Little Sarasota Bay
Water Quality Management Plan

Prepared for:

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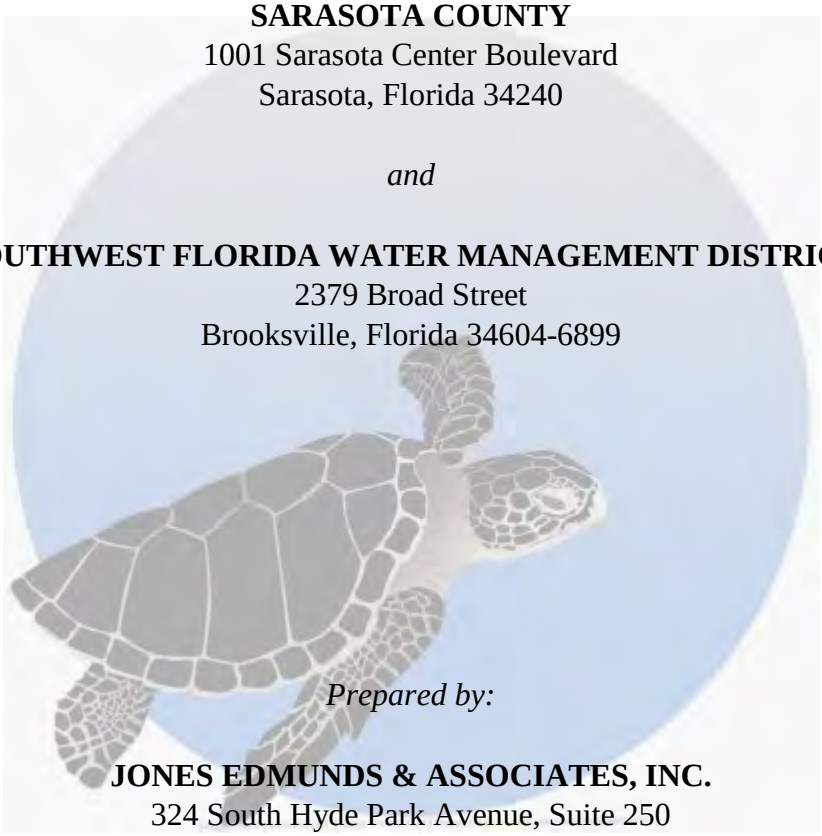

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1.0 INTRODUCTION

Sarasota County has six major watersheds located wholly or partially within its jurisdiction: Sarasota Bay, Roberts Bay North, Little Sarasota Bay, Dona and Roberts Bay, Myakka River, and Lemon Bay. The County has implemented the Comprehensive Watershed Management Program to address water quality, water quantity, flooding, and natural systems in a comprehensive manner within each watershed. This program is consistent with the Sarasota County Comprehensive Plan (Chapter 4, Goal 2, Objective 2.2, Policy 2.2.1) and employs an approach consistent with the Southwest Florida Water Management District's (SWFWMD) four areas of responsibilities related to water resource management: Water Quality, Water Supply, Flood Protection, and Natural Systems. One component of this Comprehensive Watershed Management Program is to develop a Water Quality Management Plan (WQMP) for each of the six watersheds.

The County and SWFWMD have partnered on cooperative funding projects to develop the WQMPs for Little Sarasota Bay, Sarasota Bay, Roberts Bay North, and Lemon Bay. The Roberts Bay North and Lemon Bay Plans were completed in early 2010.

While cooperative funding is provided by SWFWMD, the inclusion of proposed projects, corrective actions, and best management practices (BMPs) in this plan does not confer any special status, approval, permitting standing, or funding from SWFWMD. Requests for funding assistance must meet the requirements of specific funding programs and will be subject to SWFWMD's Governing Board appropriating funds.

Further, all projects are subject to County and SWFWMD regulatory review and permitting and are designed to be consistent with the Sarasota County Comprehensive Plan and the Sarasota County Code of Ordinances. Where applicable, all regulatory authorizations shall be obtained before a project can begin. To address these concerns, regulatory coordination will occur at the planning stages for each project discussed in this WQMP to ensure a streamlined permitting review process and address consistency with the Sarasota County Comprehensive Plan and Sarasota County Code of Ordinances before the project is designed.

This WQMP is for Little Sarasota Bay and its watershed, which consists of Little Sarasota Bay and Blackburn Bay and their drainage areas (Figure 1-1).

This WQMP presents scientific and community-based watershed management actions and the approach used to formulate, evaluate, and prioritize them. These actions will be holistic in recognition of the relationships and interdependencies of watershed functions as well as the related goals of state, regional, and federal partners.

Watershed management requires a holistic approach to protecting water resources, one that integrates all of the physical and biological components of the landscape.

The WQMP balances the goals of restoring natural systems, enhancing water quality, ensuring the sustainability of the water supply, and protecting against floods while expanding recreational and educational opportunities. This plan summarizes past, present, and future watershed conditions. The plan also contains recommendations for activities to help us reach these goals and progress toward sustaining and enhancing the health of our watershed.

Figure 1-1 Little Sarasota Bay Watershed

This Little Sarasota Bay WQMP discusses factors that affect the water quality, natural systems, flooding, and water supply in Little Sarasota Bay, Blackburn Bay, and their tributaries. The following tasks outline the work elements completed by Jones Edmunds and Janicki Environmental during the course of the WQMP development:

- *Watershed Field Trip:* Conducted an initial visual watershed assessment with stakeholders.
- *Literature Search and Creation of Watershed Bibliography:* Performed a literature search and developed an online bibliography.
- *Plan Outline:* Developed a plan outline.
- *Characterization:* Characterized the watershed.
- *Current, Historical, and Future Water Budgets:* Estimated the historical, current, and future targeted water budgets for the Little Sarasota Bay and Blackburn Bay Watersheds.
- *Flood Protection:* Summarized current County flood protection programs and practices.
- *Sediment Management Plan:* Evaluated sediment conditions in the watershed, developed sediment management plan, and identified and field-investigated potential projects to reduce erosion and remove sediment and pollutants from drainage system.
- *Water Supply:* Evaluated the change in direct runoff from historical to current conditions and identified stormwater harvesting opportunities.
- *Natural Systems:* Evaluated critical estuarine and lotic natural resources, performed habitat assessment and potential improvement strategy, and established a Natural Systems LOS.
- *Water Quality:* Assessed status, trends, and targets; analyzed pollutant loads; set Water Quality LOS; and identified potential water quality improvement opportunities.
- *Project Analysis:* Developed conceptual plans and cost estimates for recommended programs and projects.
- *Watershed Report Card Coordination:* Provided the County with detailed information to develop the Watershed Report Card.
- *Water Quality Management Plan:* Summarized comprehensive WQMP efforts.

The work elements were applied to the Little Sarasota Bay Watershed, which consists of two bay segments and eight subbasins:

Bay Segments	**Subbasins**
❖ Little Sarasota Bay	❖ Elligraw Bayou
	❖ Holiday Bayou
	❖ Clower Creek
	❖ Catfish Creek
	❖ North Creek
	❖ Little Sarasota Bay Coastal
❖ Blackburn Bay	❖ South Creek
	❖ Blackburn Bay Coastal

For a more accurate watershed evaluation, the Little Sarasota Bay Watershed was divided into two major drainage areas, the Little Sarasota Bay Watershed and the Blackburn Bay Watershed, which drain to Little Sarasota Bay Proper and Blackburn Bay, respectively. To achieve even more refined results, these watersheds were further analyzed at the coastal and tributary drainage basin level.

This plan is organized into eight sections. Following the goals and objectives (Section 2.0), the technical analyses and recommendations are presented by each watershed (Section 3.0 and Section 5.0) and each of their basins in Section 4.0, Section 5.0, and Section 6.0. Each basin section summarizes the watershed study for the particular basin. Additional details concerning the study are provided in the Appendices. Each basin section includes a characterization and analyses. The analyses cover relevant information for each area of responsibility (AOR)—water supply, water quality, natural systems, and flood protection conditions. The analyses are followed by recommendations as well as a summary and conclusions for each basin.

Much of the background information for each AOR is provided in the Little Sarasota Bay Watershed section (Section 3.0) and is not repeated in subsequent basin sections. Section 3.7 describes the program recommendations directed at the entire basin. The analyses presented in Section 3.0 include the entire Little Sarasota Bay Watershed. The characterization, water quality, and natural systems information in Section 3.0 is focused on the bay itself.

To make this plan more relevant to the individual watersheds, the characterization, analysis, and project recommendations are broken out by basin. Section 4.0 is for the tributary basins draining directly to Little Sarasota Bay, Section 5.0 is for Blackburn Bay with emphasis on the waterbody, and Section 6.0 is for the tributaries draining to Blackburn Bay.

Plan implementation is described in Section 7.0, and Section 8.9 describes linkages between goals with management actions.

2.0 GOALS AND OBJECTIVES

The Little Sarasota Bay WQMP is a regional initiative to develop and implement a water quality management plan for Little Sarasota Bay, Blackburn Bay, and their watersheds to help achieve the following objectives:

- Improve water quality.
- Restore to the greatest extent possible the historic natural hydrologic regime.
- Protect property owners from flood damage.
- Protect, enhance, and restore natural communities and habitats.
- Identify potential sustainable surface water supply options.

The Little Sarasota Bay WQMP promotes and furthers implementation of other regional plans, including the *Sarasota County Comprehensive Plan*, the Sarasota Bay Estuary Program's (SBEP) *Comprehensive Conservation and Management Plan* (CCMP), SWFWMD's *Southern Coastal Comprehensive Watershed Management Plan*, and SWFWMD's *Sarasota Bay Surface Water and Improvement* (SWIM) *Plan*.

3.0 LITTLE SARASOTA BAY WATERSHED

This section gives an overview of the technical analysis performed for Little Sarasota Bay and Blackburn Bay and their watersheds. This section also provides the results of the analysis for the entire Little Sarasota Bay Watershed.

3.1 CHARACTERIZATION

Located on the west-central coast of Florida, the Little Sarasota Bay Watershed is central to the communities of Sarasota, Osprey, Siesta Key, and Casey Key. The watershed spans approximately 16 square miles of the west-central coast of Sarasota County and is comprised of Little Sarasota Bay, five named tributaries (Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, and North Creek), one barrier island (Siesta Key), and a portion of the mainland that drains directly to the bay (Little Sarasota Bay Coastal) (see Figure 3-1).

The Little Sarasota Bay Watershed spans from the Roberts Bay North Watershed and Bee Ridge Road in the north, east to the Blackburn Bay Watershed to the west of I-75, and south to Blackburn Point. Little Sarasota Bay extends from Stickney Point Bridge at the north to Blackburn Point Bridge on the south; however, the Roberts Bay Watershed encompasses the area between Stickney Point Road and Coral Cove. The bay is bounded to the west by the barrier islands of Siesta Key, which is connected by a narrow strip of sandy beach to Casey Key where Midnight Pass was formerly located. The unincorporated community of Osprey and the

neighborhoods of Gulf Gate Estates and Vamo border Little Sarasota Bay on the mainland to the east.

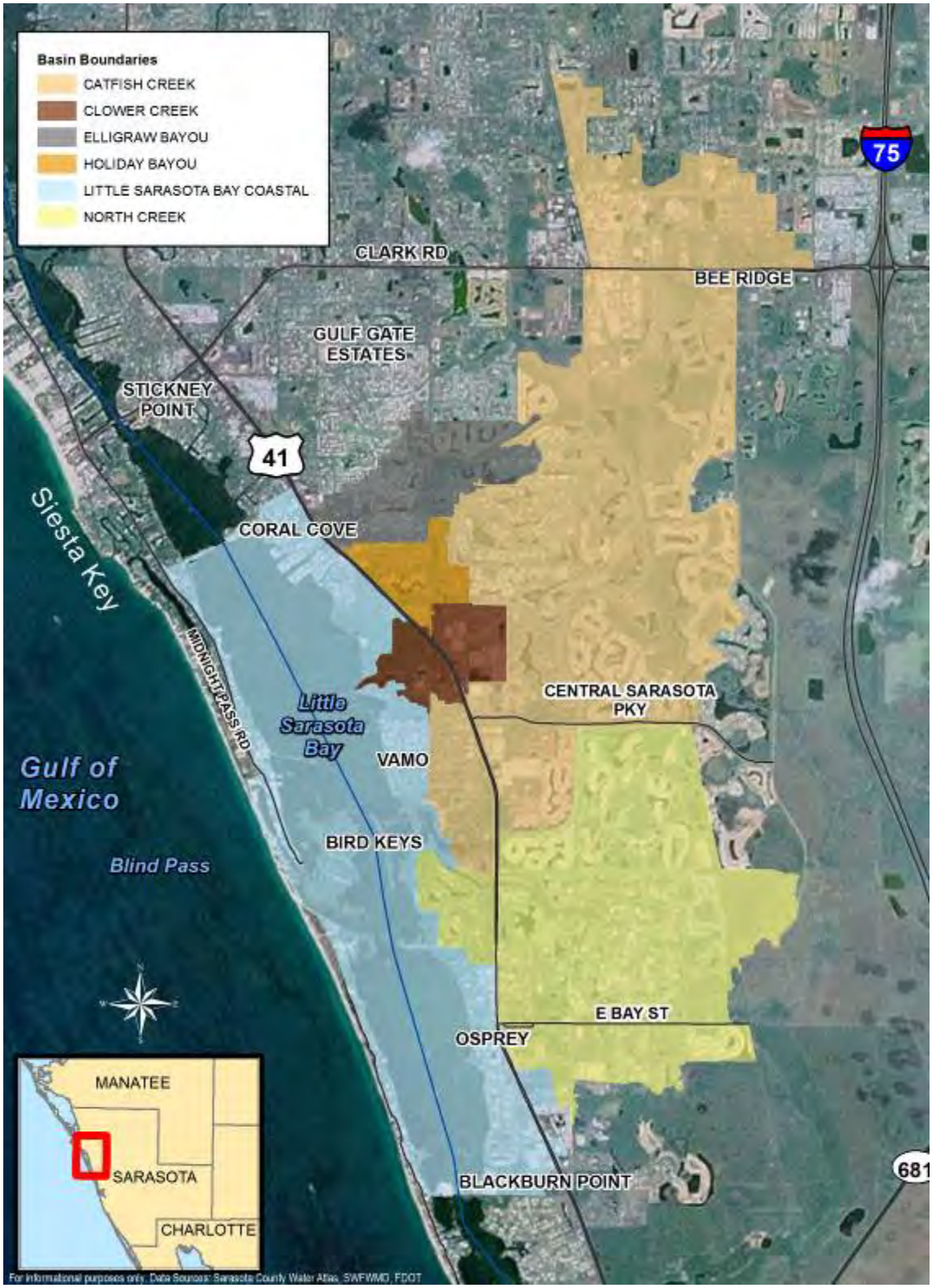


Figure 3-1 Little Sarasota Bay Watershed Basins

Archaeological evidence suggests prehistoric residents lived along the mainland and barrier island shoreline of Little Sarasota Bay from at least 4,000 years ago. The first records of the Little Sarasota Bay Watershed date back to the European explorers in the early 1500s (Figure 3-2). By the mid-1800s, modern settlement commenced on the mainland coast of Little Sarasota Bay with the establishment of the Webb family homestead in Osprey. By the early 20th century, a post office was established and the Florida West Shore Railway attracted even more settlers to Osprey.

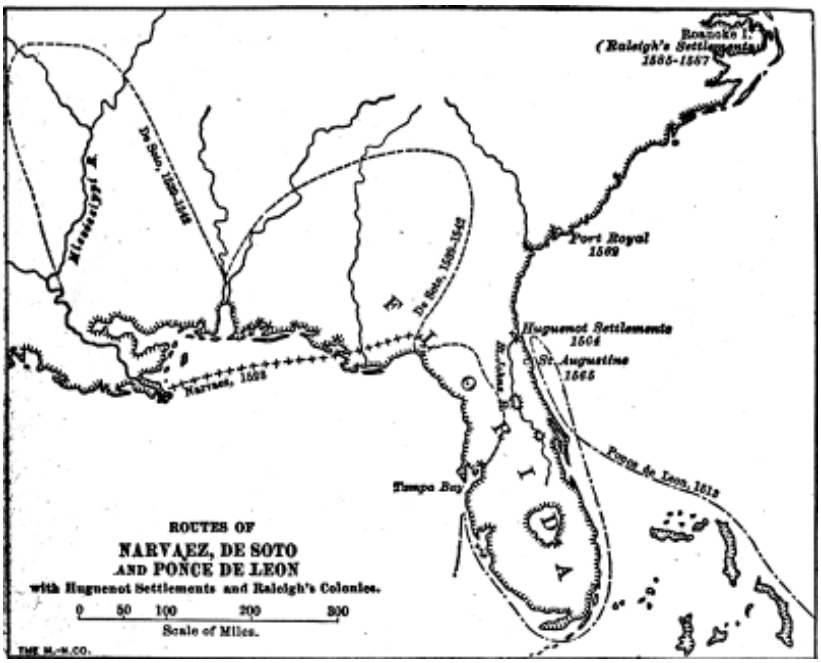


Figure 3-2 Routes of European Explorers
(Map Credit: Courtesy of the private collection of Roy Winkelman)

As development in the watershed continued, portions of the natural mangrove shoreline were replaced by concrete sea walls, reducing nursery areas essential to many marine species in Little Sarasota Bay. Ditches within tidal areas, a common mosquito control technique at the time, were constructed. Inland wetlands and flatwoods that once provided habitat, flood control, and improved water quality were altered and degraded. Natural tidal creeks and inlets were dredged and extended and wetlands were filled to accommodate agriculture, businesses, and residences. By the mid-1950s, much of the coastal mainland was developed and growth persisted inland and across the barrier islands (Figure 3-3). In addition, the closure of Midnight Pass in Little Sarasota Bay in 1983 permanently altered circulation in the bay.

