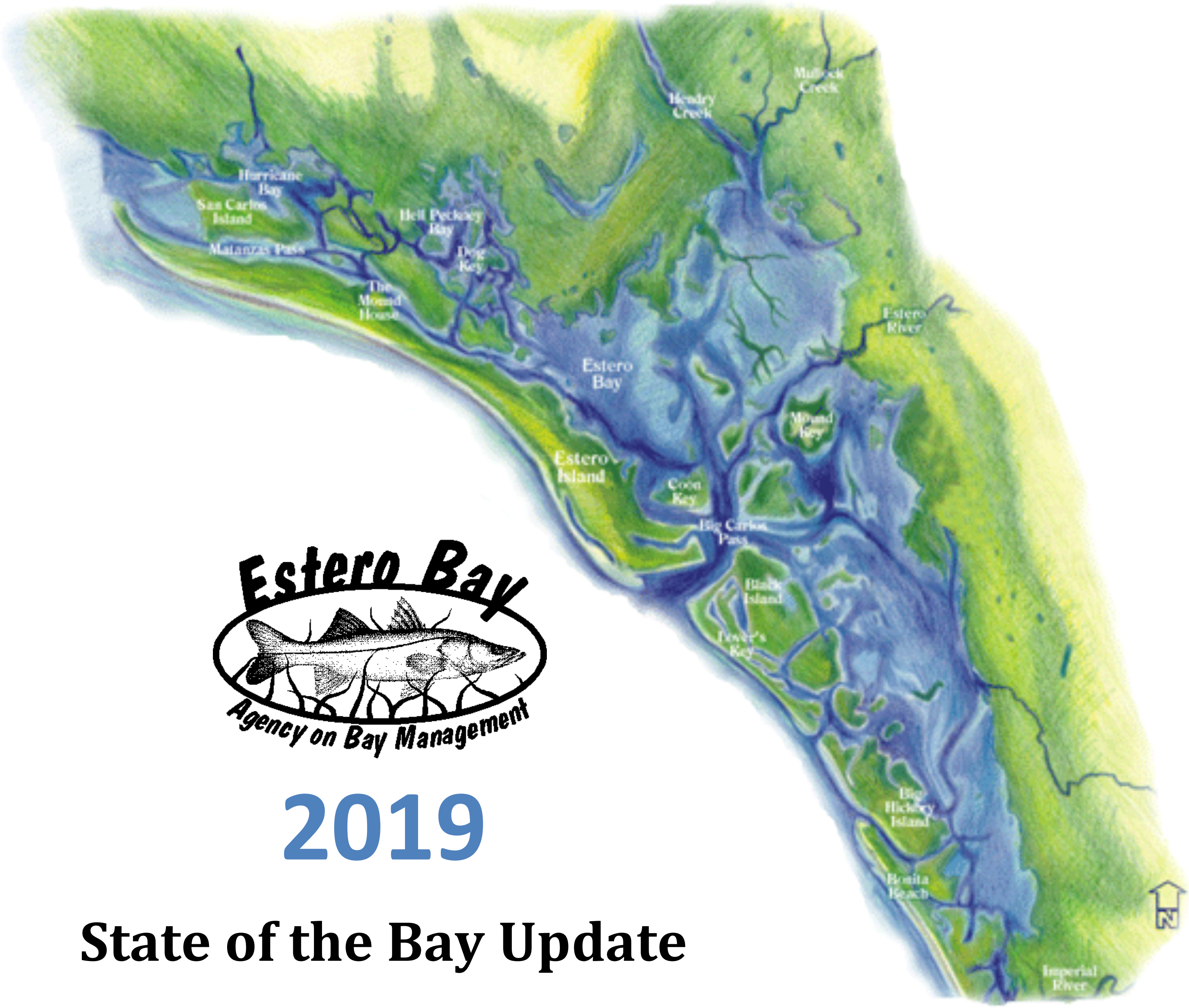

Estero Bay
Agency on Bay Management

2019

State of the Bay Update

Funded by the City of Bonita Springs.

Prepared by the Southwest Florida Regional Planning Council and the Charlotte Harbor National Estuary Program.

City of Bonita Springs Florida
Small Town Charm. Big Bright Future.

Southwest Florida Regional Planning Council
Big Issues * Real Solutions

Charlotte Harbor National Estuary Program

Contents

Estero Bay

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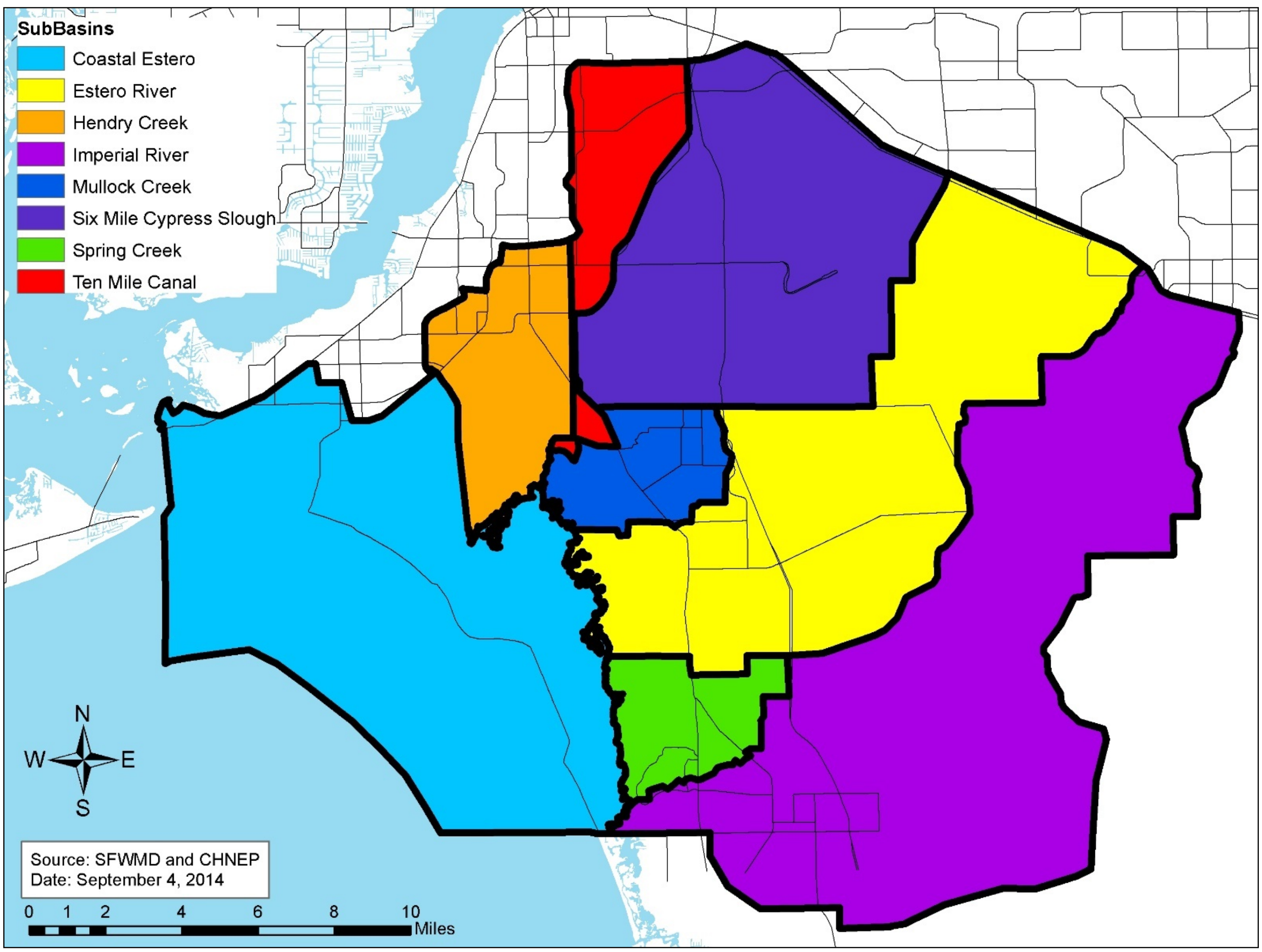
The authors of this report are:

James W. Beever III: SWFRPC

Mackenzie Moorhouse: SWFRPC AmeriCorps VISTA

Introduction

The Estero Bay Agency on Bay Management (ABM) was established in 1996 in accordance with the settlement agreement for the completion of permitting for Florida Gulf Coast University (FGCU), after the completion of the Arnold Committee study process. The ABM membership consists of, but is not limited to, representatives from the following: local chambers of commerce, citizen and civic associations, Lee County government, the South Florida Water Management District (SFWMD), the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FWC), FGCU, the Southwest Florida Regional Planning Council (SWFRPC), commercial and recreational fishing interests, environmental and conservation organizations, the Responsible Growth Management Coalition (RGMC), the Town of Fort Myers Beach, the City of Sanibel, scientists, affected property owners and the land development community. The ABM is a non-regulatory, advisory body whose directive is to make recommendations to the SWFRPC for the management of Estero Bay and its watershed (Estero Bay Agency on Bay Management 2004). The waters of Estero Bay provide a tremendous resource for local residents and tourists who enjoy fishing and appreciate the local vegetation and wildlife. It is also important to note that Estero Bay is Florida's first aquatic preserve (Estero Bay Agency on Bay Management 2002).



Principles of the Estero Bay Agency on Bay Management

I. General

I. A. The ABM will be cognizant of the "big picture" and to the concept of "ecosystem management" and sustainable development.
I. B. Water conservation practices and wastewater reuse will be encouraged throughout the watershed to protect potable water supplies."
I.C. All re-zoning requests within the Estero Bay watershed will be critically evaluated to ensure protection of water quality, rare and unique habitats, listed wildlife, and ecosystem functions.
I.D. Variances from environmental regulations and deviations from development standards will be the exception, not the rule.
I.E. Environmental protection and long-term quality of life will not suffer based on short-term economic impacts or political pressures.
I.F. Zoning resolutions that are required as a part of the approval for re-zoning must be tracked for future compliance and enforcement.
I.G. Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.
I.H. Additional staff will be hired to assist in the compliance and enforcement of zoning resolutions related to environmental issues.
I.I. Agency staffing will keep pace with increased demand on services, especially environmental protection issues. Trained and experienced wildlife biologists and environmental scientists will be hired to ensure adequate development review.
I.J. Activities in the watershed by any regulatory agency shall provide the opportunity for public participation.

II. Uplands, Headwaters and Isolated Wetlands

II. A. Land Management and Acquisition
II. A. (1) Lands identified as critical for listed species shall be targeted for public purchase and managed to maintain their environmental value.
II. A. (2) The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will consider priorities for land purchases adopted by the "Arnold Committee" and the ABM.
II. A. (3) The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will use proactive approaches to investigate the willingness of landowners to be voluntary sellers, as specified in the requirements of the ordinance that established the land acquisition program.
II. A. (4) Regulations within the existing "Notice of Clearing" process by Lee County will be developed that require wildlife surveys, habitat assessments, and a development plan for the agricultural operations so that critical habitats for state and federal listed species can be preserved.
II. A. (5) Conservation easements will be used as an option to protect critical habitats.
II. A. (6) Programs such as the "Keep It Clean" and "Florida Yards and Neighborhoods" programs should be promoted, to minimize inputs of storm water pollutants into the bay.
II. A. (7) Before off-site mitigation for wetland and listed-species upland impacts is considered, opportunities for avoidance, minimization, and on-site mitigation must be exhausted.
II. A. (8) Off-site mitigation projects should be within watershed and within habitat type wherever possible.

II. B. Vegetation
II. B. (1) Natural, native vegetation within natural systems will be retained to the greatest extent possible.

II. B. (2) Physical removal of invasive vegetation will be utilized for control rather than widespread chemical treatment.
II. B. (3) Limited application of herbicides that rapidly degrade may be used, according to the product label, on a case by case basis for the control of nuisance and invasive non-native vegetation and to maintain native plant communities.
II. B. (4) Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.
II. B. (5) Isolated and seasonal wetlands are recognized for their importance for flood protection, unique fish and wildlife habitat, water quality, and water quantity. These wetlands should be preserved to the greatest extent possible.

II. C. Physiographic
II. C. (1) Consideration will be given to the ancient relief of the watershed by: preserving vegetation that provide the characteristic habitat and canopy; retaining the relic natural features; and reconnecting historic natural flow ways that have been diverted or severed.

II. D. New Construction
II. D. (1) Construction within flood plains shall be avoided wherever possible.
II. D. (2) For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. use of pilings to raise living floor elevations versus use of fill).
II. D. (3) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

II. E. Hazardous Materials
II. E. (1) Specifically placed larvacides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

II. F. Agriculture
II. F. (1) Tax incentives should be created so that landowners may continue land use practices that maintain ecologically important habitat.
II. F. (2) Adequate staff at Property Appraisers Offices within the watershed will be provided to review the high number of applications and strictly enforce the rules for Bona fide agricultural tax exemptions.
II. F. (3) The minimum time period for re-zoning of agricultural land should be increased from three years to ten years to reduce the speculative clearing of agricultural land for "higher use" which results in the loss of natural habitat and the loss of tax revenue.
II. F. (4) Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for agriculture landowners and their heirs, who will maintain their land in agriculture.
II. F. (5) Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for landowners and their heirs, who provide permanent conservation easements on their property.

II. G. Urban
II. G. (1) Old surface water management (SWM) systems built before current regulations will be retrofitted, using best available management practices, to meet current SWM standards.
II. G. (2) Permitting must address cumulative impacts to the water storage capacity of the watershed.
II. G. (3) Grants or incentives should be provided for retrofitting old surface water management systems that are not effectively managing water volume or flow, or removing nutrients and other pollutants.
II. G. (4) Proposals that reduce impacts to Estero Bay and its watershed, that might include: rural village concepts, urban infill, redevelopment sites, greenways; should be encouraged.

II. H. Roadways
II. H. (1) All future roadways to be located in the floodplain within the Estero Bay watershed will be designed and constructed to not impede flows from a 25-year, 3-day, storm event.
II. H. (2) Transportation planning shall be undertaken with goals of increasing public transportation and enhancing new and existing roads with walkable, bikeable passageways that are connected and landscaped.

III. Water Courses

III. A. Physiographic
III. A. (1) Non-structural approaches versus structural approaches will be used for water resource management solutions.
III. A. (2) No further canalization or dredging of remaining natural watercourses will occur.
III. A. (3) A better balance of ecological needs versus water flow will be used for water resource management decisions.
III. A. (4) Establish and restore the historic basin flood plains to the maximum extent possible.
III. A. (5) The ancient relief of the upper tributary reaches will be maintained by: preserving vegetation that provide the characteristic riparian habitat and canopy, retaining the relic natural features of the tributary bank contours, and reconnecting historic natural flow ways that have been diverted or severed.

III. B. Vegetation
III. B. (1) Natural, native vegetation versus non-native invasive vegetation within flow ways and natural systems will be retained to the greatest extent possible.
III. B. (2) Physical removal of invasive vegetation versus widespread chemical treatment will be utilized for control.
III. B. (3) Limited application of herbicides that rapidly degrade may be used on a case-by-case basis, under the supervision of certified personnel, for control of nuisance and invasive nonnative vegetation and to maintain native plant communities.
III. B. (4) Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.

III. C. New Construction
III. C (1) New setback criteria will be developed and implemented along watercourses to provide construction setbacks to the maximum extent possible. These setback criteria will be based on the best available scientific data.
III. C. (2) Construction within tributary flood plains shall be avoided wherever possible.
III. C. (3) For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. pilings to raise living floor elevations versus fill).
III. C. (4) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

III. D. Hazardous Materials
III. D. (1) Specifically placed larvacides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

III. E. Boating
III. E. (1) No special accommodations will be made for boats (e.g. no cutting of over story vegetation, no removal of oxbows, no dredging or filling except for permitted maintenance of navigation channels).

IV. Bay Waters

IV. A. Water Quality
IV. A. (1) Regulatory agencies will adopt requirements for "Best Management Practices." IV. A. (2) Operation of overloaded and outdated package wastewater treatment plants will be discontinued.
IV. A. (3) All urbanization will be served by centralized sewage systems.
IV. A. (4) There should be uniform application of water quality protection measures by regulatory agencies. A holistic management scheme should be implemented that takes into consideration ecological impacts of regulated activities.
IV. A. (5) Compliance and enforcement of existing regulations are needed to protect water quality and biological integrity.
IV. A. (6) There shall be no discharge of hazardous materials into Estero Bay.
IV. A. (7) Surface water management systems in new developments will be required to utilize state-of-the-art best management practices and increased BMP's.
IV. A. (8) Grants and other incentives for retrofitting old or ineffective storm water systems should be encouraged.
IV. A. (9) The State of Florida will actively investigate and prosecute water quality violators.
IV. A. (10) Retrofitting existing shorelines hardened with vertical seawalls to sloping lime rock revetments or native, salt tolerant vegetation, should be encouraged wherever possible.
IV. A. (11) Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.

IV. B. Habitat Alteration
IV. B. (1) No further alteration of Estero Bay bottom shall occur, except as proven necessary for the health, safety and welfare of the natural resources of Estero Bay and of the people in the watershed.

IV. C. New Construction
IV. C. (1) New construction projects should utilize best management practices to minimize negative impacts to the bay to the greatest extent possible; and in addition, the project as a whole, including mitigation, should be necessary to protect the public health, safety, or welfare, or the property of others, and should improve the current condition and relative value of functions being performed by the areas affected by the project.
IV.C.(2) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood).

IV. D. Wildlife
IV. D. (1) A manatee protection plan will be adopted to reduce the number of boat-related manatee mortalities and that respects the rights of other users of the bay; to achieve a sustainable manatee population (the goal of the Marine Mammal Protection Act); to protect manatee habitat; to promote boating safety; and to increase public awareness of the need to protect manatees and their environment.
IV. D. (2) Efforts by wildlife protection agencies will be accelerated to reduce other non-boat related manatee mortalities.
IV. D. (3) Maintain and improve the overall ecology of the bay and its watershed.
IV. D. (4) Wildlife resources such as rookeries, sea grass beds and fisheries are under increasing threat from human activity. Greater efforts are required by regulatory and other agencies and groups to insure the sustained productivity of these resources.

IV. D. (5) Additional manatee research funding should be provided.

IV. E. Recreation

IV. E. (1) Regulatory agencies and boaters will make special effort to maintain the bay as a major natural resource for fishing and appreciation of vegetation and wildlife.
IV. E. (2) Safe operation of vessels is mandatory.
IV. E. (3) Respect for wildlife, its habitat, and other bay users are particularly important in a crowded bay.
IV. E. (4) Use of non-motorized boats, such as kayaks and canoes, is encouraged and supported. (Estero Bay Agency on Bay Management 2002)

Bunche Beach

Human History of Estero Bay

Calusa Period

As new archeological data are analyzed, the date of the first human habitation of Florida is pushed earlier and earlier. It is currently estimated that the first human habitation of Lower Charlotte Harbor and the Estero Bay region occurred approximately 10,000 years ago. These first inhabitants were nomadic people who used stone tools and hunted large mammals in the interior plains. Coastal villages developed as climate changed, sea levels rose, and fishing skills increased. Farming, pottery skills, and trade with people outside of Florida developed between 3,000 and 500 years ago. Archeological records indicate that copper, iron ore and maize seeds were prized imports, while pearls, shells, and fish bones were the primary exports. During this period, mound building began, and ceramic pottery was used to store goods. There is debate over whether the Estero Bay area was more dominated by the Mississippian culture or by contacts with Central and South American civilizations, with which contact existed through marine trade.

The Calusa Period spanned from 4,000 BC to 1710 AD. The Estero Bay and the Lower Charlotte Harbor area was the center of the Kingdom of the Calusa. It is thought that this tribe came from Caribbean islands. The Calusas fished the Gulf of Mexico, established settlements near freshwater tributaries, and paddled cypress canoes to colonies in other areas. Archeologists believe nearby Mound Key in Estero Bay may have been the tribe's regional center. The 125-acre island is approximately 33 feet high and covered with massive middens—refuse heaps composed of discarded shells. As had other Indian civilizations living on the Gulf of Mexico, the Calusa built large structural mounds from mollusk shells on which important buildings were constructed. Structures on the mounds ranged from the residence of the Chief to temple-like buildings. The Calusa built small canals that served as access to Lake Okeechobee and the Kissimmee River from the Caloosahatchee.

The Calusa tribal area covered most of southwest Florida and parts of southeast Florida. Population estimates vary, but the natural ecology may have maintained a native Calusa population of up to 40,000 at the time of Columbus. A population of this size was not again achieved for the same area until after World War I.

Spanish Exploration Period

The first documented Europeans to visit southwest Florida were members of the Juan Ponce de León expedition. In 1493 Juan Ponce de León sailed with Columbus on his second voyage to the Americas. He landed at St. Augustine in late March of 1513, after looking for gold and the Fountain of Youth in the Bahamas and Bimini. He named the place La Florida. It was during the final phase of his first voyage that Ponce de León led the first documented Spanish landing party ashore near Lovers Key on June 4, 1513 and first encountered the Calusa Indians. As Ponce de León and his men explored inland for wood and fresh water, they saw the Calusa tribal village at Mound Key. They encountered the Calusa and discovered that they were an unfriendly tribe. The explorers fled back to their ships and decided to leave the area, sailing back to Puerto Rico.
In 1521, Ponce de León returned to the Southwest coast of Florida to colonize. He landed on the gulf beaches near Lovers Key in Estero Bay with over 200 settlers, 50 horses, numerous beasts of burden, tools, and seeds. The plan was to set up a farming colony. As they went inland for fresh water, the Calusa ambushed them. Ponce de León was shot in the thigh by an arrow and was seriously wounded. The settlers decided to

abandon the settlement and sail back to Cuba. As a result of his wound, Ponce de León died at the age of 61 in Cuba.

Throughout the 1500s, other Spanish explorers and enterprising pirates sailed southwest Florida's coastal waters. Treasure-laden galleons from Mexico and Central America sailed past Estero Bay. Map-makers named the bay "Estero," the Spanish word for estuary.

A tenuous alliance was later formed between the Calusa and the Spanish in 1567. Mound Key was also the site of the first Jesuit mission in North America. However, the Spanish did not want to help the Calusa against their enemy the Tocobaga and the Calusa were disinterested in Christianity, so the alliance dissolved. Other Spaniards followed, and the Calusa were eventually conquered—but by disease, not warfare. Although the Calusa eventually died out in Florida due principally to the introduction of common European illnesses such as smallpox and influenza for which they had no natural immunities, they succeeded in keeping their would-be Spanish conquerors at bay for over a 250-year period. The last known documented Calusa in southwest Florida died in the late 1700s. Slavery, indenture, or conversion led to the transfer of the majority of the last remnants of the tribe by the 1800's remaining population to Cuba and other Caribbean lands where descendants can be found today.

Cuban Period

The Cuban Period spanned from 1710 to 1836. Southern Florida became lightly repopulated through migration of the southern Creek Indians from Alabama and Georgia, who likely intermarried or absorbed very small numbers of remnant native peoples and became known as Seminoles. The name Seminole is from the Creek word 'semino le', interpreted to translate as 'runaway.' Another, better description of the meaning can be "emigrants who left the main body and settled elsewhere." The term was first applied to the tribe about 1778.

Southwest Florida, while it remained under Spanish control, was not a center for major settlement. Fishing camps were established by people of direct Spanish and Cuban descent who harvested the bounty of the estuary and brought salted and smoked fish to the urban centers of Cuba and the Spanish Caribbean. Beyond fishing camps, the interior was visited only for hunting trips. Here the Cubans made contact with the Seminoles. The Cuban populations did not desire to settle in the interior of southwest Florida, so conflict with the Seminoles was minimal.

The settlement history of southwest Florida by Americans was driven by military decisions associated with the series of Seminole Wars generated by the southward movement of American settlers from Georgia and elsewhere in the southeastern United States immigrating into Florida even when it was still a Spanish possession. There were three Seminole Wars in Florida; the first Seminole War started in 1817 and shortly thereafter Spain ceded Florida to the United States. The series of wars, ending finally in 1858, led to the Seminoles moving further southward and residing in southwestern Florida, including family groups in the Estero basin.

American Period
The American Period spans from 1817, when Florida became a territory of the United States, to the present. The Treaty of Camp Moultrie was signed in 1823, legally establishing large parts of Lower Charlotte Harbor south of the Peace River as the promised Seminole territory. By 1840, the Lower Charlotte Harbor area had several forts: Fort Dulany, Fort Denaud, Fort Adams, and Fort Thompson. The last Seminole War ended in 1842 with an agreement that the Seminoles could remain in Florida but were forced further south into the Big Cypress Swamp and the Everglades.

By the mid 1800s, settler families headed south, settling on the high ground created by the Calusas and scrub lands along rivers. Estero's first American homesteader arrived in 1882. He was followed by others who farmed citrus along the river, ranched cattle and commercial fished and then used the waterway to ship harvests north via the Gulf. Frank Johnson, one of Lee County's early pioneers, settled on Mound Key and began excavating the historic site, gathering Calusa artifacts and gold and items left behind by the Spanish and Cubans.

The early settlements in the Estero Bay watershed of town size all occurred after the Civil War and were isolated pods created by land-hungry pioneers, or by visionaries in pursuit of dreams. Through the late 19th and early 20th centuries, the Estero Bay towns and area depended principally upon agriculture (citrus and cattle), commercial fishing, recreational fishing and tourism. Estero River Groves was renowned for its wonderful citrus.

Bonita Springs' history begins in 1888 when Alabama cotton farmer B.B. Coomer moved there and purchased 6,000 acres to start a plantation of pineapples, coconut and bananas. Coomer subsequently saw his entire crop wiped out by a freeze in 1893.

Estero was established and incorporated by the followers of Dr. Cyrus Teed, who proposed a theory that we live on the inside of the Earth's outer skin, and that celestial bodies are all contained inside the hollow Earth. This theory, which he called Koreshan Unity, drew followers to purchase and occupy a 320-acre tract in 1894. They were business-oriented and lived communally, prospering enough to establish their own political party ("The Progressive Liberty Party") and be considered among San Carlos Island's first developers. In 1904, the Koreshans, a celibate Utopian society, built a post office at their settlement and Estero officially became a town. But three years later, other local citizens protested the incorporation, the neophyte city was dissolved and was once again part of unincorporated Lee County.

As coastal settlements were few and far between south of San Carlos Bay, there was no incentive for the federal government to conduct bathymetric surveys and compile charts. Eventually, when the US Army Corps of Engineers (USACOE) surveyed Estero Bay in 1908, they could not locate an inland water route from Matanzas Pass to Naples, even though the Coast Survey chart seemed to indicate an interior waterway as far south as Clam Pass. At the time, there were three very small gasoline freight launches running between Fort Myers and the Estero River, one twice weekly and two three-times weekly. Also, a mail steamer provided service from Fort Myers to Carlos. As many as 36 fishing shacks were counted on the bay during the fishing season, when one carload of fish could be taken every two days to Punta Gorda for shipment by railroad. The USACOE recommended dredging a 5-foot-deep by 60-foot-wide channel from the mouth of Matanzas Pass to Surveyor's Creek (Imperial River) in 1908. This proposed project was not implemented.

By the 1920 Census, Bonita Springs and Estero were named and settled farming and fishing villages, as was Bayview (a.k.a. Crescent Beach or Estero Island, now known as the Town of Fort Myers Beach). The creation of the Tamiami Trail in the late 1920s opened up most of the Estero Bay coastal watershed, becoming motor court and trailer park destinations, and the construction of a toll bridge to Estero Island (54 cents in 1921) inspired further development of the island. The coastal component of the basin endured the same boom and bust phenomenon Florida had during the 1920s, with its own promoters engaged in the same land sales schemes depicted by the Marx Brothers in the movie *Coconuts.*

Development has changed the historic boundaries and extent of the Estero Bay watershed. The boundaries were increased when Ten Mile Canal was dredged in the 1920's thereby connecting areas that formerly flowed north to the Caloosahatchee. The dredging began as a source of fill to create a dike to prevent parts of Fort Myers from flooding with seasonal sheetflow from undeveloped lands to the east of the city boundary. The boundaries were also reduced by drainage projects associated with the development of Lehigh Acres.

World War II brought the area out of the Depression, and Fort Myers Beach was used as a rest and recreation site for trainees at the military bases, Page Field and Buckingham Field, only briefly discomfited by the 1944 hurricane.

Estero remained a quiet, sleepy citrus and fishing community for the next 50 to 60 years, harboring small retirement communities and mobile home parks. Estero River Heights, the area's first major development, was built along the river during the late 1960s; today, the neighborhood is filled with mature landscaping and trees, and renovated homes.

A set of technological innovations associated with working in the tropics developed by the U.S. military during World War II including air-conditioning, chemical mosquito control, quick land clearing and wetland filling, and the interstate highway system opened up southwest Florida to easier habitation by visitors and immigrants from the midwest and northeast. Following World War II, many of the servicemen who had trained on bases in southwest Florida and had experienced the region's environment either immediately returned to the area with their families after the war or, after working in other areas of the country, began retiring to this area. This trend created a one-way population influx beginning in the 1960s and 1970s. This population increase caused areas in the western corridor of the Estero Bay watershed, including San Carlos Park, Estero, San Carlos Estates, Estero Bay Shores, Spring Creek Village, Bonita Springs, and Bonita Beach to expand. Agricultural subsequently moved eastward to less expensive lands converted from former native range.

This post World War II boom came to the Estero Watershed later than other parts of the west coast of Florida, but ultimately with similar results. Large amounts of land were committed to residential urban/suburban purposes without commitments to urban services and infrastructure, viable higher income employment for the working age population, or a functional transportation network. The new developments either grew around or bypassed the older villages, creating new named communities from raw land, and increasing the density and intensity of development within the watershed. Fort Myers Beach and Bonita Beach went condo and high rise. San Carlos Island and San Carlos Park became intensely developed.

The first attempt to incorporate Fort Myers Beach occurred in the mid 1940's and failed by a margin of six or seven votes. A second try in the late 40's lost by a larger number, and an attempt in November 1953 was a total failure.

In 1955, private developer Walter Mack, with contributions from the Bonita (town) Chamber of Commerce, dredged a channel, 4-feet-deep by 50-feet-wide, from Big Hickory Pass south to the Cocohatchee, thereby providing boat access between Estero Bay and Wiggins Pass.

The Matanzas Harbor became a reliably accessible fishing port after maintenance dredging of Matanzas Pass. Reflecting this use, 1956 records listed 280 shrimp boats using the facilities at Fort Myers Beach. That year shrimp boats delivered 3,800 tons of shrimp. By 1960, waterborne commerce consisted principally of diesel fuel, fish, shrimp, and ice, with tanker barges delivering the fuel. The commercial facilities included two shrimp and several fish packinghouses, fuel and ice distribution points, and two marine railways. Much of the land development—construction of an ice plant and diesel fuel terminal—were for the support of the shrimp and fishing activity. The local fleet required a supply of fuel and ice in order to operate. From 1963 to 1966, the shrimp harvest increased from 1,294 to 1,713 short tons. The need for vessel facilities was strong during this period, enabling the justification for a channel extension that created a 5-foot-deep by 60-foot-wide channel from the mouth of Matanzas Pass to the Imperial River and improved the Matanzas Pass Channel from the Gulf to a turning basin off San Carlos Island. Prospects for continued commercial growth were good.

In 1958, Barry C. Williams and Investors purchased 5,500 acres along the northern and eastern coast of Estero Bay for $1.6 million. Robert Troutman, an Atlanta attorney representing investors, drew up a plan to expand a seawall deep into Estero Bay along 18 miles of this coastline. The seawall, called a bulkhead, would straighten out the jagged coastline by using 17 million cubic yards of fill. Along the way it would swallow up submerged lands and islands, creating 1,100 upland acres that previously were under water. For fill, Troutman proposed dredging a 12-foot channel through the seagrass beds around his bulkhead. The same technique had been employed along the east coast and in areas to the north, such as Tampa, St. Petersburg and Sarasota.

Determined to keep Estero Bay from the loss of habitat and degraded water quality when developers removed the mangroves and seagrass beds that served as a nursery for fish, shrimp, mammals and birds, local residents and fishermen formed the Lee County Conservation Association. At one point during the mid-1960s, it’s estimated that about 50 percent of the registered voters in Lee County belonged to the association.

The members of the association wrote letters, engaged politicians and used their voting bloc to change leadership in Lee County. They argued that submerged lands belonged to the state and tried to create the Estero Bay State Park. Florida law clearly states that any land above the high tide mark can be owned privately but property below it belongs to the state. Their efforts led to the creation of the Estero Bay Aquatic Preserve which was the first aquatic preserve designated under Florida Statutes, in 1966, and today the Department of Environmental Protection, Office of Coastal and Aquatic Managed Areas (CAMA) manages the aquatic preserves. The state eventually would use the preserve as a model to create 41 others along Florida's coastal waters.

The Ten Mile Canal was extended in the 1970s, dredging through uplands and wetlands and blasting through rock to connect it to Mullock Creek, cutting off the connection of the Six-Mile Cypress Slough to the headwaters of Hendry Creek.

From 1973 to 1976, a group of Lee County students from each of the high schools studying the role of forested wetlands in Florida's ecology became alarmed at how fast these environmental treasures were disappearing to private interests. The students, known as "the Monday Group," envisioned a place where visitors could stroll among majestic cypress trees and catch the whisper of Florida's primordial past. In such pristine surroundings, they hoped that people could begin to learn how wetlands provide priceless but often hidden benefits, such as water purification and storage, natural flood control and wildlife habitat. Knowing that Six Mile Cypress Slough was under imminent threat from logging and the channeling, the Monday Group launched a daring campaign to save the area for future generations. Lee County voters responded overwhelmingly by referendum to increase their own taxes to purchase and convert the Slough into a preserve.

Beginning in 1974, Regional Planning Councils were charged with coordination of the review of any large-scale development project which, because of its character, magnitude, or location, could have a substantial effect upon the health, safety, or welfare of the citizens of more than one county. Such a project, known as a Development of Regional Impact (DRI) is typically complex and requires input from many reviewing agencies. Demand for the southwest Florida lifestyle, the livability of the environment, the increased use of air conditioning and the control of mosquitoes, which in a large part has been due to the ongoing development, kept the land use conversions growing.

In the mid 1980s, the growth-impacted counties containing the Estero Bay basin amended their comprehensive plans in an attempt to control the location and intensity of urban land use changes. The comprehensive plans attempted to contain the urban growth to the western portion of the basin (located near US 41 and the railroads) while protecting the major wetlands systems existing in the eastern part of the basin and the state buffer preserves surrounding the Bay. The result was that, south of State Road 82 and east of 1-75, the greater part of the wetland system that was present in 1900 is now mostly identified as Density Reduction/ Groundwater Recharge (DR/GR). For a time, it looked as though this area would be protected through a combination of regulations by the United States Army Corps of Engineers (USACOE), State of Florida, the South Florida Water Management District (SFWMD), and county regulations. State wetland regulations and Federal wetland permitting practices have allowed the reduction of wetland protection (Beever 2007).

Spanish Wells was Bonita Springs' first gated community, founded in 1979, and within 20 years many upscale gated communities followed, including Bonita Bay, Pelican Landing, Worthington and Hunter's Ridge**.**

In 1980, the Coast Guard established a search and rescue station on San Carlos Island at Matanzas Pass, which is reportedly the fourth busiest station in the United States. The station handles over 600 search and rescue missions a year including Cuban refugees' interdiction and drug enforcement duty. The Coast Guard station covers a coastline of about 60 miles from Sarasota Beach to Cape Romano.

Southwest Florida Regional Airport (RSW) opened on May 14, 1983.The original terminal was located off Daniels Parkway. On May 14, 1993, ten years after opening, the airport was renamed Southwest Florida International Airport. Southwest Florida International Airport's new terminal, accessed from Ben Hill Griffin Parkway, opened in 2005 to accommodate record numbers of travelers. It was one of the newest terminals in the nation and was the largest public works project in Lee County history. A recent economic impact study showed the airport's annual contribution to the region's economy was $8.4 billion. Southwest Florida International Airport served over 10 million passengers in 2019.

The 7,000-acre Mitigation Park, located four miles southeast of Southwest Florida International Airport, was established to compensate for the impact of long-term development and expansion of the airport. The lands are among the most pristine and environmentally sensitive in the region. Site surveys resulted in identifying eight plant and eleven wildlife species listed as protected by State and Federal agencies. The site includes the Imperial Marsh, the largest freshwater marsh in Lee County, and extends from the headwaters of the Imperial and Estero river watersheds through the Flint Pen Strand, ultimately connecting to the Estero Bay. The Port Authority has been recognized and has won several industry environmental awards for this project. The total budget for the project was $30 million, which included land acquisition and restoration costs. The Lee County Port Authority maintains this property for approximately $500,000 per year. No ad valorem (property) taxes are used for airport operation or construction. Although it is called a park, this mitigation land is not a public area.

The siting of Florida Gulf Coast University, Florida's newest higher education facility, in the DR/GR, led to serious opposition, because of the possible threat to Lee County's domestic water supply, wildlife habitats, wetlands, and the cost of the infrastructure for such an inaccessible site. The formation of the Estero Bay Agency for Bay Management in 1995 was a direct result of the settlement agreement to address that opposition. Within the first two years after the FGCU founding, much residential and commercial development was approved for the area, including three Developments of Regional Impact (DRIs). The Southwest Florida International Airport reconfigured and expanded. The Lee County Metropolitan Planning Organization (MPO) also considered the possibility of new roads bisecting the area in several directions.

In 1997, Southwest Florida's only four-year university, Florida Gulf Coast University, opened in the middle of the watershed east of Estero and I -75. Then, as predicted, Germain Arena and Miromar Outlets opened in Estero in 1998, and growth exploded both east of Interstate 75 extending to the Collier County Line along Bonita Beach Road, and into the areas flanking US 41, Ben Hill Griffin Parkway and Three Oaks Parkway. The most dramatic of these changes in the land uses were the reduction in wetlands, the increases and then the decreases in agricultural areas, and the continued increasing of urbanization in a six- to eight-mile wide corridor between the Bay on the west and I-75 to the east.

In 1997, the voters of Lee County demonstrated their concern for preservation by voting for Conservation 2020, a plan for citizens to tax themselves in order to set up a fund for purchase of sensitive lands from willing sellers.

The Town of Fort Myers Beach incorporated in 1995. The City of Bonita Springs incorporated into a municipality in 1999.

According to the 2000 census, the Estero Bay basin population totaled nearly 145,000 people. By 2010, the Estero Bay basin population had grown by a third to over 195,000. The 2018 estimated population is 248,000.

The Village of Estero voted to incorporate in 2014 and became the newest municipality in the Estero Bay Watershed on January 1, 2015.

In a continuation of Florida's growing pattern of monsoon-like weather during summer months, a trough of low pressure developed over the eastern Gulf of Mexico and passed east across the Florida Peninsula on the 26th through 28th of August 2017, bringing abundant tropical moisture into the area. Heavy rain started to fall over southern Lee County during the evening of the 27th over already saturated ground and continued through the 28th. Lee County received 11.23 inches of rain from August 25th-28th 2017, easily exceeding the qualifications for a 25-year flood event.

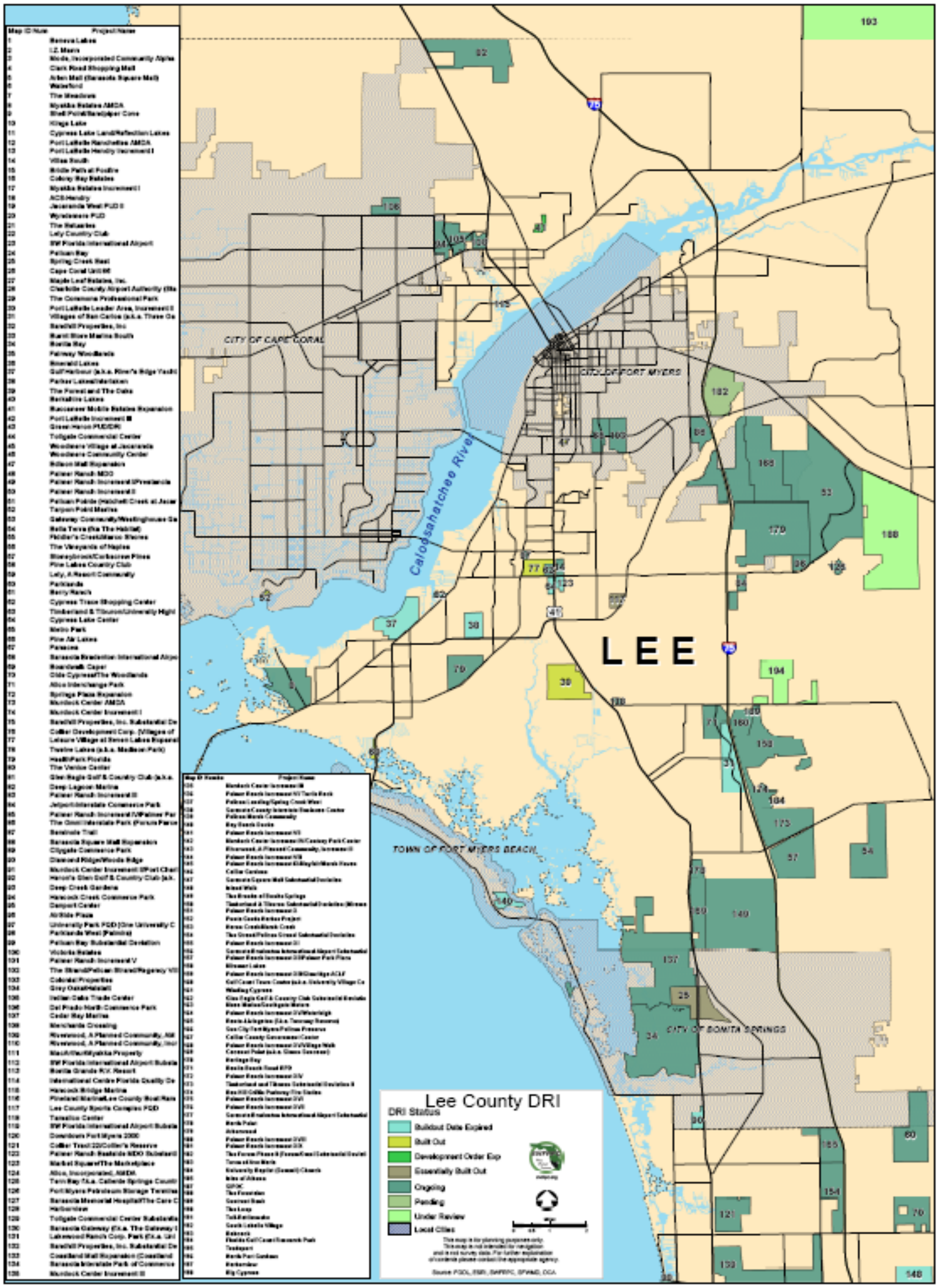
After just the first day, overflows from the Imperial River began to result in flood watches for the surrounding areas in Bonita Springs. This burst of rainfall, compounded on the fact that the Imperial River watershed had absorbed the flows of up to 3 other rivers as river lands had been filled in and developed upon, resulted in widespread flooding throughout the rivers' once undeveloped flood plains. As this river water began to flood into residential areas, it found itself trapped in neighborhoods such as the Dean Street area. Localized flooding was reported, with water entering mobile homes in Estero and Bonita Springs. A total of 70 people evacuated a mobile home park in Estero, and another 116 people evacuated a mobile home park in Bonita Springs due to rising water on the Imperial River. Trailer parks have a relatively low off-season occupancy rate of between 30-40%. Heavy rain fell across the area each day, with some areas seeing over 16 inches of rain totals throughout the event. Flood waters entered numerous homes in Lee County and made numerous roads impassable, stalling many vehicles as well.

