Sarasota Bay

Surface Water Improvement and Management (SWIM) Plan

September 2025 Draft

Southwest Florida Water Management District
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Surface Water Improvement and Management SWIM

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Executive Summary

In 1987, the Florida Legislature created the *Surface Water Improvement and Management (SWIM) Act* to protect, restore, and maintain Florida's most threatened surface water bodies. Under this Act, the state's five water management districts identified a list of priority waterbodies within their authority and implemented SWIM Plans to improve and/or protect them. Each plan is designed to preserve or improve a waterbody's overall ecological health by outlining specific management actions, initiatives, and projects within the purview of the SWIM Program. Currently, the Program comprises 12 SWIM Priority Waterbodies including Sarasota Bay. Sarasota Bay has an open water area of approximately 50 square miles and a contributing watershed of approximately 150 square miles. The watershed is split between Manatee County and Sarasota County and encompasses the City of Sarasota, as well as the island communities of Anna Maria, Holmes Beach, Bradenton Beach, and Longboat Key.

Numerous inlets allow for the exchange of Gulf waters across the estuaries that make up Sarasota Bay, including Anna Maria Sound, Longboat Pass, New Pass, Big Pass, Venice Inlet, and the recently reopened Midnight Pass due to Hurricane Milton in 2024.

Much progress has been made to restore Sarasota Bay in the years since its designation as an "Estuary of National Significance" by the US Environmental Protection Agency in 1989. With the formation of the Sarasota Bay Estuary Program (SBEP) in that year, much attention was focused on developing and implementing a series of projects aimed at restoring and protecting the natural resources of Sarasota Bay.

This SWIM Plan Update serves as the guidance document to coordinate efforts of the District's SWIM Program with those of the various local, regional, state, and federal agencies, as well as private partners, to restore and protect Sarasota Bay.

This Sarasota Bay SWIM Plan Update draws heavily on the SBEP *2022 Comprehensive Conservation and Management Plan* (CCMP). The CCMP synthesizes decades of scientific research into the Bay's most pressing problems and reflects broad-based input from citizens, stakeholders, and communities with a common interest in a healthy Bay as the cornerstone of a prosperous economy. In fact, an economic valuation study completed in 2014 concluded that Sarasota Bay contributes $11.8 billion in value to the local economy (SBEP, 2022; Hindsley and Morgan, 2014).

Since the last SWIM Plan update, Sarasota Bay has seen declines and recovery in estuarine health. Today, the estuaries that make up the Sarasota Bay SWIM Priority Waterbody are healthy to the extent that in 2024, the Florida Department of Environmental Protection removed Sarasota Bay from its impaired waters list for nutrients. Also in 2024, significant gains in seagrass coverage, a primary indicator of estuarine health, were reported by the District's Seagrass Mapping Program. Given the estuary's overall health, this SWIM Plan Update takes a "hold the line" approach for managing Sarasota Bay, an approach consistent with SBEP.

Holding the line, however, does not mean doing nothing. Careful attention is needed to ensure that the progress made over the past decade is not lost due to land use changes, sea-level rise, climate change, and other impacts. To hold the line, this SWIM Plan Update includes the following overarching water quality and natural systems goals.

Water Quality
Hold the line or reduce nitrogen loads by working with partners to minimize potential load increases from new development while implementing initiatives and projects to reduce existing loads.
Support monitoring and research to better understand estuarine response to nutrient loads, harmful algal blooms, hurricanes, and other drivers in Sarasota Bay estuaries.
Work with partners to estimate annual nutrient loads and identify ways to improve loading models to more accurately reflect actual loads.
Seek opportunities for water quality improvement projects to reduce nutrient loads and increase ecosystem resiliency across the waterbody.
Natural Systems Protection and Restoration
Administer the District's Seagrass Mapping Program in Sarasota Bay and continue working with partners to improve accessibility and utility of mapped results.
Evaluate the quality and functionality of past SWIM Program restoration projects.
Seek opportunities for habitat restoration projects that increase ecosystem resiliency across the waterbody.
Work with partners to develop and implement sustainability plans to ensure the continued health of the Sarasota Bay estuaries.

To achieve the above goals, this SWIM Plan Update identifies management actions that if implemented would help achieve these goals.

Water Quality management actions include:

Monitoring and Research
Support the SBEP Water Quality Protection Plan and prioritize monitoring and research that best align with the SWIM Program mission.
Support measures to better understand, monitor, report, respond to, recover from, mitigate, and reduce harmful algal blooms.
Better understand nutrient sources and sinks.
Investigate the potential linkages between red tide, the occurrence of macroalgal blooms, and the loss and recovery of seagrass habitat.
Support actions to estimate watershed nutrient loads based on dissolved inorganic nitrogen (DIN).
Water Quality Protection and Restoration
Support the SBEP Water Quality Protection Plan and prioritize projects that best align with the SWIM Program mission.
Work with local, regional, and state agencies to implement stormwater best management practices (BMPs) aimed at reducing pollutant loading, enhancing water quality, and improving water clarity.
Support the development of local government stormwater master plans and watershed management plans.

Education and Outreach
Continue to support Florida-friendly landscaping principles.
Continue to support stakeholders in conserving water and protecting water quality through outreach and implementation of BMPs.

Natural Systems management actions include:

Monitoring and Research
Complete biennial surveys of seagrass habitat through the District's seagrass mapping program.
Evaluate new and cost-effective technologies to improve the District's seagrass mapping program.
Complete site assessments on completed SWIM Program restoration projects consistent with methodologies implemented in other SWIM Priority Waterbodies.
Understand the impacts of hurricanes, sea-level change, and climate on the sustainability and resilience of the Sarasota Bay estuaries.
Continue to support Sarasota Bay's *Eyes on Seagrass Initiative*.
Natural Systems Conservation and Protection
Continue to support acquisition of priority lands for natural systems restoration and water quality improvement projects in the Sarasota Bay Watershed.
Natural Systems Restoration
Continue working with partners to identify natural systems restoration and enhancement efforts.
Support the assessment of restoration opportunities to incorporate natural systems and water quality improvements in redeveloped landscapes.
Support programs and projects in the SBEP 2022 CCMP.
Explore opportunities for urban stream restoration and/or enhancement, including drainage ditches to multi-stage channels.

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Introduction

The SWIM Act and SWIM Priority Waterbodies

In recognition of the need to place additional emphasis on the restoration, protection, and management of the surface water resources of Florida, the Florida Legislature, through the Surface Water Improvement and Management (SWIM) Act of 1987, directed the state's water management districts to "design and implement plans and programs for the improvement and management of surface water" (Section 373.451, Florida Statutes [FS]). The SWIM legislation requires the water management districts to protect the ecological, aesthetic, recreational, and economic value of the state's surface waterbodies, keeping in mind that water quality degradation is frequently caused by point and non-point source pollution and that degraded water quality can cause direct and indirect losses of natural systems.

The Act directs water management districts to identify priority waterbodies for inclusion in the SWIM Program based on regional significance and need for protection and/or restoration. A SWIM plan is required for each identified waterbody which must be approved by the District Governing Board and reviewed by the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FFWCC or FWC), the Florida Department of Agriculture and Consumer Services (FDACS), and local governments.

As of 1995, due to Sarasota Bay's recreational and ecological significance, it was designated an Outstanding Florida Water (OFW) by FDEP. Additionally, in 1995 the Southwest Florida Water Management District (District) listed Sarasota Bay as a SWIM Priority Waterbody. Since then, the District has partnered with state and local governments to identify issues and management actions to protect and restore Sarasota Bay, beginning with the first Sarasota Bay SWIM Plan (1997). The 1997 Sarasota Bay SWIM Plan was focused on projects designed to meet the Sarasota Bay Estuary Program's *1995 Comprehensive Conservation and Management Plan* (SWFWMD, 1997). The SWIM plan was updated in 2002, and the process and partnerships for this update to the SWIM plan are essentially the same as the previous plan. The purpose of this Sarasota Bay SWIM Plan is to set forth a course of action by identifying the quantity, scope, and required effort of projects appropriate for the system while considering the levels of funding.

Sarasota Bay Estuary Program

Sarasota Bay was identified as an estuary of national significance by the U.S. Congress 1989. The District was the initial local program sponsor and played a major role in shaping the restoration plan. After approval of the Comprehensive Conservation and Management Plan (CCMP) in 1995, Sarasota Bay was added to the District's SWIM Priority List. Today, the District is a funding partner to SBEP with membership on the SBEP Policy and Management Boards. SWIM scientists and engineers also represent the District at the SBEP Technical Advisory Committee.

The SBEP 2022 Comprehensive Conservation and Management Plan (CCMP) synthesizes decades of scientific research into the bay's most pressing problems and reflects broad-based input from citizens, stakeholders, and communities with a common interest in maintaining a healthy Bay as the cornerstone of a prosperous economy. The SBEP CCMP was last updated in 2022 and serves as a community blueprint for action. The Sarasota Bay SWIM Plan does not duplicate the SBEP CCMP; rather, it uses the CCMP as a reference to identify those elements that align with SWIM Program's core missions of water quality and natural systems.

SWIM Plan Geographic Setting

The Sarasota Bay estuary is located on the Gulf Coast of west-central Florida. Morphologically, the system is characterized as a subtropical coastal lagoon (SBEP, 2022). The estuary is bounded to the west by several dynamic barrier islands, interspersed with passages to the Gulf. The mainland watershed of Manatee and Sarasota Counties bounds the bay to the east. Anna Maria Sound is to the north marking the transition to Tampa Bay. Venice Inlet marks the southern boundary, demarcating Sarasota Bay from the contiguous Dona and Roberts Bays, and Lemon Bay. The total area encompasses 52 square miles and will be hereafter referred to as "Sarasota Bay".

The boundary of the Sarasota Bay watershed in this SWIM plan aligns with the boundary identified by the Sarasota Bay Estuary Program's (SBEP) Comprehensive Conservation Management Plan (CCMP). The open water area is comprised of one large bay segment (referred to as Sarasota Bay Proper) and several other smaller bay segments which are listed below from north to south (Figure 1):

- Palma Sola Bay
- Sarasota Bay Proper
- Roberts Bay
- Little Sarasota Bay
- Blackburn Bay

Each bay segment differs in size, depth, habitat, sediment characterization, circulation, freshwater influence, and pollutant levels. Recognizing the variability in bay conditions and watershed profiles between the segments, District seagrass monitoring and SBEP estuary health scorecards assess each segment independently and develop targeted management actions.

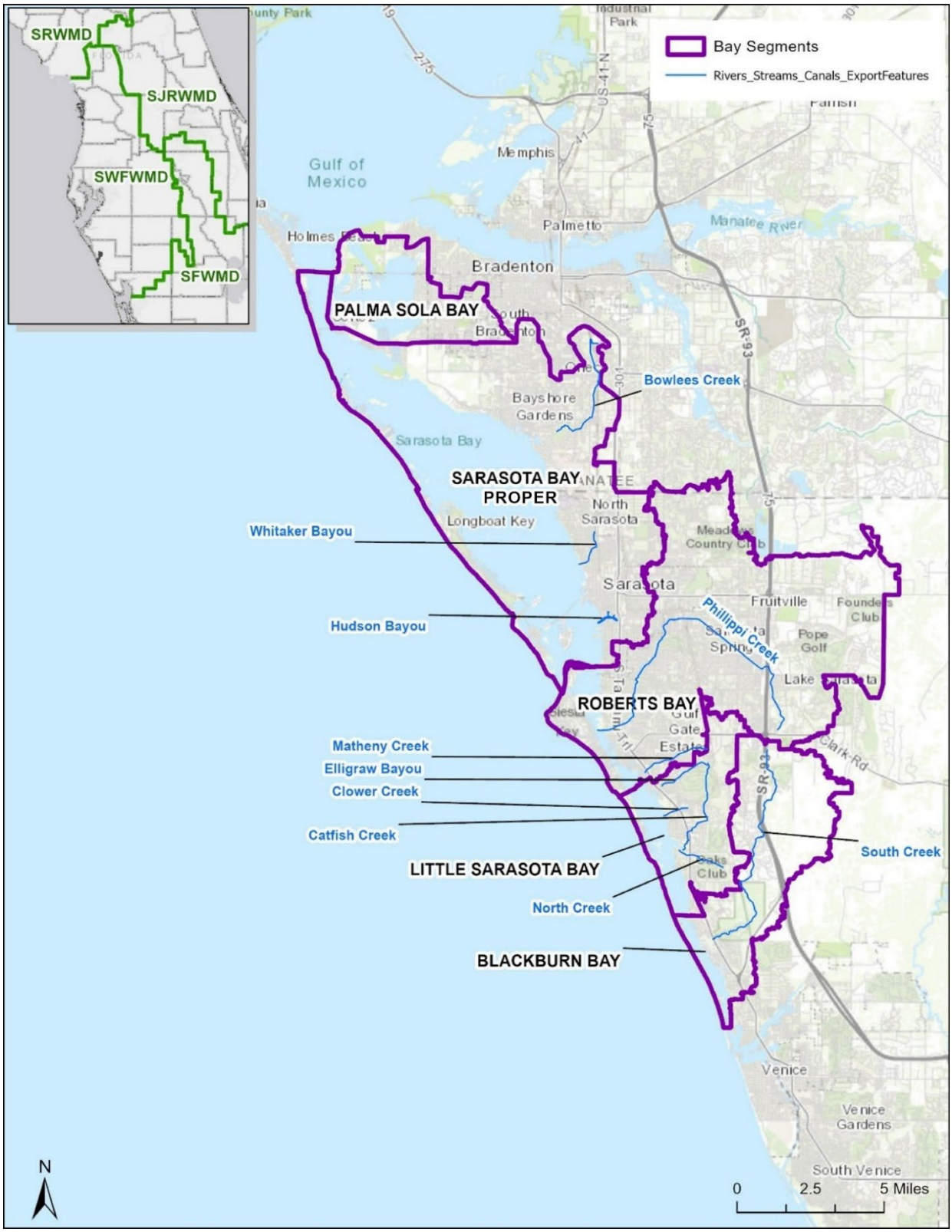
The contributing land area to Sarasota Bay is approximately 150 square miles split between Manatee and Sarasota Counties, including the communities of City of Sarasota, Anna Maria Island, Holmes Beach, Bradenton Beach, and Longboat Key. Several tributaries flow into the bay, the largest being Phillippi Creek, which drains approximately 57 square miles. Other major tributaries include Bowlees Creek, Whitaker Bayou, Hudson Bayou, Matheny Creek, Elligraw Bayou, Clower Creek, Catfish Creek, North Creek, and South Creek.

Maximum watershed elevations are over 44 feet North American Vertical Datum of 1988 (NAVD88) in the east region of the Phillippi Creek Watershed. The Sarasota Bay Watershed is highly urbanized with much of the development in the watershed occurring west of Interstate 75 (I-75).

Sarasota Bay's climate is subtropical with hot, humid summers and mild, drier winters. Average temperatures vary between 52° and 90° Fahrenheit. The area experiences an average of 53 inches of rainfall per year, with the wettest period between June and September. During this wet period, rainfall often comes from daily storms or tropical weather systems (tropical storms and hurricanes) delivering intense rainfall over short durations. Surface water runoff from rainfall flows across relatively flat terrain into ditches, storm drains, creeks, and wetlands and eventually into the Bay segments.

The Sarasota Bay Watershed lies within an area designated by the District as the Southern Water Use Caution Area (SWUCA). The SWUCA was established in 1992 to address declines in aquifer levels due primarily to groundwater withdrawals. The District adopted the SWUCA Recovery Strategy in 2006.

Part of this strategy is to adopt minimum flows and levels (MFLs) on SWUCA waterbodies. An MFL is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of a given stream or lake. The District's SWUCA and MFL programs are not direct elements of the SWIM Program and therefore are beyond the scope of this plan.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 1 – Sarasota Bay Segments and Basin Boundaries

Sarasota Bay has been the site of human activities for centuries and is known for its bounty of wild fruits, fish, and wildlife. But it was not until the latter part of the 19th Century that the richness of Sarasota Bay was discovered, and the first significant developments were constructed (SARASOTA HISTORY – History & Preservation Coalition of Sarasota County). For example, during the 1870s, a resort hotel in Osprey was one of the first business ventures (SBEP, 1992). From 1895 to 1903, the first large-scale channel alteration activities took place in Sarasota Bay, as the enlarged and/or created channels at Palma Sola Pass, at Long Bar, and in the area between Little Sarasota Bay and Venice (SBEP, 1992). During 1910 and 1911, the Sarasota City Commission mandated the sea walling of the City waterfront, and the citizens of the City of Sarasota voted for a combination water and sewage treatment system (SBEP, 1992). Ten years later, Sarasota County was officially formed by partitioning Manatee County into two counties.

Population growth in the watershed has been dramatic, especially in the post-World War II years. During this period of rapid growth, natural tidal creeks and inlets were dredged and extended, and wetlands were filled to accommodate agriculture, businesses, and residences. Examples of these activities include the conversion of Bird Key into a finger-fill canal community and in the 1960s, the dredging of the Intracoastal Waterway. Sarasota County and partner agencies have since taken steps to improve water quality through various activities including restoring natural systems (habitat), upgrading wastewater treatment facilities (WWTFs), converting septic tanks to sewer, and upgrading or constructing stormwater treatment infrastructure. Although many management actions support improved water quality and natural systems, this plan focuses only on those actions within the District's SWIM Program's area of responsibility.

The following describes each segment of the entire Sarasota Bay watershed moving from north to south.

Palma Sola Bay

Palma Sola Bay is in Manatee County just west of the City of Bradenton. The waterbody is approximately 5.1 square miles, and the total watershed area is approximately 15.3 square miles. The Bay is a shallow body of saltwater situated between Anna Maria Island and the mainland. It is bounded to the north by the unincorporated area of Palma Sola and to the south by Cortez Road. Cortez is a community on the southwest side of the Bay known for their commercial fishing. On the north side of the Bay is Manatee County's Robinson Preserve. The Bay drains into Anna Maria Sound and is characterized by relatively stable seagrass coverage, which provides habitat to many animals including manatees, dolphins, wading birds, fish, and turtles (Figure 2).

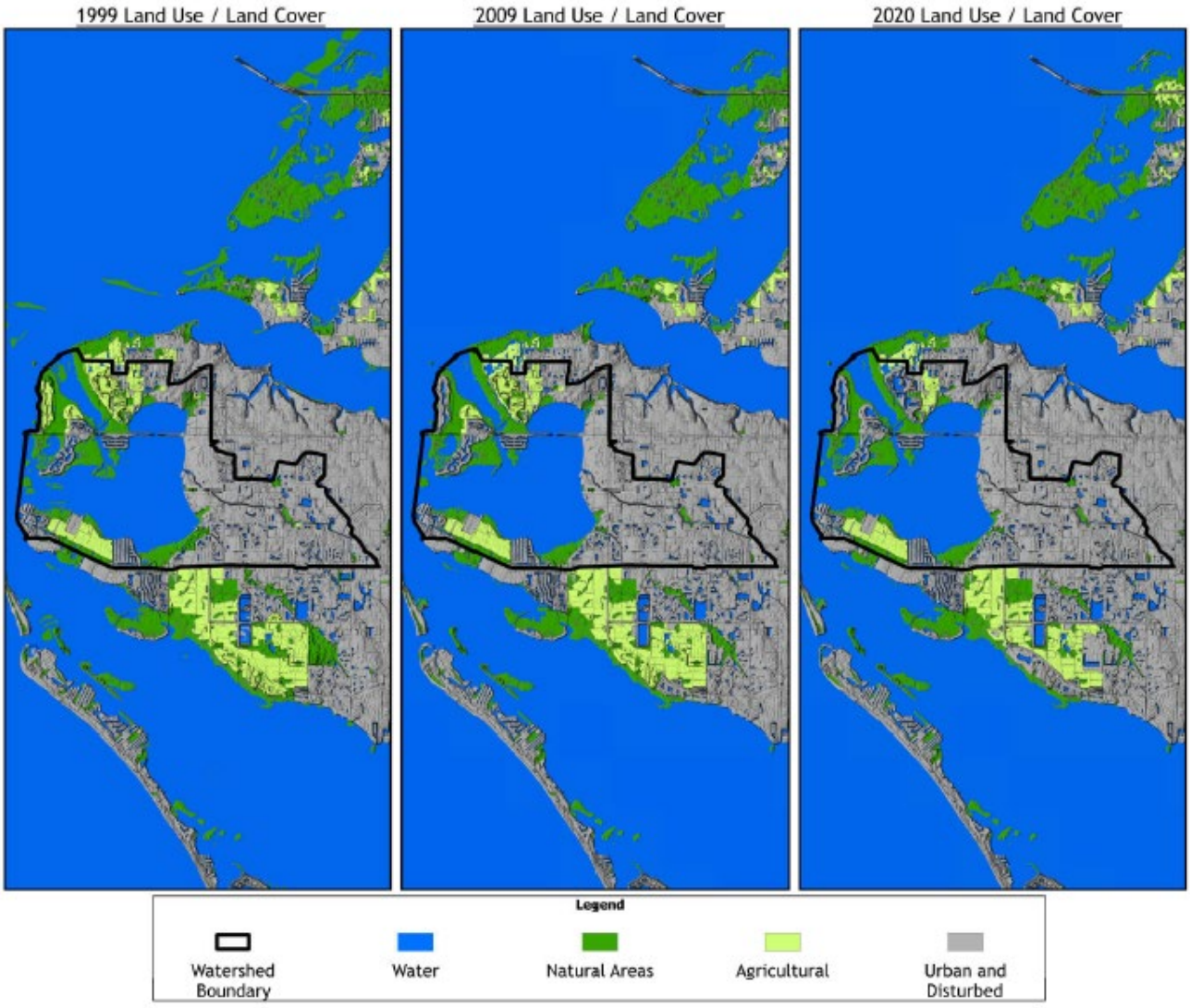
A major tributary that drains into Palma Sola Bay is appropriately named the Palma Sola Drain. This system captures runoff from the highly urbanized City of Bradenton. In addition to Palma Sola Drain, Palma Sola Creek enters the Bay from the southeast, capturing runoff from unincorporated Manatee County and the City of Bradenton.

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 2 – Basin Boundary of the Palma Sola Bay Watershed

Palma Sola Bay Land Use/Land Cover

Palma Sola Bay is a predominantly developed watershed, with almost half of the watershed designated as urban and disturbed. Land use designations include residential, commercial, industrial, institutional, and open lands such as recreational areas, parks, and other urban features. Residential land uses make up approximately 36 percent of the watershed. The next higher use aside from the Bay are mangrove swamps, making up approximately 9 percent of the watershed. Land use changes have slowed since 1999, with the major shift being a 4-percent increase in urbanization accompanied by slight decreases to the agricultural lands and natural areas. Figure 3 and Table 1 describe the land use changes that have occurred over time in the Palma Sola Bay Watershed.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 3 – Palma Sola Bay Watershed Land Use in 1999, 2009, and 2020

Table 1 – Land Use Change by Acres and Percent for Palma Sola Bay Watershed

	1999		2009		2020	
Use	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban and Disturbed	4,279	43.7%	4,507	46.0%	4,713	48.1%
Agricultural	771	7.9%	640	6.5%	359	3.7%
Natural Areas	1,398	14.3%	1,161	11.8%	1,148	11.7%
Water	3,353	34.2%	3,494	35.6%	3,581	36.5%
Totals	9,801	100.0%	9,801	100.0%	9,801	100.0%

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

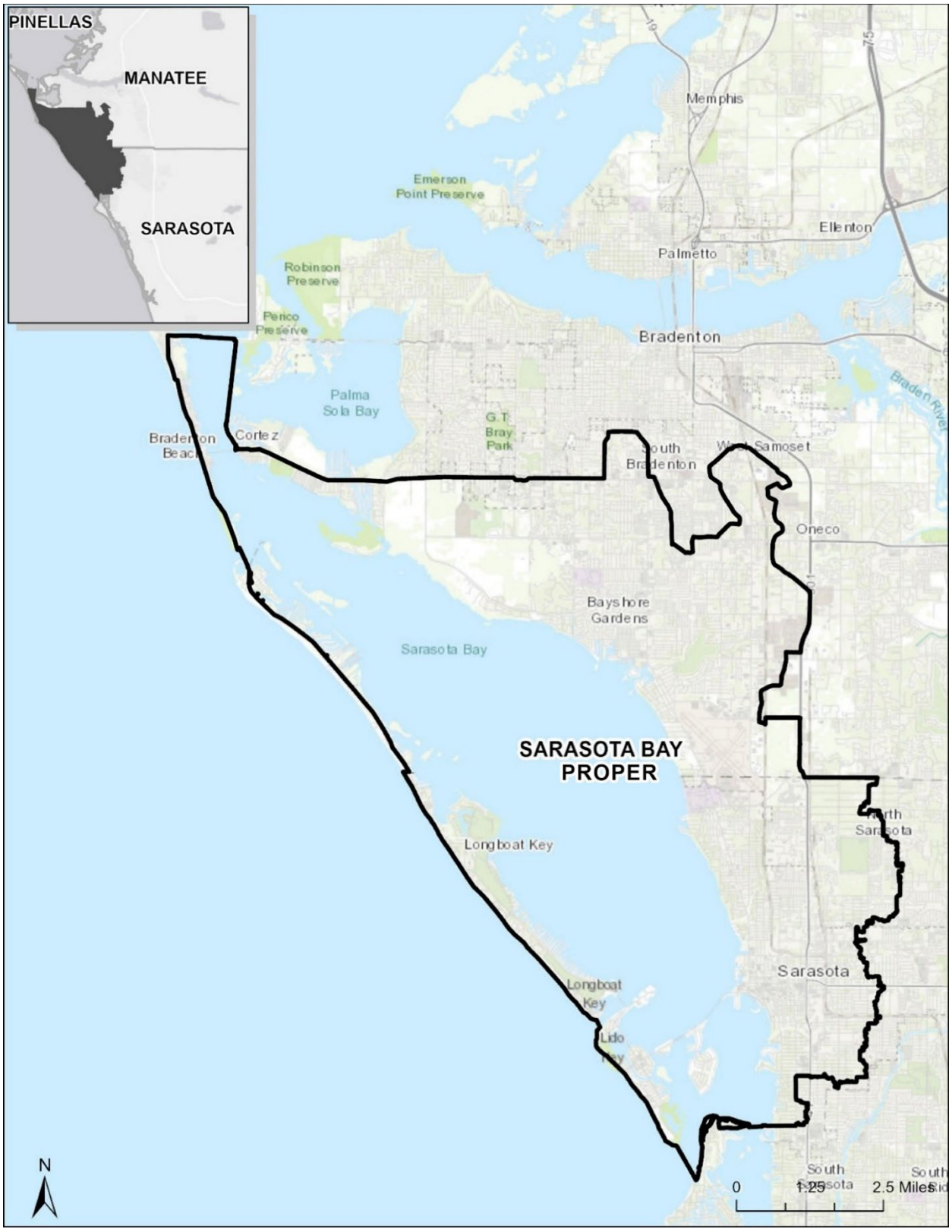
Sarasota Bay Proper

Sarasota Bay Proper is between Longboat Key, Bradenton Beach, and Lido Key to the west and the cities of Bradenton and Sarasota to the east. It is the largest and deepest bay between Tampa Bay and Charlotte Harbor (Figure 4). Several bridges span the Bay, connecting the mainland to the barrier islands, which are highly developed and popular tourist attractions. The Bay is bounded to the north by State Road (SR) 64 (Manatee Avenue W.), which is the gateway to popular destinations such Holmes Beach and Anna Maria Island. SR 684 (Cortez Road) is a frequently traveled road used to access Bradenton Beach. The longest bridge to span Sarasota Bay is SR 789 (John Ringling Causeway/John Ringling Boulevard) used to access the popular tourist destinations that include St. Armands Circle and Lido Key. The Bay is bounded to the south by SR 758 (Siesta Drive) used to access Siesta Key.

