impact and dangers of improperly discarded fishing gear and how to recover gear safely, including from entangled birds.

Horseshoe Crabs

The Florida Horseshoe Crab Watch is a citizen science program managed by FWC and Florida Sea Grant that collects data about breeding horseshoe crabs. Their surveys are used to identify nesting beaches and monitor population status. Protection and restoration of breeding beaches is a priority management activity for horseshoe crabs.

Priorities

Protecting and restoring threatened, endangered, and vulnerable wildlife is a core priority for SBEP and partners. SBEP will continue to support partner monitoring of threatened, endangered, and vulnerable species. Monitoring data will inform managers about population status and trends, help identify and address threats, and provide feedback to assess the results of efforts to

protect and restore critical habitats. SBEP and partners are committed to habitat protection and restoration, especially seagrass meadows, oyster reefs, tidal creeks, and beaches (see Watershed Habitats Action Plan). Priorities include increasing oyster reef area, replacing hardened shorelines with softened and living shorelines, and protecting and restoring habitat necessary to support upslope migration of coastal habitats to accommodate sea level rise. Identification of suitable alternative colonial-nesting bird colonies is a priority as natural disasters and human disturbances can eliminate entire nesting populations or habitats. SBEP will continue to support and conduct outreach and education about threatened, endangered, and vulnerable wildlife, including best practices to minimize adverse human-wildlife interactions. In particular, SBEP and partners will prioritize education and outreach to promote

- Ethical angling to reduce entanglement and ingestion of gear by turtles, dolphins, manatees, and birds
- Safer boating to reduce boat strikes to turtles, dolphins, and manatees and to maintain safe distances from colonial bird colonies
- Reduced wildlife feeding
- Best practices for recreational beach use, including maintaining safe distances from beach-nesting birds, turtle nests, and horseshoe crabs, keeping pets on leashes, and protecting dune vegetation from trampling
- Reduced use of contaminants, including pesticides

Strategy

Activity FW-3.1: Support monitoring of threatened, endangered, and vulnerable wildlife.

Timeframe: New activity

Collaborators: SBEP (Support); Co-Leads: CZS-SDRP, Mote, Audubon, NCF, FWC, NOAA, Turtle Watches, Florida Sea Grant

Projected 5-Year Costs and Funding Sources: \$\$\$/CZS-SDRP, Mote, Audubon, FWC, NOAA, Florida Sea Grant

Location: SBEP bays and tributaries

Activity FW-3.2: Support protection of threatened, endangered, and vulnerable wildlife, including outreach and education to minimize adverse human-wildlife interactions.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Collaborate); Co-leads: CZS-SDRP, Mote Marine Laboratory, Audubon, NCF, FWC, NOAA, Turtle Watches, USFWS, FDEP, Save Our Seabirds

Projected Five-Year Costs and Funding Sources: \$\$\$\$ / SBEP (320), Mote, Audubon, FWC, NOAA, USFWS, FDEP

Location: SBEP bays and tributaries

Benefits

Healthy native wildlife populations are critical components of the ecological integrity of SBEP bays, tributaries, and watersheds.

Five-Year Performance Metric Deliverables:

Continued monitoring of threatened, endangered, and vulnerable wildlife





COMMUNITY ENGAGEMENT *Action Plan*

GOAL: Engage, educate, and encourage environmental stewardship of Sarasota Bay and increase community connections to the estuary through low impact recreational use and enjoyment.

Introduction

Sarasota Bay is a defining part of the region's landscape, identity, and economic well-being. A 2014

Economic Valuation Study concluded that Sarasota Bay contributes \$11.8 billion in value to the local economy, including 21,000 jobs that account for \$751 million in earnings, \$3.6 billion in waterfront real estate value, and \$1.15 billion in tourism spending

(Hindsley and Morgan 2014, Figure CE-1). In economic terms, Sarasota Bay directly and indirectly improves the well-being of the region. Community engagement on bay issues aims to capture this value and translate it into a sense of ownership and stewardship among area residents and visitors that motivates personal action and support for policies that protect the bay, even those that require behavior change or financial support.

Connecting the health of Sarasota Bay to economic and community values like quality of life, public health, recreation, and sense of pride and place can motivate a wider audience. Encouraging citizens to develop a personal relationship with the bay through low impact recreational experiences like boating, fishing,

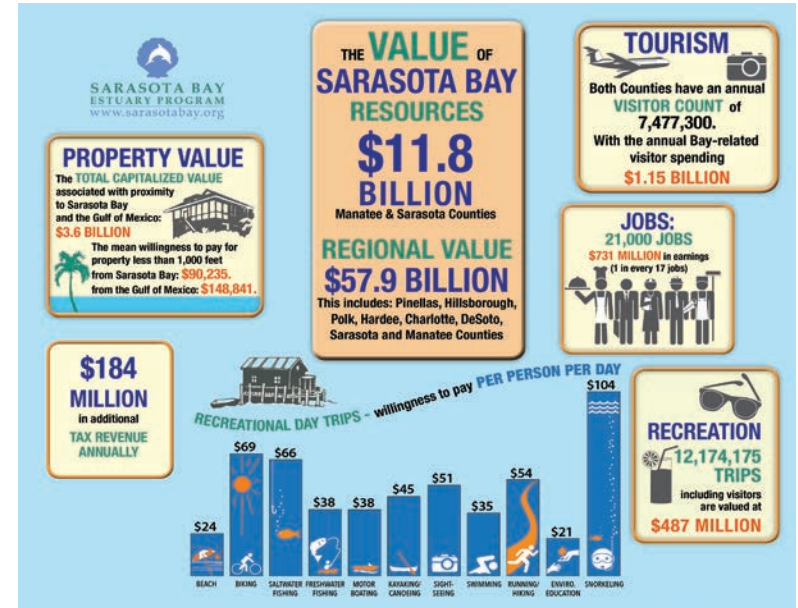


Figure CE-1. Sarasota Bay resources are worth an estimated \$11.8 billion to Sarasota and Manatee Counties.

walking, or simply taking in the view can bolster a long-lasting appreciation for and desire to protect Sarasota Bay.

SBEP plays a critical role in convening, coordinating, and supporting a wide network of community partners and formal partners with shared missions and responsibilities to protect and restore Sarasota Bay. Program sustainability and the foundation of the National Estuary Program model relies on an informed and engaged citizenry to carry out its mission. The Goals of the CCMP's other three Action Plans can only be achieved with an informed public that supports protection and restoration and makes sustainable choices to reduce harmful interactions, overharvest, pollution, and other negative impacts.

Action Plan Strategy

This Community Engagement Action Plan combines and restates the goals and many of the objectives of the 2014 CCMP Recreational Use Action Plan, Governance Action Plan, and Citizens Participation Chapter. It also includes several public engagement objectives that have been relocated from the 2014 Fisheries & Other Living Resources and Freshwater & Saltwater Wetlands Action Plans. Among the many objectives in the 2014 Action Plans that are covered in this Action Plan, three objectives have been completed as a result of the 2014 Sarasota Bay Economic Valuation Study and the formation of the Sarasota Bay Environmental Fund. One objective, to identify bay vista points in local comprehensive plans as

priorities for protection, has been retired due to overwhelming coastal building activity. Please refer to the CCMP Crosswalk in Appendix B for details. The SBEP Management Conference recommended the streamlining of the 2014 CCMP Action Plans into this one comprehensive Community Engagement Action Plan to improve SBEP's ability to track and report on implementation progress.

In this revised plan for community engagement, the SBEP Management Conference commits to four major objectives to engage, educate, and encourage environmental stewardship of Sarasota Bay, increase community connections to the estuary through low impact recreational use and enjoyment, and support and coordinate community and Interlocal Partners for CCMP implementation.

- **Objective 1:** Reduce recreational use impacts on Sarasota Bay and improve access for communities disconnected from waterways
- **Objective 2:** Improve public understanding and action on bay-related issues
- **Objective 3:** Coordinate and support community initiatives that advance CCMP implementation
- **Objective 4:** Ensure coordination of interlocal partners for CCMP implementation



Perico Bay oyster reef work day. (SBEP)

Community Engagement Objective 1: Reduce recreational use impacts on Sarasota Bay and improve access for communities disconnected from waterways.

Activity CE-1.1

Promote and support community-driven public land acquisitions and improvements, including new and expanded hiking and paddle trails, launch points, and bay views that enhance recreational access for communities disconnected from waterways, including environmental justice and other underserved communities.

Activity CE-1.2

Educate recreational users about best practices to avoid impacts to bay waters, wildlife, and habitats, including pollution prevention, safe boating, ethical angling, and sustainable tourism.

Activity CE-1.3

Support responsive and adaptive management of bay access points and recreational trails to avert impacts from overuse.

Background

Sarasota Bay anchors our community's cultural identity. The quality and diversity of recreational life it creates—whether boating, fishing, wildlife viewing, or simply enjoying the view—is the reason many people come here and decide to stay. According to an early SBEP public survey, the number one recreational use of Sarasota Bay is simply taking in the view (SBEP 1995). Maintaining and enhancing recreational opportunities is an important aspect of SBEP's mission. Participation in bay recreation can help instill a sense of ownership and stewardship among area residents and visitors that motivates personal action and support for policies that protect the bay, including those that require behavior change or financial support. Enhancing recreational access for environmental justice communities and communities disconnected from waterways increases watershed awareness and community-wide support for a healthy bay.

Efforts to enhance access and promote recreational opportunities in the bay must be accompanied by education to prevent overuse and damage. Educating users about best practices to avoid impacts to bay waters, habitats, and wildlife is an ongoing need as part of responsive and adaptive management of recreational carrying capacity. Ultimately, improving and managing Sarasota Bay recreational opportunities is key to sustaining support for the large public investments needed to protect and restore Sarasota Bay.



Wares Creek clean-up. (SBEP)



Status

Research and Monitoring

Despite the fact that a large proportion of Bay and creek shorelines is developed and privately owned, therefore limiting public access and viewshed, many coastal parks, piers, trails, boat launches, and view planes allow public access throughout the estuary (Figure CE-2). Public access to creek waterfronts is less available than bay waterfronts. From Anna Maria Sound to Lemon Bay and including rivers and creeks, there are at least 66 paddle launch locations—on average one bayfront launch site per mile of estuary coastline. Power boats can launch from 22 public ramps in the Sarasota-Manatee area, and there are a number of public piers, bridges, and jetties that offer shore fishing and stunning bay and gulf views. Bay wildlife watching can happen almost anywhere with a bay view, but especially from the dozens of bayfront and beach parks and preserves throughout the area. Many of these waterfront access points are vulnerable to degradation and loss due to sea level rise and severe storms (City of Sarasota 2017). SBEP envisions that greater managed public access to waterfronts will increase public stewardship and ownership of water resources.

Facilities are owned and maintained primarily by counties and municipalities. Sarasota County and Manatee County have dedicated parkland acquisition programs that prioritize managed public access. Sarasota County's Neighborhood Parklands Acquisition Program (NPP), passed by voter referendum in 2005, prioritizes acquisition

of sites that provide public access to the Gulf of Mexico, bays, and creeks for water dependent recreational activities and that fill a community need for equitable distribution of accessible public lands. NPP has acquired 17 properties totaling 71 acres, twelve of which provide waterfront access to bay, river, and creek locations (Figure CE-2). In 2020, Manatee County voters approved a funding referendum for conservation and park lands acquisition. Priorities will be identified by staff and a citizen advisory committee. Some privately owned homesites might be good candidates for public acquisition due to repetitive flood losses, thereby removing at-risk property from the flood zone, reducing community flood risk, and lowering flood insurance rates.

The SBEP Habitat Restoration Plan includes criteria to prioritize projects based on increasing or improving public access to the Bay and its tributaries. Conservation Foundation of the Gulf Coast, a private non-profit land trust, also prioritizes acquisition and managed public access of waterfront natural lands. Notably, the non-profit Bay Park Conservancy is implementing a long-term master plan to redevelop and re-green 53 acres of City of Sarasota-owned land on Sarasota Bay, ensuring open, public access to the bayfront for recreational and cultural activities. Along with adjacent Centennial Park and boat launch, The Bay project will be an iconic, publicly accessible destination that connects a diversity of neighborhoods and generations to the bayfront.

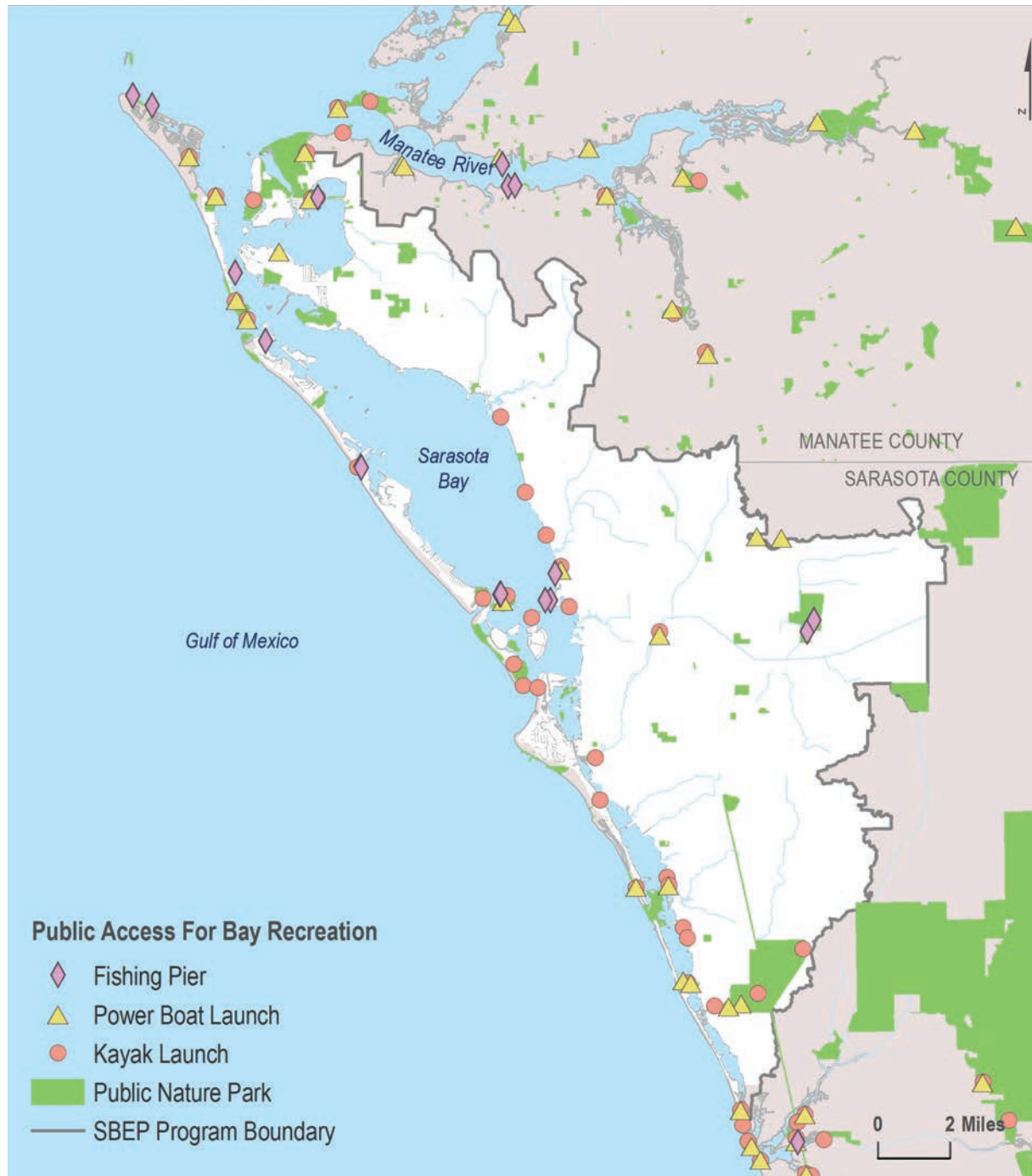
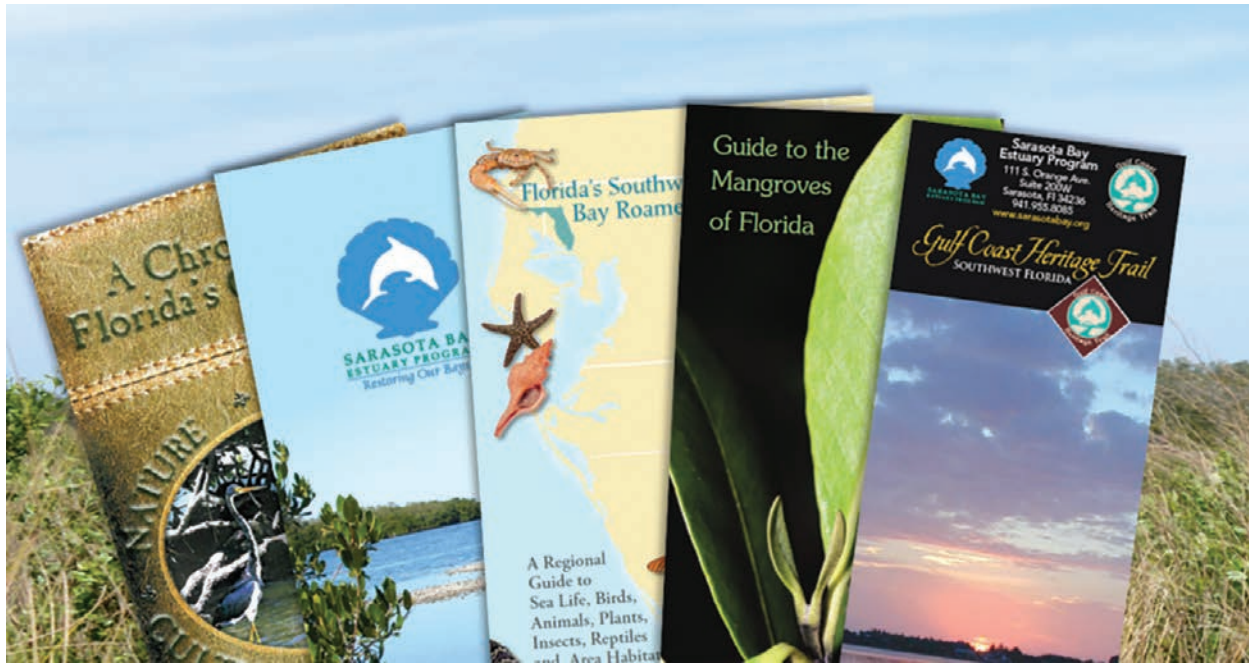


Figure CE-2. Recreational access points to Sarasota Bay estuary.