With the water unable to drain properly due to continuous flows, including sheet-flow and canal flows from the Imperial River's unnaturally enlarged watershed and sub-standard or absent storm water management systems, it was just below two weeks after these water levels began to subside that the still water-logged soil of Southwest Florida faced the imposing figure of Hurricane Irma off of Florida's coastline.

As Hurricane Irma made landfall in Florida for the second time in Collier County, it brought with it 110 mph wind speeds, and a deluge of rainfall that refilled the Imperial River's watershed that had just begun to lower towards normality. With both the soil and vegetation in the area already waterlogged, the 8-10 inches of rain (average 9.92 inches) delivered by Irma was all that was necessary for the banks of the Imperial River to overflow for the second time within thirteen days, and at a far more imposing scale. Mayor Peter Simmons reported after the storm that the entire city was affected by power outages, and over half of the city was affected by flooding. Reported storm surge at the Gulf of Mexico beaches attained 3.88 feet NGVD and left wrack lines on streets. Multiple places in mainland Bonita Springs felt the consequences of the rainwater floods. The residents who remained in place or returned to their homes after the rains subsided, found the water in their neighborhoods up to their waists or higher. Many residents were unable to reach their homes at all except by canoe or other vessel. Following this, we saw a repeat of the flood patterns that took place during the late August events. With the size of the Imperial River watershed and the Imperial River itself as the main drainage point, the floodwaters continued to flow through Bonita Springs for days before finally beginning to retreat. Even though Irma only rained about 8-10 inches on Bonita Springs, the consequences of more *frequent* flooding became clear. When floods follow one another too closely, the environment and the storm water management systems' ability to mitigate flooding is drastically diminished, and the likelihood of damage to infrastructure and homes significantly increases.

As of October 31, 2017, there had been 78.3 inches of rain (6.5 feet) in 2017 which is 26 inches of rain above average for the year as 68.9 inches of rain of that rain fell between June and Hurricane Irma with 4 major rain events (*South Florida Water Management District 2017).* Nearly 54 inches of rain, on average, fell across the 16-county district between May 21 and Oct. 28, which is the wettest 161 days on SFWMD records. District records started in 1932. The past 24 months are the wettest 24 months (125 inches of rainfall) in more than two decades.

The Invest 93 Four-Day Storm Event exceeded the 5-year storm and 25-year storm standards. Hurricane Irma rains exceeded these and the 100-year storm standards. The two storm events combined exceeded all previous documented floods in the City of Bonita Springs.


Lee County DRI
DRI Status
Buildout Date Expired
Built Out
Development Order Exp
Essentially Built Out
Ongoing
Pending
Under Review
Local Cities
CITY OF CAPE CORAL
CITY OF FORT MYERS
Caloosahatchee River
LEE
TOWN OF FORT MYERS BEACH
CITY OF BONITA SPRINGS

Water Quality Impaired Waters

2019 Water Quality Status

	Chlorophyll-a	DO	Fecal Coliform	Enterococci	Escherichia coli	Total Nitrogen	Total Phosphorus	Turbidity	Copper	Iron
Estuarine										
Estero Bay			V18			V19				
Hendry Creek						V19			V19	
Mullock Creek			V18	V19		V18				
Estero River				V19					V19	
Spring Creek			V18	V19		V19			V19	
Imperial River		V19	V18	V19		V19			V19	
Fresh										
Six Mile Cypress										
Ten Mile Canal										V19
Hendry Creek										
Mullock Creek			V18		V19					
Spring Creek										
Imperial River					V19					
Total Met 2019	**12**	**11**	**7**	**2***	**4***	**8**	**12**	**12**	**8**	**11**
				Estuarine Only	Fresh Only					

	Appears to have not met standards in 2013, based on Lee County Environmental Lab data*
	Appears to have not met standards in both 2008 and 2013*
	Appears to have not met standards in 2008 but met them in 2013*
V18	Verified as Impaired in 2018 by Florida Department of Environmental Protection
V19	Verified as Impaired in 2019 by Florida Department of Environmental Protection
V19	Verified as Impaired (macrophytes) 2019 by Florida Department of Environmental Protection

In the past, the state of Florida has not provided quantitative standards for nutrients such as nitrogen and phosphorus. These nutrients are often cited as the cause of low dissolved oxygen levels, a factor in the health of fish and wildlife resources in the Estero Bay watershed. In response from a January 14, 2009 US Environmental Protection Agency (USEPA) determination letter, the State of Florida adopted numeric standards for nitrogen and phosphorus in streams (freshwater) and southwest Florida's estuarine segments. Currently the Charlotte Harbor National Estuary Program, Sarasota Bay Estuary Program and Tampa Bay Estuary Program are evaluating tidal creeks for development of numeric nutrient criteria. For the interim, stream standards were applied in general to tidal creeks and streams.

Water Quality Standards

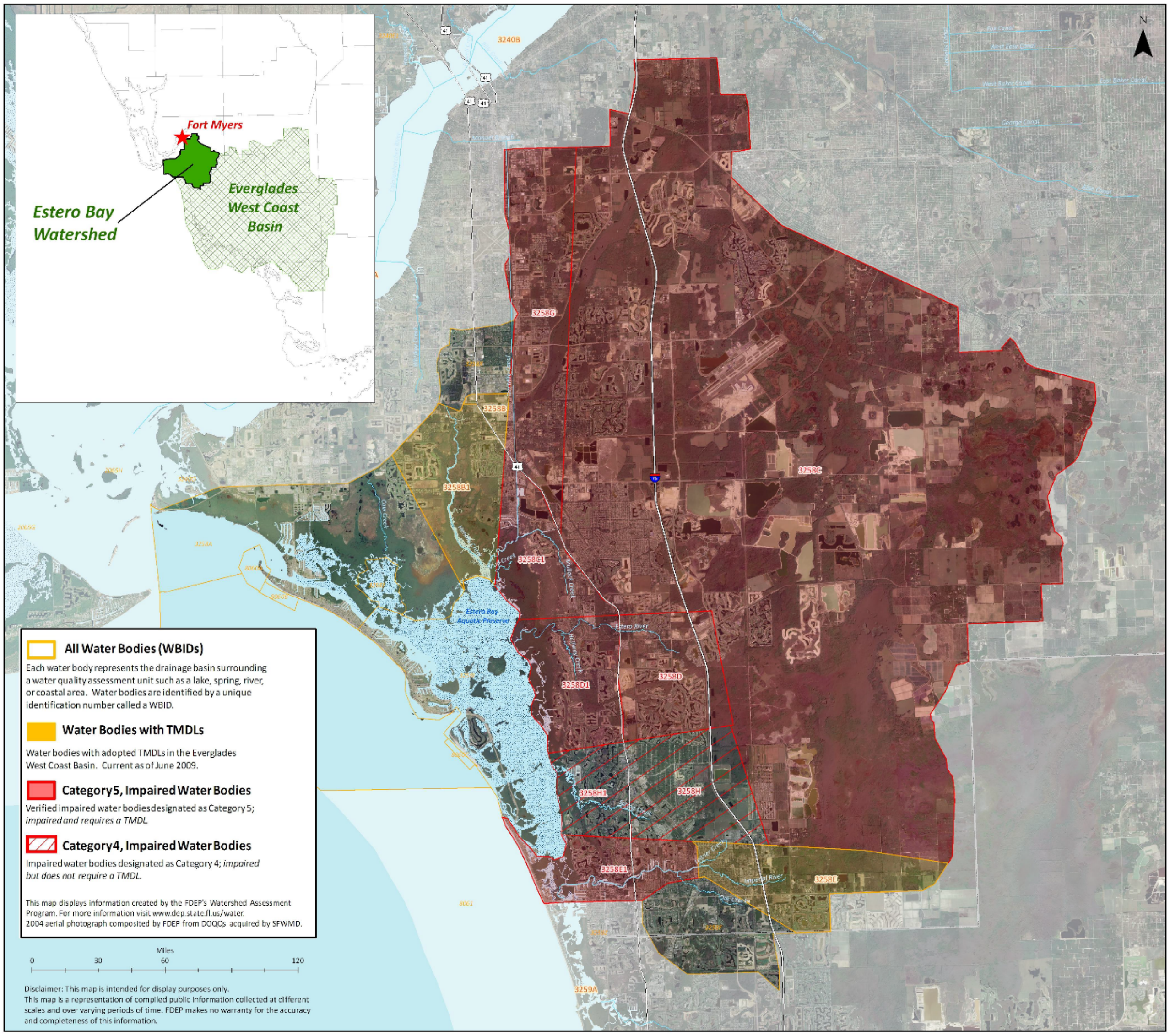
Water quality standards have evolved since the 2009 State of the Bay report. Estuarine numeric nutrient and new chlorophyll *a* standard was recommended by CHNEP, then adopted by FDEP and approved by USEPA. Freshwater numeric nutrient standards were adopted by FDEP and approved by USEPA, for implementation in 2012. Today the collection of Chlorophyll-a and Fecal Coliform data appears to have ceased in 2017, and other methods of nutrient enrichment and bacteriological pollution are being monitored including enterococci. The next State of the Bay

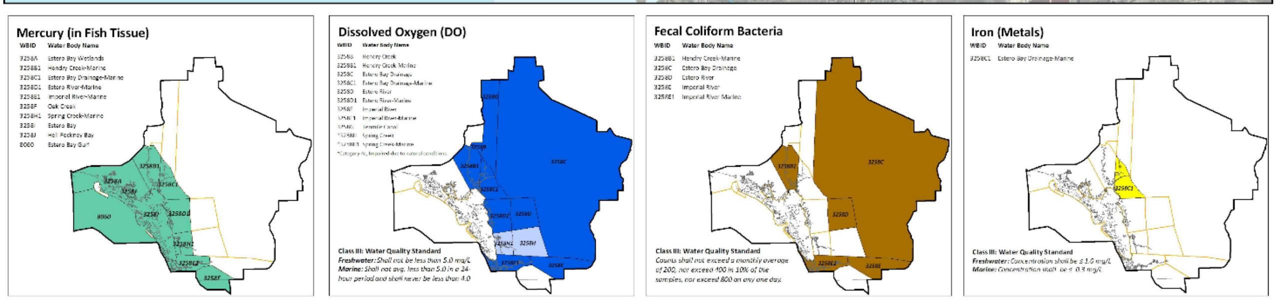
Finally, methods to measure copper were changed so that continuing comparisons to older data have no utility.

Parameter	**State Standards**		
	Estero Bay, including tidal Imperial	**Tidal Creeks**	**Freshwater Creeks**
Chlorophyll-a	5.9 ug/L	11 ug/L (superseded)	20 ug/L (superseded)
Dissolved oxygen	4.0 mg/L (superseded)	4.0 mg/L (superseded)	5.0 mg/L (superseded)
Fecal Coliform (average)	200 count/100 mL	200 count/100 mL	200 count/100 mL
Fecal Coliform (one time)	800 count/100 mL	800 count/100 mL	800 count/100 mL
Total nitrogen	0.63 mg/L	1.54 mg/L	1.54 mg/L
Total phosphorus	0.07 mg/L	0.12 mg/L	0.12 mg/L
Turbidity	29 NTUs over background	29 NTUs over background	29 NTUs over background

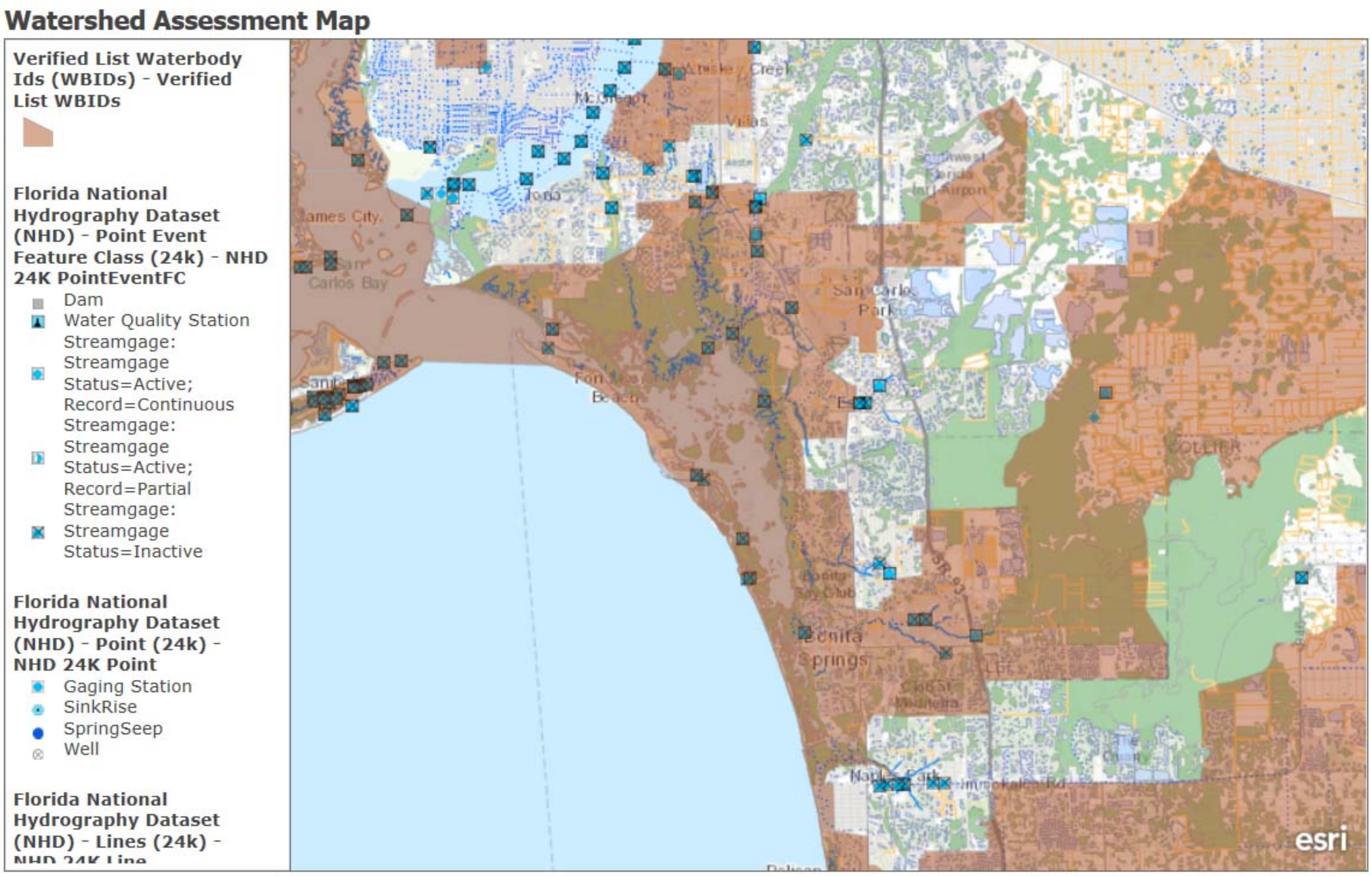
Note: mg/mL3 = ug/L (micrograms/Liter)
62-302 = Surface Water Quality Standards (August 2013)

Note: A portion of the Numeric Nutrient Standards rule became effective on 7-3-12, 20 days after filing the rule certification package for Florida’s numeric nutrient standards. USEPA approved the Florida rule November 30, 2012, resulting in approval of the Florida numeric nutrient standards in their entirety. The August 2013 date relates to additional estuary-specific standards beyond the Estero Bay basin.





The Florida Department of Environmental Protection establishes a list of water quality impairments. The map above illustrates the locations of these impairments in the Estero Bay watershed and surroundings. The verified list does not conform entirely to the 2017 water quality assessment above. As is evident from the following data, water quality varies each year. The 2019 assessment provides a snapshot in time, whereas the FDEP information shown above illustrates areas of chronic water quality problems. FDEP now has an on-line tool to view areas of those WBID that have been verified in the most recent cycle. It is shown below.



Map Direct focus for viewing Watershed Assessment data. Please refer to https://floridadep.gov/dear/watershed-assessment-section for more information

University of South Florida, County of Collier, County of Lee, FL, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS | FDEP | Florida Department of Environmental Protection (FDEP), DEAR | environment, TMDL Total Maximum Daily Load Impairment, Environmental Monitoring and Modeling | FDEP, DEAR | FDEP,WRM - Janis Paulsen, Joe Hand | Florida DEP, Division of Environmental Assessment and Restoration (DEAR), Watershed Assessment Section

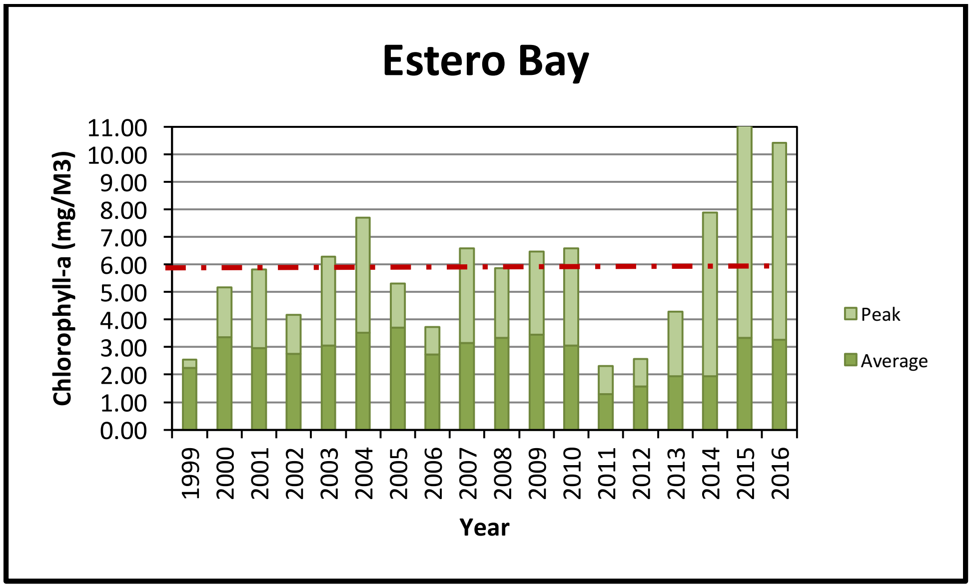
Parameter: Chlorophyll-a

Chlorophyll-a is a measure of phytoplankton activity in the water column based on the primary photosynthetic pigment of green and other algae. It is a resultant parameter that synthesizes many environmental factors including nutrients, temperature, salinity, trace elements, toxics, tides and relative dilution, including water flows. It is proposed as a presumptive measure of estuarine health for the purpose of determining impaired waters. According the Florida Impaired Waters Rule (62-303), an annual average measurement greater than 11 mg/l in estuarine conditions is considered impaired. An annual average exceeding 20 mg/M^3 in freshwater streams is considered impaired. CHNEP recommended 5.9 mg/M^3 for Estero Bay and the state adopted the standard for implementation in January 2012.

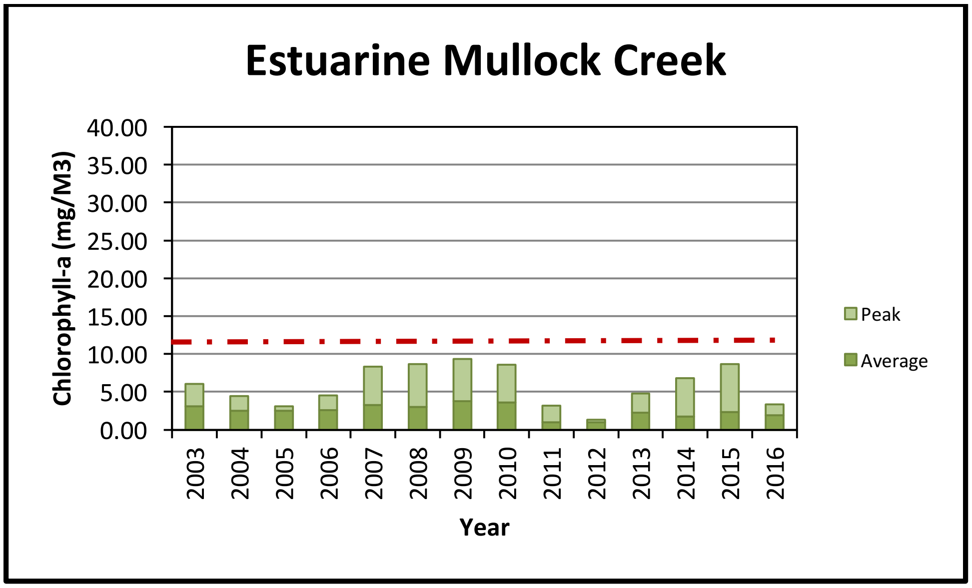
The Lee County Environmental Laboratory provided the data for all chlorophyll-a analysis. No chlorophyll-a data was collected after 2016.

Chlorophyll-a in Estuarine Systems

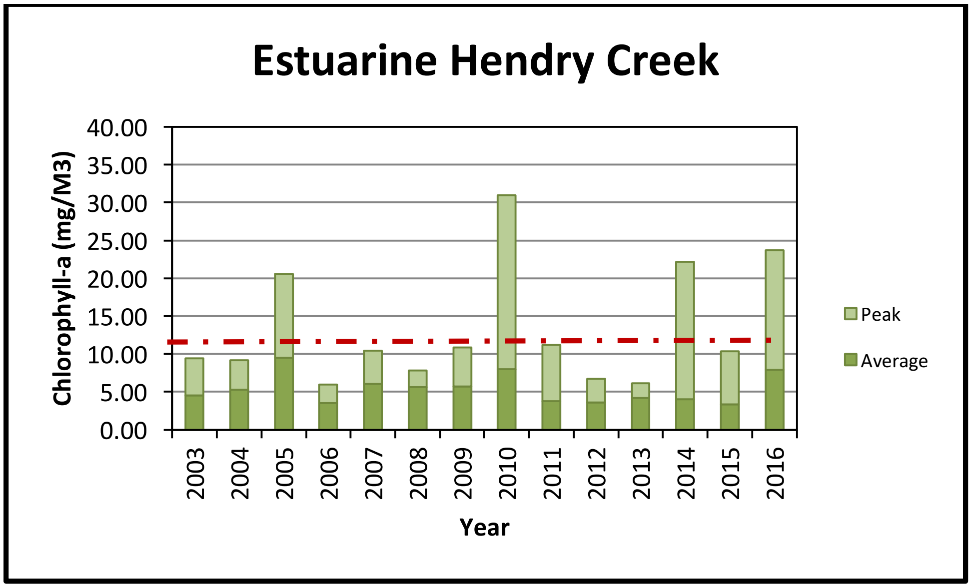
Overall, the average annual increase for the estuarine watershed was 25.2%. The peak monthly chlorophyll-a for the estuary decreased an average of 29%. In various years the peak chlorophyll-a levels exceeded standards in Estero Bay, Hendry Creek, Estero River, Spring Creek and Imperial River.



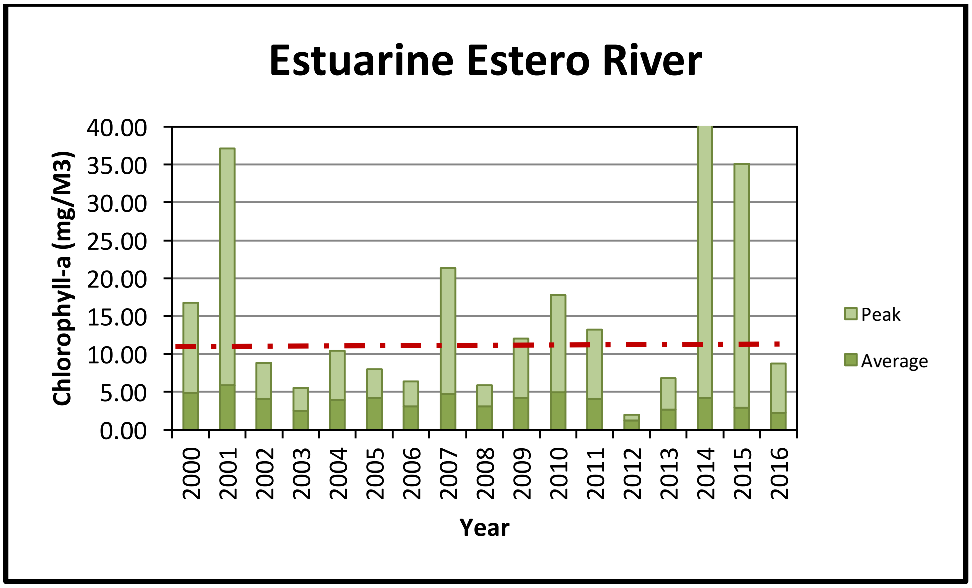
2014-2016 change			
Average	68.6%		
Peak	31.77%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.45	6.46	September
2010	3.06	6.58	August
2011	1.30	2.31	August
2012	1.58	2.58	July
2013	1.95	4.29	August
2014	1.93	7.9	January
2015	3.33	29.22	September
2016	3.26	10.41	June



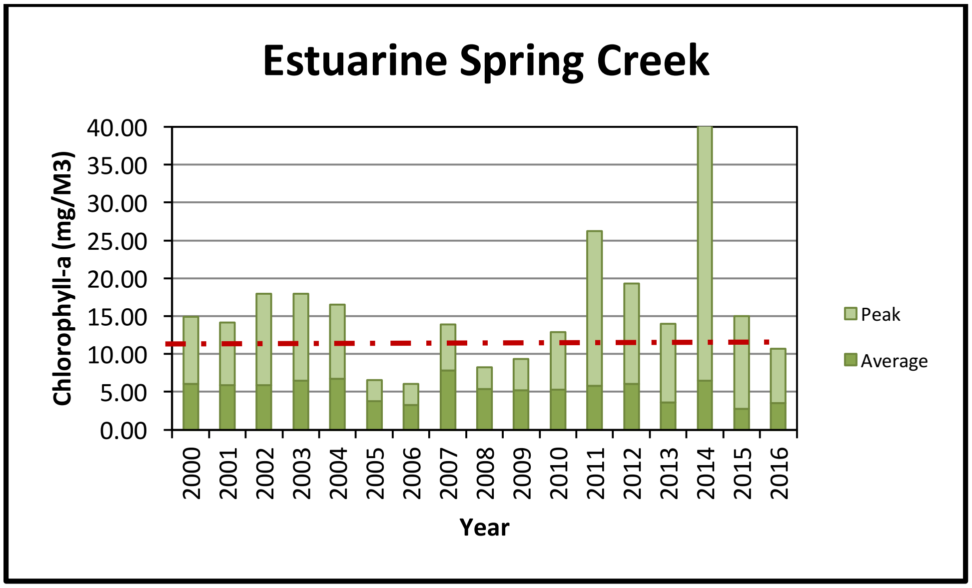
2014-2016 change			
Average	6.37%		
Peak	-50.44%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.78	9.30	June
2010	3.58	8.55	May
2011	0.99	3.20	June
2012	0.95	1.30	June
2013	2.23	4.75	December
2014	1.78	6.8	June
2015	2.34	8.65	August
2016	1.89	3.37	June



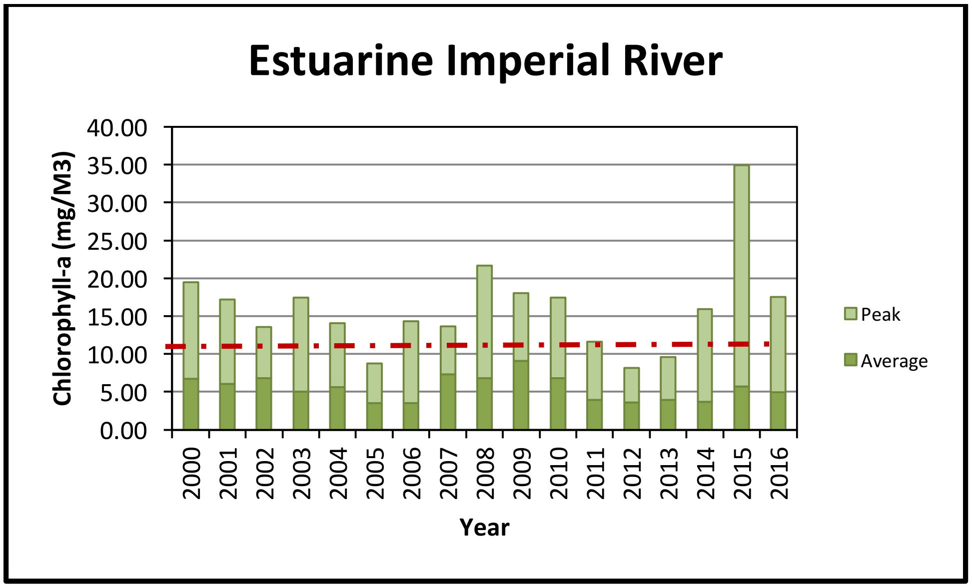
2014-2016 change			
Average	95.61%		
Peak	6.80%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	5.72	10.83	June
2010	7.96	30.98	April
2011	3.78	11.20	July
2012	3.62	6.70	October
2013	4.19	6.10	October
2014	4.02	22.20	April
2015	3.33	10.39	June
2016	7.86	23.71	February



2014-2016 change			
Average	-10%		
Peak	-86.86%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	4.17	12.08	February
2010	4.91	17.83	June
2011	4.07	13.23	August
2012	1.24	1.96	April
2013	2.63	6.77	November
2014	4.23	66.60	March
2015	2.90	35.07	March
2016	2.25	7.24	November



2014-2016 change			
Average	-46.24%		
Peak	-85.34%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	5.23	9.38	December
2010	5.28	12.85	July
2011	5.82	26.28	April
2012	6.07	19.35	January
2013	3.61	14.00	May
2014	6.47	73.10	April
2015	2.76	14.99	March
2016	3.48	10.72	May

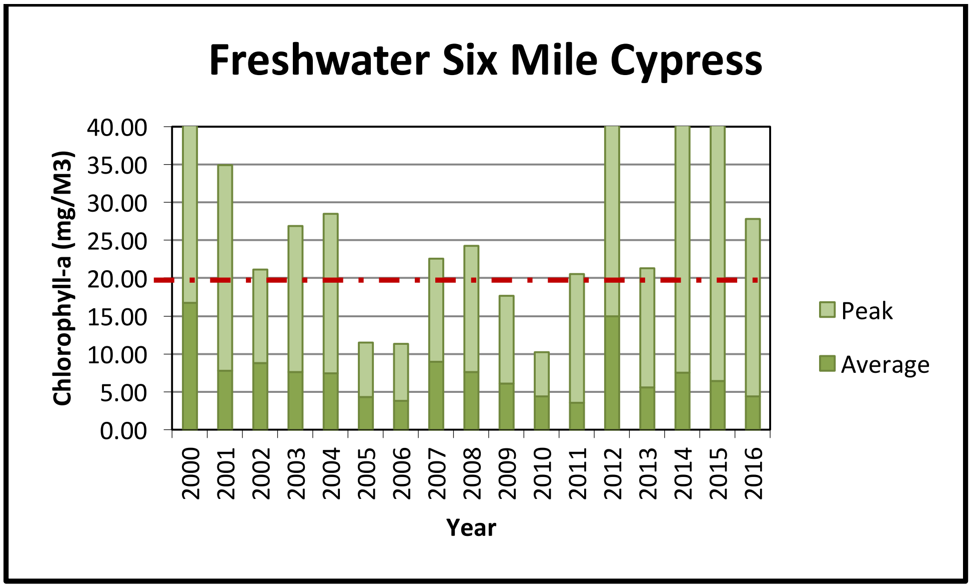


2014-2016 change			
Average	36.9%		
Peak	10.06%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	9.07	18.07	February
2010	6.80	17.43	June
2011	3.92	11.65	June
2012	3.58	8.20	May
2013	3.95	9.63	December
2014	3.65	15.90	June
2015	5.70	34.94	November
2016	4.99	17.50	November

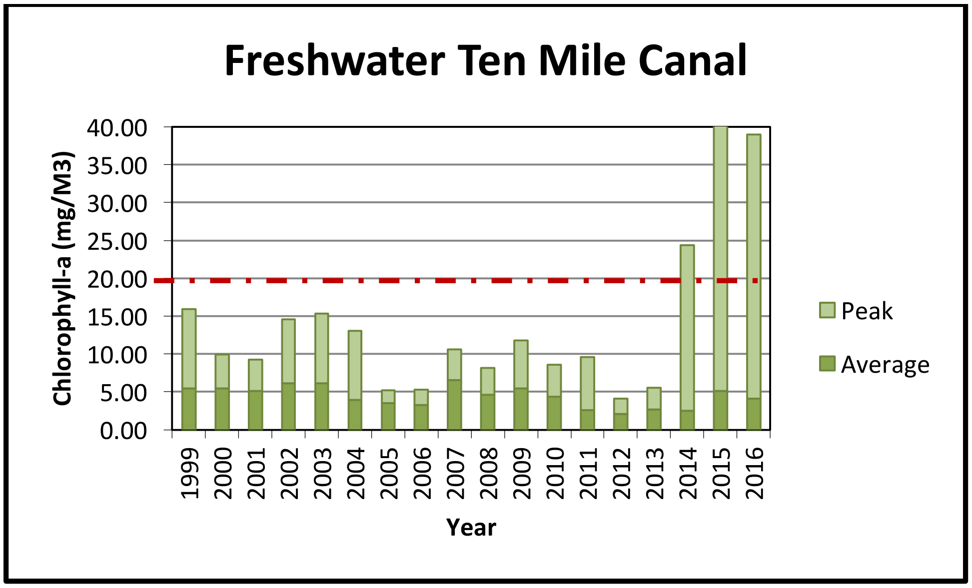
Chlorophyll-a in Fresh Systems

Between 2014 and 2016, average annual chlorophyll-a dropped in freshwater Six-Mile Cypress, Spring Creek, and Imperial River; and average annual chlorophyll-a increased in freshwater Ten Mile Canal, Hendry Creek, and Mullock Creek. The average increase for the freshwater basins was 12.2%. The peak monthly chlorophyll-a dropped in all freshwater segments except Ten Mile Canal and Hendry Creek, yet still had an overall increase of 7%, likely due to the significant percent increase in Hendry Creek.

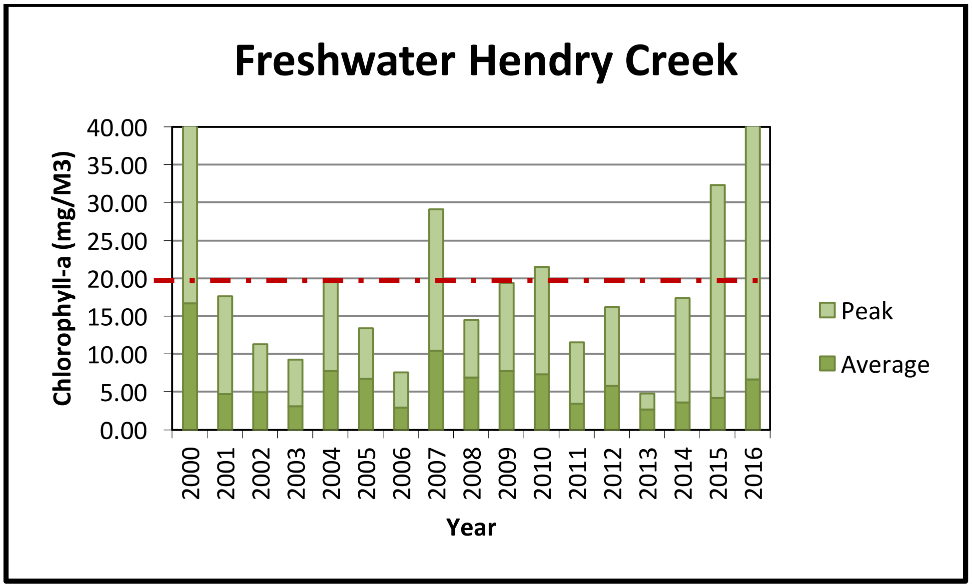
The most common peak months were June and July. These probably represented the end of dry season stagnation and wet season first flush events.



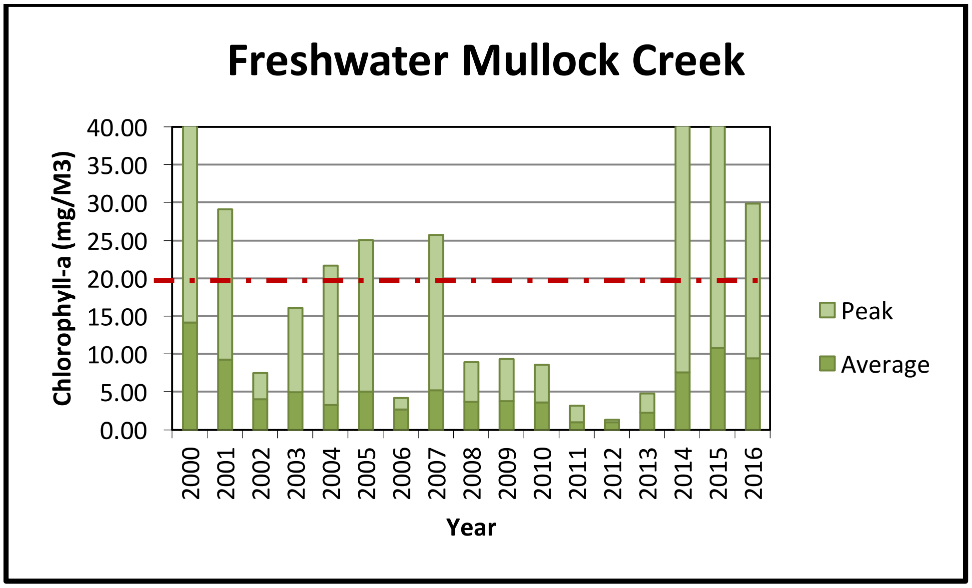
2014-2016 change			
Average	-41.75%		
Peak	-66.78%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	6.11	17.65	March
2010	4.43	10.23	June
2011	3.60	20.58	February
2012	14.99	85.38	May
2013	5.58	21.30	May
2014	7.51	83.80	May
2015	6.46	182.10	June
2016	4.38	27.84	July



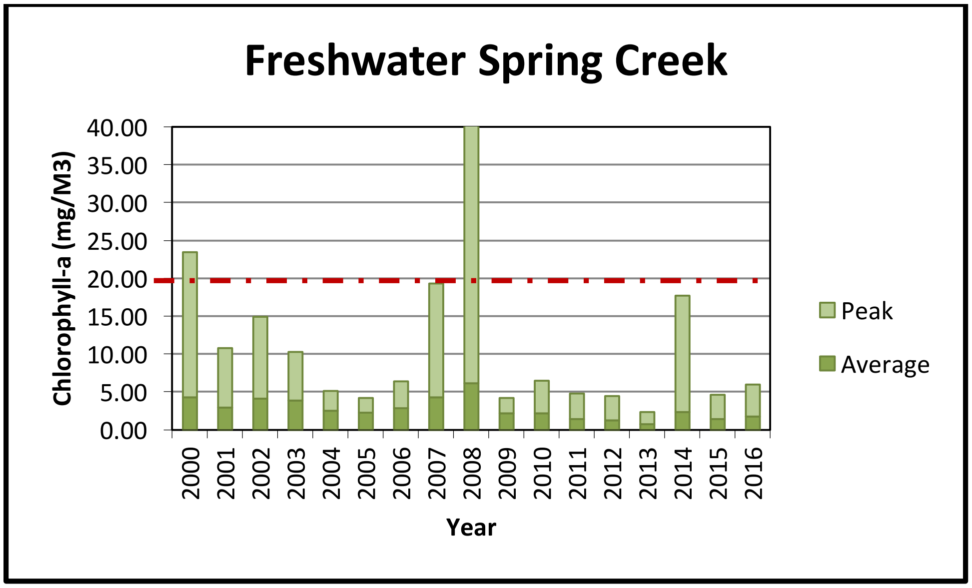
2014-2016 change			
Average	61.19%		
Peak	59.96%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	5.42	11.78	September
2010	4.33	8.62	December
2011	2.56	9.63	April
2012	2.08	4.10	May
2013	2.68	5.57	September
2014	2.53	24.40	June
205	5.14	97.36	March
2016	4.07	39.03	July



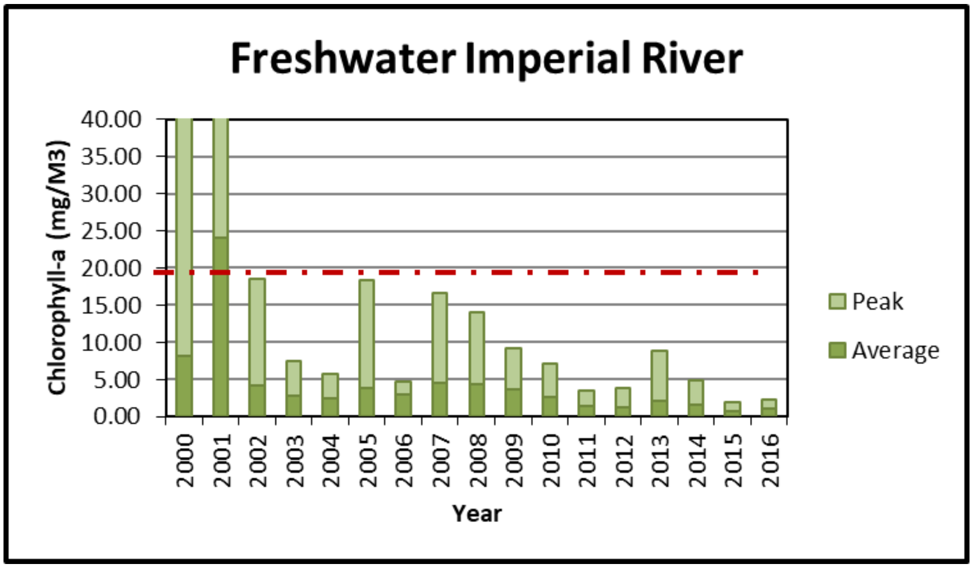
2014-2016 change			
Average	83.2%		
Peak	205.29%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	7.70	19.40	November
2010	7.28	21.50	December
2011	3.43	11.50	January
2012	5.78	16.20	April
2013	2.70	4.80	June
2014	3.63	17.40	May
2015	4.20	32.80	February
2016	6.64	53.12	April



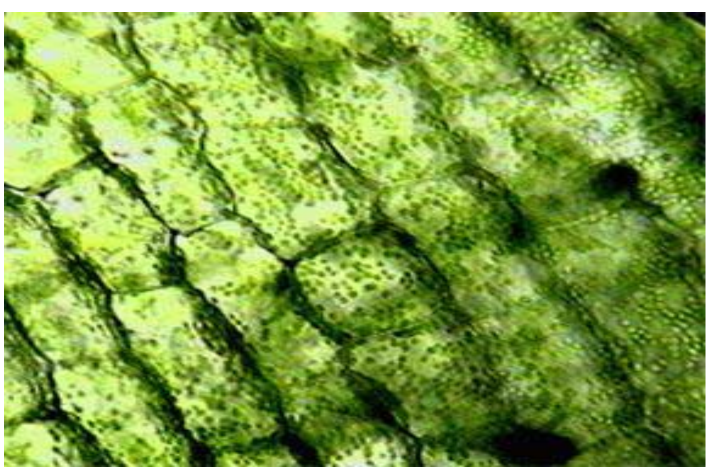
2014-2016 change			
Average	24.44%		
Peak	-37.96%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.78	9.30	June
2010	3.58	8.55	May
2011	0.99	3.20	June
2012	0.95	1.30	June
2013	2.23	4.75	December
2014	7.57	48.10	July
2015	10.74	93.69	February
2016	9.42	29.84	August



2014-2016 change			
Average	-22.27%		
Peak	-66.16%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.18	4.20	May
2010	2.18	6.50	December
2011	1.37	4.80	May
2012	1.21	4.40	May
2013	0.69	2.30	August
2014	2.29	17.70	April
2015	1.39	4.57	November
2016	1.78	5.99	June



2014-2016 change			
Average	-31.21%		
Peak	-52.24%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.63	9.15	March
2010	2.68	7.10	August
2011	1.41	3.50	May
2012	1.28	3.90	April
2013	2.07	8.80	May
2014	1.57	4.90	April
2015	0.82	1.88	July
2016	1.08	2.34	June



Parameter: Copper

Copper (Cu) is a measure of all dissolved copper in the water column, including hexavalent, bivalent, and trivalent ions. It is a resultant parameter that synthesizes many environmental inputs of copper including dissolved copper from roadways; antifouling paints for marine applications; treated wood, such as pilings; aquatic algaecides and lake treatments; architectural sources; marine cathodes; human debris; and natural sources.