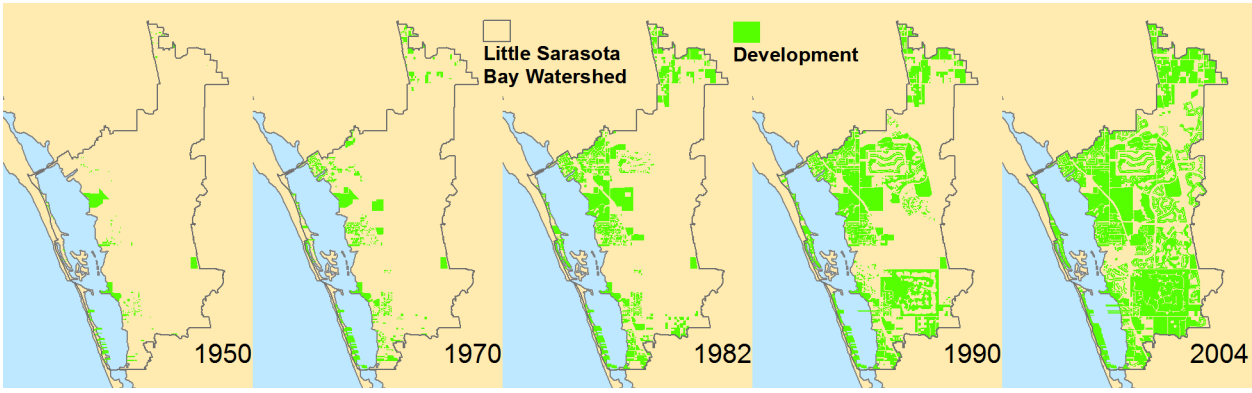


Figure 3-3 Little Sarasota Bay Development 1950-2004

Today, with the exception of designated natural areas, most of the watershed is developed and lies within an area designated by SWFWMD as the Southern Water Use Caution Area (SWUCA), which is an area where water resources are or will become critical in the next 20 years. Additionally, Little Sarasota Bay is classified as an Estuary of National Significance, SWFWMD SWIM Priority waterbody, and an Outstanding Florida Water (OFW). Before its OFW designation, Little Sarasota Bay was classified as Class III Marine (suitable for recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife).

Activities in Little Sarasota Bay and its watershed are regulated by the US Environmental Protection Agency (EPA), Florida Department of Environmental Protection (FDEP), SWFWMD, and Sarasota County. Each regulatory agency is responsible for the health of the bay and can regulate specific activities throughout the watershed. In general, State regulations should be followed unless one of the counties has adopted a more stringent rule. The same policy applies to cities within a county boundary; the more stringent regulations always take precedence. This WQMP discusses the goals and objectives for Sarasota County, and the measures the County is taking to meet these goals.

Historically, watershed management focused solely on flood control wherein the common practices of ditching and channelizing streams and the use of structural measures hastened drainage. In addition, most of the development in the watershed occurred before stormwater regulations were implemented in 1982, so stormwater from most of the watershed's developments flows into the bay without treatment. Drainage activities, flood-control projects, and the construction of impervious surfaces have changed the natural hydrology of the watershed, resulting in higher peaks than the natural flow and increases in the delivery of pollutants to the bay. Hydrologic alterations within the Little Sarasota Bay Watershed include:

One of the main challenges to protecting water quality in the watershed is to decrease stormwater runoff to allow only the amount of freshwater, sediments, and nutrients appropriate for a healthy estuarine system to enter the streams and bay.

- Reducing on-site rainfall storage by filling and ditching natural depressions and wetlands.
- Increasing stormwater runoff rates by channelizing natural streams and creating networks of interconnected ditches that flow to the bay.
- Reducing infiltration by compacting soil or introducing pavement and other impervious surfaces.
- Altering flow patterns by constructing water control weirs and increasing sedimentation in the channel from upland erosion.

Rainfall and surface water runoff are critical to maintaining the natural resources of any estuarine system and its supporting watershed. The Little Sarasota Bay Watershed is relatively flat and has

an average annual rainfall of 53 inches. The majority of the watershed has been altered, leaving only isolated natural and conservation areas that provide infiltration and habitat for many threatened and endangered native species. Only about 17% of the watershed is undeveloped, which significantly affects water quality, water quantity (flow), habitat, and flooding risks. This highly urbanized watershed consists of many older neighborhoods that pre-date stormwater treatment requirements. Surface water runoff from rainfall flows across the watershed terrain through ditches, storm drains, creeks, and wetlands, and eventually into Little Sarasota Bay. The untreated runoff contributes sediment and pollutants to Little Sarasota Bay and its tributaries.

The receiving waterbody, Little Sarasota Bay, is approximately 1,800 acres, giving the watershed a 5:1 ratio for the area of the contributing watershed to the area of estuary open water. In comparison, Blackburn Bay has a watershed-to-open-water ratio of 21:1 and Sarasota Bay has a ratio of 2:1. In general, a higher watershed-to-waterbody-area ratio leads to proportionally more freshwater inflow and pollutant-loading reaching the waterbody than in systems with a lower ratio. A higher ratio can result in a waterbody that is affected more by watershed processes than by internal cycling.

The bay receives freshwater inputs from five tributaries, including Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, and North Creek, as well as direct runoff from coastal areas. To reach the Gulf of Mexico, water in Little Sarasota Bay must flow through Roberts Bay North and Sarasota Bay to Big Sarasota Pass in the north or through Blackburn Bay to Venice Inlet to the south. Tidal circulation in Little Sarasota Bay is now forced by tides at Venice Inlet and the Intracoastal Waterway (ICW) running through the middle of the bay. The narrow estuary is relatively shallow except for the deeper ICW channel.

3.2 WATER QUANTITY AND WATER SUPPLY

Developing a sustainable water supply is a goal of Sarasota County. The County is committed to providing a sustainable water supply through protecting water resources from harm, optimizing the use of alternative water supplies such as reclaimed water and surface waters, providing reliable and cost-effective water supply to the County’s residents, and reducing demands on water resources through conservation and Low-Impact Development (LID).

Sarasota County meets its water supply needs through several sources. The bulk of the County's annual average daily demand of 19.0 million gallons per day (MGD) is supplied by the Peace River Manasota Water Supply Authority and Manatee County. Demand on average is expected to increase nearly 6 MGD over the next 6 years with the majority of the new supply coming from existing contracts and its own wellfields. Additional details concerning Sarasota County's water supply and demand are provided in Section 2 of Appendix B.

Stormwater runoff is a potential water source for non-potable uses that have been traditionally supplied by groundwater or other potable water sources. Current surface water flows in Little Sarasota Bay are about 20% higher than historical flows, and future flows are expected to remain

near current levels. Section 3.2.2 of this plan summarizes the flow analysis, or water budget, and results that are detailed in Section 3 of Appendix B.

Section 6 of Appendix G provides specific project and program recommendations to capture and use excess flow. The recommendations focus on stormwater-derived alternative water supplies for irrigation and programs aimed at reducing the potable water supply demand. Potable and reclaimed sources are covered under the County's Comprehensive Plan and water and wastewater master plans.

3.2.1 Water Supply and Demand

Water supply planning is the process by which an agency assesses the projected water demands for a period and the potential sources of water available to meet the demands. A Water Supply Plan helps the county manage one of its greatest resources, water. Water does not have boundaries; it is found in the sky and on, in, and under the ground. Water is seemingly abundant with a continual supply falling from the sky and stored in the ground and in our bodies. However, recent droughts and the impacts of over pumping have shown us that water is not as abundant as Floridians once thought, and therefore a plan is needed to help neighboring communities share and protect this important resource.

Little Sarasota Bay Watershed is within SWFWMD's SWUCA, which is defined as an area where water resources are or will become critical in the next 20 years. Regulatory requirements stemming from this distinction are described in the SWUCA Recovery Strategy (SWFWMD, 2006). For detailed information on Water supply and demand in the Little Sarasota Bay Watershed see Section 2 of Appendix B.

3.2.1.1 Water Sources

Potable and reclaimed water within the Little Sarasota Bay Watershed are distributed by Sarasota County Utilities, which falls within SWFWMD's region for supply management.

A. Water Sources within SWFWMD

The following section summarizes information in *A Sustainable Water Supply,* SWFWMD, 2001: http://www.swfwmd.state.fl.us/about/isspapers/watersupply.html.

The average rainfall of West-Central Florida is 53 inches a year, making it one of the rainiest regions in North America. However, most is lost to evaporation and runoff. The remainder replenishes the region's groundwater, which is rainwater that has soaked into the ground to an aquifer, an area of underground rock and sand, where it is "stored." Surface water refers to water on the surface of the earth, such as lakes, rivers, and streams.

Of the approximately 14 inches of rainfall that remain after evaporation SWFWMD-wide, about 9 inches go to surface waters, leaving only an average of 5 inches to resupply Florida's underground water reserves. Water users in the area regulated by SWFWMD use more than 1 billion gallons of water daily. More than 80% of this water comes from groundwater in the Intermediate and Floridan aquifers.

In some areas of SWFWMD, aquifers are connected with the lakes, rivers, and wetlands above them. If too much water is withdrawn from the aquifers, the water level of the lake or river above may decline. Excessive groundwater withdrawals can also cause the saltwater that surrounds the Floridan aquifer to move or intrude into freshwater areas, which decreases the amount of available freshwater and increases the cost for providing clean, potable water to residents. In Sarasota County, the Floridan aquifer is confined and the intermediate aquifer system is the main source of water supply.

Groundwater is expected to always be a source of drinking water, but access to other sources is essential. The balance of the region's water supply comes from surface water. Surface water use will most likely increase because the ability of the groundwater system to satisfy an ever-growing need for freshwater is limited, but surface water has limits as well. By 2030, about 84 MGD of additional water may be necessary to meet the projected water demand of all current and future water users within SWFWMD. Potential additional water availability is summarized in Table 3-1 (RWSP, SWFWMD, 2010).

B. Water Sources within Sarasota County

Sarasota County Utilities historically purchased its water from Manatee County and blended it with water from the University Wellfields. As the area grew and water demands increased, Sarasota County began developing its own water supplies and participating in the Peace River Manasota Regional Water Supply Authority as a regional partner. Currently, a variety of public and private water service providers meet the water supply demand in Sarasota County. The Cities of Sarasota, Venice, and North Port and the Town of Long Boat Key are primarily served by the local municipal utility. The unincorporated sections of Sarasota County are served by the Sarasota County Utilities Department, Englewood Water District, independent water treatment and supply systems, and individual wells. Englewood Water District and the Cities of Sarasota, North Port, and Venice own and operate the water systems that provide water within their jurisdictional boundaries. The Town of Longboat Key purchases its water from Manatee County (WSMP, Carollo, 2011).

Water demand within the Sarasota County Utility service area is met through its groundwater supplies and interlocal agreements. A water supply agreement with Manatee County expires in 2025. An agreement with the Peace River/Manasota Regional Water Supply Authority was amended in 2005 and is valid for 35 years with the option to extend for an additional 35 years (WSMP, Carollo, 2011).

Table 3-1 Potential Additional Water Availability in Southern Planning Region through 2030 (MGD) (RWSP, SWFWMD, 2010)

County	Surficial Water[1]		Reclaimed Water	Desalination		Fresh Groundwater		Water Conservation		Total
	Permitted Unused	Available Unpermitted	Offset	Seawater	Brackish Groundwater	Surficial and Intermediate	Upper Floridan[2] Unused/Permitted	Non-Agricultural	Agricultural	
Charlotte	3.7	14.6	6.2		5.5	4.7		1.4	0.7	36.8
DeSoto	17.9	80.4	1.3		0.4	1.8		0.3	2.0	104.1
Sarasota	3.2	74.6	14.5	20.0	10.3	6.0	2.7	2.5	0.7	134.5
Manatee	6.2	3.8	17.4	20.0		4.9	0.8	2.8	3.1	59.0
Total	31.0	173.4	39.4	40.0	16.2	17.4	3.5	7.0	6.53	334.4

1. All available surface water from the Peace River is shown in DeSoto County, because the calculation was based on flows in DeSoto County; however, future withdrawals from the Peace River in Hardee and Polk Counties are possible.
2. Groundwater that is permitted but unused for public supply. Estimated 2009 use is based on a linear trend for 2000 through 2008. Permitted quantities were current as of October 2009.

County-owned water system components include groundwater sources and associated treatment and transmission systems. Groundwater sources for Sarasota County include the Carlton, Venice Gardens, and University Wellfields, which withdraw groundwater from Production Zone 3 (PZ3) of the Upper Floridan and Intermediate Aquifer Systems. The County obtained its current water use permit on May 15, 2012 (WUP No. 20008836.010), which consolidated the County's previous three permits for the individual wellfields with no increase in quantities. The current permit expires on August 28, 2017.

3.2.1.2 Sarasota County Supply and Demand

Water demand projections were compiled as part of the County's *10 Year Water Supply Facilities Work Plan* (June 2012). Projected annual average water demands from Sarasota County are shown in Table 3-2.

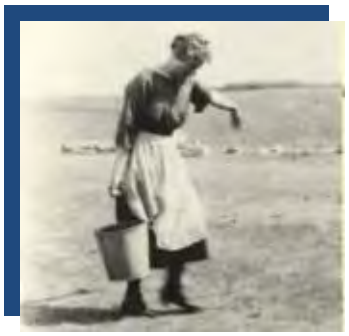
Table 3-2 Annual Average Water Demands (WSMP, Carollo, 2011)

	2010	2015	2020	2025	2030
Sarasota County	17.54	21.15	23.51	25.51	27.19

See Appendix B, Table 2-3 for a summary of average annual and maximum month water demands, facility capacities, and permitted quantities for Sarasota County Utilities based on the upper band of the demand projection cone. New water supply will need to begin development soon after 2020. The County is working on several options for future supply including the Dona Bay wastewater treatment facility and expansions of existing County-owned facilities (Carollo, 2012).

3.2.1.3 Per Capita Consumption

The average gross per capita water consumption from 2003 through 2007 in Sarasota County was 87 gallons per capita per day (gpcd). This value accounts for water use by commercial and industrial users, as well as for lost and unaccounted-for water. Although the County water system provides approximately 87 gpcd to its customers on average, a demand factor of 100 gpcd was selected to use for planning. This value accounts for any potential changes in water use patterns or shifts in demand. Conservation activities have reduced per capita water use from approximately 110 gpcd in 1992 (Carollo, 2012).



Picture yourself carrying 87 gallons of water in a bucket from a well or stream. Would you still use that much water?

3.2.2 Water Budget

3.2.2.1 Introduction and Purpose

Water follows numerous pathways in the atmosphere, on land, in freshwater water bodies, and in estuaries and the ocean. Water from the atmosphere falls to the land and the open water in liquid or solid form. Water that falls to land can either seep in the soil and become shallow or deep, confined groundwater, remain on the land surface and be transpired or evaporated back into the atmosphere (evapotranspiration (ET)), or flow from the land to a freshwater or marine water body as runoff. Shallow groundwater can also re-enter a surface water body through seepage or baseflow, which can include septic tank effluent seepage. Freshwater also enters the estuary as discharges from point sources such as wastewater treatment plants and industrial facilities.

Societal activities in the watershed affect the magnitude, timing, and distribution of freshwater inflows to the estuary. Land use changes alter how precipitation is partitioned when it reaches the ground. Urbanization reduces the area of open land that allows water to infiltrate from the ground surface to lower soil strata. Natural wetlands and upland areas are also impacted, which reduces ET levels and on-site storage. Surface water management for drainage control often results in the channelization of natural streams, which reduces aquatic and upland habitat, degrades water quality, and can increase erosion and sediment transport.

The volume, timing, and distribution of freshwater inflows significantly affect the balance of aquatic life in an estuary. Maintaining an appropriate range of freshwater inflows delivered from the watershed to the estuary is crucial to protecting the ecological health of the entire aquatic system. Freshwater plays diverse roles in supporting estuarine communities, including the following.

1) Freshwater inflows affect circulation in an estuary. Circulation can be enhanced during periods of high inflow—for example, during the wet summer months. Increased circulation has several benefits including dispersing pollutants such as excess nutrients, increasing dissolved oxygen (DO) levels in the water, and transporting suspended organisms.

2) Freshwater inflows affect residence time of water in an estuary. If water is not circulated from nutrient-rich coastal areas, excessive algal growth can occur that may result in high chlorophyll levels. Consequences of this may include lower water clarity and reduced DO levels, both of which are undesirable for aquatic biota. During periods with abundant rainfall, freshwater inflows to an estuary increase and residence time decreases. Conversely, during dry periods freshwater inflows are low and residence time increases.

3) Freshwater inflows affect salinity levels in an estuary. During dry periods, the salinity concentration in Little Sarasota Bay is close or equal to that in the Gulf of

Mexico. However, in the wet summer months freshwater inflows mix with the saline water to lower overall salinity and to form a concentration gradient within the estuary. Many commercially and recreationally important fish and benthic species rely on the lower salinity (oligohaline) conditions of estuaries for at least some portion of their life cycle.