Coordinating projects and funding opportunities among SBEP partners will enhance success (see WH-1, WH-4, and CE-4).

To facilitate and promote use of existing access sites, SBEP and partners provide a variety of free printed and online resources to assist the public in finding and enjoying bay recreation opportunities, including regional guidebooks and maps on paddling, power boating, fishing, wildlife viewing, and cultural heritage. From 2010-2020, SBEP offered free guided paddle trips through the Bay Wise Kayak Tour Program. Each year, SBEP sponsored 8–12 kayak tours that led 80–130 paddlers on the bay and tidal creeks to learn about Sarasota Bay’s natural history, wildlife, and restoration projects. These trips facilitated access to local waterways and educated paddlers about bay stewardship and best practices to avoid recreational impacts to bay waters, wildlife, and habitats (see CE-2). In 2020, Bay Wise Kayak Tours morphed into a new partnership between SBEP and Mote Marine Laboratory to engage youth from backgrounds under-represented in STEM careers and bay user groups, such as those living in environmental justice communities. The program coordinates kayak paddle trips and free admission to the Aquarium with organizations such as the Sarasota Housing Authority and Visible Men Academy.



Education

There is a need to update boat propeller scarring maps and evaluate the rate of scar recovery, as well as improve boater education and awareness of seagrass beds to reduce scarring (see WH 5.4). In 2019, SBEP partnered with Sarasota and Manatee Counties, Florida Sea Grant, Sarasota Bay Watch, New College of Florida, West Coast Inland Navigation District, and waterfront businesses to study seagrass scarring trends and boating behavior in Sarasota Bay and develop a boater outreach program featuring a Seagrass Safe Boating video, educational signage, and Sarasota Bay waterway guide that delineates areas of seagrass and safe boating practices to avoid propeller scarring. In April 2021, seagrass-safe boating signs and maps were posted at public boat ramps, marinas, and rental/tackle shops in

Sarasota and Manatee counties. SBEP will continue distribution of these materials to waterfront locations and organizations that deliver boater education courses.

SBEP and partners promote ethical angling practices with a focus on techniques for catch and release, fishing rules and regulations, prevention of marine debris, proper disposal or recycling of monofilament line and other fishing gear (see FW 1.4), and reducing impacts to birds, turtles, and marine mammals (see FW 3.2). Florida Fish and Wildlife Commission (FWC) and Florida Sea Grant host sustainable fishing clinics, and Florida Sea Grant launched a Florida Friendly Fishing Guide Certification in 2020. SBEP helps fund the Science and Environment Council's Watershed Audio Tour, which features 2-minute audio messages at locations

around the estuary with advice on best practices for plastic pollution prevention, sustainable fishing, seagrass-safe boating, and safe wildlife watching.

FWC manages the statewide Monofilament Recovery and Recycling Program (MRRP) with over 50 monofilament disposal tubes at boat launches, piers, and bridges throughout the estuary. FWC also works to increase awareness about the environmental impacts of marine debris through their Spiny Lobster, Stone Crab, and Blue Crab Retrieval Program and the Derelict Trap and Trap Debris Removal Program. Sarasota Bay Watch (SBW) conducts outreach and education about lost or discarded fishing gear through regular marine debris and monofilament line cleanups.

Almost ten percent of the economic value derived by Sarasota Bay is driven by tourism. SBEP strives to educate all recreational users, including full- or part-time residents and tourists. In 2020, a SBEP Bay Partners grant supported the development of the Sarasota Bay Sustainability Guide for visitors to "stay, eat, and play sustainably while visiting Sarasota Bay." The guide will be printed and distributed to hotels and restaurants on the barrier islands in 2021. SBEP also encourages its contractors and partners to achieve certification by the Florida Society for Ethical Ecotourism, when appropriate. The Sarasota-Manatee area has more certified eco-destinations and guides than any other region of Florida and the only two Platinum certified guides in the State.

Management

Ongoing education of recreational users to reduce impacts to habitat and wildlife and ensure positive user experiences is critical. But with the region's rapid population growth, the numbers of boaters, fishers, beachgoers, park visitors, and sight seers grows, while the natural resources that support those activities do not. From 2010–2019, the number of households and the total number of registered motorized boats in Sarasota and Manatee Counties both grew by 7% (US Census Bureau 2019, EDR 2020, FLHSMV 2019). On average, one out of every eight households owns a motorboat. Over that period, the number of mid-size 16–26-foot vessels—the size typically used to cruise the bay—increased by 13% or the equivalent of 22 boats joining the fleet every month. Over the same period, the number of saltwater recreational fishing licenses in Sarasota and Manatee Counties increased 44% from 43,636 in 2010 to 62,835 in 2020.

Managing recreational impacts is not just about tracking the numbers of users; understanding when, where, and how those users interact with natural resources is critical. Adaptive and responsive management of recreational access and use requires 1) establishing thresholds of acceptable impacts along with potential mitigating management tactics, 2) monitoring to know when thresholds are crossed, and 3) implementing those targeted management tactics. Adaptive management is especially important when opening new natural areas or increasing access to existing resources.

The net impacts of additional users may be reduced by widespread adoption of sustainable practices, enhanced by ongoing education by SBEP and partners. Management of the time, place, and intensity of recreational activities can also reduce impacts and user conflicts. For example, no-wake and slow speed zones have been established and enforced at inlets and certain segments of the intracoastal waterway. Buffer zones have been established around Critical Wildlife Areas (see FW 3-2), and some bay islands like Whale Key are off-limits for recreation. By default, parking capacity at boat ramps limits the number of boats that can launch from that location on any given day.

In response to recreational user impacts and conflicts at popular kayak launch sites, Sarasota County implemented a capacity management scheme in 2013 wherein commercial kayak tour operators must register and pay an annual permit fee per kayak to launch from Ted Sperling Park at South Lido Beach. The program was expanded to Turtle Beach Park on Siesta Key in 2017. In 2021, the County will further limit the total number of commercial operators to twelve and the number of kayaks to 260 at these locations through a formal competitive bid process.

In 2021, Manatee County will begin limiting the total number of commercial kayaks permitted to launch from Robinson Preserve, Emerson Point Preserve, and possibly North Coquina Boat Ramp. Manatee County's overall strategy regulates user behavior rather than numbers by restricting recreational access and activities in certain areas of



Bald eagle. (Patti Cross)

its preserves, such as limited access to mangrove shorelines, restricting wading and cast netting in certain areas, and prohibiting dogs in sensitive areas such as Perico Preserve.

Priorities

SBEP will continue to coordinate and collaborate with partners to improve bay recreation access points through community-driven land acquisitions and improvements and to promote managed sustainable recreational use of the bay. Bay access will be encouraged as part of public and private sector coastal developments. In order to encourage bay recreation by environmental justice communities and communities disconnected from the bay, SBEP will focus on distributing existing bay resource guides and guided experiences targeted to audiences identified in the Communications Plan, especially traditionally under-represented bay user groups. New distribution partners, such as hotels, restaurants, marinas, neighborhood associations, and youth clubs, will be recruited. SBEP will facilitate community discussion and adoption of adaptive and responsive management strategies to minimize impacts from recreational use, including improved understanding of carrying capacity for new and popular sites.

Strategy

Activity CE-1.1:

Promote and support community-driven public land acquisitions and improvements, including new and expanded hiking and paddle trails, launch points, and bay views that enhance recreational access for communities disconnected from waterways, including environmental justice and other underserved communities.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Support), Co-leads: County and Municipal Governments, Bay Park Conservancy, Conservation Foundation of the Gulf Coast

Projected Five-Year Costs and Funding Sources: \$/SBEP; \$\$\$\$\$/acquisitions.

Location: SBEP bays and tributaries

Activity CE-1.2:

Educate recreational users about best practices to avoid impacts to bay waters, wildlife, and habitats, including pollution prevention, safe boating, ethical angling, and sustainable tourism.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Co-Leads: SBEP (Conduct), FWC, FDEP, SWFWMD, Sarasota Bay Watch, Chicago Zoological Society's Sarasota Dolphin Research Program, Audubon Florida, Save Our Seabirds, Mote Marine Laboratory, Around the Bend Nature Tours, Wayne Adventures, Science and Environment Council

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Activity CE-1.3:

Facilitate responsive and adaptive management of bay access points and recreational trails to avert impacts from overuse.

Timeframe: Ongoing since 1995 CCMP; Conduct workshop by 2025

Collaborators: SBEP (Coordinate), County and Municipal Governments (Co-lead), Conservation Foundation of the Gulf Coast, Science and Environment Council, NOAA, FWC, FDEP (Co-lead), SWFWMD (Co-Lead)

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Benefits

Reducing recreational use impacts helps ensure the sustainability of bay resources. Enhancing managed recreational access for communities disconnected from waterways helps grow watershed awareness and community-wide support for a healthy bay.

Five-Year Performance Metric Deliverables:

Offer at least 15 guided kayak tours, coastal walks, and other recreational opportunities annually with a focus on engaging communities that are traditionally underrepresented in bay user groups, including environmental justice and other underserved communities.



Community Engagement Objective 2: Improve public understanding and action on bay-related issues and expand reach to priority audiences.

Activity CE-2.1

Inform and engage the public about priority environmental issues and the multiple benefits of watershed and estuary and restoration, including climate change adaptation.

Activity CE-2.2

Support volunteer restoration and citizen science activities that contribute to assessment, monitoring, and restoration of bay and gulf waters, shorelines, wetlands, and other habitats.

Activity CE-2.3

Assist and empower citizens to adopt sustainable bay-friendly lifestyles and to lead community initiatives that reduce pollution, conserve water and energy, and promote community health.

Background

Outreach that delivers consistent and compelling science-based environmental education can help inspire and motivate bay users, homeowners, visitors, and other target audiences to care about and participate in conserving, protecting, and restoring Sarasota Bay. SBEP education efforts focus specifically on bay-related priority issues such as reducing stormwater and wastewater pollution (see WQQ Action Plan), mitigating and adapting to climate change, protecting and restoring seagrass and coastal wetlands (see WH Action Plan), protecting native fish, shellfish, and wildlife (see FW Action Plan), and minimizing recreational use impacts (see CE-1).



Perico Bay oyster reef work day. (SBEP)

Status

The SBEP Communications Plan (SBEP 2018) outlines strategic communication tactics and priority target audiences, including local business and community leaders, recreational users, seasonal residents, and retirees, and especially those communities disconnected from the bay. Enhancing participation by communities disconnected from waterways increases watershed awareness and a sense of ownership and stewardship, that in turn increases community-wide support for SBEP's mission for a healthy bay.

SBEP's education programs and materials targeting K-12 students and teachers include field trips, classroom tech kits, and teacher training workshops. SBEP funds dozens of field trips throughout the Sarasota Bay watershed that serve nearly 2,000 students each year. Professional teacher training workshops are funded by SBEP three times per year where K-12 science teachers improve teaching skills and science literacy. In 2022, SBEP will dedicate all environmental education funds to hands-on bay-related experiences for Title I schools and youth-focused human service organizations that reach under-served populations. The inaugural Sarasota Bay Educators' Workshop will also be held in 2022 to convene formal and informal educators to identify gaps in bay-related K-12 education and brainstorm potential new or expanded programs to fill those gaps.



Volunteers oyster reef building at Perico Preserve, Manatee County. (SBEP)

In 2019, SBEP began a new partnership with Mote Marine Laboratory and local human service organizations to provide kayak instruction, bay exploration, and aquarium trips for youth in communities that are traditionally underrepresented in bay user groups. So far, this partnership has engaged approximately 50 individuals through organizations that support minority or at-risk youth, including Visible Men Academy, the Sarasota Housing Authority, Girls Inc., Unidos Now!, and the Bradenton Dream Center.

Throughout the year, SBEP staff interact with the general public by tabling at community events and through invited speaking engagements at colleges and universities, adult classes, homeowner associations, and other community

groups. Almost 5,000 followers and subscribers are engaged on a variety of timely bay-related issues, activities, and program accomplishments through semi-weekly social media posts and SBEP's quarterly e-newsletter *Bay Reflections*. In 2017, SBEP redesigned and launched a new website that is easier to navigate, more visually engaging, mobile friendly, and more complete with new, improved, and better organized content. In particular, SBEP's comprehensive collection of brochures and booklets are organized and available for download. SBEP also promotes the online Sarasota County Water Atlas (see WQQ-1) that displays and explains local water resources and water quality monitoring data.

SBEP also develops guides and tools to assist the public and practitioners in adopting best practices for bay protection. New in 2020, a comprehensive section of the SBEP website expands on the *Sarasota Bay Repair Kit* brochure with in-depth guidance on bay-friendly living—around the home, yard, community, school, workplace, and on the water. In 2018, SBEP oversaw development of *Living Shorelines: Guidance for Sarasota Bay Watershed*, which serves as a technical guide for crafting an outreach strategy to inform waterfront homeowners about the benefits of living shorelines. In 2017, in collaboration with Mote Marine Laboratory, SBEP published the second edition of *Sea Level Rise: Tips for Adaptation Planning* along with a 7-minute professional video that draws from local, regional, and national examples to lay the groundwork for conversations about sea level rise scenarios and adaptation strategies.

Engaging the public with interactive and hands-on experiences is also a core strategy of SBEP outreach. For example, since 2016, SBEP has partnered with Sarasota County's Annual Volunteer Seagrass Survey to host the Seagrass Festival. The festival is an educational celebration that highlights the value of seagrass and progress toward seagrass recovery and gives participants the opportunity to snorkel and observe seagrass beds. The annual King Tide Photo Contest is an opportunity for citizens to observe and photograph the state of sea level rise in their neighborhood during autumn high tides.