The waters of the bay segment cover over 35.6 square miles and drain a watershed of approximately 78.7 square miles, including parts of Manatee and Sarasota Counties. The Bay receives runoff from several freshwater tributaries that flow through highly urbanized areas, including Bowlees Creek in Manatee County and Whitaker Bayou and Hudson Bayou in Sarasota County. This Bay segment has clearer water than other segments due to the size and depth of the Bay and the significant tidal exchange through Longboat Pass, New Pass, and Big Sarasota Pass.

Like many parts of Sarasota Bay, this segment includes waters designated as OFW. Notable areas of natural habitat include large seagrass meadows on either side of the Bay around Longbar Point and the north shoreline between New College and Cortez, as well as on tidal shoals adjacent to New Pass and north of Longboat Pass. A mosaic of mangroves, high marsh, and transitional and coastal uplands occur on the Leffis Key, Quick Point, and Joan Durante Preserves.

Sarasota Bay includes an area that is conditionally approved for shellfish harvesting. However, the area has been closed for decades due to elevated bacterial pollution. Addressing elevated bacteria, although important, is within the purview of FDEP and the Florida Department of Health (FDOH); therefore, it is beyond the scope of this SWIM Plan. However, many initiatives to address nutrient pollution would likely result in some improvements for bacteria levels.

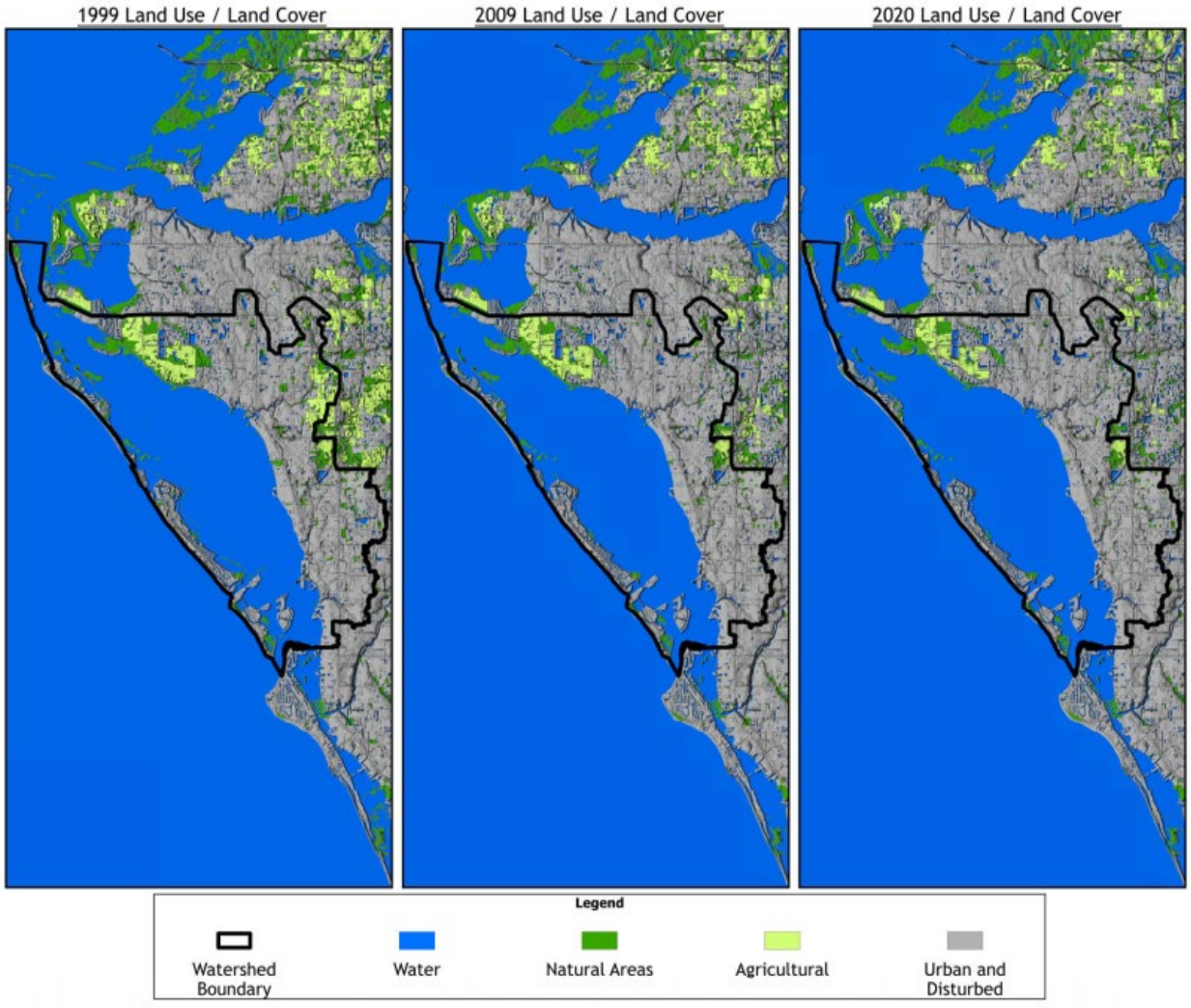


Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 4 – Basin Boundary of the Sarasota Bay Proper Watershed

Sarasota Bay Proper Land Use/Land Cover

Much of the watershed has been developed, with residential land use making up approximately 26 percent of the area. Coastal and bayside areas, particularly on the islands, have experienced significant development, including a mix of commercial properties and residential communities punctuated by numerous finger canals. The finger canals drain runoff from homes and businesses and provide a means for docking boats and other watercraft. Significant development over the last 20 years has occurred just south of SR 70 and west of I-75. Figure 5 and Table 2 describe the land use changes occurring since 1999 in the Sarasota Bay Watershed.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 5 – Sarasota Bay Proper Land Use in 1999, 2009, and 2020

Table 2 – Land Use Change by Acres and Percent for Sarasota Bay Proper Watershed

	1999		2009		2020	
Use	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban and Disturbed	21,366	42.4%	22,764	45.2%	23,190	46.1%
Agricultural	2,357	4.7%	1,568	3.1%	1,211	2.4%
Natural Areas	3,255	6.5%	2,463	4.9%	2,333	4.6%
Water	23,363	46.4%	23,545	46.8%	23,605	46.9%
Totals	50,340	100.0%	50,340	100.0%	50,340	100.0%

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

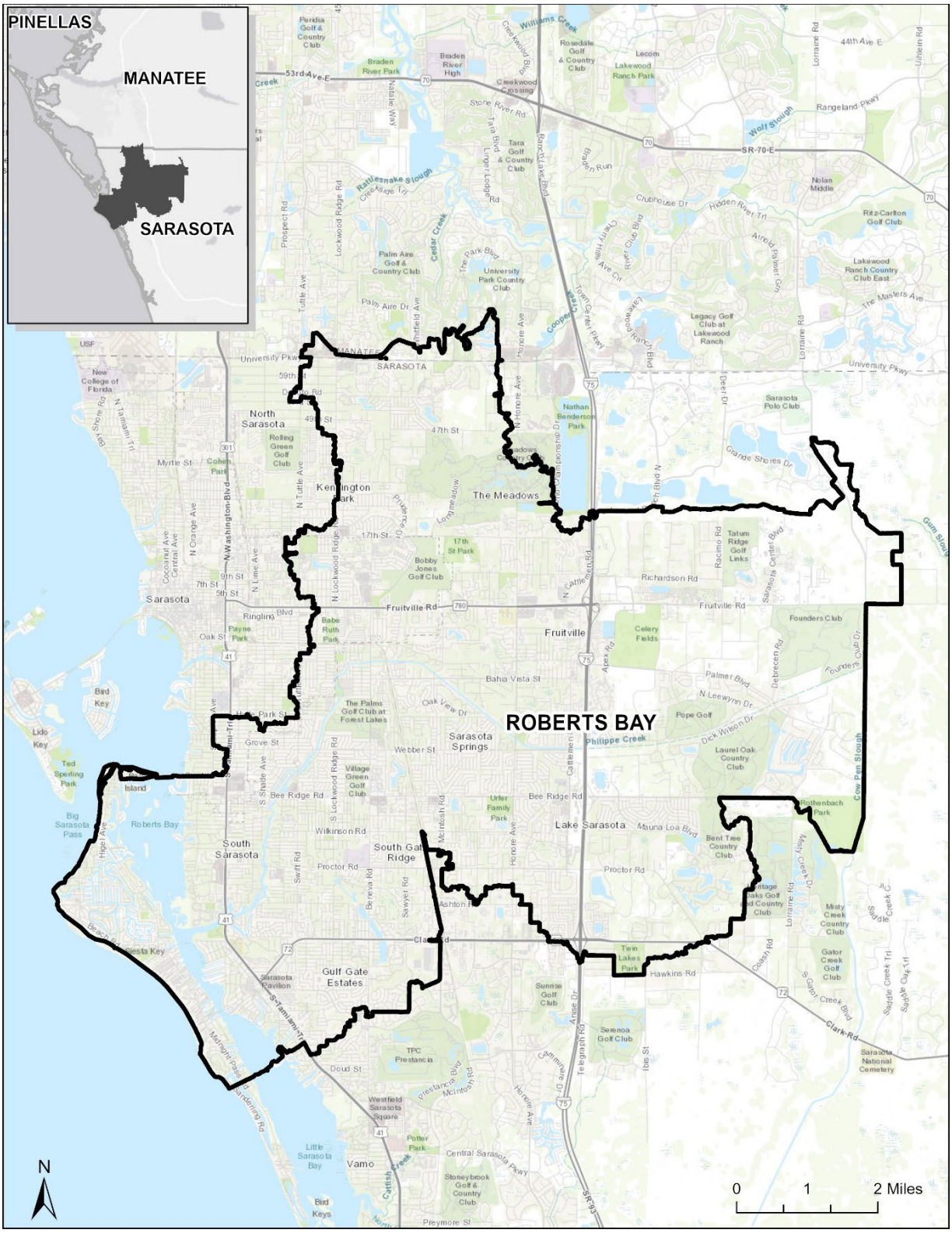
Roberts Bay

Roberts Bay is between Siesta Key and the mainland (Figure 6). The Bay's water surface area is approximately 2.1 square miles, with a relatively large total watershed area of about 65.9 square miles. Compared to the other Bay segments, Roberts Bay has the potential to be significantly influenced by contributions from the land surface. Although not the largest of the Bay segments, Roberts Bay receives freshwater runoff from the largest tributary of all the Bay segments, Phillippi Creek. The Bay receives saltwater input from the Gulf via Big Pass.

The Roberts Bay estuary is a wide, shallow embayment in Sarasota County immediately south of the east end of Big Sarasota Pass. The north end of Roberts Bay has a narrow opening confined from the west by Fishery Point on north Siesta Key and by mainland Sarasota to the east. Fishery Point and north Siesta Key constrain the exchange of Gulf water into Roberts Bay. The main road that runs across this opening is Siesta Drive and the Siesta Key North Bridge. Roberts Bay narrows as it reaches the mouth of Phillippi Creek and continues to Siesta Key.

As the largest tributary that outfalls to Roberts Bay, the Phillippi Creek basin historically consisted of large areas of sawgrass marshes. These marshes were drained for agricultural purposes beginning in the late 1800s. Extensive drainage networks were constructed through the Fruitville and Hyde Park Drainage Districts. Eventually, these systems were expanded and straightened to accommodate larger flows that eventually drain to Roberts Bay. The following activities summarize some of the significant changes that have altered the hydrology of the watershed (refer to Roberts Bay North Watershed Management Plan (WMP) in the Literature Cited):

- 1910s – Extensive agricultural ditching in the north portions of the basin.
- 1940s – Water control weir for agriculture was constructed in the downstream Phillippi Creek channel.
- 1950s – Urbanization in the lower portions of the basin accelerated. Flooding issues occur in the new developments.
- 1960s – Drainage study of the Phillippi Creek was authorized. Dredging begins at the mouth of Phillippi Creek to convey stormwater to the Bay.
- 1999 – Construction completed for the Celery Fields Regional Stormwater Facility.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

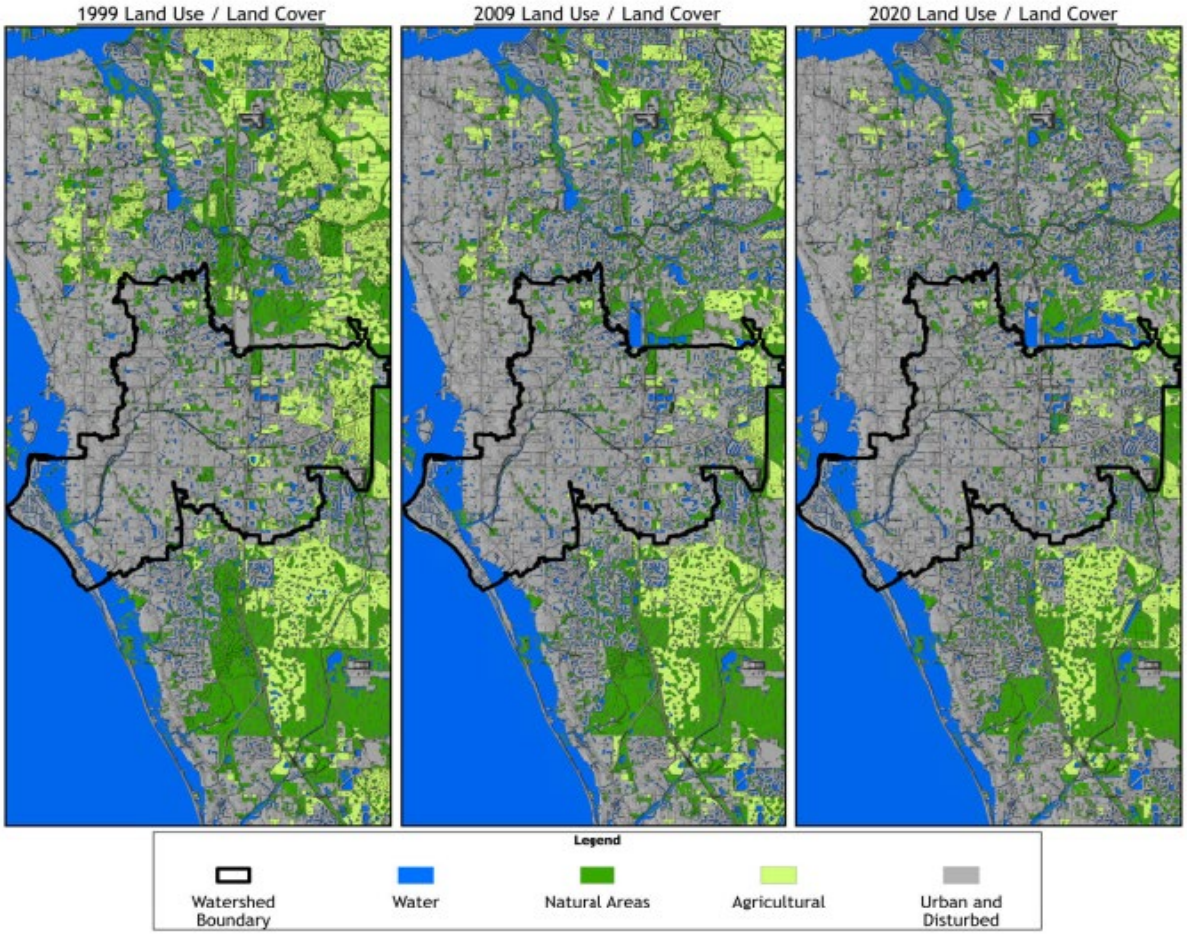
Figure 6 – Basin Boundary of the Roberts Bay Watershed

Pollution from failing septic systems has been a prevalent issue in the watershed. In 2001, Sarasota County began the *Phillippi Creek Septic System Replacement Program* to reduce the pollution from failures of these systems. As a result of that program, over 10,000 parcels have been converted to the central sewer system.

The Phillippi Creek watershed is approximately 57 square miles and made up of approximately 7 miles of natural creeks and over 100 miles of manmade ditches and canals. It is a highly urbanized watershed that includes areas within the City of Sarasota and unincorporated areas of the County.

Roberts Bay Land Use/Land Cover

Of the Sarasota Bay watersheds, Roberts Bay is the most developed, with more than 80 percent classified as disturbed or developed. The area has seen a 10-percent increase in development within the last 20 years. It has the highest concentration of residential land uses (i.e., low-, medium-, and high-density), making up over 57 percent of the watershed's land use. Many of the agricultural areas along the east portions of the watershed have been converted to urban developments since the early 2000s. Figure 7 and Table 3 describe the land use changes that have occurred over time in the Roberts Bay Watershed.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 7 – Roberts Bay Watershed Land Use in 1999, 2009, and 2020

Table 3 – Land Use Change by Acres and Percent for Roberts Bay Watershed

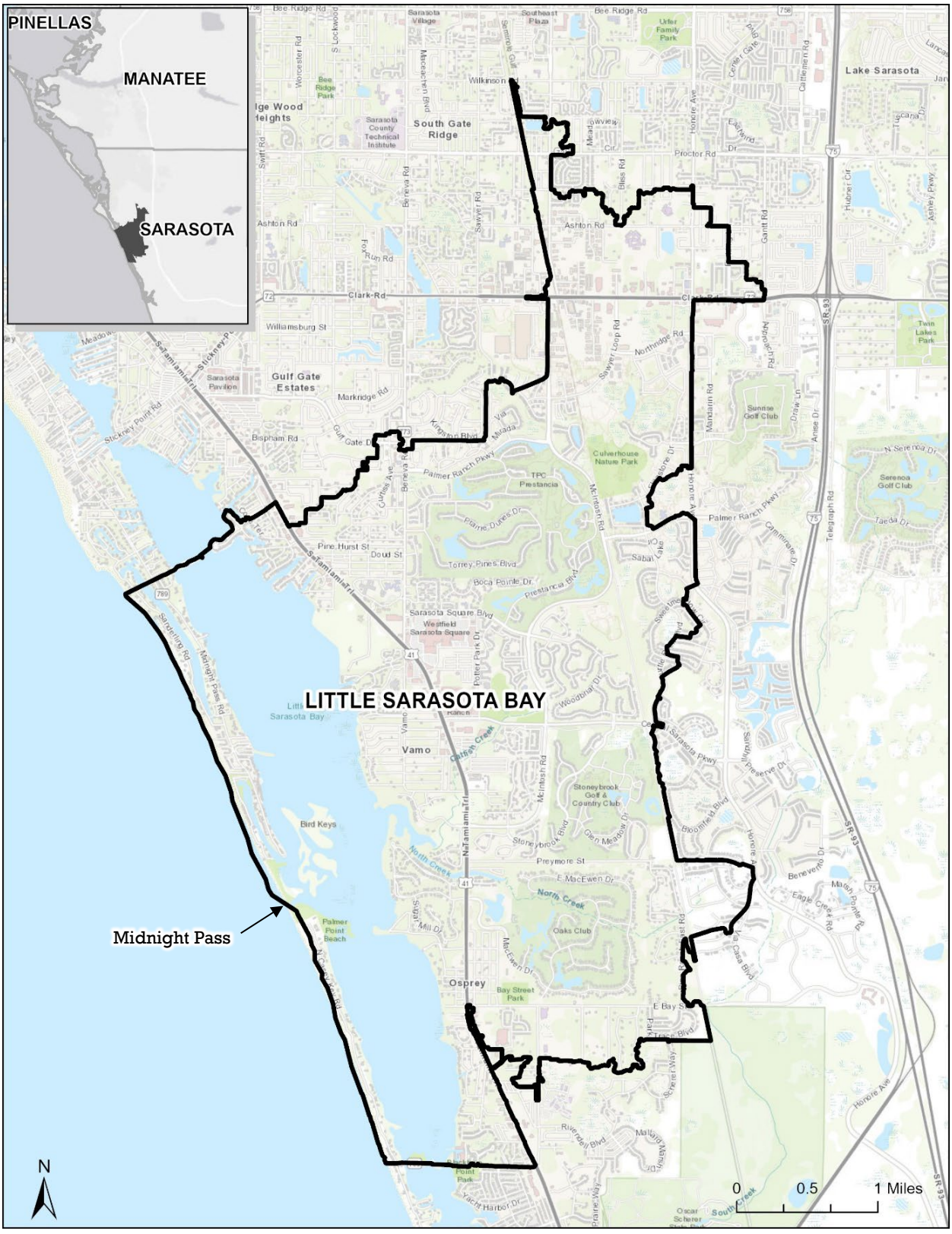
	1999		2009		2020	
Use	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban and Disturbed	29,880	70.9%	32,718	77.6%	33,788	80.1%
Agricultural	4,599	10.9%	2,220	5.3%	1,274	3.0%
Natural Areas	4,614	10.9%	3,924	9.3%	3,571	8.5%
Water	3,075	7.3%	3,306	7.8%	3,536	8.4%
Totals	42,168	100.0%	42,168	100.0%	42,168	100.0%

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Little Sarasota Bay

Located between Roberts Bay and Blackburn Bay, Little Sarasota Bay is bounded on the north by Point Crisp Road and Caribbean Drive and on the south by Blackburn Point Road. The Bay receives freshwater from several creeks, including Matheny Creek, Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, and North Creek, as well as direct runoff from the coastal communities (Figure 8). Historically, Midnight Pass, separated Siesta Key and Casey Key but was closed in 1983. Midnight Pass remained closed until fall 2024 when Hurricanes Helene and Milton re-opened the pass. To date, Midnight Pass remains open, and Sarasota County is evaluating the viability of keeping it open. The ecological effects that a re-opened Midnight Pass will have on Little Sarasota Bay is a topic of discussion by the SBEP Technical Advisory Committee (TAC). The SWIM Program supports efforts to better understand how Midnight Pass will impact this and the other estuaries of Sarasota Bay.

Little Sarasota Bay comprises approximately 2.9 square miles of waterbody, with a total contributing watershed area of 16.4 square miles. Most of the watershed is developed. Despite this development, the area has maintained a considerable amount of its coastal wetlands compared to the other basins within the Sarasota Bay watershed. The mainland area, especially east of US Highway (US) 41 (Tamiami Trail), contains many communities that were developed using detention ponds as part of the stormwater runoff strategy in the area.

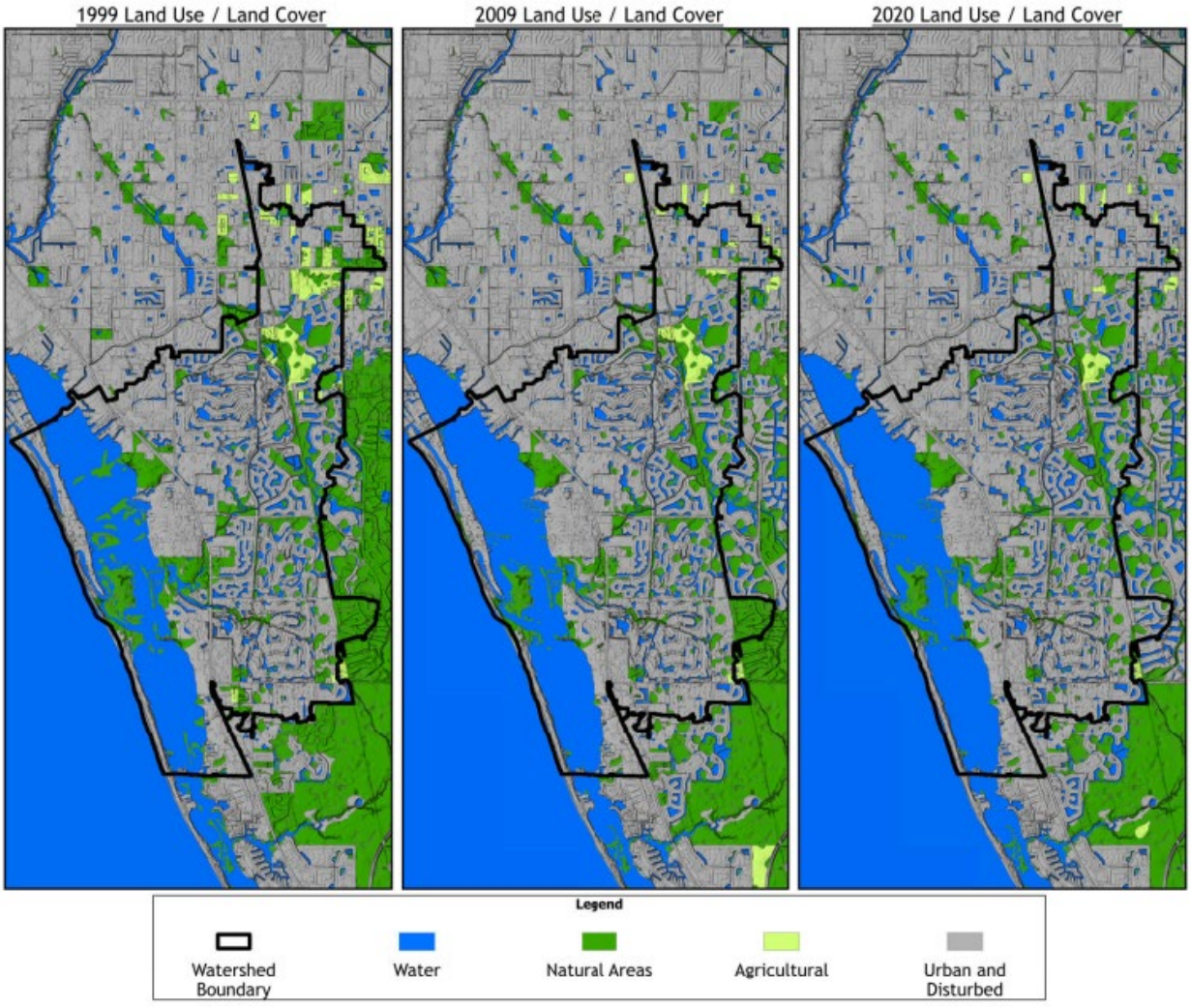


Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 8 – Basin Boundary of the Little Sarasota Bay Watershed

Little Sarasota Bay Land Use/Land Cover

Little Sarasota Bay has experienced only a 5 percent increase in development over the last 2 decades, mostly because this watershed was almost completely built out. Despite the intense urbanization, much of the coastal wetland habitat is still intact. Recent development has occurred mostly on the north portion of the watershed along SR 72. Over 40 percent of the Little Sarasota Bay Watershed is classified as residential land use. The watershed also contains the highest concentration of golf courses, making up approximately 7 percent of the total watershed area. Figure 9 and Table 4 describe the land use changes that have occurred over time in the Little Sarasota Bay Watershed.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 9 – Little Sarasota Bay Watershed Land Use Map

Table 4 – Land Use Change by Acres and Percent for Little Sarasota Bay Watershed

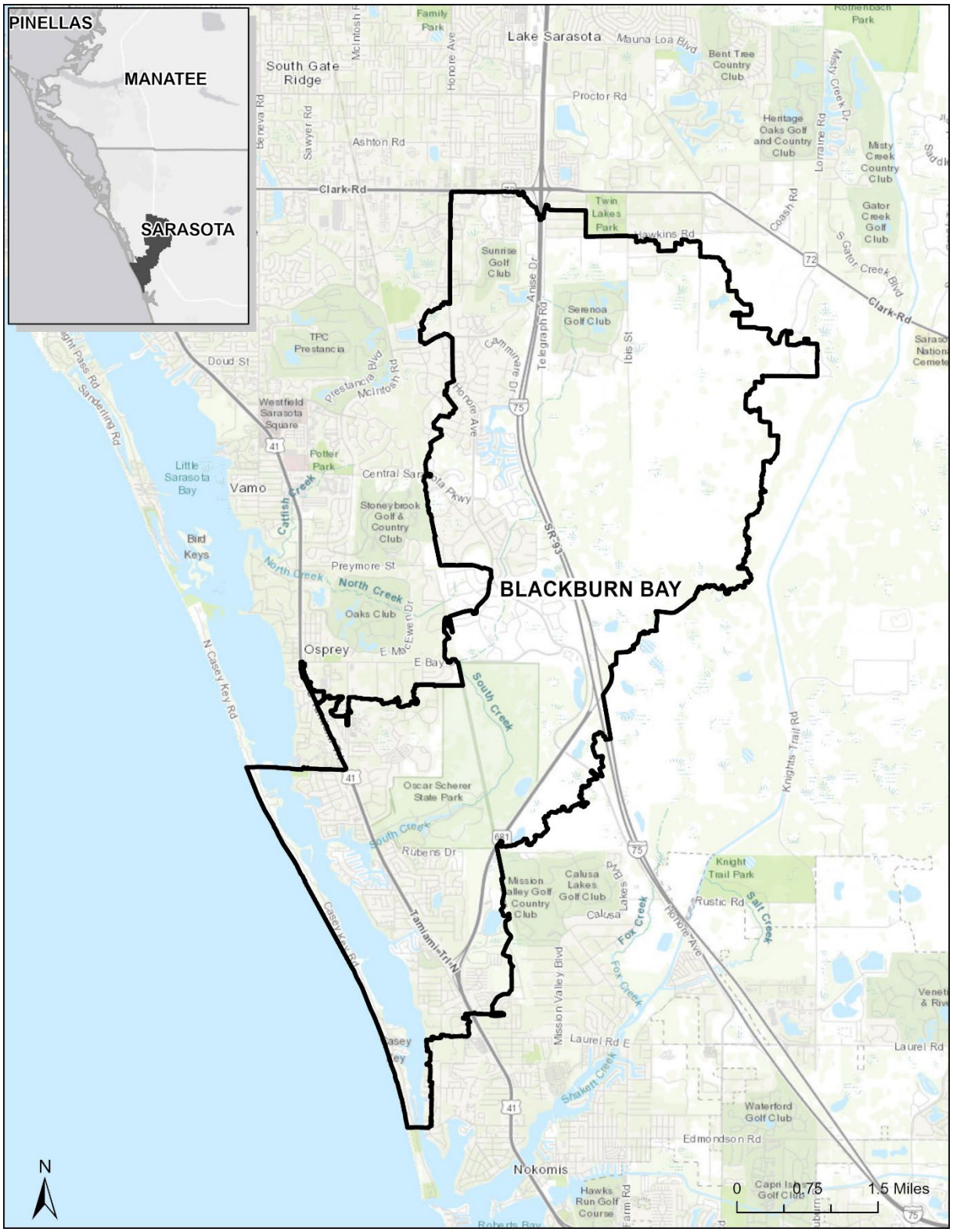
	1999		2009		2020	
Use	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban and Disturbed	6,116	58.1%	6,484	61.6%	6,668	63.3%
Agricultural	300	2.8%	146	1.4%	77	0.7%
Natural Areas	1,756	16.7%	1,422	13.5%	1,258	11.9%
Water	2,357	22.4%	2,477	23.5%	2,526	24.0%
Totals	10,528	100.0%	10,528	100.0%	10,528	100.0%

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Blackburn Bay

The south-most estuary in the Sarasota Bay watershed is Blackburn Bay (Figure 10). Blackburn Bay receives saltwater through the Venice Inlet and fresh water from South Creek and several man-made canals. Tidal flushing from the bays to the Gulf occur via Big Sarasota Pass, Venice Inlet, or both.