The salinity gradient is especially important near the mouth and in the lower reaches of coastal streams. Freshwater mixes with saltwater to form a salinity gradient in the stream that ranges from marine to fresh water. The low salinity zones are important habitat, providing areas for feeding and nursery for a variety of fish and benthic organisms.

4) Freshwater inflows supply sediments and nutrients to an estuary. The delivery of watershed-based suspended and dissolved materials is important to the health of an estuary and provides many benefits. However, excessive loadings may cause detrimental effects to the receiving water body. High sediment loading may smother the bay bottom and degrade benthic habitat. Elevated nutrient loads can result in high algal growth, which can cause lower DO levels and reduce water clarity.

Many of the ecological problems for an estuary are caused by changes in the watershed. Watershed-based actions that can adversely affect an estuary include alterations to the surface water and groundwater systems that deliver freshwater to the estuary. Water can be diverted into or out of an estuary, changing the volume of freshwater delivered to the receiving water. Urbanization and channelization of natural streams also affect the magnitude, timing, and distribution of freshwater inflow to an estuary.

This relationship between the watershed and estuary is the focus of the water budget investigation. By understanding how altering freshwater inflows affects the health of the estuary, we can better manage watershed-based activities to protect and enhance Little Sarasota Bay's aquatic resources.

The objectives of evaluating freshwater inflows to Little Sarasota Bay are to provide answers to the following questions:

1) Have historical land use changes or other watershed-based activities substantially altered freshwater inflows to the bay on an annual and seasonal basis?
2) Can we expect future land use changes or other watershed-based activities to affect freshwater inflows?
3) Have land use changes altered the relative contributions of the individual sources of freshwater inflows to the bay?

3.2.2.2 Methods and Assumptions

Water budgets for Little Sarasota Bay and Blackburn Bay and their watersheds under historical, current, and future conditions were developed using the Sarasota SIMPLE (Spatially Integrated Model for Pollutant Loading Estimates) model. The model integrates rainfall, land use, and soils data with algorithms using rate constants developed for local conditions to calculate the water budget using six components:

- Atmospheric deposition (direct rainfall to the open water estuary).
- Direct runoff (stormwater).
- Baseflow (shallow groundwater seepage).
- Irrigation (seepage and runoff from reclaimed water land application).
- Point sources (wastewater treatment plant and industrial discharges).
- Septic tanks.

The current conditions were provided by a SIMPLE model run for 1989 through 2008. The original modeling was completed for a project funded by SBEP (*Numeric Nutrient Criteria for Sarasota Bay*, prepared by Janicki Environmental [2010]).

The water budgets were developed using the current conditions rainfall (1989-2008) for all three scenarios and varying the other inputs to simulate historical and future conditions. The results provide a basis for comparing historical and current conditions, as well as current and future conditions, due to anthropogenic activities, without having to account for changing rainfall patterns.

A Decision Memorandum was developed by the Project Team to specify assumptions, data, and approach used to estimate inflows for historical and future conditions. The memorandum outlined changes regarding changes to land use, wastewater treatment and septic tanks, and other sources that resulted in changes to freshwater inflow patterns. A detailed description of the Decision Memorandum is provided in Appendix B – Water Quantity.

The results of the analyses are provided below. Historical, current, and projected future freshwater inflows to the bay are summarized for the bay as a whole and for individual basins in the watersheds.

3.2.2.3 Little Sarasota Bay/Watershed Water Budget

Historical, current, and future freshwater inflows to Little Sarasota Bay were estimated using the methods summarized above and detailed in Appendix B. Selected results are presented below. The analyses of these data included examining and comparing the spatial and temporal variation in freshwater inputs to Little Sarasota Bay. Spatial, annual, and seasonal variations in rainfall are described, followed by comparisons of historical\current and current\future inflows and sources.

These analyses are essential to understanding the role of freshwater to the health of the bay for several reasons:

- An assessment of rainfall is critical to the analysis, as rainfall drives many natural processes in the bay.
- Examining historical conditions allows us to compare freshwater inflows from the past to current conditions. This helps identify to what extent changes in the watershed have affected freshwater inflows to date.
- Comparing current to future conditions is also important for effective resource management, as it helps identify potential future problems and facilitates developing pro-active, preventative actions.

A. Rainfall

Annual rainfall averaged approximately 48 inches per year across the watershed during 1989 through 2008 and ranged from about 31 inches per year in 2000 to approximately 66 inches in 1995. Only a 20-year period of rainfall was evaluated and may not apply to the long-term rainfall record. Annual rainfall totals for Little Sarasota Bay and the watershed are shown in Figure 3-4.

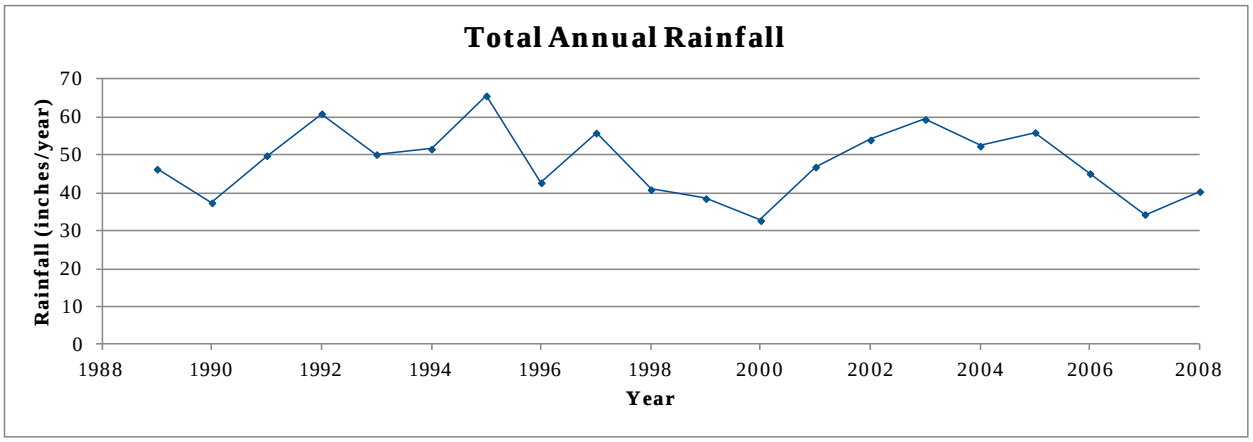


Figure 3-4 Total Annual Rainfall to Little Sarasota Bay and its Watershed for Current Conditions (NEXRAD)

A distinct seasonal signal in precipitation exists in the watershed. As is typical of peninsular Florida, June through September are significantly wetter than the other 8 months. The four wet season months have average rainfall of between 6 and 8 inches, while the eight dry season months average between 2 to 3 inches. Monthly rainfall for the Little Sarasota Bay Watershed is presented in Figure 3-5.

A spatial trend in precipitation also exists for Little Sarasota Bay and its watershed. For 1989 through 2008 significantly higher rainfall occurred in the most inland portions of the watershed with lower precipitation along the coast. The precipitation gradient is almost 5 inches per year difference across the Little Sarasota Bay Watershed, as shown in Figure 3-6.

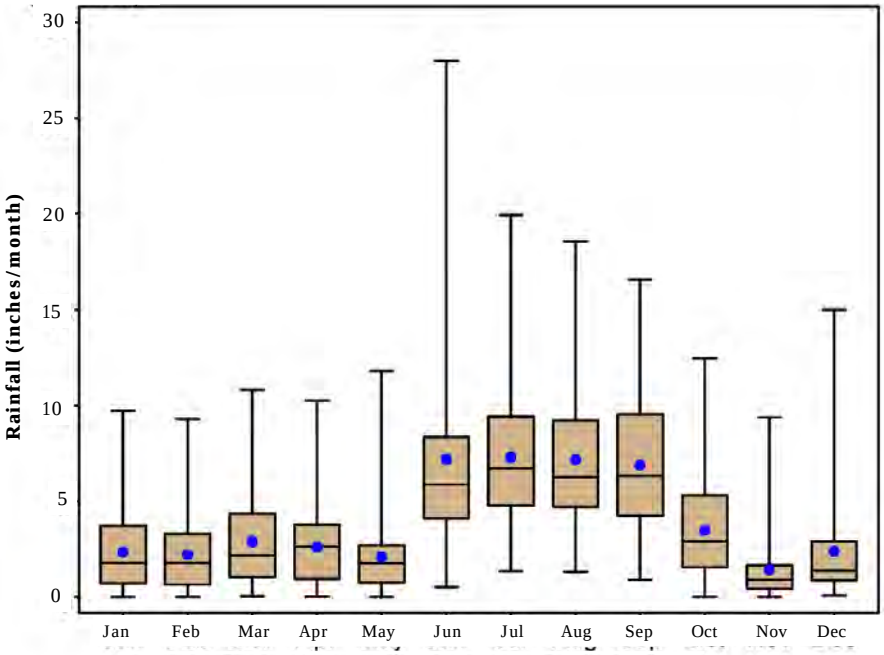


Figure 3-5 Seasonal Variation in Total Monthly Rainfall within Little Sarasota Bay and its Watershed for Current Conditions

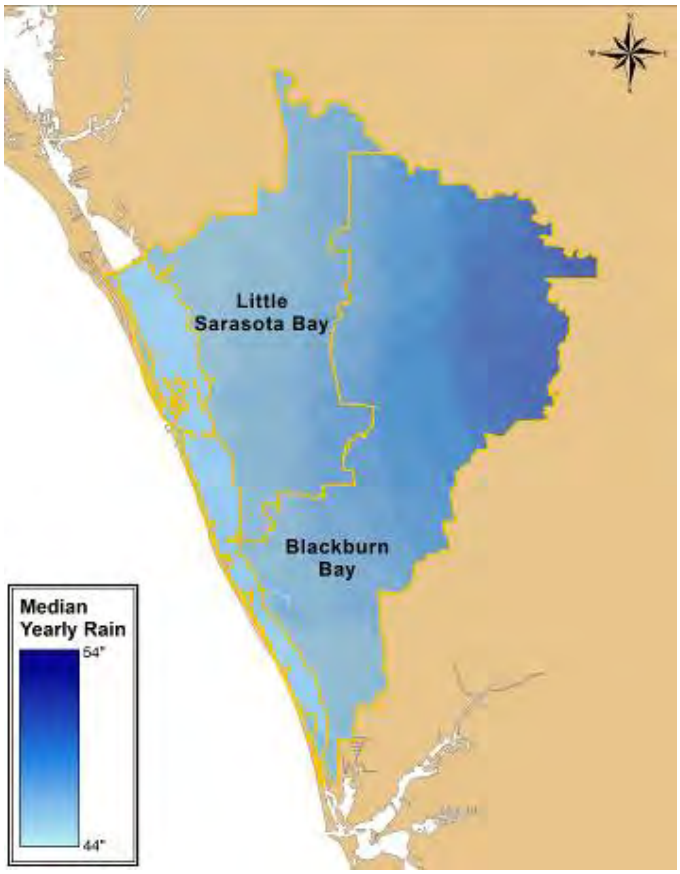


Figure 3-6 Median of Annual Rainfall (1989–2008) used in the SIMPLE Model to Estimate Freshwater Inflows to Little Sarasota Bay

Freshwater inflows to Little Sarasota Bay originate from sources in nature and from human activities. Rainfall is one of the primary sources of freshwater in the Little Sarasota Bay system. Atmospheric deposition (direct rainfall to the open water estuary) contributes a significant amount of freshwater to the bay. This is because the relative size of the open water estuary with respect to the watershed land area is relatively large, although not as large as Sarasota Bay, where atmospheric deposition is the major freshwater source.

Sources of freshwater inflows that are rainfall-dependent but are also influenced by human activities include direct runoff (stormwater) and baseflow (shallow groundwater seepage). These sources vary in direct response to rainfall patterns but are also influenced by alterations to the drainage system and land use changes. Replacement of natural uplands and wetlands with urban land uses has a profound effect on the timing and volume of freshwater reaching the bay.

Other sources of freshwater inflows are directly influenced by human activities. Irrigation (seepage and runoff from reclaimed water land application), point sources (wastewater treatment plant and industrial discharges), and septic tanks seepage all vary according to human activity and control. In general these sources contribute much less freshwater than rainfall, direct runoff, and baseflow, and their management is more important with respect to pollutant-loading rates.

As stated above, the historical and current periods were both evaluated using current rainfall so that effects due to land use changes and other watershed-based activities could be better identified. The results of the analyses indicate that total freshwater inputs to the bay for the current period (1989 through 2008) were on average approximately 20 % higher than during the historical period. Although this change is substantial, some portions of the Little Sarasota Bay Watershed were already developed in the historical period (circa 1950). Freshwater inflow frequently increases as the area of urban land in a watershed increases, so if more land had been available for development the percent increase in freshwater inputs would have been greater. Current freshwater inflows were also compared to projected future inflows. Future total freshwater inflows were estimated to be approximately 8% higher than current, again a function of expected increased urbanization in the watershed. Figure 3-7 shows similar wet (July through September) and dry (October through June) season patterns for all three periods, although the magnitudes of inflows have changed.

Total freshwater inflow to the bay was higher during the current period than during the historical period and higher during the future period than the current. This is a result of land use changes and alterations to the surface water drainage system including filling natural storage areas and channelizing natural streams. However, annual and within-year variability were similar for all periods, as shown in Figure 3-7 and Figure 3-8. As noted above, the same 1998 through 2009 rainfall was used to assess all periods (historical, current, and future), which contributed to the similarity in the freshwater inflow patterns. The figures also demonstrate that freshwater inflows for both periods mainly depend on rainfall and that land use changes do not influence the seasonality of freshwater inflows to the bay.

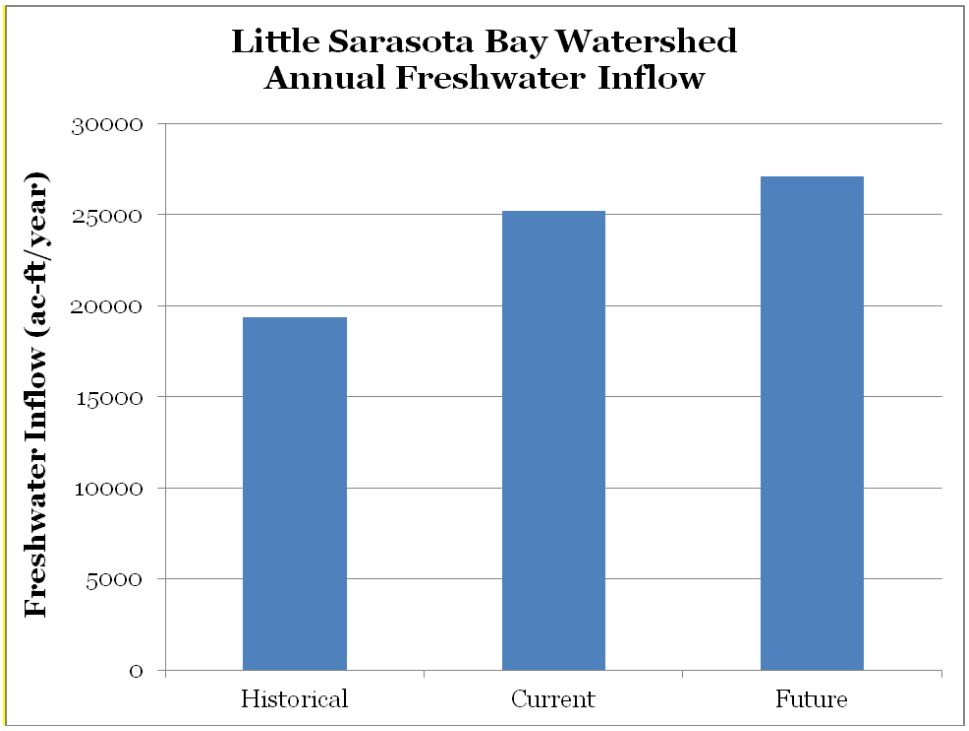


Figure 3-7 Annual Total Freshwater Inflows to Little Sarasota Bay for Historical, Current, and Future Conditions

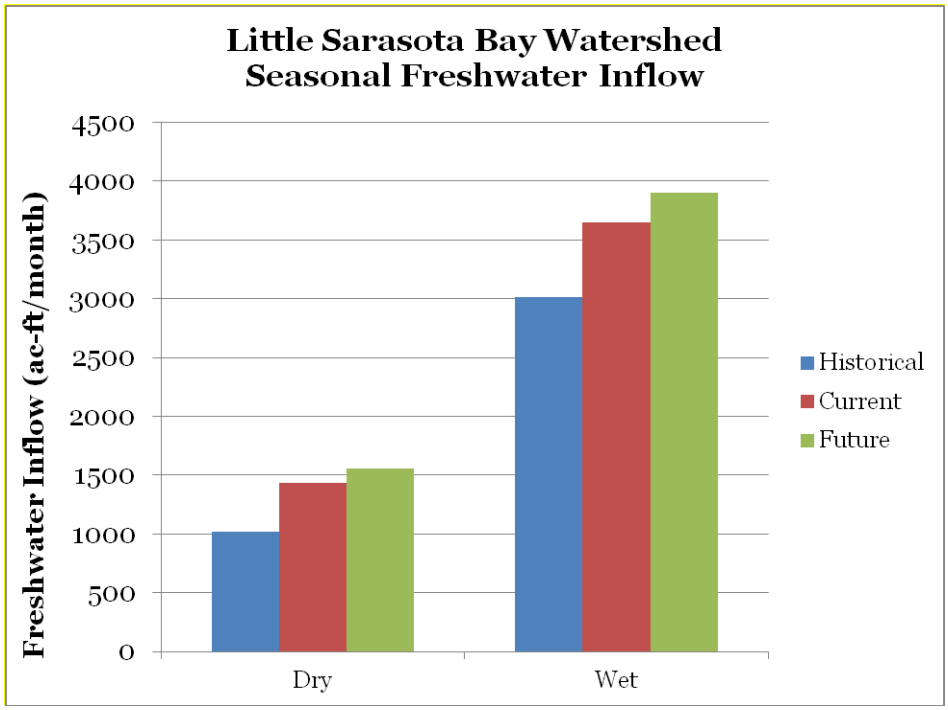


Figure 3-8 Seasonal Variability in Total Freshwater Inflows to Little Sarasota Bay for Historical, Current, and Future Conditions

As stated above, the freshwater inflow analysis was completed using the results of the SIMPLE computer model. The watershed was delineated into seven drainage areas for use in the SIMPLE model. These drainage areas are the basis of the analyses described in Appendix B. For the WQMP, the Little Sarasota Bay Coastal drainage area was aggregated with the Siesta Key Basin. The basins are shown in Table 3-3 and Figure 3-9.