SBEP's most popular community engagement program is the Sarasota Bay Guardians, which empowers volunteers to become stewards of the

Sarasota Bay watershed. The program annually engages 300–400 volunteers of all ages in hands-on work projects to restore Sarasota Bay. The program focuses on educating volunteers about watershed ecology and encouraging participants to look beyond the volunteer workday for opportunities to improve the Bay. Each year, volunteers remove thousands of pounds of invasive plants and trash, and they restore shorelines with thousands of native plantings and new oyster reef substrate. Between 2010–2020, 3,613 Sarasota Bay Guardians volunteers donated over 7,742 hours valued at \$180,000 to remove 8,479 pounds of trash and 21,610 pounds of invasive plants and install 46,525 native plants and 80 tons of oyster shell reefs.

SBEP collaborates with partners on Bay Guardians events, including Sarasota County, Manatee County, City of Sarasota, local colleges, Florida Sea Grant, and Florida Audubon. SBEP also strives to partner with local schools and human service organizations such as the Boys and Girls Clubs to reach new volunteers who are not actively involved with environmental issues. SBEP's partner organizations also engage citizens with hands-on projects that help implement the CCMP.

These community-level activities support the bay and increase stewardship. Some bay-related priority issues must be tackled at the individual level through personal choices and behaviors. SBEP's outreach strategy seeks to empower community members with tools and incentives to make these choices. SBEP co-promotes UF/IFAS Extension programs, such as the Florida Friendly Yards Program, the Florida Waters Stewardship Program, and home energy and water audit kits.

Priorities

SBEP's priorities for outreach include continuing general and targeted public education on priority issues, expanding citizen-science opportunities, and developing new behavior change campaigns targeted to households. SBEP will continue to work collaboratively with its many education partners to deliver messaging to the general public through web, social media, e-newsletters, and events. SBEP will use relevant framing such as benefits to public health, quality of life, and property values to connect with target audiences identified in the Communications Plan on a variety of bay-related issues, including:

- Reducing stormwater pollution from leaks and spills from improper use of domestic central sewer and septic systems, urban fertilizer, and reclaimed irrigation water;
- Reducing stormwater pollution and climate changing greenhouse gas emissions from gas-powered vehicles and equipment; and
- Reducing recreational impacts to seagrass, coastal wetlands, dunes, and wildlife.

In addition, SBEP has recently collaborated with Florida Sea Grant, fellow National Estuary Programs, and other partners to develop new citizen-science opportunities for vertical oyster gardening, seagrass and macroalgae monitoring, and sea level rise. Finally, SBEP will develop targeted outreach campaigns to empower citizens with tool kits, incentives, and hands-on experiences that make household changes more personally rewarding, convenient, or economical, such as irrigation evaluations and downspout modification kits.

Strategy

Activity CE-2.1:

Inform and engage the public about priority environmental issues and the multiple benefits of watershed and estuary and restoration, including climate change adaptation.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Co-Leads: SBEP (Conduct), County and Municipal Governments, Florida Audubon, Save Our Seabirds, Conservation Foundation of the Gulf Coast, FDEP, Around the Bend Nature Tours, Florida Native Plant Society, Chicago Zoological Society's Sarasota Dolphin Research Program, Mote Marine Laboratory, UF/IFAS Extension, Florida Sea Grant, Science and Environment Council, Sarasota Bay Watch, FWC, FDEP, SWFWMD

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Activity CE-2.2:

Support volunteer restoration and citizen science activities that contribute to the assessment, monitoring, and restoration of bay and gulf waters, shorelines, wetlands, and other habitats.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Co-leads: SBEP (Conduct), County & Municipal Governments, New College of Florida, Florida Sea Grant, UF/IFAS Extension, Florida Audubon, GCORR, FWC, Sarasota Bay Watch, Mote Marine Laboratory, Longboat Key Turtle Watch, Anna Maria Island Turtle Watch

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Activity CE-2.3:

Assist and empower citizens to adopt sustainable bay-friendly lifestyles and to lead community initiatives that reduce pollution, conserve water and energy, and promote community health.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Co-leads: SBEP (Conduct), Florida Sea Grant, UF/IFAS Extension, County and Municipal Governments

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries



Perico Bay oyster reef work day. (SBEP)



Benefits

Working collaboratively with partners on outreach and education that informs and empowers citizens to take community and individual bay-friendly actions helps sustain a healthy Sarasota Bay.

Five-Year Performance Metric Deliverables:

- (1) Engage Bay Guardians volunteers at 5 events annually,
- (2) Sarasota Bay Educators' Workshop in 2022.

Community Engagement Objective 3: Coordinate and support community initiatives that advance CCMP implementation.

Activity CE- 3.1

Support capacity of non-profit, community, and business partners to educate and engage the public in outreach and stewardship that furthers CCMP implementation through professional development opportunities, workshops, and grants.

Activity CE-3.2

Connect the value of natural resource protection with preservation of cultural heritage and traditional use of Sarasota Bay through partnerships with cultural heritage organizations.

Background

Support Partners to Educate and Engage the Community

Through the management conference, SBEP supports the capacity of non-profit, community, and business partners to educate and engage the public in outreach and stewardship that furthers CCMP implementation through supporting professional development, workshops and meetings, and grants. By developing, enhancing, and leveraging capacities of collaborating organizations, SBEP is able to drive implementation of CCMP goals and objectives for protecting and restoring Sarasota Bay.

Connect Bay Protection to Cultural Heritage and Traditional Use

Sarasota Bay's waters and abundant fish and wildlife have attracted and sustained human populations along its shores for the past ten thousand years. From mullet and snapper to oysters, clams, and scallops, harvesting from the healthy, bountiful waters of Sarasota Bay was central to supporting early populations. Today, a growing urban population, together with degradation and loss of historically important bay waters and habitats, have reduced Sarasota Bay's capacity to provide plentiful seafood for



P.I.E.R field trip to Celeryfields, Sarasota County. (SBEP)

the population. The Cortez fishing village, dating back over 100 years, is the last working waterfront on Sarasota Bay and one of the last commercial fishing villages in Florida. Fishers depend on healthy waters and bay habitats to sustain their livelihoods and cultural identity. Development pressure and climate stressors, including intensifying storms and rising seas, will continue to threaten working waterfronts. Remnants of historical cultural sites persist along the bayfront, some in the form of large mounds of discarded shell, called middens. Many of these sites are vulnerable to degradation and loss due to climate stressors. SBEP and partners are working to protect and restore critical components of bay ecosystem integrity, function, and services necessary to protect and restore working waterfronts sustaining Sarasota Bay's cultural heritage. SBEP supports ways to promote protection and placemaking by connecting past and present cultural values through science, art, and alternative engagement initiatives. By connecting bay protection and restoration to cultural heritage and traditional use, SBEP can increase support for CCMP goals and objectives.

A number of dedicated organizations are working in the Sarasota Bay area to preserve working waterfronts and imperiled cultural heritage sites.

The Florida Institute for Saltwater Heritage (FISH) is a non-profit grassroots organization established in 1991 to promote, educate, and preserve Cortez and Florida's commercial fishing and other traditional maritime culture,

including the environment upon which these communities depend. FISH assists in the operation of the Florida Maritime Museum Cortez, conducts research and assists in collecting, preserving, and interpreting the culture and folk-life of Florida's traditional Gulf Coast maritime communities and their commercial fisheries. They also promote public awareness and support for protecting marine resources and traditional maritime skills and values. Each year, FISH organizes the Cortez Commercial Fishing Festival in February. SBEP has a longstanding partnership with FISH to restore FISH Preserve, a coastal property in Bradenton.

Historic Spanish Point is a 30-acre environmental and museum complex located in Osprey, Florida operated by Marie Selby Botanical Gardens. The complex features an archeological exhibit of a prehistoric shell midden, a pioneer homestead historic house, and a traditional boatyard.

The Florida Public Archaeology Network (FPAN) promotes and facilitates conservation, study, and public understanding of Florida's archaeological heritage through regional centers throughout the state.

New College of Florida's Public Archaeology Lab facilitates studies of archaeology and historic preservation for Sarasota and Manatee Counties through ethical, community-based research and public engagement.

Continuing to develop and nurture working relationships with cultural organizations on projects that co-benefit cultural and historic

preservation and the environment will help increase support and implementation of CCMP goals and objectives.

Status

SBEP and partners continue to provide support to partners to educate and engage the community on issues related to protecting and restoring Sarasota Bay and to develop relationships and partnerships with organizations that can help strengthen and communicate the connection between protecting and restoring Sarasota Bay and preserving cultural heritage and traditional use.

Support Partners to Educate and Engage the Community

SBEP supports and provides leadership for environmental workshops, meetings, and conferences that build capacity for communities to improve understanding and support for protecting and restoring SBEP bays, tributaries, and watershed. For example, in October 2021, SBEP convened high level stakeholders in a Water Quality Restoration Workshop to address water quality status and plans for infrastructure investments (See WQQ-2).

In 2018, SBEP sponsored and participated in the Environmental Summit, hosted by the Science and Environment Council. The Summit highlighted connections between environmental heritage and a resilient future, natural habitats and fish and wildlife, and a healthy environment and quality of life.

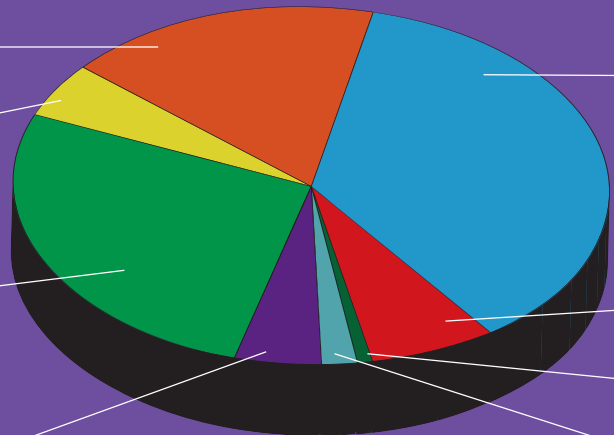
Organization type receiving Bay Partners Grants

School
17.3%

Neighborhood
4.8%

HOA
26.9%

Government
4.8%



NGO
36.5%

Business
6.7%

Church
1.0%

College/Uni
1.9%

Starred (*) organizations conducted projects that reached environmental justice communities, Title/schools, or other underserved groups.

- Anna Maria Environmental Enhancement
- Anna Maria Historical Society
- Anna Maria Island Elementary School
- Anna Maria Island Power and Sail Squadron
- Anna Maria Island Turtle Watch
- Aquarian Quest
- Around the Bend Nature Tours
- *Ballard Elementary
- Bay Haven Elementary School
- Bayou Oaks Neighborhood Association
- Bay Wise Kayak Tours
- *Bayshore Elementary School
- *Bayshore High School
- Bayside Terraces HOA
- Beachplace Association, Inc
- Beekman Place
- *Booker High School
- *Boys and Girls Clubs
- Calusa Lakes Community
- Casco Dorado Condominium Association
- Center of Anna Maria Island
- Central Cocoanut Neighborhood Association
- City of Bradenton Beach
- City of Holmes Beach
- City of Sarasota
- Cortez Village Historical Society
- Crooked Creek Condominium Association

- ecoGENESIS LLC
- ELM West Coast, Inc.
- Fairway Bay
- Florida House Institute/Southface Institute
- Founders Garden Club of Sarasota
- Foxfire West
- Friends of Florida Maritime Museum
- Gardeners Out East
- Garden Lakes HOA
- Girls Inc.
- Gulf Coast Heritage Association, Inc
- GWIZ
- Happy Paddler Kayak Tours & EcoVentures
- Hardee County Schools
- Harllee Middle School
- High Impact Networks LLC
- Hudson Bayou Association
- Island Village Montessori School
- Keep Manatee Beautiful
- Kinnan Elementary School
- Lakeridge Falls
- Lakeshore Village HOA
- Landings Management Association
- Manatee County Government
- Manatee Fish and Game Association
- *Manatee County YMCA
- Marie Selby Botanical Gardens

- Meadows Community Association
- Mission Estates
- Mote Marine Laboratory
- Nature's Academy, Inc
- *New College of Florida
- Oaks Bayside HOA
- Orchid Oaks Condominium Association
- Palma Sola Botanical Park
- Palma Sola Presbyterian Church
- Pelican Cove Condominium Association
- Plymouth Harbor
- Reef Rakers
- Reef Rovers
- Riggs Landing
- Rivendell Community Association
- Riverview High School
- Saint Stephen's Episcopal School
- Sarasota Audubon Society
- *Sarasota Bay Watch
- Sarasota County Schools
- Save Our Seabirds
- Scenic Waves Partnership Committee
- Science and Environment Council of Southwest Florida
- Sea Breeze Elementary School
- *Sea to Shore Alliance
- Sherwood Forest Owners Association
- Sierra Club
- Siesta Key Association
- Simply Green Solutions, LLC
- Solutions to Avoid Red Tide (START)
- South Gate Community Association
- Stonebridge Community
- Sunbow Bay Condominium Association
- Suncoast Reef Rovers
- Suncoast School for Innovative Studies
- Suncoast Waterkeeper
- Sunshine Community Compost
- School in the Park
- Tidy Island
- Town of Longboat Key
- USF Sarasota-Manatee
- Venice Area Audubon Society
- Venice Area Beautification
- Village in the Pines
- VillageWalk HOA
- Wakeland Elementary School
- WAVES
- Westchester Condominium Association
- *Wilkinson Elementary School
- Windward Bay Condominium Association
- Youth Environmental Action Committee of Manatee County

Figure CE-4: Organization type receiving Bay Partners Grants.

In 2022, SBEP will convene formal and informal educators and organizations that serve them in the inaugural Sarasota Bay Educators' Workshop. Participants will discuss how to make bay related education more effective, accessible, and equitable. The workshop aims to connect local stakeholders, inventory what topics, audiences, and experiences already exist, identify gaps in programming and audience reach, and develop new connections and programs.

SBEP's Bay Partners Grants Program promotes environmental education, community involvement, and stewardship to improve Sarasota Bay and its tributaries. Grants are provided to local businesses, non-profit organizations, schools, academic institutions, civic associations, religious organizations, homeowner associations, and neighborhood associations for a wide variety of projects that focus on water and habitat quality improvement and bay-related environmental outreach, education, and engagement. Bay Partners Grants are funded once per year and applications are reviewed by a Bay Partners Grant committee, recommended by the Citizen's Advisory Committee, reviewed by the Management Board, and approved by the Policy Board.

Ten to twelve community projects are funded each year with a maximum of \$4,000 per project (in 2020). Examples of recent projects include:

Restoration and Partner Building: Bowlees Creek Bird Sanctuary Island Diversity Plantings.

Manatee Fish and Game Association partnered with New College of Florida, Around the Bend Nature Tours, Almost Heaven Kayak Adventures, and community members to plant 176 native

coastal berm trees, shrubs, and forbs along a cleared path meandering through the center of Bowlees Creek Island. The project aimed to increase vegetative diversity by adding 24 species of native plants.

Education: Dunes Do's and Don'ts. Anna Maria Island Turtle Watch organized local elementary school students to create and deploy 61 educational signs about dune and turtle protection on Anna Maria Island.

Restoration and Education: Save Our Seabirds Campus Native Planting. Save Our Seabirds created an oasis of native plants for migrating birds, improved the native plant footprint of their bayside campus, and educated the general public about the importance of native plants to the environment and bird populations.

Restoration and Community Building: Orchid Oaks Preserve Restoration Project at Phillippi Creek. The Orchid Oaks Condominium Board, Sarasota County, and Riverview High School removed nuisance and exotic invasive plants, including Brazilian pepper, carrotwood, and air potato from the Orchid Oaks shoreline along Phillippi Creek. In addition to the direct environmental benefits of creating habitat for native species and improving water quality runoff in the creek, the volunteer event helped build support for restoring and improving the creek and other upstream habitats of Sarasota Bay.

Education: PUSH/SUCCESS. New College of Florida created and implemented an intensive educational program focused on using the scientific method to guide middle- and high-

school students through modules to learn about bay-related topics.

Education: EcoExplore Camp. Sea to Shore Alliance hosted a one-week camp for under-represented Booker High School students to learn about marine issues important to the Sarasota region.

SBEP aims to conduct outreach and make changes to the Bay Partners Grants program to make awards more equitable, to increase funding accessibility for a broader range of organizations, and to support initiatives that address environmental justice and climate equity.