Blackburn Bay comprises approximately 1.1 square miles of waterbody, with a total contributing watershed area of 23.9 square miles. Most of the watershed is developed, particularly west of I-75. Large tracts of land east of I-75 remain undeveloped and include the publicly owned and preserved lands within the Scherer Thaxton Preserve and the Oscar Scherer State Park. The remaining open space east of I-75 is not in preservation.

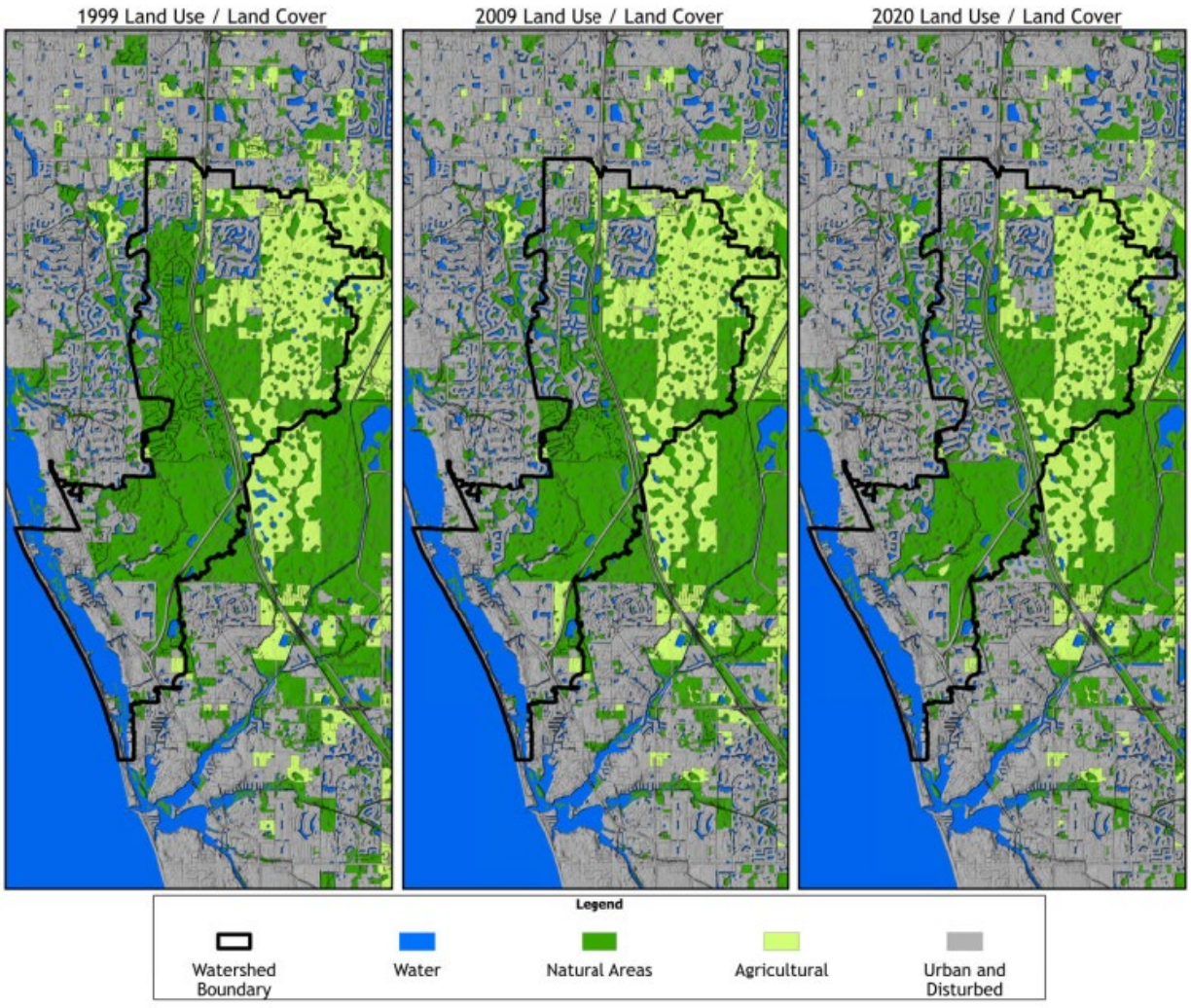


Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 10 – Basin Boundary of the Blackburn Bay Watershed

Blackburn Bay Land Use/Land Cover

Development in Blackburn Bay has primarily occurred in the past 20 years. Development has increased by almost 12 percent of the watershed area, particularly along the west I-75 corridor. This development has been accompanied by the creation of many detention ponds for stormwater treatment and attenuation. Despite increased urbanization, agriculture and natural areas continue to make up a significant portion of the watershed. The Oscar Scherer State Park and campgrounds make up approximately 1,800 acres on the west side of I-75. Large agricultural tracts remain east of I-75, although developments have expanded in the area within the last 5 years in the north portion of the watershed. Figure 11 and Table 5 describe the land use changes that have occurred over time in the Blackburn Bay Watershed.



Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Figure 11 – Blackburn Bay Watershed Land Use Map

Table 5 – Land Use Change by Acres and Percent for Blackburn Bay Watershed

	1999		2009		2020	
Use	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban and Disturbed	3,657	23.9%	4,459	29.1%	5,608	36.7%
Agricultural	3,148	20.6%	3,182	20.8%	2,762	18.1%
Natural Areas	7,270	47.5%	6,241	40.8%	5,325	34.8%
Water	1,222	8.0%	1,416	9.3%	1,603	10.5%
Totals	15,298	100.0%	15,298	100.0%	15,298	100.0%

Source: Jones Edmunds and ESA, 2025a; SWFWMD.

Issues and Drivers

Status of the 2002 SWIM Plan

The 2002 Sarasota Bay SWIM Plan depicted a waterbody recovering from its most degraded condition in the late 1980s to a much healthier condition by the early 2000s. Improved water quality was attributed primarily to successful management of point-source pollution, particularly improvements in wastewater treatment. Despite these improvements, the plan cited continued population growth and development in the watershed as a potential threat to the bay's recovery in the form of non-point source pollution like stormwater. Therefore, the overarching goal of the 2002 Sarasota Bay SWIM Plan was to outline a series of research and/or restoration projects that would allow the preservation and restoration of a healthy Sarasota Bay, despite projected population increases in the watershed.

Consistent with SBEP's CCMP, the 2002 SWIM Plan identified five goals to maintain a healthy Sarasota Bay. A summary of progress toward achieving these goals is included below.

- Improve Water Transparency in Sarasota Bay
    - Status: Improved water transparency, also known as water clarity, allows greater light penetration through the water column, reducing light limitation to the existing seagrass beds and facilitating potential expansion beyond the current deep edge. Excessive nutrients can increase phytoplankton production (expressed as chlorophyll-a concentration), which absorbs light in the same wavelengths needed by the seagrasses. Reducing the nutrient load from the watershed to the estuary can reduce phytoplankton abundance and increase light penetration to seagrass. The District and Sarasota County funded the Spatially Integrated Model for Pollutant Loading Estimation (SIMPLE) model, developed by Jones Edmunds & Associates Inc., to quantify nutrient loads from six sources to target effective nutrient reduction projects.
- Decrease the Quantity and Increase the Quality of Stormwater Runoff to Sarasota Bay
    - Status: The District collaborated with local governments and other partners to identify and implement stormwater retrofit projects to reduce stormwater runoff volume and nutrient concentrations. The District continues to support the development of watershed management plans that recommend projects to address flooding, water quality improvements, and natural systems enhancement. Two cooperatively funded projects completed since the 2002 SWIM plan are the 2006 Celery Fields Regional Stormwater Facility Project and the 2020 Hudson Bayou In-stream Restoration Project. Since 1989, the SWIM Program and its cooperators have completed 14 water quality projects for Sarasota Bay, treating over 45,000 acres of watershed.
- Restore Shoreline Habitats in Sarasota Bay
    - Status: The efforts of the SWIM Program and its partners have restored over 7,100 feet of shoreline habitats, including the 2011 Herb Dolan Living Shoreline Project, which restored over 1,600 linear feet of shoreline.

- Restore and Sustain Fish and Other Living Resources in Sarasota Bay
    - Status: In addition to the habitat value provided by shoreline restoration projects, the SWIM Program has funded and led natural systems restoration projects that enhance fisheries and fish habitats. Projects completed at Leffis Key and the FISH Preserve in Manatee County created or restored tidal channels, mangrove and marsh environments across depth and salinity gradients to provide habitat for various life stages of fish.
- Continue Monitoring Programs and Applied Research Projects in Sarasota Bay
    - Status: The District actively supports research and monitoring throughout the Sarasota Bay region. The District's SWIM Program administers an extensive Seagrass Mapping Program that includes all Sarasota Bay estuaries. Since 1988, the District has mapped seagrass coverage in Sarasota Bay biennially using a combination of aerial imagery and field data. The results from these maps are used extensively as one of the primary indicators of estuarine health. Additionally, the SWIM Team assists the SBEP's community-based seagrass monitoring network known as "Eyes on Seagrass," which provides site-specific information on seagrass species, condition, and density. The District's Water Quality Monitoring Program is dedicated to water quality sampling, data management, and analysis for several long-term ground and surface water monitoring efforts designed to assess water resource quality. The District recently initiated a project to assess the status of completed restoration projects to determine if historical projects are still meeting the expected benefits. Restoration condition assessments are included in the SWIM Restoration Geodatabase, a web-based archive of objectives, design, funding, and ongoing conditions of SWIM Program restoration projects.

Since the last SWIM Plan update in 2002, projects designed to reduce nutrient runoff have been implemented by the District's SWIM Program, Sarasota County, Manatee County, SBEP, and other stakeholders. Examples of projects the District has directly supported include Central Holmes Beach Water Quality BMPs and Bradenton Beach Stormwater Retrofit project. In 2022, the District's SWIM Program helped fund the City of Sarasota Treatment Wetlands project, which was completed in 2023. This project demonstrated the value and cost-effectiveness of large regional-scale projects in strategic locations, treating over 5,800 acres of watershed and removing over 900 pounds of nitrogen per year.

Although significant progress has been made to improve water quality in Sarasota Bay, most of these improvements have been brought about through the successful management of point sources of pollution. Pollutant loading from nutrients continues to be the priority within the Sarasota Bay Watershed. To continue offsetting nutrient loads to the Bay, implementation of stormwater retrofits in tributaries as well as public outreach to educate homeowners on BMPs for landscaping and proper fertilizer applications must remain a priority. Additional measures, such as the adoption by local governments of more stringent stormwater regulations for new development may be worth considering.

Additionally, the 2002 SWIM Plan Update identified two projects related to water quality that were to determine nitrogen loading sources from urban land use categories and monitor changes in the watershed. These projects included the development of a Geographic Information Systems (GIS) based pollutant loading model and the analysis of the status and water quality trends in the watershed.

Water Quality Issues and Drivers

As the bay conditions have improved, this plan update has shifted focus from restoring water quality to sustaining water quality. Aligned with the SBEP, this SWIM plan adopts a "hold the line" approach to maintaining water quality, specifically seeking to maintain nitrogen and chlorophyll concentrations in relation to the existing ecological health and recreational value of the bay. "Hold the line" does not mean "do nothing." Rather this plan recognizes the policy and infrastructure improvements that have facilitated improved bay health. The focus now is identifying water quality issues and drivers that most threaten the bay's condition and seeking opportunities for tangible improvements. Ongoing nutrient reduction will also be required to accommodate the growing population, aging infrastructure, and the changing dynamics of nutrient transport, sources, and sinks. To ensure that Sarasota Bay "holds the line" on water quality, the SBEP with support from the District's SWIM Program and other stakeholders began developing a Water Quality Protection Plan (WQPP) in 2021. The WQPP aims to maintain improvements in water quality and address future challenges, like climate change and increased nutrient loading from population growth. The WQPP builds on previous work and has a 30-year planning horizon. This SWIM Plan update recognizes the establishment and implementation of the SBEP WQPP as both a management action and a priority initiative.

Nitrogen is the primary water quality pollutant of concern in Sarasota Bay. An excess of nitrogen can lead to increased algae growth, low dissolved oxygen, poor water clarity, and loss of critical seagrass habitat. Algal growth is a normal part of an estuary's ecology and not inherently bad. However, elevated nitrogen concentrations can overstimulate algal growth resulting in harmful levels. A common proxy for phytoplankton algae abundance in the water column is chlorophyll-a concentration most often expressed in ug/L.

Estuarine numeric nutrient criteria for Sarasota Bay are based on total nitrogen (TN) concentration. Chemically speaking, however, nitrogen comes in various forms, or species. TN can consist of both inorganic and organic nitrogen species. Inorganic nitrogen is the sum of nitrate, nitrite, and ammonium (usually expressed as ammonia-N). Inorganic nitrogen is readily available for uptake by primary producers (algae and higher plants). Organic nitrogen on the other hand is bound in various complex organic compounds and therefore is not readily bioavailable. For organic nitrogen to become bioavailable, it must first be re-mineralized into an inorganic form via microbial pathways. Nitrogen can be further subdivided into its particulate and dissolved fractions. Particulate nitrogen is that fraction that is bound to particles greater than 0.45 microns. Particles less than 0.45 microns make up the dissolved fraction which is more bioavailable than the particulate fraction (Likens, 2010).

In 2021, the SBEP Water Quality Consortium, of which the District is a member, focused on management actions and projects targeted at reducing the dissolved inorganic nitrogen (DIN) load entering Sarasota Bay. Much of this DIN load comes from treated wastewater where DIN can make up 80-90% of the TN concentration. Whereas DIN from stormwater only makes up 30-40% of the TN concentration. Local governments including Manatee and Sarasota Counties have invested heavily to upgrade and improve their wastewater treatment infrastructure. One of the largest wastewater treatment plants in the Sarasota Bay watershed is Manatee County Utilities Department's Southwest Regional Water Reclamation Facility. In early 2017, nearly $25 million in upgrades to the treatment plant improved nitrogen removal from effluent by more than 40%. Also contributing to reductions in DIN loads, in 2022 the Bee Ridge Water Reclamation Facility completed the expansion and conversion to advanced wastewater treatment. The result has been a noticeable improvement in Sarasota Bay water quality, an increase in seagrass coverage, and reductions in macroalgal abundance.

Projects focusing on wastewater are beyond the scope of this plan update, the SWIM Program does support efforts to better understand reclaimed water nutrient concentrations and the potential impacts on downstream waterbodies. The District's Water Supply Section within the Water Resources Bureau works with District partners to identify and implement cooperatively funded projects designed to provide potable water supply and resource alternatives including beneficial reuse of reclaimed water.

Although wastewater contains a greater proportion of DIN than other sources, stormwater runoff from residential, commercial, agricultural and industrial land use continues to be the largest TN input to Sarasota Bay (SBEP 2022). Historically, the SWIM Program has invested in stormwater improvements and therefore, this plan continues to prioritize projects that reduce stormwater nutrient loads. A particular focus is to identify stormwater treatment opportunities for urban areas that were established prior to regulatory requirements for integrated stormwater management. To date, the SWIM Program has cooperatively funded stormwater BMPs for several of the barrier island municipalities including the City of Bradenton Beach, City of Anna Maria, City of Holmes Beach, and coastal and urban areas of the City of Sarasota (e.g. 10th street BMPs, Hudson Bayou). The District also helped fund the Sarasota Treatment Wetlands Project with the City of Sarasota as part of the redevelopment of the Bobby Jones Golf Club. This regional treatment system detains and treats runoff from over 5,800 acres of urban watershed with limited existing treatment, removing over 900 pounds of TN. Large regional treatment systems offer significant advantages including the large amount of nutrients removed, the cost-effectiveness of such removal, and the opportunity to incorporate natural systems within the project.

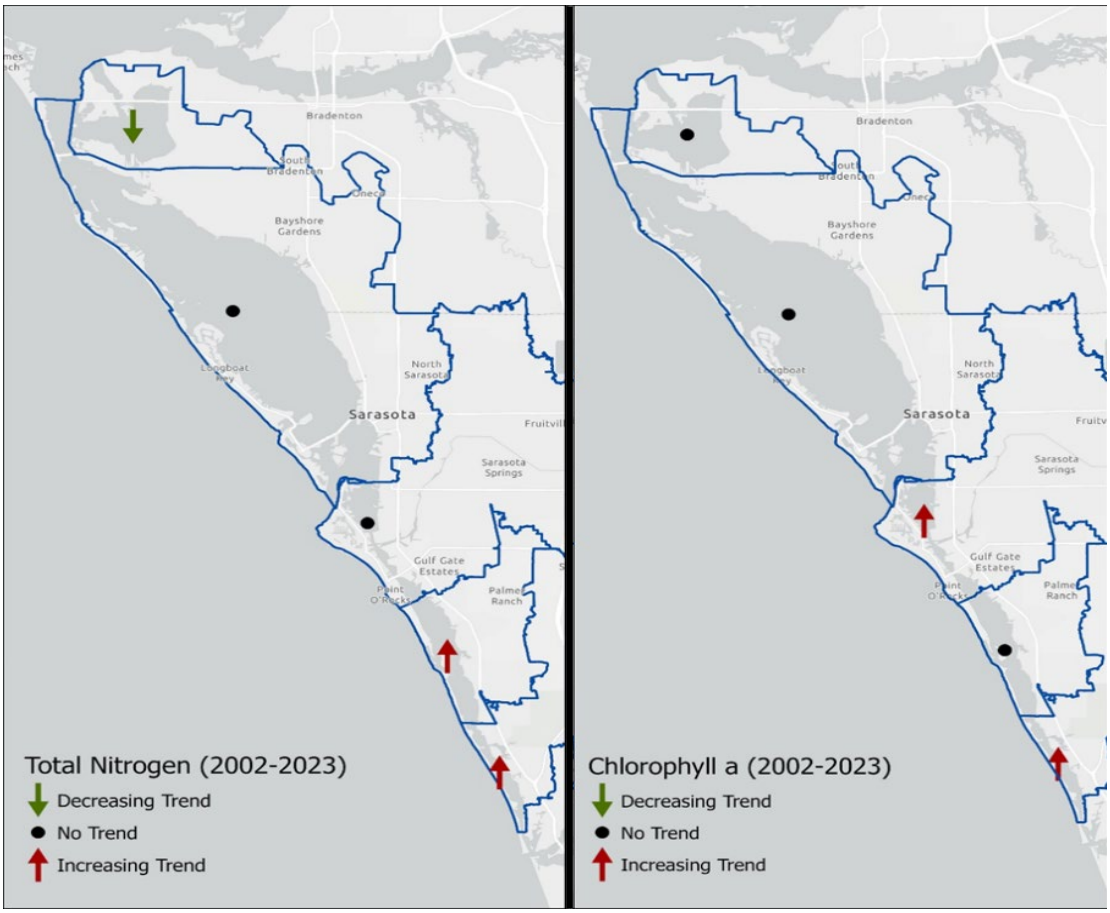
Water Quality Status and Trends

Water quality data exist prior to 2006, and the 2002 Sarasota Bay SWIM Plan update reported water quality status and trends from 1968 to 1998 from various water quality data sources (SBEP, 1992). The 2002 SWIM Plan characterized Sarasota Bay as a system recovering from its most degraded condition in the late 1980s (SWIM, 2002). This improvement was evidenced in part by analyses showing decreased total nitrogen (TN) concentrations from 1989 to 1998 for most of the bay segments.

For this SWIM Plan update, water quality status and trends analyses were completed for data collected between 2002 and 2023, covering the period since the last SWIM Plan update in 2002. Trend analysis using the Kendall Tau approach (Jones Edmunds and ESA, 2025c) were conducted for several parameters but focused primarily on total nitrogen (TN) and chlorophyll-a.

Statistically significant trends were identified if the p-value was less than or equal to 0.05 and are indicated by an up arrow (⬆) if increasing or down arrow (⬇) if decreasing. For data with no discernable trend, a (●) is indicated. The up arrows indicate a statistically significant increasing trend, and the down arrows indicate a statistically significant decreasing trend in the measured parameter values.

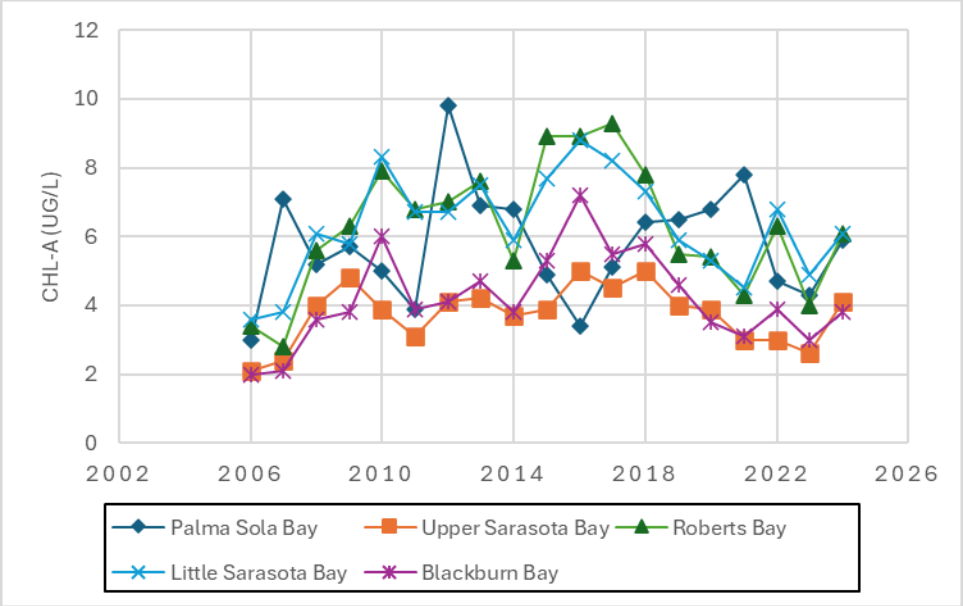
Figure 12 shows between 2002-2023 Palma Sola Bay was the only bay segment to have a decreasing trend in TN. Sarasota Bay Proper and Roberts Bay showed no trend while the TN trend for Little Sarasota Bay and Blackburn Bay increased. For chlorophyll, Palma Sola Bay, Sarasota Bay Proper, and Little Sarasota Bay Proper showed no trend and Roberts Bay and Blackburn Bay showed an increasing trend.



Source: Jones Edmunds and ESA, 2025c.

Figure 12 – Water Quality Trend Analysis for 2002–2023

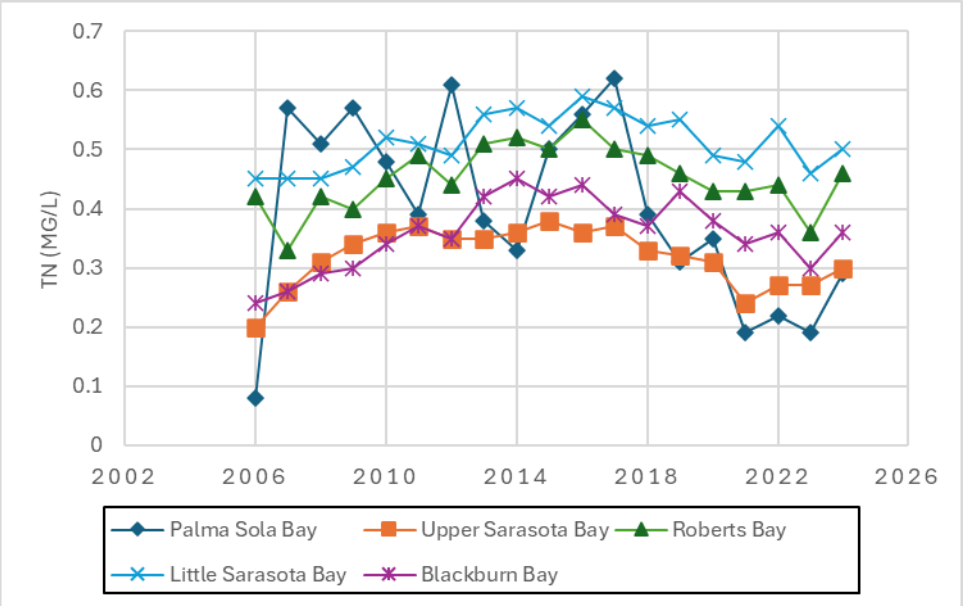
For Sarasota Bay, water quality and estuarine health have improved in recent years. In 2023, the Sarasota Bay estuary was no longer listed by the FDEP as impaired for nutrients having met the established numeric criteria for phytoplankton in the water column, expressed as chlorophyll-a, over the preceding three years (2020-2022). Since 2017, chlorophyll concentrations have dramatically declined in four of the five bay segments (Figure 13).