In December 2008, the City of Naples, just outside the Estero Bay watershed, enacted a ban on copper-containing herbicides commonly used in city lakes for control of aquatic plants. The ordinance stated that, "…amending the existing Code to prohibit the use of copper sulfate or any other copper-containing herbicide in City lakes is likely to provide enhanced environmental protection to Naples Bay, decrease the amount of copper entering the City's lakes and natural waterways, including Naples Bay, thus improving water quality…" (City of Naples 2008). Subsequently, the Florida Department of Agriculture and Consumer Services has pre-empted the local government and restricted the City of Naples from enforcing this ban.

According to USEPA, National Recommended Water Quality Criteria, the "Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect" (US Environmental Protection Agency 2009). For copper in marine or estuarine systems, the CCC is 3.1 µg/L and in freshwater systems, the CCC is 9.0 µg/L. This appears to be a tightening of the federal standards. The general state standard for copper is 3.7 µg/L in Class III marine and Class II fresh waters.

The Lee County Environmental Laboratory had a methodological change in 2009, with results driven substantially by the methods change. Marine Spring Creek is the one verified impairment for copper within the Estero Bay basin. The Concentration of Criterion or Threshold Not Met is $\leq$ 3.7 µg/L. The FDEP priority for development of a TMDL for this is currently medium.

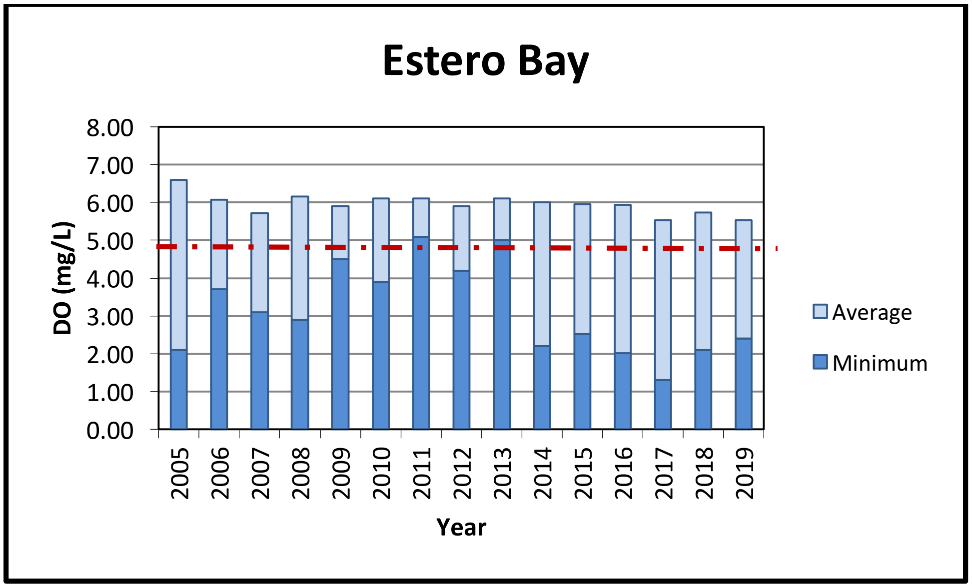
Parameter: Dissolved Oxygen

Dissolved oxygen (DO) is a measure of all dissolved oxygen in the water column. DO is vital to aerobic organisms in the aquatic ecosystem, and most higher taxa require higher DO levels for healthy life cycles and successful reproduction. Many factors affect DO including wind mixing, turbulence, flow volumes and rates, biochemical oxygen demand, algal blooms, photosynthesis and respiration, salinity and thermal stratification, anthropogenic eutrophication, and toxic spills.

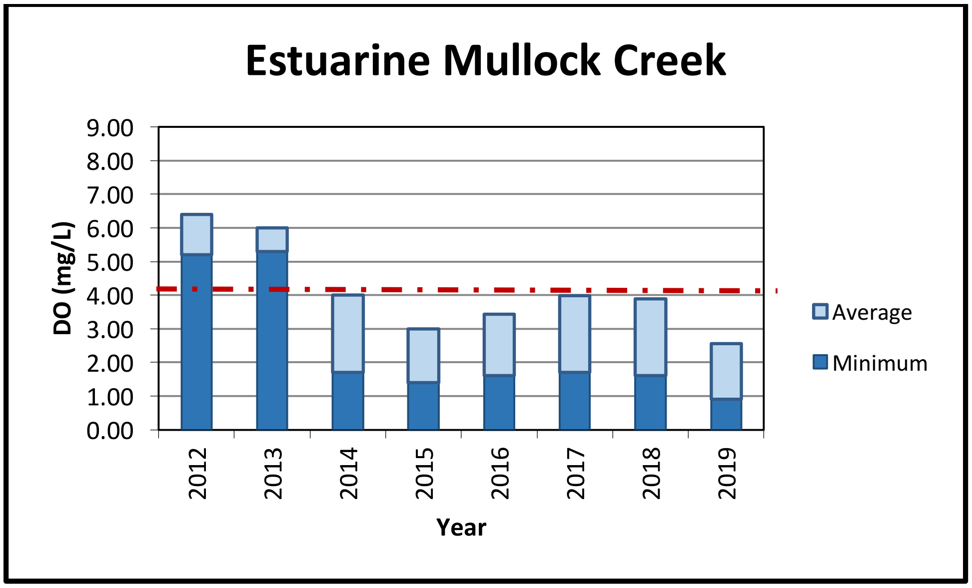
Florida's water quality standards state that dissolved oxygen in Class III freshwaters, "…shall not be less than 5.0 [mg/L]," and in Class III marine waters, "Shall not average less than 5.0 in a 24-hour period and shall never be less than 4.0." (Florida State Legislature 2008) Some natural estuaries will experience periods of low DO during the night due to community respiration exceeding the level of dissolved oxygen in the water column. This is rapidly recovered by community photosynthesis during the day. Prolonged periods of DO below 4.0 mg/L indicate problems. These may be transient, such as an algal bloom. However, prolonged systemic DO depression from anthropogenic inputs and other excess nutrient loading (such as atmospheric doposition) is not recoverable without source reduction efforts. Conditions below 2.0 mg/L are considered anoxic and can be fatal to most fishes and invertebrates.

The Lee County Environmental Laboratory as shown in the CHNEP Water Atlas provided the data for all dissolved oxygen data.

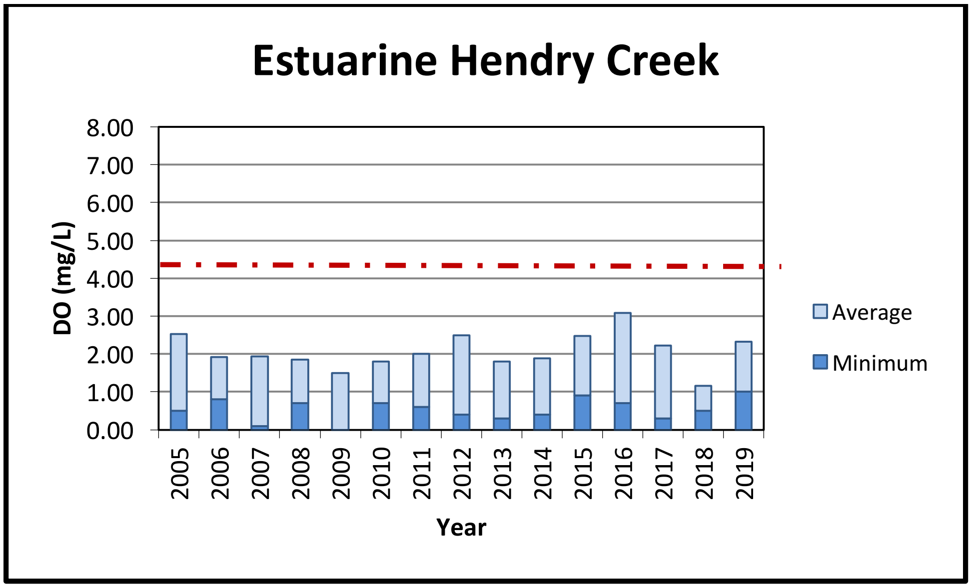
Between 2014 and 2019, average dissolved oxygen decreased in Estero Bay, Mullock Creek and Imperial River; and it increased in Hendry Creek, Estero River, and Spring Creek. The average decrease was -0.54%. The monthly minimum dissolved oxygen increased in all estuarine segments but Mullock Creek which decreased and Spring Creek which remained the same. The most common minimum months were May and June, however, all months except January and December were represented.



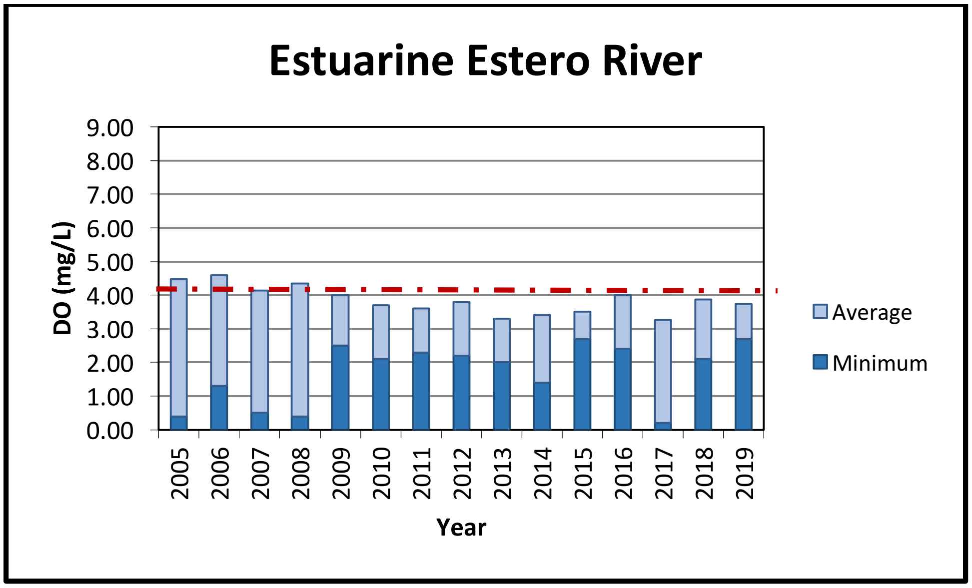
2014-2019 change			
Average	-7.83%		
Minimum	9.09%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	5.9	4.50	October
2010	6.1	3.90	August
2011	6.1	5.10	August
2012	5.9	4.2	August
2013	6.1	5.00	September
2014	6.0	2.20	August
2015	5.95	2.52	July
2016	5.93	2.02	July
2017	5.54	1.30	September
2018	5.73	2.10	April
2019	5.53	2.40	July



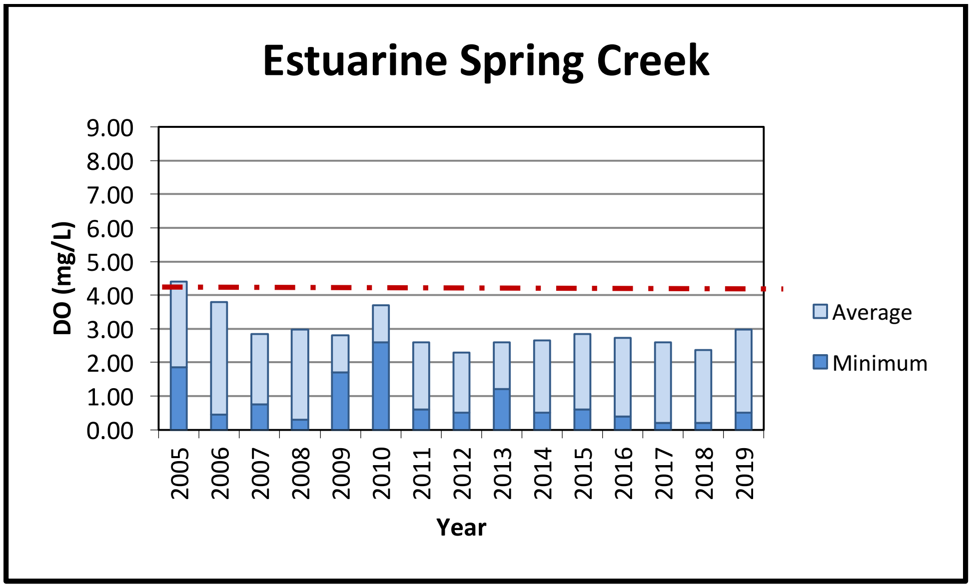
2014-2019 change			
Average	-36.16%		
Minimum	-47.06%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2012	6.4	5.2	December
2013	6.0	5.3	December
2014	4.01	1.7	June
2015	3.00	1.4	August
2016	3.43	1.6	August
2017	3.98	1.7	May
2018	3.88	1.6	September
2019	2.56	0.9	August



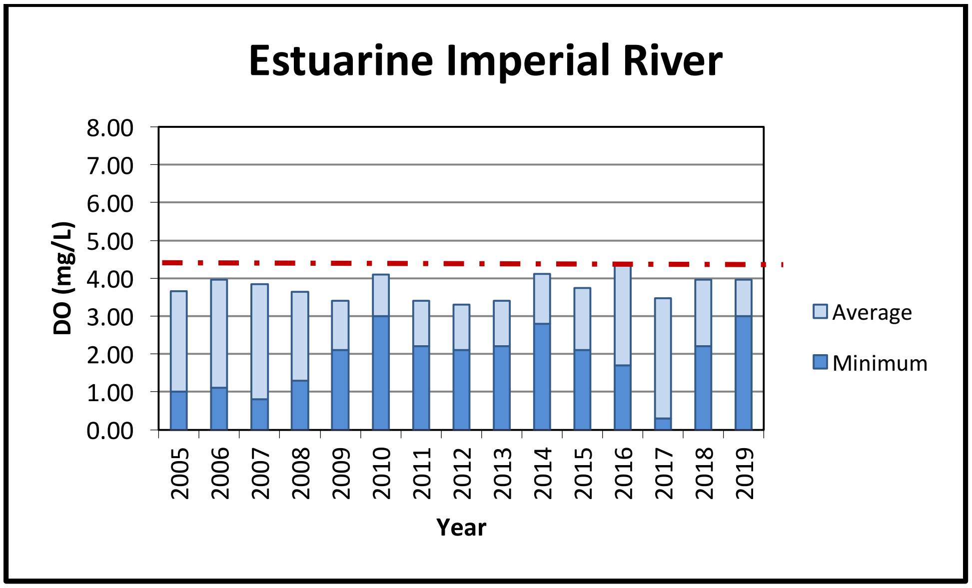
2014-2019 change			
Average	23.28%		
Minimum	150.00%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	1.5	0.0	June
2010	1.8	0.7	May
2011	2.0	0.6	April
2012	2.5	0.4	June
2013	1.8	0.3	April
2014	1.89	0.4	February
2015	2.47	0.9	June
2016	3.08	0.7	April
2017	2.23	0.3	March
2018	1.16	0.5	June
2019	2.33	1.0	September



2014-2019 change			
Average	9.06%		
Minimum	92.86%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	4.0	2.5	September
2010	3.7	2.1	June
2011	3.6	2.3	August
2012	3.8	2.2	August
2013	3.3	2.0	July
2014	3.42	1.4	June
2015	3.5	2.7	April, May
2016	4.0	2.4	May
2017	3.26	0.2	June
2018	3.87	2.1	May
2019	3.73	2.7	April



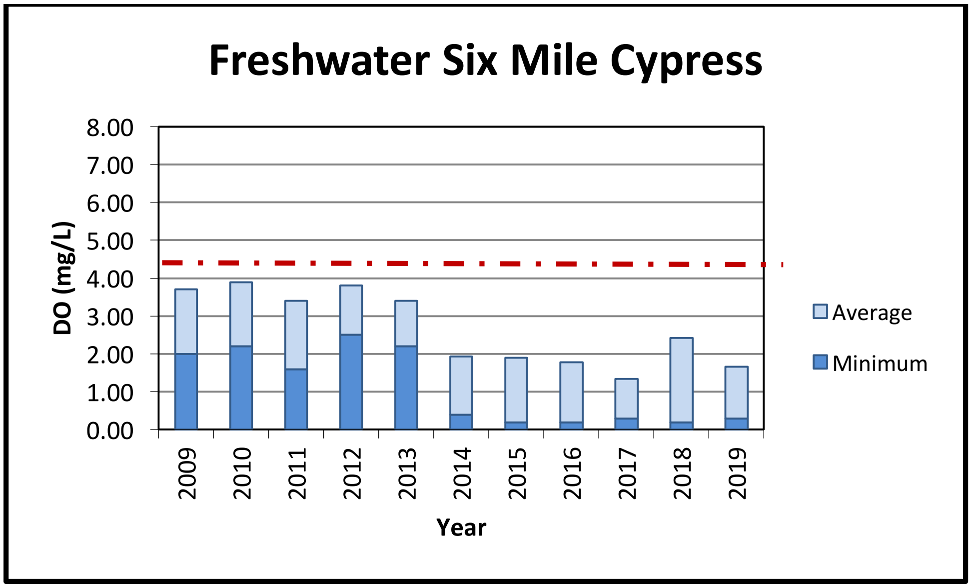
2014-2019 change			
Average	12.03%		
Minimum	0%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	2.8	1.7	November
2010	3.7	2.6	June
2011	2.6	0.6	June
2012	2.3	0.5	June
2013	2.6	1.2	April
2014	2.66	0.5	March
2015	2.84	0.6	November
2016	2.73	0.4	May, November
2017	2.59	0.2	February, April, May
2018	2.37	0.2	February
2019	2.98	0.5	June



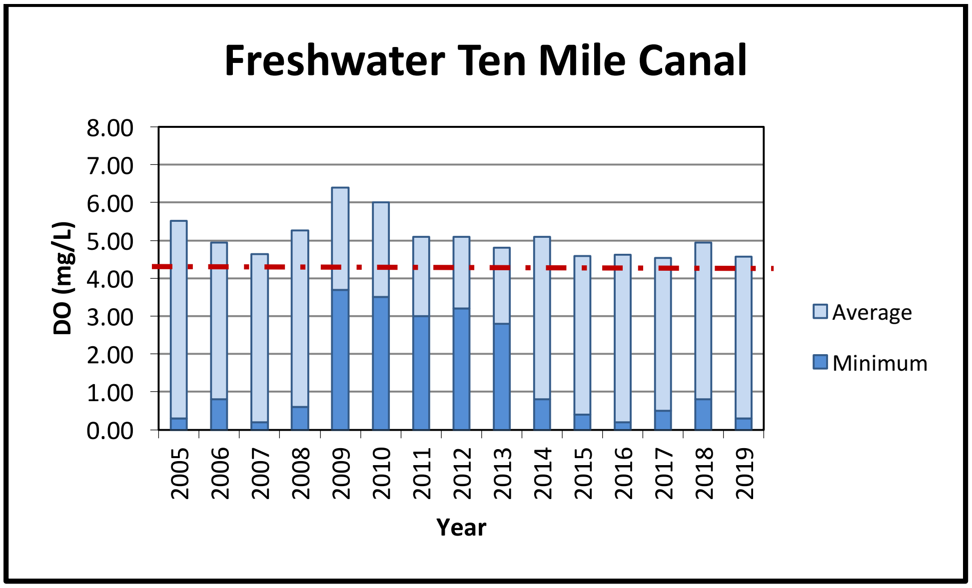
2014-2019 change			
Average	-3.65%		
Minimum	7.14%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	3.4	2.1	August
2010	4.1	3.0	August
2011	3.4	2.2	September
2012	3.3	2.1	August
2013	3.4	2.2	July
2014	4.11	2.8	August
2015	3.75	2.1	July
2016	4.36	1.7	June
2017	3.47	0.3	September
2018	3.97	2.2	May
2019	3.96	3.0	October

Dissolved Oxygen in Fresh Systems

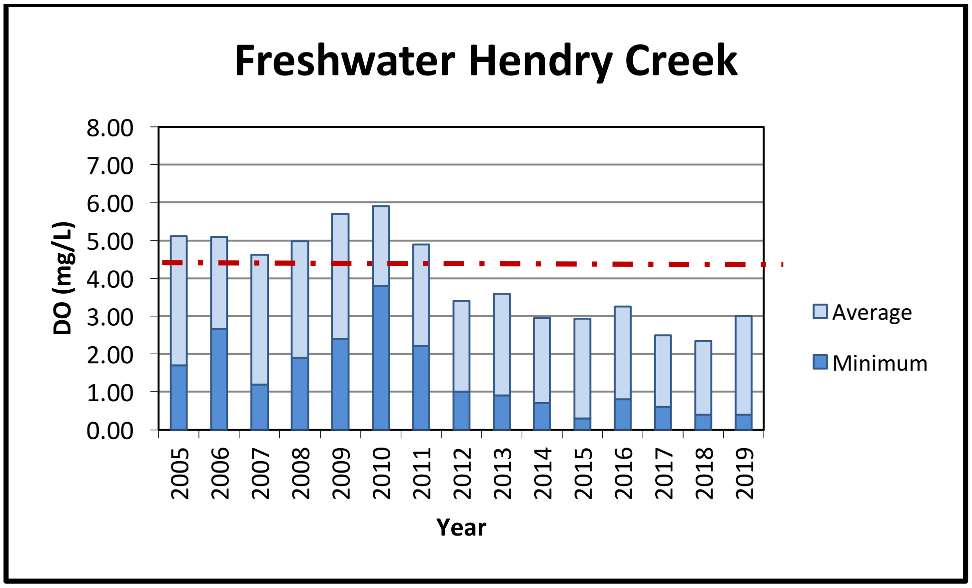
Between 2014 and 2019, average annual dissolved oxygen increased in Hendry Creek, Imperial River, and Estero River; and decreased in Six-Mile Cypress, Ten-Mile Canal and Spring Creek. Overall, the average of all freshwater watersheds decreased -0.91%. The monthly minimum dissolved oxygen decreased in Six-Mile Cypress, Hendry Creek, Ten-Mile Canal and Spring Creek; increased in Estero River; and stayed the same in the Imperial River.



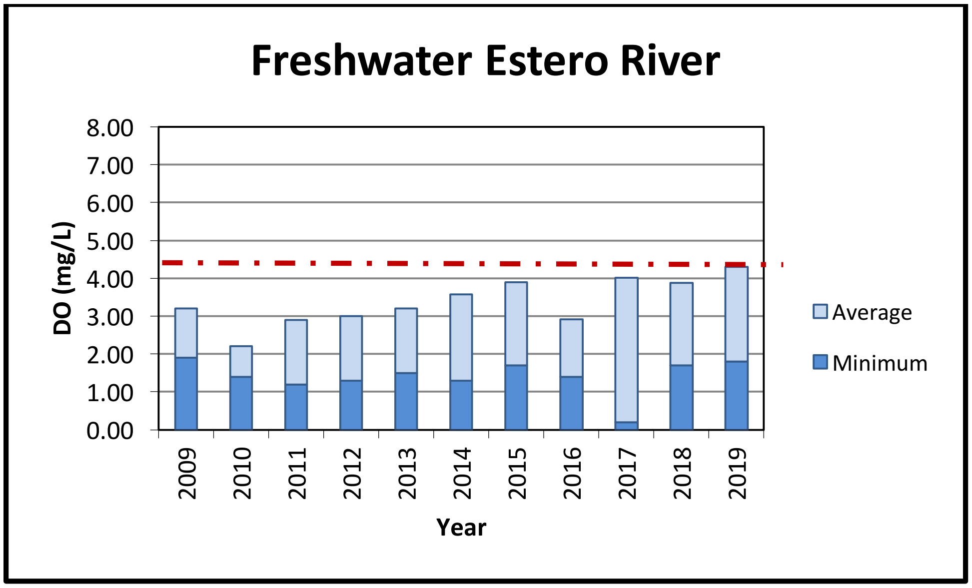
2014-2019 change			
Average	-13.99%		
Minimum	-25.00%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	3.7	2.0	September
2010	3.9	2.2	September
2011	3.4	1.6	July
2012	3.8	2.5	September
2013	3.4	2.2	July
2014	1.93	0.4	March
2015	1.89	0.2	November
2016	1.78	0.2	September
2017	1.34	0.2	July, September, October
2018	2.43	0.2	September, October
2019	1.66	0.3	February, September



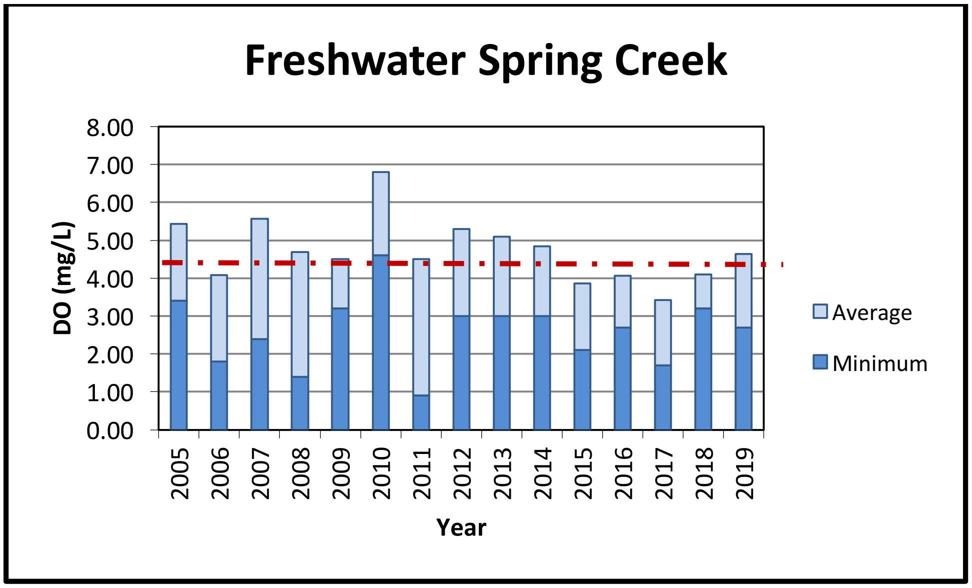
2014-2019 change			
Average	-10.22%		
Minimum	-62.50%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	6.4	3.7	June
2010	6.0	3.5	May
2011	5.1	3.0	July
2012	5.1	3.2	September
2013	4.8	2.8	August
2014	5.09	0.5	June
2015	4.58	0.4	August
2016	4.63	0.2	December
2007	4.53	0.5	May
2008	4.95	0.8	May
2019	4.57	0.3	June



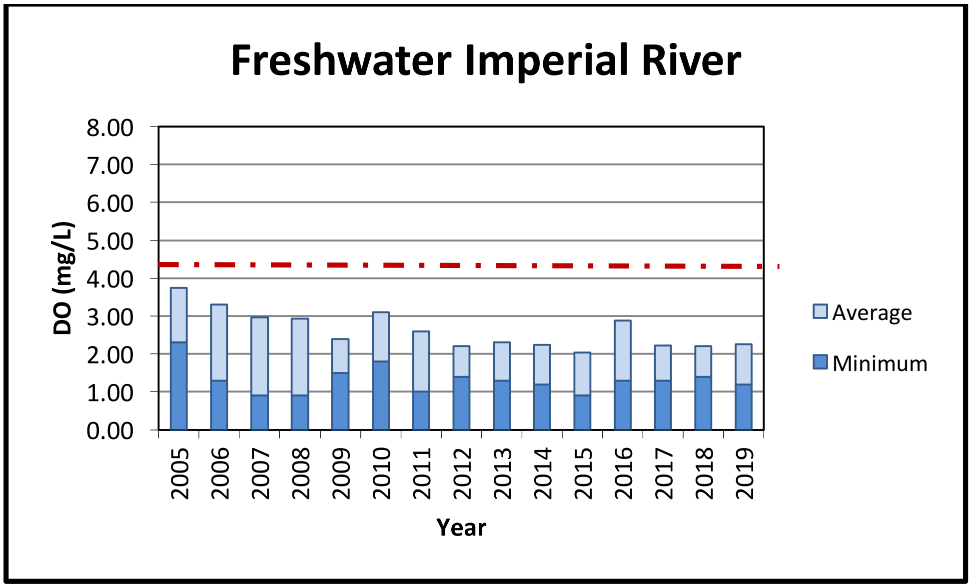
2014-2019 change			
Average	1.69%		
Minimum	-42.86%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	5.7	2.4	May
2010	5.9	3.8	May
2011	4.9	2.2	June
2012	3.4	1.0	May
2013	3.6	0.9	April
2014	2.96	0.7	May
2015	2.93	0.3	April
2016	3.26	0.8	August, September
2007	2.49	0.6	May
2008	2.33	0.4	April
2019	3.01	0.4	June



2014-2019 change			
Average	20.45%		
Minimum	38.46%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	3.2	1.9	December
2010	2.2	1.4	September
2011	2.9	1.2	July
2012	3.0	1.3	June
2013	3.2	1.5	September
2014	3.57	1.30	August
2015	3.9	1.70	October
2016	2.92	1.40	June
2017	4.02	0.20	September
2018	3.88	1.70	July
2019	4.30	1.80	October



2014-2019 change			
Average	- 4.33%		
Minimum	-10.00%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	4.5	3.2	June
2010	6.8	4.6	September
2011	4.5	0.9	July
2012	5.3	3.0	July
2013	5.1	3.0	December
2014	4.85	3.0	June
2015	3.87	2.1	April
2016	4.06	2.7	September
2017	3.43	1.7	September
2018	4.10	3.2	February, September, October
2019	4.64	2.7	October



2014-2019 change			
Average	0.89%		
Minimum	0%		
Year	**Mean**	**Minimum**	**Month of Minimum**
2009	2.4	1.5	December
2010	3.1	1.8	February
2011	2.6	1.0	May
2012	2.2	1.4	July
2013	2.3	1.3	May
2014	2.24	1.2	July
2015	2.03	0.9	July
2016	2.88	1.3	May
2007	2.23	1.3	May
2008	2.21	1.4	November
2019	2.26	1.2	June

Parameter: Fecal Coliform

Fecal coliform is a measure of bacteriological contamination of the water column based on the activity of *Escheria coli*, commensal bacteria of higher vertebrates. It is a surrogate measure for other more harmful bacteriological and viral contaminants associated with waste material from human and vertebrate fecal discharges. This parameter includes inputs from many environmental inputs of fecal waste including human sewage (from vessel holding tanks, septic tanks, land sludge spreading, and package and other sewage treatment plants), waste from livestock (including cattle and chickens), and waste from wild and feral animals. Fecal coliform can also be naturally high in association with active bird rookeries; therefore, a healthy estuary with normal animal activity will have a natural background level.

According to State of Florida standards, a measurement of more than 800 bacterial colonies per 100 mL on any single day of sampling or a monthly average of 200 colonies per 100 mL indicates impairment in Class III waters. Based on USEPA recommendations, Florida's fecal coliform standards were amended in the next year or two.

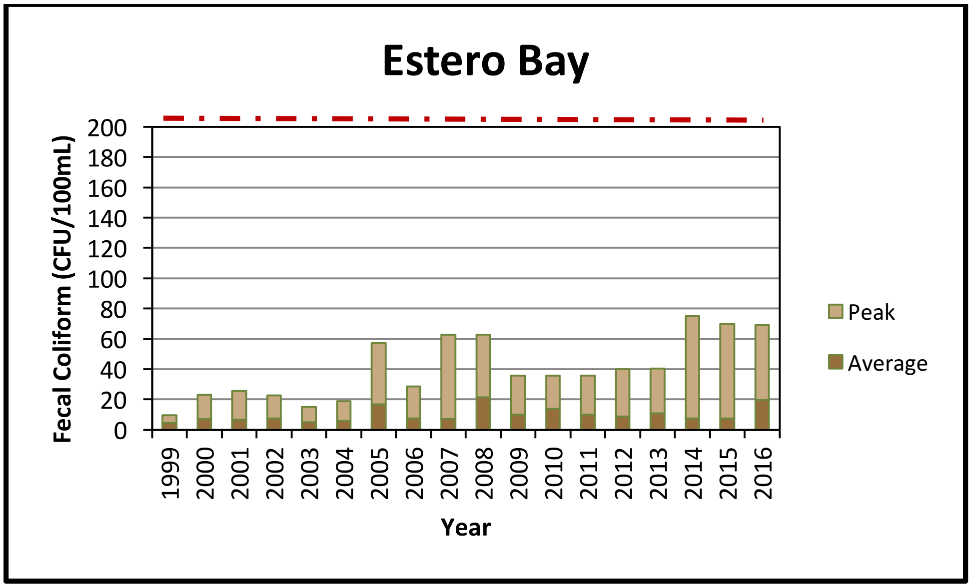
In 1986, based on additional studies, the USEPA shifted away from fecal coliform to recommending that *E. coli* and enterococci be used as the indicator organisms for human sewage and in 2012 the USEPA refined the 1986 recommendations for using *E. coli* and enterococci. The FDEP has recently changed standards to fit the 2012 recommendations. Florida's fecal coliform criteria were based on 1976 USEPA recommendations, which have since been updated twice by the USEPA. Recently, new bacteria criteria to replace the fecal coliform standards were developed by FDEP. These criteria adopt Recreational Water Quality Criterion (RWQC) promulgated by USEPA in 2012. This new RWQC is specific for *E. coli* and enterococci, rather than fecal coliform, a broader class of organisms. It was found that enterococci and *E. coli* are superior indicators of fecal contamination than simply fecal coliform, because a) the correlation between swimmer disease and bacteria levels is stronger for these specific bacteria than for the larger class of fecal coliform bacteria, and b) fecal coliform testing can also measure the presence of some bacteria that did not come from feces. *E. coli* will now be used for fresh waters, and enterococci will be used for saline waters. As a result, future Estero Bay State of the Bay reports will not have fecal coliform data for comparison and *E. coli* will be used for fresh waters, and enterococci will be used for saline waters.

The Lee County Environmental Laboratory provided the data for all fecal coliform analysis.

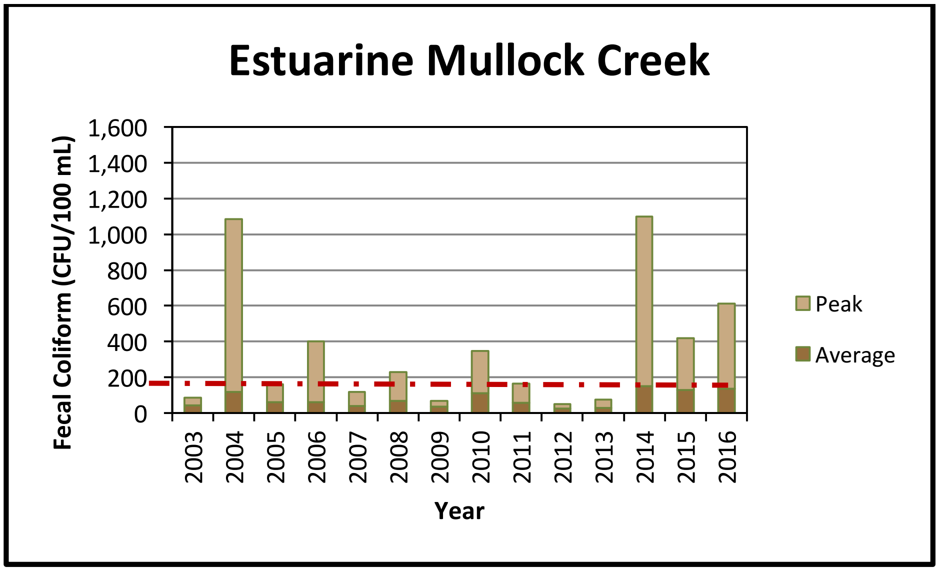
Fecal Coliform in Estuarine Systems

Between 2014 and 2016, average fecal coliform increased in Estero Bay and Estero River and decreased in all the other estuarine tributaries. There was however a major jump in Mullock Creek fecal coliform levels in the year 2014 that has begun to decline. The average estuarine increase was 5.8%. The peak monthly fecal coliform decreased in all estuarine. The average reduction was -49%.

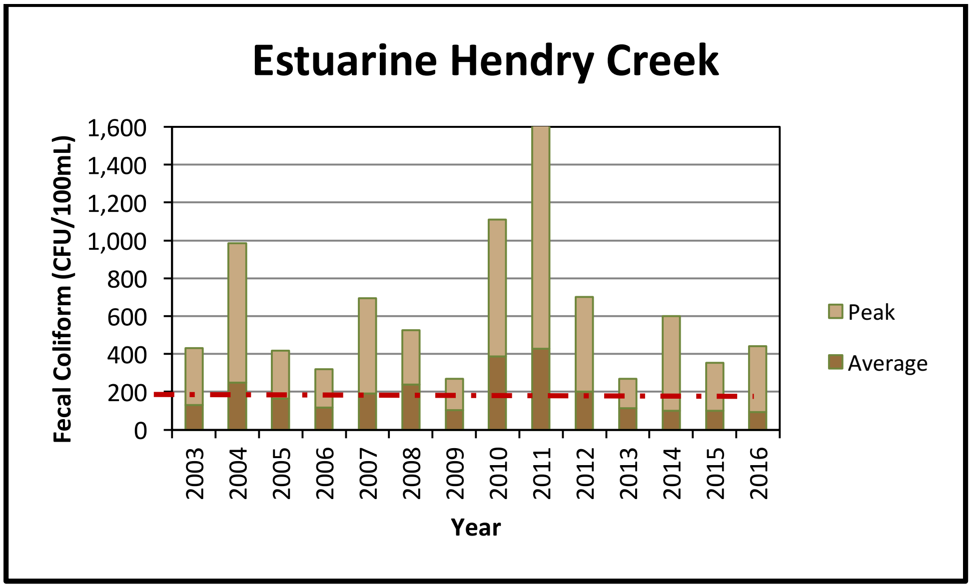
The most common peak months were January and June.