Connect Bay Protection to Cultural Heritage and Traditional Use

Since its inception, SBEP and partners have understood the importance of connecting Sarasota Bay's rich cultural history and traditional use with healthy Bay waters. Early Program branding materials heavily referenced Sarasota's history and culture and their dependence on the bay. SBEP produced the *Gulf Coast Heritage Trail Guide* that identifies, describes, and locates the Bay's many historical, environmental, and arts and cultural points of interest on a detailed map. In addition to providing a compelling narrative of the history of the Sarasota Bay area, the guide makes important connections between preserving the health of Sarasota Bay and the development and sustainability of heritage, culture, and arts through history to present day. SBEP

also created *A Chronicle of Florida's Gulf Coast* (2000), which aims to increase appreciation and stewardship of Sarasota Bay by featuring its nature, recreation, culture, and history. Both guides are available for download from SBEP's online library of educational brochures.

SBEP supports fishing heritage through restoration of important fish habitats and oyster reefs (see FW Action Plan). For example, SBEP is a key partner on a coastal restoration project at the Florida Institute for Saltwater Heritage (FISH) Preserve, a 100-acre habitat east of the historic Cortez fishing village in Manatee County (see callout box in CE-4). FISH Preserve hosts important fish habitat necessary to support sustainable fishing activities in the area.

Priorities

SBEP and partners will continue to support the capacity of non-profit, community, and business partners to educate and engage the public in outreach and stewardship that further CCMP implementation through professional development, workshops and conferences, and Bay Partner Grants. SBEP will continue to develop funding for Bay Partners Grants through its Sarasota Bay Environmental Fund. SBEP will continue to improve public support for bay protection and restoration by improving understandings between healthy bay waters and preservation of cultural heritage and traditional use of Sarasota Bay. SBEP will develop and enhance working partnerships with area cultural heritage organizations.

Strategy

Activity CE-3.1:

Support capacity of non-profit, community, and business partners to educate and engage the public in outreach and stewardship that further CCMP implementation through professional development opportunities, workshops, and grants.

Timeframe: Ongoing since 1995 CCMP

Collaborators: Co-leads: SBEP (Conduct), County and Municipal Governments, UF/IFAS Extension, Science and Environment Council, Bay Partner Grantees.

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Activity CE-3.2:

Connect the value of natural resource protection with preservation of cultural heritage and traditional use of Sarasota Bay through partnerships with cultural heritage organizations.

Timeframe: New activity; coordinate 2022-2026 as opportunities arise

Collaborators: SBEP (Coordinate), Co-leads: Florida Institute for Saltwater Heritage (FISH), Marie Selby Botanical Gardens' Historic Spanish Point, New College of Florida Public Archaeology Lab, Florida Public Archaeology Network (FPAN)

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP bays and tributaries

Benefits

CCMP implementation can be improved by increasing the capacity of non-profit, community, and business partners to educate and engage the public about bay issues and solutions.

Five-Year Performance Metric Deliverables:

Fund at least \$25,000 in Bay Partners Grants to community organizations annually

Community Engagement Objective 4: Ensure coordination of interlocal partners for CCMP implementation.



Activity CE-4.1

Implement the Finance and Implementation Plan, including continuation of the Interlocal Agreement and participation in the Florida Estuaries Alliance.

Activity CE-4.2

Coordinate multi-partner projects supportive of CCMP objectives and partner reporting of CCMP performance metrics.

Activity CE-4.3

Provide regular updates to policymakers and decisionmakers about priority issues, best available science, and examples of success.

Activity CE-4.4

Support and encourage interlocal partners to develop and implement climate vulnerability assessments and adaptation plans. Provide tools and assistance to mitigate and adapt to climate change impacts.

Activity CE-4.5

Incorporate CCMP objectives and activities in local government comprehensive plans, land development regulations, or ordinances.

Background

SBEP is organized as a management conference of SBEP staff and four Committees that bring together a diverse assemblage of interests, perspectives, and expertise to coordinate information sharing and problem solving in SBEP bays and watersheds (see CCMP introduction for detailed conference structure and roles). By convening policy-makers (Policy Board), managers (Management Board), scientists (Technical Advisory Committee), and community members (Citizens Advisory Committee), SBEP has a unique, centralized role for informing policy and management decisions and guiding the development of technical studies, monitoring, restoration and management plans, projects, and outreach and education throughout SBEP watersheds.

SBEP's Comprehensive Conservation and Management Plan (CCMP) was first adopted in 1995 and updated in 2000, 2006, 2010, and 2014. It is a multi-partner, science-based, and consensus-driven strategic plan that prioritizes goals, objectives, and actions to protect and restore the water quality and ecological integrity of Sarasota Bay. Local, state, and federal governmental and regulatory partners have formally committed to implementing CCMP goals through adoption of an Interlocal Agreement, enacted in 2004. Partnering organizations include:

- USEPA
- Town of Longboat Key
- City of Bradenton
- City of Sarasota
- Manatee County
- Sarasota County
- Southwest Florida Water Management District
- Florida Department of Environmental Protection
- Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute
- US Fish and Wildlife Service
- US Army Corps of Engineer

Other agencies and organizations referenced in the Interlocal Agreement serve as CCMP implementing partners, including Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute, US Fish and Wildlife Service, and US Army Corps of Engineers.

SBEP's Long-Range Finance Plan (SBEP 2016) provides options and opportunities for funding to implement its 2014 CCMP. The Plan addresses funding for program operations, technical and outreach projects, implementation of the Five-Year Habitat Restoration Plan, research, and CCMP updates. Through the CCMP and Interlocal Agreement, SBEP and its partners have made significant progress in protecting and restoring Sarasota Bay. Continued support of the Interlocal Agreement and improved coordination among partners will catalyze continued success.

Coordination of Statewide Estuary Restoration, Research, Stewardship, and Education

In 2016, Florida's four National Estuary Programs—Coastal and Heartland National Estuary Partnership, Sarasota Bay Estuary Program, Tampa Bay Estuary Program, and the Indian River Lagoon Council, host of the Indian River Lagoon National Estuary Program—created the Florida Estuaries Alliance (Florida Estuaries Alliance 2016). The Alliance aims to help advance Florida as a national leader in coastal and estuarine restoration, research, stewardship, and education. It provides a comprehensive approach to estuarine challenges statewide, cost-effective collaboration and shared resources, fundraising, and public and private stakeholder support on multiple levels and geographic scales. The Alliance will partner with agencies and organizations that share its goals, such as FDEP's Coastal Office, National Estuarine Research Reserves, Aquatic Preserves, Florida's five water management districts, The Florida Keys National Marine Sanctuary, The Florida Ocean Alliance, and others. The Alliance will work to inform statewide leaders and the public about environmental, economic, and cultural assets associated with Florida's estuaries.

Coordination of Communication with Policymakers

Improved protection and restoration of Sarasota Bay depends on sound environmental policy and decision-making. Providing regular updates to policymakers about environmental challenges





Planting at Robinson Preserve, Manatee County. (SBEP)

and solutions and making multiple connections between a healthy Sarasota Bay and healthy economies, communities, and families will enhance support for CCMP implementation. Demonstrating the value of the NEP model to leverage federal support and create efficient, coordinated, and collaborative local partnerships is important. SBEP staff travel to Washington DC and Tallahassee at least once per year to meet with federal and state elected and agency leaders to inform them about priority challenges and science-based, consensus-driven solutions for environmental protection. SBEP is a trusted broker of science-based knowledge about Sarasota Bay and can be an important resource to decision-makers through effective communication.

Coordination of Multi-Partner Projects and Reporting

Local coordination of multi-partner projects can leverage partner investments and create efficiencies in accomplishing CCMP goals. SBEP has participated in more than 200 water quality or habitat improvement projects since the program's inception in 1989. Through its role as a project manager, SBEP brings together partners, funding, and contractors. SBEP's Five-Year Habitat Restoration Plan guides efforts of SBEP and partners to identify, prioritize, and implement restoration projects throughout the bay and its watersheds. Funding for projects requires coordination with funding opportunities and partner priorities. Tracking and reporting habitat restoration accomplishments is important for monitoring progress toward water quality and habitat goals. SBEP reports completed habitat

restoration projects annually to USEPA through the National Estuary Program Online Reporting Tool (NEPORT). Improved coordination of partner reporting, such as standardizing categories and metrics for restoration, monitoring, and management activities and CCMP performance metrics will increase the clarity and value of these reports for tracking improvements in water and habitat quality in SBEP bays and tributaries.

Coordination of CCMP Implementation by Partners

CCMP implementation can be facilitated by encouraging partners to identify and prioritize goals, objectives, and activities from the CCMP that complement their priorities and incorporate them into their own comprehensive plans, land development regulations, ordinances, and other guidance documents. Tampa Bay Estuary Program and Tampa Bay Regional Planning Council's *Comprehensive Conservation and Management Plan—Local Government Comprehensive Plan Crosswalk Project* provides an effective model to accomplish this activity (TBEP CCMP 2017). Their approach prioritizes CCMP goals, objectives, and actions suitable for inclusion in local government comprehensive plans, land development regulations, and other guidance documents; identifies relevant elements of government plans, regulations, and documents that could serve as the most appropriate vehicle for incorporating CCMP priority goals and actions; and provides model language for local governments to consider.

Development and Implementation of Climate Vulnerability Assessments and Adaptation Plans

Sarasota Bay and its coastal communities are vulnerable to climate change stressors, including rising air and water temperatures, changing patterns of rainfall, increased intensity of storms, rising seas, and ocean acidification (SBEP and Shafer 2017). Threats arising from climate stressors will interact with threats from ongoing and new anthropogenic stressors and will change over time. As climate changes, so does our understanding of climate science and environmental impacts. Similarly, conservation, restoration, mitigation, and adaptation management tools are evolving to help mitigate or adapt to changes. Effective resource management will need to be adaptive and sensitive to new information and management tools and will need to operate at scales sometimes beyond traditional political boundaries. Adaptation will require collaboration and partnerships among various sectors of the community and coordination across municipal, county, state, and federal governments. As a science-based, consensus driven, multi-partner regional organization, SBEP is uniquely positioned to help partners coordinate and collaborate to develop and implement climate vulnerability assessments and adaptation plans. Continuing to incorporate the effects of climate change into the management

framework for Sarasota Bay is essential to the continued success of SBEP and its partners to protect and restore Sarasota Bay.

Status Funding Coordination

SBEP implemented its 2016–2020 Finance Plan through matching federal NEP funds with local funding from partners through its Interlocal Agreement, successful grant proposals, and a new Sarasota Bay Environmental Fund established through the Gulf Coast Community Foundation. The new fund has already begun to support outreach and education through Bay Partners Grants and restoration through a stormwater retrofit design at G.T. Bray Park in Manatee County.

Beginning in 2022 and ongoing through the following five years, SBEP will receive additional funding of approximately \$910,000 per year through the US EPA Bipartisan Infrastructure Law (BIL). The BIL highlights the following NEP CCMP activities as those that assist with implementing the Law: “protecting and restoring habitat, including wetlands; supporting water quality protection and restoration, including Total Maximum Daily Load plan implementation; monitoring and addressing toxics and pathogen loads and contamination; implementing stormwater management, reducing non-point source pollution impacts, and promoting the adoption of green infrastructure approaches; preventing the spread of aquatic invasive species and/or managing their impacts; developing and implementing nutrient reduction strategies; conducting climate vulnerability assessments and

developing and implementing climate change adaptation strategies and using adaptation tools to promote coastal resilience; and developing and implementing strategies to provide opportunities for residents of urban minority and/or underserved communities to have greater access to urban waters, participate in urban ecosystem restoration, and participate in capacity-building/educational activities.” As of early 2022, SBEP is in conversations with the Management Conference to determine an appropriate plan to spend the funds.

SBEP worked through the newly created Florida’s Estuaries Alliance with state and federal legislators to secure NEP status and funding. The Florida National Estuary Program Act (HB 791 and S 1608) aimed to make Florida NEPs eligible for recurrent dedicated funding from FDEP, which would make it easier to plan and implement large multi-year habitat restoration and clean water initiatives. Both bills were withdrawn. The federal Protect and Restore America’s Estuaries Act (HR 4044), cosponsored by US Representative Vern Buchanan, and its companion legislation in the Senate (S 3171) reauthorized the National Estuary Program for FY2022–2026, expanded annual funding from \$26.5 to \$50 million, and increased the types of projects that qualify for grants under the program, such as those addressing coastal resiliency, stormwater runoff, and accelerated land loss. The Act was signed into law January 2021. These accomplishments demonstrate the value of working together with Florida’s other Estuary Programs to communicate the environmental, economic, and public health importance of NEPs and estuaries to policymakers.

Project and Partner Coordination

Coordinated, multi-partner projects—such as required for habitat restoration—are key to protecting and restoring Sarasota Bay. Of the

almost 70 projects identified in SBEP’s Habitat Restoration Plan, 35 have been completed and nine are underway (see Watershed Habitats Action

Plan Objective 1). Outreach projects like SBEP’s *Be Seagrass Safe* program also benefit from collaboration among multiple partners (see CE-1).



The Florida Institute for Saltwater Heritage (FISH) Preserve encompasses over 100 acres of environmentally sensitive coastal habitat east of the historic Cortez fishing village in Manatee County. The Preserve provides important fisheries habitat in an area of Sarasota Bay called the Kitchen—so named for its historically rich bounty of seafood. SBEP recently restored nearly half of the preserve through a cooperative funding agreement with FISH and SWFWMD. The restoration removed accumulated refuse on the site and improved wetland acreage, tidal circulation, and natural hydroperiods while replacing invasive exotic vegetation with native species. An additional parcel of the Preserve was completed through a partnership with the Florida Fish and Wildlife Commission, adding new hydrological connections to the adjoining bay. When fully restored, FISH Preserve will be an important piece of the diverse mosaic of habitats necessary to support sustainable fishing activities in the area. Other restoration partners at FISH include the Southeast Aquatic Resources Partnership, Ocean Trust, US Fish and Wildlife Service, Fish America Foundation, Bonefish Grill and Outback Restaurants, Manateens, and private citizens. The USEPA's Climate Ready Estuaries (CRE) Program provides funds to SBEP to support local planning for climate change. The CRE assists NEPs and coastal communities to conduct climate vulnerability assessments, adaptation strategies, education, and



Sea Level Rise Monitoring. (SBEP)

engagement. Using CRE funds, SBEP conducted a vulnerability assessment to determine potential impacts on its ability to protect and restore Sarasota Bay due to climate change (SBEP and Shafer 2017). The Assessment identified 54 threats arising from four climate stressors (sea level rise, changes in precipitation, warming air and water temperatures, and ocean acidification) that present a range of challenges to achieving CCMP goals. The project was guided by the USEPA's *Being Prepared for Climate Change; A Workbook for Developing Risk-Based Adaptation Plans* (USEPA 2014). During development of the Assessment, SBEP coordinated input from its partners, Technical and Citizens Advisory Committees, the Science and Environment Council, non-governmental organizations, and citizens. In all, 74 people contributed to the Assessment.

Over the past five years, SBEP partners have made progress in assessing climate vulnerabilities and planning for climate change.

The City of Sarasota conducted a climate vulnerability assessment and adaptation plan of over 200 city-owned assets in 2017 (City of Sarasota 2017). The assessment considered how sea level rise, storm surge, extreme heat, and extreme precipitation might impact city water supply, stormwater and wastewater management, transportation, public lands, and critical buildings. Eighty assets, including nine public parcels and two public shorelines, were identified as being vulnerable to future climate conditions and high-level strategies were presented to protect them. The City of Sarasota also tracks greenhouse gas emissions community-wide and within city operations, supports transition to renewable energy through the Ready for 100 initiative, participates in the community canopy program that distributes free native trees to city residents and the Partners for Green Places Program that helps local nonprofits become more energy efficient.

The Town of Longboat Key has completed the first phase of a four-phase Comprehensive Adaptation Plan for sea level rise.

Manatee County conducted a sea level rise vulnerability analysis for its public infrastructure, natural environment, and social environment (Manatee County 2019). Results can be viewed by the public on the County's innovative Climate Adaptation Portal, along with tools, data, and case studies.