Source: SBEP.

Figure 13 – Average annual chlorophyll-a concentrations over the period 2006 to 2024 for the five Sarasota Bay segments.

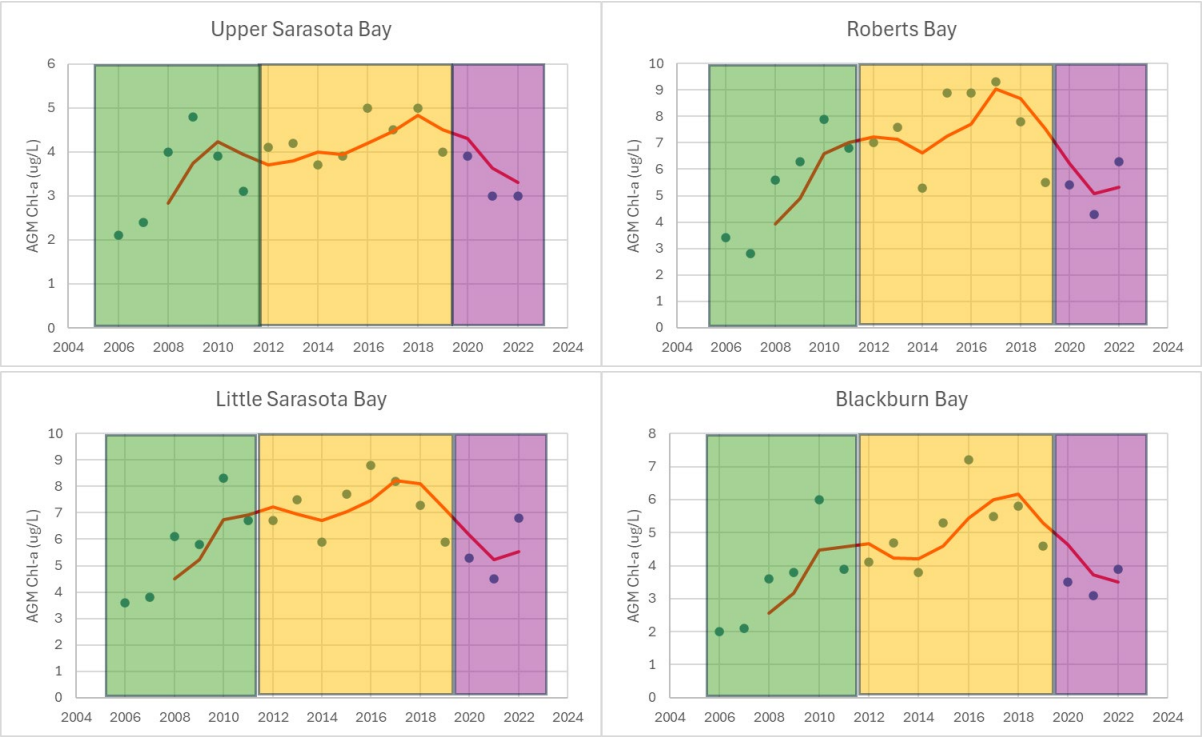
This decreasing trend in chlorophyll is attributed to reductions in total nitrogen concentrations over similar time periods (Figure 14).



Source: SBEP.

Figure 14 – Average annual total nitrogen (TN) concentrations over the period 2006 to 2024 for the five Sarasota Bay segments.

SBEP through the Water Quality Consortium, developed an ecosystem report card based on the distribution of chlorophyll concentration, TN concentration, seagrass coverage, and macroalgal coverage. The report card is discussed in the next section. Based on this weight of evidence approach, there are three discrete water quality periods for each bay segment (Figure 15). The first period is considered the reference period from 2006-2012, the second period from 2013-2019 is the degraded period, and the third is the recovery period from 2020-2024. During the reference period, total nitrogen concentrations were approximately 12-35% lower than during the degraded period (Figure 14) corresponding to lower chlorophyll concentrations (Figures 13 & 15). For example, in Roberts Bay, chlorophyll concentrations were 34% higher during the degraded period relative to the reference period. In Blackburn Bay, concentrations were almost 45% higher during the degraded period.



Source: SBEP.

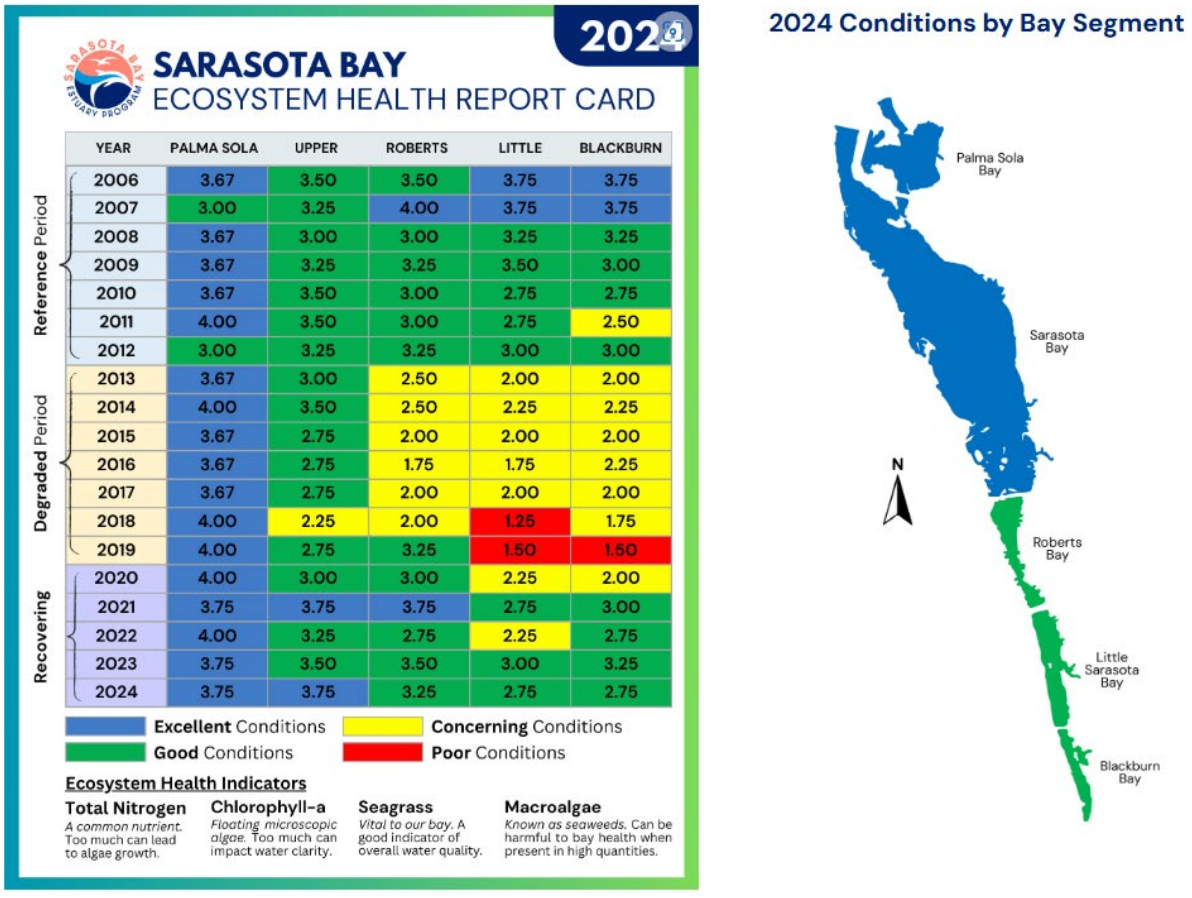
Figure 15 – Average annual geometric mean for chlorophyll across the planning period 2006-2022 for each bay segment. Upper Sarasota Bay includes Sarasota Bay Proper and Palma Sola Bay. The period 2006-2011 (green) represents the reference period, 2012-2019 (yellow) represents the degraded period, and 2020-2022 (purple) represents the recovery period.

SBEP Annual Ecosystem Health Report Card

Sarasota Bay has a robust water quality monitoring network that includes data collected by Manatee County Parks and Natural Resources Department, Sarasota County Public Works, SBEP, and other partners. These data are analyzed by the SBEP and presented as part of the SBEP Annual Ecosystem Health Report Card (Report Card | Sarasota Bay Estuary Program) which uses four indicators of estuarine health: Total nitrogen, chlorophyll-a, seagrass coverage, and macroalgal abundance. To create this report card, the SBEP compares these four report card indicators for a given year to a "reference period" of time from 2006-2012 when water quality and seagrass coverage was favorable across all bay segments. During this reference period, seagrass coverage increased, low levels of

nitrogen were reported, there were no regulatory impairments for phytoplankton, and no widespread increases in macroalgae. This SWIM Plan update uses the same reference period as the basis for the "hold the line" approach.

For 2024, the SBEP reported the following: "Sarasota Bay has shown significant improvement in recent years compared to the period from 2013 to 2019, particularly in contrast to the poor conditions observed in 2018 and 2019. The increased health of the bay in recent years is related to improving water quality, which appears to mainly be a result of the reduced nitrogen loads to the system. The 20% nitrogen load reduction goal set back in 2021 has likely been achieved through wastewater infrastructure upgrades, regional stormwater retrofit projects in Phillippi Creek and Hudson Bayou, completion of several habitat restoration/stormwater retrofit projects, and public awareness around improving the bay's health (Report Card | Sarasota Bay Estuary Program)" (Figure 16).



Source: Report Card | Sarasota Bay Estuary Program

Figure 16 – The Sarasota Bay estuary report card published annually by the SBEP

Pollutant Loading Model

The implementation of effective pollutant load reduction actions is contingent upon understanding nutrient sources and sinks in a watershed and receiving waterbody. Accurately characterizing nutrient pathways is challenging and requires the use of numerical models that employ mathematical and statistical methods to represent the behavior of complex physical, chemical, and biological processes over time.

One such model funded by the District and Sarasota County is called the Spatially Integrated Model for Pollutant Load Estimation (SIMPLE) developed by Jones Edmunds & Associates, Inc. in 2009 (Jones Edmunds & Associates, Inc, 2009). The model was an upgrade from the previous Watershed Management Model that was utilized prior to SIMPLE's development. The SIMPLE model uses spatially explicit and temporally dynamic inputs to calculate monthly nutrient loading estimates from six sources.

- Direct runoff
- Baseflow
- Point source discharge (including accidental spills)
- Septic systems
- Reclaimed water irrigation
- Atmospheric deposition

A schematic of the model is provided in Figure 17 showing how the individual model modules are aggregated to generate total pollutant loadings.

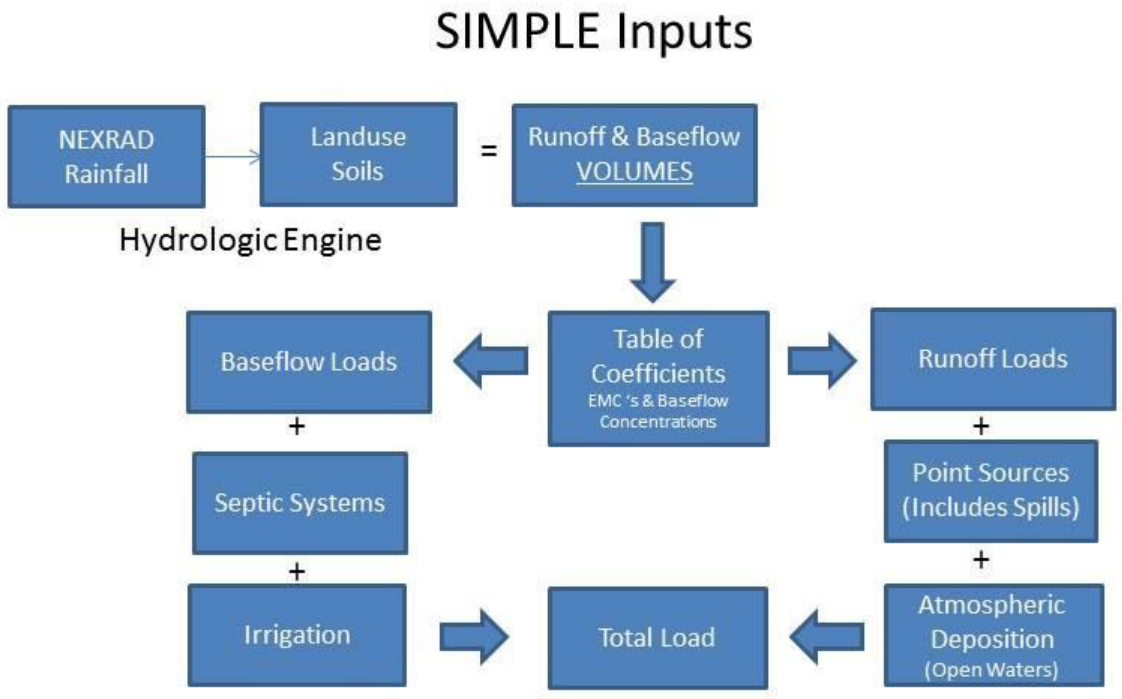


Figure 17 – Schematic of SIMPLE model architecture.

A hydrologic engine uses daily NEXRAD (Next Generation Weather Radar) precipitation data and spatially explicit land-use and soils information to generate runoff and baseflow volumes at a monthly time step. NEXRAD rainfall data are used to simulate the interaction between infiltration, evapotranspiration, groundwater flow, leakage from the surficial aquifer, and to evaluate a watershed's water budget on a daily time-step. NEXRAD rainfall is provided by the District, and evapotranspiration estimates from the United States Geological Survey (USGS). A table of coefficients including event mean concentrations for runoff and base flow concentrations are used to generate the runoff and baseflow loads, respectively. In an additive process, point sources (including spills) and direct atmospheric deposition (for open waters) are added to the runoff loads. Estimates from septic systems and reclaimed water irrigation are added to the baseflow component to generate the total load at the sub-basin level. The loads can then be aggregated over various spatial and temporal extents.

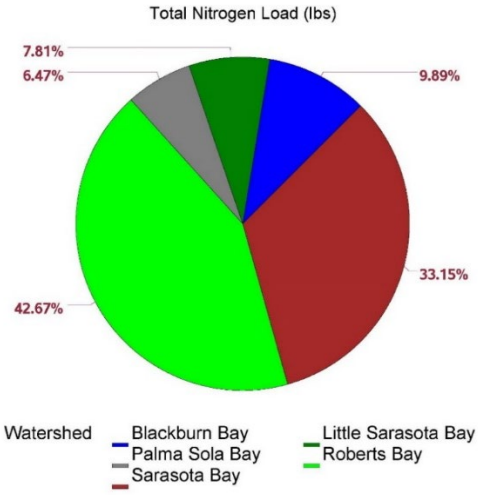
The SIMPLE model estimates several water quality parameters, including inorganic nitrogen, organic nitrogen, total phosphorus, orthophosphorous, and selected metals including lead, copper, zinc, and cadmium. The SIMPLE model also provides estimates of other water quality parameters including biological oxygen demand, chemical oxygen demand, total suspended solids, total dissolved solids, and oils. Because nitrogen is the primary pollutant of concern in Sarasota Bay, it is highlighted in this section. More detailed information about the SIMPLE model and other water quality parameters can be found in Appendix A.

SIMPLE Model Output

Sarasota County hosts a SIMPLE Monthly Dashboard for the Sarasota County portion of the Sarasota Bay estuary (SIMPLE Monthly Viewer). This is an interactive tool to visualize pollutant loading estimates for nitrogen and other SIMPLE parameters. The Manatee County portion of Sarasota Bay was recently added to the SIMPLE model, the details of which can be found in Appendix A.

Based on the SIMPLE model output, the greatest relative nitrogen contribution across all Sarasota Bay estuaries comes from the Roberts Bay watershed (Figure 18) representing 43% of the total nitrogen load. Nitrogen enters Roberts Bay primarily via Phillipi Creek, the main drainage feature in this watershed. The Sarasota Bay Proper watershed has the second largest contribution representing 33% of the total load. Unlike Roberts Bay, Sarasota Bay Proper does not have a major drainage feature, rather it is comprised of small creeks and other drainage features in the urban downtown area of Sarasota and the airport and commercial zones between the cities of Sarasota and Bradenton (Jones Edmunds and ESA, 2025b).

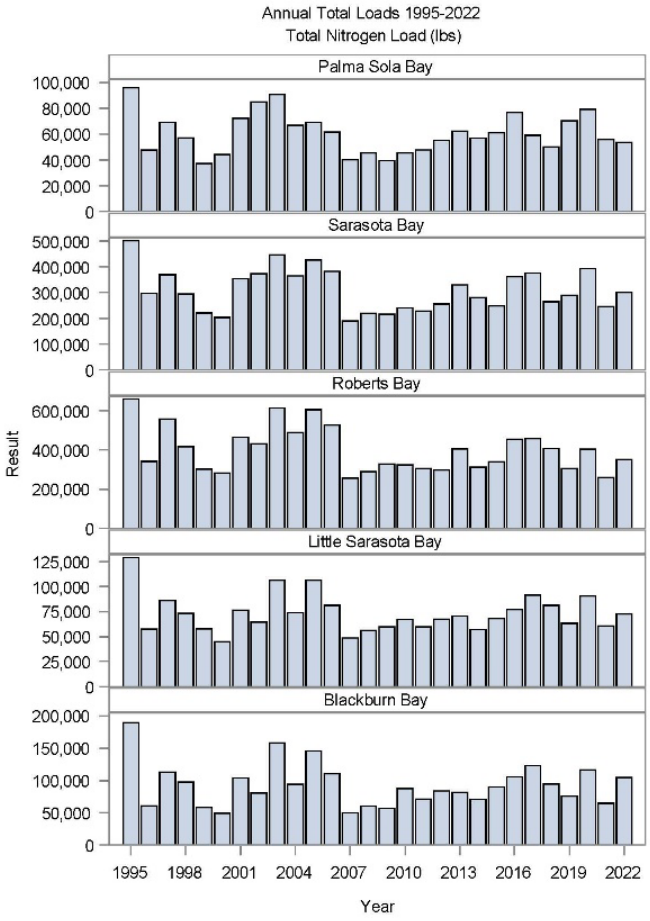
The largest contributor of nitrogen and the most critical factor for bay management is direct runoff from rainfall (Appendix A: Figures 13 through 15).



Source: Jones Edmunds and ESA, 2025b; SWFWMD.

Figure 18 – Proportion of Nitrogen Loads by Watershed in Sarasota Bay

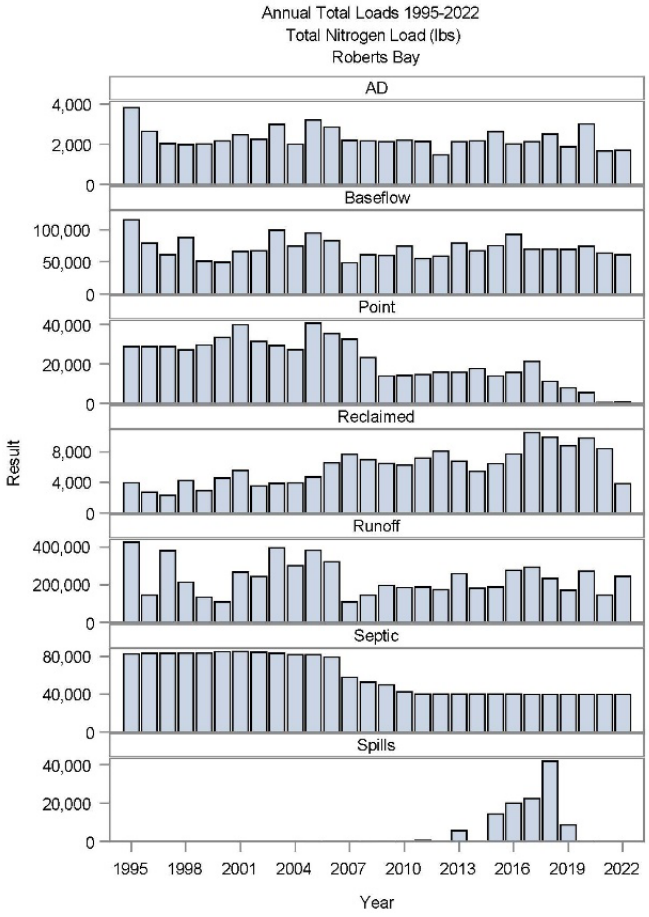
In 2022, Roberts Bay also had the greatest absolute total nitrogen load (approximately 400,000 lbs TN) followed by Sarasota Bay Proper at approximately 300,000 lbs TN (Figure 19).



Source: Jones Edmunds and ESA, 2025b; SWFWMD.

Figure 19 – Time-series of annual loads to each bay segment for total nitrogen.

In all segments atmospheric deposition and baseflow remained relatively consistent throughout the modeled period 1995-2022. All bay segments increased in reclaimed water loads mostly related to increases in development with reclaimed water irrigation. Decreasing contributions in point source loads from decommissioning of wastewater treatment facilities. Overall decrease in total nitrogen loading from septic systems from the Phillippi Creek Septic System Replacement Program in Roberts Bay. Between 2013 and 2019, wastewater overflows (spills) were captured in Roberts Bay (Figure 20).



Source: Jones Edmunds and ESA, 2025b; SWFWMD.

Figure 20 – Time-series of annual total nitrogen loads by source to Roberts Bay. Direct runoff to Roberts Bay contributes more than an order of magnitude to the total nitrogen load. AD is direct atmospheric deposition to the open water portion of Roberts Bay.

Results from the SIMPLE model have shown that stormwater runoff continues to be a major contributor to the total nitrogen load in each Sarasota Bay segment. The greatest contribution of total nitrogen to the Sarasota Bay estuary is in Roberts Bay and Sarasota Bay Proper. Based on these outputs, the Sarasota Bay SWIM Plan update focuses on these two bay segments while aggressively looking for opportunities to implement nitrogen load reduction projects in all Sarasota Bay segments.

Natural Systems Protection and Restoration

Restoring and safeguarding interconnected habitats is crucial to the health of Sarasota Bay and its tributaries. Estuarine habitats such as seagrasses, oyster beds, and wetlands were severely impacted in the 1900s due to deteriorating water quality and dredge-and-fill operations meant to create boat access for waterfront properties. Since SWIM's inception, habitat restoration has been a cornerstone of the program. From 1989 to 2025, the SWIM Program in cooperation with its many partners completed 38 restoration projects, 14 of which met water quality initiatives. This resulted in over 1,000 acres of coastal habitat restoration, and more than 45,000 acres of watershed treated. For an updated project list, the District's SWIM Program publishes an annual report outlining restoration activities across all twelve SWIM priority waterbodies (https://www.swfwmd.state.fl.us/projects/swim).

Given the urbanized nature of the entire Sarasota Bay watershed, future restoration opportunities are becoming few and far between. Conservation lands within the Sarasota Bay Watershed are generally small and isolated. The largest conservation land is Oscar Scherer State Park, which protects approximately 1,500 acres of predominately pine flatwoods, including pockets of depressional freshwater marshes and floodplain swamps adjacent to South Creek. The park is an important refuge for Florida scrub-jay and serves as an important riparian buffer for South Creek. Beyond this parcel, there is little opportunity for large habitat restoration projects.

This SWIM Plan update continues to prioritize working with local partners like the City of Sarasota, Sarasota County, Manatee County, and others to find opportunities for habitat restoration projects.

Previous Habitat Restoration Activities

Several natural systems restoration projects have been completed in the Sarasota Bay Watershed. The District's SWIM Program has led and collaborated with local partners in a variety of natural systems restoration projects. As of 2025, the SWIM Program has completed 38 restoration projects totaling over 1,000 acres of restoration in the Sarasota Bay Watershed.

Notable natural systems restoration projects completed in the Sarasota Bay Watershed include the Robinson, Neal, and Perico Preserves. All three projects were restored by the SWIM Program in partnership with Manatee County. These adjacent parks form an important network of coastal habitats on the north shore of Palma Sola Bay, providing an important natural bridge between the Tampa Bay and Sarasota Bay Watersheds. Nearly 300 acres of open water, freshwater wetlands, intertidal wetlands, and coastal uplands were created or restored at Robinson Preserve Phases 1 and 2. Neal Preserve, completed in 2011, restored intertidal and coastal upland habitats on nearly 120 acres. Hydrologic alterations at Neal Preserve provide water quality benefits through stormwater treatment before discharging into Sarasota Bay. Perico Preserve included over 50 acres of creation and enhancement of open water, intertidal wetlands, and coastal upland habitats. This project provides improved hydrologic conditions thus improving habitat and water quality on the site.

The SWIM Program helped fund the Ungarelli Preserve, a 35-aces parcel on the south shore of Palma Sola Bay where intertidal wetlands and coastal uplands have been restored. Several habitat restoration phases have also been completed at the Florida Institute for Saltwater Heritage (FISH) property near the Cortez Preserve as a collaborative effort between the District, the Sarasota Bay Estuary Program, FISH, the Florida Fish and Wildlife Conservation Commission, The United States Environmental Protection Agency (EPA), and the National Oceanic and Atmospheric Administration. The final phase

was completed in 2023 (Figure 21). More information on this 100-acre site can be found at FISH Preserve Fully Restored.

Source: SBEP.

Figure 21 – Final Phase of the FISH Preserve completed in November 2023

Since becoming a SWIM Priority Waterbody, coastal preserves along the barrier islands have been enhanced or restored in partnership with the SBEP including South Lido Park (approximately 100 acres), Quick Point Nature Preserve (34 acres), Joan M. Durante Park (approximately 32 acres), and Leffis Key Preserve (approximately18 acres).

Red Bug Slough is a 72-acre preserve in suburban Sarasota. The preserve was acquired in 2000–2001 through the Environmentally Sensitive Lands Program, with additional funding assistance from the Florida Communities Trust. The District and Sarasota County cooperatively funded a restoration project in 2010 to re-contour portions of the main ditch system to reduce erosion and create a littoral shelf, as well as enhancing wetland vegetation. Like many small preserves in the watershed, the proximity to urban development and large edge relative to the size of the natural area necessitate regular maintenance to manage invasive species and water-quality impacts.

The area known as Celery Fields were used for various farming operations, mostly celery, until acquired by Sarasota County in 1995 are and used primarily as a flood attenuation area, but the District and Sarasota County restored over 170 acres of wetlands in the south cells, which are now part of the Great Florida Birding and Wildlife Trail, which the Audubon Society uses for several of their tours and activities. The District supported the City of Sarasota in developing a regional stormwater treatment

facility as part of the redevelopment of the Bobby Jones Golf Club. This 18-acre system of interconnected wetlands captures runoff from over 5,000 acres of urban and residential areas with limited existing treatment. It is expected that the treatment wetlands could remove over 900 lbs of nitrogen and 300 lbs of phosphorous annually from Phillippi Creek and Sarasota Bay.

Natural Systems Status and Trends

The 2022 SBEP CCMP prioritizes habitat restoration. For example. The Palmer Point Beach Park and Jim Neville Marine Preserve, together comprising about 150 acres near the south end of Siesta Key, have been identified by SBEP as one of the last remaining opportunities for restoration in the area. Few restoration and conservation opportunities exist in the eastern part of Sarasota Bay, particularly away from the shore.

Similarly, the District supports Sarasota County's plans to purchase the 49-acre Gulf Gate Executive Golf Course to create another regional stormwater treatment facility. As with the Sarasota Treatment Wetlands project, this parcel is downstream of older developments that predated regulatory requirements for integrated treatment and retention systems (Sarasota Herald Tribune 11/6/2023). SBEP's *Five-Year Habitat Restoration Plan* was last updated for FY2016 to FY2020. The next update to the *Five-Year Habitat Restoration Plan* is expected to be completed in 2025. SWIM Program's mission aligns with and supports the goals identified in the *Five-Year Habitat Restoration Plan*. The habitat types within the watershed that are critical habitats for healthy ecological function and water quality include wetlands, seagrass, and upland habitats.