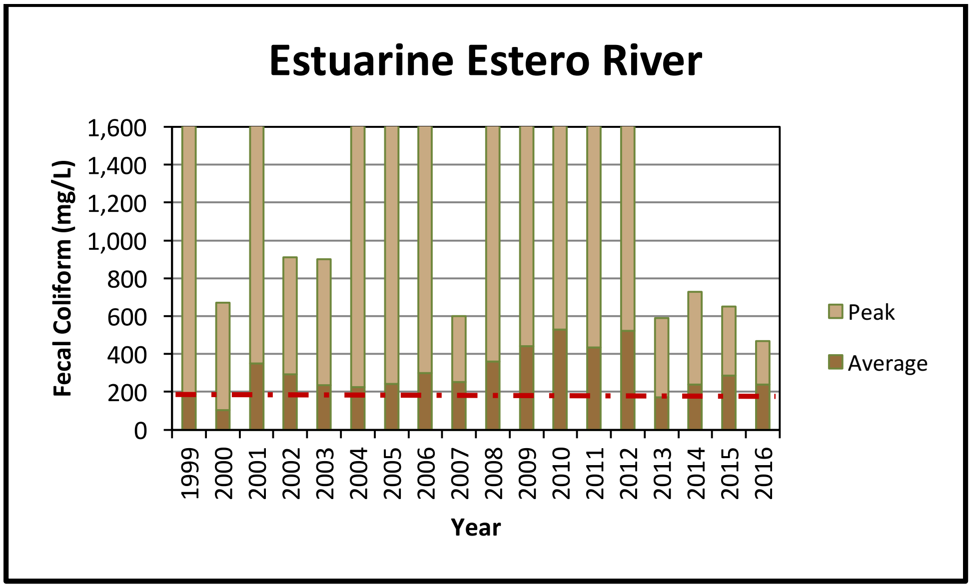
2014-2016 change			
Average	162.89%		
Peak	-8%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	10	36	June
2010	14	36	April
2011	10	36	October
2012	9	40	December
2013	11	40	July
2014	7.46	75	June
2015	7.45	70	September
2016	19.61	69	June



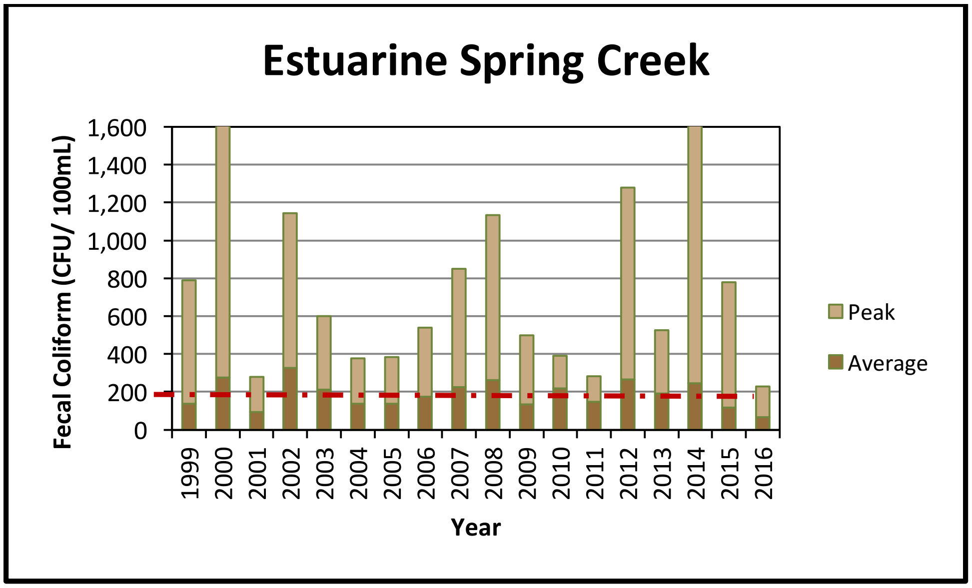
2014-2016 change			
Average	-9.49%		
Peak	-44.27%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	36	70	October
2010	112	347	August
2011	58	166	August
2012	25	49	December
2013	28	75	August
2014	151.36	1100	January
2015	129.75	420	August
2016	137.00	613	June



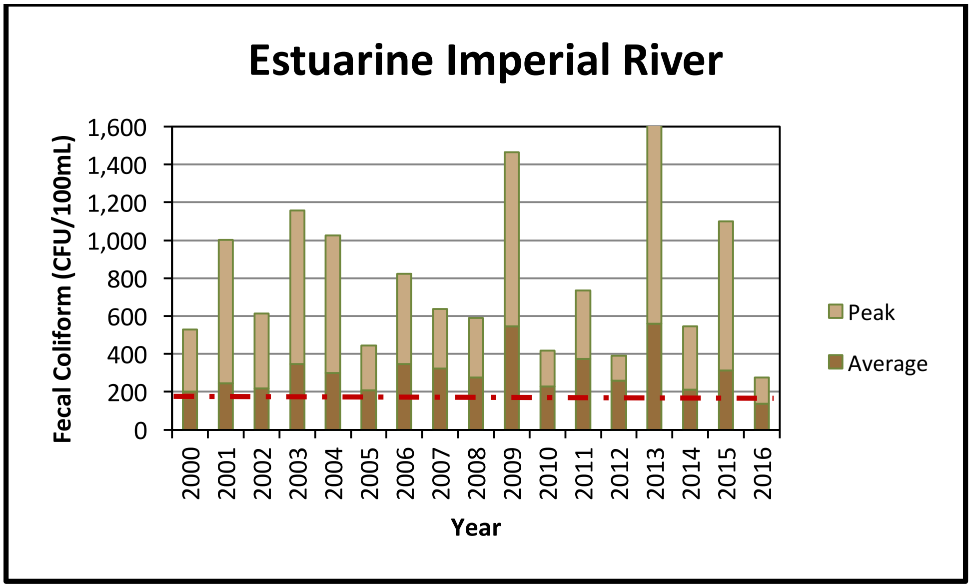
2014-2016 change			
Average	-8.49%		
Peak	-26.67		
Year	**Mean**	**Peak**	**Month of Peak**
2009	104	267	March
2010	388	1,110	February
2011	428	1,846	October
2012	201	700	June
2013	114	269	May
2014	100.15	600	August
2015	99.86	353	August
2016	91.83	440	May



2014-2016 change			
Average	1.02%		
Peak	-36.03%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	440.44	2,600	November
2010	529.73	3,100	June
2011	432.90	2,500	December
2012	524	6,600	February
2013	170.56	590	December
2014	236.92	730	January
2015	286.58	650	January
2016	239.33	467	June

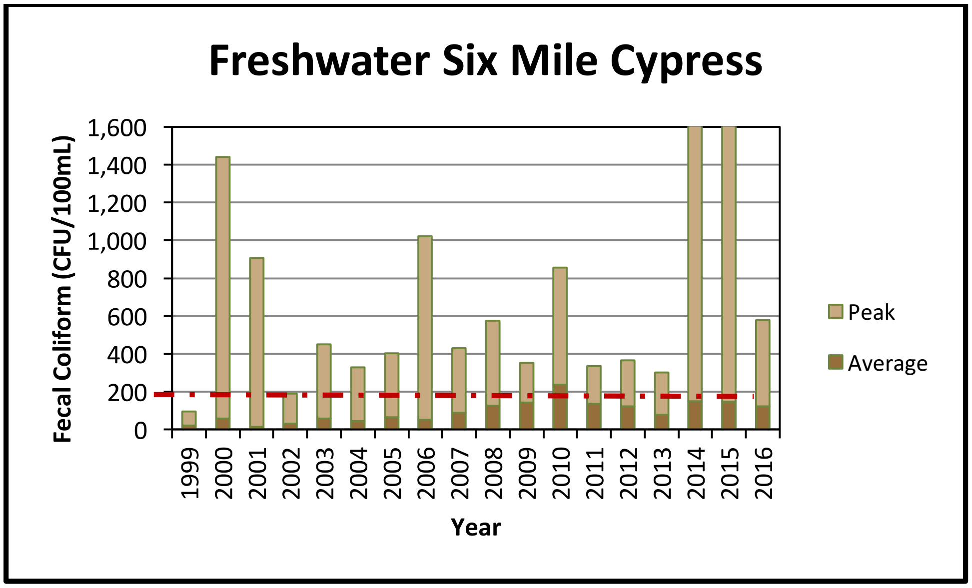


2014-2016 change			
Average	-72.60%		
Peak	-86.37%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	137	497	October
2010	206	391	September
2011	159	281	August
2012	293	1,280	June
2013	210	432	September
2014	246.33	1680	November
2015	116.80	780	March
2016	67.50	229	January

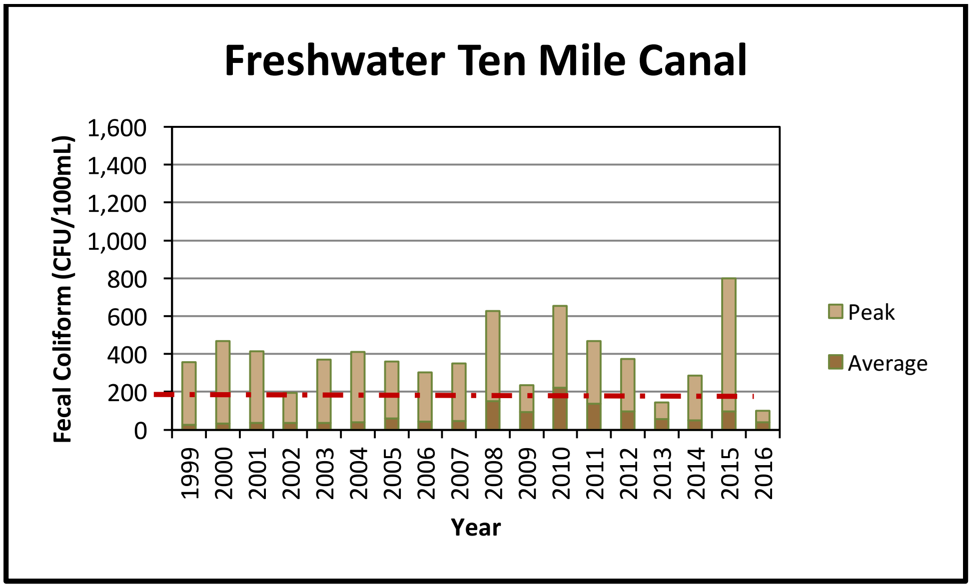


2014-2016 change			
Average	-38.56%		
Peak	-49.36%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	227	416	November
2010	373	734	November
2011	259	390	February
2012	560	4,538	June
2013	255	593	September
2014	153	547	September
2015	224.4	1100	March
2016	94	277	March

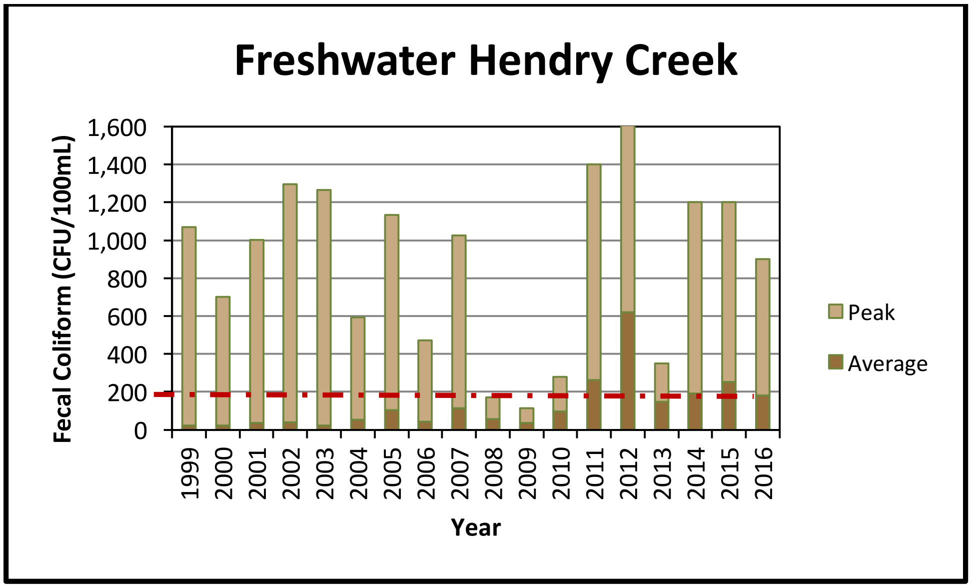
Between 2014 and 2016, average fecal coliform increased in Estero River, Mullock Creek, and Spring Creek; and decreased in Six-Mile Cypress, Ten Mile Canal, Hendry Creek, and Imperial River. The peak monthly fecal coliform increased in Estero River and Spring Creek and decreased in all other freshwater segments. All months were represented as peak months.



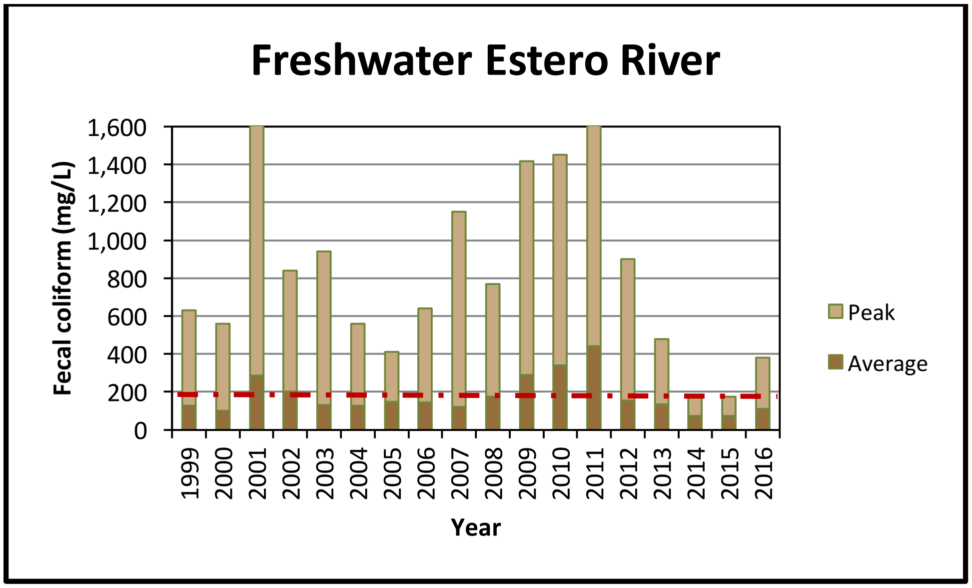
2014-2016 change			
Average	-17.58%		
Peak	-70.41%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	141	352	December
2010	222	855	August
2011	155	368	December
2012	93	233	May
2013	75	300	August
2014	149.75	1960	September
2015	147.31	1920	November
2016	123.42	580	February



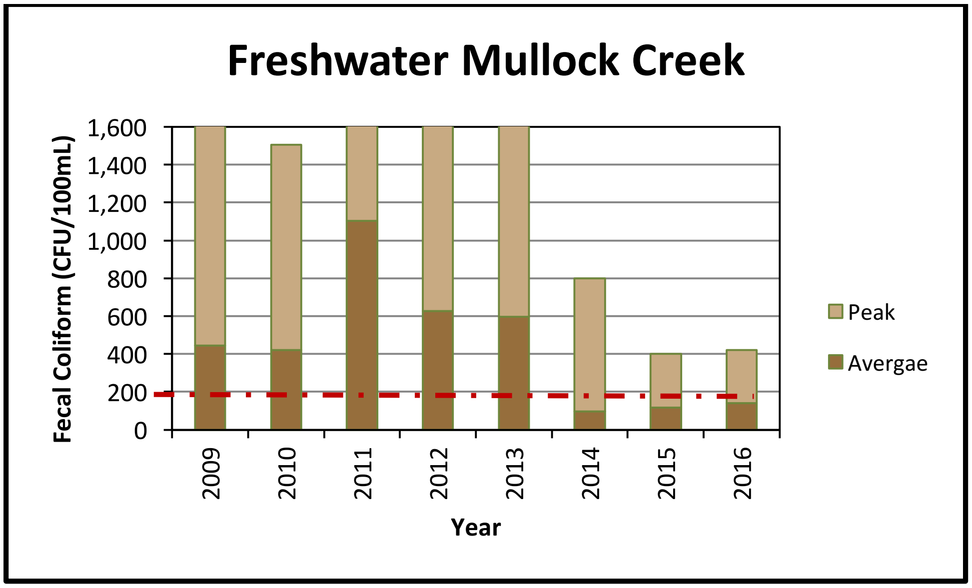
2014-2016 change			
Average	-16.55%		
Peak	-64.69%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	91	237	September
2010	208	654	June
2011	162	470	August
2012	75	207	April
2013	44	133	August
2014	46.68	286	June
2015	96.49	800	July
2016	40.62	101	January



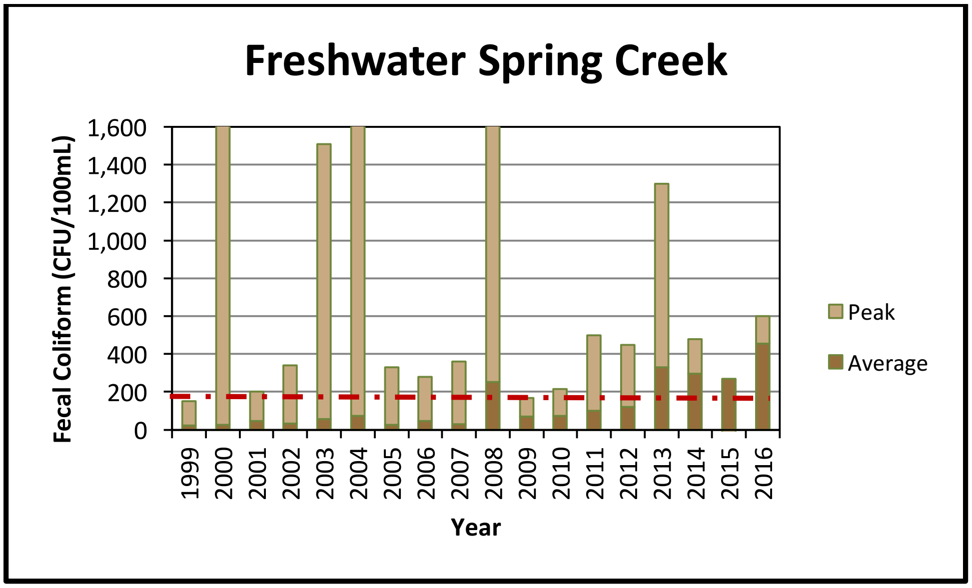
2014-2016 change			
Average	-5.73%		
Peak	-25.00%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	75	280	February
2010	264	1,400	November
2011	563	3,500	October
2012	141	350	November
2013	70	270	July
2014	191.48	1200	May
2015	252.84	1200	June
2016	180.50	900	June



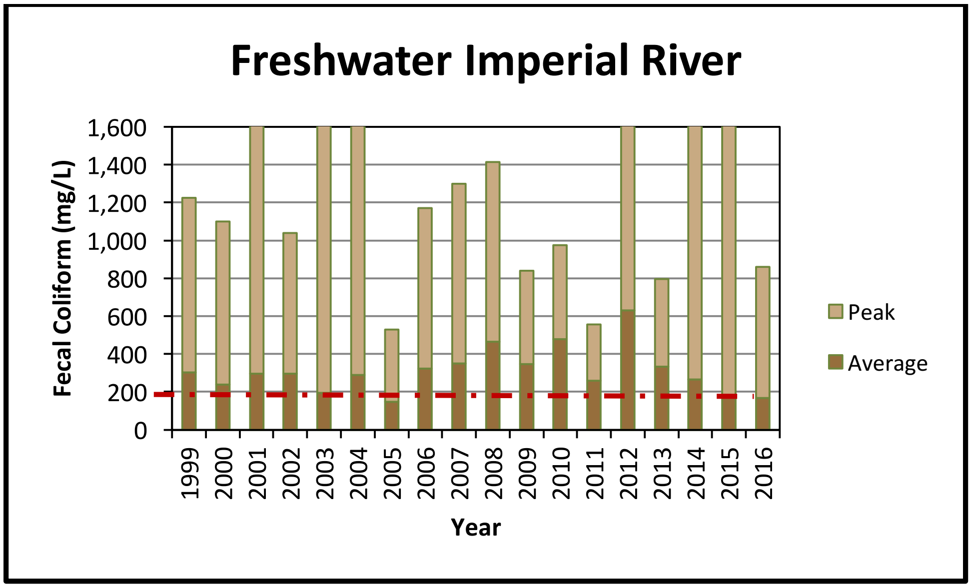
2014-2016 change			
Average	51.30%		
Peak	132.07%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	289.92	539	February
2010	339.08	651	November
2011	442.29	1386	October
2012	153.25	497	November
2013	135.38	161	July
2014	73.58	237	September
2015	74.13	289	March
2016	111.33	550	June



2014-2016 change			
Average	47.14%		
Peak	-47.50%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	445	1,705	September
2010	422	1,507	August
2011	1,105	3,260	July
2012	628	1,990	July
2013	595	2,122	December
2014	96.27	800	August
2015	115.87	400	December
2016	141.64	420	April



2014-2016 change			
Average	53.47%		
Peak	25.00%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	66	168	August
2010	68	214	June
2011	123	500	July
2012	249	1,300	February
2013	219	530	April
2014	295.46	480	May
2015	269.31	251	June
2016	453.43	600	May



2014-2016 change			
Average	-26%		
Peak	-71.33%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	382	840	November
2010	476	974	September
2011	360	1,252	February
2012	559	1,866	July
2013	284	888	January
2014	153	3000	September
2015	224	3900	February
2016	94	860	January

Parameter: Total Nitrogen

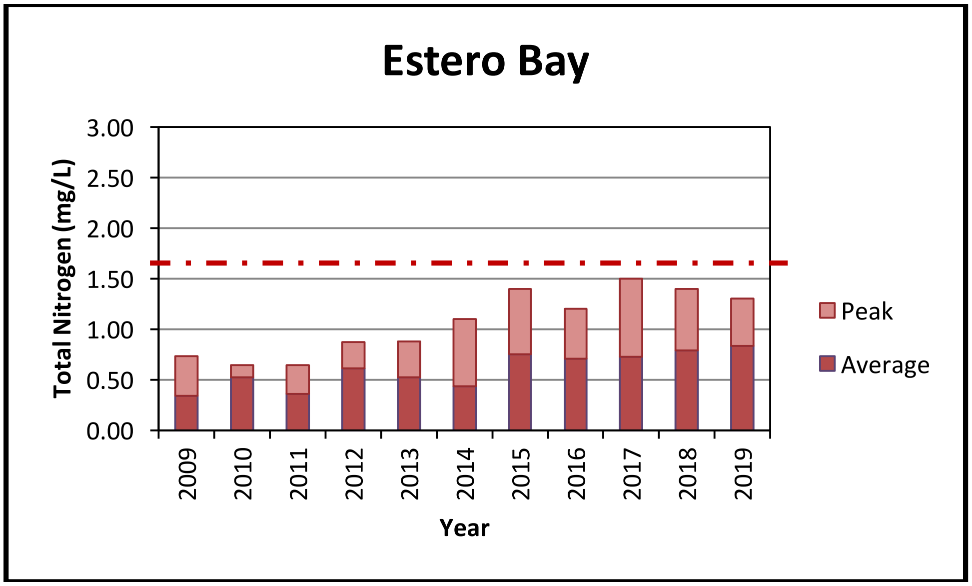
Total nitrogen (TN) is a measure of all dissolved nitrogen in the water column, including nitrates, nitrites and ammonia. It is a resultant parameter that synthesizes many environmental inputs of nitrogen, including the dissolved organics from algae, sea grass, mangrove, and phytoplankton productivity. Also included are anthropogenic inputs, such as from agriculture and fertilizer over-application, which may run off into water bodies.

The USEPA Nutrient Criteria for this area, Aggregate Ecoregion XII, the Southeastern Coastal Plain, is 0.9 mg/L for rivers and streams (USEPA 2000). While the state of Florida has in the past had only narrative criteria for nutrients in water bodies, in response to a lawsuit by the Sierra Club, the Conservancy of Southwest Florida, the Florida Wildlife Federation, and others, USEPA recently issued a determination letter requiring the state to determine and adopt numeric nutrient standards for nitrogen and phosphorus in water bodies. USEPA has stated that the state must propose nutrient limits by January 14, 2010 and the resultant rule must be finalized by October of 2010.

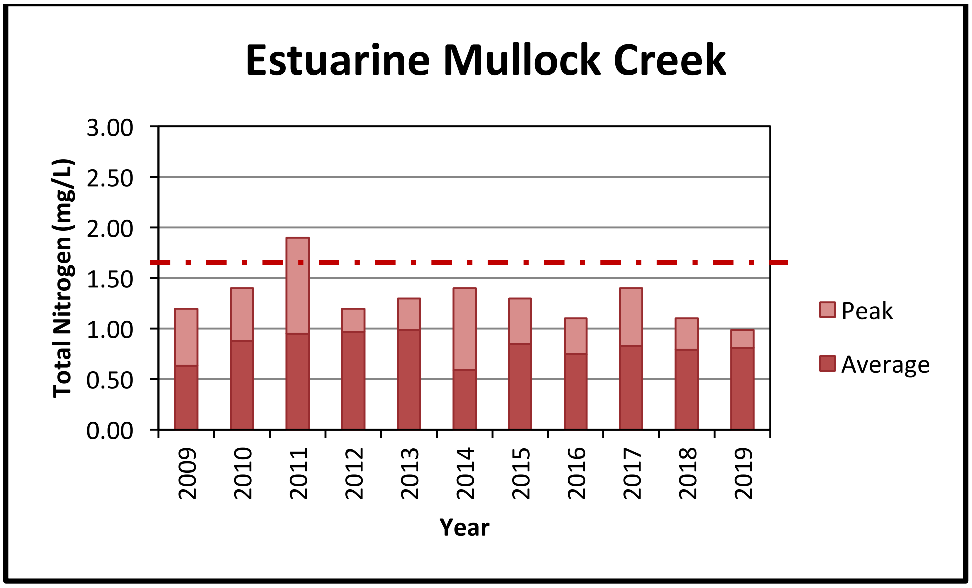
The southwest Florida region has been proactive in addressing nutrient pollution at the local level. The Lower West Coast Watersheds Committee of the Southwest Florida Regional Planning Council developed a resolution regarding fertilizer regulation, which was adopted by Lee County as ordinance No. 08-08 in May of 2008. The ordinance regulates the nitrogen and phosphorus content of landscaping fertilizers, establishes a fertilizer black-out period during the rainy season, and establishes a 10-foot no-fertilizer buffer around waterbodies. Most municipalities in Lee County have followed suit, adopting the Lee County standards in whole, or some variation. The Lee County Environmental Laboratory provided the data for all total nitrogen analysis.

Total Nitrogen in Estuarine Systems

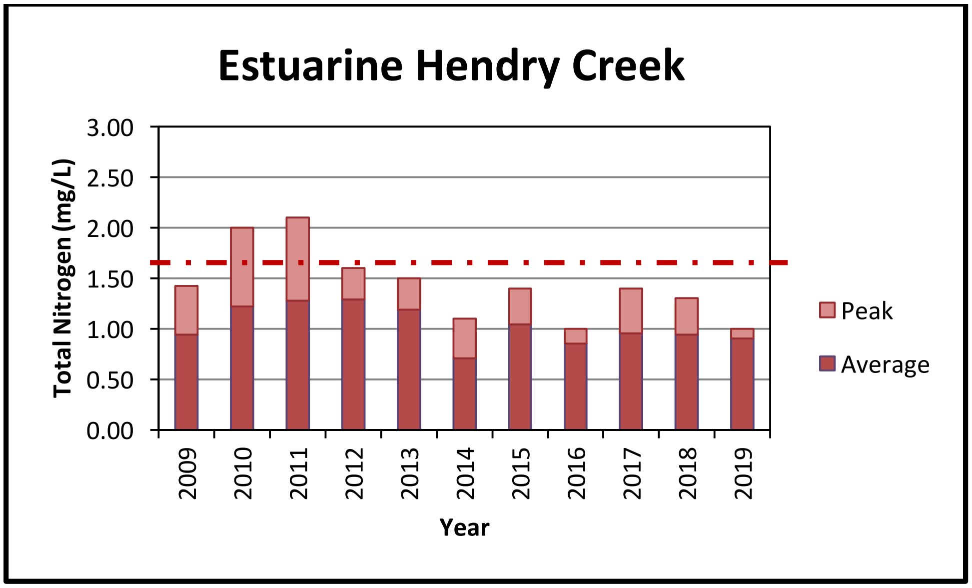
Between 2014 and 2019, average annual total nitrogen increased in all estuarine segments, however the geometric mean nitrogen standards were not exceeded. The average increase was overall increase was 35.9 %. The peak monthly nitrogen decreased in Mullock Creek, Hendry Creek, Spring Creek, and Imperial River; increased in Estero Bay; and stayed the same in Estero River, for an average of -13.63%. The most common peak months were March, April, and June; however, all months were represented.



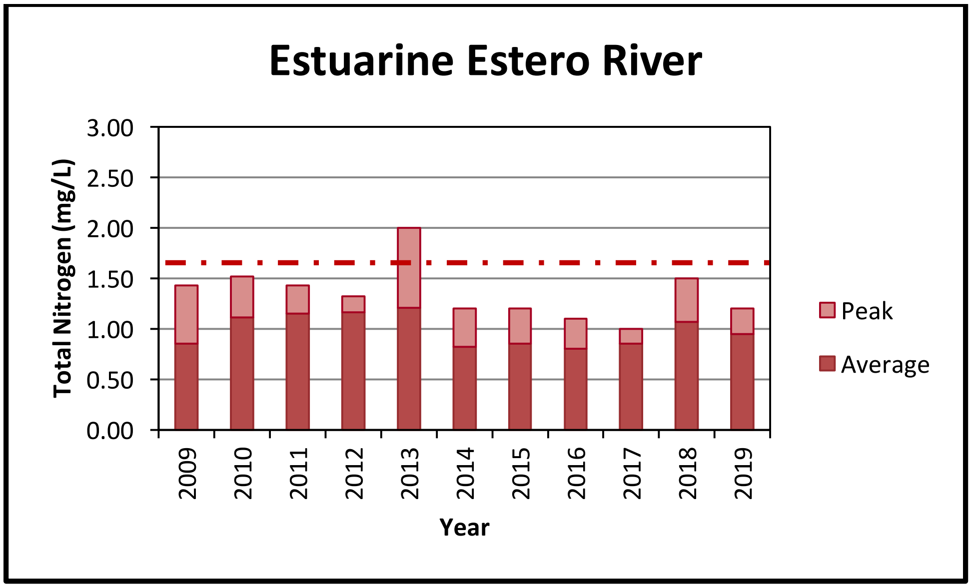
2014-2019 change			
Average	92.49%		
Peak	18.18%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.34	0.73	December
2010	0.52	0.64	August
2011	0.36	0.64	August
2012	0.61	0.87	September
2013	0.52	0.88	September
2014	0.43	1.1	January
2015	0.75	1.4	September
2016	0.70	1.2	November
2017	0.73	1.5	October
2018	0.79	1.4	June
2019	0.83	1.3	January



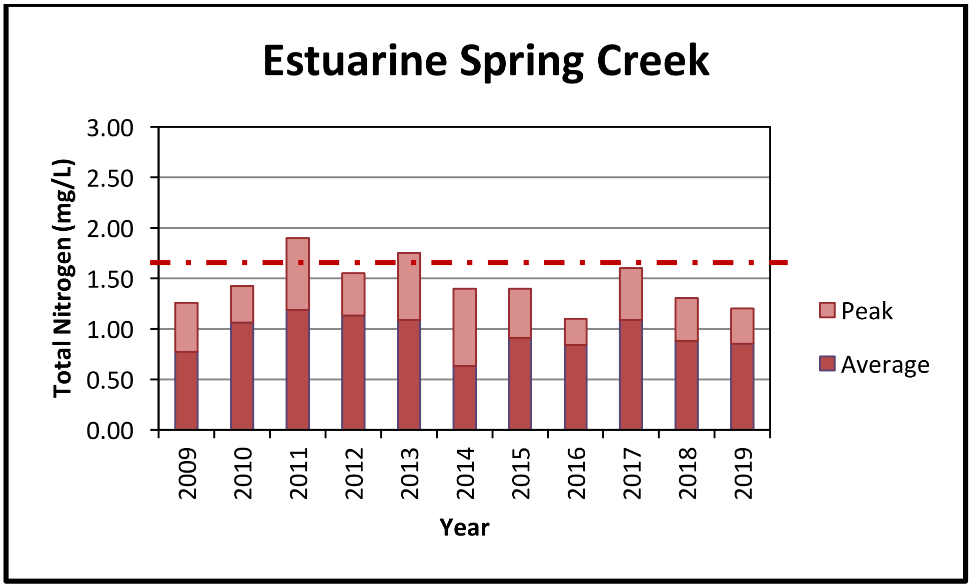
2014-2019 change			
Average	38.64%		
Peak	-50.44%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.63	1.20	December
2010	0.88	1.40	August
2011	0.95	1.90	October
2012	0.97	1.20	October
2013	0.99	1.30	December
2014	0.59	1.4	January
2015	0.85	1.3	December
2016	0.75	1.1	April
2017	0.83	1.4	September
2018	0.79	1.1	May
2019	0.81	0.99	February



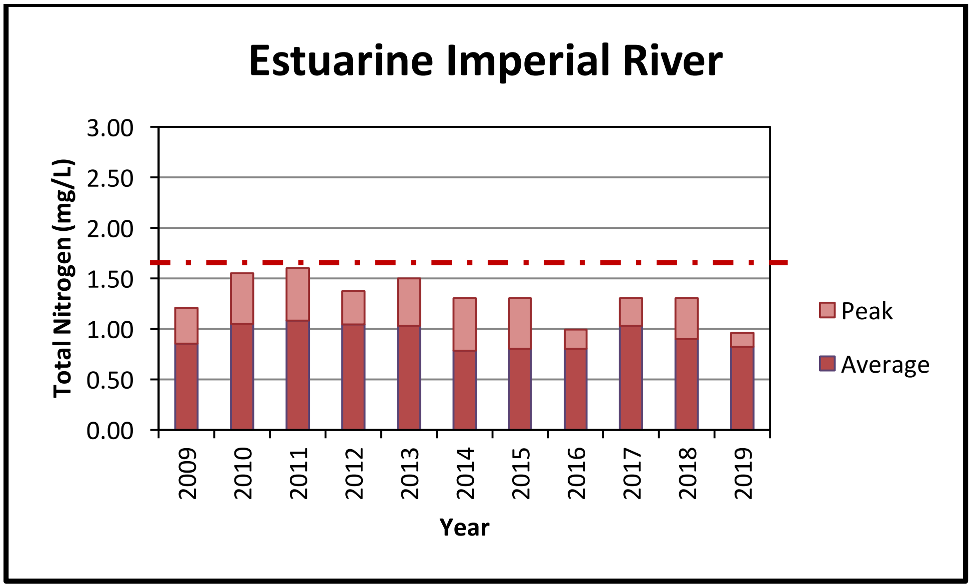
2014-2019 change			
Average	28.37%		
Peak	-9.09%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.94	1.42	December
2010	1.22	2.00	August
2011	1.28	2.10	July
2012	1.29	1.60	July
2013	1.19	1.50	May
2014	0.71	1.1	April
2015	1.05	1.4	June
2016	0.86	1.0	December
2017	0.96	1.4	June
2018	0.94	1.3	April
2019	0.91	1.0	May



2014-2019 change			
Average	15.85%		
Peak	0.0%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.85	1.43	October
2010	1.11	1.52	September
2011	1.15	1.43	July
2012	1.16	1.32	February
2013	1.21	2.00	September
2014	0.82	1.2	August
2015	0.85	1.2	August
2016	0.80	1.1	June
2017	0.85	1.0	September
2018	1.07	1.5	May
2019	0.95	1.2	April

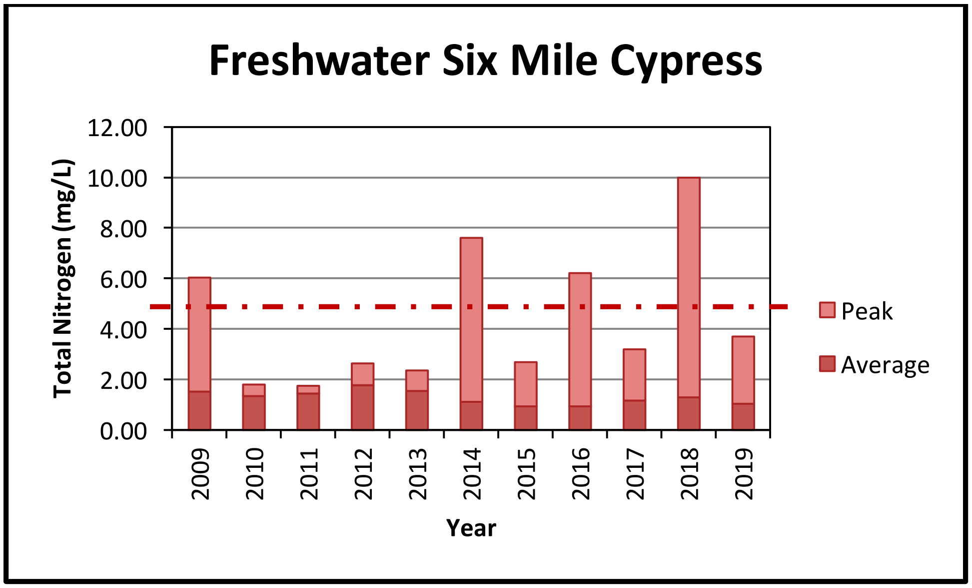


2014-2019 change			
Average	34.92%		
Peak	-14.29%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.77	1.26	January
2010	1.06	1.42	January
2011	1.19	1.90	November
2012	1.13	1.55	July
2013	1.09	1.75	September
2014	0.63	1.4	February
2015	0.91	1.4	December
2016	0.84	1.1	May
2017	1.09	1.6	March
2018	0.88	1.3	April
2019	0.85	1.2	March

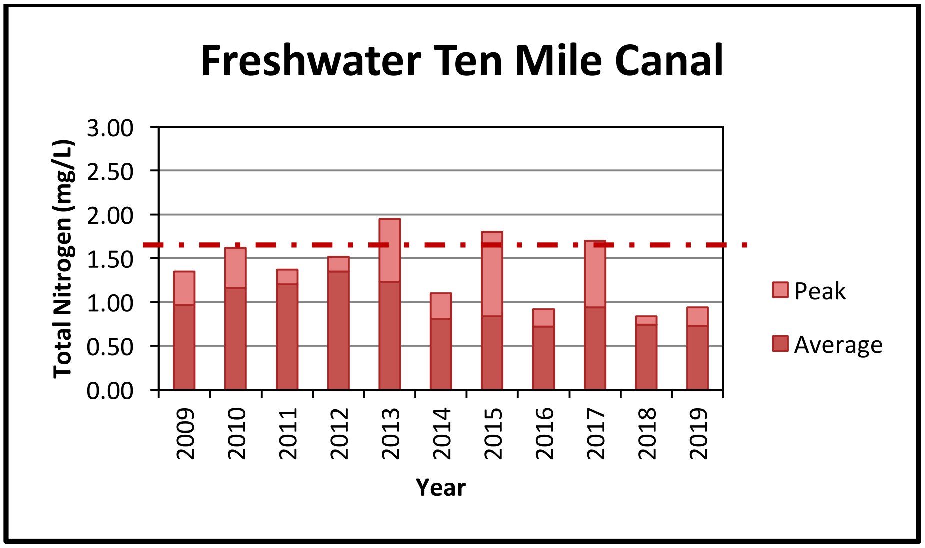


2014-2019 change			
Average	5.13%		
Peak	-26.15%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.85	1.21	June
2010	1.05	1.55	September
2011	1.08	1.60	October
2012	1.04	1.37	October
2013	1.03	1.50	September
2014	0.78	1.3	March
2015	0.80	1.3	August
2016	0.80	0.99	July
2017	1.03	1.3	March, June
2018	0.90	1.3	May
2019	0.82	0.96	January

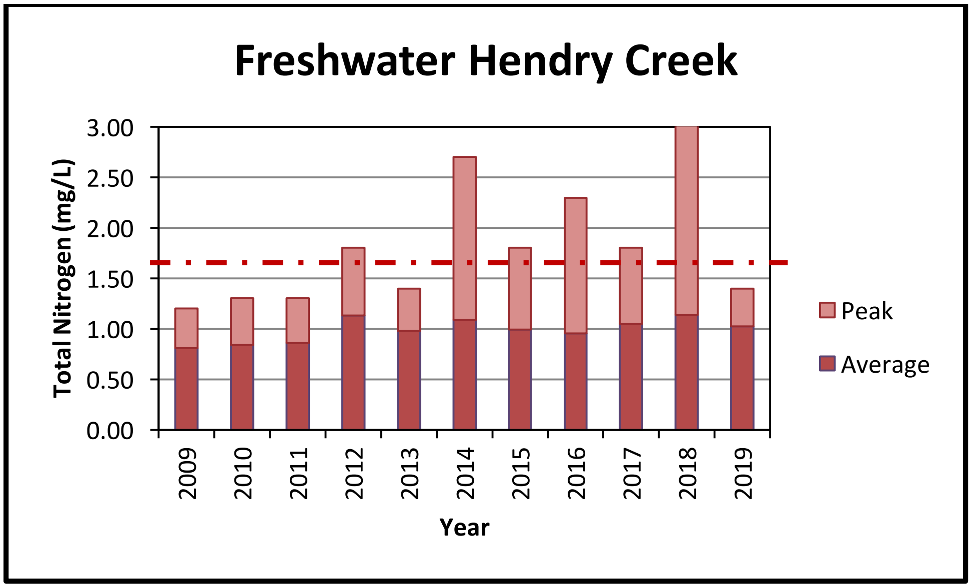
Between 2014 and 2019, average annual total nitrogen increased in Mullock Creek and Spring Creek and decreased in all other freshwater segments. Overall, the average decrease was small at -.97%. The peak monthly total nitrogen decreased in all freshwater segments but had an average of -32.23% decrease. The most common peak month were April and May. All months except July and November were represented.