Sarasota County conducted a sea level rise vulnerability assessment that analyzes vulnerabilities of county assets and provides recommendations for sea level rise planning (Sarasota County 2021). Recommendations included

- developing an administrative directive that formalizes evaluation procedures and establishes an organizational commitment to considering SLR if county projects collaboratively across departments most involved in capital projects and other facility and infrastructure investments
- joining and participating in regional local government and non-profit collaborations to inform county actions as appropriate
- working with county departments to inventory additional data, analyses, and tools
- conducting public education and outreach

Sea level rise is also addressed in the County's Post Disaster Redevelopment Plan, and watershed planning for Sarasota Bay, Little Sarasota Bay, Lemon Bay, and Dona Bay.

Sarasota and Manatee Counties are members of the Tampa Bay Regional Resilience Coalition, where they convene with members from Citrus,



King tide. (SBEP)

Hernando, Hillsborough, Pasco, and Pinellas Counties and 21 Tampa Bay municipalities to discuss complex regional issues associated with climate change, develop strategic regional responses, and build consensus for accomplishing regional goals.

SBEP is a founding partner of the Sarasota-Manatee Climate Council, a network of experts and practitioners working on climate change issues, facilitated by the Science and Environment Council. The Climate Council works collaboratively to advance regional understandings of climate change through science and education and to translate those understandings into planning and projects. SBEP provides leadership and guidance through its work with the Climate Council Education Outreach Working Group and participates in a variety of collaborative education projects.

SBEP has also produced a short video about preparing Sarasota Bay for Sea Level Rise, a brochure featuring information and resources for sea level rise adaptation planning, King Tides Photo Contests, and a climate change tech kit

that provides lesson plans and hands-on activities for teaching students about climate change. SBEP also organized a blue carbon citizen science volunteer event in 2018 in which volunteer participants learned about the benefits of carbon sequestration by natural systems in Manatee County preserves.

Priorities

SBEP will continue to provide exceptional value to its Interlocal Agreement Partners in protecting and restoring Sarasota Bay so that it can continue to provide a wealth of ecosystem services and economic and recreational benefits to the region. SBEP will continue to advance CCMP implementation through coordination with the Florida Estuaries Alliance, multi-partner education and restoration projects, local government comprehensive plans, land development regulations, and ordinances, and by supporting development and implementation of partner climate vulnerability assessments, watershed management plans, and adaptation plans.

Strategy

Activity CE-4.1:

Implement the Finance and Implementation Plan, including continuation of the Interlocal Agreement and participation in the Florida Estuaries Alliance.

Timeframe: Ongoing since 2016; update Finance Plan by 2025

Collaborators: SBEP (Conduct/Lead), USEPA, Town of Longboat Key, City of Bradenton, City of Sarasota, Manatee County, Sarasota County, SWFWMD, FDEP, Coastal and Heartland National Estuary Partnership, Tampa Bay Estuary Program, Indian River Lagoon National Estuary Program, Gulf Coast Community Foundation

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP watersheds

Activity CE-4.2:

Coordinate multi-partner projects supportive of CCMP objectives and partner reporting of CCMP performance metrics.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Conduct/Lead), County and Municipal Governments, SWFWMD, FDEP, NGOs, USEPA, USFWS, NOAA, USACE

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP watersheds

Activity CE-4.3:

Provide regular updates to policymakers and decision makers about priority issues, best available science, and examples of success.

Timeframe: Ongoing since 1995 CCMP

Collaborators: SBEP (Conduct/Lead)

Projected Five-Year Costs and Funding Sources: \$\$/SBEP (320)

Location: SBEP watersheds



SBEP, Sarasota County and UF/IFAS staff.



Sarasota County Beach University. (SBEP)

Activity CE-4.4:

Support and encourage interlocal partners to develop and implement climate vulnerability assessments and adaptation plans. Provide tools and assistance to mitigate and adapt to climate change impacts.

Timeframe: 2022-2025

Collaborators: SBEP (Collaborate), County and Municipal Governments (Leads)

Projected Five-Year Costs and Funding Sources: \$/SBEP (320); \$\$\$/USEPA, NOAA, USACE, Grants, County and Municipal Governments

Location: SBEP watersheds

Activity CE-4.5:

Incorporate CCMP objectives and actions in local government comprehensive plans, land development regulations, or ordinances.

Timeframe: 2022-2025

Collaborators: SBEP (Collaborate), County and Municipal Governments (Leads)

Projected Five-Year Costs and Funding Sources: \$/SBEP (320); \$\$\$/USEPA, NOAA, USACE, Grants, County and Municipal Governments

Location: SBEP watersheds

Benefits

Coordination of partners, projects, and funding for CCMP implementation will leverage resources and create efficiencies to protect and restore SBEP bays, tributaries, and watersheds.

Five-Year Performance Metric Deliverables:

Develop a CCMP performance metric reporting tool for the SBEP website; update Finance Plan by 2025.

APPENDIX A: ACTION PLANS AT A GLANCE

WATER QUALITY AND QUANTITY ACTION PLAN STRATEGY

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WQ-1: Support comprehensive and coordinated surface water and groundwater quality monitoring, assessment, and reporting.	WQ-1.1: Support long-term, coordinated, and timely collection, archiving, analysis, reporting, and quality assurance/quality control of water quality data. Support and enhance timely public communication of water quality monitoring data.	Ongoing since 1995 CCMP	SBEP (Support); County & Municipal Governments (Leads), FDOH, FDEP, FWC, SWFWMD, USGS, USF	\$\$\$ / SBEP (CWA 320); County & Municipal Governments	SBEP waterbodies and watersheds	Long-term, standardized water quality data that is regularly analyzed and publicly accessible supports identification of waterbody improvements or impairments and management actions to improve water quality.	<ul style="list-style-type: none"> • Completion of CCMP Monitoring Strategy • Creation of a water quality status and trends communication piece
	WQ-1.2: Review and evaluate monitoring programs, increase efficiencies, fill water and air quality monitoring gaps, reevaluate estuary circulation models, identify sources of pollution, and update pollutant sources in pollutant load models.	CCMP Monitoring Strategy by 2025	SBEP (Collaborate); Water Quality Consortium, County Governments, Mote Marine Laboratory, FDEP, FDOH, USF, USGS	\$\$\$ / SBEP (CWA 320), County & Municipal Governments, SWFWMD, FDEP			
WQ-2: Develop improvement plans to maintain, attain, or surpass state water quality standards.	WQ-2.1: Revise and implement watershed management plans and prioritized projects. Include hydrologic improvement planning in watershed management plans.	Ongoing since 2014 CCMP; Update Sarasota Bay Watershed Management Plan by 2022	SBEP (Collaborate), County & Municipal Governments (Leads), SWFWMD	\$\$\$ / County & Municipal Governments, SWFWMD	SBEP waterbodies and watersheds SBEP waterbodies and watersheds	Watershed management plans and projects developed from accurate nutrient pollutant loading models and science-based criteria for water quality indicators, targets, and thresholds result in measurable water quality improvements.	<ul style="list-style-type: none"> • Establishment of a Water Quality Consortium • Creation of a report detailing water quality indicators and a pathway to remediation • Creation of a prioritized list of water quality projects
	WQ-2.2: Convene a Sarasota Bay Water Quality Consortium and produce a report detailing water quality indicators and a pathway to remediation	New activity; Convene Water Quality Consortium in 2021; Reasonable Assurance Plan complete by 2026	SBEP (Conduct/Lead), County & Municipal Governments, FDEP, Consortium Stakeholders	\$\$ / SBEP (CWA 320), Sarasota County, Manatee County, Town of Longboat Key, City of Bradenton, FDEP, SWFWMD			

APPENDIX A: ACTION PLANS AT A GLANCE

WATER QUALITY AND QUANTITY ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
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 \$\$\$\$\$ (> 1 M)

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WQQ-3: Improve and manage hydrology for a more natural pattern of timing, quantity, and distribution of surface water flows.	WQQ-3.1: Understand historic, current, and projected hydrologic regimes, accounting for projected climate change and the role of beneficial reuse. Identify and prioritize hydrologic improvement projects.	New activity; Update Sarasota Bay Watershed Management Plan by 2022	SBEP (Collaborate), County & Municipal Governments (Leads), SWFWMD, USGS	\$\$\$ /County & Municipal Governments, SWFWMD	SBEP priority hydrologic alteration areas.	Improving hydrology to a more natural state provides multiple benefits for water quality, recreation, habitat, and flood protection.	<ul style="list-style-type: none"> Completion of an inventory of prioritized projects for hydrologic restoration
	WQQ-3.2: Support floodplain management that benefits resiliency to flooding and climate change, stormwater quality and quantity improvement, nutrient reduction, and flowway and floodplain restoration to mimic natural system function.	Ongoing since 1995 CCMP	SBEP (Coordinate), County & Municipal Governments (Co-Leads), SWFWMD (Co-Lead), FEMA (Co-Lead)	\$\$\$\$ /County & Municipal Governments, SWFWMD			
WQQ-4: Reduce pollutant loading from stormwater.	WQQ-4.1: Support development and adoption of green infrastructure and smart growth standards in comprehensive land-use plans and land development regulations, including stormwater rules and design manuals, to reduce stormwater quantity and pollutant loading.	Ongoing since 1995 CCMP	SBEP (Support), County & Municipal Governments (Leads)	\$/County & Municipal Governments, Sarasota-Manatee Metropolitan Planning Organization (MPO)	SBEP watersheds, Stormwater Utility in Manatee County	Reduced pollutant loading from stormwater improves water quality necessary for human uses and healthy aquatic systems.	<ul style="list-style-type: none"> Creation of an HOA/homeowner BMP manual for residential LID practices.
	WQQ-4.2: Install green infrastructure projects to improve stormwater management for efficient pollution reduction and flood control.	Ongoing since 1995 CCMP	SBEP (Coordinate/ Collaborate), County & Municipal Governments (Leads), SWFWMD, FDEP, FDOT	\$\$\$\$ /SWFWMD, FDEP, County & Municipal Governments, FDOT, MPO			
	WQQ-4.3: Establish the fee schedule for the Manatee County stormwater utility and consider utilizing stormwater utility funding for water quality improvement projects, especially green infrastructure.	Ongoing since 1995 CCMP	SBEP (Support), Manatee County (Lead)	\$/Manatee County			

APPENDIX A: ACTION PLANS AT A GLANCE

WATER QUALITY AND QUANTITY ACTION PLAN STRATEGY

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GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WQ-4: Reduce pollutant loading from stormwater.	WQ-4.4: Evaluate nutrient removal performance and cost-benefits of nutrient removal BMPs. Support development of a homeowner/HOA BMP manual and a model vendor contract supportive of water quality.	New activity; BMP manual development began in 2021	SBEP (Collaborate), UF/IFAS Extension (Lead), Sarasota County, FDEP	\$/SBEP (320); UF/IFAS Extension; USEPA	SBEP watersheds	Reduced pollutant loading from stormwater improves water quality necessary for human uses and healthy aquatic systems.	Creation of an HOA/homeowner BMP manual for residential LID practices.
WQ-5: Reduce pollutant loading from septic and other onsite sewage treatment and disposal systems.	WQ-5.1: Continue conversion of septic systems to centralized sewer systems and consolidation of small wastewater treatment plants, prioritized in coastal areas.	Ongoing since 1995 CCMP	SBEP (Support), County & Municipal Governments (Leads), private utilities	\$\$\$\$/County & Municipal Governments	SBEP priority watersheds and coastal areas	Improving understanding and management of pollutant loading from septic systems and converting parcels from septic to sewer service will reduce pollutant loading from septic systems.	<ul style="list-style-type: none"> Improved inventory of onsite sewage treatment and disposal systems, Creation of a prioritized list of future septic to sewer service conversions.
	WQ-5.2: Encourage regular inspection and maintenance of septic systems and installation of supplemental and advanced septic system technologies, prioritized in coastal areas and basins with impaired waters.	Ongoing since 1995 CCMP	SBEP (Support), FDOH (Co-Lead), FDEP (Co-Lead)	\$/SBEP (320)	SBEP priority watersheds and coastal areas		
	WQ-5.3: Improve inventory and mapping of septic and other on site sewage treatment and disposal systems and increase understanding about septic system capacity to treat nutrient pollution and pathogens under different site conditions, including climate change.	Ongoing since 1995 CCMP; CCMP Monitoring Strategy complete by 2025	SBEP (Collaborate), FDOH (Co-Lead), County & Municipal Governments (Co-Lead)	\$/County & Municipal Governments	SBEP priority watersheds and coastal areas		

APPENDIX A: ACTION PLANS AT A GLANCE

WATER QUALITY AND QUANTITY ACTION PLAN STRATEGY

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GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WQQ-6: Reduce pollutant loading from centralized wastewater collection, treatment and disposal systems, including reuse.	WQQ-6.1: Support advanced wastewater treatment or better throughout SBEP watersheds, considering population growth, climate change, and opportunities for beneficial reuse. Improve public understanding of the value of AWT.	Ongoing since 1995 CCMP; Sarasota County Bee Ridge Water Reclamation Facility will be upgraded to AWT by 2025	SBEP (Support), County & Municipal Governments (Leads)	\$/SBEP (320), \$\$\$\$\$/County & Municipal Governments	SBEP watersheds	Reducing spills and overflows from failing or underperforming centralized wastewater infrastructure and converting WWTPs to advanced treatment will reduce pollutant loading from centralized wastewater collection, treatment, and disposal systems, including reuse.	<ul style="list-style-type: none"> Updated pollutant load model for SBEP bays
	WQQ-6.2: Evaluate and manage impact of reuse storage and distribution on nutrient loading and hydrology, including reuse irrigation in population growth centers and siting of reuse ponds relative to bays and creeks. Develop management plans and BMPS to avoid overflows, releases, and excess nutrient loading.	New activity; development of BMP guides for reuse irrigation began in 2021	SBEP (Collaborate), County & Municipal Governments, UF/IFAS Extension (Lead), FDEP	\$\$\$/County & Municipal Governments, FDEP			
	WQQ-6.3: Encourage proactive inspection, maintenance and FOG avoidance, and replacement of failing or underperforming sanitary sewer infrastructure to prevent inflow and infiltration, overflows, and spills. Support improved quantitative public reporting requirements for accidental and emergency sewage discharges.	Ongoing since 1995 CCMP; local governments plan to invest > \$500 million to construct new or maintain existing sanitary sewer infrastructure 2021-2031.	SBEP (Support), County & Municipal Governments (Leads), FDOH, FDEP	\$/SBEP (320), \$\$\$\$/County & Municipal Governments, FDOH, FDEP			
WQQ-7: Improve understanding of pollutant loading from atmospheric nitrogen deposition.	WQQ-7.1: Evaluate air quality monitoring network and programs to quantify sources, pathways, and contribution of direct and indirect atmospheric deposition to area waters.	New activity; CCMP Monitoring Strategy by 2025	SBEP (Coordinate), County & Municipal Governments, FDOH (Lead), FDEP, EPA	\$/SBEP (320), FDEP	SBEP waterbodies and watersheds	Improving understanding of pollutant loading from atmospheric deposition will improve management of water quality in SBEP watersheds and bays.	<ul style="list-style-type: none"> Literature review of local atmospheric nitrogen deposition; communication piece linking air quality to water quality to encourage emissions reductions

APPENDIX A: ACTION PLANS AT A GLANCE

WATER QUALITY AND QUANTITY ACTION PLAN STRATEGY

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 \$\$\$\$\$ (> 1 M)