Wetlands Habitat

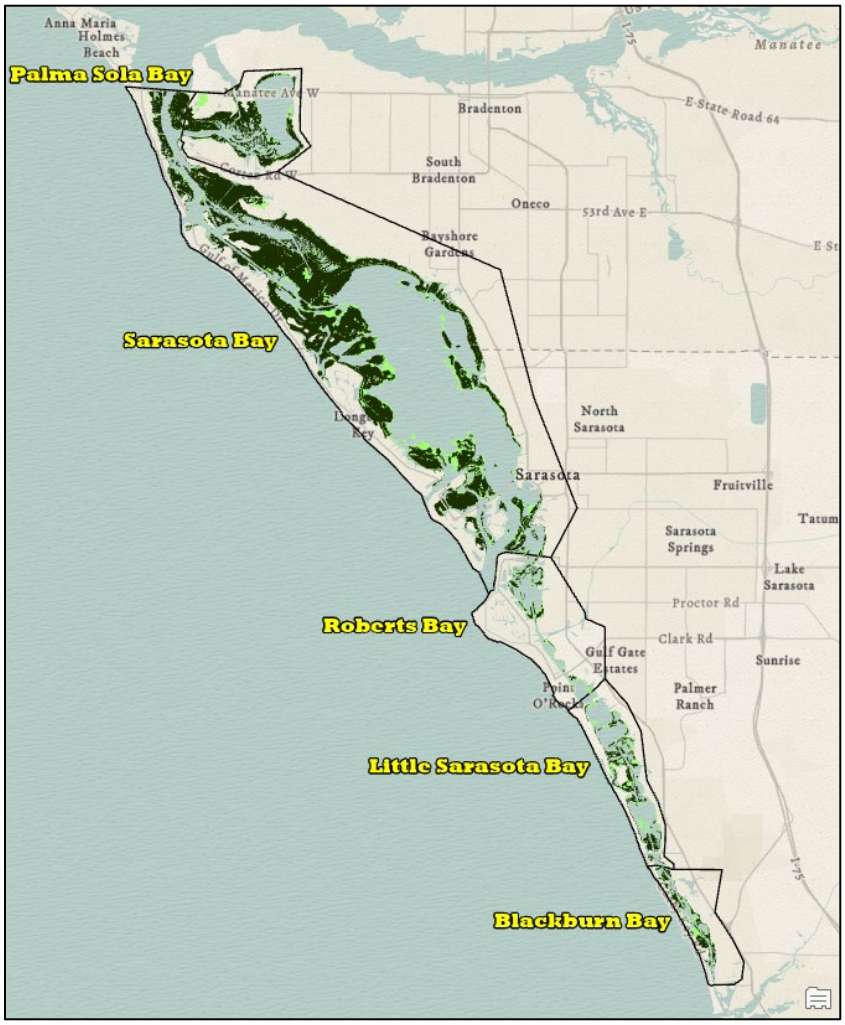
Wetlands provide flood retention, water quality improvement, and habitats for feeding and sheltering a variety of fish, birds, and other wildlife. Therefore, the CCMP identifies wetland habitat enhancement and/or creation projects as a priority for bay restoration. Wetlands are classified into two types – tidal or freshwater – based on salinity range.

The suite of tidal wetlands includes mangrove forests, salt marshes, and salt barrens that exist in a dynamic equilibrium controlled by factors such as storm surge and flood damage, periodic freezes, and sea level rise (Robison, 2010). In Sarasota Bay, vegetated tidal wetlands provide essential nursery habitat for many aquatic species. Tidal marshes absorb excess nutrients before they reach oceans and estuaries and buffer shorelines to slow erosion. Mangrove forests are a crucial habitat for most fish species at various stages in their life cycle in addition to providing shelter and nesting sites for waterfowl.

Freshwater wetlands include natural streams, waterways, and lakes; wetland hardwood forests (e.g., bay swamps); wetland coniferous forests (e.g., cypress swamps); wetland mixed; and vegetated non-forested wetlands (e.g., freshwater marshes). Estuarine health depends on the quantity, quality, and timing of freshwater inputs (Olsen, et al., 2006). Freshwater wetlands, sawgrass marshes, and ponds were once the predominant freshwater features within Sarasota Bay. More than 75 percent of all freshwater wetlands have been dredged or filled to some degree, with only 21 percent exhibiting no signs of human impact (SBEP, 1992). Less water is being retained within the watershed, reducing groundwater recharge and natural surface water storage. Sarasota Bay's *Framework for Action* (SBEP, 1992) documented an approximate 39-percent decline in wetland habitats throughout the Bay's watershed during 1950–1990. The 2022 SBEP CCMP estimated that Sarasota Bay has 5,678 acres of freshwater wetlands.

Seagrass Habitat

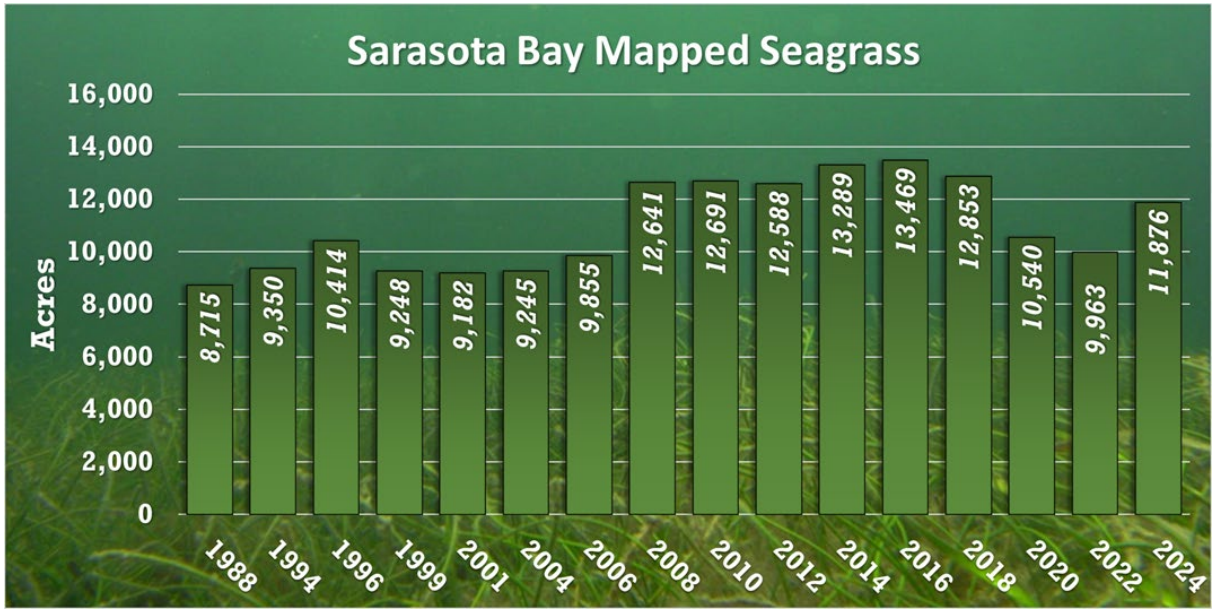
The District has been mapping seagrasses in Sarasota Bay since the late 1980s using aerial imagery collected specifically for mapping seagrass habitat. This is part of a larger seagrass mapping program that encompasses the entire District coastal region and represents one of the most comprehensive seagrass mapping programs in the world. The District's seagrass maps are used extensively by various stakeholders as the primary indicator of long-term estuarine health. Over the decades, these seagrass maps have been used to measure the success of projects and initiatives within the watershed designed to improve the Bay's water quality. Seagrass maps are produced in Sarasota Bay every 2 years, with the most recent map to date completed in 2024. The 2024 seagrass map of the Sarasota Bay estuaries includes Palma Sola Bay, Sarasota Bay Proper, Roberts Bay, Little Sarasota Bay, and Blackburn Bay (Figure 22). Dark green shading represents areas mapped as continuous seagrass defined as those areas between 25% and 100% coverage. Light green shading represents areas mapped as patchy or sparse seagrass defined as those areas with less than 25% coverage.



Source: SWFWMD.

Figure 22 – 2024 Seagrass Map of the Sarasota Bay Estuaries

In 2024, seagrass habitats in the estuaries of Sarasota Bay were relatively healthy, although since 1988 gains and losses have occurred (Figure 23).



Source: SWFWMD.

Figure 23 – Sarasota Bay Seagrass Acreage 1988–2024

Between 1988 and 2016, total seagrass coverage expanded from 8,715 acres to a record 13,469 acres—a 55-percent gain over the 28-year period. In 2018, a slight loss of seagrass was followed by sharp declines in 2020 and 2022. Between 2016 and 2022, Sarasota Bay lost 26 percent or 3,506 acres. This loss was a combination of impacts from wastewater and the 2017–2019 red tide event, the worst on record for Southwest Florida. Following improvements in wastewater management and the absence of major red tide, seagrass coverage rebounded in 2024 with a 19-percent gain compared to 2022. Although this recovery is good news and local governments like Sarasota County are continuing to make progress in reducing wastewater impacts to the lowest possible levels, other impacts such as increased development, aging stormwater infrastructure, and future red tide events underscore the need for the District's seagrass mapping program to continue monitoring these ecologically and economically important estuaries.

Upland Habitat

The collection of upland habitats in Sarasota Bay consists of dry prairies, shrubs and brushland (native grasslands), mixed rangeland, upland coniferous forests (e.g., pine flatwoods), and upland hardwood forests (ex. oak hammocks). The Sarasota Bay area has 5,678 acres of freshwater wetlands and 4,899 acres of forested uplands remaining (SBEP, 2022).

As urban development expands within the watershed, large-scale restoration opportunities have become limited and conservation areas are fragmented, reducing their overall effectiveness. Residential development and the interstate (I-75) encroach on the Oscar Scherer Park boundary. With increasing development predicted east of I-75 in the next 20 years, the Oscar Scherer Park will likely become one of the last remaining islands of undeveloped land in this watershed.

Sarasota Bay SWIM Plan Goals

The 2025 Sarasota Bay SWIM Plan Update analyzed status and trends in the Bay's water quality. Given the estuary's overall health, the SWIM Plan Update takes a "hold the line" approach for managing Sarasota Bay, an approach consistent with the SBEP. Holding the line, however, does not mean doing nothing. Careful attention is needed to ensure that the progress made over the past 2 decades is not lost due to land use changes, sea-level rise, red tide, climate change, and other impacts. To hold the line, this SWIM Plan Update includes the overarching water quality and natural systems goals shown in Table 6. Goals were developed to align with established partnerships with regional stakeholders and complement Sarasota Bay's CCMP.

Table 6 – Water Quality and Natural Systems Goals

Water Quality
Hold the line or reduce nitrogen loads by working with partners to minimize potential load increases from new development while implementing initiatives and projects to reduce existing loads.
Support monitoring and research to better understand estuarine response to nutrient loads, harmful algal blooms (HABs), hurricanes, and other drivers in Sarasota Bay estuaries.
Work with partners to estimate annual nutrient loads and identify ways to improve loading models to more accurately reflect actual loads.
Seek opportunities for water-quality improvement projects to reduce nutrient loads and increase ecosystem resiliency across the waterbody.
Natural Systems Protection and Restoration
Administer the District's Seagrass Mapping Program in Sarasota Bay and continue working with partners to improve accessibility and utility of the mapped results.
Evaluate the quality and functionality of past SWIM Program restoration projects.
Seek opportunities for habitat restoration projects that increase ecosystem resiliency across the waterbody.
Work with partners to develop and implement sustainability plans to ensure the continued health of Sarasota Bay estuaries.

Management Actions

One of the goals of this SWIM Plan Update is to identify strategic initiatives that will address the major issues and drivers and provide management actions that will improve and maintain the ecological health of Sarasota Bay. Management actions are grouped into discrete focus areas of water quality and natural systems (Table 7 and Table 8). These focus areas are interdependent, and this plan focuses on projects and initiatives that will address both focus areas to maximize the return on investment. For example, water-quality management actions may have direct impacts on achieving the natural systems seagrass targets for a particular Bay segment. Monitoring and research actions to better understand the dynamics between complex drivers and estuarine conditions are included for each of the focus areas and are essential elements to adaptive management.

This SWIM plan update, together with the SBEP, takes a "hold the line" approach to maintain desirable water quality and maximize beneficial ecosystem function. Hold-the-line does not mean "do nothing" rather it is a call to implement management actions, projects, and initiatives toward building resiliency and helping maintain a healthy Sarasota Bay. Reducing nutrient inputs to the Bay is a proven way to increase the bays resiliency against future impacts like red tide, hurricanes, and development. To date the SBEP proposes to use a reference period approach to establishing nitrogen reduction goals in their WQPP. This reference period approach is based upon conditions during the 2009-2012 period, a time when nutrient concentrations were low and seagrass coverage was increasing.

This plan update follows SBEP's reference period approach as an indicator for tracking progress only and not as a specific numeric goal or target. This plan recognizes the need to focus more on seizing opportunities to reduce the anthropogenic nitrogen footprint rather than meeting a specific numeric target. This plan's approach affords the flexibility to refine existing paradigms and management actions in a rapidly changing environment.

Water Quality

Table 7 – Water Quality Management Actions

Monitoring and Research
Support SBEP's Water Quality Protection Plan and prioritize monitoring and research that best align with the SWIM Program's mission.
Support measures to better understand, monitor, report, respond to, recover from, mitigate, and reduce HABs.
Better understand nutrient sources and sinks.
Investigate the potential linkages between red tide, the occurrence of macroalgal blooms, and the loss and recovery of seagrass habitat.
Support actions to estimate watershed nutrient loads based on dissolved inorganic nitrogen (DIN).
Water Quality Protection and Restoration
Support the SBEP's Water Quality Protection Plan and prioritize projects that best align with the SWIM Program's mission.
Work with local, regional, and state agencies to implement stormwater BMPs aimed at reducing pollutant loading, enhancing water quality, and improving water clarity.
Support the development of local government stormwater master plans and watershed management plans.
Education and Outreach
Continue to support Florida-friendly landscaping principles.
Continue to support stakeholders in conserving water and protecting water quality through outreach and implementation of BMPs.

Natural Systems Protection and Restoration

Table 8 – Natural Systems Management Actions

Monitoring and Research
Complete biennial surveys of seagrass habitat through the District's seagrass mapping program.
Evaluate new and cost-effective technologies to improve the District's seagrass mapping program.
Complete site assessments on completed SWIM Program restoration projects consistent with methodologies implemented in other SWIM Priority Waterbodies.
Understand the impacts of hurricanes, sea-level change, and climate on the sustainability and resilience of Sarasota Bay estuaries.
Continue to support Sarasota Bay's *Eyes on Seagrass Initiative*.
Natural Systems Conservation and Protection
Continue to support acquisition of priority lands for natural systems restoration and water quality improvement projects in the Sarasota Bay Watershed.
Natural Systems Restoration
Continue working with partners to identify natural systems restoration and enhancement efforts.
Support the assessment of restoration opportunities to incorporate natural systems and water-quality improvements in redeveloped landscapes.
Support programs and projects in the SBEP 2022 CCMP.
Explore opportunities for urban stream restoration and/or enhancement, including drainage ditches to multi-stage channels.

Projects and Initiatives

Projects and initiatives for Sarasota Bay identified in this plan address specific management actions as outlined in the previous section. However, not every management action has a specific project associated with it. The SWIM Plan is meant to be a living document with adaptive management at its core. This section is expected to be updated to include additional projects and initiatives as needed. The proposed projects and initiatives listed below are broken into the two major focus areas of Water Quality and Natural Systems Protection and Restoration. This plan recognizes that each of these focus areas are not mutually exclusive. Therefore, some projects may contain elements that overlap across focus areas.

Water Quality Projects and Initiatives

Monitoring and Research
Support the SBEP's Water Quality Protection Plan and prioritize monitoring and research that best align with SWIM's mission. **Partners:** The District, SBEP 1. Continue supporting the long-term surface water and groundwater quality monitoring, assessment, and reporting. 2. Provide District representation on the SBEP's TAC and subcommittees. 3. Leverage District's technical expertise to evaluate water-quality monitoring design, analysis, and reporting.
Support measures to better understand, monitor, report, respond to, recover from, mitigate, and reduce HABs. **Partners:** The District, SBEP, FWC, FDEP, Local Municipalities 1. Support researching, developing, testing, and evaluating standardized tools for monitoring and reporting HABs. 2. Provide support to the District's Emergency Operations Center Water Quality Response and Recovery Unit after major storm events and coordinate with state and local municipalities.
Better understand nutrient sources and sinks. **Partners**: The District, SBEP, FWC, Universities 1. Identify localized nutrient load sources (i.e., groundwater and internal nutrient cycling) near areas of significant seagrass loss and drift and attached macroalgae. 2. Improve quantitative estimates of Bay nitrogen loadings from reclaimed water use in the Sarasota Bay Watershed. 3. Track beneficial uses of reclaimed water and evaluate cumulative effects on ground and surface water quality/quantity.
Investigate the potential linkages between red tide, the occurrence of macroalgal blooms, and the loss and recovery of seagrass habitat. **Partners:** The District, SBEP, FWC, Universities 1. Characterize impacts of the 2018 red tide event on long-term seagrass sustainability in Sarasota Bay estuaries.

Support actions to estimate watershed nutrient loads based on DIN.

Partners: The District, SBEP, Local Municipalities

1. Support development of DIN summaries for the Manatee County portion of the Sarasota Bay Watershed.
2. Maximize the use of measured nitrogen loads as the basis for planning purposes and pollutant loading model calibration/verification.
3. Provide technical review and evaluation of monitoring programs and updates to pollutant sources in pollutant load models.

Water Quality Protection and Restoration

Work with local, regional, and state agencies to implement stormwater BMPs aimed at reducing pollutant loading, enhancing water quality, and improving water clarity.

Partners: The District, SBEP, Local Municipalities

1. Work with partners to prioritize nutrient-reduction projects in watersheds that have the greatest nitrogen contribution with special attention to those sources closest to Sarasota Bay estuaries.
2. Support designing, permitting, and construction of regional stormwater improvement projects for efficient pollution reduction.
3. Support projects from Sarasota Bay estuaries watershed management plans.

Natural Systems Protection and Restoration Projects and Initiatives

Monitoring and Research

Evaluate new and cost-effective technologies to improve the District's seagrass mapping program.

Partners: The District, Florida WMDs, FWC

1. Coordinate research, development, testing, and evaluation with Fish and Wildlife Research Institute (FWRI) Seagrass Integrated Mapping and Monitoring Program (SIMM).
2. Participate in the SIMM Inter-WMD Seagrass Mapping and Monitoring annual conference.

Complete site assessments on completed SWIM Program restoration projects consistent with methodologies implemented in other SWIM Priority Waterbodies.

Partners: The District

1. Publish a document of "lessons learned" specific to projects across the Sarasota Bay Priority Waterbody.
2. Work with local partners to develop plans to improve project performance and sustainability.
3. Train local partners on assessment methodology.

Understand the impacts of hurricanes, sea-level change, and climate on the sustainability and resilience of Sarasota Bay estuaries.

Partners: The District, SBEP, Local Municipalities

1. Evaluate ecosystem response in Little Sarasota Bay, Roberts Bay, and Blackburn Bay to Midnight Pass reopening.

Natural Systems Restoration
Continue working with partners to identify natural systems restoration and enhancement efforts. **Partners:** The District, SBEP 1. Leverage the SWIM Program's technical expertise to assist with updating SBEP's Five-Year Habitat Restoration Plan.
Support the assessment of restoration opportunities to incorporate natural systems and water-quality improvements in redeveloped landscapes. **Partners:** The District, Local Municipalities 1. Work with partners to identify opportunities for designing, permitting, and constructing natural systems restoration in urbanized watersheds and redeveloped landscapes.
Support programs and projects in the SBEP 2022 CCMP. **Partners:** The District, SBEP, Local Municipalities 1. Assist with fulfilling the CCMP objectives that support the SWIM Program's mission. 2. Provide technical expertise for the CCMP update.

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APPENDICES

Appendix A: Spatially Integrated Model for Pollutant Loading Estimation (SIMPLE) for Sarasota Bay

Memorandum

date	December 12, 2024
to	Lizanne Garcia, Project Manager
cc	Khan Boupha, Jones Edmunds
from	Jon Perry, ESA
subject	Pollutant Loading Model Review

Spatially Integrated Model for Pollutant Loading Estimation

The Spatially Integrated Model for Pollutant Loading Estimation (SIMPLE) model was originally developed in 2009 for the Southwest Florida Water Management District (District) and Sarasota County (Jones Edmunds, 2009a) to support various planning efforts underway at Sarasota County. The model also went through a calibration exercise using Sarasota County-provided flow and water quality data (Jones Edmunds, 2009b). The model is spatially and temporally explicit and was designed to provide monthly estimates of nutrients, metals, and other general parameters from six distinct loading sources including:

- Direct Runoff
- Baseflow
- Point Sources
- Septic Systems
- Irrigation
- Atmospheric Deposition

A schematic of the model provided in Figure 1 shows how the individual model "modules" are aggregated to generate total pollutant loadings. Briefly, a hydrologic engine uses daily Next Generation Radar (NEXRAD) precipitation data and spatially explicit land use and soils information to generate runoff and baseflow volumes at a monthly time step. Evapotranspiration and other losses are accounted for. Then a table of coefficients, including event mean concentrations (EMCs) for runoff and base flow concentrations, is used to generate the runoff and baseflow loads, respectively. In an additive process, point sources (including spills) and atmospheric deposition (for open waters) are added to the runoff loads and estimates from septic systems and reclaimed water irrigation are added to the baseflow component to generate the total load at the sub-basin level. The loads can then be aggregated over various spatial and temporal extents.

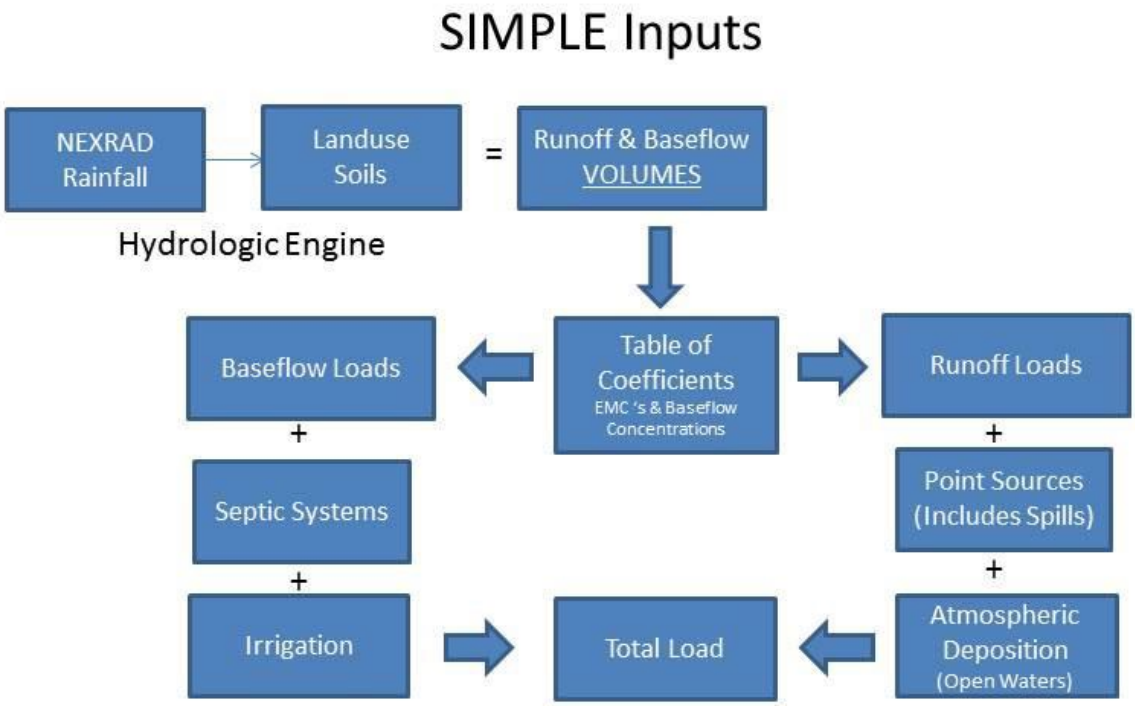

Figure 1. Schematic of the SIMPLE Model Architecture

The model is capable of tracking loads for nutrients (total phosphorus [TP], dissolved phosphorus, total nitrogen [TN], ammonia, nitrite, and total Kjeldahl nitrogen [TKN]), metals (cadmium, copper, zinc, and lead), general parameters (biochemical oxygen demand, chemical oxygen demand, total suspended solids, total dissolved solids, and oil and grease), and fecal coliform bacteria.

Sarasota County hosts the SIMPLE Monthly Dashboard. The dashboard allows users to view and export SIMPLE analysis results. The data are limited to the Sarasota County portion of the Sarasota Bay SWIM Plan project area. The web address is https://simpleviewer.scgov.net/ .

The following sections describe each of the modules in greater detail.

Hydrologic Engine

The primary pollutant loading driver is the hydrologic load from precipitation and is expressed as direct runoff or baseflow loads. The SIMPLE model uses a hydrologic engine for estimating the hydrologic load and was developed to use spatially explicit, daily NEXRAD rainfall data to simulate the interaction between infiltration, evapotranspiration, and groundwater flow and leakage from the surficial aquifer and evaluate the water budget of a watershed on a daily time-step. The NEXRAD rainfall (Figure 2) is provided by the District and evapotranspiration from the US Geological Survey (USGS).

Due to the complexity of the hydrologic calculations required, the hydrologic engine or module is run before the pollutant loading modules. The hydrologic engine calculates the daily runoff and baseflow volumes for each pixel, land use, and soil type combination, which are then summed at a monthly time-

step. Results are stored in the hydrologic lookup table for each pixel, land use, and soil combination with the units of (cubic foot [ft^3]/square foot [ft^2]). When the loading model is run, the actual area of the pixel/land use/soil combination is then multiplied by the volume in the table. This preprocessing saves time because 15 possible land use categories and four soil types exist.