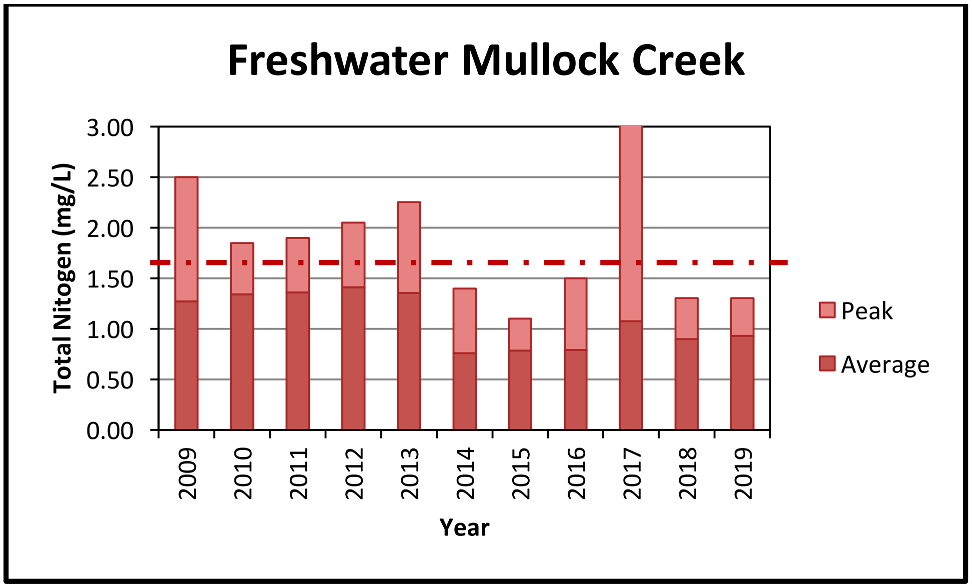
2014-2019 change			
Average	-7.32%		
Peak	-51.32%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	1.52	6.04	April
2010	1.34	1.80	June
2011	1.46	1.75	April
2012	1.78	2.63	April
2013	1.55	2.35	April
2014	1.12	7.6	May
2015	0.95	2.7	May
2016	0.94	6.2	December
2017	1.17	3.2	March
2018	1.30	10.0	April
2019	1.04	3.7	May



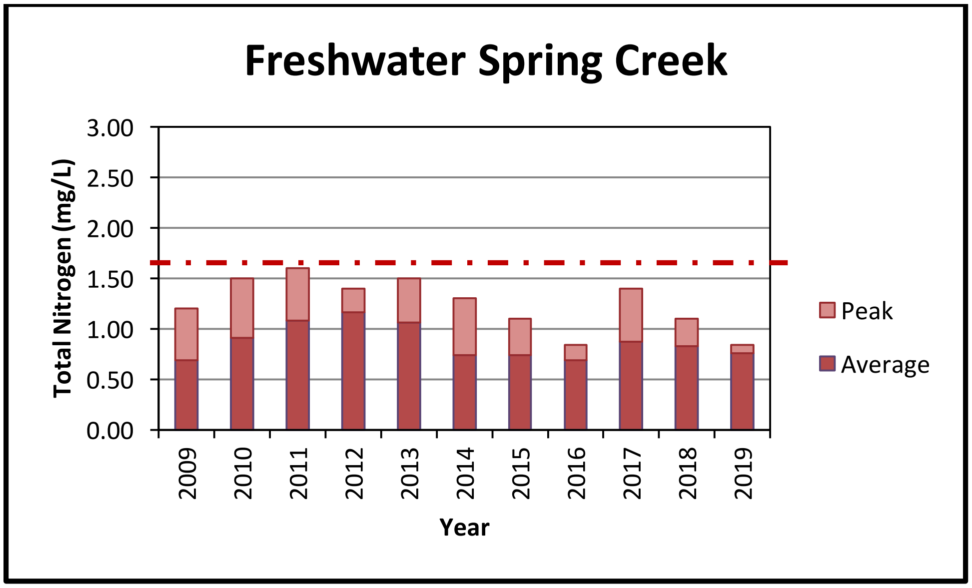
2014-2019 change			
Average	-9.88%		
Peak	-14.55%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.97	1.35	October
2010	1.16	1.62	June
2011	1.20	1.37	November
2012	1.35	1.52	November
2013	1.23	1.95	September
2014	0.81	1.1	March
2015	0.84	1.8	January
2016	0.72	0.92	April
2017	0.94	1.7	May
2018	0.74	0.84	June
2019	0.73	0.94	February



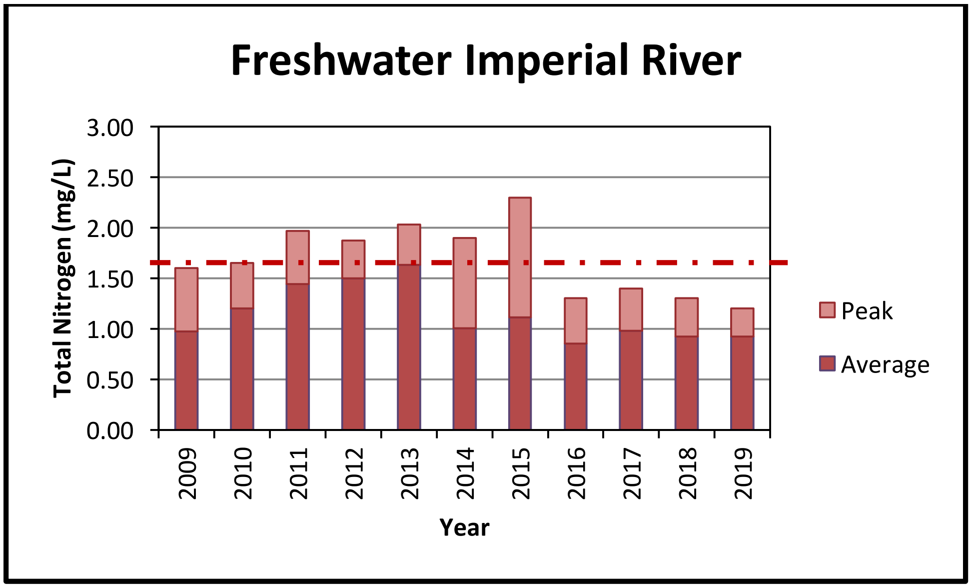
2014-2019 change			
Average	-6.06%		
Peak	-48.15%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.81	1.20	November
2010	0.84	1.30	August
2011	0.86	1.30	February
2012	1.13	1.80	June
2013	0.98	1.40	December
2014	1.09	2.7	May
2015	0.99	1.8	October
2016	0.95	2.3	April
2017	1.05	1.8	December
2018	1.14	3.7	June
2019	1.02	1.4	January



2014-2019 change			
Average	23.18%		
Peak	-7.14%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	1.27	2.50	October
2010	1.34	1.85	September
2011	1.36	1.90	December
2012	1.41	2.05	September
2013	1.35	2.25	September
2014	0.76	1.4	March
2015	0.79	1.1	August
2016	0.79	1.5	September
2017	1.08	4.2	May
2018	0.90	1.3	May
2019	0.93	1.3	January



2014-2019 change			
Average	2.70%		
Peak	-35.38%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.69	1.20	June
2010	0.91	1.50	September
2011	1.08	1.60	June
2012	1.16	1.40	June
2013	1.06	1.50	September
2014	0.74	1.3	March
2015	0.74	1.1	August
2016	0.69	0.84	September
2017	0.87	1.4	June
2018	0.83	1.1	April
2019	0.76	0.84	January



2014-2019 change			
Average	-8.46%		
Peak	-36.84%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.97	1.60	July
2010	1.20	1.65	December
2011	1.44	1.97	October
2012	1.50	1.87	October
2013	1.63	2.03	October
2014	1.01	1.9	March
2015	1.12	2.3	April
2016	0.86	1.3	April
2017	0.98	1.4	February
2018	0.92	1.3	April
2019	0.92	1.2	March

Parameter: Total Phosphorus

Total phosphorus (TP) is a measure of all dissolved phosphorus in the water column, including phosphates. It is a resultant parameter that synthesizes many environmental inputs of phosphates. The USEPA Nutrient Criteria for this area, Aggregate Ecoregion XII, the Southeastern Coastal Plain, is 40.0 µg/L for rivers and streams (USEPA 2000), which is equivilent to 0.04 mg/L. As discussed above, the state of Florida is in the process of developing numeric criteria for this nutrient.

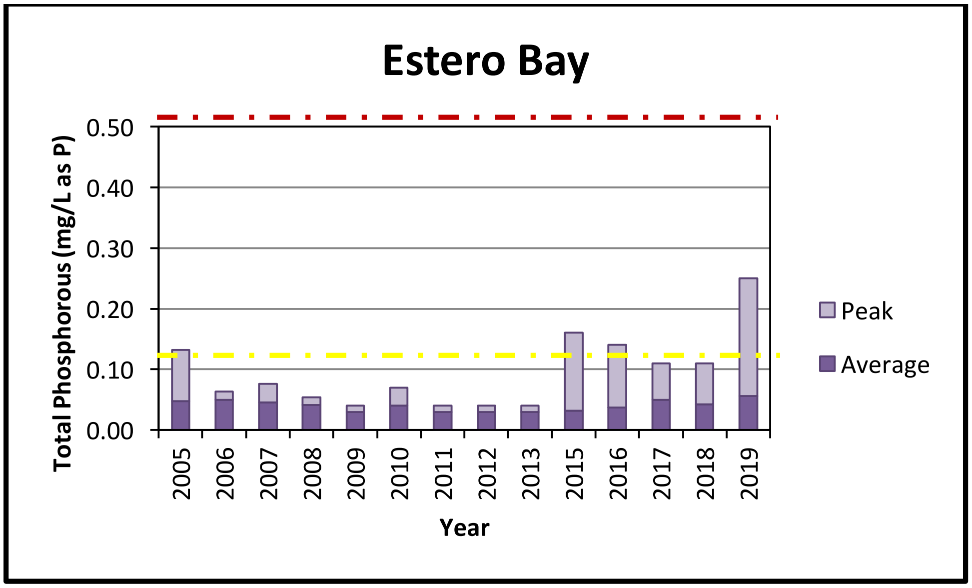
TP, in and of itself, does not identify the source phosphorus in the water column. The main contributor is stormwater runoff containing excess fertilizer from residential and agricultural sources. The fertilizer regulations noted above are intended to help reduce these inputs.

Because phosphorus standards were not adopted before the last water quality assessment conducted for Estero Bay basin, no such map is available to date.

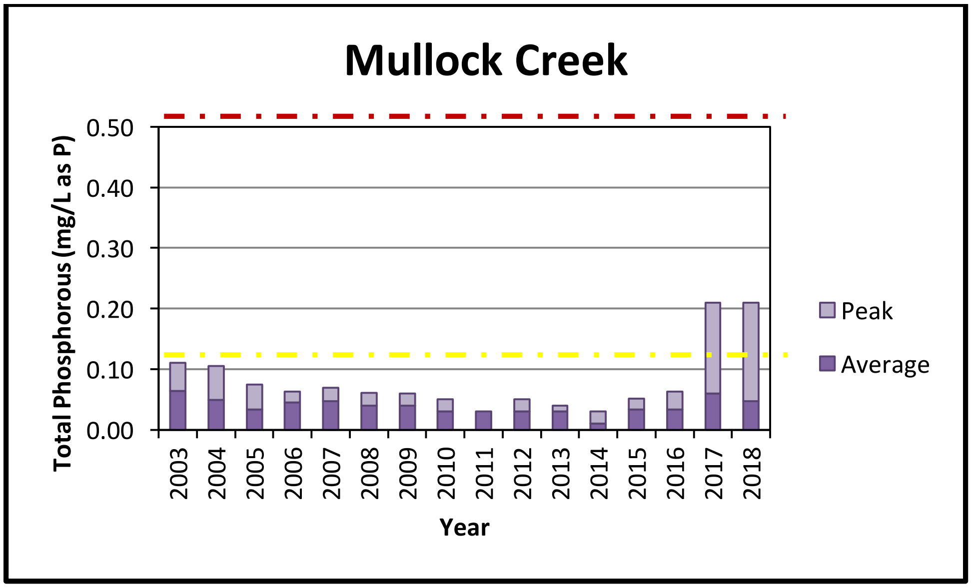
The Lee County Environmental Laboratory provided the data for all total phosphorus analysis.

Total Phosphorus in Estuarine Systems

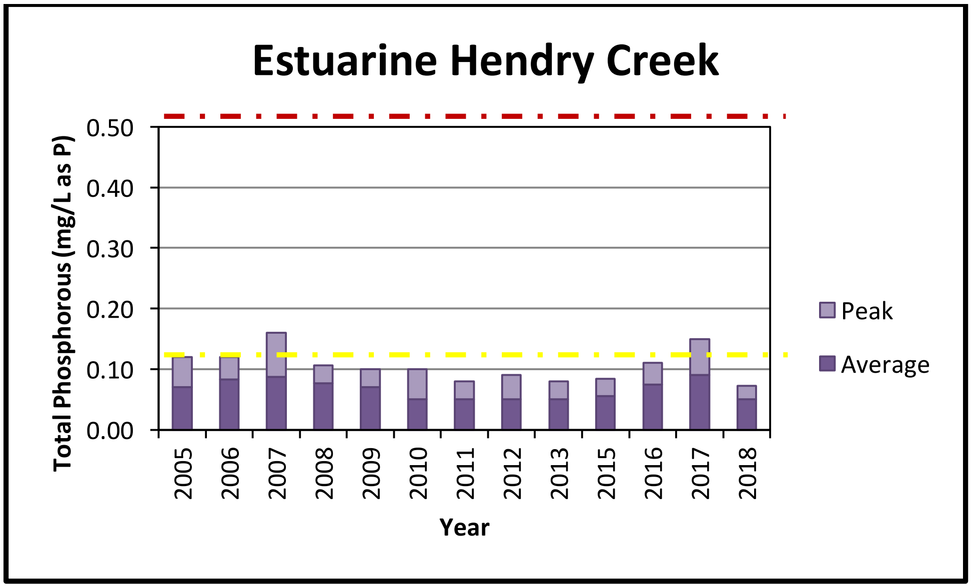
Between 2015 and 2019, average annual total phosphorus increased in all estuarine segments except Hendry Creek which decreased and Spring Creek which remained the same. The average increase was 51.04%. The peak monthly total phosphorus increased in all estuarine segments except Imperial River, Hendry Creek, and Spring Creek, for an average of -22.22 % decrease. Data for 2014 was not available for all segments. The most common peak month was June, followed by April.



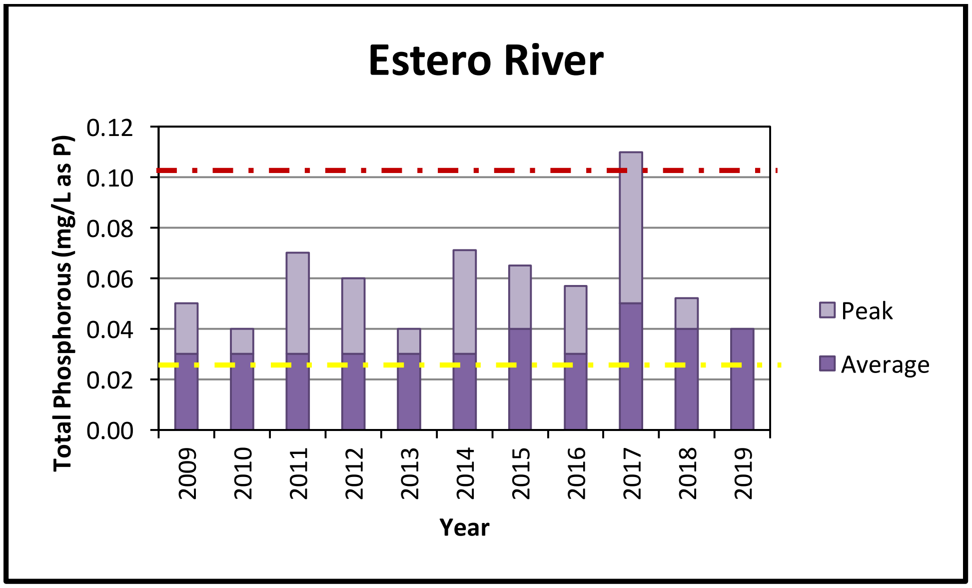
2015-2019 change			
Average	77.27%		
Peak	56.25%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.03	0.04	November
2010	0.04	0.07	December
2011	0.03	0.04	September
2012	0.03	0.04	November
2013	0.03	0.04	September
2015	0.03	0.16	February
2016	0.04	0.14	November
2017	0.05	0.11	January
2018	0.04	0.11	August
2019	0.06	0.25	January



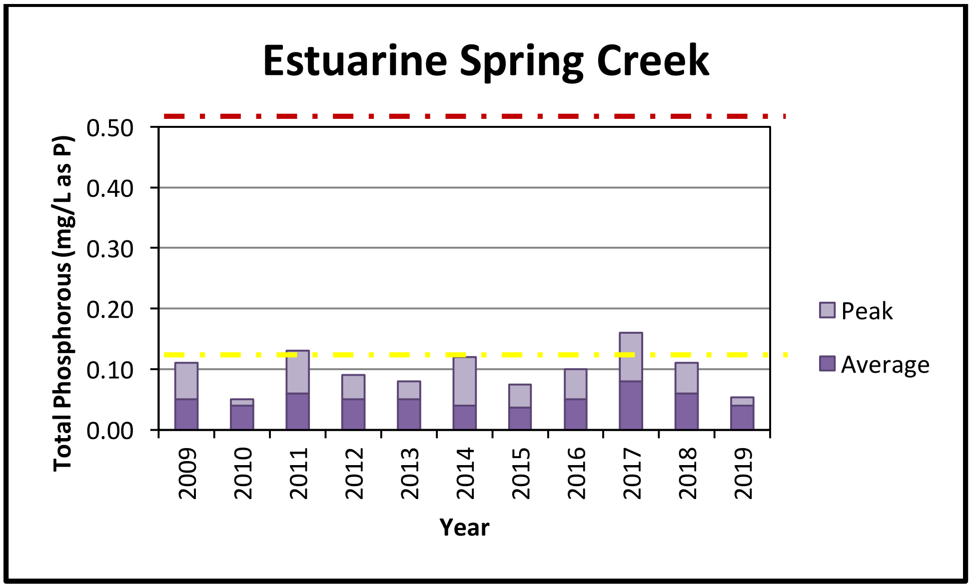
2014-2018 change			
Average	366.67%		
Peak	600%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.04	0.06	August
2010	0.03	0.05	June
2011	0.03	0.03	December
2012	0.03	0.05	June
2013	0.03	0.04	June
2014	0.01	0.032	December
2015	0.03	0.05	August
2016	0.03	0.06	September
2017	0.06	0.21	October
2018	0.05	0.21	May



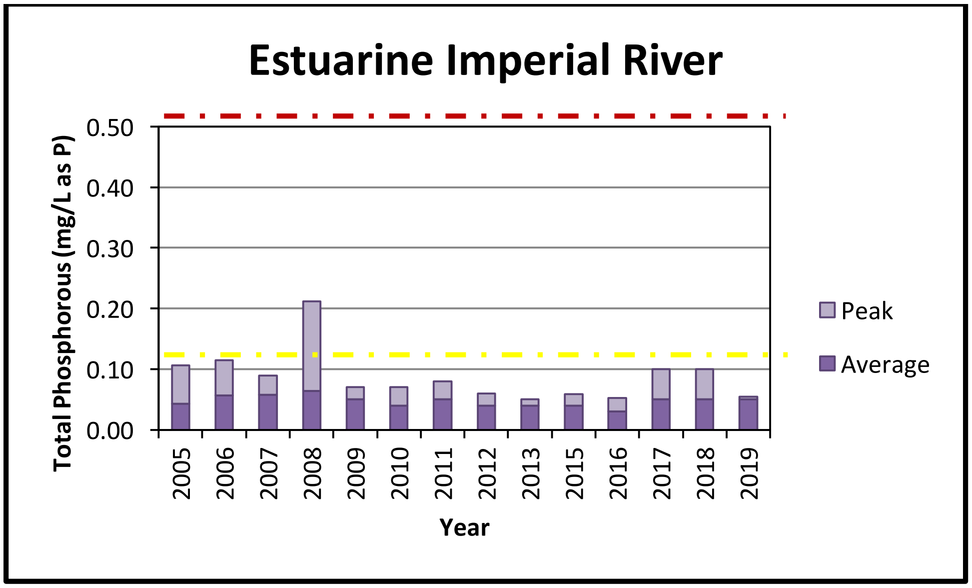
2015-2018 change			
Average	-9.09%		
Peak	-14.29%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.07	0.10	May
2010	0.05	0.10	June
2011	0.05	0.08	July
2012	0.05	0.09	September
2013	0.05	0.08	May
2015	0.06	0.084	June
2016	0.08	0.11	June
2017	0.09	0.15	June
2018	0.05	0.072	April



2014-2019 change			
Average	33.33%		
Peak	38.03%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.03	0.05	September
2010	0.03	0.04	June
2011	0.03	0.07	June
2012	0.03	0.06	June
2013	0.03	0.04	June
2014	0.02	0.071	June
2015	0.03	0.065	March
2016	0.03	0.057	June
2017	0.05	0.11	June
2018	0.05	0.052	October
2019	0.03	0.98	April

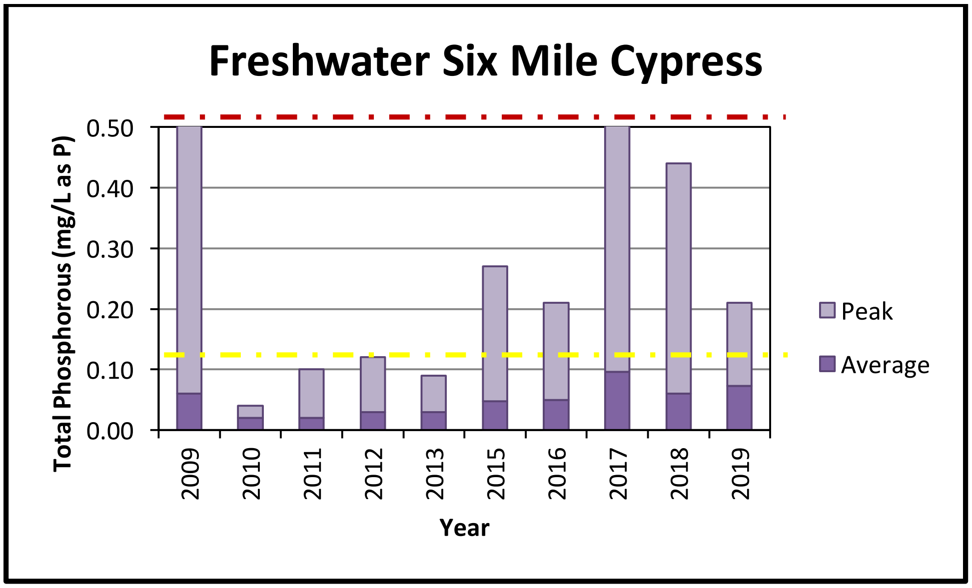


2014-2019 change			
Average	0%		
Peak	-55.83%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.05	0.11	January
2010	0.04	0.05	August
2011	0.06	0.13	January
2012	0.05	0.09	May
2013	0.05	0.08	September
2014	0.04	0.12	April
2015	0.04	0.075	April
2016	0.05	0.1	April
2017	0.08	0.17	April
2018	0.06	0.11	February
2019	0.04	0.053	January

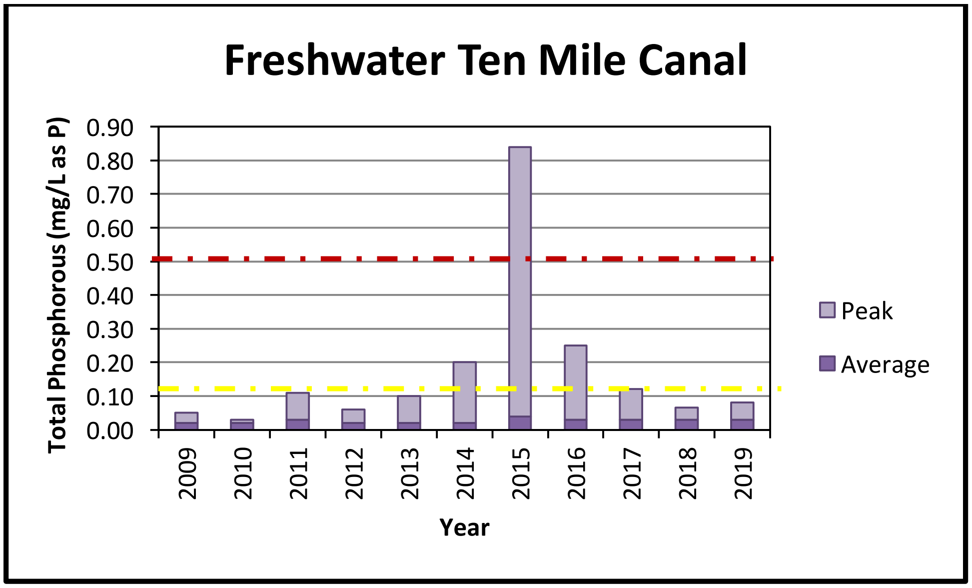


2015-2019 change			
Average	25%		
Peak	-8.47%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.05	0.07	January
2010	0.04	0.07	January
2011	0.05	0.08	June
2012	0.04	0.06	June
2013	0.04	0.05	May
2015	0.03	0.059	May
2016	0.03	0.052	June
2017	0.05	0.1	September
2018	0.04	0.1	June
2019	0.05	0.054	January

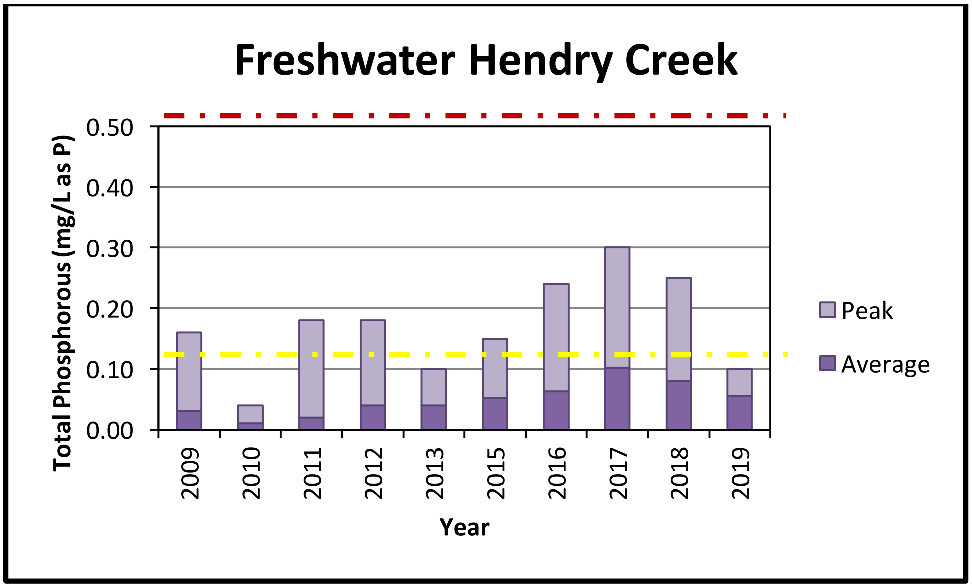
Between 2014 and 2019, average annual total phosphorus increased in Ten Mile Canal and in Spring Creek it remained the same. Between 2015 and 2019, average annual total phosphorous increased in all other freshwater segments. In all tributaries the geometric mean standard was achieved after adoption of the fertilizer ordinances. The average increase was 48.12%. The peak monthly total phosphorus dropped in all freshwater segments except Mullock Creek and Imperial River, for an average of -22.64% decrease. The most common peak month was April, followed by January and June. February, July, and November were not represented.



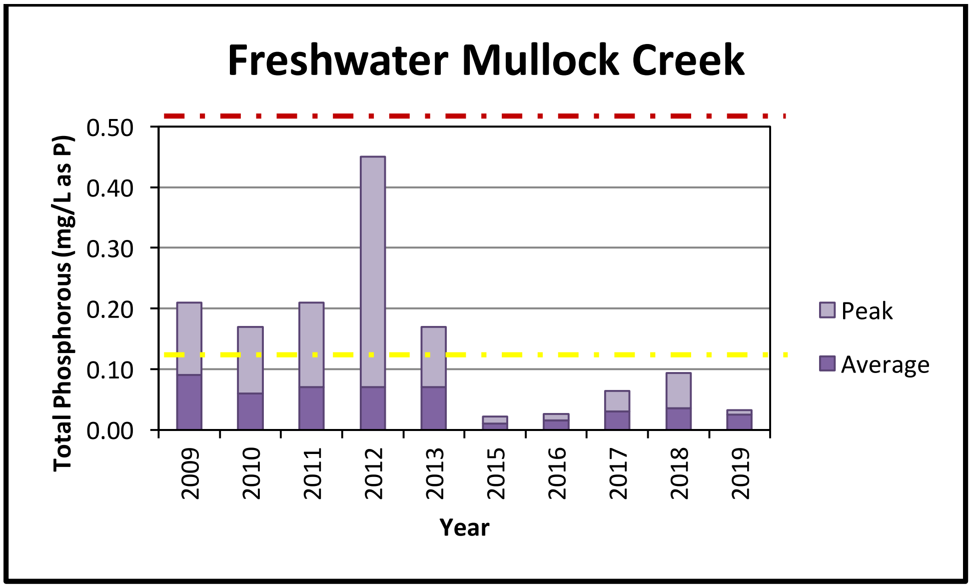
2015-2019 change			
Average	51.04%		
Peak	-22.22%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.06	0.56	April
2010	0.02	0.04	November
2011	0.02	0.10	September
2012	0.03	0.12	May
2013	0.03	0.09	May
2015	0.05	0.27	December
2016	0.05	0.21	March
2017	0.10	0.67	March
2018	0.06	0.44	April
2019	0.07	0.21	August



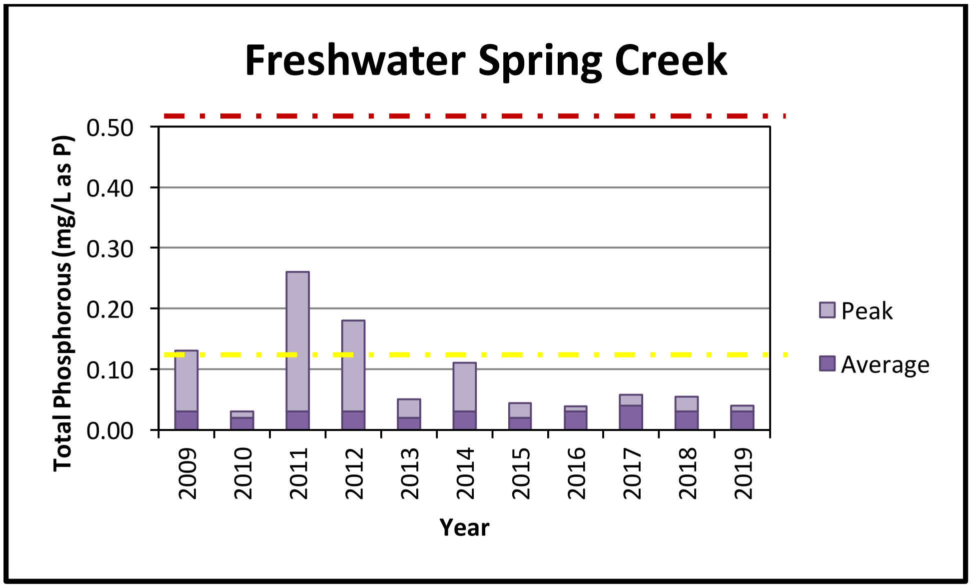
2014-2019 change			
Average	50.0%		
Peak	-59.50%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.02	0.05	September
2010	0.02	0.03	May
2011	0.03	0.11	June
2012	0.02	0.06	September
2013	0.02	0.10	October
2014	0.02	0.2	June
2015	0.04	0.84	October
2016	0.03	0.13	April
2017	0.03	0.12	April
2018	0.03	0.065	October
2019	0.03	0.081	January



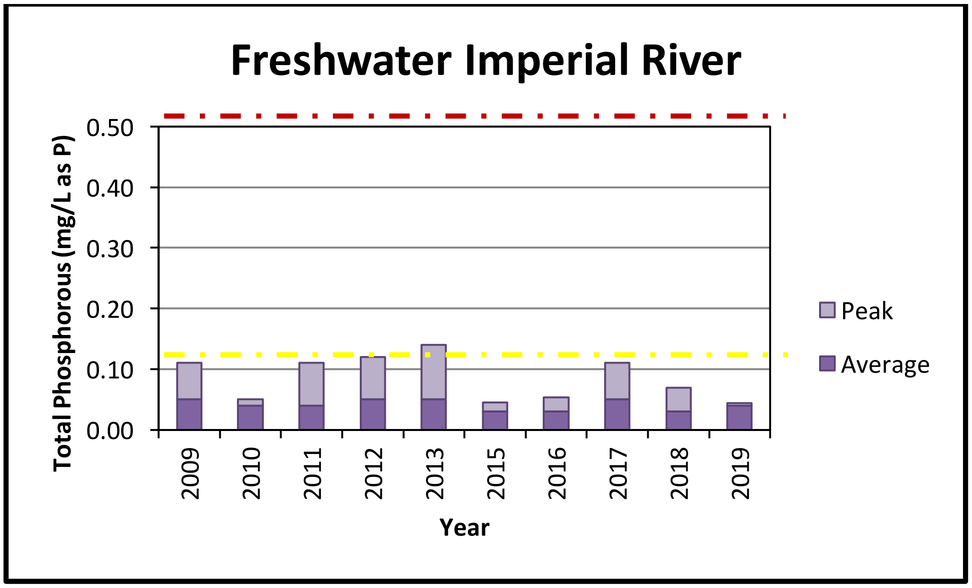
2015-2019 change			
Average	7.31%		
Peak	-33.33%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.03	0.16	May
2010	0.01	0.04	November
2011	0.02	0.18	June
2012	0.04	0.18	June
2013	0.04	0.10	May
2015	0.05	0.15	June
2016	0.06	0.24	June
2017	0.10	0.3	June
2018	0.08	0.25	August
2019	0.06	0.1	January



2015-2019 change			
Average	150%		
Peak	45.45%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.09	0.21	December
2010	0.06	0.17	October
2011	0.07	0.21	July
2012	0.07	0.45	May
2013	0.07	0.17	April
2015	0.01	0.022	October
2016	0.02	0.026	August
2017	0.03	0.064	September
2018	0.04	0.094	April
2019	0.03	0.032	January



2014-2019 change			
Average	0.0%		
Peak	-63.63%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.03	0.13	May
2010	0.02	0.03	June
2011	0.03	0.26	March
2012	0.03	0.18	June
2013	0.02	0.05	September
2014	0.04	0.11	April
2015	0.04	0.044	April
2016	0.05	0.039	September
2017	0.06	0.058	September
2018	0.05	0.054	April
2019	0.04	0.04	January



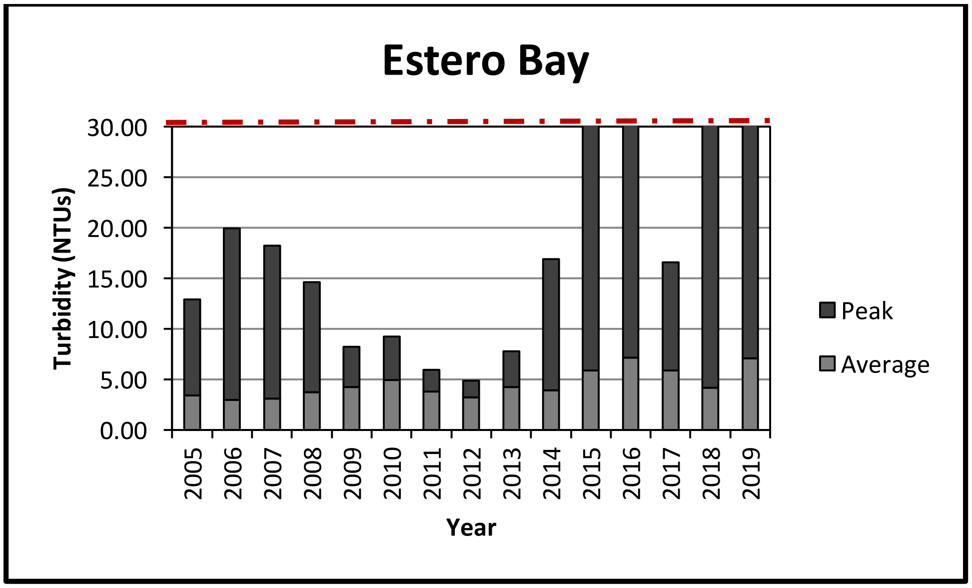
2015-2019 change			
Average	33.33%		
Peak	-2.22%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	0.05	0.11	July
2010	0.04	0.05	April
2011	0.04	0.11	January
2012	0.05	0.12	September
2013	0.05	0.14	June
2015	0.03	0.098	June
2016	0.03	0.053	June
2017	0.05	0.11	September
2018	0.03	0.069	May
2019	0.04	0.044	January

Parameter: Turbidity

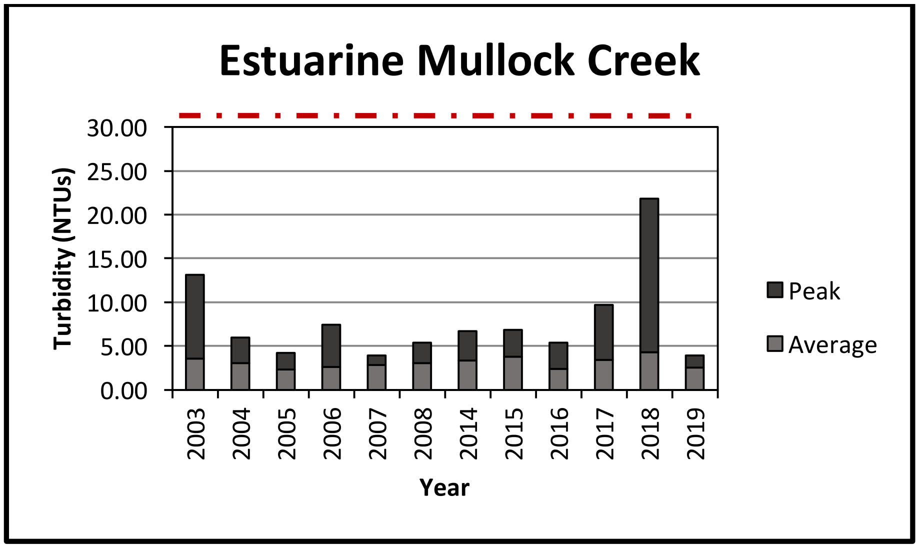
Turbidity is a measure of water clarity. It is a resultant parameter that synthesizes many environmental inputs of particles and dissolved materials, including the organics from detritus, plankton productivity, natural suspended particles and pollutants. The USEPA Nutrient Criteria for this area are 1.9 NTU, whereas the state standard is expressed as 29 or fewer NTUs above normal background levels.

Turbidity in Estuarine Systems

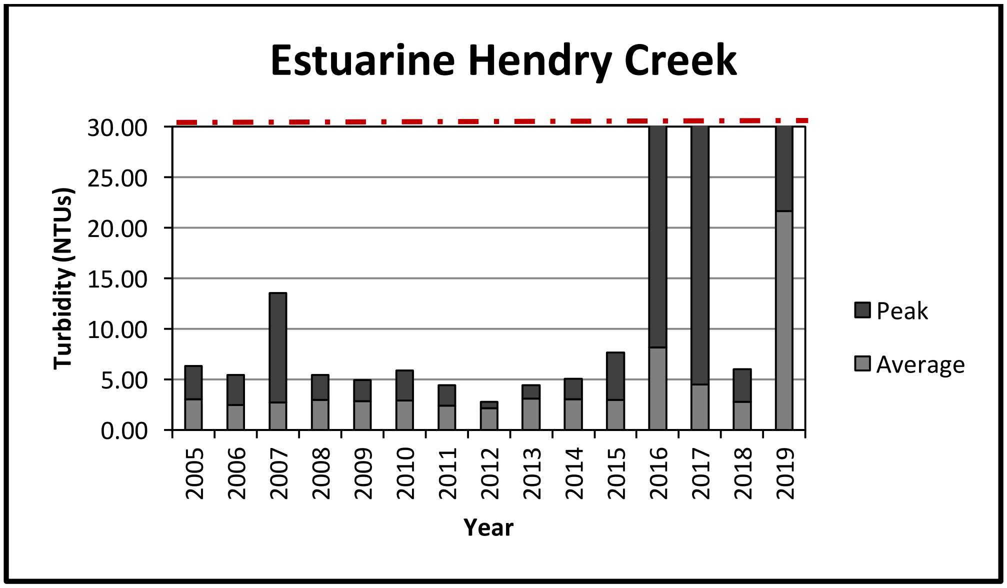
Between 2014 and 2019, average annual turbidity increased in Estero Bay and Hendry Creek; and decreased in all other estuarine segments. The same trend was found for annual peak turbidity in the estuarine segments.