Table 3-3 Little Sarasota Bay Watershed Plan Basins and SIMPLE Basin Names

Plan Basin Name	SIMPLE Drainage Area Name
Elligraw Bayou	Elligraw Bayou
Holiday Bayou	Holiday Bayou
Clower Creek	Clower Creek
Catfish Creek	Catfish Creek
North Creek	North Creek
Little Sarasota Bay Coastal	Little Sarasota Bay Coastal
	Siesta Key

The relative contributions of sources of freshwater for historical, current, and future conditions were compared. The relative importance of all sources remained relatively consistent for the three periods. Atmospheric deposition was the main freshwater contributor for the historical period, but direct runoff contributed the most inflow during the current and future periods. Figure 3-10 shows the relative contributions of freshwater inflows by source for historical, current, and future conditions. The results indicate that, although the overall volume of freshwater inflows to the bay has changed, the relative importance of individual sources has not changed significantly.

Additionally, the relative contribution of individual sources remains constant year-to-year, although the magnitudes of source-specific inflows change. Rainfall, direct runoff, and baseflow all vary much more than the controlled sources but always represent the bulk of the inflows. This is illustrated in Appendix B, Figure 5-1.

Thus, land use changes in the past have altered the volume but not the seasonal patterns of freshwater entering Little Sarasota Bay. Also, the relative importance of individual sources of freshwater has not changed significantly. Despite the current urban nature of much of the watershed, areas of land are not currently developed, particularly in the Catfish Creek and North Creek Basins. If urbanization spreads to these areas, significant changes to freshwater inflows could occur. The results of this analysis suggest that, although freshwater inflows have increased since the historical period and future freshwater inflows may be expected to increase due to urban growth, appropriate management activities should preclude adverse effects to the bay due to changes to freshwater inflows in the future.

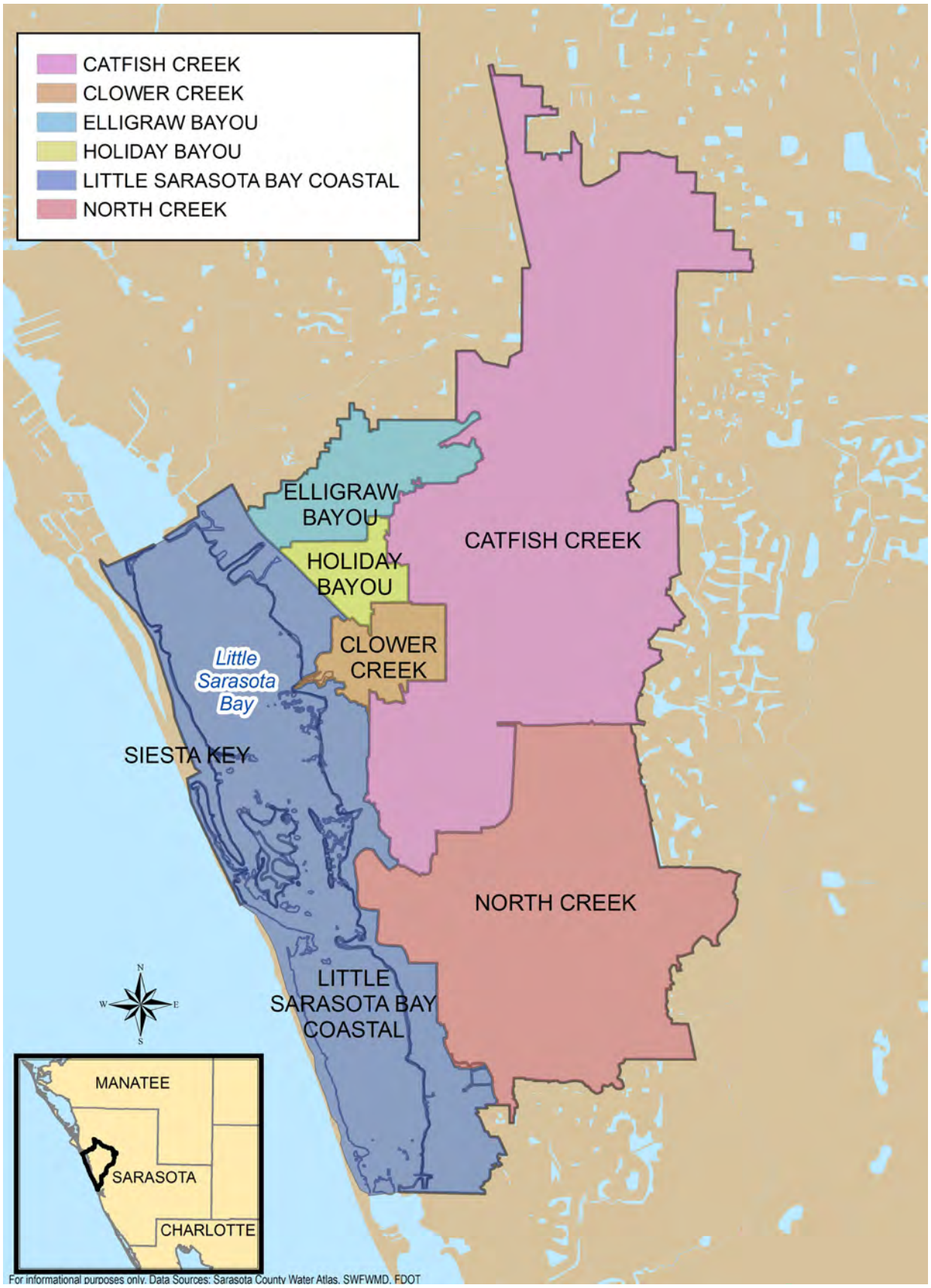


Figure 3-9 Little Sarasota Bay and Blackburn Bay Watershed Basins

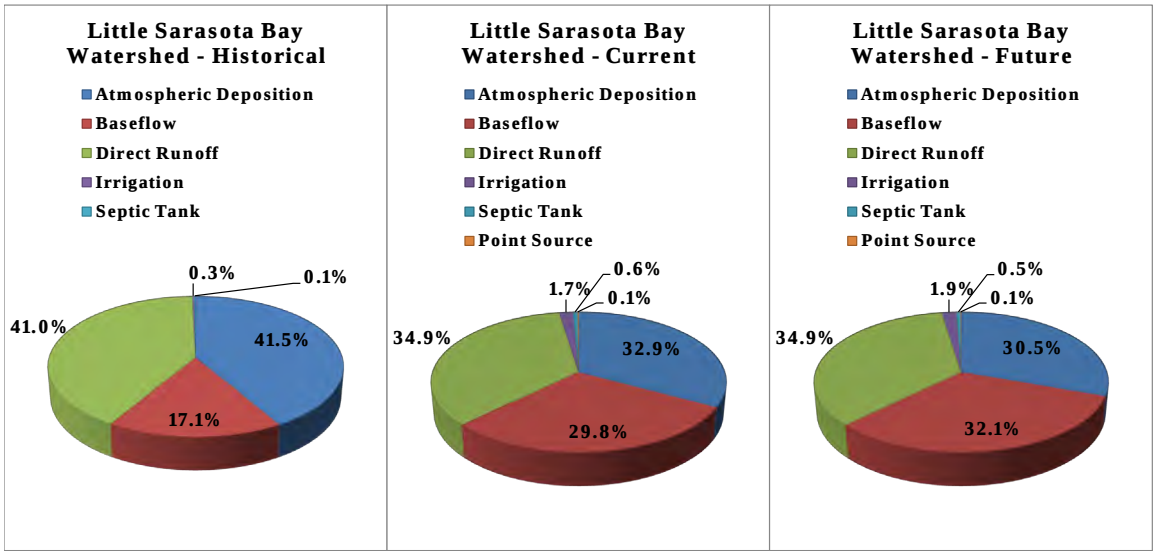


Figure 3-10 Relative Contributions of Freshwater Inflows to Little Sarasota Bay by Source for Historical, Current, and Future Conditions

3.3 WATER QUALITY

Maintaining appropriate water quality is crucial to protecting the health of the bays' living resources, many of which depend on managing watershed-based activities. The estuary and watershed systems depend on water quality in the bay. Water quality in the bays is affected by natural processes and anthropogenic activities in the watershed and can be characterized by several parameters:

- *Seagrass* is not a water quality parameter, but its abundance and distribution depends on several water quality constituents. Seagrass requires light to grow; subsequently if water clarity and resultant light penetration is low, seagrasses are confined to shallow areas of an estuary. If nutrient levels reach extreme levels, high algae growth will limit the extent of seagrass growth by increasing shading in the water column. Thus, the extent of seagrass coverage in the bays provides insight into overall water quality conditions.
- *Salinity* is a measure of dissolved salt in the water. The salinity gradient in the bays and tidal segments of tributaries varies constantly according to precipitation, tidal action, and internal circulation. Salinity is a major factor controlling the distribution of estuarine flora and fauna.
- *Dissolved Oxygen (DO)* is the amount of O_2 dissolved in water. Aquatic animals need oxygen to survive, and low DO levels can deplete areas of valuable fish and benthos.
- *Nutrients* are an important source of food for vegetation. However, in excessive amounts nutrients can cause high algal growth rates, which can negatively affect DO levels and water clarity. Nitrogen and phosphorus promote vegetation and algae growth; however, nitrogen is the controlling, or limiting nutrient in many

estuaries. Thus, the control of nitrogen inputs must be a priority for a successful management plan.

- *Chlorophyll* is a measure of the abundance of algae in water. High chlorophyll levels are an indicator of high algae growth rates. If chlorophyll is uncontrolled, eutrophication can result in detrimental effects to water clarity and DO levels.
- *Water clarity* is a controlling factor in the depth to which seagrass, which depends on light penetrating the water, can grow. Thus water clarity largely controls the extent of seagrass coverage in the estuaries. Seagrass is an extremely valuable habitat and food source for many aquatic species and also stabilizes bay bottom sediments.
- *Suspended solids* is the amount of fine-grained organic and mineral matter within the water column. Total suspended solids (TSS) can affect water clarity and, most often after large rainstorms with high stormwater runoff, smother beneficial bay bottom habitat.

Little Sarasota Bay is a vital resource for Sarasota County, providing economic, recreation, and aesthetic benefits. The bay is connected with Roberts Bay North and Blackburn Bay, as well as with the watershed through inputs of freshwater, chemicals, and mineral materials conveyed to the bay in coastal streams. Understanding the relationship of the bay to these inputs is important to protecting and enhancing bay resources.

3.3.1 Estuarine Water Quality Status and Trends

Monitoring water quality and assessing status and trends has several benefits including:

- Describes current and past environmental conditions.
- Facilitates early detection of problems.
- Assesses the effectiveness of existing management efforts.

Water quality in the bay has been regularly monitored for salinity, nutrients (total nitrogen [TN] and total phosphorus [TP]), DO, TSS, water clarity, and other parameters since 1998. A review of in-bay concentration data shows:

- Statistically significant decreasing trends in the TP and turbidity concentrations occurred over the period of record.
- No significant trends in the chlorophyll a, TN, TSS, salinity, or water clarity were found over the period of record.

These results indicate that current water quality conditions in the bay as a whole are good. Parameters that could indicate undesirable conditions (TN, chlorophyll) are stable. Additionally, targets for seagrass survival are being met or exceeded, signifying that existing water quality conditions are adequate for seagrass growth and that current management efforts to protect bay resources are successful. Figure 3-11 and Figure 3-12 show seagrass coverage and chlorophyll

concentrations in the bay in comparison to criteria established by SBEP. These criteria (targets and thresholds) are further discussed below.

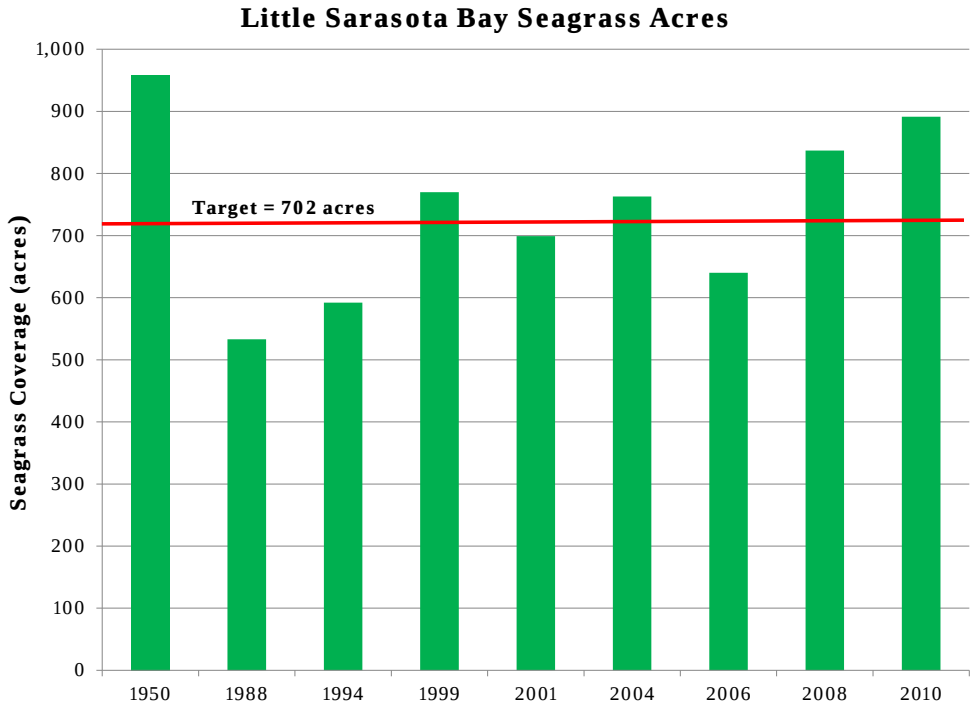


Figure 3-11 Little Sarasota Bay Seagrass Coverage Shown with SBEP Target (702 acres)

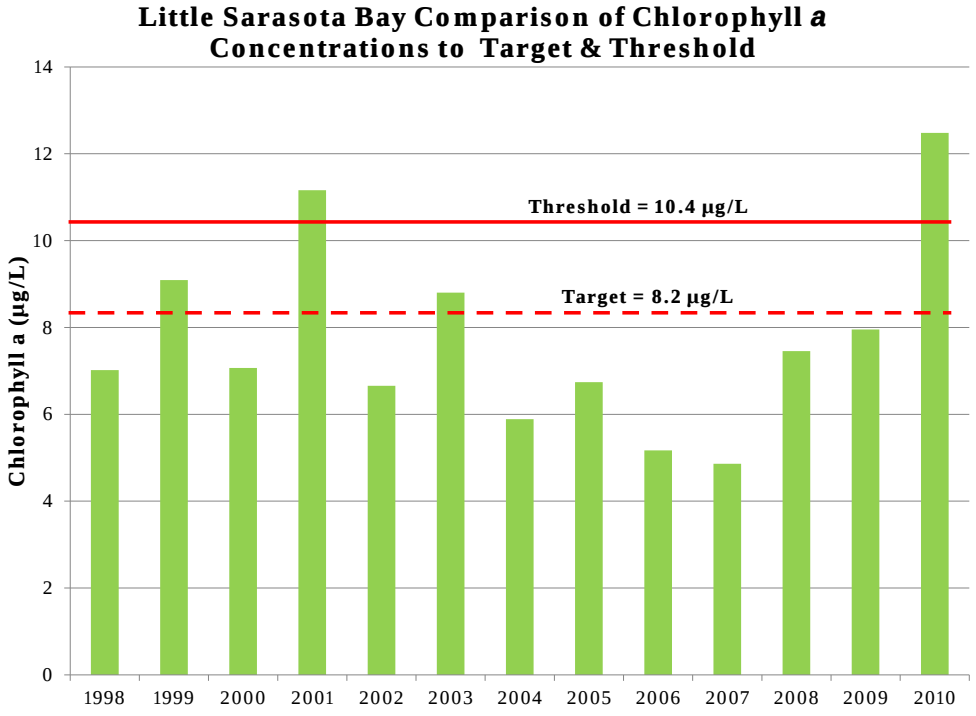


Figure 3-12 Little Sarasota Bay Chlorophyll Concentrations Shown with SBEP Target (8.2 µg/L) and Threshold (10.4 µg/L)

3.3.2 Hydrologic and Pollutant Loading

Evaluating current levels of pollutant loading to the bay, especially nutrients and TSS, and projecting potential future loading rates, can provide an early warning to potential problems. Sources of pollutant loading to the bay include the following:

- Atmospheric Deposition (direct precipitation to the open water estuary).
- Baseflow (shallow groundwater seepage).
- Direct Runoff (stormwater that enters the bay).
- Irrigation (by reclaimed water).
- Point Sources (surface water discharges from wastewater treatment plants or industrial facilities).
- Septic Tanks.