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WQQ-7: Improve understanding of pollutant loading from atmospheric nitrogen deposition.	WQQ-7.2: Support initiatives to reduce emissions from vehicles, landscape maintenance equipment, and other mobile sources.	New activity; began communication initiative in 2022	SBEP (Support), County & Municipal Governments, FDEP, UF/IFAS Extension (Lead)	\$/SBEP (320), County & Municipal Governments, FDEP	SBEP waterbodies and watersheds	Improving understanding of pollutant loading from atmospheric deposition will improve management of water quality in SBEP watersheds and bays.	<ul style="list-style-type: none"> Literature review of local atmospheric nitrogen deposition; communication piece linking air quality to water quality to encourage emissions reductions
WQQ-8: Support measures to better understand, monitor, report, respond to, recover from, mitigate, and reduce harmful algal blooms.	WQQ-8.1: Support development of coordinated, standardized tools for monitoring and reporting HABs, evaluating their impact on the environment, economy, and human health, and improving capacity to mitigate, prepare for, respond to, and recover from them.	Ongoing since 2014 CCMP; CCMP Monitoring Strategy by 2025	SBEP (Support), FWC (Co-Lead), FDOH (Co-Lead), FDEP (Co-Lead), Florida Sea Grant, NOAA, Colleges & Universities, County & Municipal Governments, Mote Marine Laboratory, SWFWMD, TBEP, Science and Environment Council	\$\$\$\$/SBEP (320), FWC, FDOH, FDEP, Florida Sea Grant, USF, UF, NOAA, Mote Marine Laboratory, SWFWMD, GCOOS, GOMA, FWC, TBEP	SBEP waterbodies	Improved knowledge about HABs and their impacts on environment, economy, and human health and improved capacity to prepare for, respond to, and recover from them will build public support for water quality improvement and habitat restoration and will increase human and ecosystem resilience to impacts from HABs.	<ul style="list-style-type: none"> Improved coordination on HAB monitoring, reporting, and response; Improved HAB communication tools.
	WQQ-8.2: Support research and monitoring to better understand the taxonomic composition, toxicity, severity, extent, and duration of HABs, and the role nutrient sources and climate change play in bloom initiation, growth, maintenance, and termination.	Ongoing since 2014 CCMP; CCMP Monitoring Strategy by 2025	SBEP (Support), FWC (Co-Lead), Florida Sea Grant (Co-Lead), USF, Colleges & Universities, County & Municipal Governments, Mote Marine Laboratory, NOAA, GCOOS, FDEP	\$\$\$\$/SBEP (320), FWC, NOAA, FDEP, Florida Sea Grant, Colleges & Universities, Mote Marine Laboratory, SWFWMD, USACE			

SBEP Actions	SBEP Engagement	SBEP (320) Funds
Support	Encourage actions that support CCMP implementation.	Staff time only
Coordinate	Convene partnering entities, ensure open communication, and maximize efficiencies.	Yes, for some meetings
Collaborate	Invest funding and staff time as a partner, but not as the lead agency.	Yes
Conduct	Invest funding and staff time as the lead agency.	Yes

APPENDIX A: ACTION PLANS AT A GLANCE

WATERSHED ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

GOAL: Restore shoreline, wetland, and bay.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WH-1: Update and implement the SBEP Five-Year Habitat Restoration Plan	WH-1.1 Update the five-year Habitat Restoration Plan with consideration of local watershed management plan priority projects and resiliency strategies. Coordinate, track, and report progress metrics for habitat restoration.	Ongoing since 2004; Complete update by 2024	SBEP (Conduct/Lead), SWFWMD (except beach and dune projects), FDEP, FWC, FDOT, Audubon, County and Municipal governments	\$/SBEP (CWA 320)	SBEP watersheds	A science-based approach to identifying and prioritizing restoration projects effectively and efficiently guides program resources to maximize habitat protection and restoration.	<ul style="list-style-type: none"> Updated Habitat Restoration Plan
WH-2: Protect, enhance, and restore uplands and freshwater wetlands	WH-2.1 Encourage and support the permanent conservation of natural lands through acquisition and conservation easements, including freshwater wetlands and flowways, corridors, and uplands adjacent to coastal habitats necessary for habitat resiliency and migration.	Ongoing since 2014 CCMP	SBEP (support), FWC, SWFWMD (Co-Lead), FDEP (Co-Lead), FDACS, County & Municipal Governments, NOAA, Conservation Foundation of the Gulf Coast (Co-Lead)	\$\$\$\$/County and Municipal Governments, Conservation Foundation of the Gulf Coast, Landowners, SWFWMD, USDA-NRCS	SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts	Healthy and interconnected, upland and freshwater wetland habitats support the natural processes necessary for a healthy bay.	<ul style="list-style-type: none"> Increased acreage of conserved, restored, or managed habitat
	WH-2.2 Restore and manage natural lands through prescribed fire, eradication of invasive exotic plants and animals, hydrologic improvement, and reestablishment of threatened and endangered plants.	Ongoing since 1995 CCMP	SBEP (Support/Co-Lead), FWC (Co-Lead), SWFWMD (Co-Lead), FDEP (Co-Lead), FDACS, County & Municipal Governments (Co-Lead), NOAA, Audubon Florida (Co-Lead), US EPA	\$\$\$\$/SBEP (CWA 320), County and Municipal Governments, SWFWMD, FWC, FDEP, NOAA, USDA-NRCS, USFWS, US EPA Bipartisan Infrastructure Law (BIL) funding			
WH-3: Improve tributary habitats with a special emphasis on fisheries	WH-3.1 Create and implement a strategy for restoring habitat in tributaries to: <ul style="list-style-type: none"> characterize, delineate, and quantify tributary shoreline and habitat features supportive of fisheries; prioritize habitat restoration projects that increase critical juvenile 	Ongoing since 1995 CCMP	SBEP (collaborate/Co-Lead), Mote Marine Laboratory (Co-Lead), County & Municipal Governments (Co-Lead), SWFWMD, FWC (Co-Lead), FDEP	\$\$\$\$/SBEP (CWA 320), FDEP, County & Municipal Governments, SWFWMD, FWC, NFWF, Colleges and Universities, NOAA, U.S. EPA Bipartisan Infrastructure Law (BIL) funding	SBEP tributaries	Improvements to the habitat quality and connectivity of tributaries support water quality and fish populations, while providing flood control and increasing property values.	<ul style="list-style-type: none"> Increased acreage and linear feet of improved shorelines and tributary habitats

APPENDIX A: ACTION PLANS AT A GLANCE

WATERSHED ACTION PLAN STRATEGY

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 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

GOAL: Restore shoreline, wetland, and bay.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WH-4: Protect, enhance, and restore coastal wetlands and improve shoreline resiliency	WH-4.1 Continue coastal wetland restoration and protection projects prioritized by the Habitat Restoration Plan.	Ongoing since 1995 CCMP	SBEP (conduct/ Co-Lead), SWFWMD (Co-Lead), FDEP, FWC, USACE, County and Municipal Governments (Co-Lead)	\$\$\$\$/SBEP (CWA 320), County and Municipal Governments, Landowners, SWFWMD, FWC, FDEP, NOAA, Florida Sea Grant, USACE, WCIND, NFWF, NOAA, U.S. EPA Bipartisan Infrastructure Law (BIL) funding	SBEP watersheds with a focus on areas recommended in the HRP, including environmental justice areas, underserved communities, and areas specifically vulnerable to climate change impacts	Expanded use of softened shorelines in bay and tidal tributary locations improves wildlife habitat, water quality, and resilience to storms and sea level rise. Expanded ecosystem services and non-habitat related benefits.	<ul style="list-style-type: none"> Increased acreage and linear feet of created or restored coastal habitat 10 workshops or consultations with government, waterfront property owners, or marine contractor representatives
	WH-4.2 Continue spoil island restoration and protection. Support establishment of protected managed areas for bay islands.	Ongoing since 1995 CCMP	SBEP (Conduct/ Co-Lead), County and Municipal Governments (Co-Lead), FWC, USACE, Audubon Florida (Co-Lead), FDEP	\$\$\$\$/SBEP (CWA 320), FWC, USACE, WCIND, NFWF, NOAA, FDEP, RESTORE, U.S. EPA Bipartisan Infrastructure Law (BIL) funding			
	WH-4.3 Implement shoreline resiliency strategies to: <ul style="list-style-type: none"> conserve adjacent uplands; encourage installation of living shorelines through education, incentives, technical and permitting assistance, workshops, and trainings; and support consistent policies across jurisdictions regarding rolling easements, coastal construction setbacks, and shoreline alterations that encourage or do not prohibit living shorelines, especially for resiliency and post-disaster planning. 	Ongoing since 2014 CCMP	SBEP (Conduct), Co-Leads: FWC, NOAA, Florida Sea Grant, USACE, County & Municipal Governments, FDEP	\$\$\$\$/SBEP (CWA 320), County and Municipal Governments, Landowners, NOAA, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding			
WH-5: Protect, enhance, and restore seagrass and other benthic habitats	WH-5.1 Monitor artificial and oyster reef habitat quality, explore optimal placement of new reefs, and establish/enhance oyster and artificial reefs in Sarasota Bay.	Ongoing since 1995 CCMP	SBEP (Conduct/ Co-Lead), County Governments (Co-leads), FWC (Co-Lead), FDEP, Florida Sea Grant, Mote Marine Laboratory, USACE)	\$\$\$/SBEP (CWA 320), SWFWMD, County Governments, FWC, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding	SBEP bays	Mapping, monitoring, and enhancing hard bottom and seagrass habitats supports fish and shellfish populations and improves water quality.	<ul style="list-style-type: none"> Reporting of acres of extant seagrass and hard-bottom habitats Net area of hard-bottom habitat created or restored

APPENDIX A: ACTION PLANS AT A GLANCE

WATERSHED ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
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 \$\$\$\$\$ (> 1 M)

GOAL: Restore shoreline, wetland, and bay.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
WH-5: Protect, enhance, and restore seagrass and other benthic habitats	WH-5.2 Participate in inventories of benthic and living hard-bottom habitat in Sarasota Bay and nearshore Gulf water and passes.	New activity; Begin coordination in 2022	SBEP (collaborate), USGS, Florida Coastal Mapping Program (Lead)	\$\$/SBEP (CWA 320), FIO, USF, SWFWMD, U.S. EPA Bipartisan Infrastructure Law (BIL) funding	SBEP bays	Mapping, monitoring, and enhancing hard bottom and seagrass habitats supports fish and shellfish populations and improves water quality.	<ul style="list-style-type: none"> • Reporting of acres of extant seagrass and hard-bottom habitats • Net area of hard-bottom habitat created or restored
	WH-5.3: Reevaluate seagrass indicators and targets in bay segments. Implement water quality improvement strategies to increase seagrass habitat.	Ongoing since 1995 CCMP; target re-evaluation began in 2021; implementation will be ongoing (see Water Quality and Quantity Action Plan)	SBEP (Conduct/Co-Lead), Co-Leads: County & Municipal Governments, FDEP, SWFWMD	\$\$/SBEP (CWA 320), County & Municipal Governments, SWFWMD, FDEP, U.S. EPA Bipartisan Infrastructure Law (BIL) funding			
	WH-5.4: Continue seagrass mapping and monitoring and expand seagrass monitoring transects to Manatee County.	Ongoing since 1988; biennial	SBEP (support), SWFWMD (lead), County Governments	\$\$\$ /SWFWMD, County Governments			
WH-6: Protect, enhance, and restore beaches and dunes for wildlife and resiliency	WH-6.1: Restore coastal dunes and encourage protection of beach wrack communities.	New activity	SBEP (collaborate), County & Municipal Governments (Leads), Audubon, FWC, Mote Marine Laboratory, USACE, DEP, Audubon	\$\$/SBEP (CWA 320), FWC, WCIND, USACE	SBEP beaches	Better understanding of impacts of dredge and fill activities on beach and dune habitat improves comprehensive planning and protection of sensitive fish, birds, turtles, and invertebrates.	<ul style="list-style-type: none"> • Increased acreage of restored dunes • Technical report on impacts of dredge and fill activities on beach and bay habitats
	WH-6.2: Curate scientific knowledge of habitat impacts of sand replenishment and movement.	New activity; Begin in 2023	SBEP (conduct); Mote Marine Laboratory, Florida Audubon, FWC, FDEP, NOAA	\$\$/SBEP (CWA 320)	SBEP beaches		
	WH-6.3: Explore the role of SBEP in regional sediment management planning and monitoring, including coordination with USACE.	New activity; Begin in 2023	SBEP (conduct/Lead), County & Municipal Governments, USACE, FDEP	\$/SBEP (CWA 320)	SBEP beaches		

SBEP Actions	SBEP Engagement	SBEP (320) Funds
Support	Encourage actions that support CCMP implementation.	Staff time only
Coordinate	Convene partnering entities, ensure open communication, and maximize efficiencies.	Yes, for some meetings
Collaborate	Invest funding and staff time as a partner, but not as the lead agency.	Yes
Conduct	Invest funding and staff time as the lead agency.	Yes

APPENDIX A: ACTION PLANS AT A GLANCE

FISH AND WILDLIFE ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
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 \$\$\$\$\$ (> 1 M)

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
FW-1: Protect, restore, and enhance the diversity and abundance of native fish.	FW-1.1: Continue fish population monitoring programs to support fisheries management, monitor invasive species, and understand habitat usage through all life stages. Explore opportunities to expand monitoring programs to include a greater diversity of species, tidal creeks and canals, and use of innovative monitoring technologies.	Ongoing since 1995 CCMP	SBEP (Collaborate), FWC (Co-Lead), CZS-SDRP (Co-Lead), NCF (Co-Lead), SCAN, Florida Sea Grant, NOAA, Mote	\$\$\$ / SBEP (320), FWC, County & Municipal Governments, NOAA	SBEP bays and tributaries	Native fish are critical components of the ecological integrity of SBEP bays and tributaries.	Continued bimonthly fish population monitoring in priority SBEP estuary segments
	FW-1.2: Support research to fill fisheries data gaps, including habitat connectivity between tidal tributaries, bays, and the Gulf of Mexico; migration barriers; HAB response and recovery; and projected climate change impacts.	Ongoing since 1995 CCMP	SBEP (Collaborate), Co-Leads: Mote, FWC, NCF, Florida Sea Grant, NOAA	\$\$\$ / SBEP (320), Grants	SBEP bays and watersheds		
	FW-1.3: Explore capacity and potential effectiveness of protected managed areas, enhanced fishery management actions, and stock enhancement to protect and restore fish diversity, abundance, and resilience.	Ongoing since 1995 CCMP	SBEP (Support), FDEP, FWC, Mote	\$\$\$ / Grants	SBEP bays and tributaries		
	FW-1.4: Promote ethical angling practices that increase conservation and prevent marine debris.	Ongoing since 1995 CCMP	SBEP (Collaborate), FWC (Co-Lead), CZS-SDRP (Co-Lead), NCF (Co-Lead), SCAN, Florida Sea Grant, NOAA, Mote	\$\$\$ / SBEP (320), FWC, County & Municipal Governments, NOAA	SBEP bays and tributaries		

APPENDIX A: ACTION PLANS AT A GLANCE

FISH AND WILDLIFE ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

GOAL: Improve water quality and the timing, quantity, and distribution of freshwater flow to the estuary.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
FW-2: Protect, restore, and enhance the diversity and abundance of native shellfish.	FW-2.1: Monitor native bivalve populations and protect, restore, and enhance their habitats.	Ongoing since 1995 CCMP	(Conduct/Co-Lead), County Governments (Co-Leads), Sarasota Bay Watch (Co-Lead), Mote (Co-Lead), FWC	\$\$\$/SBEP (320), County Governments, FWC, Sarasota Bay Watch, Mote, RESTORE	SBEP bays and tributaries	Native fish are critical components of the ecological integrity of SBEP bays and tributaries.	10 acres of oyster reef created or enhanced
	FW-2.2: Support research to understand native shellfish recruitment, habitat needs, and vulnerabilities to climate change impacts.	New activity, conduct 2022-2026 as opportunities arise.	SBEP (Coordinate), Florida Sea Grant, Gulf Shellfish Institute, Mote, FWC	\$\$/SBEP (320), Grants, FWC	SBEP bays and watersheds		
	FW-2.3: Support research to understand the benefits of native bivalve stock enhancement for improvements to water quality, habitat, and native populations.	New activity, conduct 2022-2026 as opportunities arise.	SBEP (Coordinate), Florida Sea Grant (Co-Lead), Gulf Shellfish Institute (Co-Lead), FWC, County Governments	\$\$/SBEP (320), Grants, FWC	SBEP bays and tributaries		
FW-3: Monitor and protect threatened, endangered, and vulnerable wildlife.	FW-3.1 Support monitoring of threatened, endangered, and vulnerable wildlife.	New activity	SBEP (Support); Co-Leads: CZS-SDRP, Mote, Audubon, NCF, FWC, NOAA, Turtle Watches, Florida Sea Grant	\$\$\$/CZS-SDRP, Mote, Audubon, FWC, NOAA, Florida Sea Grant	SBEP bays and tributaries	Healthy native wildlife populations are critical components of the ecological integrity of SBEP bays, tributaries, and watersheds.	Continued monitoring of threatened, endangered, and vulnerable wildlife
	FW-3.2 Support protection of threatened, endangered, and vulnerable wildlife, including outreach and education to minimize.	Ongoing since 1995 CCMP	SBEP (Collaborate); Co-Leads: CZS-SDRP, Mote, Audubon, NCF, FWC, NOAA, Turtle Watches, USFWS, FDEP, Save Our Seabirds	\$\$\$\$/SBEP (320), Mote, Audubon, FWC, NOAA, USFWS, FDEP	SBEP bays and tributaries		

SBEP Actions	SBEP Engagement	SBEP (320) Funds
Support	Encourage actions that support CCMP implementation.	Staff time only
Coordinate	Convene partnering entities, ensure open communication, and maximize efficiencies.	Yes, for some meetings
Collaborate	Invest funding and staff time as a partner, but not as the lead agency.	Yes
Conduct	Invest funding and staff time as the lead agency.	Yes

APPENDIX A: ACTION PLANS AT A GLANCE

COMMUNITY ENGAGEMENT ACTION PLAN STRATEGY

GOAL: Engage, educate, and encourage environmental stewardship of Sarasota Bay and increase community connections to the estuary through low impact recreational use and enjoyment.