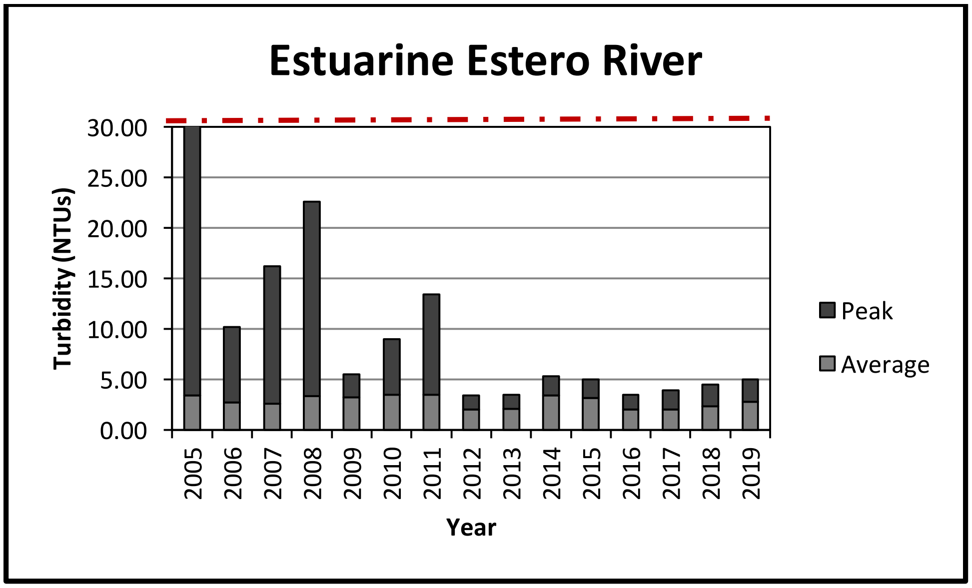
2014-2019 change			
Average	81.79%		
Peak	324.85%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	4.22	8.23	January
2010	4.94	9.25	April
2011	3.79	5.93	January
2012	3.22	4.82	October
2013	4.23	7.74	January
2014	3.89	16.9	January
2015	5.84	35.6	September
2016	7.10	64.3	February
2017	5.86	16.6	December
2018	4.16	30.4	December
2019	7.08	71.8	January



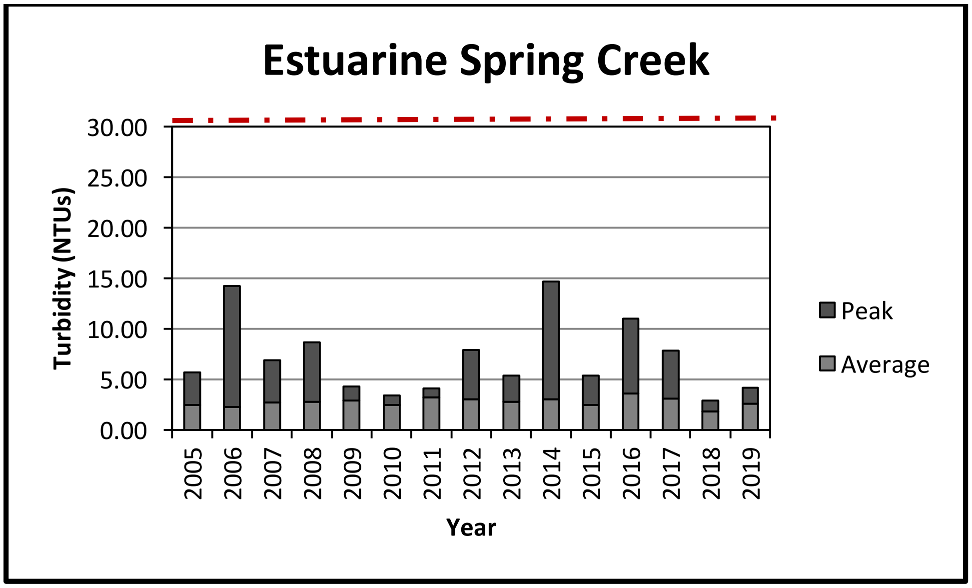
2014-2019 change			
Average	-24.83%		
Peak	-41.77%		
Year	**Mean**	**Peak**	**Month of Peak**
2003	3.56	13.15	January
2004	3.06	6.00	April
2005	2.32	4.20	January
2006	2.98	7.40	October
2007	2.85	3.91	January
2008	3.04	5.38	
2014	3.36	6.68	April
2015	3.81	6.84	November
2016	2.36	5.39	August
2017	3.43	9.7	October
2018	4.27	21.8	May
2019	2.52	3.89	March



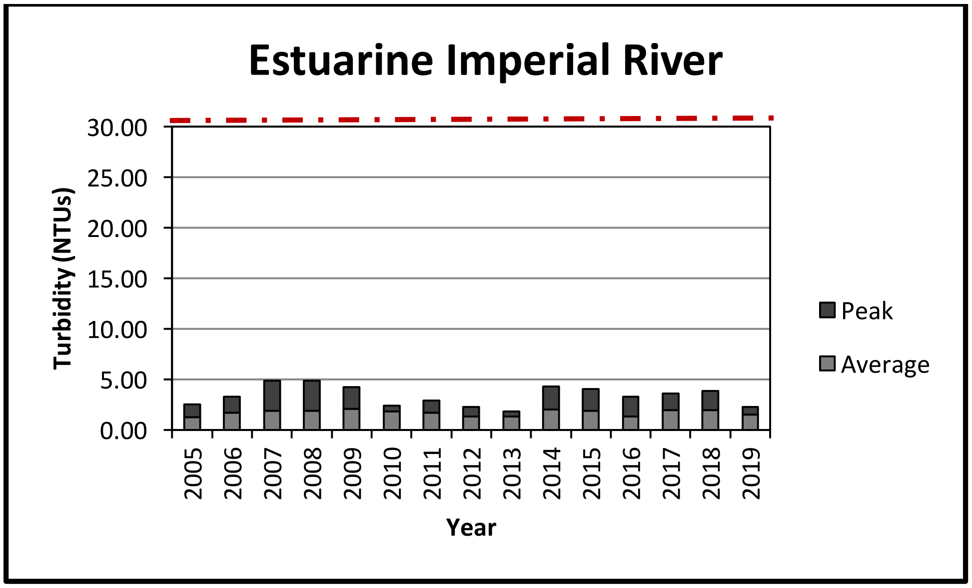
2014-2019 change			
Average	619.51%		
Peak	4481.67%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.82	4.91	September
2010	2.87	5.86	April
2011	2.39	4.40	June
2012	2.13	2.78	June
2013	3.10	4.39	February
2014	3.01	5.02	May
2015	2.97	7.61	October
2016	8.93	83.8	March
2017	4.50	53.3	March
2018	2.79	6.01	February
2019	21.63	230.00	June



2014-2019 change			
Average	-19.23%		
Peak	-5.31%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.19	5.49	May
2010	3.44	8.95	June
2011	3.47	13.38	August
2012	1.98	3.40	February
2013	2.06	3.43	February
2014	3.38	5.27	March
2015	3.11	4.96	March
2016	2.01	3.44	September
2017	2.03	3.90	September
2018	2.33	4.50	January
2019	2.73	4.99	April

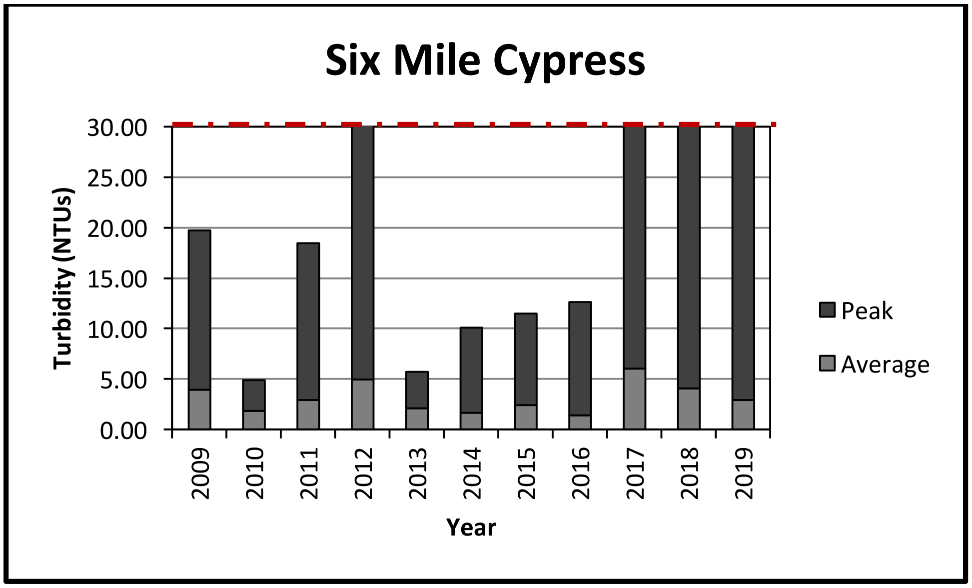


2014-2019 change			
Average	-16.12%		
Peak	-71.77%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.87	4.28	January
2010	2.47	3.42	November
2011	3.19	4.06	May
2012	3.02	7.87	July
2013	2.75	5.34	May
2014	3.04	14.7	May
2015	2.47	5.37	December
2016	3.57	11.00	February
2017	3.10	7.82	February
2018	1.82	2.86	December
2019	2.55	4.15	August

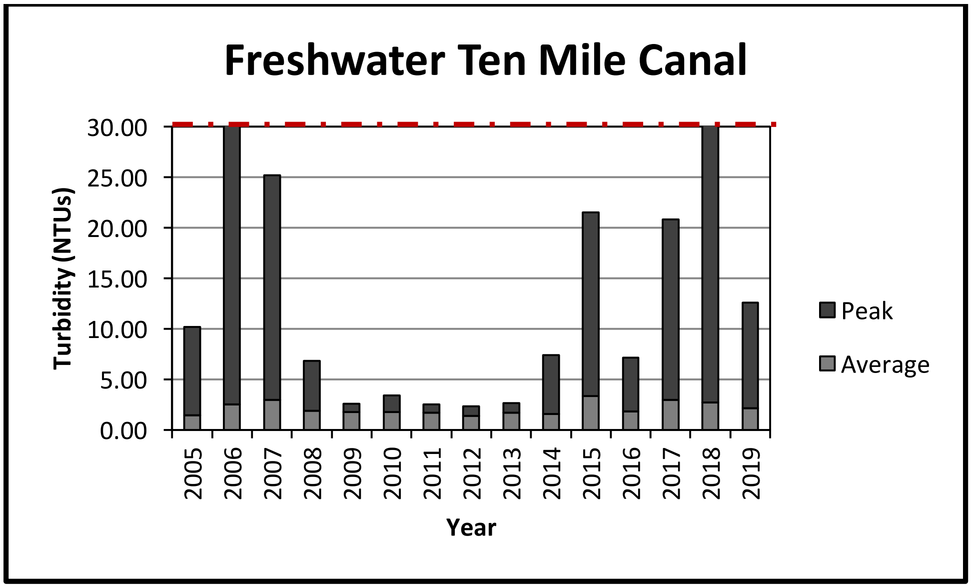


2014-2019 change			
Average	-28.63%		
Peak	-47.79%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.06	4.21	May
2010	1.82	2.36	February
2011	1.66	2.86	June
2012	1.29	2.24	June
2013	1.31	1.83	February
2014	1.97	4.29	April
2015	1.90	4.o1	June
2016	1.30	3.29	April
2017	1.93	3.59	May
2018	1.44	3.81	February
2019	1.47	2.24	May

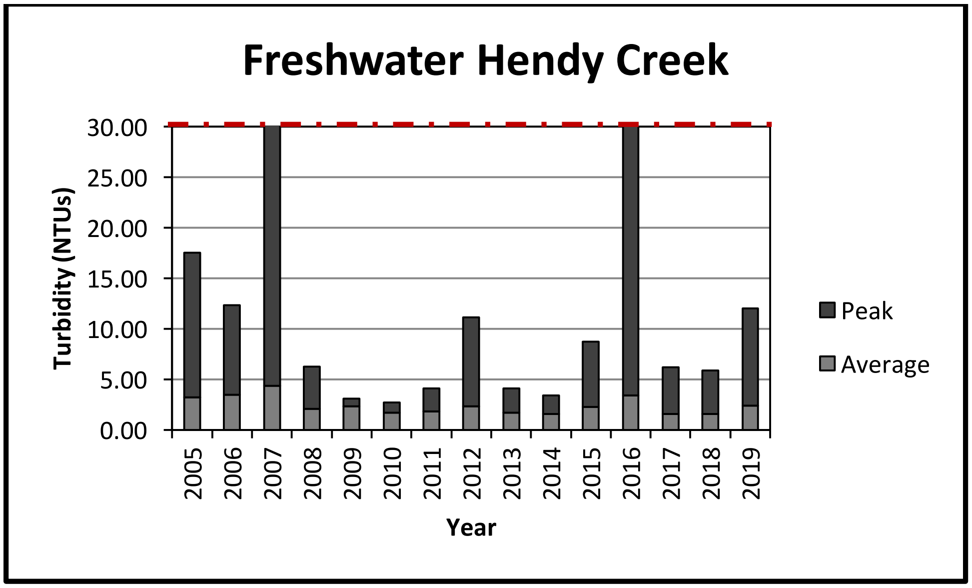
Between 2014 and 2019, average annual turbidity increased in Six-Mile Cypress, Ten Mile Canal, and Hendry Creek; and decreased in Mullock Creek, Spring Creek, and Imperial River. The average increase was 19.79%. The peak monthly turbidity increased in Six-Mile Canal, Ten Mile Canal, Hendry Creek, and Imperial River; and decreased in Mullock Creek and Spring Creek.



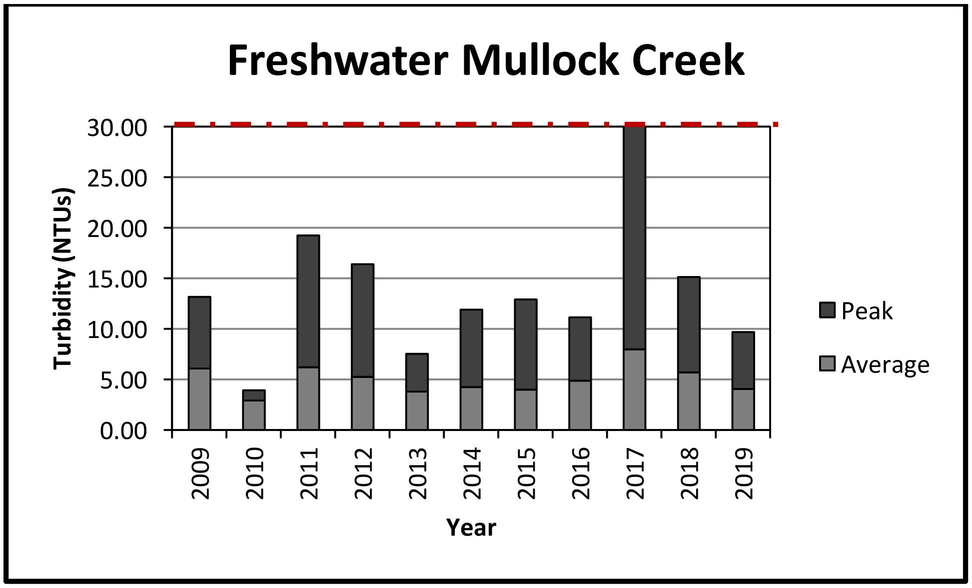
20014-2019 change			
Average	71.72%		
Peak	393.07%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	3.97	19.70	April
2010	1.85	4.87	January
2011	2.93	18.44	June
2012	4.93	33.60	May
2013	2.10	5.72	April
2014	1.69	10.1	May
2015	2.44	11.5	June
2016	1.43	12.6	March
2017	6.05	58.2	May
2018	4.09	35.6	April
2019	2.90	49.8	May



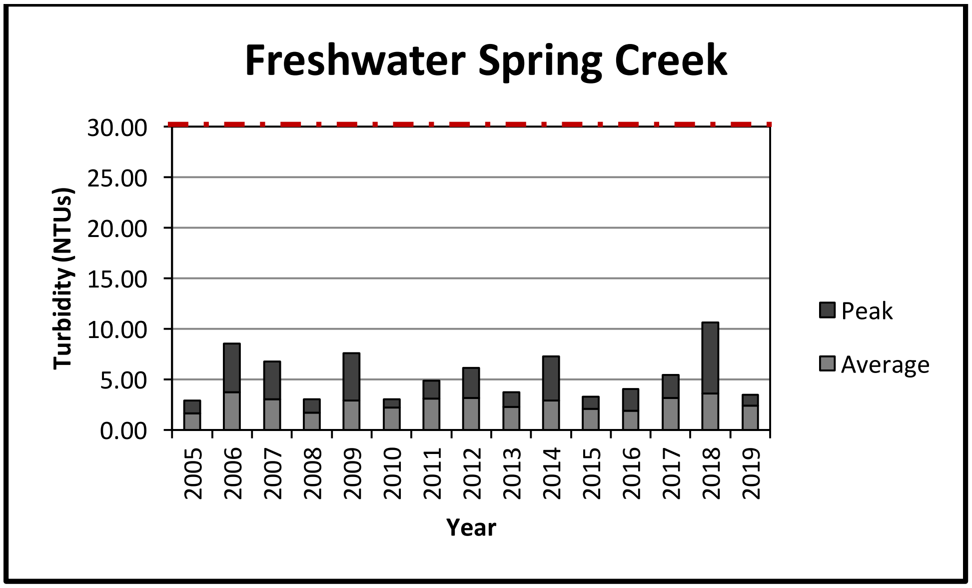
2014-2019 change			
Average	34.18%		
Peak	70.73%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	1.72	2.60	July
2010	1.76	3.41	June
2011	1.68	2.49	April
2012	1.38	2.31	May
2013	1.67	2.62	October
2014	1.58	7.38	October
2015	3.34	21.50	April
2016	1.82	7.14	July
2017	2.93	20.80	September
2018	2.67	33.80	February
2019	2.12	12.60	August



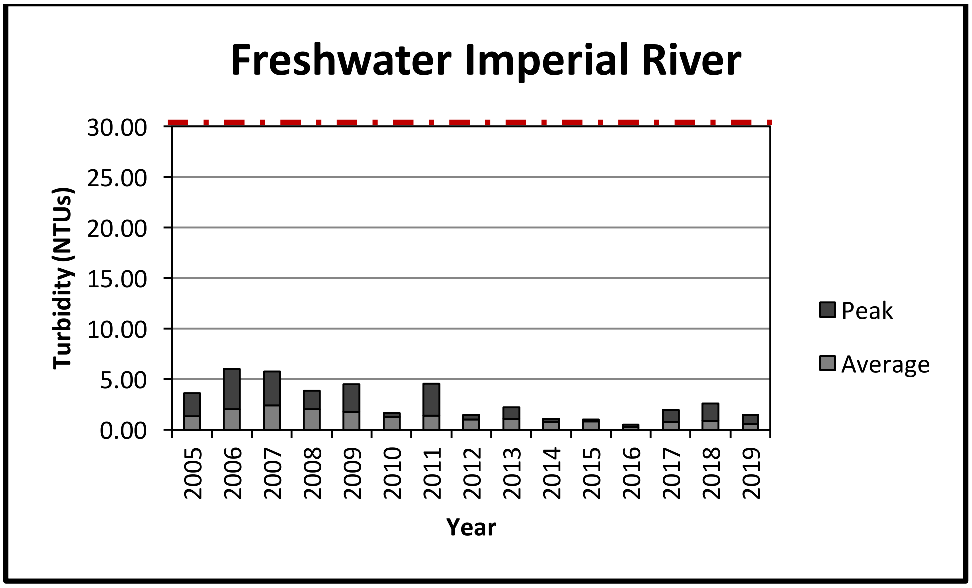
2014-2019 change			
Average	57.70%		
Peak	250.88%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.32	3.09	November
2010	1.70	2.69	January
2011	1.83	4.07	June
2012	2.29	11.10	June
2013	1.70	4.09	November
2014	1.53	3.42	April
2015	2.28	8.70	August
2016	3.40	73.00	April
2017	1.55	6.19	July
2018	1.54	5.89	May
2019	2.41	12.00	June



2014-2019 change			
Average	-4.14%		
Peak	-18.66%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	6.05	13.12	October
2010	2.86	3.93	July
2011	6.17	19.26	July
2012	5.23	16.40	June
2013	3.75	7.49	April
2014	4.23	11.9	April
2015	4.00	12.9	December
2016	4.83	11.1	May
2017	7.94	64.5	May
2018	5.70	15.1	December
2019	4.06	9.68	June



2014-2019 change			
Average	-16.78%		
Peak	-52.54%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	2.87	7.57	June
2010	2.17	3.01	October
2011	3.09	4.88	February
2012	3.12	6.09	July
2013	2.23	3.73	March
2014	2.86	7.29	May
2015	2.06	3.25	August
2016	1.90	4.0	May
2017	3.12	5.40	October
2018	3.57	10.60	April
2019	2.38	3.46	February



2014-2019 change			
Average	-23.94%		
Peak	38.24%		
Year	**Mean**	**Peak**	**Month of Peak**
2009	1.77	4.45	July
2010	1.24	1.61	January
2011	1.35	4.55	January
2012	0.99	1.44	June
2013	1.08	2.21	January
2014	0.71	1.02	October
2015	0.77	1.01	August
2016	0.21	0.45	June
2017	0.72	1.91	June
2018	0.88	2.56	January
2019	0.54	1.40	January

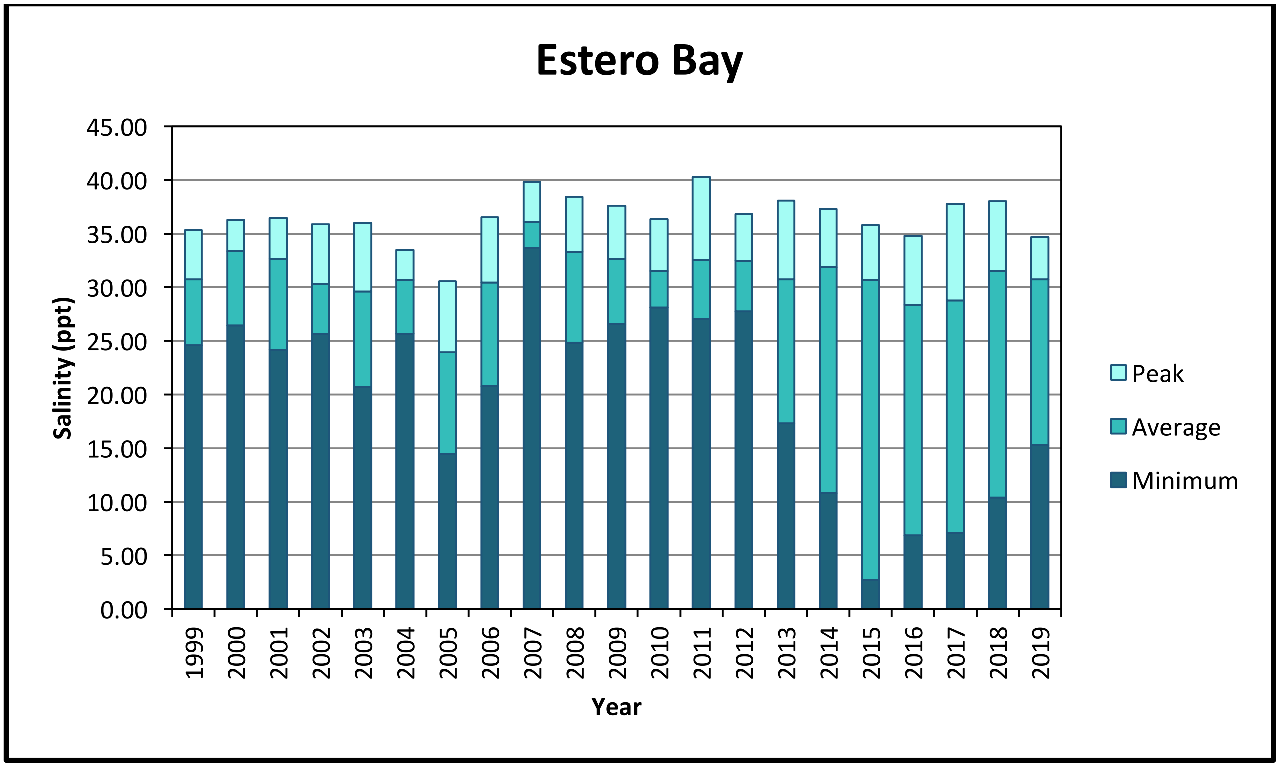
Charlotte Harbor NEP Status and Trends Assessment

Hydrology

Parameter: Salinity

Long term salinity changes in estuaries can reflect many changing factors. In Gulf of Mexico estuaries, landscape changes which alter the volume and periodicity of freshwater delivery to the estuaries can result in measureable changes. Examples include hypersalinity in lagoons and major freshwater dumping to bays at the receiving end of major canals. There is was a rising trend of salinity for Estero Bay until 2012. Salinity then began to decline in annual average and minimums although it slightly increased in peaks. Of note is the contrast between annual minimums and annual peaks. In the period of record, 2005 had the lowest peak, while 2016 had the lowest minimum. The highest minimum and the highest peak occurred in 2007. In the 2014 - 2018 period, the average salinity dropped by 6%, the peak increase by 1% and the minimum was at its lowest since 2005, dropping 35% from 2009 values.

The Lee County Environmental Laboratory provided the data for all salinity analysis.

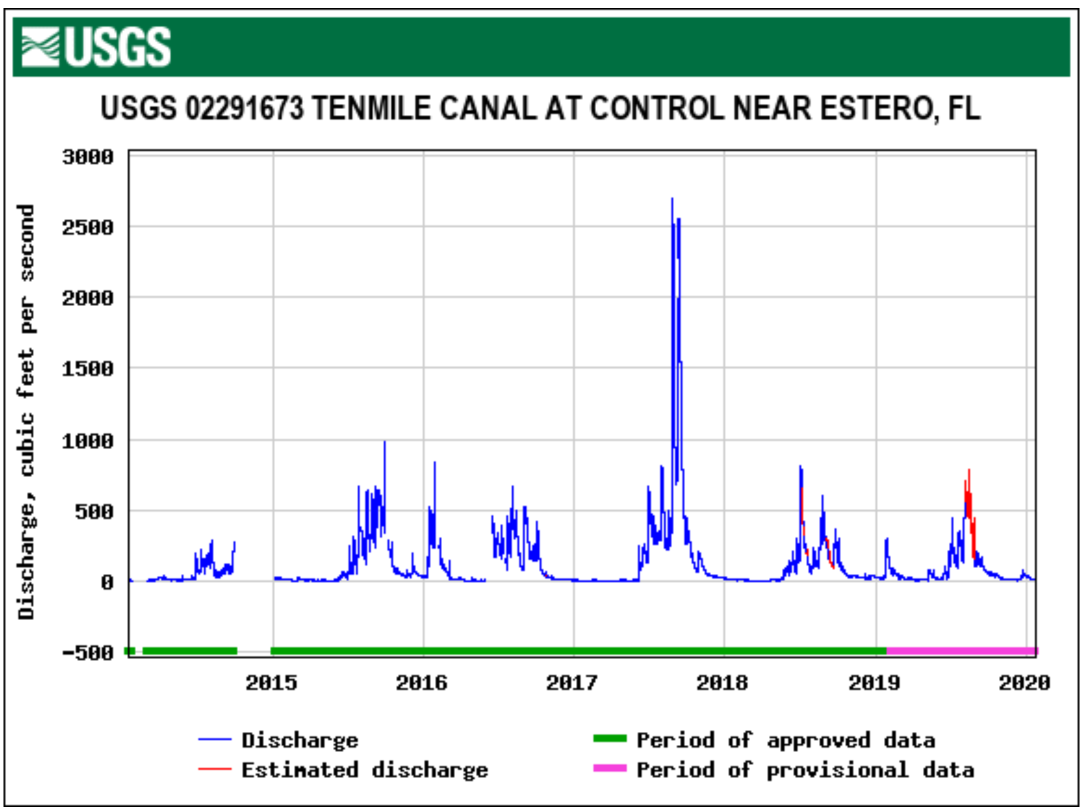


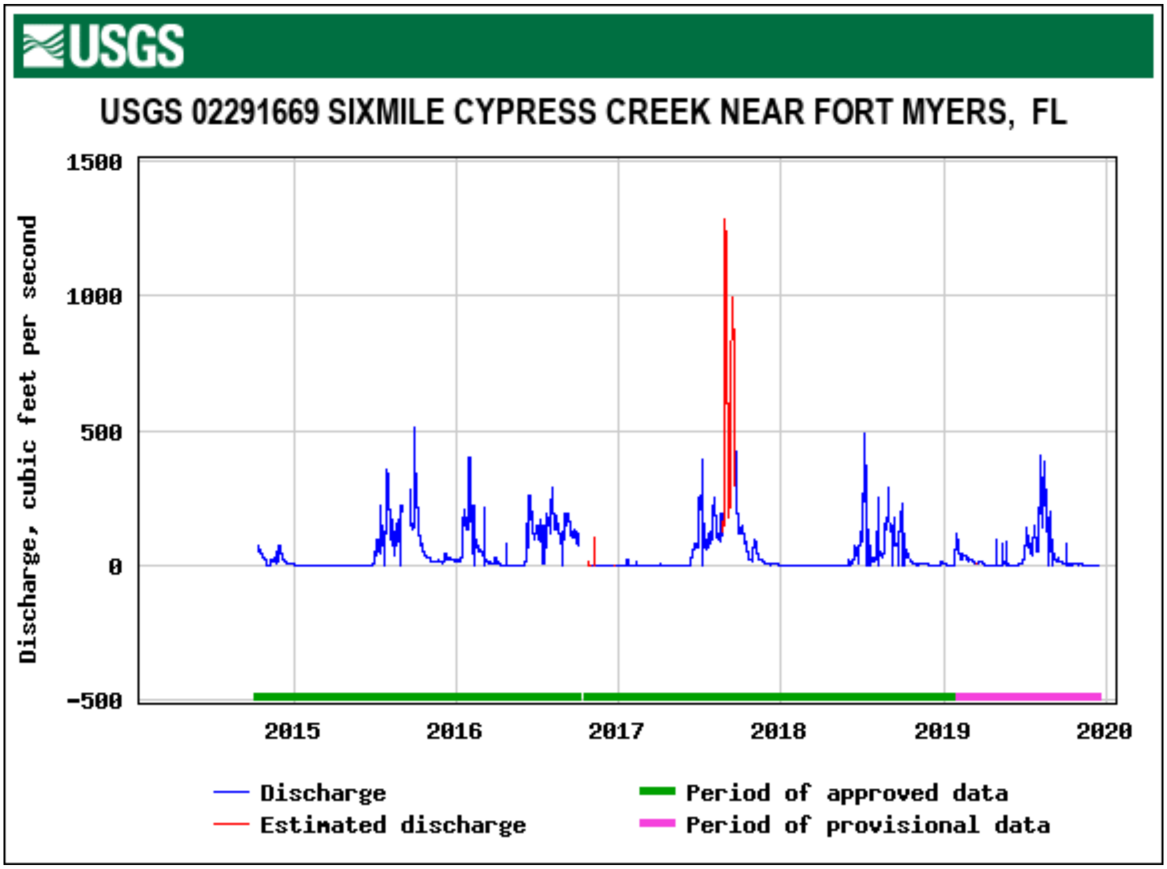
2014-2019 change					
Average	-3.5%				
Peak	-6.9%				
Minimum	41.6%				
Year	**Average**	**Peak**	**Month of Peak**	**Minimum**	**Month of Minimum**
2014	31.8	37.3	August	10.8	September
2015	30.7	35.8	July	2.7	September
2016	28.3	34.8	November	6.9	August
2017	28.8	37.8	May	7.1	September
2018	31.5	38.0	May	10.4	September
2019	30.74	34.7	January	15.3	February

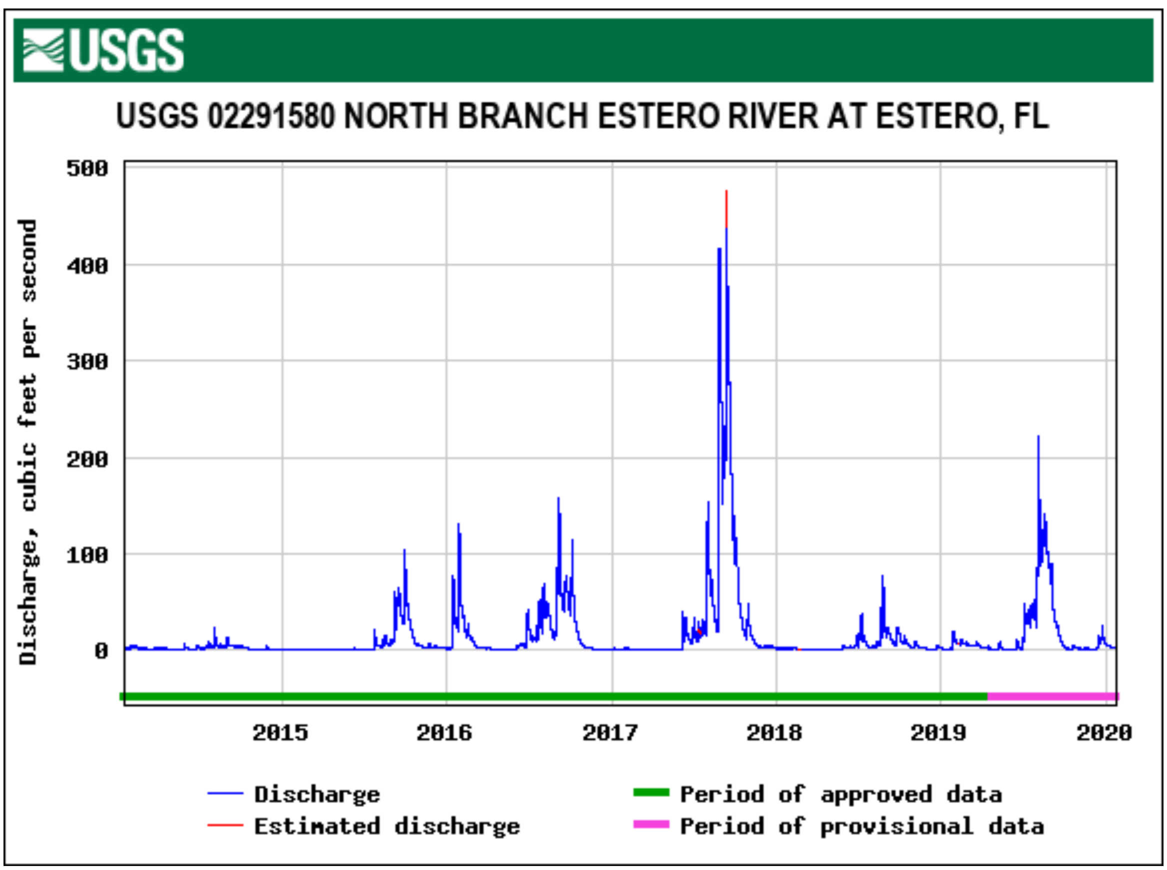
Factor: Tributary Flows

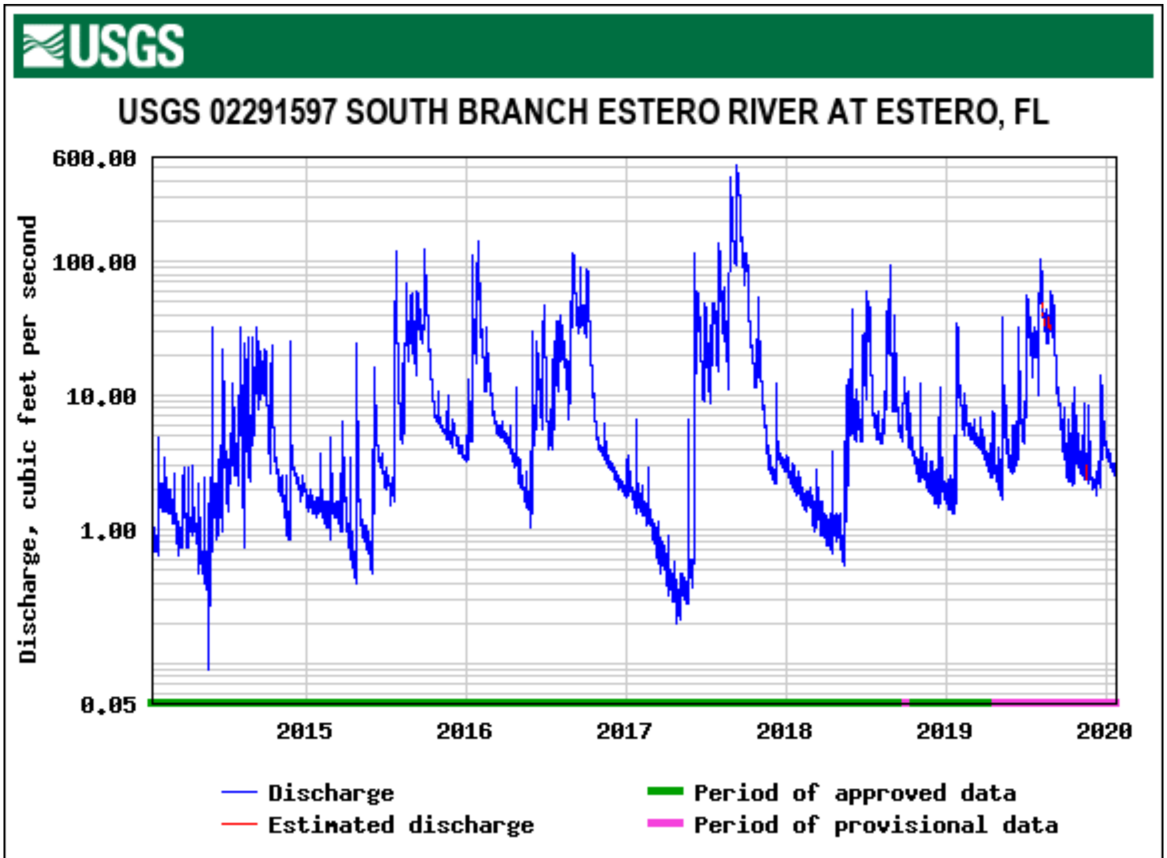
Tributary flows to Estero Bay have been altered by enhancements intended to drain land surfaces during the wet season and to retain water behind weirs and salinity barriers during the dry season. This continues to result in a spiked hydroperiod with little discharge of water during the dry season and sharp peaks during rain events, particularly when water control structures are opened. The lack of surface water retention on the landscape and the elimination of gradual sheetflow delivery to the estuary has shortened freshwater wetland hydroperiods. Surface water table elevations are rapidly lowered and drought conditions are accentuated, encouraging the invasion of exotic vegetation into wetlands and increasing the severity of fire season. Fisheries and wildlife that are dependent on depressional wetlands and riparian habitats lose valuable breeding periods and nursery habitats as the hydrologic system acts as a flush plumbing mechanism. In some areas, wading bird breeding is reduced and fails as wetlands drain too quickly and vital food concentration is lost. Amphibians, such as gopher frogs and tree frogs, are unable to complete reproductive life cycles. Under these conditions, exotic fish, amphibian and plant species fill in and flourish.

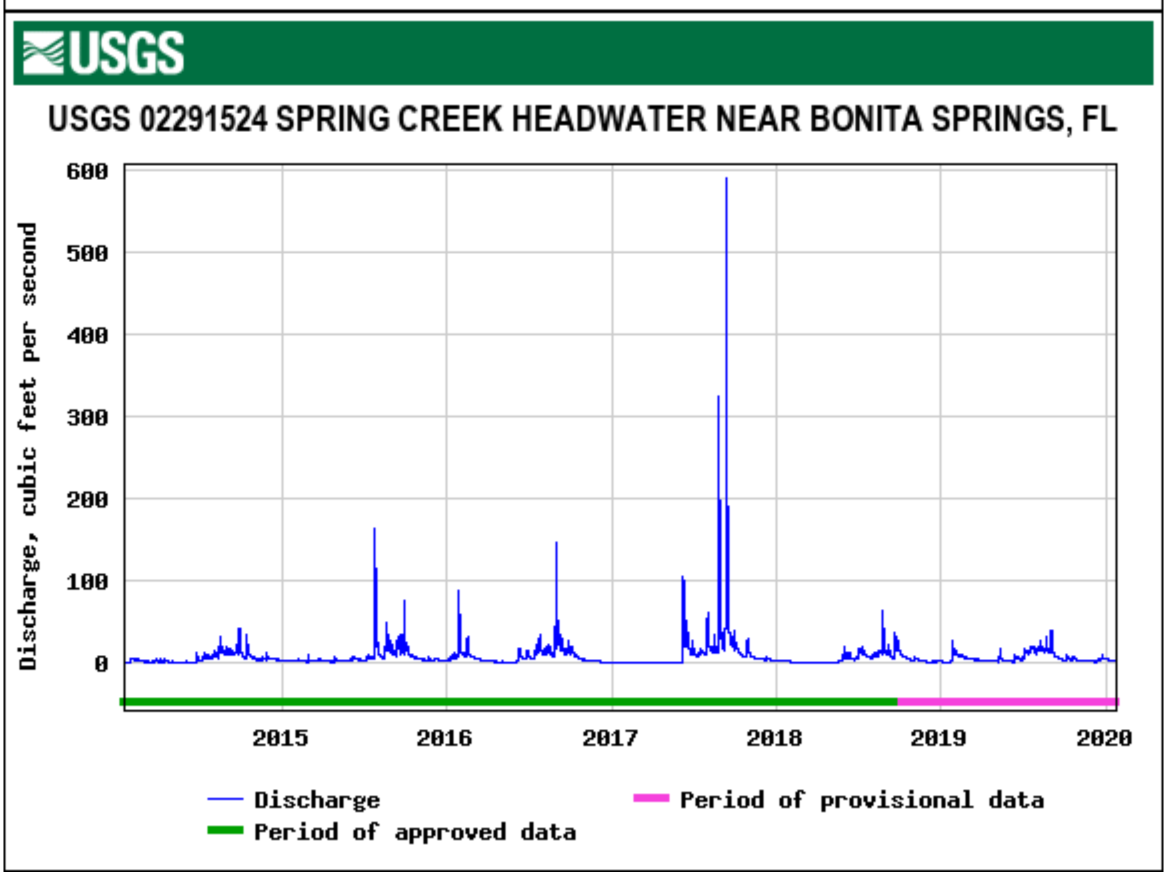
Data for analysis in this section is from the US Geological Survey (US Geological Survey 2014)

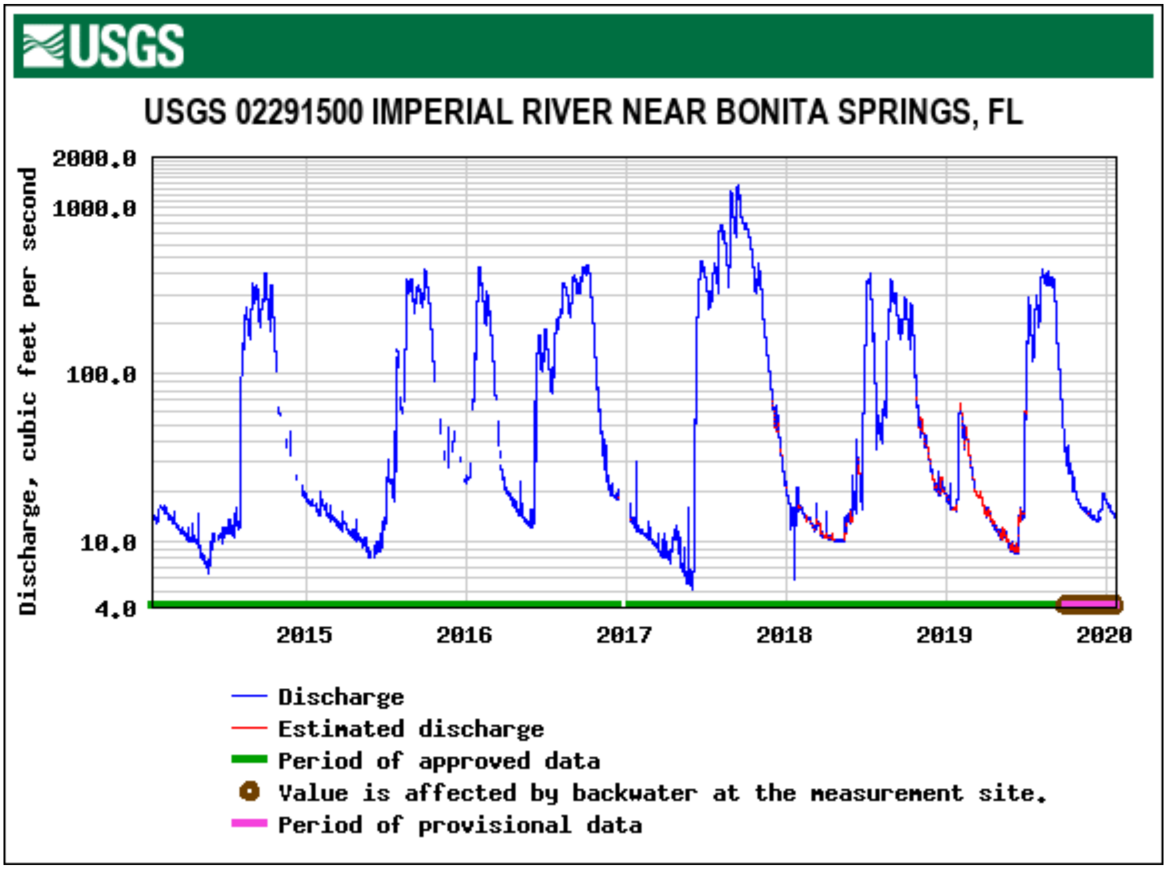



USGS
USGS 02291669 SIXMILE CYPRESS CREEK NEAR FORT MYERS, FL
Discharge, cubic feet per second
1500
1000
500
0
-500
2015
2016
2017
2018
2019
2020
Discharge
Estimated discharge
Period of approved data
Period of provisional data


USGS
USGS 02291580 NORTH BRANCH ESTERO RIVER AT ESTERO, FL
Discharge, cubic feet per second
500
400
300
200
100
0
2015
2016
2017
2018
2019
2020
Discharge
Estimated discharge
Period of approved data
Period of provisional data


USGS
USGS 02291597 SOUTH BRANCH ESTERO RIVER AT ESTERO, FL
Discharge, cubic feet per second
600.00
100.00
10.00
1.00
0.05
2015
2016
2017
2018
2019
2020
Discharge
Estimated discharge
Period of approved data
Period of provisional data


USGS
USGS 02291524 SPRING CREEK HEADWATER NEAR BONITA SPRINGS, FL
Discharge, cubic feet per second
600
500
400
300
200
100
0
2015
2016
2017
2018
2019
2020
Discharge
Period of provisional data
Period of approved data

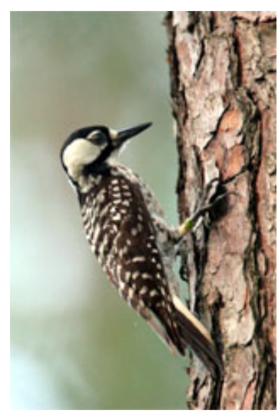

USGS
USGS 02291500 IMPERIAL RIVER NEAR BONITA SPRINGS, FL
Discharge, cubic feet per second
2000.0
1000.0
100.0
10.0
4.0
2015
2016
2017
2018
2019
2020
Discharge
Estimated discharge
Period of approved data
Value is affected by backwater at the measurement site.
Period of provisional data

Wildlife

Factor: Red-Cockaded Woodpecker Presence

Measure: Number of Red-Cockaded Woodpecker Family Groups
Time Frame: 1991-2019
Data Source: FWC
Level of Change: -100% in EBABM area; locally extinct
Meeting Recovery? No

Significant loss of red cockaded woodpecker families and individuals have occurred in south and central Florida within the past twenty-three years from catastrophic natural events (Hurricane Andrew), loss of foraging and nesting habitat to exotic invaders such as melaleuca and Brazilian pepper, direct violation takes, hydrologic change and land conversion from pine flatwoods to residential and agricultural landscapes lacking pines. This includes the apparent local extirpation of the red-cockaded woodpecker from the Estero Bay watershed in southern Lee County, 37% loss in Collier County west of the Big Cypress National Preserve, apparent local extinction in Sarasota, Manatee, Hillsborough, northern Hendry, and perhaps Hardee Counties in the last twenty-eight years. The average loss of clusters in the Southwest Florida Regional Planning Council Area on private lands in the years before their local extinction in the Estero Bay watershed was 44%. The last known red-cockaded woodpecker colonies were in the areas of what is now Gateway. If a reintroduction program were to be proposed the hydric pine flatwoods areas of the CREW and the SWFIA mit6igation areas would be the best remaining candidate habitats.