Current and projected future loadings to the bay were estimated with the SIMPLE computer model, which was used for SBEP, Sarasota County, and SWFWMD pollutant-loading studies (Janicki Environmental, Inc., 2010). Future loads were estimated by making assumptions developed in concert with the County and SWFWMD regarding likely condition for land use, wastewater treatment, and disposal options, and atmospheric deposition rates for an unspecified future period. Measured rainfall for 1989 through 2008 was used to generate current and future conditions loads. Using current rainfall for future conditions was the preferred approach because future rainfall would be difficult to predict, but even more importantly using the same rainfall for both conditions allowed a comparison to be made of loadings for both scenarios due only to changes in anthropogenic conditions and not natural variability.

Figure 3-13 shows annual TN loadings for 1989 through 2008, which represent current conditions. Inter-annual variation is largely a function of rainfall, as sources other than atmospheric deposition, direct runoff, and baseflow (all are driven by rainfall) are relatively small. Future total loadings to the bay are almost the same as current (less than 1% different), as baseflow and direct runoff increases are partially offset by a projected reduction in atmospheric deposition TN loading (based on estimates developed by EPA. Because the watershed is generally urbanized at present, no large changes in land use-based loadings such as direct runoff and baseflow are foreseen.

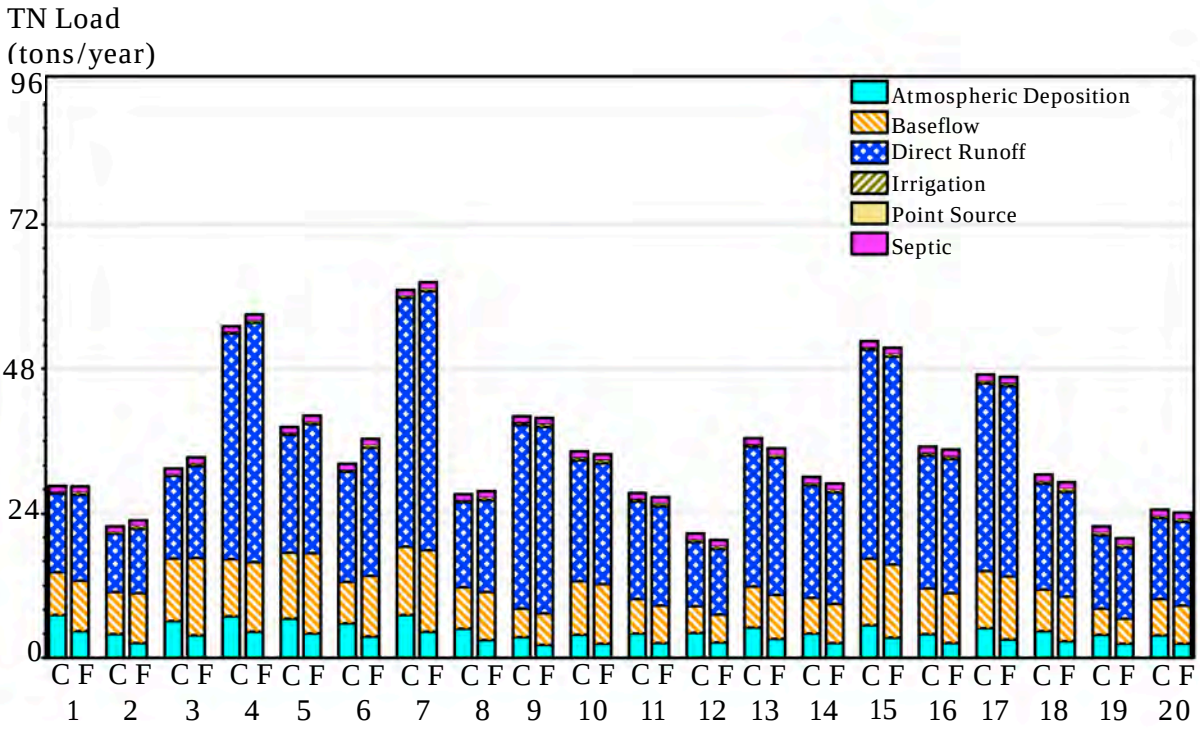


Figure 3-13 TN Loads to Little Sarasota Bay for Current (C) and Future (F) Conditions
Values across the horizontal axis (1–20) represent years of rainfall used for both scenarios (1989–2008).

3.3.3 Comparison of Ambient Water Quality to Regulatory Criteria and Management Levels of Service (LOS)

Setting resource protection LOS is one of the most important elements of an effective WQMP. An overall approach for protecting Little Sarasota Bay's resources has recently been established through the work of SBEP, SWFWMD, Sarasota County, other local governments, FDEP, and other interested parties.

In-bay water quality was compared to current and existing water quality criteria (targets and thresholds). The development of Water Quality LOS is based on a paradigm that distinguishes targets from thresholds, i.e., that distinguishes water quality management levels from regulatory levels. A **target** is a desired water quality condition and can be used as an "early warning" of undesirable change in water quality. However, there may be years in which water quality targets may be exceeded without causing significant changes in the receiving waterbody. Therefore, there is some allowable amount of variation that should not elicit a significant degradation in water quality and, subsequently, seagrass coverage. **Thresholds** have often been set to allow for variability in annual conditions and to meet the need for a regulatory level. Where these regulatory levels have not been established, there remains the need for a second water quality management level that elicits significant responses to their exceedance. Therefore, a distinction

is made between a target, i.e., a desired water quality condition, and a threshold, i.e., a water quality level above which undesirable conditions exist.

Water quality was compared to the existing and proposed targets and thresholds (management criteria and regulatory limits) described below to assess the ecological health of the watershed. Results of the assessments are detailed in the individual basin sections and summarized in Table 3-4.

- Seagrass extent has exceeded the adopted SBEP acreage coverage criteria for Little Sarasota Bay of 702 acres (Figure 3-11). SBEP (of which Sarasota County and SWFWMD are members) sponsored an investigation to determine a desirable, realistic goal for seagrass growth based on a review of current and historical data (Janicki Environmental, Inc., 2010).

- Ambient chlorophyll concentrations have met the adopted SBEP chlorophyll threshold in every year except two since 1998 (Figure 3-12). SBEP also sponsored extensive investigations to determine appropriate limits for chlorophyll in the bay that would promote seagrass growth (Janicki Environmental, Inc., 2010, 2011).

- Ambient TN concentrations have had no exceedances of the SBEP numeric nutrient threshold (Figure 3-14). TN loads and TP concentrations and loads also had no exceedances. Although nitrogen is the nutrient that limits algal growth in the bay, phosphorus can also affect water quality; therefore, LOS for both have been developed as discussed in Appendix C, Water Quality. For concentrations or loads not meeting the criteria to be considered an exceedance, the values must be higher than the threshold in 2 years of any 3-consecutive-year period. SBEP, Sarasota County, SWFWMD, and others supported work that resulted in establishing these nutrient targets and thresholds for the purpose of limiting algae growth rates and keeping chlorophyll concentrations at levels that promote seagrass growth.

Table 3-4 Comparison of Ambient Water Quality for 2006 through 2010 to Regulatory Limits and Management Criteria for the Little Sarasota Bay Watershed

	Little Sarasota Bay Coastal	Elligraw Bayou	Holiday Bayou	Clower Creek	Catfish Creek	North Creek
FDEP Freshwater (NNC)	N/A*	TN and TP levels in the freshwater segment of the Elligraw Bayou Basin met the threshold criteria in all years (2006–2010).	N/A**	TN and TP levels in freshwater reaches of the Clower Creek Basin met the threshold criteria in all years (2006–2010).	TN and TP levels in freshwater reaches of the Catfish Creek Basin met the threshold criteria in all years (2006–2010).	Because the North Creek sampling site is in a tidal segment these criteria are not applicable.
FDEP Proposed DO Standards	DO levels in the bay met both current and proposed DO criteria.*	Elligraw Bayou had one exceedance of the proposed DO criteria.	N/A**	Clower Creek had four exceedances of the proposed DO criteria, the highest of any tributary in the watershed.	Ambient DO saturation met or exceeded the proposed threshold during all years.	North Creek has one sampling site in the tidal segment of the stream. DO at the site met or exceeded the proposed threshold during all years.
Impaired Water Bodies	No open bay segments are considered impaired *	The marine segment of Elligraw Bayou is impaired for low DO, resulting from excessive nutrients (TN and TP).	N/A**	The marine segment of Clower Creek is impaired for low DO resulting from excessive nutrients (TN and TP), high nutrients (as evidenced by high chlorophyll levels), and fecal coliform bacteria.	The marine segment of Catfish Creek is impaired for low DO, resulting from excessive nutrients (TN).	The marine segment of North Creek is impaired for low DO, resulting from excessive nutrients (TN and TP).
Basin Loadings	no exceedance	no exceedance	no exceedance	no exceedance	no exceedance	no exceedance
Seagrass Extent	Exceeded criteria	N/A***	N/A***	N/A***	N/A***	N/A***
Ambient Chlorophyll Concentrations		N/A***	N/A***	N/A***	N/A***	N/A***
Ambient TN Concentrations	no exceedances	N/A***	N/A***	N/A***	N/A***	N/A***

*Parts of the Little Sarasota Bay Coastal Basin are contained within WBIDs defined for the marine segments of Elligraw Creek, Clower Creek, Catfish Creek, and North Creek.
**The Holiday Bayou Basin is split between Elligraw Bayou (WBID 1975) and Clower Creek (WBID 1975A)
*** SBEP criteria, which applies only to the bay.

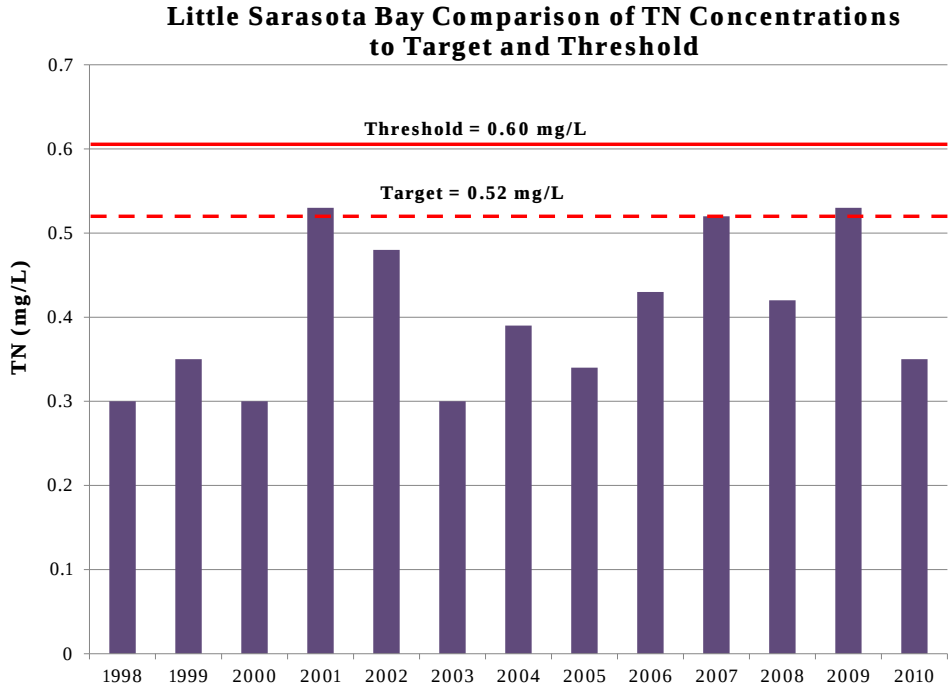


Figure 3-14 Comparison of Annual TN Loadings to Little Sarasota Bay to SBEP Target (0.52 mg/L) and Threshold (0.60 mg/L)

❖ DO levels in the bay met both current and proposed DO criteria. In Florida DO has traditionally been held to a standard based on concentration. The DO standard for marine waters is a minimum concentration of 4.0 mg/L. Recognizing that the standard does not allow for variability in natural conditions based on water temperature or salinity, FDEP has proposed DO criteria based on percent saturation, which is the expected amount of DO in water given ambient conditions. For predominantly marine waters (Class II and III, which includes Little Sarasota Bay), those standards are:

- The daily average percent DO saturation shall not be below 41.7%.

and

- The 7- and 30-day average percent DO saturations shall not be below 51.0 and 56.5%, respectively.

A review of in-bay DO concentration data revealed that both the existing and proposed standards were met each year of the period of record (1998–2010). This shows that algae growth, which can cause depressed DO at excessive rates, and inputs of oxygen consuming organisms (biochemical oxygen demand [BOD]) are being successfully controlled in Little Sarasota Bay.

❖ No open bay segments are considered impaired under the State's Impaired Waters Rule (IWR) (Chapter 62-303, FAC). FDEP administers the EPA's Total

Maximum Daily Load (TMDL) program in Florida. The TMDL program is intended to identify water bodies that are receiving a higher pollutant load than can be assimilated while maintaining the water body's designated use. If a water body does not meet State water quality standards according to IWR protocol, that water body is deemed "impaired." A TMDL may be developed that identifies excessive pollutant loadings and sources and specifies required reductions in pollutant loads to enable the water body to meet its designated use. FDEP delineated all waterbodies in the State into drainage areas known by their water body identification (WBID), of which four in the Little Sarasota Bay Watershed are listed as impaired (Figure 3-15). No portions of the open water bay, however, have been deemed impaired under the TMDL program, again providing evidence that water quality conditions in the bay are good overall.

Figure 3-15 Impaired WBIDs within the Little Sarasota Bay Watershed—Elligraw Bayou marine (WBID 1975), Clower Creek marine (WBID 1975A), Catfish Creek marine (WBID 1984), and North Creek marine (WBID 1984A)

- FDEP Freshwater Numeric Nutrient Criteria (NNC)—The FDEP adopted NNC for freshwater streams vary by bioregion, which allows the standards to reflect local conditions. The Little Sarasota Bay Watershed and its tributaries are in the Peninsula bioregion, with thresholds of 1.65 mg/L for TN and 0.49 mg/L for TP. These criteria are applicable only to freshwater streams.

- Basin Loadings—Annual TN, TP, and TSS loadings for 1989 through 2008 were developed for each basin as part of the SIMPLE modeling. The basin loading target is the average of annual loads for 2001 through 2005. This is consistent with the reference period approach used to develop chlorophyll targets. A higher threshold was also determined to allow for variability within the system. To be classified as an exceedance, the annual load must be higher than the threshold for 2 years of a 3-consecutive-year period. No exceedances occurred in the Little Sarasota Bay Watershed Basins during this period.

3.4 NATURAL SYSTEMS

While the Little Sarasota Bay Watershed still contains some beneficial upland, wetland, stream, and estuarine natural systems, the effects of urbanization and other land development have diminished their abundance, diversity, and beneficial functions.

3.4.1 Critical Estuarine Systems

3.4.1.1 Seagrass

Seagrasses are a fundamental component of the ecological structure of most Florida estuaries. Seagrasses provide numerous benefits including stabilizing sediments, providing refuge for juvenile fishes and invertebrates, and serving as a food source for manatee and sea turtles.

Seagrasses are also important and accurate indicators of the ecological health of an estuary. Results of the most recent 2010 mapping efforts indicate that seagrass coverage in Little Sarasota Bay/Blackburn Bay is 1,273 acres (Figure 3-16). The extent of seagrass digitized from circa 1950 aerials was estimated to be 1,260 acres. As a result, it is estimated that in 2010, seagrass acreage for both bays combined was 1% higher than historical estimates.

Source: Jon Perry, Sarasota, FL

Figure 3-16 2010 Seagrass Coverage in Little Sarasota Bay and Blackburn Bay (SWFWMD, 2010)

3.4.1.2 Shoreline

The Little Sarasota Bay and Blackburn Bay shoreline is not only the boundary of the estuary and the watershed but also plays an important role in the ecology of the system. Shorelines define the land-water interface and are ecological transition zones between terrestrial and aquatic life. Shorelines include a littoral zone where diverse habitat types affect the organization of floral and faunal assemblages and the interactions between terrestrial and aquatic plants and animals. Littoral zones are especially important in tidal water bodies. Human activities including mechanical dredging and filling and depositing channel spoil material have significantly altered the bays' shorelines since population began growing along the coast in the 1920s. A review of available data sources indicate that in 1948, Little Sarasota Bay had approximately 87 miles of shoreline, only 2% of which was hardened. Most of the hardened (vertical seawall) shoreline was in Little Sarasota Bay proper, including one area on Siesta Key, as well as the mainland. The only hardened shoreline in Blackburn Bay was at the Blackburn Point Road Bridge. By 2010, Little Sarasota Bay had 62 miles of total shoreline, a reduction due in part to decreased coverage of mangrove islands. Substantial shoreline hardening has taken place between historical and current periods, increasing the extent of hardened shoreline to 25% of the total.