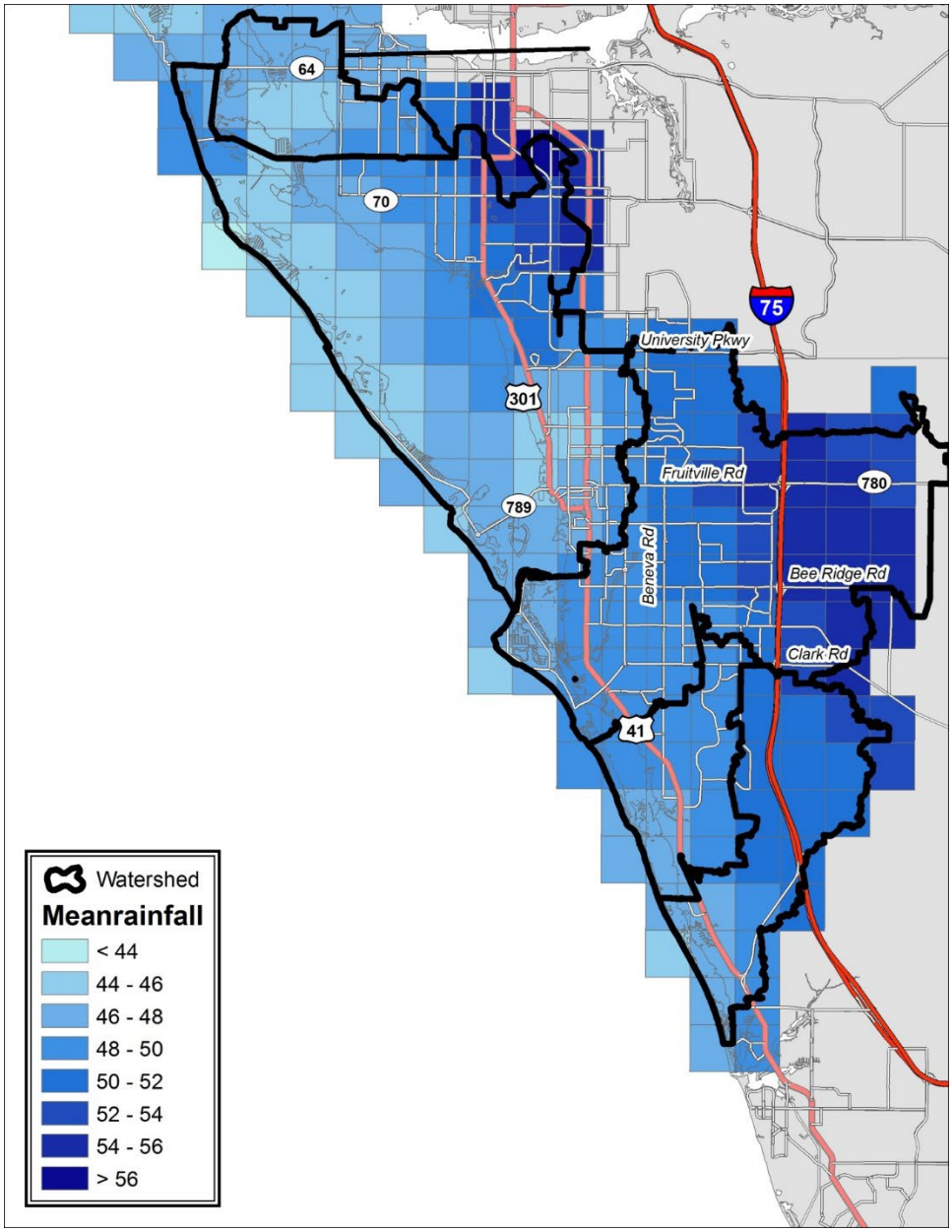

Figure 2. Mean annual rainfall derived from NEXRAD estimates 1995–2019

The methodology for determining the direct runoff volumes follows a modified Natural Resources Conservation Service (NRCS) Technical Report No. 55 (TR-55) methodology, which incorporates a separate value for directly connected impervious areas. For baseflow, or surficial aquifer flow, the model uses the Dupuit-Forchheimer equation found in the Stormwater Management Model.

The spatial resolution of the hydrologic load estimation defines the minimum spatial unit used to estimate pollutant loadings. For this project, these were based on the stormwater catchments provided by Sarasota County (Sherry Smith, personal communication, 08/10/2021) combined with a basin file for Manatee County (Figure 3). These provide a proper scale to identify areas in need of possible management actions. The loading estimates can be spatially aggregated to represent a number of spatial scales. For this project, the loading estimates are reported at the catchment, basin, and watershed scales.

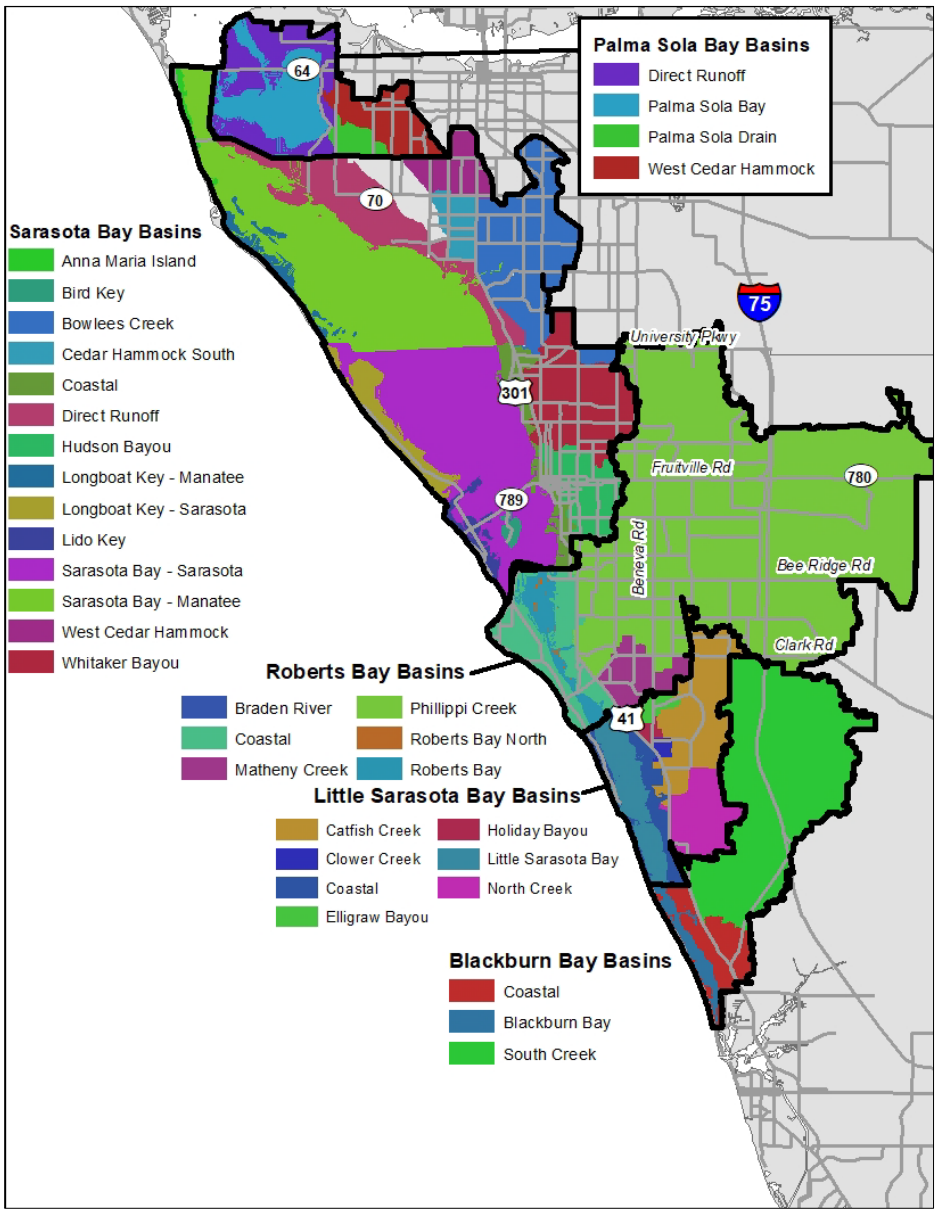

Figure 3. Basins Used within the SIMPLE Model

The land use layer used in this project was derived from an overlay of the District's land use features. Since the model is temporally enabled, changes in land use can be expressed over time. For example, an area once forested could be cleared for pasture, which could then be further developed into a

medium-density residential development and the model could track the changes in loadings from those changes over time. Figure 4 presents the 2021 land uses.

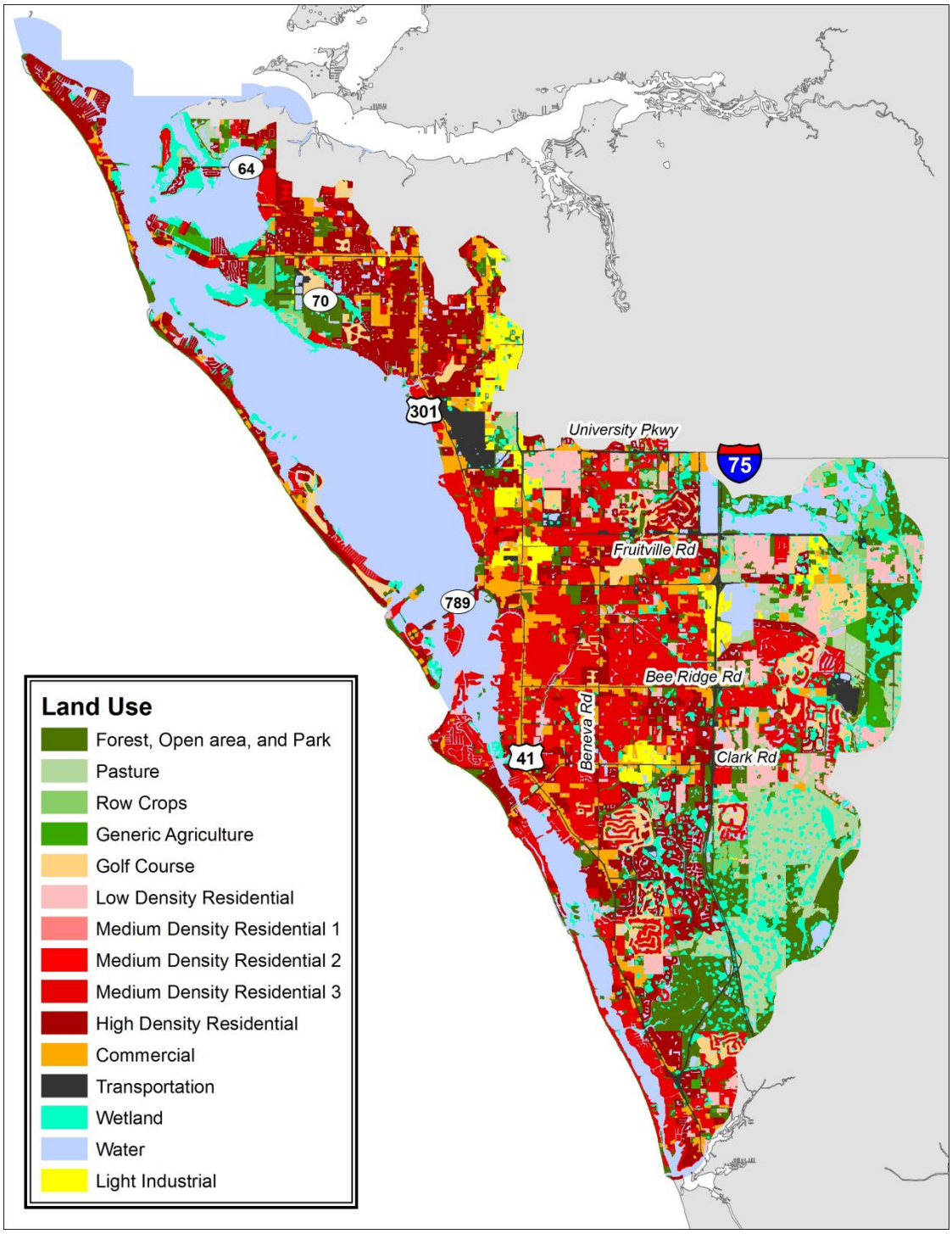

Figure 4. Map of the 16 Major Land Use Categories Used in the SIMPLE Model for 2021

The soils data used in this project were obtained from the 2018 NRCS soils layer. The model relies on the hydrologic soil groups for various loading modules including runoff, baseflow, and septic tanks and drainfields (Figure 5).

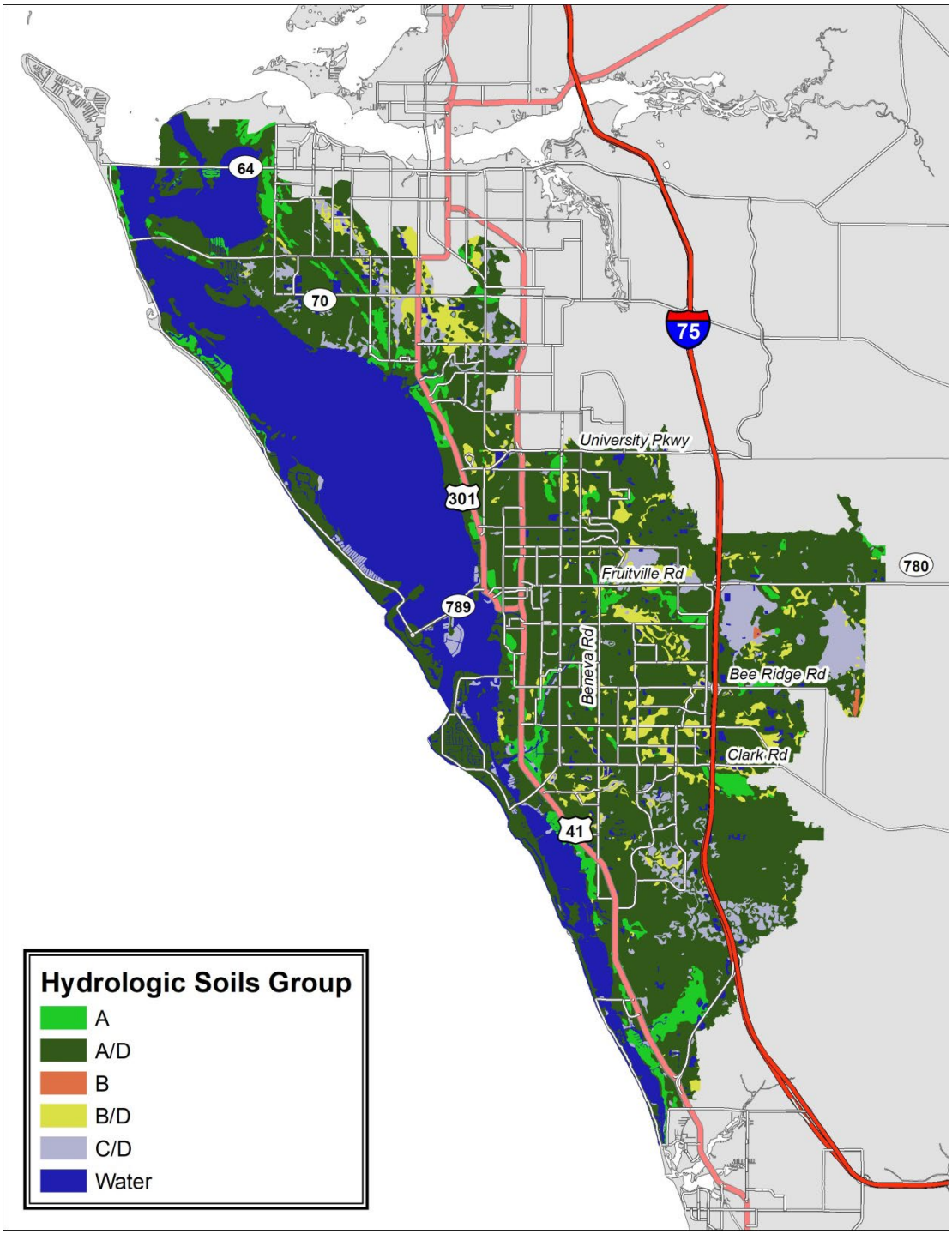

Figure 5. Map of the Hydrologic Soil Groups (NRCS, 2018) within the Sarasota Bay Watershed

Direct Runoff and Baseflow Loadings

To estimate the runoff/baseflow loads, the module requires the intersection of the basin, soils, NEXRAD pixels, and time-stamped land use feature classes to identify the proper hydrologic loads from the hydrologic engine.

The hydrologic loads are then combined with the appropriate land use EMCs (Table 1) and baseflow concentrations (Table 2) to calculate the runoff and baseflow loads. As described in the model report (Jones Edmunds, 2005) for runoff loads, EMC lookup tables are predominantly based on those used in the *Watershed Management Model* (SWMM) (Camp Dresser & McKee [CDM], 1993) and were supplemented as needed with EMCs for pollutant runoff from wetlands from the Lemon Bay Model (ERD, 2003) (for biochemical oxygen demand [BOD], total suspended solids [TSS], TP, and TN).

TABLE 1 - EVENT MEAN CONCENTRATIONS FOR DIRECT RUNOFF LOADING ESTIMATION

Description	TP (mg/L)	DP (mg/L)	TKN (mg/L)	NO_2+NO_3 (mg/L)	NH_3 (mg/L)	TN (mg/L)
Forest, Open Area, and Parks	0.055	0.02	0.92	0.23	0.22	1.15
Pasture	0.616	0.23	2.79	0.68	0.67	3.47
Row Crops	0.593	0.22	2.12	0.53	0.51	2.65
Generic Agriculture	0.431	0.16	2.23	0.56	0.54	2.79
Golf Course	1.13	0.42	2.99	0.75	0.72	3.74
Low Density	0.191	0.08	1.29	0.32	0.31	1.61
Med. Density Residential	0.327	0.13	1.66	0.41	0.4	2.07
High Density Residential	0.52	0.25	1.86	0.46	0.45	2.32
Commercial	0.345	0.23	2.16	0.24	0.52	2.4
Transportation	0.22	0.15	1.47	0.17	0.35	1.64
Wetland	0.09	0.06	0.73	0.71	0.18	1.44
Water	0.17	0.12	0.5	0.48	0.12	0.98
Bay	0	0	0	0	0	0
Light Industrial	0.26	0.17	1.08	0.12	0.26	1.2

Note: DP = Dissolved Phosphorus; NH_3 = ammonia; NO_2+NO_3 = nitrite and nitrate.

Baseflow concentrations are also the same as those used in the SWMM (CDM, 1993).

TABLE 2 - BASEFLOW LOADING CONCENTRATIONS

TP (mg/L)	DP (mg/L)	TKN (mg/L)	NO_2+NO_3 (mg/L)	NH_3 (mg/L)	TN (mg/L)
0.2	0.05	0.7	0.05	0.1	0.75

A structural best management practices (BMPs) feature class that identifies BMPs by type and location was updated through 2022 (Figure 6). Most of the BMPs exist as stormwater wet-detention ponds. Each BMP has specific percent-removal efficiencies associated with them for use in reducing the pollutant loads (Table 3). BMP removal efficiencies for wet detention are based on values used in the SWMM (CDM, 1993). Other removal efficiencies were based on published monitoring results from numerous studies conducted by the Florida Department of Environmental Protection (FDEP), the US Environmental Protection Agency, the Federal Highway Administration, the District, and the Metropolitan Washington, D.C. Council of Governments (Jones Edmunds, 2005). Exfiltration values mimic retention, since both remove pollutants via overall loss of rainfall volume. Removal efficiencies for oil and grease and fecal coliform were obtained from values compiled within the International Best Management Practices Database (https://bmpdatabase.org/). The model is flexible enough to support as many BMP types as necessary. Project-specific efficiencies can also be accommodated. The predominant BMP type is wet detention designed under the standard District criteria. All efficiencies assume that the BMPs are maintained and operated as designed. Additional BMPs are also represented in the model whose removal efficiencies are constant across all parameters, including retention, exfiltration, and retention facilities for discharges to Outstanding Florida Waters with removal efficiencies of 90, 90, and 99, respectively. The removal efficiencies listed are relatively standard around the state.

The primary limitation of the implementation of BMPs in the SIMPLE model is that the efficiencies are only applied to the overall loads treated by the BMP; however, the volume of water captured by a BMP is not reduced.

For baseflow loads, the infiltrated volume (from the vadose zone) becomes part of the saturated groundwater module (Jones Edmunds, 2005). The Dupuit-Forchheimer equation was chosen because it has wide application in predicting surficial aquifer groundwater flow. This equation is one of the options used in the SWMM (CDM, 1993) and is well documented.

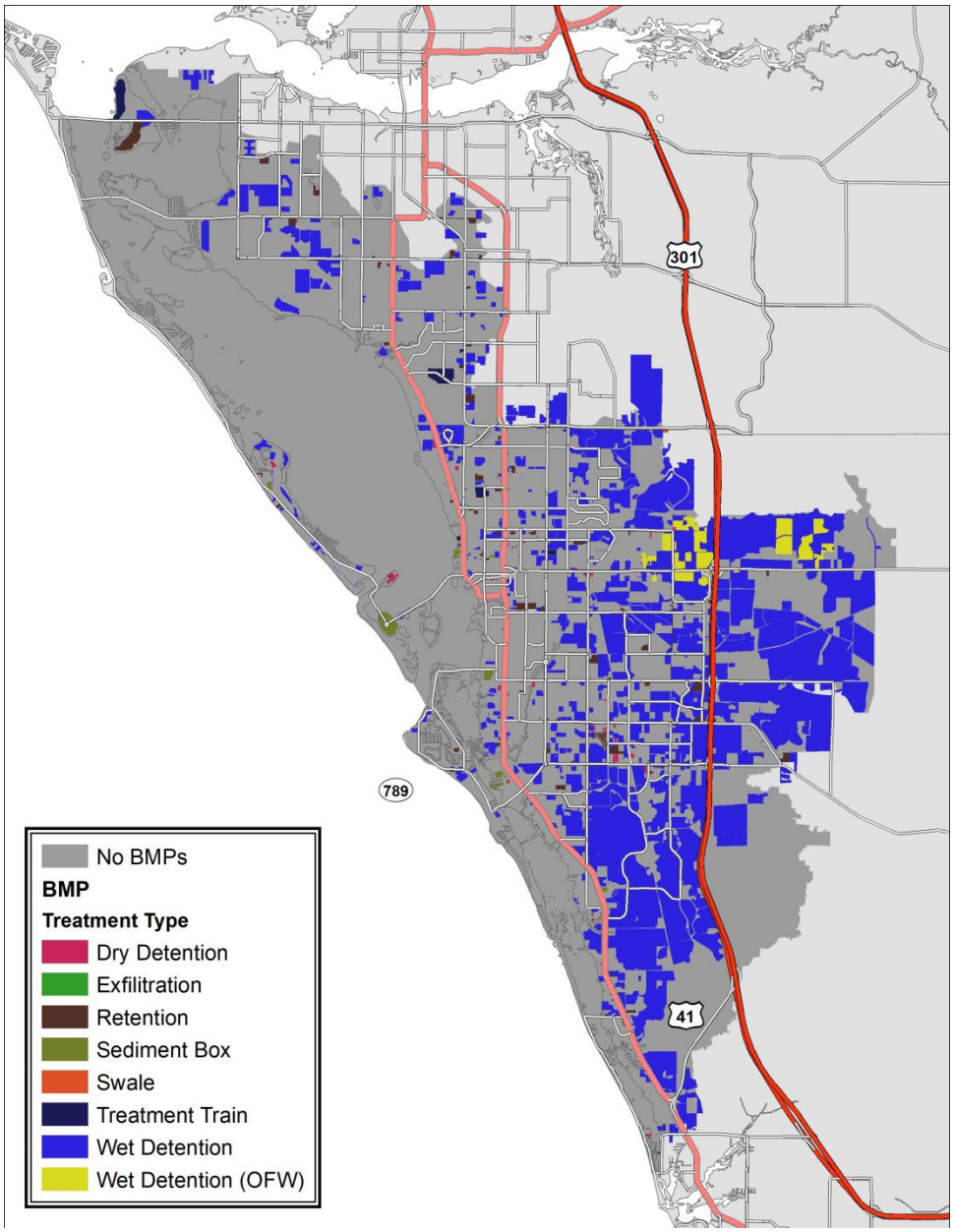

Figure 6. Map Showing the Locations of Structural BMPs within the Sarasota Bay Watershed

TABLE 3 - POLLUTANT REMOVAL EFFICIENCIES USED WITHIN THE SIMPLE MODEL AS PERCENT REDUCTIONS

BMP Type	TP	DP	TKN	NO_2+NO_3	NH_3	TN
Wet Detention	60	70	30	70	70	35
Wet Detention OFW	70	80	35	80	75	40
Dry Detention	25	25	15	15	15	15
Baffle Box	30	30	10	10	10	10
Swale	35	35	25	25	25	25

Point Sources

Point source loads include any permitted discharges from wastewater treatment facilities (WWTFs) as well as any accidental spills reported to FDEP. For accidental releases, the reported location and date of a release are used to attribute the load to the proper basin and month/year.

The input are data from monthly discharge monitoring reports provided to FDEP. Where data are missing, either permitted values or long-term means are used. Each record includes a monthly time-stamp to track loads temporally. The point source module requires the basin, point source, and non-compliance feature classes, as well as lookup tables of flows and concentrations. Figure 7 presents the locations of point sources within the study area.

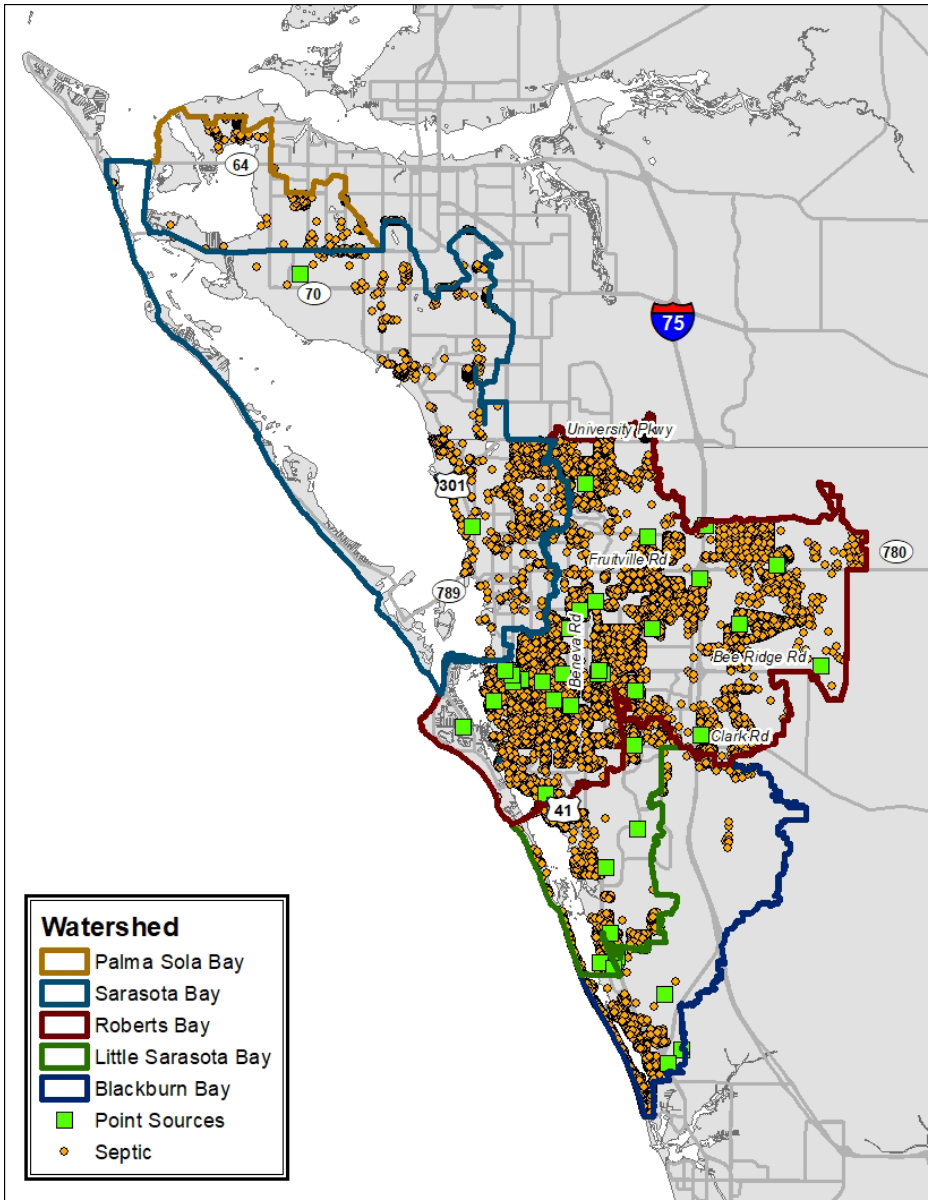

Figure 7. Location of Point Sources and Septic Systems within the Study Area Between 1998–2023

Septic Systems

During the initial development of SIMPLE, the septic module probably garnered the most attention as Sarasota County was beginning an aggressive septic-to-sewer replacement program in the Phillippi Creek basin to alleviate a bacteria impairment. The module begins with the location of the tanks. The Florida Department of Health (FDOH) manages the permitting of septic systems in Florida. Based on permit applications and the presumption that any parcel not connected to the wastewater system has a septic system, the septic feature class was developed. As with other layers, the septic feature class records have a year-built field that activates the calculation of a load from that location. This feature class also has a field to stop load calculations in the case when a parcel is converted to central sewer. With an aggressive septic-to-sewer conversion program, these time-stamp features are key to tracking this loading source.