Factor: Bald Eagle Nesting

Measure: Number of Successful Bald Eagle Nests
Time Frame: 1995-2016
Data Source: FWC
Level of Change: - 33% in EBABM area
Meeting Recovery? Yes, according to FWC

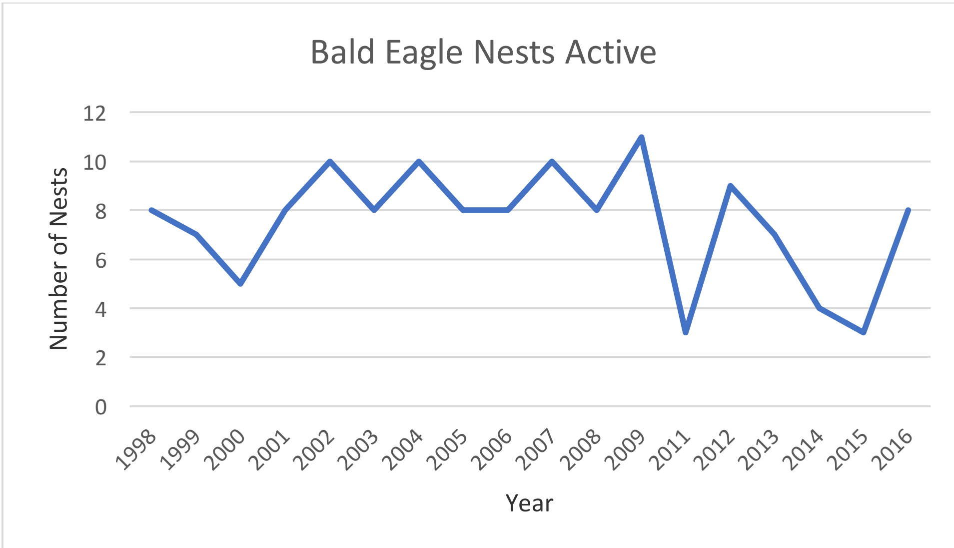
Changes in the nesting success of bald eagles have occurred in the Estero Bay Basin in response to land use changes and shifts in food resources. In 1995 there were nine bald eagle nests in the basin. By 1999 there were 11. In 2009, there were 12. The number of known nests has ranged from a low of four in 2014 to a peak of 14 in 2000 and 2001. In general, nests in interior locations depending on freshwater wetlands were less productive in fledging young than coastal nests. In the 1995 to 2013-time frame there is a 22% loss of nesting territories. There is a 33% decline in active nesting territories occurring in the period since the last State of the Bay report in 2009. Since 2009, four new nest territories were established in the Estero Bay Basin but 8 have been lost. We were not able to find any publicly available bald eagle nesting data for the Estero Bay watershed for the period of 2017- 2018. The 2019 to 2020 nesting season is ongoing.

In 2008, the statewide bald eagle nesting territory survey protocol changed. The protocol change reduces annual statewide survey effort and increases the amount of information gained from the nests that are visited during the survey season. Because of the sampling change data for 2010 and 2011 were not collected. Nest productivity is now determined for a sub-sample of the nests that are surveyed annually. Nest activity and productivity information are critical to determining if the goals and objectives of the Bald Eagle Management Plan are being met.

Accuracy of the nest locations is estimated to be within 0.1 miles of the true location. Not all eagle nests in Florida have been documented by FWC. Non-documented nests are said to receive the same level of protections as FWC documented nests.

Year	Number of Nests	Success Rate
1995	9	5 (55%)
1996	10	6 (60%)
1997	10	4 (40%)
1998	11	7 (64 %)
1999	11	6 (55 %)
2000	14	?
2001	14	10(71%)
2002	11	2(18%)
2003	9	2(22%)
2004	12	6(50%)
2005	11	?
2006	10	7(70%)
2007	11	4(37%)
2008	9	6(67%)
2009	12	5(42%)

2012	6	?
2013	7	
2014	4	?
2015	3	?
2016	8	?



Factor: Florida Scrub Jay Nesting

Measure: Number of Successful Florida Scrub Jay Nests
Time Frame: 1995-2019
Data Source: FWC
Level of Change: -100% in EBABM area, Locally Extinct
Meeting Recovery? No

The Florida scrub jay became locally extinct in the Estero Bay Basin in the mid-1990's. At least one and perhaps two families of Florida scrub jays were found on the Chapel Ridge scrub system. Presence was confirmed during surveys by Estero Bay Aquatic Preserve and Lee County biologists in 1989. The nest territories were within the proposed acquisition area (at that time) for the Estero Bay Buffer Preserve CARL project. During site reviews for the development project now known as West Bay Club these jay families were no longer present. The last confirmed siting was in 1994. Unless a translocation is performed to some public land with improved scrub management there is no reasonable expectation that the Florida scrub jay will return to the Estero Bay Watershed. It is not clear there is sufficient remaining native, undeveloped xeric oak scrub habitat remaining in the Estero Bay watershed for any such re-establishment relocation to succeed.

Factor: Wading Bird and Brown Pelican Rookeries

Time Frame: 1986-1999/2008-2009-2013, 2014-2019
Data Source: FWC and FDEP EBAP
Level of Change since 2014: + 11.7% in rookery number and 34% in total nest number
Meeting Recovery? Not Yet

Wading birds are an important indicator species for the health of the estuaries since they feed at such a high trophic level. Their indicator species status and dramatic decline since the 1930s makes their protection a necessity. Surveying and documenting trends in wading bird populations will help document the preservation of biodiversity in Estero Bay Aquatic Preserve.

Estero Bay Aquatic Preserve (EBAP) was designated in 1966, becoming Florida's first aquatic preserve. EBAP is a field site of the Florida Department of Environmental Protection managed by the Office of Resilience and Coastal Protection. All the information in this section is from the reports of the FDEP EBAP. Changes in the nesting success of wading birds and brown pelicans have occurred in the Estero Bay Basin in response to land use changes, altered hydrology, and shifts in food resources. In a preliminary survey of Estero Bay's coastal and estuarine resources, conducted in 1971, Tabb et al. indicated, "The abundance of brown pelicans is of particular note. Approximately 120 were recorded on a single island location in Estero Bay between Julie's Island and Coon Key." In 1977, brown pelican surveys were initiated in Estero Bay and continued through 1982. The surveys were expanded in 1983 to include all wading and diving birds and continued through 1989. In 1986 there were nine wading bird or brown pelican rookeries in the basin. Surveys conducted in May of 1997 and 1998 only documented brown pelican nesting activity. By 1999 there were six. Rookeries were lost from interior locations depending on freshwater wetlands. In 1998, 2001, and 2007 surveys of all wading and diving bird nests were conducted during April.

The colonial nesting, wading and diving bird monitoring and protection program was initiated in 2008 with 15 islands but has since expanded to 34 islands, 20 of which were active this year. By 2013 there were 17 rookeries active. Two islands (Emily's Keys and Taylor Island) were added as they were discovered during the 2019 breeding season. Historically, the highest concentration of wading and diving bird nesting activity has been observed on three islands: Matanzas, Coconut Point East, and Big Carlos West of M-52. These islands are designated as Critical Wildlife Areas (CWA) and were marked in February of 2018.

The objectives of this program are:

- provide peak estimates of nesting effort for each species of colonial nesting bird,
- monitor population trends,
- record movement of colonies, human disturbance and bird fatalities due to fishing line entanglement,
- reduce the number of entanglements and fatalities due to fishing line and trash within the bay, and
- provide recommendations for the management of nesting wading and diving bird colonies in the aquatic preserve.

Surveys between 2009 and 2013 were conducted once, mid-month throughout the nesting season. Each year, surveys were initiated when birds were observed carrying nesting materials and concluded when all chicks had fledged. Perimeter surveys were conducted by boat using a direct count method. Islands were surveyed at a distance of 30 to 45 meters by two observers; nests were documented by species and nesting stage. The primary observer, an aquatic preserve staff member, was consistent throughout the study period, and trained volunteers conducted secondary observer counts. The average of the two observers' counts was reported. Species monitored include: double-crested cormorant (DCCO), brown pelican (BRPE), great blue heron (GBHE), great egret (GREG), snowy egret (SNEG), little blue heron (LBHE), tricolor heron (TRHE), reddish egret (REEG), anhinga (ANHI), black-crowned night heron (BCNH), yellow-crowned night heron (YCNH), green heron (GRHE), and cattle egret (CAEG).

The presence/absence of fishing line was documented monthly on nesting islands. Line was removed by staff and volunteers whenever it could be done without disturbing nesting activities. The length of the line removed and number of hooks were documented. Birds found entangled in fishing line were recorded by their species and taken to a wildlife rehabilitation facility if they were still living when documented.

Historic survey (1977 - 1982) methodology was outlined by Clark and Leary (2013), which analyzed Estero Bay Aquatic Preserve data from 1977-2011.

A qualitative trend analysis was performed using a simple linear regression to compute a rate of change over time (i.e. slope) in an effort to estimate nesting trends between 2009 and 2013. Due to the low sample size, no formal statistical test was performed with the linear regression. Comparison of brown pelican peak nest counts between historic (1977-1982) and modern (2009-2013) time periods were conducted using the Wilcoxon rank sum test, since data were not normally distributed. All statistical analyses were performed using Excel 2013 (Version 15.0, Microsoft, Santa Rosa, CA, USA), R (R version 3.1.1, The R Foundation for Statistical Computing) and JMP (Version 10.0.0, SAS, Cary, NC, USA).

Peak nest counts over the five-year period showed an increasing trend in nesting activity for brown pelican, snowy egret, little blue heron, tricolored heron, reddish egret, yellow-crowned night heron, and green heron. Double-crested cormorant, great blue heron, great egret, and black-crowned night heron showed a decreasing trend in nesting effort. For this time period, overall nesting effort in Estero Bay showed a slight decline (Figure 1).

Between 1977 and 2008, nesting was documented on 21 islands within Estero Bay with the number of islands surveyed increasing annually as new colonies were formed and documented; inactive islands continue to be monitored. Between 2009 and 2013, the number of active islands ranged annually from 14 (2009) to 17 (2012 and 2013), and the total nest counts ranged between 352 (2011) and 439 (2009) (Table 1) with an average nest count on 406 for this time period.

A comparison of April historic (1998 and 2001) to modern (2009-2013) nests counts show an increase in double-crested cormorant, great blue heron, yellow-crowned night heron, and green heron nesting efforts, while all other species showed a decrease in nesting effort (Table 2).

Brown pelican nesting was documented on four islands in 2009 and three islands from 2010 to 2013. Over the five-year time period, recorded nesting efforts were greatest in 2013 (n=110) and lowest in 2010 (n=77). Overall, nesting data showed an increasing trend in nesting activity with an average annual increase of 1.5 nests.

Comparison of historic and modern brown pelican nest counts conducted during the month of May showed a significant downward shift in nesting ($p<0.01$). Mean May nest count for historic surveys were 171 (±28.58 SD) versus 70.6 (±16.58 SD) for modern surveys (Figure 2), showing a decrease of 58.7 percent from the historic to the modern survey period.

Fishing line fatalities on nesting islands in Estero Bay averaged 21 birds annually during this five-year period with a total of 106 fatalities documented (Figure 3). Three entangled BRPE were rescued and released during this time.

Peak nest counts are calculated by using the highest nest count for each species at each of the colonies and adding them to obtain the total peak nest count for the season. Peak nest counts may exclude nests that are not occupied during the peak of the nesting season and therefore may underestimate nesting when nesting seasons are spread out. Monthly nest surveys used to calculate peak nest counts may provide a more accurate representation of the nesting population than annual surveys, since peak nesting time for individual species may vary from year to year. Shifts in nesting time may represent shifts in food availability (Keith, 1978; North American Bird Conservation Initiative, U.S. Committee, 2010) or shifts in age composition of the population since younger birds tend to nest later in the season (Perrins, 1970).

The qualitative assessment of species nesting trends in Estero Bay showed increased nesting for seven out of 11 species, however the short length of time (~5 years) precluded rigorous quantitative assessment. Most species of colonial waterbirds are long-lived and decades of data are needed for analysis (Steinkamp et al., 2003). Continued monitoring over the next five years using consistent survey methods will allow for a more comprehensive evaluation of nesting trends in colonial waterbirds over time in Estero Bay. Additionally, due to the complex annual cycles and wide geographic ranges of some species of colonial waterbirds (Kushlan, 1993), regional coordination is imperative for the protection of these species. Combing data from Estero Bay with data collected by Charlotte Harbor Aquatic Preserves and J.N. “Ding” Darling National Wildlife Refuge, who currently use the same survey techniques, will provide a larger geographical scale to evaluate trends in the future.

Brown pelican nest counts during the month of May have remained stable the past three years; 2011 (n=82), 2012 (n=82), 2013 (n=84). However, they are still not at historic levels. Results from this analysis of brown pelican data in Estero Bay are similar to Clark and Leary’s (2013) OLS regression which showed a mean decrease of 56.9 percent for brown pelican nests during the month of May from 1977-2011.

Brown pelican nesting efforts have centered on three islands in Estero Bay: Matanzas Island, Coconut Point West, and Big Carlos W of M-52. Critical Wildlife Area designation or an alternative method of enforcement of marked buffer zones around brown pelican nesting colonies in Estero Bay is necessary to protecting the species from human disturbance and fishing line entanglement. Over 50 percent of the fishing line fatalities recorded on nesting islands in Estero Bay are of brown pelican.

Surveys between 2008 and 2019 were conducted monthly throughout the nesting season. Since 2012, surveys have been conducted year-round due to the extended period of nesting. Employing a direct count method, two observers surveyed each island by boat from a distance of 30 to 45 meters with a third person recording the data for each nest’s species and stage. The primary observer, an EBAP staff member, was consistent throughout the study period of 2008-2016, but transitioned to another staff member in September of 2016. In January of 2019, the primary observer transitioned to another EBAP staff member. Trained volunteers and EBAP staff members conducted secondary observer counts. The average of the two observers’ counts were reported. Peak nest counts from 2019 are compared with mean peak nest counts from 2008 through 2018, which represent an eleven-year average for nesting effort in Estero Bay. Peak nest counts of species that started nesting in recent years were compared to the average counts since their nesting establishment in Estero Bay. This includes ANHI, WHIB, and ROSP.

The peak nesting effort for wading and diving birds was 531 nests. June marked the height of nesting season in Estero Bay with an estimated 388 active nests. The Matanzas Pass colony, with an annual peak of 189 nests, had the greatest nesting concentration in the bay. Overall, nesting effort increased 21 percent from the eleven-year average. All species-specific increases or decreases in nesting effort are in comparison with the eleven-year average.

Double-crested cormorant (DCCO) nests were documented on seven islands; nesting activity peaked in May (n=37). DCCO peak nesting numbers for 2019 (n=46) decreased 35 percent.

Brown pelican (BRPE) nests were documented on three islands. Nesting peaked in May (n=216) with a season peak of 227 active nests—a 94 percent increase.

Great blue heron (GBHE) nests were documented on fourteen islands. Nesting effort peaked in March (n=28) with a season peak of 44 nests—a 36 percent decrease. No white morphs were documented in 2019.

Great egret (GREG) nests were documented on five islands. Nesting peaked in June (n=25) and the annual peak was 45 nests, which represented a 20 percent decrease in nesting effort.

Snowy egret (SNEG) nests were documented on five islands, with peak nest counts in June (n=35). SNEG had an annual peak nest count of 33, which is a 15 percent increase.

Little blue heron (LBHE) nests were documented on five islands, with peak nest counts in May (n=5). The annual peak nest count (n=9) represented a 38 percent decrease in nesting effort.

Tricolored heron (TRHE) nests were documented on five islands. Peak nesting effort occurred in June with 43 nests. The annual peak (n=57) represented a 69 percent increase in nesting effort.

Reddish egret (REEG) nests were documented on five islands, with peak nesting effort in June (n=11). The annual peak nest count (n=14) represents a 93 percent increase.

Black-crowned night heron (BCNH) nests were documented on nine islands, with peak nesting effort in August (n=16). The annual peak (n= 21) represents a 34 percent increase.

Yellow-crowned night heron (YCNH) nesting were documented on six islands, with a peak in June (n=15). The annual peak nest count was 17 nests, which represents an 11 percent decrease in nesting effort.

Green heron (GRHE) nests were documented on six islands, with peak nesting effort in July (n=9). The annual peak nest count (n=15) represents a 162 percent increase.

Cattle egret (CAEG) nesting was not documented in Estero Bay in 2019, a 100 percent decrease in nesting effort during the eleven-year period.

Roseate spoonbill (ROSP) nesting were documented on one island in May and June (n=2). The annual peak nest count (n=2) represents a 100 percent increase. This is the third recorded ROSP nesting season in Estero Bay.

Anhinga (ANHI) nesting were documented on one island in July, with a peak nesting effort of one nest. This is the second recorded ANHI nesting season in Estero Bay.

White ibis (WHIB) nesting was not documented in Estero Bay in 2019; since monitoring began, only two WHIB nests were documented in Estero Bay in 2018.

Between January and September 2019, volunteers contributed 365 hours of service to monitoring and protecting wading and diving bird colonies in Estero Bay. Staff and volunteers removed 1172 feet of fishing line and 61 hooks from nesting islands and nearby locations during this time. Large scale cleanups of the islands are conducted after nesting season to minimize disturbance to colonies. After the nesting season of 2018, EBAP staff and volunteers collected 2351 feet of fishing line and 46 hooks. Fourteen bird fatalities (5 DCCO, 4 BRPE, 1 SNEG, 1 ANHI, 1 ROSP, 1 FICR, and 1 unknown) due to fishing line entanglement were documented.

Estero Bay nesting activity exhibits annual variation. Despite the remaining hurricane damage, the annual peak nest counts this season (n=531) was greater than the eleven-year average (n=439) and was the third highest season since monitoring began in 2008. Two new rookery islands were added during the 2019 nesting season. Emily's Keys had GRHE nesting and Taylor Island had GRHE, YCNH, and BCNH.

Six species (BRPE, SNEG, TRHE, REEG, BCNH, and GRHE) showed improvement in nesting activity in 2019 compared to the eleven-year average. For the third time on record, ROSP nested in Estero Bay. Five species (DCCO, GBHE, GREG, LBHE, CAEG, and YCNH) showed a decline in nesting activity in 2019 compared to the eleven-year average. Two species (WHIB and ANHI) also saw a decline in nesting effort, however they were first observed nesting in Estero Bay in 2018 and were therefore only compared to 2018 data.

Table 1: Peak nest counts, by species, for surveys conducted in Estero Bay from 2014 to 2019.

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and July 2014.

Colony	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	CAEG	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	4	0	0	4
Big Bird Island	26.38286	-81.84995	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Big Carlos Pass M-43	26.43155	-81.90066	0	0	0	0	0	0	0	3	0	0	4	0	0	7
Big Carlos Pass M-48	26.42771	-81.90050	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass M-50&52	26.42244	-81.89527	1	0	0	0	0	0	0	0	0	0	5	0	0	6
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Big Carlos Pass W of M-52	26.42469	-81.89359	8	0	16	6	16	5	4	8	3	2	0	0	0	68
Big Hickory E of M-85	26.35315	-81.84164	10	0	0	9	1	2	1	0	0	0	0	0	0	23
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coconut Point East	26.38411	-81.84905	19	0	28	8	6	1	0	0	0	0	0	0	0	62
Coconut Point West	26.38111	-81.84976	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Denegre Key *	26.43772	-81.86728	0	0	0	5	0	0	0	0	0	0	1	3	0	9
Estero River North *	26.43653	-81.86091	0	0	0	0	0	1	0	0	0	0	8	4	0	13
Estero River South *	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	2	1	0	3
Hogue Channel M-78	26.34988	-81.84644	1	0	0	1	0	0	0	0	0	1	4	0	0	7
Matanzas Pass	26.46092	-81.95717	15	0	38	15	5	12	15	13	4	2	0	0	0	119
New Pass M-21	26.38865	-81.85925	0	0	0	1	0	0	0	0	0	0	0	0	0	1
New Pass M-9	26.40465	-81.86816	2	0	0	3	0	0	0	0	0	0	0	0	0	5
North Coconut E of M-3	26.41131	-81.85486	0	0	0	4	3	5	0	0	0	1	0	0	0	13
North Coconut M-4	26.40737	-81.85998	0	0	0	3	0	0	0	0	0	0	0	0	0	3
Ruth's Island	26.40783	-81.85302	0	0	0	2	0	0	0	0	0	0	0	1	0	3
Total			56	0	82	59	31	26	20	24	7	6	29	10	0	350

* Surveys conducted April to July

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and July 2015.

Colony	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	2	0	2
Big Bird Island	26.38286	-81.84995	0	0	0	2	0	0	0	0	0	0	0	0	2
Big Carlos Pass M-43	26.43155	-81.90066	1	0	0	2	0	0	0	0	0	0	3	0	6
Big Carlos Pass M-48	26.42771	-81.90050	0	0	0	1	0	0	0	1	0	0	4	0	6
Big Carlos Pass M-50&52	26.42244	-81.89527	0	0	0	0	0	0	0	0	0	0	1	0	1
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	0	1	0	0	0	0	0	0	0	0	1
Big Carlos Pass W of M-52	26.42469	-81.89359	9	0	18	5	10	7	1	9	2	5	3	0	69
Big Hickory E of M-85	26.35315	-81.84164	3	0	0	6	2	0	0	0	1	1	0	0	13
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	1	0	1
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0
Coconut Point East	26.38411	-81.84905	26	0	38	8	6	1	0	0	0	2	0	0	81

Coconut Point West	26.38111	-81.84976	0	0	0	1	0	0	0	0	0	0	0	0	1
Denegre Key	26.43772	-81.86728	0	0	0	4	0	0	0	0	0	0	5	6	15
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	0	1	1
Estero River North	26.43653	-81.86091	0	0	0	0	0	0	0	0	0	0	7	4	11
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	1	0	1
Hogue Channel M-78	26.34988	-81.84644	0	0	0	0	0	0	0	0	0	0	4	0	4
Matanzas Pass	26.46092	-81.95717	22	0	42	16	3	16	7	17	5	3	1	0	132
New Pass M-21	26.38865	-81.85925	0	0	0	0	0	0	0	0	0	0	0	0	0
New Pass M-9	26.40465	-81.86816	3	0	0	4	0	0	0	0	0	0	0	0	7
North Coconut E of M-3	26.41131	-81.85486	0	0	0	4	4	8	1	1	0	1	2	0	21
North Coconut M-4	26.40737	-81.85998	0	0	0	0	0	0	0	0	0	0	0	0	0
Ruth's Island	26.40783	-81.85302	0	0	0	1	0	0	0	0	0	0	0	1	2
Total			64	0	98	55	25	32	9	28	8	12	34	12	377

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and July 2016.

Colony	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	1	0	1
Big Bird Island	26.38286	-81.84995	0	0	0	4	0	0	0	0	0	0	0	0	4
Big Carlos Pass M-43	26.43155	-81.90066	0	0	0	0	0	0	0	0	0	0	3	0	3
Big Carlos Pass M-48	26.42771	-81.90050	0	0	0	0	0	0	0	0	0	0	0	1	1
Big Carlos Pass M-50&52	26.42244	-81.89527	8	0	0	4	0	0	0	0	0	1	1	1	15
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-52	26.42469	-81.89359	7	0	26	6	20	12	2	11	3	6	0	0	93
Big Hickory E of M-85	26.35315	-81.84164	6	0	0	10	2	0	0	0	3	0	0	0	21
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0
Coconut Point East	26.38411	-81.84905	23	0	54	6	7	7	1	0	1	4	0	0	103
Coconut Point West	26.38111	-81.84976	0	0	0	4	0	0	0	0	0	0	0	0	4

Denegre Key	26.43772	-81.86728	0	0	0	6	0	0	0	1	0	1	3	6	17
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	0	1	1
Estero River North	26.43653	-81.86091	0	0	0	0	0	0	0	0	0	0	0	1	1
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	0	0	0
Hogue Channel M-78	26.34988	-81.84644	1	0	0	0	0	0	0	0	0	0	4	0	5
Matanzas Pass	26.46092	-81.95717	21	0	47	13	6	11	6	20	4	1	1	0	130
New Pass M-21	26.38865	-81.85925	0	0	0	1	0	0	0	0	0	0	0	0	1
New Pass M-9	26.40465	-81.86816	1	0	0	7	0	0	0	0	0	0	0	0	8
North Coconut E of M-3	26.41131	-81.85486	0	0	0	3	2	3	0	2	0	3	0	0	13
North Coconut M-4	26.40737	-81.85998	0	0	0	0	0	0	0	0	0	0	0	0	0
Ruth's Island	26.40783	-81.85302	0	0	0	1	0	0	0	0	0	0	0	0	1
Total			67	0	127	65	37	33	9	34	11	16	13	10	422

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and August 2017.

Colony	Latitude	Longitude	DCCO	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	BCNH	YCNH	GRHE	CAEG	ROSP	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Bird Island	26.38286	-81.84995	0	0	1	0	0	0	1	0	0	0	0	0	0	2
Big Carlos Pass M-43	26.43155	-81.90066	3	0	3	0	0	0	0	0	0	2	0	0	0	8
Big Carlos Pass M-48	26.42771	-81.90050	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Big Carlos Pass M-50&52	26.42244	-81.89527	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass S of M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-46	26.42926	-81.90137	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Carlos Pass W of M-52	26.42469	-81.89359	8	18	6	25	6	0	12	2	2	1	0	0	0	80
Big Hickory E of M-85	26.35315	-81.84164	7	0	11	2	1	1	0	1	0	0	0	0	0	23
Big Hickory M-83	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 2NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Hickory M-49 3NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coconut Point East	26.38411	-81.84905	20	47	8	12	11	1	1	1	3	0	0	0	1	105

Coconut Point West	26.38111	-81.84976	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Denegre Key	26.43772	-81.86728	0	0	7	0	1	0	2	0	2	1	2	0	0	15
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Estero River North	26.43653	-81.86091	0	0	3	0	0	0	0	0	0	1	0	0	0	4
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hogue Channel M-78	26.34988	-81.84644	0	0	0	0	0	0	0	0	0	4	0	0	0	4
Matanzas Pass	26.46092	-81.95717	14	53	11	4	15	8	38	1	3	0	0	2	0	149
New Pass M-21	26.38865	-81.85925	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Pass M-9	26.40465	-81.86816	0	0	5	0	0	0	0	0	0	0	0	0	0	5
North Coconut E of M-3	26.41131	-81.85486	0	0	4	3	9	0	4	0	0	0	0	0	0	20
North Coconut M-4	26.40737	-81.85998	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Ruth's Island	26.40783	-81.85302	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total			**52**	**118**	**64**	**46**	**43**	**10**	**59**	**5**	**10**	**10**	**3**	**2**	**1**	**423**

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and August 2018.

Island	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	BCNH	YCNH	GRHE	ROSP	Total
619038c	26.36737	-81.84357	0	0	0	1	0	0	0	0	0	0	0	1	0	0	**2**
Big Bird Island	26.38286	-81.84995	0	0	0	2	0	0	0	0	0	0	0	0	0	0	**2**
Big Carlos Pass between M-50&52	26.43155	-81.90066	11	0	0	7	1	0	0	0	0	0	0	6	0	0	**25**
Big Carlos Pass M-43	26.42771	-81.90050	0	0	0	0	0	0	0	0	0	0	0	0	3	0	**3**
Big Carlos Pass M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Big Carlos Pass S of M-48	26.42774	-81.90218	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Carlos Pass between M-46&48	26.42926	-81.90137	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Big Carlos Pass W of M-46	26.42244	-81.89527	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Carlos Pass W of M-52	26.42469	-81.89359	11	0	52	2	51	6	2	18	2	1	10	0	0	0	**155**
Big Hickory E of M-85	26.35315	-81.84164	19	1	0	17	4	1	0	2	2	0	4	0	0	0	**50**
Big Hickory M-83 Seagrass Island	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Hickory Pass M-49 2 NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Big Hickory Pass M-49 3 NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Coconut Point East	26.38411	-81.84905	23	1	16	3	21	5	1	2	1	0	3	0	0	0	**76**
Coconut Point West	26.38111	-81.84976	0	0	0	6	0	0	0	0	0	0	0	0	0	0	**6**
Chain of Islands	26.43803	-81.86937	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Denegre Key	26.43772	-81.86728	2	0	0	8	1	1	1	4	0	0	8	1	0	0	**26**
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Estero River North	26.43653	-81.86091	0	0	0	0	0	0	0	0	0	0	0	4	0	0	**4**
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Houge Channel M-78	26.34988	-81.84644	0	0	0	0	0	0	0	0	0	0	0	3	0	0	**3**
Hurricane Pass/Rebecca's Island	26.46812	-81.95352	0	0	0	3	0	0	0	0	0	0	0	1	0	1	**5**
Matanzas Pass	26.46092	-81.95717	21	0	77	11	19	21	14	30	4	3	7	0	0	0	**209**
Little Davis Key	26.39682	-81.86441	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
New Pass M-21	26.38865	-81.85925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
New Pass M-9	26.40465	-81.86816	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Kelsey's Island	26.40498	-81.86449	0	0	0	3	0	0	0	0	0	0	0	0	0	0	**3**
North Coconut M-2	26.40572	-81.86338	0	0	0	8	0	0	0	0	0	0	0	0	0	0	**8**
North Coconut E of M-3	26.41131	-81.85486	0	0	0	1	5	14	2	7	0	0	9	0	0	0	**38**

North Coconut M-4	26.40737	-81.85998	9	0	33	5	15	0	0	0	0	0	0	0	0	0	**62**
Ruth's Island	26.40783	-81.85302	0	0	0	1	0	0	0	0	0	0	1	0	0	0	**2**
Taryn's Key	26.41069	-81.85412	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Total			**96**	**2**	**178**	**80**	**117**	**48**	**20**	**63**	**9**	**4**	**43**	**17**	**6**	**1**	**686**

Peak nest counts documented in Estero Bay Aquatic Preserve colonies between January and August 2019.

Island	Latitude	Longitude	DCCO	ANHI	BRPE	GBHE	GREG	SNEG	LBHE	TRHE	REEG	CAEG	BCNH	YCNH	GRHE	ROSP	Total
619038c	26.36737	-81.84357	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Bird Island	26.38286	-81.84995	2	0	0	2	0	0	0	0	0	0	1	0	0	0	**5**
Big Carlos Pass between M-50&52	26.43155	-81.90066	4	0	0	4	0	0	0	0	0	0	1	5	0	0	**14**
Big Carlos Pass M-43	26.42771	-81.90050	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Big Carlos Pass M-48	26.42672	-81.89852	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Carlos Pass S of M-48	26.42774	-81.90218	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Carlos Pass between M-46&48	26.42926	-81.90137	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Big Carlos Pass W of M-46	26.42244	-81.89527	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Carlos Pass W of M-52	26.42469	-81.89359	3	0	58	0	20	7	1	17	2	0	4	0	0	0	**112**
Big Hickory E of M-85	26.35315	-81.84164	5	0	0	5	0	0	0	0	2	0	1	0	0	0	**13**
Big Hickory M-83 Seagrass Island	26.35057	-81.84388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big Hickory Pass M-49 2 NW	26.36766	-81.84658	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Big Hickory Pass M-49 3 NW	26.36831	-81.84698	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Coconut Point East	26.38411	-81.84905	16	1	69	1	9	7	2	2	0	0	4	0	0	2	**113**
Coconut Point West	26.38111	-81.84976	0	0	0	2	0	0	0	0	0	0	0	0	0	0	**2**
Chain of Islands	26.43803	-81.86937	0	0	0	0	0	0	0	0	0	0	0	0	6	0	**6**
Denegre Key	26.43772	-81.86728	2	0	0	3	0	1	0	7	1	0	5	0	1	0	**20**
Estero River M-30	26.43029	-81.86113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Estero River North	26.43653	-81.86091	0	0	0	1	0	0	0	0	0	0	0	7	2	0	**10**
Estero River South	26.43416	-81.86211	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Houge Channel M-78	26.34988	-81.84644	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Hurricane Pass/Rebecca's Island	26.46812	-81.95352	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Matanzas Pass	26.46092	-81.95717	14	0	100	13	5	13	5	28	8	0	2	1	0	0	**189**
Little Davis Key	26.39682	-81.86441	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
New Pass M-21	26.38865	-81.85925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
New Pass M-9	26.40465	-81.86816	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Kelsey's Island	26.40498	-81.86449	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
North Coconut M-2	26.40572	-81.86338	0	0	0	2	0	0	0	0	0	0	0	0	0	0	**2**
North Coconut E of M-3	26.41131	-81.85486	0	0	0	2	7	5	1	3	1	0	2	1	0	0	**22**

North Coconut M-4	26.40737	-81.85998	0	0	0	6	4	0	0	0	0	0	0	0	0	0	**10**
Ruth's Island	26.40783	-81.85302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Taryn's Key	26.41069	-81.85412	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Emily's Keys*	26.45286	-81.86753	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**
Taylor Island**	26.42438	-81.89769	0	0	0	0	0	0	0	0	0	0	1	1	3	0	**5**
Total			**46**	**1**	**227**	**44**	**45**	**33**	**9**	**57**	**14**	**0**	**21**	**17**	**15**	**2**	**531**

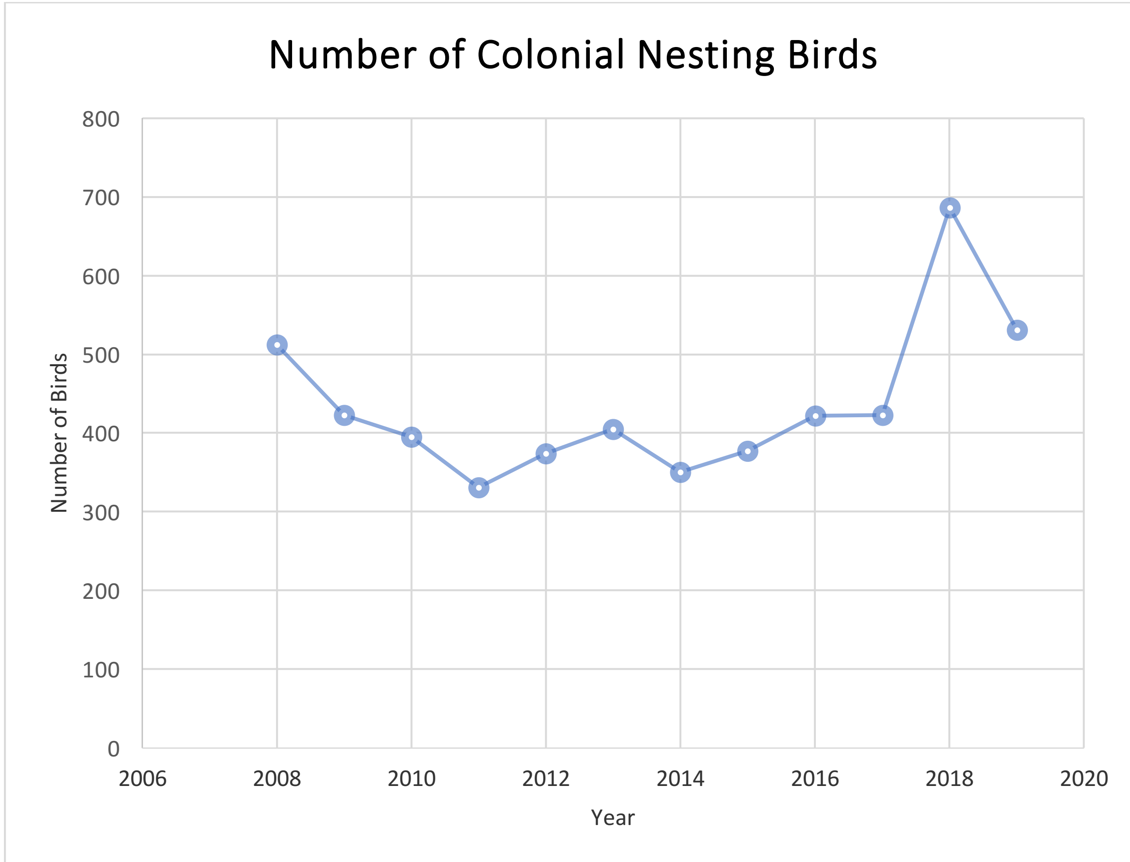


Figure 2: Peak nest counts, by species, for surveys conducted in Estero Bay from 2008 to 2019

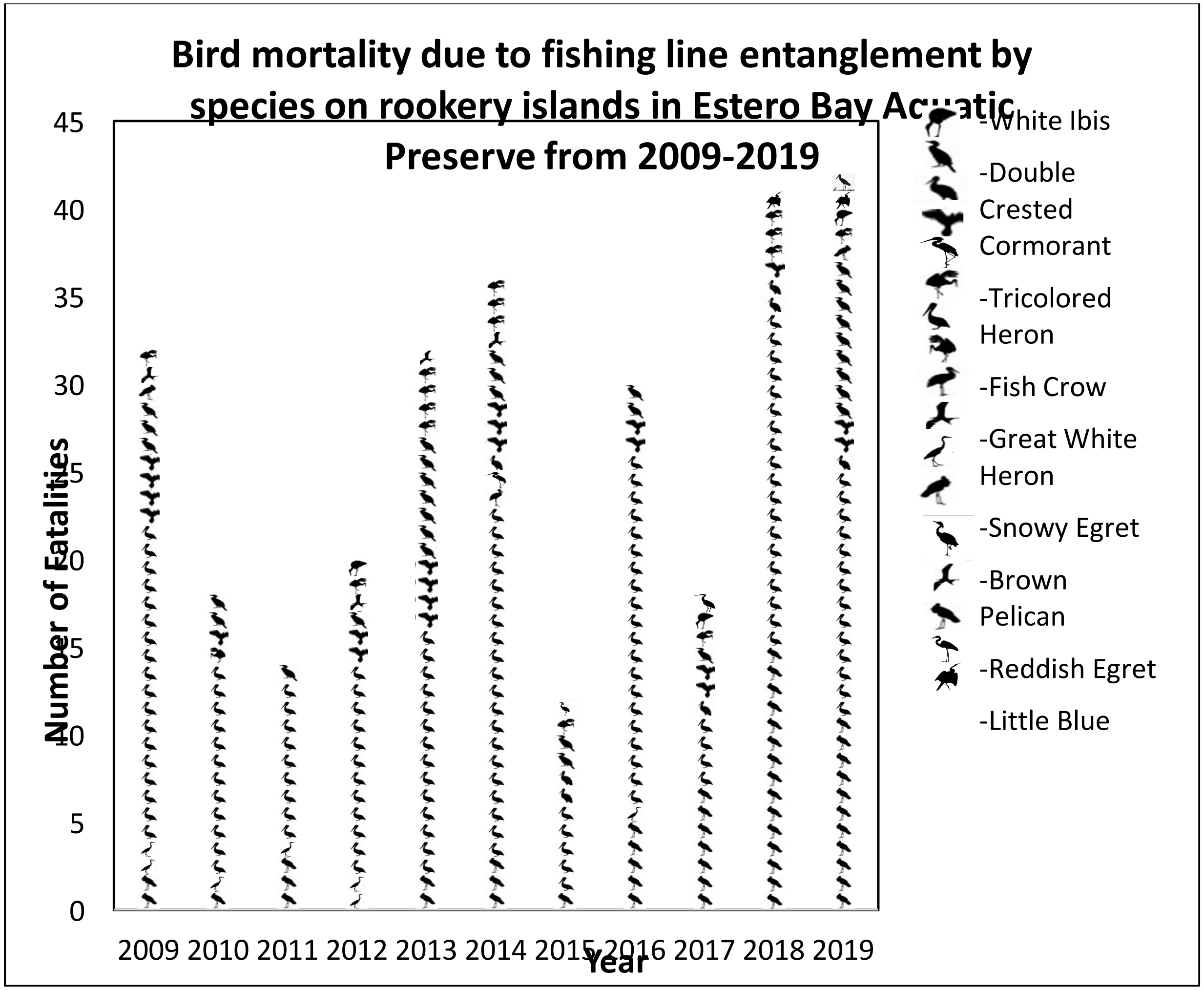
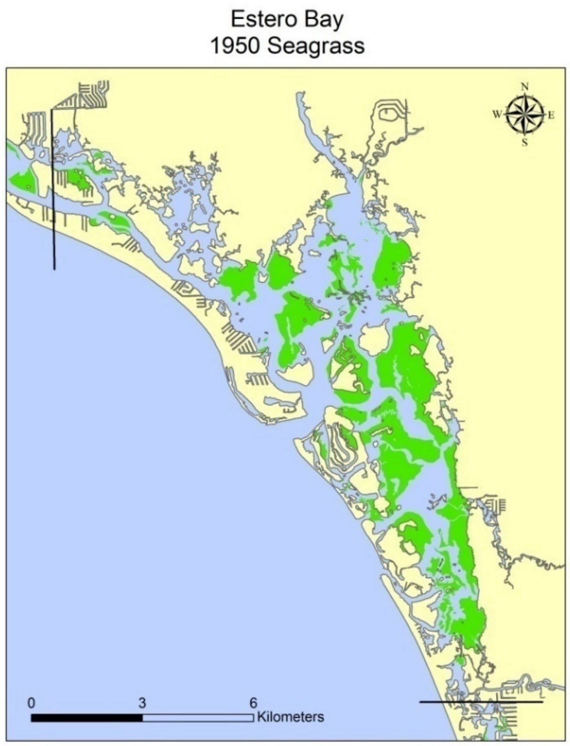
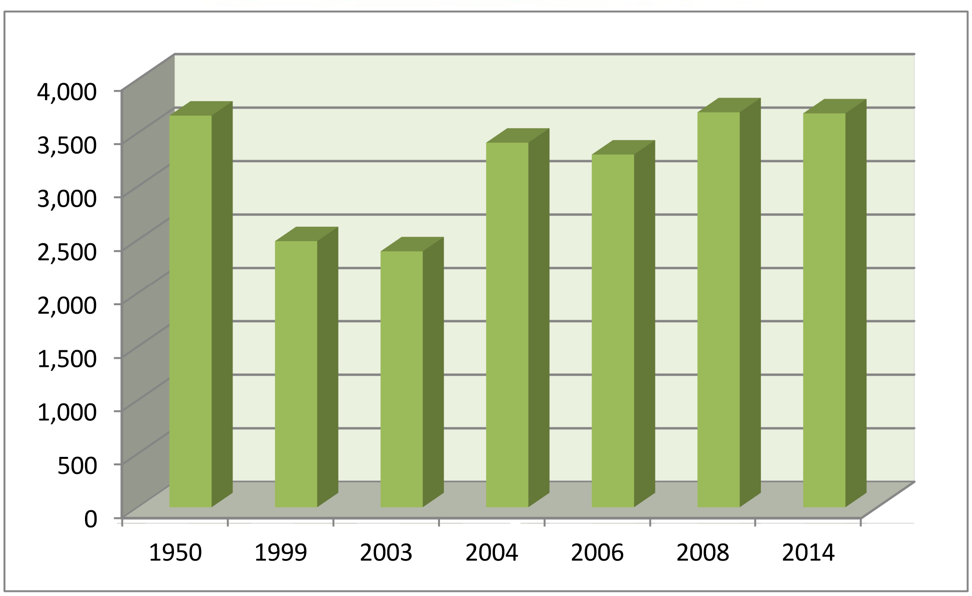


Figure 1: Bird mortality due to fishing line entanglement by species on nesting islands in Estero Bay Aquatic Preserve from 2008 to 2013.