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
CE-1: Reduce recreational use impacts on Sarasota Bay and improve access for communities disconnected from waterways.	CE-1.1 Promote and support community-driven public land acquisitions and improvements, including new and expanded hiking and paddle trails, launch points, and bay views that enhance recreational access for communities disconnected from waterways, including environmental justice and other underserved communities.	Ongoing since 1995 CCMP	SBEP (Support), Co-Leads: County & Municipal Governments, Bay Park Conservancy, Conservation Foundation of the Gulf Coast	\$/SBEP; \$\$\$\$\$/acquisitions	SBEP bays and tributaries	Reducing recreational use impacts helps ensure the sustainability of bay resources. Enhancing managed recreational access for communities disconnected from waterways helps grow watershed awareness and community-wide support for a healthy bay.	<ul style="list-style-type: none"> Offer at least 15 guided kayak tours, coastal walks, and other recreational opportunities annually with a focus on engaging communities that are traditionally underrepresented in bay user groups, including environmental justice and other underserved communities.
	CE-1.2 Educate recreational users about best practices to avoid impacts to bay waters, wildlife, and habitats, including pollution prevention, safe boating, ethical angling, and sustainable tourism.	Ongoing since 2014 CCMP	Co-Leads: SBEP (Conduct), FWC, FDEP, SWFWMD, Sarasota Bay Watch, Chicago Zoological Society's Sarasota Dolphin Research Program, Audubon Florida, Save Our Seabirds, Mote Marine Laboratory, Around the Bend Nature Tours, Wayne Adventures, Science and Environment Council	\$\$/SBEP (320)			
	CE-1.3 Support responsive and adaptive management of bay access points and recreational trails to avert impacts from overuse.	Ongoing since 1995 CCMP; Conduct workshop by 2025	SBEP (Support/Co-Lead), FWC (Co-Lead), SWFWMD (Co-Lead), FDEP (Co-Lead), FDACS, County & Municipal Governments (Co-Lead), NOAA, Audubon Florida (Co-Lead), US EPA	\$\$\$\$\$/SBEP (CWA320), County and Municipal Governments, SWFWMD, FWC, FDEP, NOAA, USDA-NRCS, USFWS, US EPA Bipartisan Infrastructure Law (BIL) funding			
CE-2: Improve public understanding and action on bay-related issues and expand reach to priority audiences.	CE-2.1 Inform and engage the public about priority environmental issues and the multiple benefits of watershed and estuary and restoration, including climate change adaptation.	Ongoing since 1995 CCMP	Co-Leads: SBEP (Conduct), County and Municipal Governments, UF/IFAS Extension, Science and Environment Council, Bay Partner Grantees.	\$\$/SBEP (320)	SBEP bays and tributaries	CCMP implementation can be improved by increasing the capacity of non-profit, community, and business partners to educate and engage the public about bay issues and solutions.	Fund at least \$25,000 in Bay Partners Grants to community organizations annually.

APPENDIX A: ACTION PLANS AT A GLANCE

COMMUNITY ENGAGEMENT ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
 \$\$ (25-99 K)
 \$\$\$ (100-500 K)
 \$\$\$\$ (500 K - 1 M)
 \$\$\$\$\$ (> 1 M)

GOAL: Engage, educate, and encourage environmental stewardship of Sarasota Bay and increase community connections to the estuary through low impact recreational use and enjoyment.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
CE-2: Improve public understanding and action on bay-related issues and expand reach to priority audiences.	CE-2.2: Support volunteer restoration and citizen science activities that contribute to assessment, monitoring, and restoration of bay and gulf waters, shorelines, wetlands, and other habitats.	Ongoing since 1995 CCMP	Co-Leads: SBEP (Conduct), County & Municipal Governments, New College of Florida, Florida Sea Grant, UF/IFAS Extension, Florida Audubon, GCORR, FWC, Sarasota Bay Watch, Mote Marine Laboratory, Longboat Key Turtle Watch, Anna Maria Island Turtle Watch	\$\$/SBEP (320)	SBEP bays and tributaries	CCMP implementation can be improved by increasing the capacity of non-profit, community, and business partners to educate and engage the public about bay issues and solutions.	Fund at least \$25,000 in Bay Partners Grants to community organizations annually.
	CE-2.3: Assist and empower citizens to adopt sustainable bay-friendly lifestyles and to lead community initiatives that reduce pollution, conserve water and energy, and promote community health.	Ongoing since 1995 CCMP	Co-Leads: SBEP (Conduct), County & Municipal Governments, New College of Florida, Florida Sea Grant, UF/IFAS Extension, Florida Audubon, GCORR, FWC, Sarasota Bay Watch, Mote Marine Laboratory, Longboat Key Turtle Watch, Anna Maria Island Turtle Watch	\$\$/SBEP (320)	SBEP bays and tributaries		
CE-3: Coordinate and support community initiatives that advance CCMP implementation.	CE-3.1: Support capacity of non-profit, community, and business partners to educate and engage the public in outreach and stewardship that furthers CCMP implementation through professional development opportunities, workshops, and grants.	Ongoing since 1995 CCMP	Co-Leads: SBEP (Conduct), County and Municipal Governments,	\$\$/SBEP (320)	SBEP bays and tributaries	CCMP implementation can be improved by increasing the capacity of non-profit, community, and business partners to educate and engage the public about bay issues and solutions.	Fund at least \$25,000 in Bay Partners Grants to community organizations annually
	CE-3.2: Connect the value of natural resource protection with preservation of cultural heritage and traditional use of Sarasota Bay through partnerships with cultural heritage organizations.	New activity; coordinate 2022-2026 as opportunities arise	SBEP (Coordinate), Co-Leads: Florida Institute for Saltwater Heritage (FISH), Marie Selby Botanical Gardens' Historic Spanish Point, New College of Florida Public Archaeology Lab, Florida Public Archaeology Network (FPAN)	\$\$/SBEP (320)	SBEP bays and tributaries		

APPENDIX A: ACTION PLANS AT A GLANCE

COMMUNITY ENGAGEMENT ACTION PLAN STRATEGY

KEY TO COSTS: \$ (< 25 K)
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 \$\$\$\$\$ (> 1 M)

GOAL: Engage, educate, and encourage environmental stewardship of Sarasota Bay and increase community connections to the estuary through low impact recreational use and enjoyment.

Objectives	Activities	Timeframe	Collaborators	Projected 5-Year Costs	Location	Benefits	5-Year Performance
CE-4: Ensure coordination of interlocal partners for CCMP implementation.	CE-4.1 Implement the Finance and Implementation Plan, including continuation of the Interlocal Agreement and participation in the Florida Estuaries Alliance.	Ongoing since 2016; update Finance Plan by 2025	SBEP (Conduct/Lead), USEPA, Town of Longboat Key, City of Bradenton, City of Sarasota, Manatee County, Sarasota County, SWFWMD, FDEP, Coastal and Heartland National Estuary Partnership, Tampa Bay Estuary Program, Indian River Lagoon National Estuary Program, Gulf Coast Community Foundation	\$/SBEP (320)	SBEP watersheds	Coordination of partners, projects, and funding for CCMP implementation will leverage resources and create efficiencies to protect and restore SBEP bays, tributaries, and watersheds.	Develop a CCMP performance metric reporting tool for the SBEP website; update Finance Plan by 2025.
	CE-4.2 Coordinate multi-partner projects supportive of CCMP objectives and partner reporting of CCMP performance metrics.	Ongoing since 1995 CCMP	SBEP (Conduct/Lead), County and Municipal Governments, SWFWMD, FDEP, NGOs, USEPA, USFWS, NOAA, USACE	\$/SBEP (320)	SBEP watersheds		
	CE-4.3 Provide regular updates to policymakers and decisionmakers about priority issues, best available science, and examples of success.	Ongoing since 1995 CCMP	SBEP (Conduct/Lead)	\$/SBEP (320)	SBEP watersheds		
	CE-4.4 Support and encourage interlocal partners to develop and implement climate vulnerability assessments and adaptation plans. Provide tools and assistance to mitigate and adapt to climate change impacts.	2022-2025	SBEP (Collaborate), County and Municipal Governments (Leads)	\$/SBEP (320); \$\$\$/USEPA, NOAA, USACE, Grants, County and Municipal Governments	SBEP watersheds		
	CE-4.5 Incorporate CCMP objectives and activities in local government comprehensive plans, land development regulations, or ordinances.	2022-2025	SBEP (Collaborate), County and Municipal Governments (Leads)	\$/SBEP (320); \$\$\$/USEPA, NOAA, USACE, Grants, County and Municipal Governments	SBEP watersheds		

SBEP Actions	SBEP Engagement	SBEP (320) Funds
Support	Encourage actions that support CCMP implementation.	Staff time only
Coordinate	Convene partnering entities, ensure open communication, and maximize efficiencies.	Yes, for some meetings
Collaborate	Invest funding and staff time as a partner, but not as the lead agency.	Yes
Conduct	Invest funding and staff time as the lead agency.	Yes

**APPENDIX B:
CROSSWALK OF 2014 CCMP OBJECTIVES
AND ACTIVITIES TO 2021 CCMP**

KEY: Ongoing - continuing activity that is largely unchanged or only slightly modified
Revised - continuing activity that is modified, reorganized, or reconceived
Completed - the objective or activity has been accomplished
Retired - the activity is no longer a program priority or the activity is no longer feasible

2014 ACTION	2014 ACTION SUMMARY	STATUS	2021 OBJECTIVE
WW - WASTEWATER TREATMENT & RECLAMATION			
WW-1.1	Local governments in the Sarasota Bay region should require by ordinance, and appropriate monitoring and enforcement, the wastewater treatment policies outlined in the CCMP.	Revised	WQQ-6
WW-1.2	Educate the public about the need for consistent policies on wastewater treatment and reclamation.	Revised	WQQ-6
WW-2.0	Continue to use excess capacity of the City of Sarasota wastewater treatment facility to provide sewer service to areas with inefficient septic systems and package treatments plants to maximize collection and treatment of wastewater.	Completed	
WW-3.1	Complete septic tank replacement and wastewater treatment plant consolidation in northern Sarasota County.	Revised	WQQ-5, WQQ-6
WW-3.2	Remaining privately owned utilities should upgrade to meet the Wastewater Treatment and Reclamation policies in this Action Plan.	Revised	WQQ-6
WW-4.1	Reconsider a regional program to reclaim treated wastewater.	Completed	
WW-4.2	Explore options for alternative supply, including the use of treated wastewater or potable water, aquifer recharge and protection, and other uses in the Southern Water Use Caution Areas.	Ongoing	WQQ-6
WW-5.1	Set resource-based water quality targets providing a framework for the establishment of site-specific alternative criteria.	Completed	
WW-5.2	Develop and participate in the preparation of Basin Management Action Plans for "impaired" waters or to meet established water quality targets.	Revised	WQQ-2
SW - STORMWATER TREATMENT & PREVENTION			
SW-1.1	Implement Florida Friendly Landscaping, which emphasizes reduction in use of pesticides and water and encourages broader use of slow-release nitrogen fertilizers.	Ongoing	CE-2, CE-3
SW-1.2	Sediment control: encourage onsite sediment management in the FFL.	Revised	CE-2, CE-3
SW-1.3	Develop and support pollution prevention programs.	Ongoing	WQQ-2, WQQ-4, CE-2, CE-3
SW-2.1	Develop and implement a revised watershed management master plan for the Sarasota Bay region, with priority on the following tributaries: Phillippi Creek, Bowlees Creek, Cedar Hammock Creek, Hudson Bayou and Whitaker Bayou.	Ongoing	WQQ-2
SW-2.2	Implement a stormwater utility with appropriate rate structure and related public education in Manatee County.	Ongoing	WQQ-4
SW-2.3	Focus watershed master plans on reducing toxins, sediment, and nitrogen loads to the Bay while also controlling flooding.	Ongoing	WQQ-2
WE - Freshwater & Saltwater Wetlands			
WE-1.1	Update the five-year Habitat Protection and Restoration Plan and develop a database for tracking progress in habitat restoration	Ongoing	WH-1
WE-1.2	Enhance, restore, and create wetlands throughout the Bay region.	Ongoing	WH-2, WH-4
WE-1.3	Maintain wetland protection in local comprehensive plans, ordinances, and land development regulations. Incorporate wetlands and open space concept in road, bridge, stormwater, wastewater, and other infrastructure projects.	Ongoing	CE-4
WE-1.4	Recognize the importance of adjacent upland areas as buffers in restoring, creating, or protecting wetlands.	Ongoing	WH-4
WE-1.5	Encourage and facilitate wetland protection through public ownership or private conservation easements.	Ongoing	WH-2, WH-4
WE-1.6	Remove exotic noxious plants.	Ongoing	WH-2
WE-1.7	Coordinate wetlands activities with the SBEP, citizen organizations, and existing citizen advisory committees of local governments.	Ongoing	CE-2, CE-3

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2014 ACTION	2014 ACTION SUMMARY	STATUS	2021 OBJECTIVE
WE - Freshwater & Saltwater Wetlands			
WE-1.8	Develop and implement policies that are consistent across jurisdictions regarding shoreline alterations such as docks, seawall, or other shoreline protection alternatives.	Revised	WH-4
WE-1.9	Provide cooperative consultations (as requested) to the private and public sectors on development proposals and regulatory issues that impact wetlands.	Retired	CE-2
WE-1.10	Continue to provide technical information to programs to increase public education and citizen involvement in wetlands issues.	Ongoing	CE-3
WE-1.11	Encourage that fines for environmental violations at the regional and local level (from either permitted or unpermitted activities) be directed to environmental enhancement projects within the watershed.	Retired	
WE-2.1	Support an ongoing education program on mangrove protection and care.	Ongoing	WH-4, CE-3
WE-2.2	Encourage citizen groups to restore and protect wetlands through removal of trash and exotic plants	Ongoing	CE-2, CE-3
WE-2.3	Coordinate wetlands activities with the SBEP, citizen organizations, and existing citizen advisory committees of local governments.	Ongoing	CE-2, CE-3
WE-2.4	Continue to promote neighborhood wetlands protection and homeowner shoreline management through the Florida Friendly Landscaping Program.	Ongoing	CE-2
FL - FISHERIES & OTHER LIVING RESOURCES			
FL-1.1	Identify salinity zones within the tributaries	Ongoing	WQQ-3, WH-3
FL-1.2	Prioritize restoration projects within tributaries as to their potential for increasing critical juvenile habitat (restoring the balance).	Ongoing	WQQ-3, WH-3
FL-1.3	Characterize, delineate, and quantify shoreline features (habitats) within the tributaries.	Ongoing	WH-3
FL-1.4	Develop methods/measures to quantify improvements to juvenile fisheries.	Ongoing	FW-1
FL-2.1	Educate the public on the need for improved fishery habitats	Ongoing	CE-1
FL-2.2	Restore, enhance, and protect the value of freshwater and saltwater wetlands as fishery habitats.	Ongoing	FW-1
FL-2.3	Improve Sarasota Bay tributaries to restore the value of juvenile fisheries habitats.	Ongoing	FW-1
FL-2.4	Install seawall habitat modules along seawalls where appropriate.	Revised	WH-4
FL-2.4.1	Encourage private-sector manufacturing and marketing of the most effective designs for these modules.	Revised	WH-4
FL-2.4.2	Encourage homeowners to volunteer their seawalls and shoreline for projects. Encourage their participation through education, incentives, and permitting assistance.	Revised	WH-4, CE-2
FL-2.4.3	Develop measures to demonstrate restoration effectiveness to increase acceptability by permitting agencies.	Revised	WH-4
FL-2.4.4	Sponsor a workshop to review research, share ideas, develop criteria, and discuss permitting issues.	Revised	WH-4, CE-2
FL-2.5	Explore opportunities for living shorelines throughout the Sarasota Bay area.	Ongoing	WH-4
FL-2.5.1	Sponsor community workshops on living shorelines.	Revised	WH-4, CE-2
FL-3.1	Establish a conservation area near Sister Keys with limited access or activity.	Revised	FW-1
FL-3.2	Promote catch-and-release and other angling practices to increase conservation.	Ongoing	FW-1, CE-1