This module assumes 100 gallons per person per day are produced and that 2.5 persons are served by each residential system. Other factors that affect the loads are the date the systems went in service, the distance from a waterbody, and whether the flow path of the surficial groundwater might be intercepted by a BMP such as a wet detention pond.

Irrigation

The irrigation module was developed to more accurately represent the distribution of irrigation water nutrient loadings in a spatially explicit manner. Since SIMPLE's inception, new information has become available regarding where (Figure 8) and at what volume reclaimed water is applied, as well as the concentrations from the water reclamation facilities through monthly discharge monitoring reports. The irrigation module was updated in July 2020 to incorporate irrigation using reclaimed water (Janicki Environmental, 2021; SBEP, 2021). The utility providers monitor the volume of reclaimed water delivered to customers through meter billing records. These records are used to provide better estimates of the distribution of reclaimed water within each basin. This use of empirical data was a major upgrade to previous versions of the model which relied on published application rates and the assumption of advanced wastewater treatment effluent concentrations.

The irrigation module requires the basin, irrigation feature classes, and the reclaimed water lookup table. The module assumes an 85-percent attenuation rate to represent the retention due to such processes as plant uptake, soil absorption, and denitrification.

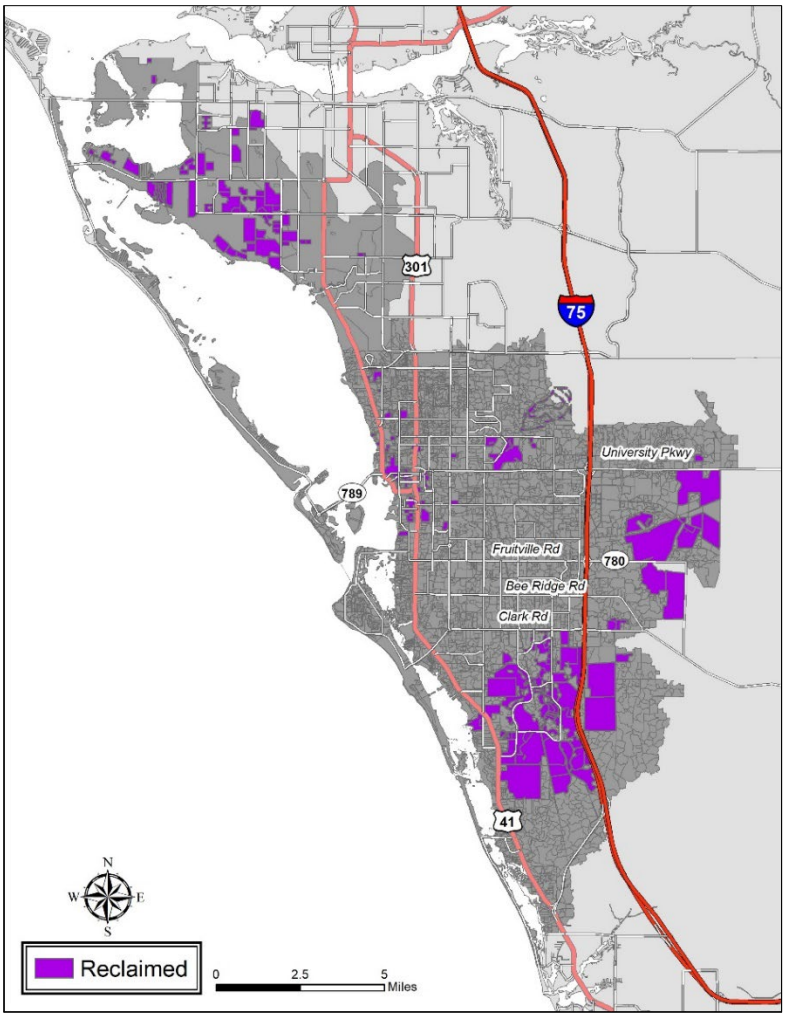

Figure 8. Map of Areas with Reclaimed Water Irrigation

Atmospheric Deposition

Atmospheric deposition (i.e., wet + dry fall) represents the direct load to waterbodies. Only TN and TP are calculated through this module, and loads are only generated for the open bay segments (i.e., direct deposition to the water surface). The nitrogen load is based on information from the National Atmospheric Deposition Program site at the Verna Wellfield (FL41) in east Sarasota County. Based on the relationships between nitrogen and phosphorus loads as determined for Tampa Bay (Poor, 2002), atmospheric phosphorus loads are estimated.

Pollutant Loading Estimates

Although the model has many capabilities, its primary purpose is to estimate the amount of nutrients generated within a hydrologic unit, in this case a watershed. Nitrogen was identified as the limiting nutrient controlling the production of chlorophyll-a producing algae (SBEP, 1992). Since nitrogen is the primary nutrient of concern, it is the focus of this analysis. Figure 9 illustrates the proportion of nitrogen by watershed supplied to the Sarasota Bay system. The largest percentage of the load enters the system through Roberts Bay (43 percent) followed by Sarasota Bay (33 percent).

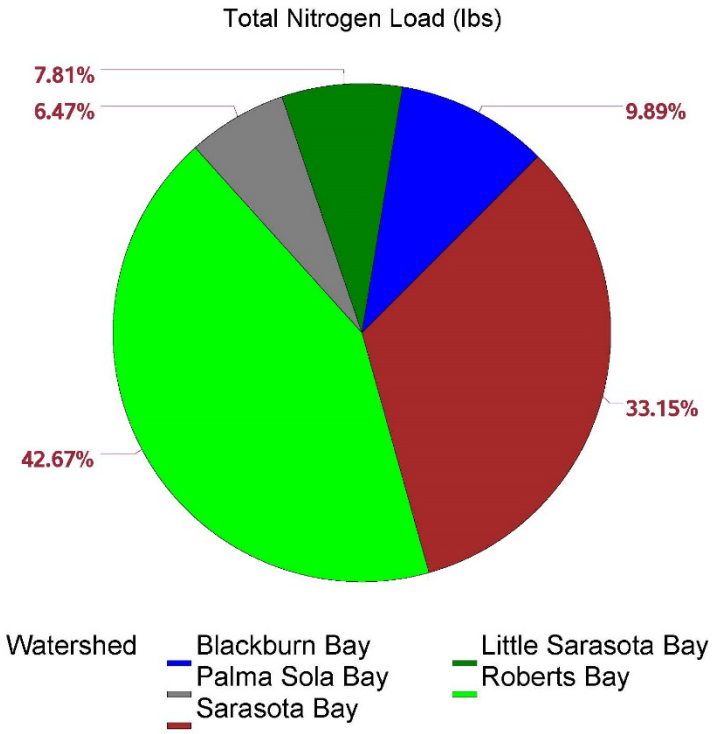

Figure 9. Proportion of Nitrogen Loads by Watershed to the Sarasota Bay

The plots in Figure 10 illustrate the percentage of TN and TP by source for the period of record in 5-year increments starting in 1995 running through 2022. Several trends can be seen: decreasing point source loads in all segments as surface water discharges ceased and a small delegated WWTF was decommissioned; an increasing trend in the use of reclaimed water and its associated load can also be seen; and what has remained constant over time is the relative contribution of direct runoff and baseflow, which rank numbers 1 and 2, respectively, in all watersheds and all time frames.

The bottom panels of Figure 10 provide the relative contributions of TN from nitrate-nitrite (inorganic) and TKN (organic). The primary source of inorganic nitrogen is direct runoff. However, in Bay segments with relatively large open surface waters, such as Sarasota Bay, Palma Sola Bay, and Little Sarasota Bay, atmospheric deposition plays a significant role in contributing inorganic nitrogen. Unfortunately, the contribution from reclaimed water cannot be further broken into its constituents since the source of the water only reports TN.

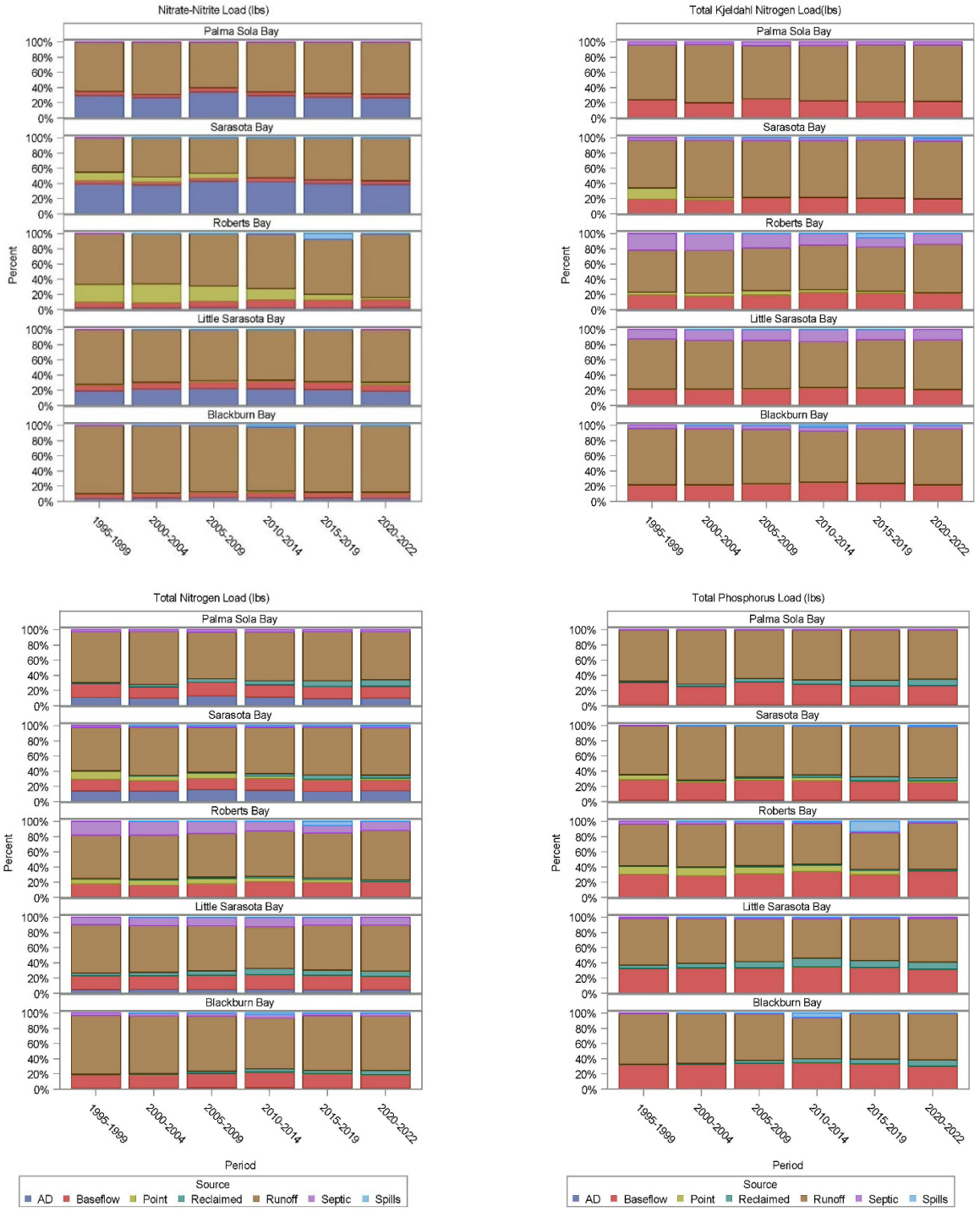

Figure 10. Percentile Contributions by Loading Sources of Nitrite-Nitrate (top, left), TKn (top, right), TN (bottom, left), and TP (bottom, right)

Another ability of the loading model is to visualize loads over time (Figure 11). Generally, increasing trends in TN and TP loading can be seen since 2007. Similar trends can be seen in Nitrate-Nitrite and TKN. This is not surprising as the largest contributor to the total load is direct runoff.

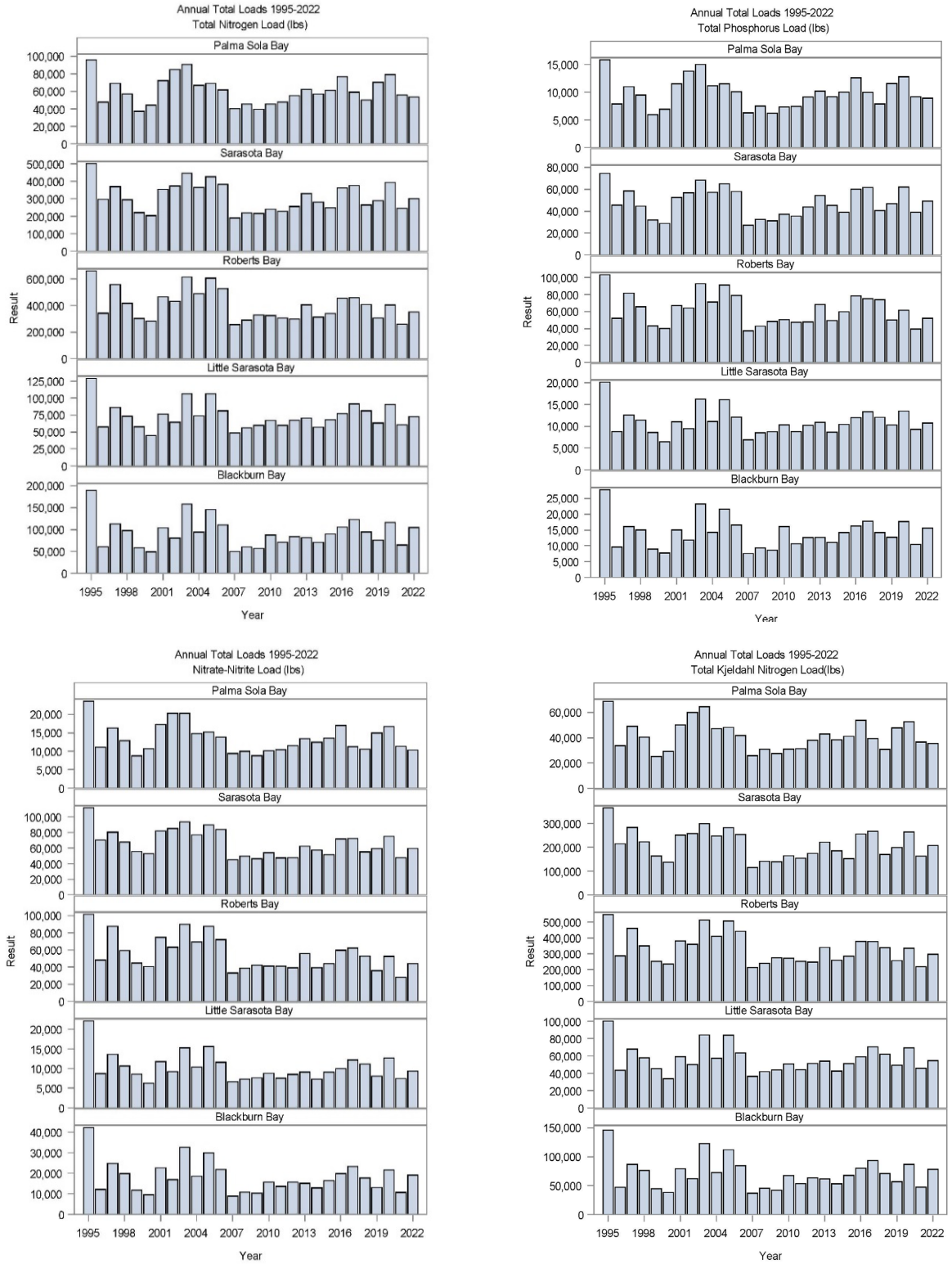

Figure 11. Time-Series of Annual Loads to each Bay Segment for Total Nitrogen (top, left), Total Phosphorus (top, right), Nitrite-Nitrate (bottom, left) and TKN (bottom, right)

The model is also capable of tracking the individual contributions of loads from the various sources (Figures 12 and 13). In all segments, atmospheric deposition and baseflow remained relatively consistent throughout the period modeled. All segments show an increase in reclaimed water loads, mostly related to increases in development with the associated need for reclaimed water irrigation. Decreasing contributions in point source loads are due to decommissioning a WWTF. General decreases in loadings are from septic systems from the Phillippi Creek Septic System Replacement Program in Roberts Bay. The relatively large contributions of the reclaimed water spills in the Roberts Bay Watershed between 2013 and 2019 are also evident.

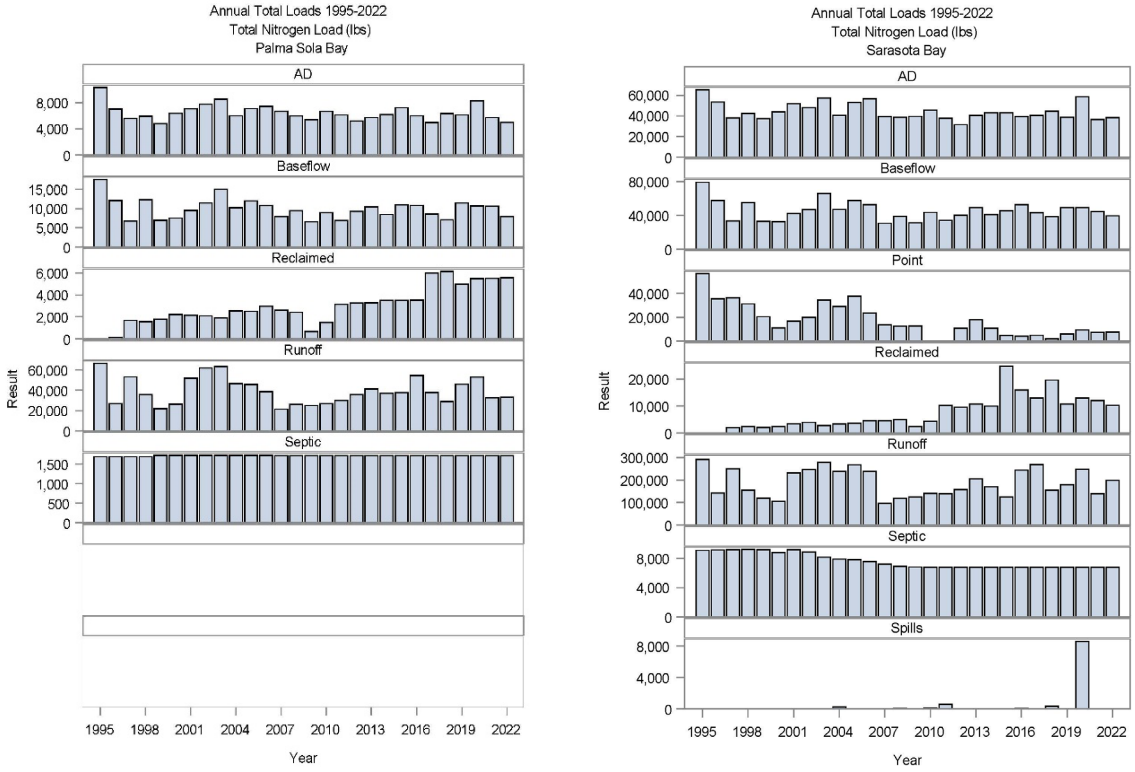

Figure 12. Time-Series of Annual Loads by Source to Each Bay Segment: Palma Sola Bay (left) and Sarasota Bay (right)

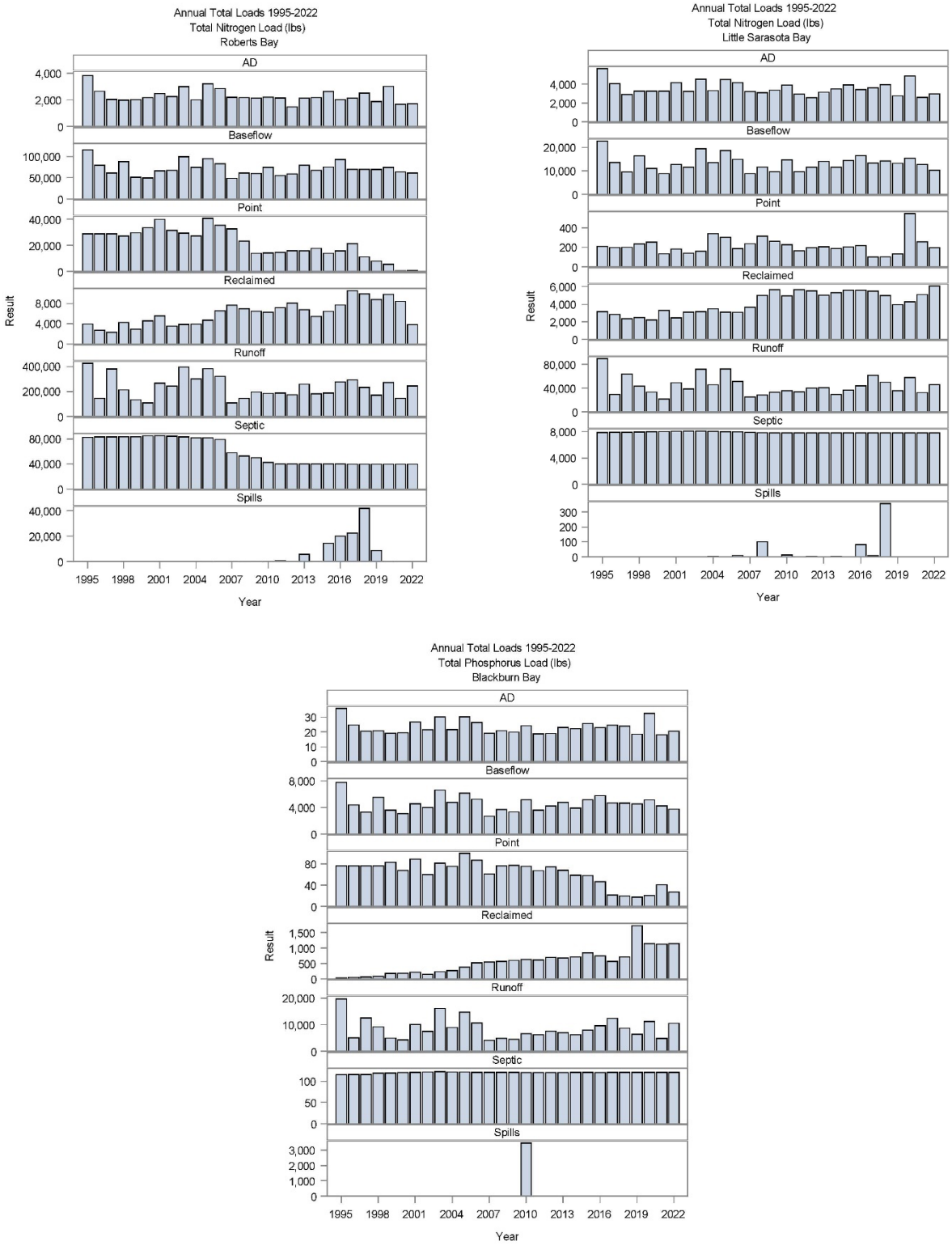

Figure 13. Time-Series of Annual Loads by Source to Each Bay Segment: Roberts Bay (top, left), Little Sarasota Bay (top, right), and Blackburn Bay (bottom, center)

Conclusion

In 2006, Jones Edmunds developed the Spatially Integrated Model for Pollutant Load Estimation (SIMPLE) model with funding from the District and Sarasota County. The model was an upgrade from the previous watershed management model that was used before SIMPLE's development. The new model uses spatially and temporally explicate inputs to provide monthly loading estimates from six loading sources for various parameters. The six loading sources are direct runoff, baseflow, point sources (including spills), septic systems, reclaimed water irrigation, and atmospheric deposition to open waters.

The largest contributor of nitrogen and the most critical factor for Bay management is direct runoff from rainfall (Figures 14 through 16). This is true in each watershed, followed by baseflow loads. Recent efforts to reduce loads from runoff have focused on regional facilities, but the area needed to create these facilities is decreasing with the area's continued development. Further reductions are going to require innovation to maintain loads conducive to a healthy Bay system.

In terms of inorganic nitrogen, the form most available for algae growth and the subject of increased scrutiny by the SBEP, direct runoff again is the largest contributor, followed by atmospheric deposition to Bay segments with large surface areas.

The relative contributions from baseflow could be better informed through further research. Baseflow within the model is broken into several components: baseflow (driven by rainfall), septic systems, and reclaimed water irrigation. Currently, the model uses a single baseflow concentration regardless of land cover type, which may be an oversimplification. Research is underway in Sarasota County examining surficial aquifer concentration from various land uses. This research could better inform the model regarding nutrients in baseflow which could be treated with relatively new technology, e.g., biochar walls.