3.4.1.3 Oysters

Oysters are an important indicator of estuarine health, and their status can help identify water-management problems. Oyster reefs serve several valuable ecological functions. They provide habitat for estuarine fauna, including conch, mud crab, fish, and other bivalves (Wells, 1961; Tolley and Volety, 2005) and help improve water quality by filtering as they feed. Based on a review of historical 1948 photographs, Little Sarasota Bay supported a significant extent of oyster beds. However, in 2010, only a total of 260 individual oyster bars ranging in size from 0.002 to 4.7 acres and having a total areal extent of 61.9 acres were identified (Figure 3-17).

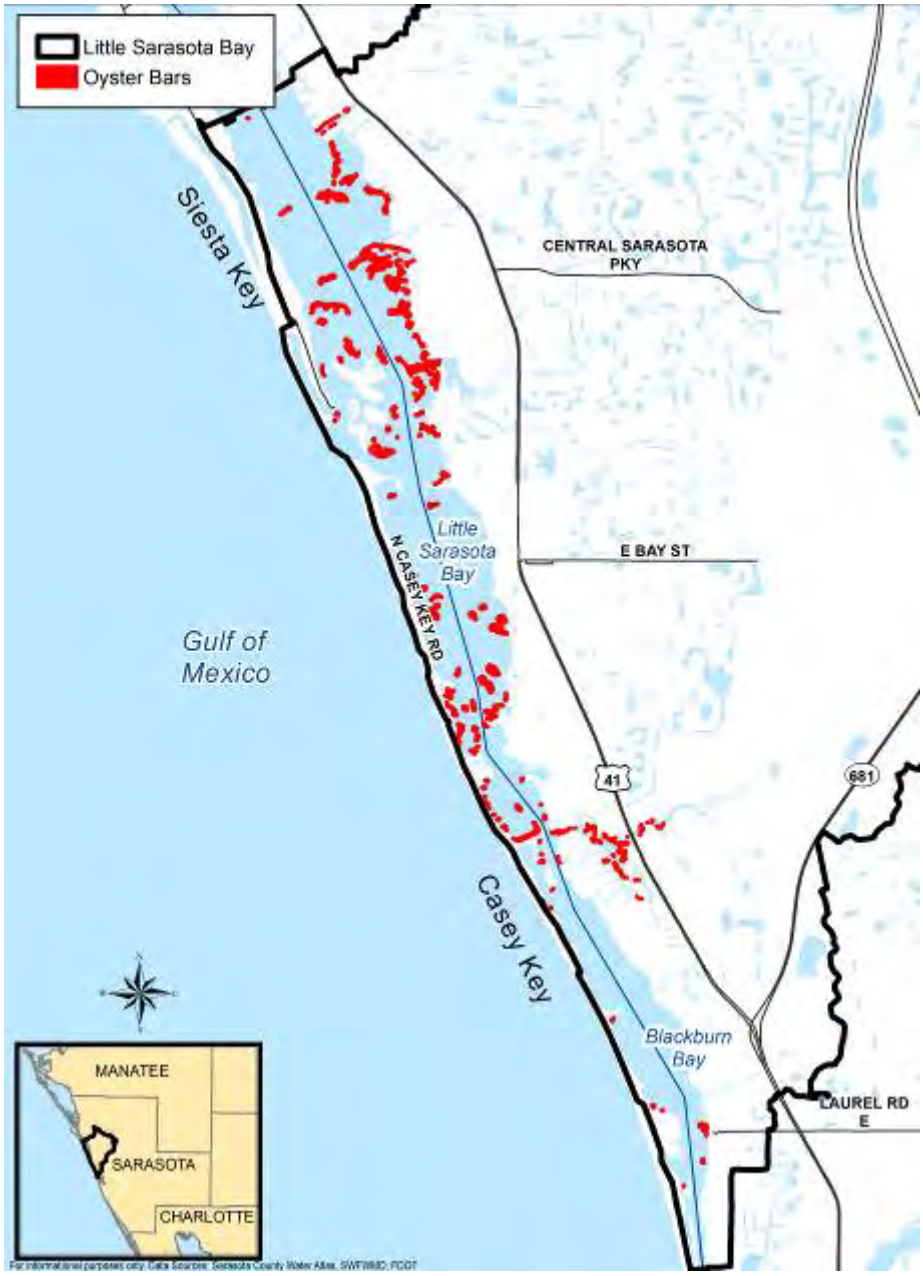


Figure 3-17 Oyster Bars Sites within Little Sarasota Bay and Blackburn Bay (2010)

3.4.1.4 Scallops

Scallops are also an important indicator of estuarine health. Once plentiful along Florida's southwest coast, they now exist locally in greatly diminished abundance. Several potential causes of the decline in the scallop population include decline in available habitat, changes in water quality, and over-harvesting. This decline led to drastic changes in the way scallops were managed in State waters. In 1994, waters south of the Suwannee River were closed to commercial harvesting while recreational limits were reduced. Through a combination of restoration and management practices, the recreational fishery was re-opened in West-Central Florida but still remains closed in the Sarasota Bay estuarine system.

The number of scallops observed County-wide has dropped in recent years, with 947 found in 2008 (Figure 3-18), 136 scallops identified in 2009, and only 12 in 2010. However, this inventory relies on a volunteer effort and the number of scallops found may reflect the number of participants in the searches or may be a reflection of natural variability. Field notes from these scallop searches indicate that the highest abundances of scallops are observed near passes and/or in association with seagrass meadows.

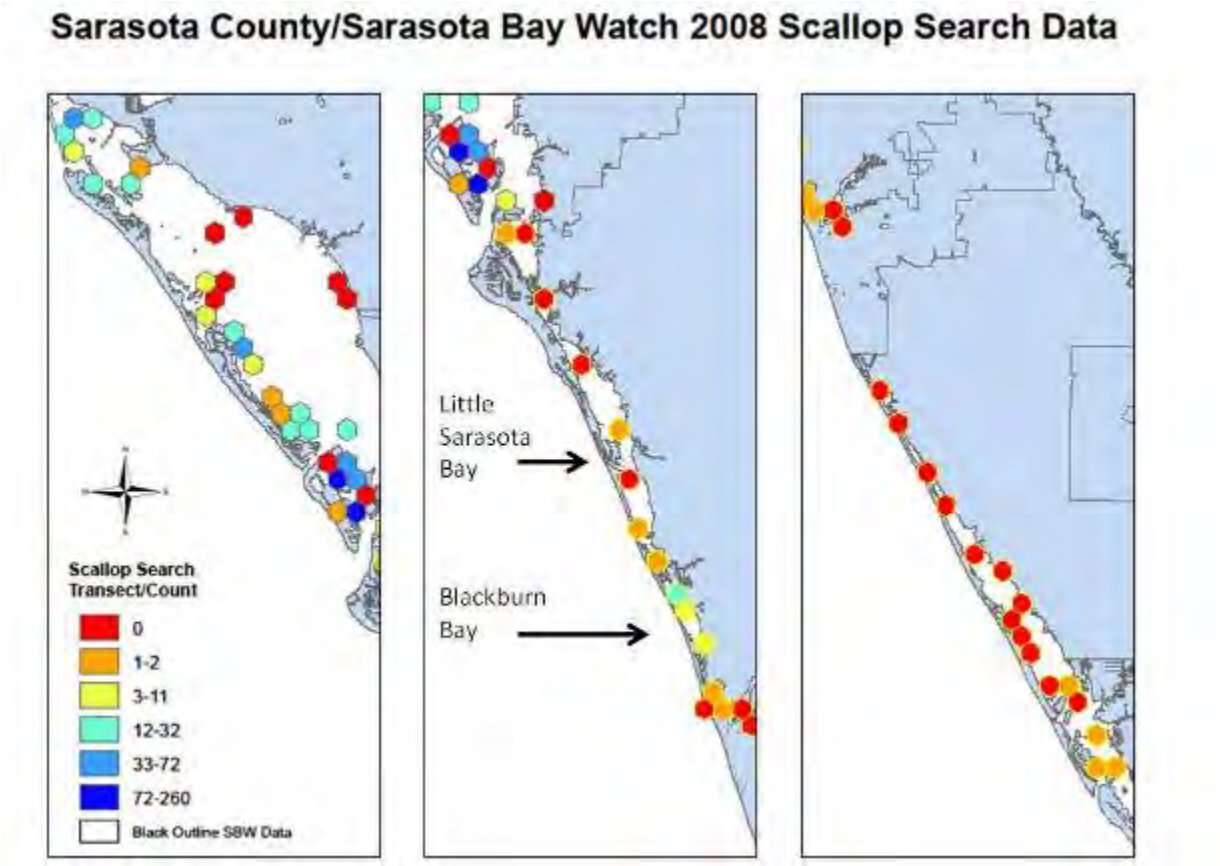


Figure 3-18 Results of 2008 Sarasota County/Sarasota Bay Watch Scallop Search (Sarasota County, 2008)

3.4.1.5 Tidal Creeks

Tidal creeks, or coastal streams as they are called in the Sarasota County Comprehensive Plan, are relatively small coastal tributaries that link between freshwater terrestrial and estuarine systems. Because of their close connection to the marine and freshwater systems, tidal creeks play a unique and integral role in the ecological function of coastal estuaries.

Three tidal creeks are tributaries to Little Sarasota Bay—Clower Creek, Catfish Creek, and North Creek. The physiography and history of these creeks have been documented in Appendix A – Project Background and Physical Setting, Section 1.3. As reported, most tidal creeks have urbanized watersheds, with few remaining natural wetlands and open space (see Table 3-5). The portions of tidal creeks that have not been channelized or urbanized have tidal marsh and mangrove at the mouth and contiguous wetlands or hammocks upstream. The low flows of coastal streams usually come from wells that tap the Floridan Aquifer and typically cease to flow during the dry season.

Unlike shallow embayments and open estuarine areas, submerged aquatic vegetation is often absent from tidal reaches of coastal creeks, perhaps due to the proximity to freshwater pulses and the resulting lower salinities found in tidal creeks.

Sarasota County conducted ecological monitoring and assessment in coastal creeks for the Sarasota County Tidal Creek Condition Index (TCCI) from 2008 through 2010 (Figure 3-19). Sixteen tidal creeks in Sarasota County are assessed annually. Four tidal creeks are tributaries to Little Sarasota Bay or Blackburn Bay—Clower Creek, Catfish Creek, North Creek, and South Creek. Much of the shorelines in these systems have been altered, and little natural habitat remains within the tidal creek reaches (Briley, Wilde, & Associates, 1993).

Based on the scoring criteria used by Estevez (2007), South and Clower Creeks were ranked highest of the creeks scored. North Creek was in the third-lowest quartile, and Catfish Creek was among the lowest scored. All four creeks scored high in percent-live oysters, with South Creek also scoring well for oyster size. Clower, North, and Catfish Creeks scored high for filamentous algae cover, an indication of relatively high nutrient inputs to these creeks. North, South, and Catfish Creeks also scored high for periphyton cover. Of the four creeks, only Clower Creek scored high for burrow density, indicating greater bioturbation of benthic sediments. Higher scores are indicative of higher ecological integrity.

The health of Little Sarasota Bay's small streams is critical to the ultimate health of Elligraw Bayou, Holiday Bayou, and Little Sarasota Bay. The health of streams is often linked to changes that occur to the stream channel such as dredging, straightening, and removing bank and adjacent vegetation. Where channel morphology is modified or structural features are added, stream dynamics and energy dissipation can change significantly. Channelization of naturally meandering creeks results in increased stream velocities and increased bank erosion, which can produce large pulses of freshwater that can decrease the salinity in the bay.

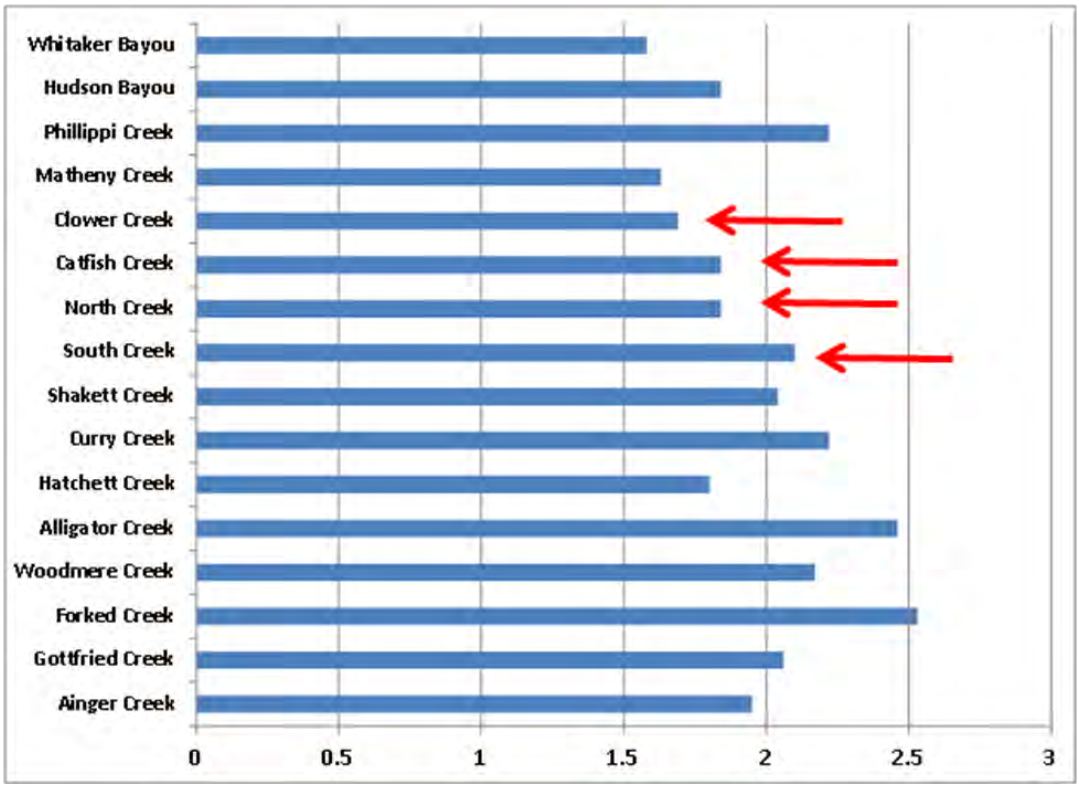


Figure 3-19 Tidal Creek Condition Index Scores (2008–2010)
Creeks in the Little Sarasota Bay Watershed (Clower, Catfish and North Creek) and Blackburn Bay Watershed (South Creek).

Table 3-5 Little Sarasota Bay Watershed Current Land Use (SWFWMD 2008)

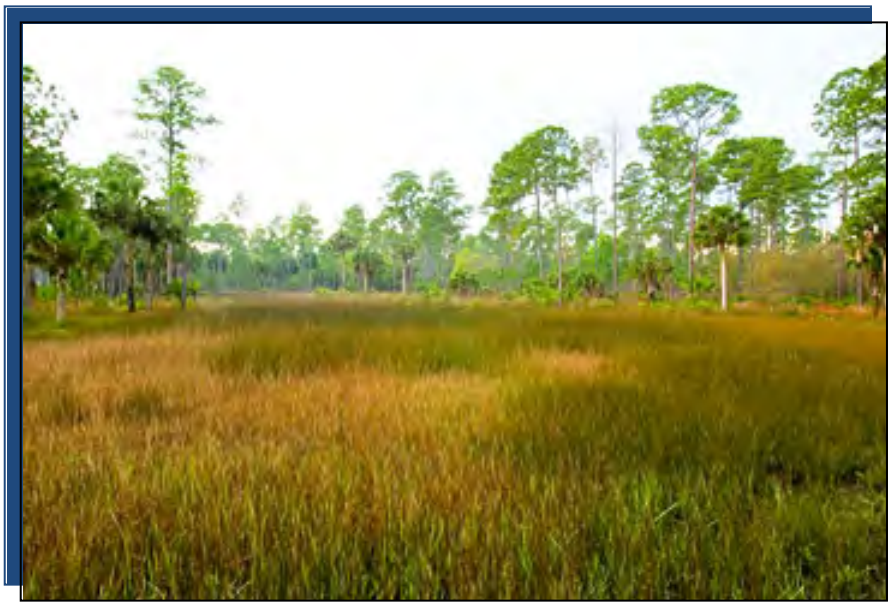
Land Use	Basin												Little Sarasota Bay Watershed	
	Elligraw Bayou		Holiday Bayou		Clower Creek		Catfish Creek		North Creek		Little Sarasota Bay Coastal			
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Water	34	7%	11	6%	14	5%	375	9%	181	8%	1,820	60%	2,436	24%
High-Density Residential	100	21%	56	28%	99	35%	1,104	28%	294	13%	212	7%	1,867	18%
Medium-Density Residential	219	46%	43	22%	0	0%	417	10%	644	28%	476	16%	1,798	17%
Forest, Open Area, and Park	32	7%	16	8%	31	11%	446	11%	276	12%	193	6%	994	10%
Golf Course	36	8%	1	0%	0	0%	340	9%	400	17%	0	0%	777	8%
Wetlands	8	2%	0	0%	1	<1%	390	10%	180	8%	162	5%	741	7%
Commercial	26	6%	54	27%	119	42%	235	6%	101	4%	94	3%	629	6%
Light Industrial	0	0%	0	0%	0	0%	315	8%	0	0%	0	0%	315	3%
Low-Density Residential	8	2%	0	0%	0	0%	50	1%	205	9%	38	1%	301	3%
Transportation/ Utilities	10	2%	19	9%	19	7%	164	4%	40	2%	31	1%	283	3%
Pasture	0	0%	0	0%	0	0%	148	4%	2	<1%	0	0%	150	1%
Agriculture	0	0%	0	0%	0	0%	0	0%	6	<1%	0	0%	6	<1%
Total	473	100%	201	100%	284	100%	3,983	100%	2,330	100%	3,026	100%	10,297	100%

3.4.2 Freshwater Natural Systems

Due to the extensive residential and commercial development that has occurred west of US 41 and along the ICW shores of Little Sarasota Bay, many of the freshwater tributaries have been dredged and channelized and are referred to as canals.