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2014 ACTION	2014 ACTION SUMMARY	STATUS	2021 OBJECTIVE
FL-FISHERIES & OTHER LIVING RESOURCES			
FL-3.3	Seek designation of Sarasota Bay as a test area for enhanced fisheries management measurement measures combined with careful monitoring. Establish a baseline for relative fish abundance and diversity within Sarasota Bay.	Revised	FW-1
FL-4.1	Reduce levels of contaminants in tributaries and restore natural stream flows to creeks and streams to restore and enhance shellfish populations and their habitats.	Ongoing	FW-2
FL-4.2	Establish oyster reefs in appropriate locations in Sarasota Bay.	Ongoing	FW-2, CE-2
FL-4.3	Support the reestablishment of bay scallops with appropriate monitoring. Continue bay scallop seeding where water quality has improved.	Ongoing	FW-2, CE-3
FL-5.1	Improve channel marking on the Intracoastal Waterway and connector channels to protect seagrasses from scarring by boat propellers.	Ongoing	WH-5, CE-1
FL-6.1	Establish or exceed seagrass targets and meet water quality targets for the maintenance of seagrass acreage in designated areas.	Ongoing	WH-5
FL-6.2	Implement water quality improvement strategies to increase productive seagrass habitat.	Ongoing	WH-5
FL-6.3	Using appropriate techniques, restore seagrass habitat in selected areas of disturbed excavated Bay bottom by using dredge material as applicable, to elevate the bottom to within six feet of mean sea level, pending outcome of demonstration project.	Revised	WH-5
FL-6.4	Enforce boat speed limits in Sarasota Bay watershed to reduce turbidity.	Revised	WH-5C CE-1
FL-6.5	Repair seagrass scarring where appropriate.	Revised	WH-5
FL-8.1	Reexamine the artificial reef master plan every five years.	Revised	WH-5
FL-8.2	Document reef habitat quality.	Revised	WH-5
FL-8.3	Establish targets for artificial reefs.	Revised	WH-5
RU-RECREATIONAL USE			
RU-1.1	Promote enforcement for boat speeds and no-wake zones in Sarasota Bay.	Revised	CE-1
RU-2.1	Promote channel marking to protect threatened marine areas such as seagrasses	Ongoing	CE-1
RU-2.2	Promote posting markers to discourage boats from approaching bird rookeries.	Ongoing	FW-3, CE-1
RU-2.3	Discourage deliberate feeding of seabirds and marine mammals through education and signage.	Ongoing	FW-3, CE-1
RU-2.4	Support fishing catch-and-release activities.	Ongoing	FW-1, CE-1
RU-2.5	Promote disposal of fishing line and other marine debris in appropriate containers.	Ongoing	FW-1, CE-1
RU-2.6	Promote enhanced enforcement of all boating, fishing, and other waterborne rules and laws.	Revised	CE-1
RU-2.7	Encourage marinas and other waterfront businesses to follow safe, non-polluting practices.	Ongoing	CE-3
RU-2.8	Encourage and support coastal cleanup initiatives.	Ongoing	CE-1, CE-2, CE-3
RU-3.1	Facilitate neighborhood-initiated improvements for visual access to the Bay through the Florida Friendly Landscaping Program.	Revised	CE-2
RU-3.2	Enhance recreational use of publicly owned Bayfront land.	Ongoing	CE-1

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2014 ACTION	2014 ACTION SUMMARY	STATUS	2021 OBJECTIVE
RU-RECREATIONAL USE			
RU-3.3	Acquire undeveloped Bay shoreline for public recreation, Bayfront parks, or low-impact preserves.	Ongoing	CE-1
RU-3.4	Identify Bay vista points in local comprehensive plans and consider them in landscaping, roadbuilding, and other construction.	Retired	
RU-3.5	Fully implement and expand the Sarasota Heritage Trail and Blueways System.	Revised	CE-1
RU-4.1	Work with appropriate organizations to increase enrollment in boater education programs to promote better protection of Bay resources.	Ongoing	CE-3
RU-4.2	Develop an educational program for target audiences, including youths, tourists, and visitors, to improve awareness and sensitivity about the Bay.	Revised	1&2
RU-5.1	Continue to develop and market a system of integrated recreational opportunities.	Revised	CE-1
RU-5.2	Promote litter prevention throughout the Sarasota Bay region.	Ongoing	CE-1, CE-2, CE-3
GO - Governance to Oversee Implementation			
GO-1.1	Implement the CCMP utilizing the Interlocal Agreement and appropriate committee structure and staff.	Ongoing	CE-4
GO-1.2	Conduct an independent strategic assessment of program performance at intervals not to exceed three years subsequent to approval by Florida's governor and the US EPA administrator.	Retired	
GO-2.1	Support Clean Water Act reauthorization for continuing appropriation for CCMP implementation.	Ongoing	CE-4
GO-2.2	Maintain the designation of Sarasota Bay (in 1995) as a State of Florida Surface Water Improvement and Management program priority water body.	Ongoing	CE-4
GO-2.3	Continue and expand grant writing to benefit Sarasota Bay and fund specific projects in the CCMP.	Ongoing	CE-4
GO-2.4	The SBEP encourages an independent foundation to further support the goals of the CCMP.	Completed	CE-4
GO-2.5	Implement the Southwest Florida Regional Ecosystem Restoration Plan.	Revised	CE-4
GO-3.0	Expand environmental education programs, with an emphasis on boaters	Ongoing	CE-1, CE-2, CE-3
GO-4.0	Implement Land Use and Environmental Permitting policy.	Revised	CE-4, WQQ-4
CP - Citizens Participation			
CP-1.1	Promote the Florida Yards and Neighborhood Program.	Ongoing	CE-2
CP-1.2	Promote Climate Friendly Landscaping guidelines.	Ongoing	CE-2
CP-1.3	Encourage gardens and native plants.	Ongoing	CE-2
CP-2.1	Promote the use of Low Impact Development principles in development and redevelopment.	Ongoing	WQQ-4
CP-2.2	Promote and educate the community on the benefits of best management practices for roofs.	Revised	CE-2
CP-2.3	Promote smart growth principles for coastal and waterfront communities.	Revised	WQQ-4
CP-3.1	Encourage use of rainwater collection systems for reuse, including rain barrels and cisterns.	Ongoing	CE-2
CP-3.2	Educate households and businesses regarding smart water use choices, including pervious surfaces, outdoor water use, and energy-efficient appliances.	Ongoing	CE-2

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2014 ACTION	2014 ACTION SUMMARY	STATUS	2021 OBJECTIVE
RU-RECREATIONAL USE			
CP-3.3	Participate in, and actively promote, area conferences and public events which highlight water conservation, energy efficiency, and watershed health.	Ongoing	CE-2, CE-3
CP-4.1	Identify the economic impact that natural capital has on the local economy.	Completed	
CP-4.2	Promote natural capitalism as a strategy for economic development.	Completed	
CP-4.3	Promote ecotourism to create local jobs while protecting important environmental values.	Revised	CE-2
CP-5.1	Encourage citizen engagement in environmental monitoring.	Ongoing	CE-2
CP-5.2	Assess and measure behavioral changes that indicate positive impact on Sarasota Bay and its tributaries.	Ongoing	CE-1, CE-2
CP-6.1	Complete an estuary-wide vulnerability assessment that will serve as a framework for future land acquisition, research, and monitoring efforts.	Ongoing	CE-4
CP-6.2	Identify critical areas to be addressed related to adaptation for the Sarasota Bay area.	Ongoing	CE-4
CP-6.3	Develop local tools to address climate change, such as best management practices for habitat restoration design, that will be resilient and achieve success in the face of a changing climate.	Ongoing	CE-4, WH-1
CP-6.4	Encourage communities to mitigate and adapt to the effects of climate change.	Ongoing	CE-2, CE-4

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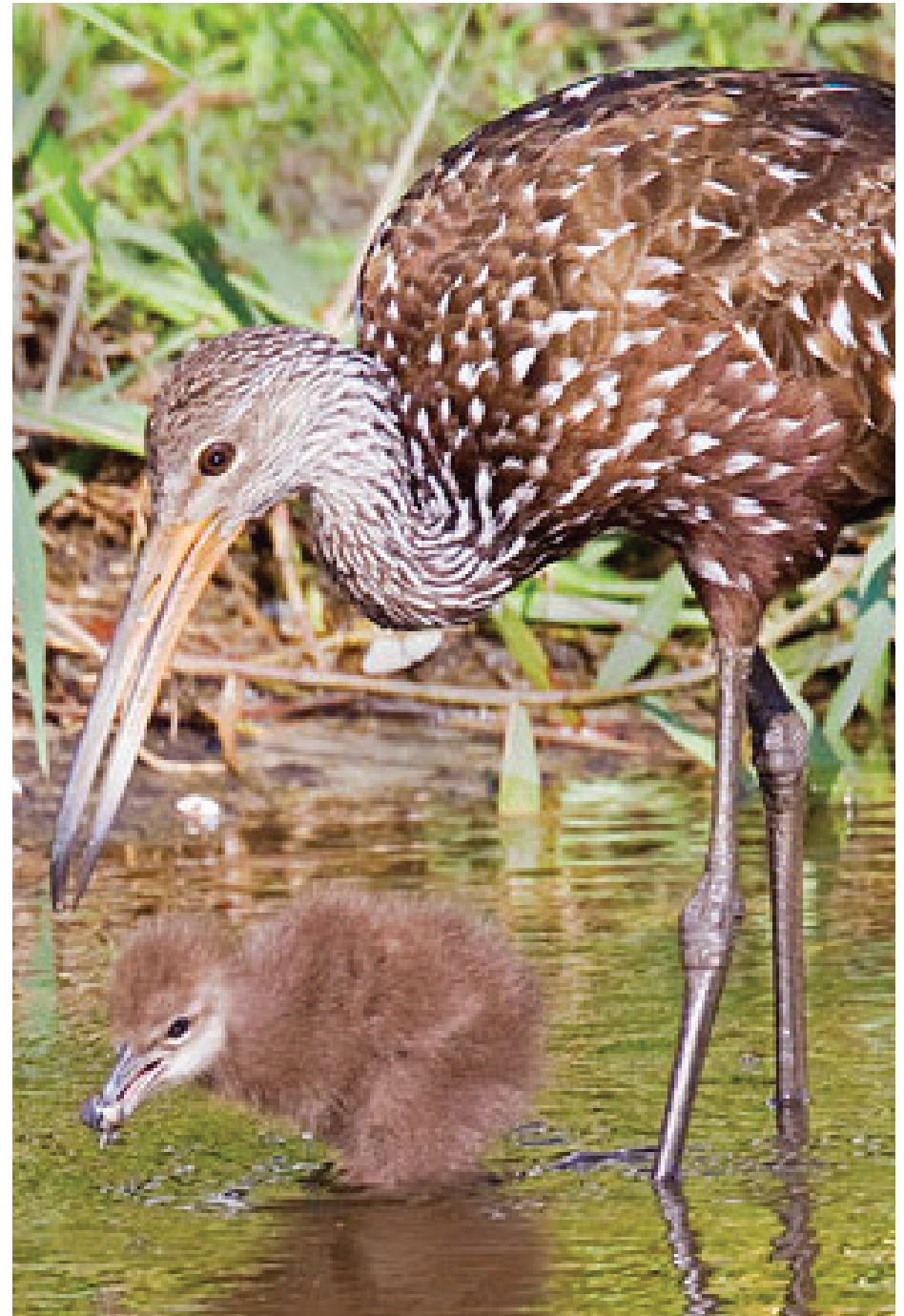
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Acronyms

ASR	Aquifer Storage and Recovery
AWT	Advanced Wastewater Treatment
BMAP	Basin Management Action Plan
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CCMP	Comprehensive Conservation and Management Plan
CE	Community Engagement Action Plan
CRE	Climate Ready Estuaries
CWA	Clean Water Act
CWA	Critical Wildlife Area
CZS-SDRP	Chicago Zoological Society's Sarasota Dolphin Research Program
DO	Dissolved oxygen
ELAP	Environmental Land Acquisition Program
FCMaP	Florida Coastal Mapping Program
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FIM	Fisheries Independent Monitoring
FISH	Florida Institute for Saltwater Heritage
FLWMI	Florida Water Management Inventory
FPAN	Florida Public Archaeology Network
FW	Fish and Wildlife Action Plan
FWC	Florida Fish and Wildlife Conservation Commission
GCOOS	Gulf of Mexico Coastal Ocean Observing System
GCORR	Gulf Coast Oyster Recycling and Renewal
HAB	Harmful Algal Bloom

HABSOS	Harmful Algal Bloom Observing System
HOA	Homeowner Association
HRP	Habitat Restoration Plan
INBS	Index Nesting Beach Survey
LID	Low Impact Development or Low Impact Design
MPA	Marine Protected Area
MPO	Metropolitan Planning Organization
MRRP	Monofilament Recovery and Recycling Program
MS4	Municipal Separate Storm Sewer System
NCF	New College of Florida
NEP	National Estuary Program
NEPORT	National Estuary Program On-line Reporting Tool
NGO	Non-governmental organization
NMFS	National Marine Fishery Service
NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPP	Neighborhood Parklands Acquisition Program
OIMMP	Oyster Integrated Mapping and Monitoring Program
OSTDS	Onsite Sewage Treatment and Disposal Systems
PALS	Passive Acoustic Listening Stations
PAR	Photosynthetically Active Radiation
PIER	Protection, Involvement, Education, and Restoration
RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
SBEP	Sarasota Bay Estuary Program
SCAN	Sarasota Coast Acoustic Network
SGCN	Species of Greatest Conservation Need

SNBS	Statewide Nesting Beach Survey
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management Plan
SWRWRP	Southwest Regional Water Reclamation Facility
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UF	University of Florida
UF IFAS	University of Florida Institute of Food and Agricultural Sciences
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USF	University of South Florida
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
WH	Watershed Habitats Action Plan
WIN	Watershed Information Network
WQQ	Water Quality and Quantity Action Plan
WWTP	Wastewater Treatment Plant



Glossy ibis. (Lou Newman)

Acknowledgments

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Isaac Brownman, *Town of Longboat Key*
Justin Bloom, *CAC*
Vivianna Bendixson, *Southwest Florida Water Management District*
Greg Blanchard, *TAC*

SBEP Technical Advisory Committee

The Technical Advisory Committee (TAC) provides technical peer review and input to SBEP for various projects and programs. TAC members include local and regional environmental managers and researchers who are familiar with the Sarasota Bay estuarine system. The TAC initiates technical studies, assists SBEP with restoration and management plans, and reviews projects recommended by the Citizens Advisory Committee (CAC) and other groups.

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SBEP Citizen Advisory Committee

The Citizen Advisory Committee (CAC) provides community input to SBEP and assists the Program in sharing information with the public. The CAC also develops action plans to support SBEP programs and projects in an effort to influence public policies that impact our Bay and its resources.

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Marion Kuster	

SBEP Staff

Dr. David Tomasko, *Executive Director*
Dr. Jay Leverone, *Program Scientist*
Heather Moody, *Finance and Grants Manager*
Megan Barry, *Public Outreach Manager*
Cheryl Dexter, *Executive Assistant*
Christine Quigley, *Public Outreach Assistant*
Don Conn, *Program Attorney*

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