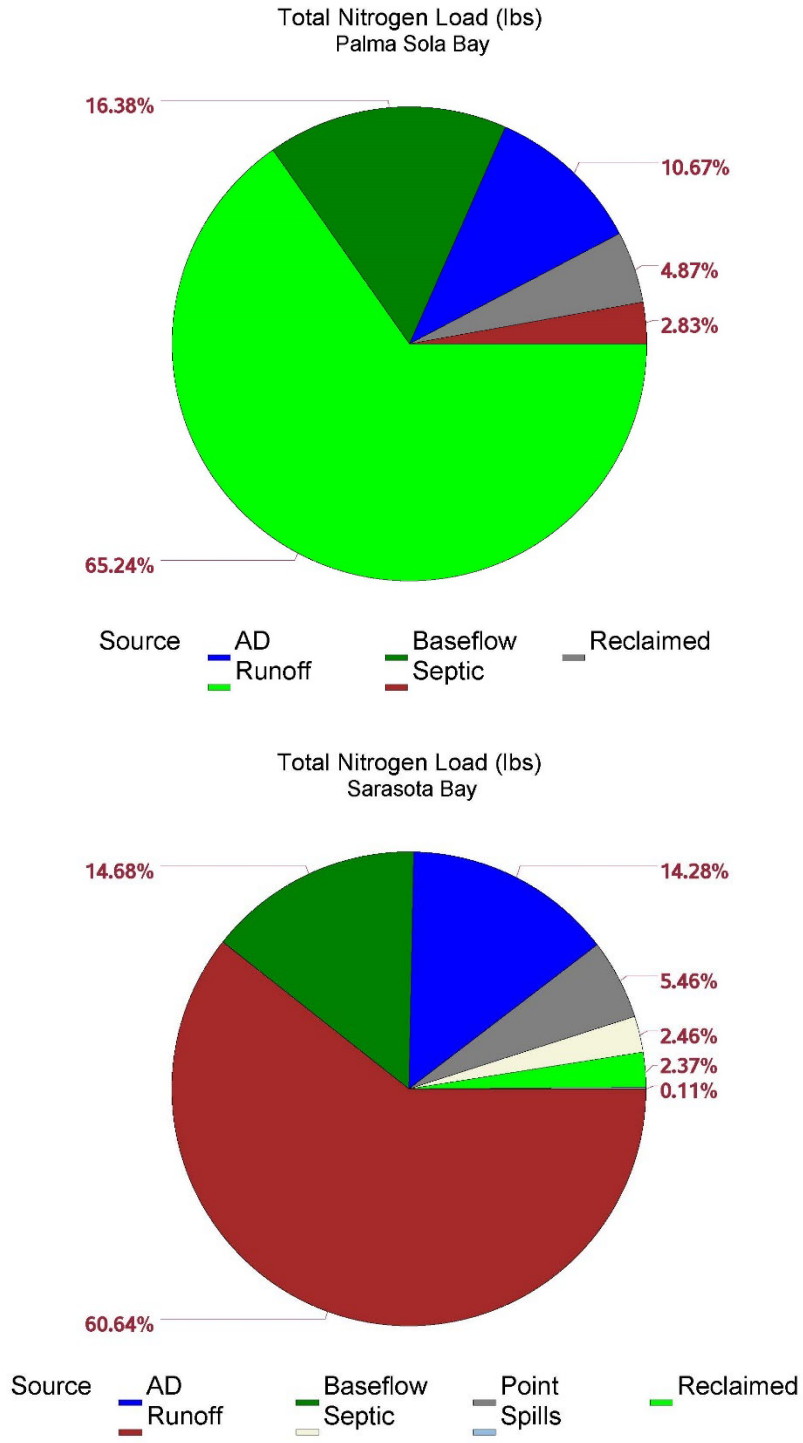

Figure 14. Pie Charts Illustrating the Percentile Contributions by Pollutant Source to Each Bay Segment: Palma Sola Bay (top), Sarasota Bay (bottom)

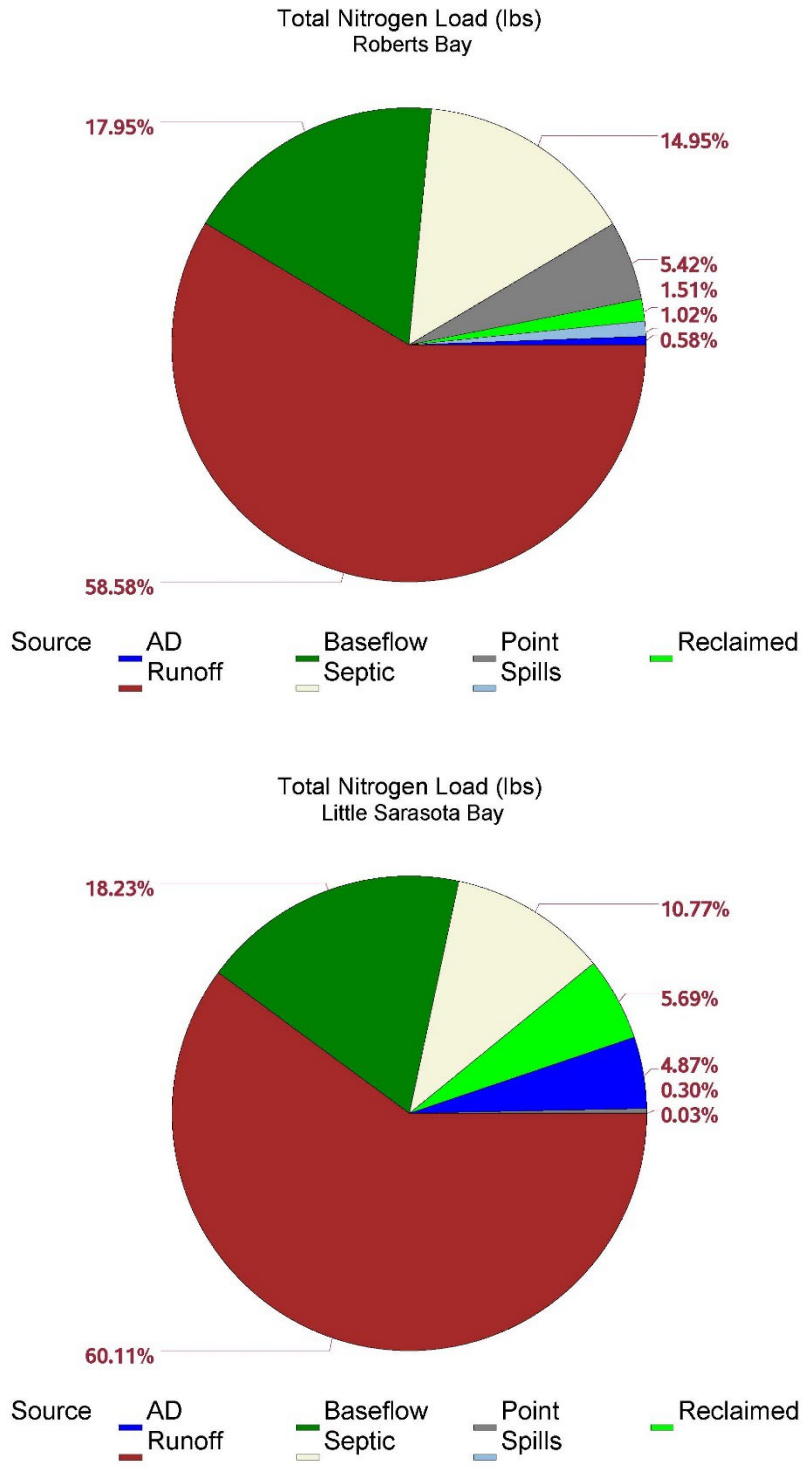

Figure 15. Pie Charts Illustrating the Percentile Contributions by Pollutant Source to Each Bay Segment: Roberts Bay (top), Little Sarasota Bay (bottom).

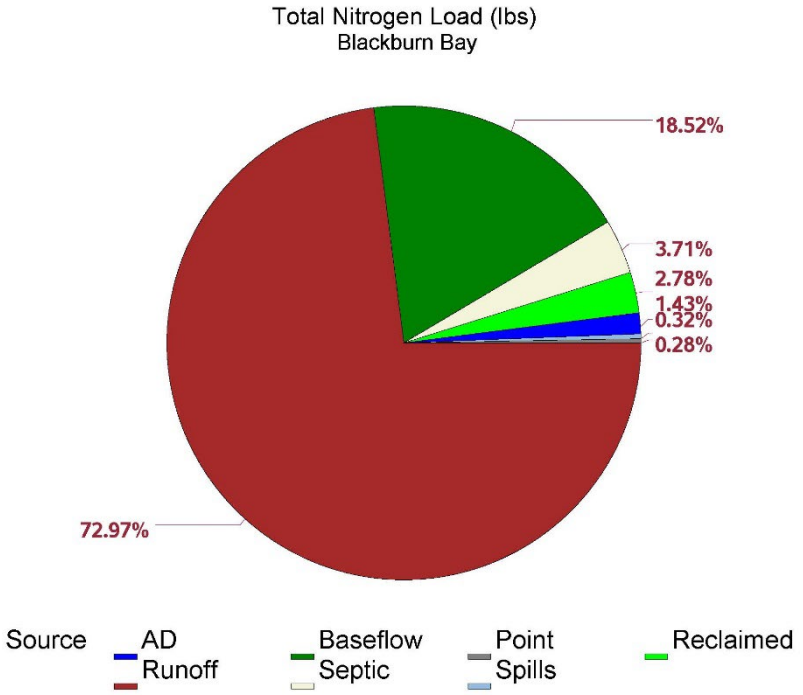

Figure 16. Pie Chart Illustrating the Percentile Contributions by Pollutant Source to Blackburn Bay.

References and Further Information

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Links

SIMPLE Model Development Design Report -January 2009

SIMPLE Monthly Calibration Report - June 2009

Sarasota County Pollutant Load Modeling Bibliography

Appendix B: Sarasota Bay SWIM Plan Technical Working Group

SWIM Plan Update Technical Working Group

The Sarasota Bay Surface Water Improvement and Management (SWIM) Plan Technical Working group includes members from the Southwest Florida Water Management District and the Sarasota Bay Estuary Program (SBEP), as well as the SBEP Technical Advisory Committee (TAC). The SBEP's TAC consists of representatives from academia, the private sector, and local, regional, state, and federal agency scientific and technical staff with regulatory or management mandates that affect Sarasota Bay.

This Technical Working Group was convened to assist the District in reviewing data and identifying issues and management actions for consideration in the Sarasota Bay SWIM Plan Update. Participants in the Sarasota Bay Technical Working group are identified below.

Sarasota Bay SWIM Plan Update Technical Work Group Members	
Member	**Organization**
Brian Norman	City of Bradenton
Chris Anastasiou	District SWIM
Damon Moore	Oyster River Ecology
Dave Tomasko	Sarasota Bay Estuary Program (SBEP)
Eric Weather	Florida Fish and Wildlife Conservation Commission (FWC)
Greg Blanchard	Manatee County (Co-Chair)
Heather Bryen	Sarasota County
Jay Leverone	Sarasota Bay Estuary Program (SBEP)
Jon Perry	Environmental Science Associates (ESA)
Khan Boupha	Jones Edmunds & Associates, Inc.
Lizanne Garcia	District SWIM
Mark Sramek	National Oceanic and Atmospheric Administration (NOAA)
Mark Walton	District SWIM
Natalie Moreno	Manatee County Ecological & Marine Resources
Randy Edwards	Resident
Ryan Schloesser	Mote Marine Laboratory
Sherri Swanson	Manatee County Ecological & Marine Resources
Stephen Suau	Resident
Tammy Plazak	District SWIM
Tara Harter	District SWIM

Appendix C: Permitted Point Sources within the Sarasota Bay Watershed

Appendix C describes the nutrient point sources within the Sarasota Bay Watershed. The data described below were downloaded from FDEP's Geospatial Open Data website on July 23, 2024. For the most up-to-date point source data, visit http://geodata.dep.state.fl.us/.

Point Sources

Wastewater Facilities

More than 31 wastewater permits exist within the Sarasota Bay Watershed, including 18 domestic wastewater permits for municipal, mobile home or recreational vehicle (RV) parks, apartment complexes, and schools and 13 industrial wastewater programs.

Stormwater Facilities

A Municipal Separate Storm Sewer System or MS4 is defined in Section 62-624.200(8), Florida Administrative Code (FAC), as follows: "Municipal separate storm sewer or MS4 means a conveyance or system of conveyances like roads with stormwater systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels, or storm drains: Owned or operated by a State, city, town, county, special district, association, or other public body (created by or pursuant to state law) having jurisdiction over management and discharge of stormwater, or an Indian tribe or an authorized Indian tribal organization, that discharges to waters of the state; Designed or used for collecting or conveying stormwater; Which is not a combined sewer; and Which is not part of a Publicly Owned Treatment Works (POTW). POTW means any device or system used in the treatment of municipal sewage or industrial waste of a liquid nature which is owned by a 'State' or 'municipality'." This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment. As of July 2024, the Sarasota Bay Watershed includes four MS4 permits covering eight jurisdictions.

Consent Orders

Table C-1 lists the wastewater facilities currently operating under a consent order as of February 2025.

Table C-1

List of Wastewater Facilities Operating under a Consent Order

Facility Name	Facility ID	Consent Order No.
City of Sarasota	FL0040771	22-2873
Sarasota County	FLA013372, FLA013455, FLA043494	19-0255

Appendix D: Jurisdictional Authority within the Sarasota Bay Watershed

Various levels of government are involved in resource management and regulatory activities within the Sarasota Bay watershed. These include single-purpose local governments (i.e., independent taxing districts), general-purpose local governments (i.e., cities and counties), regional agencies (i.e., Southwest Florida Water Management District), and state and federal agencies.

Federal Agencies

Federal jurisdiction in the Sarasota Bay SWIM Program watershed involves the regulatory responsibilities of the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Coast Guard, U.S. Fish and Wildlife Service, and U.S. Department of Interior (which coordinates its many agriculture-related activities with those of the Florida Department of Agriculture and Consumer Services). Their main regulatory functions include overseeing dredge-and-fill activities, maintaining navigability of the waters of the United States, overseeing cleanups following pollution spills, protecting endangered species, protecting overall environmental quality, and managing offshore activities. These agencies, in conjunction with the US Geological Survey and the National Oceanic and Atmospheric Administration, also contribute to the collection of technical data concerning Sarasota Bay and its watershed. Land-based conservation measures within the watershed may be addressed by the US Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS), which provides farmers and ranchers with financial and technical assistance to voluntarily apply conservation measures that benefit the environment and agricultural operations.

U.S. Army Corps of Engineers (USACE)

The USACE Regulatory Program began in 1890 with the responsibility of protecting and maintaining the nation's navigable waterways. As a result of changing public needs and evolving policy via new laws and court decisions, protection has been extended to all waters of the United States, including many wetlands. The Jacksonville Regulatory Division of USACE (https://www.saj.usace.army.mil/Missions/Regulatory/Office-Locations/) has jurisdiction over the geographic region of Florida, Puerto Rico, and the U.S. Virgin Islands. The Division is geographically aligned in three Permitting Branches, which are further divided into 11 Sections, the Mitigation Bank Team, and the Enforcement Section. The Jacksonville District administers the largest regulatory permitting program in USACE, which provides protection for waters of the United States, including federally delineated wetlands and navigable waters.

U.S. Coast Guard (USCG)

USCG is a branch of the US Armed Forces. It encompasses a law enforcement organization, a regulatory agency, and many other responsibilities and partnerships. USCG is the principal federal agency responsible for maritime safety, security, and environmental stewardship in United States ports and inland waterways. In inland waters, the USCG Auxiliary, a volunteer group, performs boating safety inspections and search and rescue missions.

U.S. Department of Agriculture (USDA)

The primary environmental related functions of USDA are to preserve and conserve natural resources through restored forests, improved watersheds, and healthy private working lands. These broad objectives are facilitated by three USDA agencies: Farm Service Agency, U.S. Forest Service, and NRCS.

U.S. Department of Interior (USDOI)

The primary water-related functions performed by this agency involve reviewing proposed activities that may impact threatened or endangered species, reviewing USACE permits for potential effects on fish and wildlife, and managing all federally owned public lands. Within USDOI, the U.S. Geological Survey conducts investigations concerning hydrology, hydrogeology, water use, and ground and surface water quality. The U.S. Fish and Wildlife Service manages and restores fish and wildlife populations and conducts research on the effects of pollution on those resources. The National Park Service maintains federal parks and sanctuaries, regulating multiple uses on these lands to achieve a balance of benefits for both man and wildlife. USDOI also oversees those requests and offshore activities associated with exploration and development on the outer continental shelf.

U.S. Environmental Protection Agency (EPA)

EPA (Southeast Regional Office, Region IV, Atlanta, Georgia) through its Water Division, implements the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA) as well as portions of the Marine Protection Research and Sanctuaries Act (MPRSA) and the Coastal Zone Act Reauthorization Amendments (CZARA). The Division works with states and tribes to develop and approved programs to protect public health and natural resources through source water protection, improving aging infrastructure, and encouraging water reuse and nutrient reduction.

U.S. Fish and Wildlife Service (USFWS)

The U.S. Fish and Wildlife Service, working with others, is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people through fFederal programs relating to migratory birds, endangered species, interjurisdictional fish and marine mammals, and inland sport fisheries.

U.S. Geological Survey (USGS)

USGS is the nation's largest water, earth, and biological science and civilian mapping agency. USGS collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. Of particular relevance are the surface water and groundwater quality monitoring, stream flow measurements, and groundwater recharge and contamination research.

Natural Resources Conservation Service (NRCS)

NRCS is an agency of the USDA, which provides financial and technical assistance to farmers, ranchers, and forest landowners. NRCS administers multiple programs: Farm Bill conservation programs, Landscape Conservation Initiatives, small-scale farm fact sheets, and resources. All NRCS programs are voluntary science-based solutions. NRCS was established by Congress under Public Law 74-46 in 1935.

State Agencies

Many state agencies are involved in environmental regulation and resource management in the Sarasota Bay watershed and estuary. The Florida Department of Environmental Protection (FDEP) is the lead state agency in the protection and management of Sarasota Bay. Other relevant entities include the Florida Fish and Wildlife Conservation Commission, the Marine Fisheries Commission, Florida Department of Agriculture and Consumer Services, Florida Department of Health, Florida Sea Grant Program, and the Florida Department of Transportation.

Florida Department of Agriculture and Consumer Services (FDACS)

The FDACS Division of Agricultural Environmental Services (AES) administers various state and federal regulatory programs concerning environmental consumer protection issues. These include state mosquito control program coordination; agricultural pesticide registration, testing, and regulation; pest-control regulation; and feed, seed, and fertilizer production inspection and testing. The Division ensures that pesticides are properly registered and used in accordance with federal and state requirements; mosquito-control programs are effectively conducted; and feed, seed, and fertilizer products are safe and effective.

The FDACS Office of Agricultural Water Policy (OAWP) facilitates communications among federal, state, and local agencies and the agricultural industry on water quantity and water quality issues. FDACS OAWP collaborates with Florida's agricultural landowners and producers to implement best management practices (BMPs) for nutrient reduction, irrigation management, and the protection of water resources. Agricultural BMPs are an integral part of water resource protection required under the regulatory BMP Program implemented by FDACS OAWP. The office is directly involved with statewide programs to implement the Federal Clean Water Act's TMDL requirements for agriculture. Once a TMDL is adopted, FDEP may develop a basin management action plan (BMAP) that identifies enforceable strategies for restoring the impaired waterbody. The agricultural industry is one of many stakeholders identified in most BMAPs. Florida laws require agricultural landowners within BMAPs to enroll in FDACS' BMP Program and properly implement the BMPs applicable to their property and operation or conduct water-quality monitoring activities. Enrollment in the BMP Program and the proper implementation of applicable BMPs provide a presumption of compliance with state water quality standards that is not provided otherwise. Producers or agricultural landowners within a BMAP who are enrolled in the FDACS' BMP Program and are properly implementing the applicable BMPs in accordance with the FDACS BMP Checklist are entitled to a presumption of compliance with state water quality standards. FDACS is required to perform BMP Implementation Verification (IV) site visits to enrolled operations every 2 years to ensure that BMPs are being properly implemented. Producers and agricultural landowners outside BMAP areas are strongly encouraged to enroll in the BMP Program for the benefits that enrollment provides.

Florida Department of Environmental Protection (FDEP)

The Florida Department of Environmental Protection (FDEP) is the lead state agency involved in water quality, pollution control, and resource recovery programs. The FDEP sets state water quality standards and has permit jurisdiction over point and non-point source discharges, certain dredge and fills activities, drinking water systems, power plant siting, and many construction activities conducted within waters of the state. The FDEP also interacts closely with other federal and state agencies on water-related matters, and the FDEP and the District share responsibilities in non-point source management and wetland permitting.

FDEP has six district offices located regionally located throughout the state. The district offices review permit applications, conduct inspections of permitted facilities, respond to reports of environmental damage, and conduct compliance assistance and enforcement activities. The Southwest District Office in Sarasota has responsibility for proprietary and regulatory permitting issues in Manatee County, while and the South District Office in Ft. Myers has responsibility for Sarasota County. Additionally, FDEP's responsibility related to water quality restoration is to develop Total Maximum Daily Loads (TMDLs) for impaired surface waters. The state-adopted TMDLs are available at: https://floridadep.gov/dear/water- quality-evaluation-tmdl/content/final-tmdl-reports.

The FDEP Division of State Lands oversees the management of state lands, including state parks. The Division of Recreation and Parks and the Office of Resilience and Coastal Protection are directly responsible for day-to-day land management, and beaches in this watershed. The Florida Geological Survey Division provides geoscience products to support initiatives related to water-resource conservation and management, and improvement of the quality of natural resources. The FDEP is the primary reviewer of SWIM Plans and is responsible for the disbursement of legislatively appropriated funds to the water management districts. The FDEP is also highly involved in the management of estuarine resources.

Florida Department of Health (FDOH)

Chapter 154, 381, and 386, Florida Statutes and the 64E Series of the FAC, known as the "Sanitary Code," are the primary statutes providing FDOH authority. Each county has an FDOH Office responsible for jurisdiction within the county. The environmental focus of FDOH is to prevent disease of environmental origin. Environmental health activities include prevention, preparedness, and education, which are implemented through routine monitoring, education, surveillance, and sampling of facilities and conditions that may contribute to the occurrence or transmission of disease. The responsibilities of FDOH include the public health functions of water supplies (primarily small to medium supplies), on-site sewage treatment and disposal systems permitting and inspection, septic tank cleaning and waste disposal (in conjunction with FDEP), and solid waste control (secondary role).

Florida Department of Transportation (FDOT)

FDOT's Project Development and Environmental Offices assist in the design, review, and permitting of roadway and right-of-way projects in the state.

Florida Fish and Wildlife Conservation Commission (FFWCC)

The Florida Fish and Wildlife Conservation Commission (FFWCC or FWC) manages fish and wildlife resources for their long-term well-being and the benefit of people. Agency personnel work together to protect and manage more than 575 species of wildlife, 200 species of freshwater fish, and 500 species of saltwater fish. The FWC works to balance the needs of these fish and wildlife species and the habitats that support them with the needs of Florida's population of 21.7 million people and approximately 100 million visitors each year. The FWC is comprised of six divisions including the Fish and Wildlife Research Institute, Freshwater Fisheries Management, Habitat and Species Conservation, Hunting and Game Management, Law Enforcement, and Marine Fisheries Management.

The FWC accomplishes its mission by pursuing strategic goals such as those highlighted in Florida's State Wildlife Action Plan, a comprehensive, statewide plan for conserving Florida's wildlife and natural areas for future generations (https://myfwc.com/conservation/special-initiatives/swap/). Through collaborative efforts, FWC researchers and resource managers have informed and assisted multiple hydrologic and aquatic habitat restoration efforts supporting the District's SWIM Program objectives.

The FWC's efforts within the watershed primarily involve freshwater sport and commercial fishing management, fisheries and habitat management, fish stocking, fisheries research, wildlife monitoring, enforcement of fisheries/wildlife regulations enforcement, listed species protection, wildlife research, development review, and regional planning. The FWC is directed by Rule 62-43, F.A.C., to review SWIM Plans to determine if the plan has adverse effects on wild animal life and freshwater aquatic life and their habitats.

Florida Sea Grant Program

The Florida Sea Grant Program is supported by awards from the Office of Sea Grant (National Oceanic and Atmospheric Administration) under provisions of the National Sea Grant College and Programs Act of 1966. The Florida Sea Grant Program has three major components: applied marine research, education, and advisory services (through local marine extension agents). The Florida Sea Grant Program provides scientific research and habitat-related information that are useful in the management of Sarasota Bay's natural resources.

Regional Agencies

Several regional agencies exist within the District's boundaries of the Sarasota Bay watershed.

Southwest Florida Water Management District (District)

The District's mission is to manage water and related natural resources to ensure their continued availability while maximizing the benefits to the public. Central to the mission is maintaining the balance between the water needs of current and future users and protecting and maintaining water and related natural resources, which provide the region with its existing and future water supply. The District is responsible for performing duties assigned under Chapter 373, FS, as well as duties delegated through FDEP for Chapters 253 and 403, FS, and for local plan review (Chapter 163, FS) for the entire Sarasota Bay watershed within its boundaries

Tampa Bay Regional Planning Council (TBRPC)

TBRPC was established in 1962 and includes the counties of Hillsborough, Manatee, Pasco, and Pinellas, with Hernando and Citrus added in 2015. The TBRPC mission is to serve its citizens and member governments by providing a forum to foster communication, coordination, and collaboration to identify and address needs/issues regionally. TBRPC is a multi-purpose agency responsible for providing a variety of services including natural resource protection and management, emergency preparedness planning, economic development and analysis, transportation and mobility planning, growth management and land use coordination, and technical assistance to local governments. Within TBPRC's Resiliency Planning focus area is the Tampa Bay Regional Resiliency Coalition, which serves seven county boundaries including Citrus, Hernando, Pasco, Pinellas, Hillsborough, Manatee, and Sarasota Counties.

Southwest Florida Regional Planning Council (SWFRPC)

SWFRPC is a Regional Planning Agency designated in Section 186.505, FS. It performs the responsibilities described in that section and the Regional Planning Agency roles assigned in Section 380.05, FS (Resource Planning Committees, DRI reviews, and Chapter 163, FS, Local Plan Reviews), for Sarasota County and its municipalities. The mission of the organization is to protect and improve the physical, economic, and social worlds of the affected communities through cooperation between neighboring communities and organizations. Some of the focus areas of the organization pertinent to this plan include water quality, storm resiliency, and climate change.

Peace River Manasota Regional Water Supply Authority (PRMRWSA)

PRMRWSA provides wholesale drinking water to three of its four members and the City of North Port. Members of the PRMRWSA include the Counties of Charlotte, DeSoto, Manatee, and Sarasota. The PRMRWSA mission is to provide the region with a sufficient, high-quality, and safe drinking water supply that is reliable, sustainable, and protective of our natural resources now and into the future. PRMRWSA acquired the Peace River Water Treatment Facility in 1991 and has expanded the facility to meet regional demands. It is an independent special district authorized by Section 373.1962, FS, as subsequently reenacted in Section 373.713, FS, and created by an interlocal agreement executed pursuant to Section 163.01, FS, in 1982.

West Coast Inland Navigation District (WCIND)

WCIND is a multi-county special taxing body, covering Manatee, Sarasota, Charlotte, and Lee Counties. Its mission is to preserve and enhance the commercial, recreational, and ecological values of the waterways it serves. WCIND assists member counties in navigation projects, waterway research, erosion and accretion studies, and environmental restoration projects. Activities carried out by WCIND also include posting of manatee protection speed zone signs and sponsoring programs to encourage boating safety and environmental stewardship.

Local Governments

The Sarasota Bay Watershed includes portions of Sarasota County, Manatee County, and several cities and towns.

Sarasota County

Sarasota County, established in 1921, has an estimated (2023) population of 464,223 (University of Florida Bureau of Economic and Business Research [BEBR]) and a land area of 573 square miles. It contains five general-purpose local governments: the Board of County Commissioners, City of Sarasota (population 57,005), City of Venice (population 27,793), City of North Port (population 86,552), and Town of Longboat Key (which is shared between Sarasota County and Manatee County, Sarasota population 4,776). Except for the City of North Port, the above-mentioned entities have jurisdiction within the Sarasota Bay watershed.

Manatee County

Manatee County has an estimated (2023) population of 439,566 (BEBR) and a surface area of 747 square miles. It contains seven general-purpose local governments: the Board of County Commissioners, City of Bradenton (population 57,253), City of Palmetto (population 13,927), City of Holmes Beach (population 3,026), Town of Longboat Key (Manatee population 2,761), City of Anna Maria (population 987), and City of Bradenton Beach (population 902). Except for the City of Palmetto, the above-mentioned entities have jurisdiction within the Sarasota Bay watershed.

Appendix E: List of Acronyms

Abbreviation	Description
BEBR	Bureau of Economic and Business Research
BMPs	Best Management Practices
CCMP	Comprehensive Conservation and Management Plan
CFI	Cooperative Funding Initiative
CWA	Clean Water Act
District	Southwest Florida Water Management District
DIN	Dissolved Inorganic Nitrogen
EPA	U.S. Environmental Protection Agency
ESA	Environmental Science Associates
FAC	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FFWCC or FWC	Florida Fish and Wildlife Conservation Commission
FS	Florida Statutes
FWRI	Fish and Wildlife Research Institute
GIS	Geographic Information Systems
HABs	Harmful algal blooms
I-75	Interstate 75
lbs	pounds
mg/l	milligrams per liter
NAVD88	North American Vertical Datum of 1988
NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
OAWP	Office of Agricultural Water Policy
OFMAS	Office of Fisheries Management and Assistance Services
OFW	Outstanding Florida Water
PRMRWSA	Peace River Manasota Regional Water Supply Authority
SBEP	Sarasota Bay Estuary Program
SIMPLE	Spatially Integrated Model for Pollutant Loading Estimation
SWFRPC	Southwest Florida Regional Planning Councils
SWFWMD	Southwest Florida Water Management District

Abbreviation	Description
SWIM	Surface Water Improvement and Management
SWUCA	Southern Water Use Caution Area
TAC	Technical Advisory Committee
TBRPC	Tampa Bay Regional Planning Council
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
UMAM	Uniform Mitigation Assessment Method
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WBIDs	Water Body Identification units
WBIDS	Water Body Identification Numbers
WCIND	West Coast Inland Navigation District
WMP	Watershed Management Plan
WQPP	Water Quality Protection Plan
WWTF	Wastewater Treatment Facility