Wetlands are often referred to as the 'kidneys' of the landscape and are a significant factor in the health and existence of other natural resources of the watershed, such as rivers, streams, inland lakes, groundwater, wildlife, and estuaries. Wetlands play a key role in storing and modifying potential pollutants, such as chemical fertilizers, in ways that maintain downstream water quality. They also export organic carbon to streams and other downstream waterbodies. In limited amounts, organic carbon is essential to maintaining a healthy aquatic ecosystem.

Historically, the Little Sarasota Bay Watershed contained approximately 5,486 acres of freshwater wetlands with herbaceous depressional marshes and wet prairies comprising 99% of the total wetland acreage In 2007, Little Sarasota Bay had 2,560 acres of freshwater wetlands, with 1,981 acres being herbaceous and 579 forested, which represents a 53% loss in wetland acreage for this 60-year period. Wetland losses are primarily due to the filling to convert land to residential and commercial land use or dredging to make water features such as stormwater treatment ponds (Figure 3-20). A majority of the wetland loss occurred west of I-75 and east of US 41.



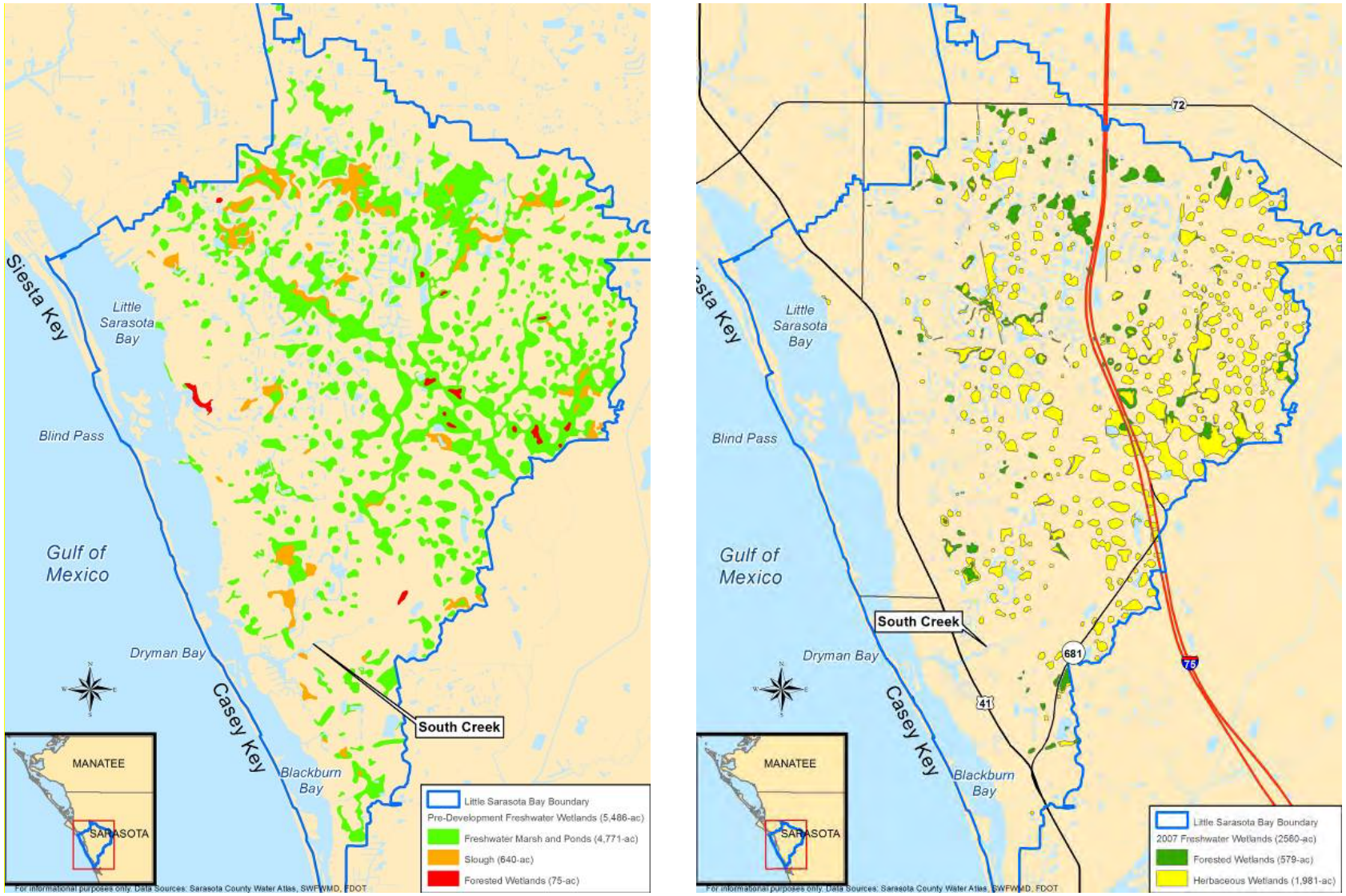


Figure 3-20 Left: Map of Freshwater Wetlands in the Little Sarasota Bay Watershed (GIS data developed from1948 USDA aerial photographs), Right: 2007 Freshwater Wetlands in the Little Sarasota Bay Watershed (GIS data courtesy of the Native Habitat Study by Earthbalance)

3.5 FLOOD PROTECTION

The Little Sarasota Bay Watershed is subject to coastal and inland flooding. Coastal flooding sources include storm surge and wind-driven waves. Inland flooding results from excessive rainfall. Storm surges are caused by high winds, and coastal and inland flooding are usually associated with hurricanes or other tropical weather events. The relatively flat and low-lying topography of Sarasota County make it inherently prone to both types of flooding, and the County's "poorly drained" soils further promote inland flooding. Additionally, development has changed the natural environment within the Little Sarasota Bay Watershed and likely exacerbated the flooding problem before modern stormwater management regulations were implemented. Increased impervious surfaces throughout the heavily urbanized Clower Creek, Catfish Creek, North Creek, Elligraw Bayou, Holiday Bayou, and Coastal Basins have decreased the rainfall infiltration, and gutters and storm sewers speed runoff to the channels. As a result, more water runs off more quickly, and drainage systems including creeks can become overloaded, leading to flooding.

The County's goal with regard to flood protection is to minimize flood risk to protect human safety and property in existing developed areas while protecting natural and beneficial functions of the remaining floodplain. This WQMP does not contain new analyses of flood conditions since the conditions have been analyzed and recommendations for improvements were previously proposed. Instead, this WQMP provides an overview of existing flood-protection-related activities and previous flood-protection recommendations. This section is an important component of the WQMP as flooding in the watershed directly impacts water quality in the tributaries and bay. Water quality BMPs are often designed to capture debris and sediment and remove pollutants during low-flow events and may not be as effective during larger storm events. Additionally, during large storm events, runoff may pool or flow in areas outside drainage systems, such as over roads or in parking lots, and may collect more debris and pollutants than a low-flow event fully contained within a drainage system with water quality BMPs. Therefore, reducing the risk of flooding is an important component of improving water quality in Little Sarasota Bay.

3.5.1 History of Flooding and Sarasota County Stormwater Program

Historically, the Little Sarasota Bay Watershed consisted of pine and palmetto flatwoods with scattered isolated wetlands that sometimes connected during the rainy season. This diverse landscape provided significant flood storage capacity as well as a slow meandering natural flow of water from land to Little Sarasota Bay. Clower Creek, Catfish Creek, North Creek, Elligraw Bayou, and Holiday Bayou acted as tidal extensions of the Little Sarasota Bay estuary. Freshwater inflows were from direct runoff during extremely wet conditions or flood events.

These natural patterns began to be interrupted and altered during the early 20th century, as the area's population grew and more development occurred. Early residents of the Little Sarasota Bay Watershed were plagued by mosquitoes. To alleviate the problem, many ditches were dug in

mangrove areas along the coast to extend the natural creeks inland to connect many of the large, isolated wetlands. The result is a network of man-made drainage ditches that dramatically altered the movement of freshwater from the land to tidal creeks, estuaries, and bays and in turn extended the tidal influence inland. Over time many wetlands and floodplains were filled without mitigation or compensation, and impervious surfaces were created. As a result, flood storage capacity was reduced and runoff increased, raising flood stages and decreasing water quality in creeks and bays. Since much of the watershed is now densely populated, flooding affects homes, businesses, and agriculture in the floodplains, especially those areas developed before the adoption of County Land Development Regulations (LDR) in 1981 (Figure 3-21).

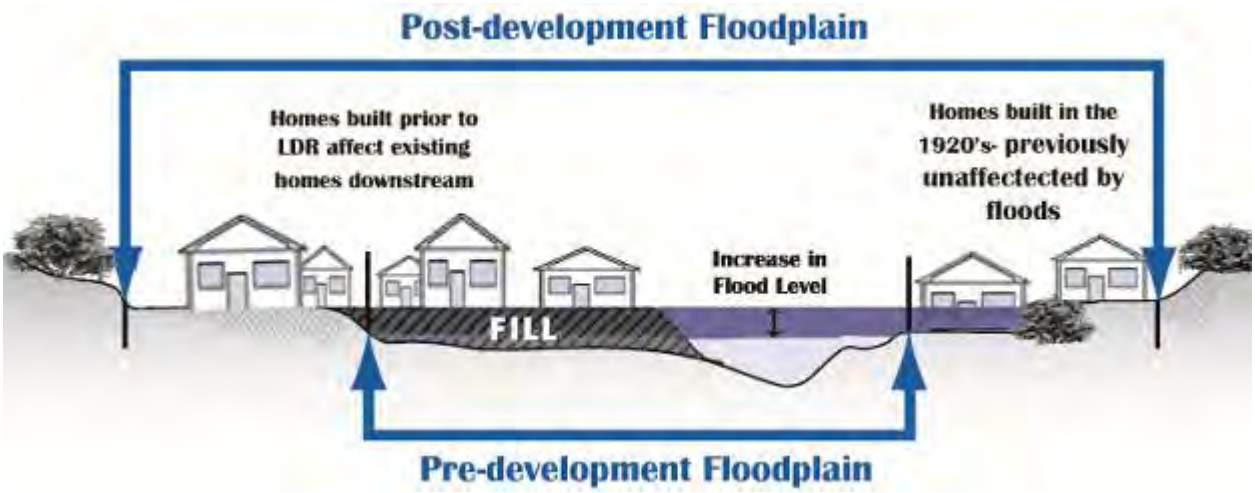


Figure 3-21 Floodplain Changes Schematic (Adapted from *http:\\www.dnr.sc.gov*)

The County took the first step toward developing a stormwater program in 1981 with the creation of the Stormwater Management Division. By the early 1990s, the Sarasota County Stormwater Environmental Utility (SEU) initiated a County-wide basin master planning project to develop hydrologic and hydraulic models to identify problematic flooding areas for all of the County's major watersheds. These models are also used to analyze proposed drainage improvements to the County's stormwater system. The Basin Master Plans for the Clower Creek, Catfish Creek, North Creek, South Creek, Elligraw Bayou, and Holiday Bayou Basins were completed between 1994 and 2001. In addition, SEU continues to maintain the model by updating it periodically.

In the mid-1990s, the County LDR was modified to require stormwater systems to be designed for a 100-year storm (10 inches of rain in 24 hours). The County then completed feasibility analyses for projects in problem areas identified in the Basin Master Plans.

Sarasota County's stormwater utility started its first capital improvement projects in 1994 and began assessing drainage basins for Stormwater Improvement Assessments in 1995. The SEU currently assesses its customers based on Equivalent Stormwater Units that are based on the effective impervious area of the average single-family parcel. Two types of assessments are collected in the Little Sarasota Bay Watershed. The first is a service assessment, which is

imposed on properties within the utility area to fund customer service, planning, and maintenance. A capital assessment is also imposed on certain basins to fund the cost of stormwater improvements currently planned or under construction in those basins. This is known as the Capital Improvement Program (CIP). Capital assessments vary from basin to basin and from year to year. Currently, properties in the Elligraw Bayou, Clower Creek, and Catfish Creek Basins have capital improvement assessment programs in place. More information on the assessments can be found at http://www.scgov.net/ (Keyword = SEU).

Today, several CIP projects, such as stormwater control structures, retrofit projects, and retention and detention ponds, have been constructed throughout the Little Sarasota Bay Watershed.

For more information on Legislation and Ordinances in place to minimize damage caused by flooding, see Appendix E – Section 3.0.

3.5.2 Flood Protection Level of Service (FPLOS)

The stormwater quantity FPLOS requires that public and private stormwater management systems provide adequate control of stormwater runoff. The stormwater quantity or FPLOS and design criteria are defined in the Sarasota County Comprehensive Plan and LDR (Table 1) and used throughout the Basin Master Plan program (See Appendix E – Section 5.1).

The goal of the FPLOS design criteria is to prevent flooding of emergency shelters and structures providing essential services during storms equal to or exceeding the 100-year event (10 inches in 24 hours). The FPLOS goal for habitable structures and employment/service centers is no flooding from storms up to and including the 100-year storm. Flooding of garages, barns, sheds, and other out-buildings is not considered structure flooding. The FPLOS established for roadways varies depending on the classification of the street or roadway. The goal of these criteria is to prevent flooding of evacuation routes and major arterial roadways during storms up to and including the 100-year event. Figure 3-22 shows acceptable flooding for a 100-year storm. For more information the FPLOS and acceptable flooding criteria, See Appendix E – Section 4.0.

Figure 3-22 Acceptable Flooding for a 100-Year Storm

3.5.3 Planning Studies and Efforts

The drainage plans and programs from the early 1920s through the 1960s emphasized removing surface waters from the land, primarily for mosquito control and agricultural uses. Water quality did not begin emerging as a major concern until the late 1960s.

In 1984, the Board of County Commissioners recognized major inadequacies in the existing stormwater management system and authorized the preparation of a Stormwater Master Plan to assess the need for improving major drainage systems in the developed portions of the County. The objectives of the plan included:

- Assessing the adequacy of primary stormwater conveyance systems in developed or developing basins.
- Estimating the cost for public stormwater improvements as watersheds are developed to their ultimate use.
- Prioritizing stormwater management needs of each basin within a framework of the needs within the entire County.
- Developing a plan or identifying options available to the County for financing the cost of construction, operation, and maintenance of stormwater management facilities.

3.5.4 Basin Master Planning

Numerous hydrologic studies dating back to the late 1950s have been completed throughout Sarasota County; by late 2001 the Basin Master Plans for the Clower Creek, Catfish Creek, North Creek, Elligraw Bayou, and Holiday Bayou Basins were completed.

Little Sarasota Bay Watershed Basin Master Plans:

- *Clower Creek – March 1994*
- *Catfish Creek – July 2001*
- *North Creek – April 1999*
- *South Creek – June 2001*
- *Elligraw Bayou – April 1994*
- *Holiday Bayou – August 1997*

These Basin Master Plans were based on a detailed analysis of these studies of existing and projected land uses, existing drainage facilities, and projected stormwater management needs. This information was used to develop hydrologic and hydraulic models using ICPR's routing engine to simulate runoff, conveyance, and flooding conditions for these Little Sarasota Bay subbasins. Model results were used to identify the location and magnitude of existing flooding problems in the basins. Based on model results, the plans provide recommendations for facilities improvements and management standards that will need to be met by the private sector for new construction and the expansion of existing activities to bring stormwater conveyance systems within the basins into compliance with the recommended FPLOS criteria.

An important product of the Basin Master Plan effort is the horizontal limits of the riverine, 100-year floodplain. Much of the County riverine floodplain maps to be used for local stormwater management planning have been completed. These maps and the detailed flood-prediction models must, however, be kept up to date to reflect changes in the watershed, such as land development and stormwater projects, or they will become obsolete.

3.6 SEDIMENT MANAGEMENT

Sediment production is a natural watershed process, but urbanization and other land-use changes can impact the processes associated with the sedimentation cycle: erosion, transport, and deposition. Within an urbanized setting like the Little Sarasota Bay Watershed, sediment production has two primary sources: wash-off from land surface and in-stream channel erosion. Bank steepness, degree of concentration (runoff velocity), and stability (e.g., vegetation) influence the quantity of the sediment load that reaches the waterbody. Increased sediment load from wash-off and in-stream erosion can affect water quality, natural habitat, navigation, flood control, and recreational uses downstream. In addition, alterations in circulatory patterns caused by dredging can re-suspend and transport existing sediments.

Sediment transported and deposited in waterbodies can disrupt aquatic ecosystems. Excess sediment can cloud the water, which can suffocate fish and block the light required by aquatic plants for photosynthesis. In addition, sediment-rich discharges tend to carry higher loadings of pollution because nutrients, pesticides, and heavy metals adsorb to and are transported along with sediment. Pollutants of concern including TSS, TN, and TP are associated with the sediment and contaminants attached to sediment in the Little Sarasota Bay Watershed.

Nitrogen and phosphorus are nutrients that occur in soils naturally. Increased erosion increases the nutrient load to the system. Other common sources of nitrogen and phosphorus in an urbanized area are septic systems, pet wastes, urban debris, grass clippings, fertilizer, industrial wastes, and landfills. Additionally, Florida's geology contains sedimentary deposits of marine origin, some of which are high in phosphorus content. The watershed's phosphorus-rich geology and soils, therefore, significantly influence the TP concentrations in the Little Sarasota Bay tributaries and estuary. Excess nutrients combined with the tropical temperatures in Sarasota County can lead to excessive algae growth impacting the recreational aspects of the waterways as well as creating an oxygen deficit for the marine life and aquatic habitats.

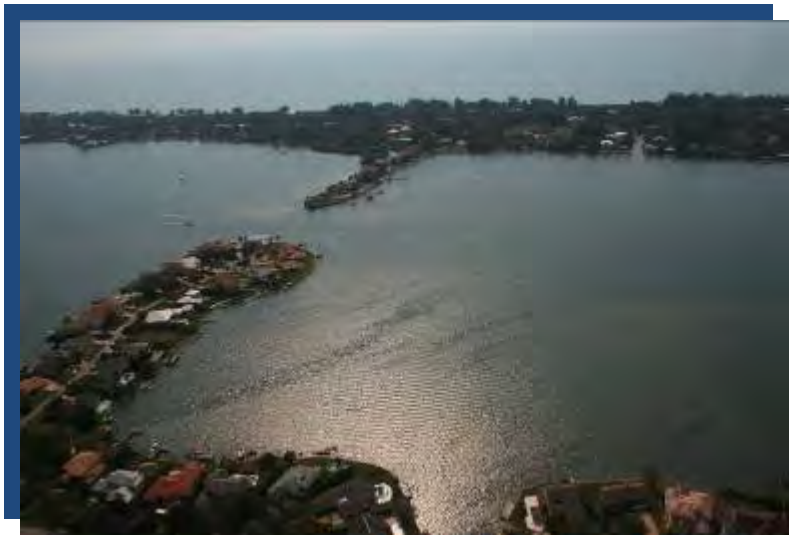
Previous studies found that sediment in several of the Little Sarasota Bay tributaries contains contaminants including metals and organics. The *County Wide Survey of Sediment at Weirs* (2003) included the Catfish Creek, Elligraw Bayou, Holiday, Bayou, and Clower Creek Basins as priority areas due to enriched sediments. The study did not find any correlation between contaminant concentration and sediment depth; however, a comparison of upstream versus downstream samples showed upstream sediment concentrations were higher for arsenic, chromium, copper, zinc, TN, silt/clay fractions, and percent organic material. Lead and cadmium concentration, on the other hand, were higher downstream of the weirs. Higher lead concentrations, for example, were found downstream of the Sarasota Parkway in Catfish Creek than were found at upstream weirs.

Watershed management includes identifying sediment problems, identifying sediment sources, and recommending improvement projects that address the source as well as capturing sediment before it reaches the estuaries. Several potential sediment management projects were identified throughout the watershed for this plan. These potential projects incorporate strategies such as providing source control to reduce or remove solids in upland areas, implementing maintenance practices designed to reduce sedimentation, and improving eroding and sloughing banks for long-term stability.

Source control activities include activities such as LID projects, street sweeping, and construction-area silt fencing. Regularly scheduled maintenance activities include cleaning out baffle boxes, removing vegetation debris resulting from maintenance activities from swales and roadside ditches, replacing or repairing damaged infrastructure, and maintaining control structures, weirs, and pumps. Bank stabilization in an urban setting is challenging. For stabilization to be effective in the long term, management and restoration should not be limited to a single point in the stream but will be more effective when conducted as multiple projects along a channel system. Implementing projects that incorporate these strategies will reduce turbidity, increase clarity, and reduce nutrient and sediment load and therefore improve the overall health of the tributaries and Little Sarasota Bay.

See Appendix F for detailed Sediment Management Plan information for Little Sarasota Bay and Blackburn Bay. Sediment management recommendations are summarized for each of the basins in Section 4.0 and Section 6.0 of this plan.

3.7 LITTLE SARASOTA BAY WATERSHED ASSESSMENT SUMMARY AND RECOMMENDATIONS



The bay receives freshwater inputs from five tributaries, including Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, and North Creek, as well as direct runoff from coastal areas. The relative contributions of sources of freshwater for historical, current, and future conditions indicate that, although the overall volume of freshwater inflows to the bay has changed over time, the relative importance of individual sources has not changed significantly. Additionally, the relative contribution of individual sources remains constant year-to-year, although the magnitudes of source-specific inflows change. Rainfall, direct runoff, and baseflow represent the bulk of the inflows.

Despite the current urban nature of much of the watershed, areas of land are not currently developed, particularly in the Catfish Creek and North Creek Basins. If urbanization spreads to these areas, significant changes to freshwater inflows could occur in the future.

Although the indicators described in Section 3.3 provide abundant evidence of a healthy estuary and the entire bay currently meets state water quality standards, some of the watershed's stream segments have listed impairments. Coastal areas and tidal portions of tributaries with limited circulation are especially vulnerable to water quality problems.

A defensible strategy for managing Little Sarasota Bay's water quality is to maintain current conditions overall; however if isolated problem areas are identified, then remedial action should be considered.

Several potential projects were identified throughout the watershed for this plan. These potential projects incorporate strategies such as providing source control to reduce or remove solids in upland areas, implementing maintenance practices designed to reduce sedimentation, improving eroding and sloughing banks for long-term stability, capturing excess runoff before it enters the streams, improving natural habitats, and providing buffers to capture nutrients. Implementing these projects will help the Little Sarasota Bay remain a healthy system.

Issues noted in the preceding sections (less-than-desirable seagrass coverage, increasing nitrogen levels) may be partially attributable to the bay reaching for a new equilibrium after the closure of

Midnight Pass. However, the effective management of watershed-based activities is critical to maintaining the health of the estuary. A dual approach should be used whereby currently developed areas that exhibit water quality problems such as Clower Creek should be subject to intensive management and undeveloped areas such as those in the Catfish Creek and North Creek Basins should be protected from environmental degradation. Basin-specific conditions are discussed in the following sections.

3.7.1 Project and Program Recommendations

Information used to develop this plan included previous studies, GIS data, and stakeholder input, to identify potential projects. A GIS desktop analysis was conducted to identify water quality, sediment, natural systems, and water supply 'hot spots' throughout the watershed. These hot spots were then refined to potential project sites. Finally, field investigations of these sites were conducted to evaluate potential project options. This methodology is summarized in Figure 3-23. Benefits and costs, including capital and operation and maintenance costs, were calculated at a conceptual level for each recommended project. Non-quantitative benefits were also documented and considered in ranking the projects based on priority.

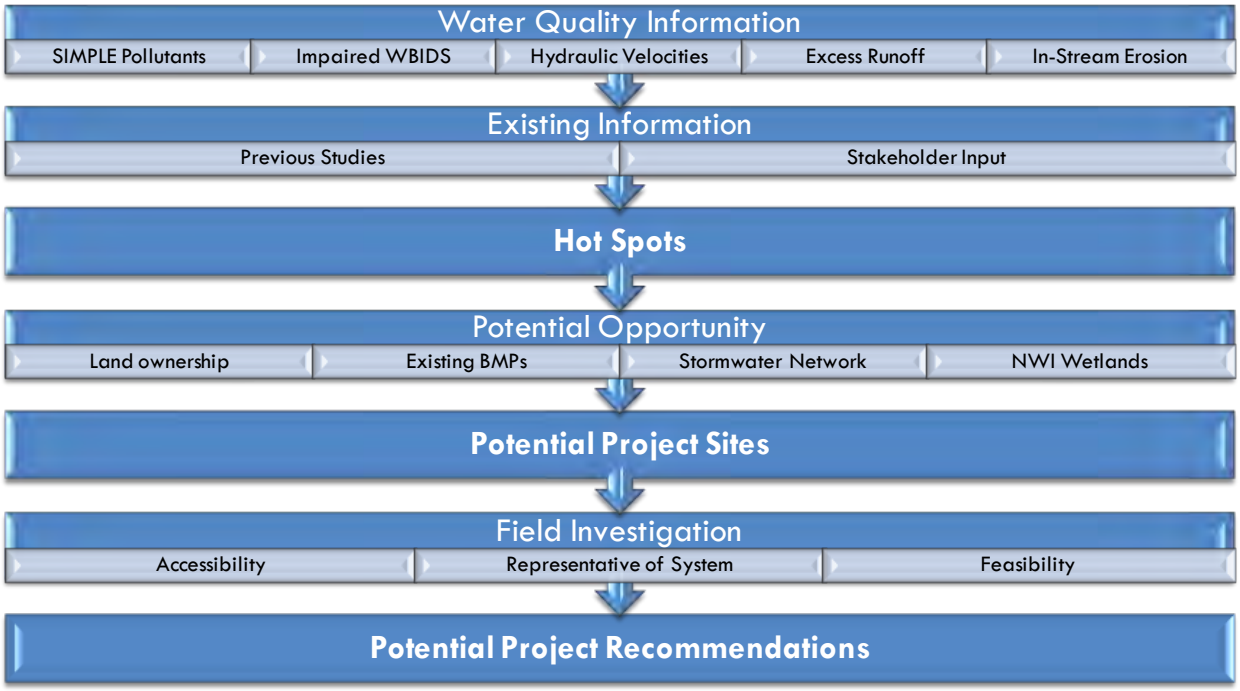


Figure 3-23 Methodology to Identify Potential Improvement Projects

Fifteen projects are recommended throughout the Little Sarasota Bay Watershed (Table 3-6 and Figure 3-24). Recommended projects are only conceptual. Each project should be modeled to ensure that it will not negatively affect the existing floodplain or increase maximum flood stages before being implemented. See Appendix G – Section 6 for Conceptual Plans and Cost Estimates.

Table 3-6 Project Priority Ranks

Project ID	Project Name	Impairment	TN Reduction (lb/year)	Benefits / Costs	Project Rank
Impaired WBID (FDEP Consent Decree) No TMDL					
WQ7	Catfish Creek Regional Stormwater Facility	DO	155	4.97	2
SMP1B	Catfish Creek between Central Sarasota Parkway and Tamiami Trail	DO	19	2.66	3
WS04	Catfish Creek Regional Stormwater Facility	DO	0	2.40	4
WS05	Gypsy Street Pond	DO	0	1.76	5
SMP7	Tamiami Trail – Catfish Creek Bioswale System	DO	25	1.39	6
NS3	Elligraw Reach at Tuckerstown Road	DO	50	1.18	8
SMP1A	Catfish Creek at Central Sarasota Parkway	DO	14	1.06	9
WS09	Vamo Way Pond	DO	0	0.98	11
SMP1C	Catfish Creek at Tamiami Trail	DO	18	0.93	12
NS6	Catfish Creek Upstream of Central Sarasota Parkway	DO	14	0.38	13
WS01	Sarasota Middle School	DO	16	0.30	14
WQ3	Potter Park	DO	0	0.19	16
SMP2	Catfish Creek at Palmer Ranch Pkwy	DO	5	0.15	17
WS03	Ashton Elementary School	DO	16	0.10	18
Impaired WBID (No TMDL)					
NS2	Bay Street Park		9	0.55	19

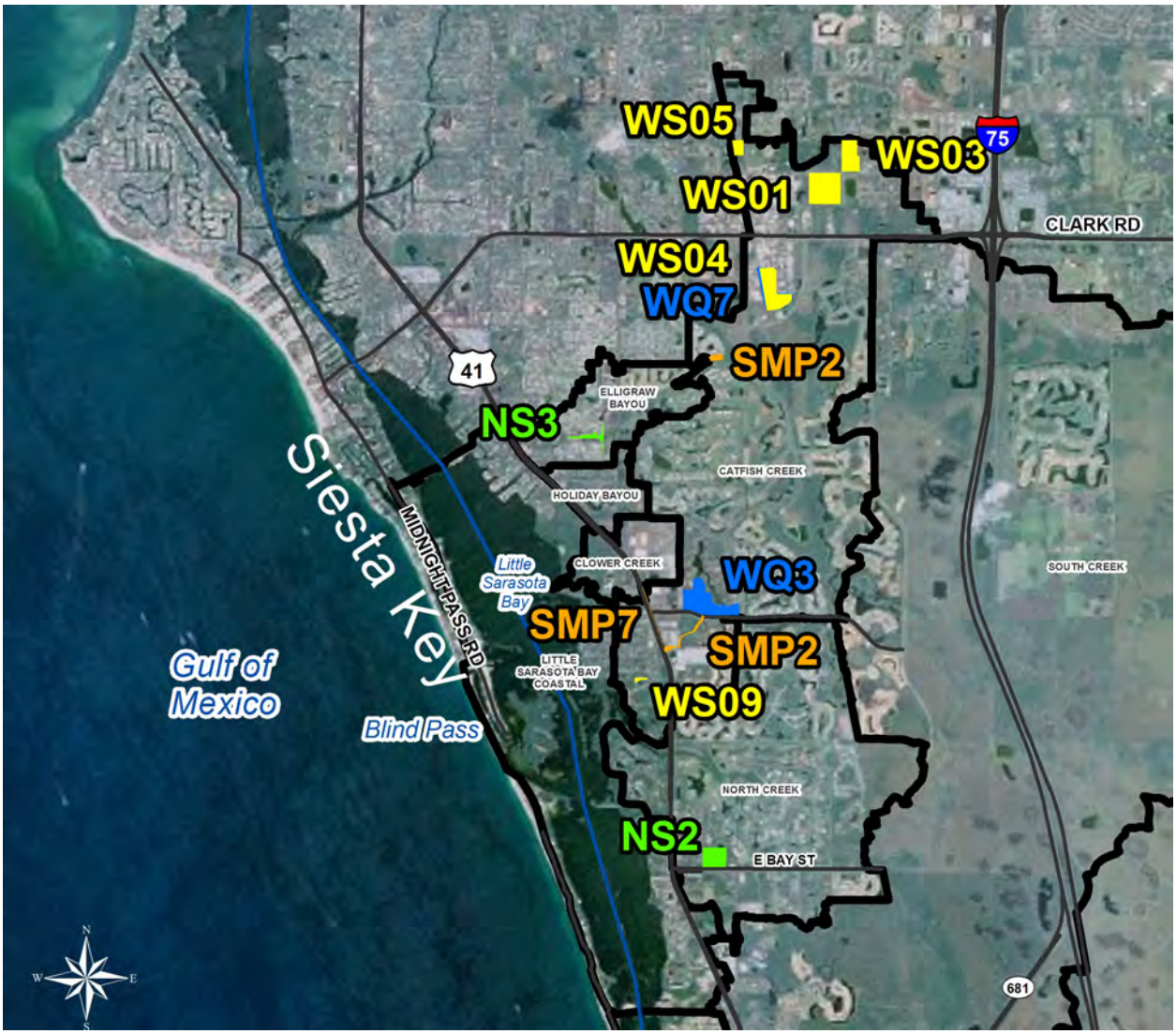


Figure 3-24 Little Sarasota Bay Recommended Project Locations

While cooperative funding is provided by SWFWMD, the inclusion of proposed projects, corrective actions, and BMPs in this plan does not confer any special status, approval, permitting standing, or funding from SWFWMD. Requests for funding assistance will have to meet the requirements of funding programs and be subject to SWFWMD's Governing Board appropriating funds.

Further, all projects are subject to County and SWFWMD regulatory review and permitting and are designed to be consistent with the Sarasota County Comprehensive Plan and the Sarasota County Code of Ordinances. Where applicable, all regulatory authorizations shall be obtained before a project can begin. To address these concerns, regulatory coordination will occur at the planning stages for each project discussed in this WQMP to ensure a streamlined permitting review process and address consistency with the Sarasota County Comprehensive Plan and Sarasota County Code of Ordinances before the project is designed.

Twenty-six Program Recommendations center on sustainability and conservation (Table 3-7) in Little Sarasota Bay and throughout Sarasota County. Some have direct nutrient-reduction impacts, while others have less quantifiable impacts but are important to improving environmental quality throughout the County. See Appendix G – Section 5 for more information on recommended programs.

Table 3-7 Program Recommendations

Section	Program Name	Existing County Program
5.1	Stormwater Harvesting	
5.2	Rainwater Harvesting/Cisterns	Yes
5.3	Fertilizer Ordinance	Yes
5.4	Watercourse Setback	Yes
5.5	Septic Tank Pump-Out Regulation	Yes
5.6	Public Outreach and Education	Yes
5.7	Teacher Training/Campus Projects	
5.8	Aquatic Harvester	
5.9	Street Sweeping	Yes
5.10	National Pollutant Discharge Elimination System (NPDES)	Yes
5.11	Facilitating Agricultural Resource Management Systems	
5.12	Preservation Areas	Yes
5.13	Mangrove Monitoring	Yes
5.14	Shoreline Softening	
5.15	Septic Replacement Program	Yes
5.16	Septic to Cistern	Yes
5.17	Strategic Maintenance Manual	Yes
5.18	Stormwater Manual	Yes
5.19	Composting Pilot Study	
5.20	Low-Impact Development (LID)	Yes
5.21	Exotic Plants Management Program	Yes
5.22	Boat Ramp BMP Program	
5.23	Irrigation Utilities for New Development	Yes
5.24	Public Education on Water Conservation Practices	Yes
5.25	Potable Water Demand-Side Management Analysis	
5.26	Florida Water Star^{SM}	Yes