Factor: Seagrass Extents

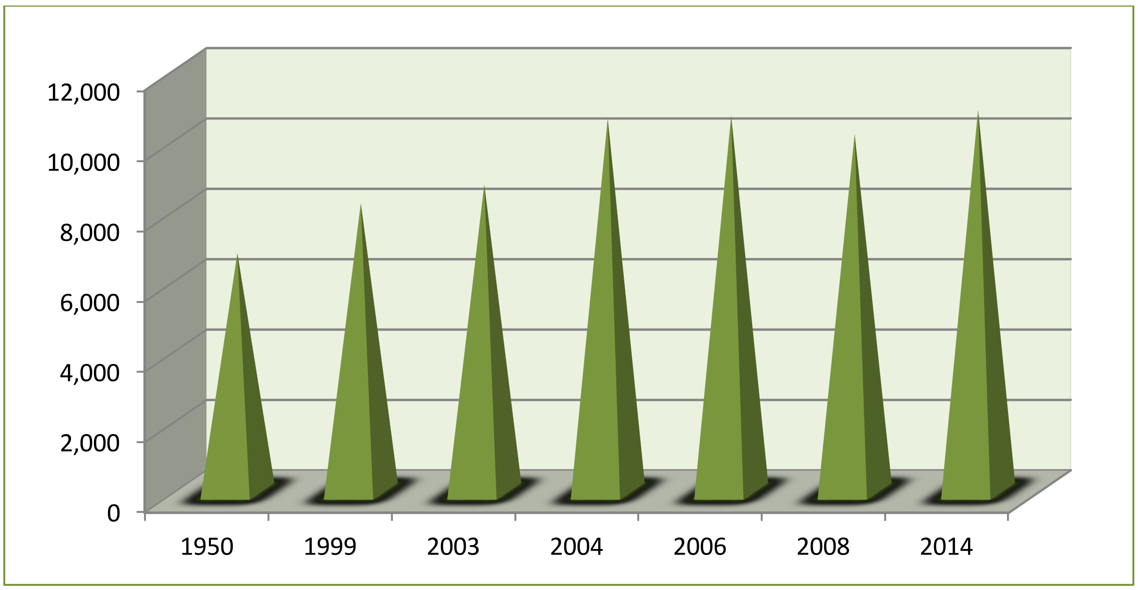
It is estimated that, in 1950, Estero Bay contained 3,769 acres of seagrasses. While seagrass acreage declined between 1950 and 1999, significant gains have been made since then. All figures and data for analysis in this section are from the South Florida Water Management District (2014).



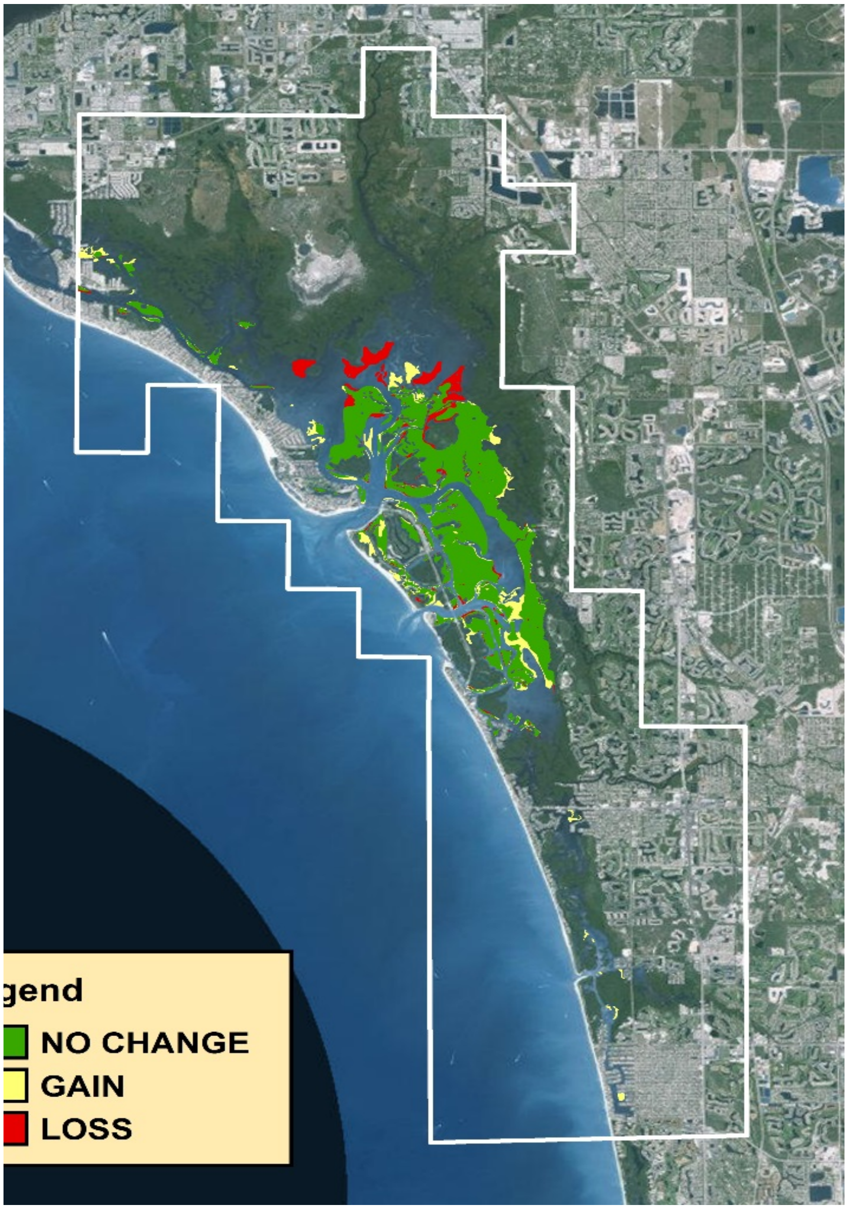


Change in Seagrass Acreages in the Estero Bay Segment of the CHNEP

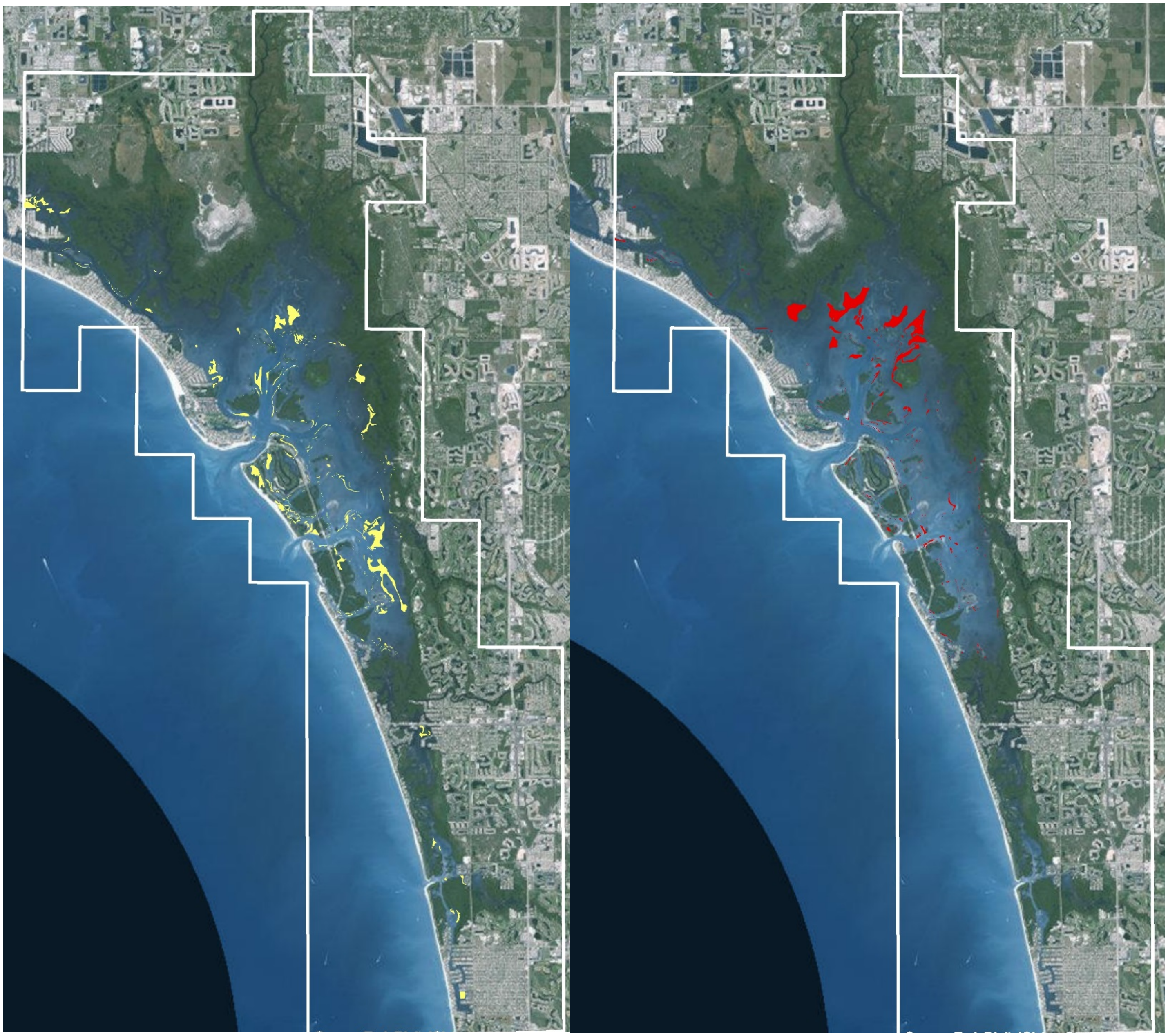
Seagrass Acreages in the Estero Bay Segments of the CHNEP							
Harbor Segment	**1950s**	**1999**	**2003**	**2004**	**2006**	**2008**	**2014**
San Carlos Bay	3,118	3,709	4,338	5,192	5,376	6,482	7,167
Estero Bay	3,662	2,488	2,393	3,409	3,298	3,683	3,683
TOTAL	6,780	8,196	8,734	10,605	10,680	10,165	10,850



Change in Seagrass Acreages in the Estero Bay and San Carlos Bay Segments of the CHNEP



Estero Bay	
2008–2014 Seagrass	
Coverage	**Acreage**
No Change	3,162
Gain	520
Loss	428



Losses (red) and gains (yellow) are usually found along deeper edge of beds and shoaling areas.

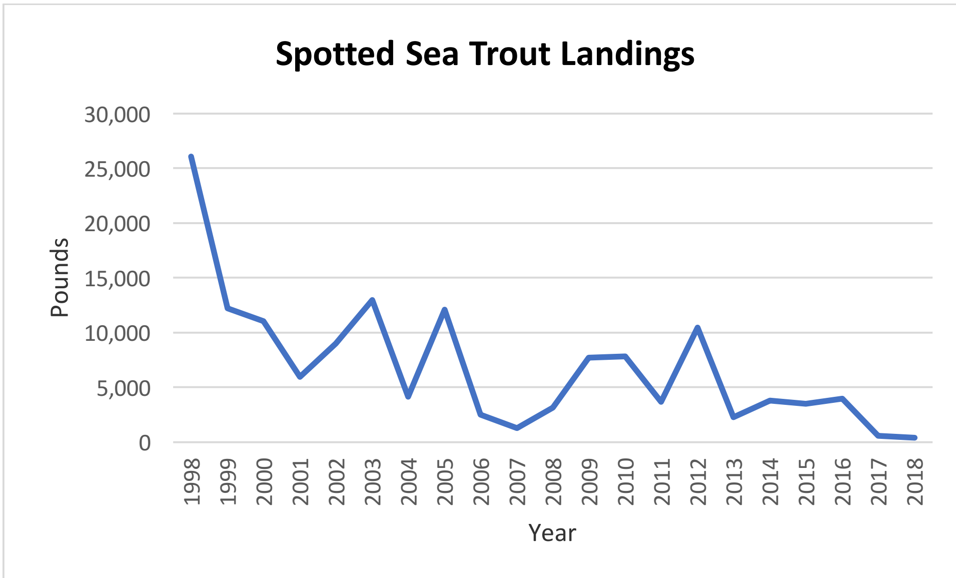
Persistence of seagrass has also been tracked. Persistence appears to be linked to water depth, with the most persistent areas being shallower and near-shore. It is estimated that Estero Bay contains 107 acres of seagrasses that have been lost and are not restorable.

Factor: Landings

Data on fisheries landings for all of Lee County were collected for Spotted Sea Trout, Mullet, and Blue Crab. Pounds (landings), number of trips and landings per trip are shown below for all three species. Landings for all three species have had a downward trend for the period between 1998 and 2019. In addition, the number of successful fishing trips for the three species has similarly declined. Blue crab landings have been increasing from a low period in 2013.

Spotted Sea Trout
1998-2018

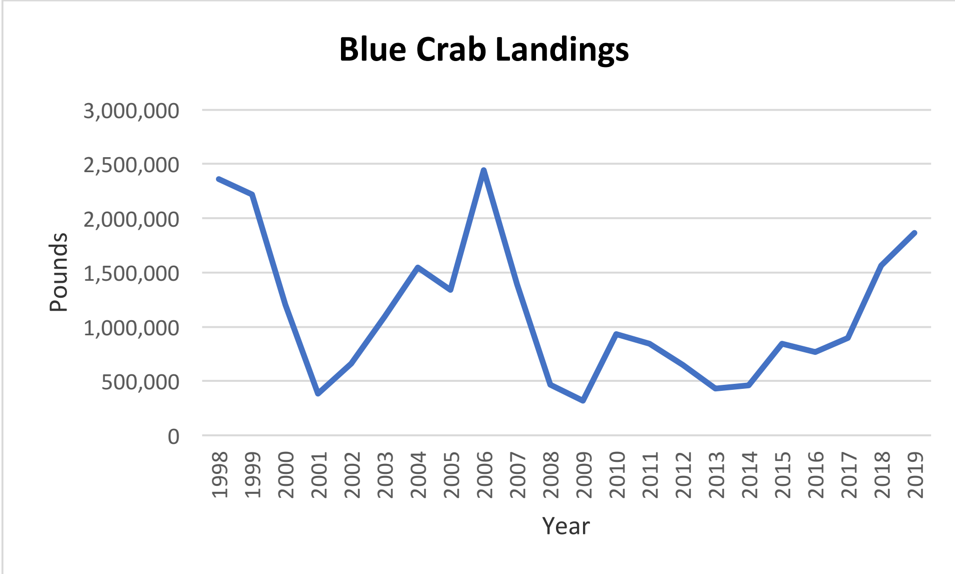
Year	Landings	Trips	Landings/Trip
1998	26,085	949	27
1999	12,224	566	22
2000	11,054	636	17
2001	5,975	369	16
2002	8,963	358	25
2003	12,985	392	33
2004	4,120	198	21
2005	12,113	359	34
2006	2,479	149	17
2007	1,248	95	13
2008	3,166	142	22
2009	7,706	377	20
2010	7,817	282	28
2011	3,683	157	23
2012	10,435	353	30
2013	2,268	114	20
2014	3,798	323	12
2015	3,521	239	15
2016	3,967	253	16
2017	574	134	4
2018	415	80	5
1998-2018 change	-98.4 %	-91.6	-81.5



Spotted Sea Trout Landings
30,000
25,000
20,000
15,000
10,000
5,000
0
Pounds
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year

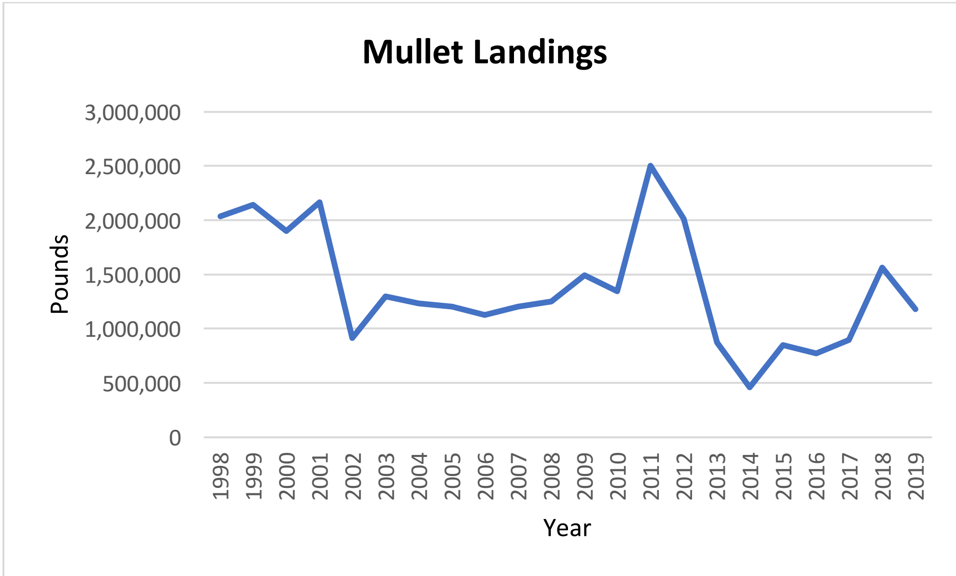
Blue Crab
1998-2013

Year	Landings	Trips	Landings/Trip
1998	2,361,740	8,889	266
1999	2,217,971	8,549	259
2000	1,205,304	6,194	195
2001	384,724	3,075	125
2002	661,615	3,914	169
2003	1,092,288	4,967	220
2004	1,547,053	4,606	336
2005	1,338,285	4,708	284
2006	2,441,143	6,343	385
2007	1,390,276	5,087	273
2008	463,839	2,879	161
2009	317,974	2,238	142
2010	932,757	3,910	239
2011	842,171	3,763	224
2012	649,485	3,039	214
2013	428,421	1,857	231
2014	459,810	2,410	191
2015	846,120	3,581	236
2016	769,884	3,744	206
2017	896.123	3,905	299
2018	1,565,346	4,931	317
1998-2018 change	-22.34%	-44.52%	+19.17%


Blue Crab Landings
Pounds
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year

Mullet
1998-2013

Year	Landings	Trips	Landings/Trip
1998	*2,035,783*	*6,755*	*301*
1999	*2,141,311*	*5,904*	*363*
2000	*1,900,655*	*5,586*	*340*
2001	*2,168,389*	*5,045*	*430*
2002	*912,046*	*3,118*	*293*
2003	*1,296,915*	*3,828*	*339*
2004	*1,229,949*	*4,123*	*298*
2005	*1,202,347*	*3,888*	*309*
2006	*1,127,618*	*3,669*	*307*
2007	*1,202,984*	*3,643*	*330*
2008	*1,247,834*	*3,392*	*368*
2009	*1,493,269*	*4,500*	*332*
2010	*1,344,186*	*4,113*	*327*
2011	*2,504,178*	*4,836*	*518*
2012	*2,014,653*	*4,805*	*419*
2013	*871,807*	*2,565*	*340*
2014	*459,810*	*2,410*	*191*
2015	*846,120*	*3,581*	*236*
2016	*769,884*	*3,744*	*206*
2017	*896,123*	*3,905*	*229*
2018	*1,565,346*	*4,931*	*317*
2019	*1,178,016*	*3,931*	*299*
1998-2008 change	*-57.87%*	*-58.19%*	*-0.6%*



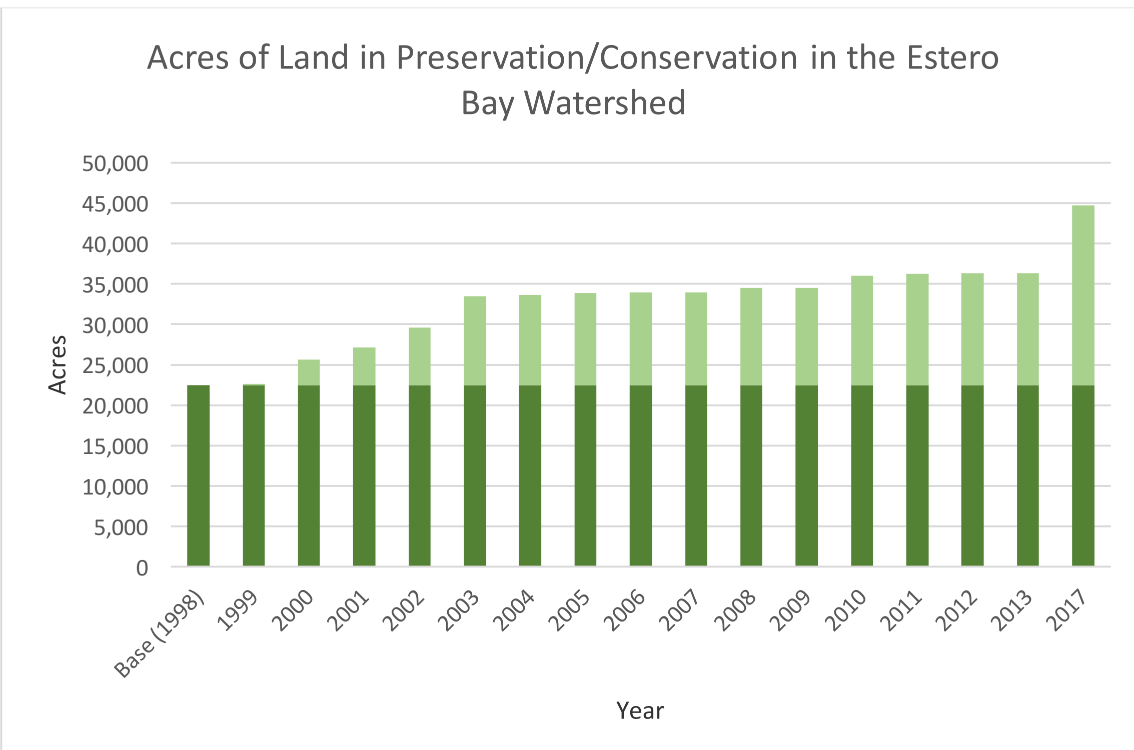
Mullet Landings
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Pounds
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year

Conservation Lands Extents

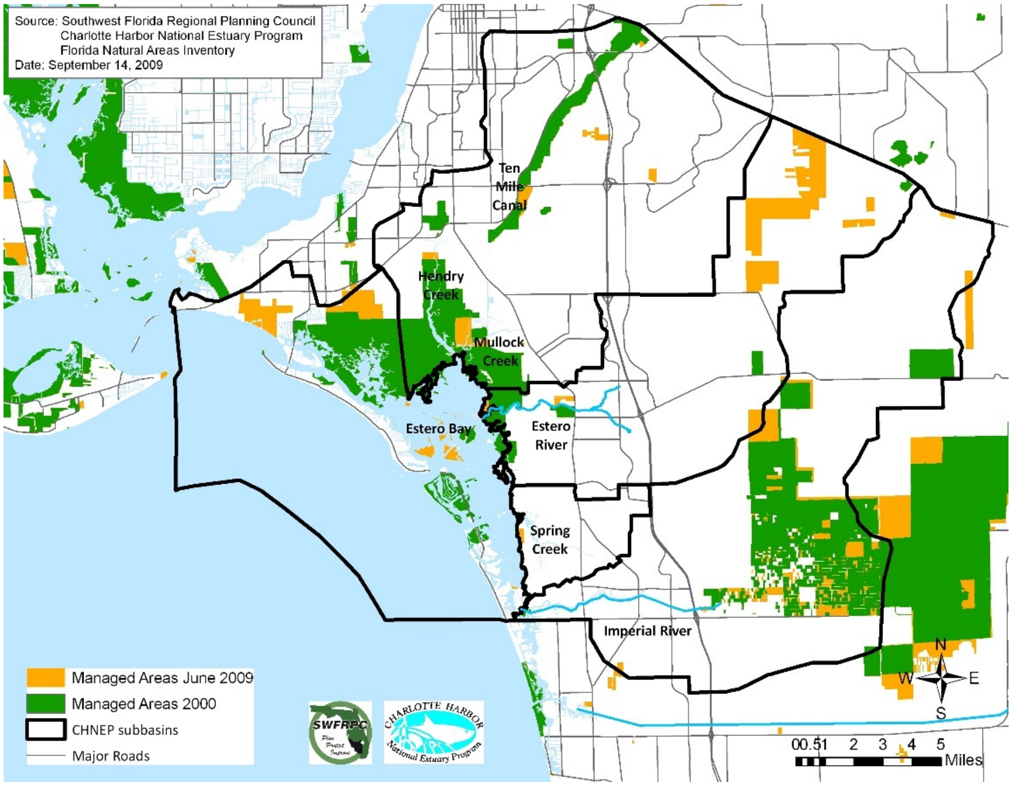
It is estimated that, in 1998, the Estero Bay watershed contained 22,502 acres of conservation lands. Significant gains (98.81% increase) have been made since then. A plateau and decline in land acquisition progress began in 2011 and is continued until 2017 with the most significant activity coming from local government. All figures and data for analysis in this section are from CHNEP (2019).

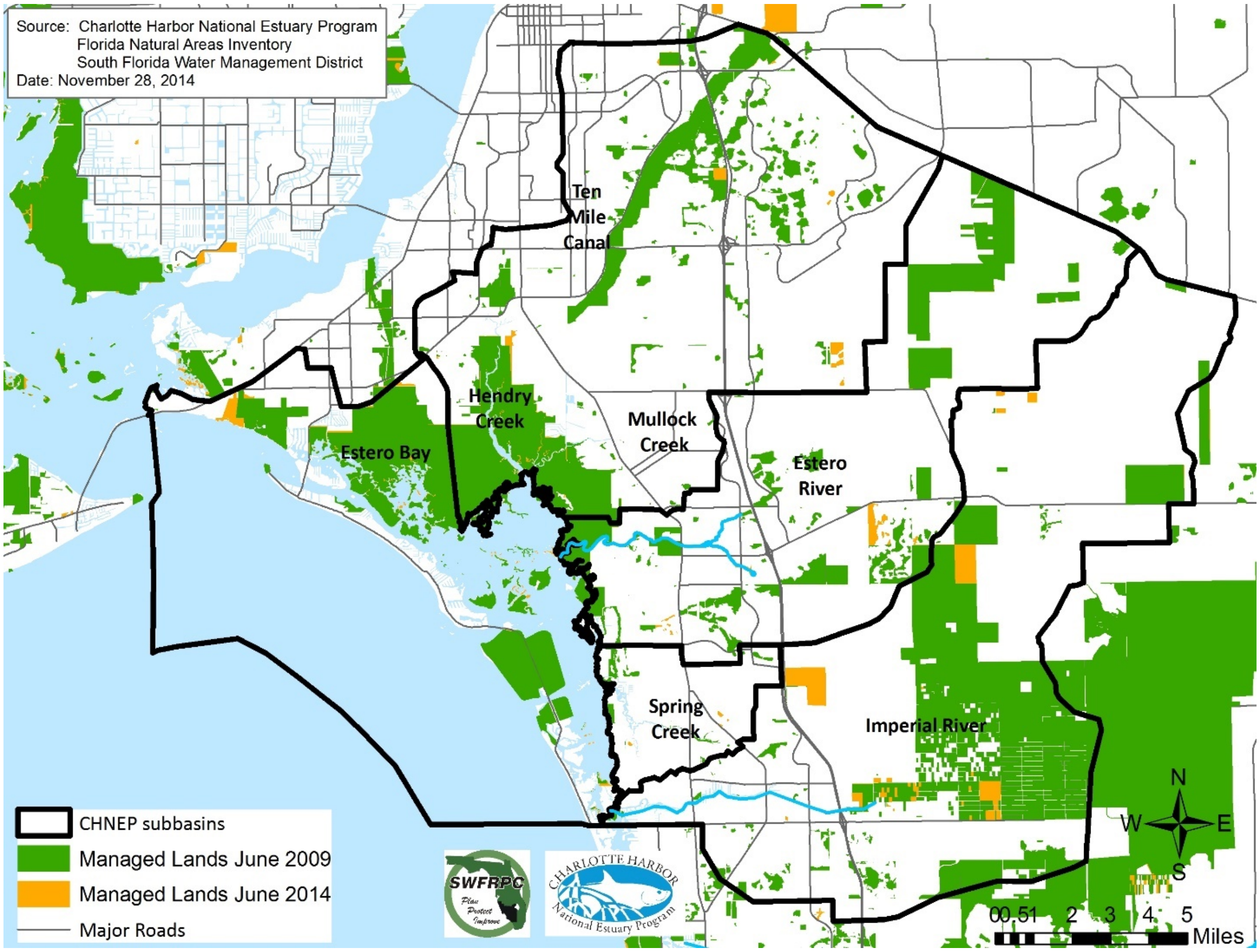
Year	Base (1998)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acres	22,502	122	3,032	1,491	2,429	3,887	167	238	109	1,042	511

Year	2009	2010	2011	2012	2013	2017
Acres	19	1,523	210	63	0	22,234

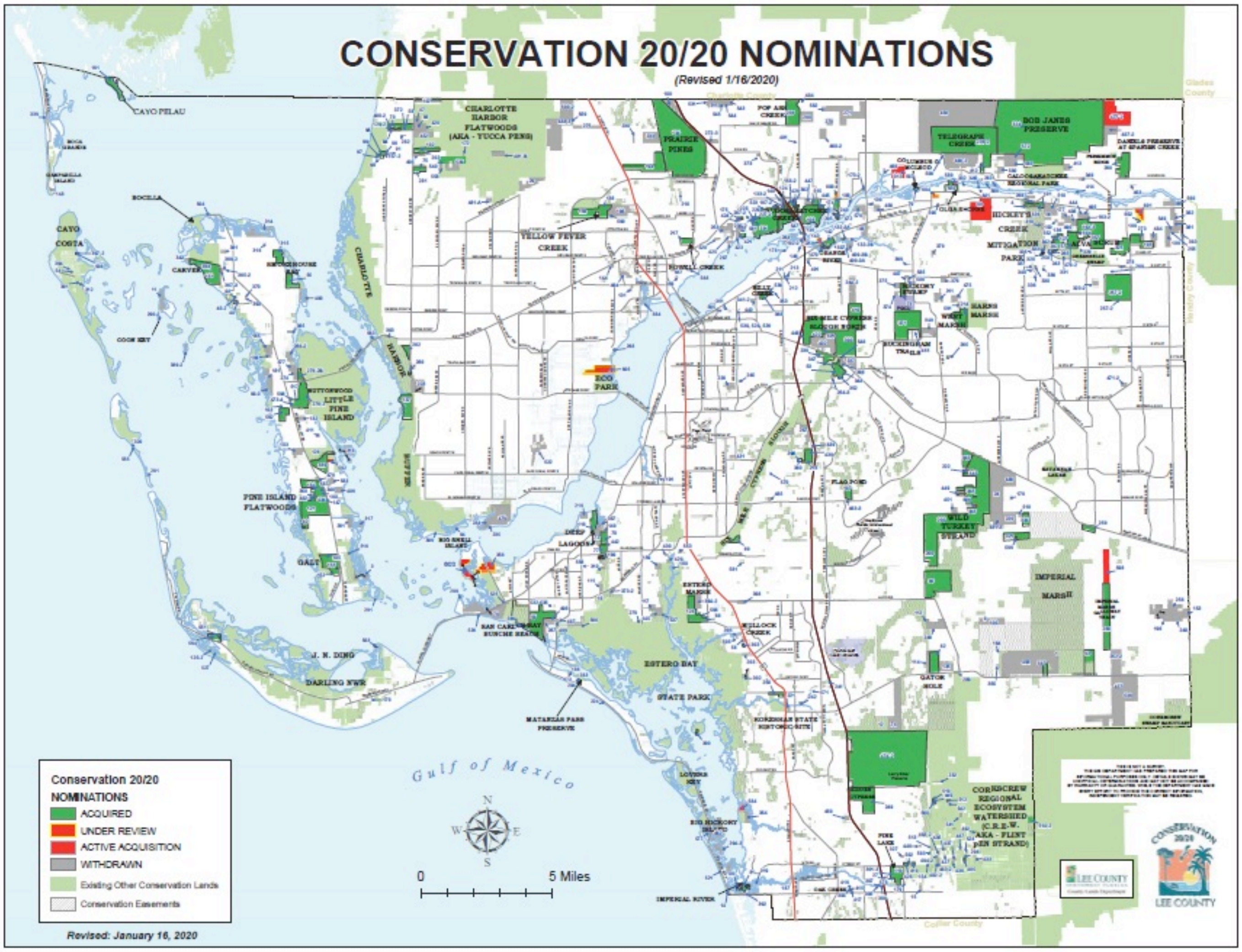


Original Target CCMP Acres	Total CCMP Additions in Acres	Total Acres	Percent Increase over Base
5,626 (25%)	22,234	44,736	98.81%


Source: Southwest Florida Regional Planning Council
Charlotte Harbor National Estuary Program
Florida Natural Areas Inventory
Date: September 14, 2009
Ten
Mile
Canal
Hendry
Creek
Mullock
Creek
Estero Bay
Estero
River
Spring
Creek
Imperial River
Managed Areas June 2009
Managed Areas 2000
CHNEP subbasins
Major Roads
N
W
E
S
0 0.5 1 2 3 4 5
Miles



2014 Conservation Lands of the Estero Bay Watershed with Conservation Easements



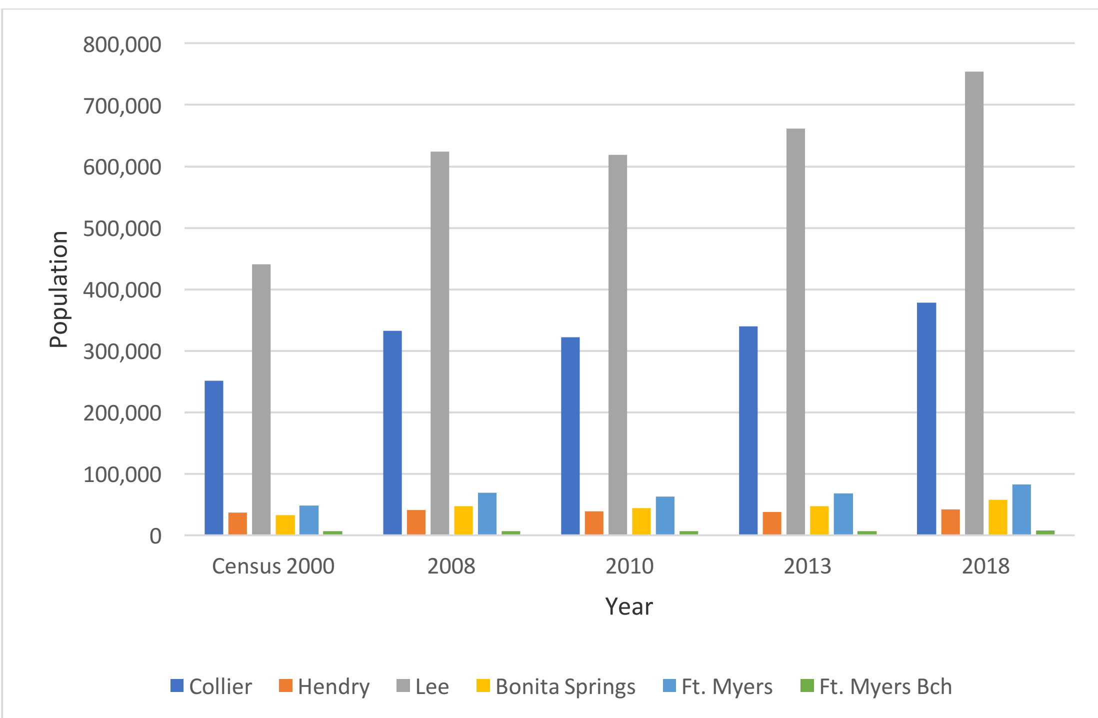
CONSERVATION 20/20 NOMINATIONS
(Revised 1/16/2020)
CAYO PELAU
CHARLOTTE HARBOR FLATWOODS (AKA - YUCCA PENS)
PRAIRIE PINES
BOB JANES PRESERVE
TELEGRAPH CREEK
YELLOW FEVER CREEK
HICKEY'S CREEK MITIGATION PARK
ALVA SCRUB
ECO PARK
BUTTONWOOD LITTLE PINE ISLAND
PINE ISLAND FLATWOODS
GALT
WILD TURKEY STRAND
IMPERIAL MARSH
DEEP LAGOON
BIG SHELL ISLAND
SAN CARLOS BAY BUNCHE BEACH
J. N. DING DARLING NWR
ESTERO BAY STATE PARK
MATANZAS PASS PRESERVE
Gulf of Mexico
CORKSCREW REGIONAL ECOSYSTEM WATERSHED (C.R.E.W. AKA - FLINT PEN STRAND)
IMPERIAL RIVER
N
S
W
E
0
5 Miles
Conservation 20/20
NOMINATIONS
ACQUIRED
UNDER REVIEW
ACTIVE ACQUISITION
WITHDRAWN
Existing Other Conservation Lands
Conservation Easements
Revised: January 16, 2020
CONSERVATION 20/20
LEE COUNTY

Social

Factor: Population

At the time of the 2000 Census, the Estero Bay Basin had nearly 145,000 people living within its boundaries. By 2010, the Estero Bay basin population had grown by a third to over 195,000. Most of the population has been concentrated around Estero Bay itself. The presence of the Estero Bay state preserve has served as a buffer, keeping development back from the edges of the bay. Since the last State of the Bay report, there have been significant changes in population and development trends, most recently with a slight decline in population in Hendry County, Fort Myers, and Fort Myers Beach occurring as a result of the economic downturn of 2008-2009. In contrast Collier County, Lee County, and Bonita Springs continued to grow in population at a lower rate. By 2018 the population is estimated to be 248,000 (25% increase since 2014 and a 71% increase since 2000).

The figures below reflect population in the counties and cities that contribute to the Estero Bay Watershed. Most of the population within the watershed resides within Lee County.

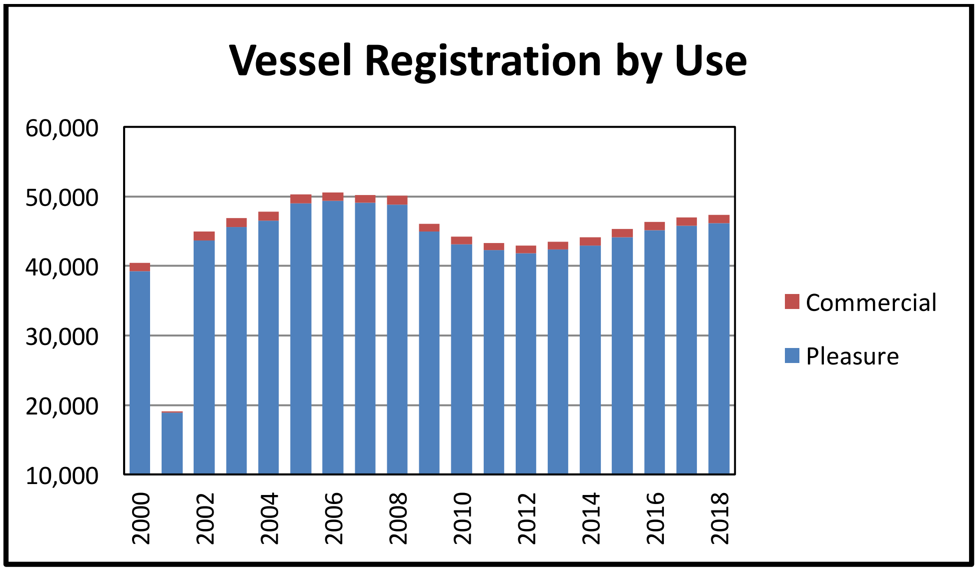


(Southwest Florida Regional Planning Council 2009)

Factor: Boating

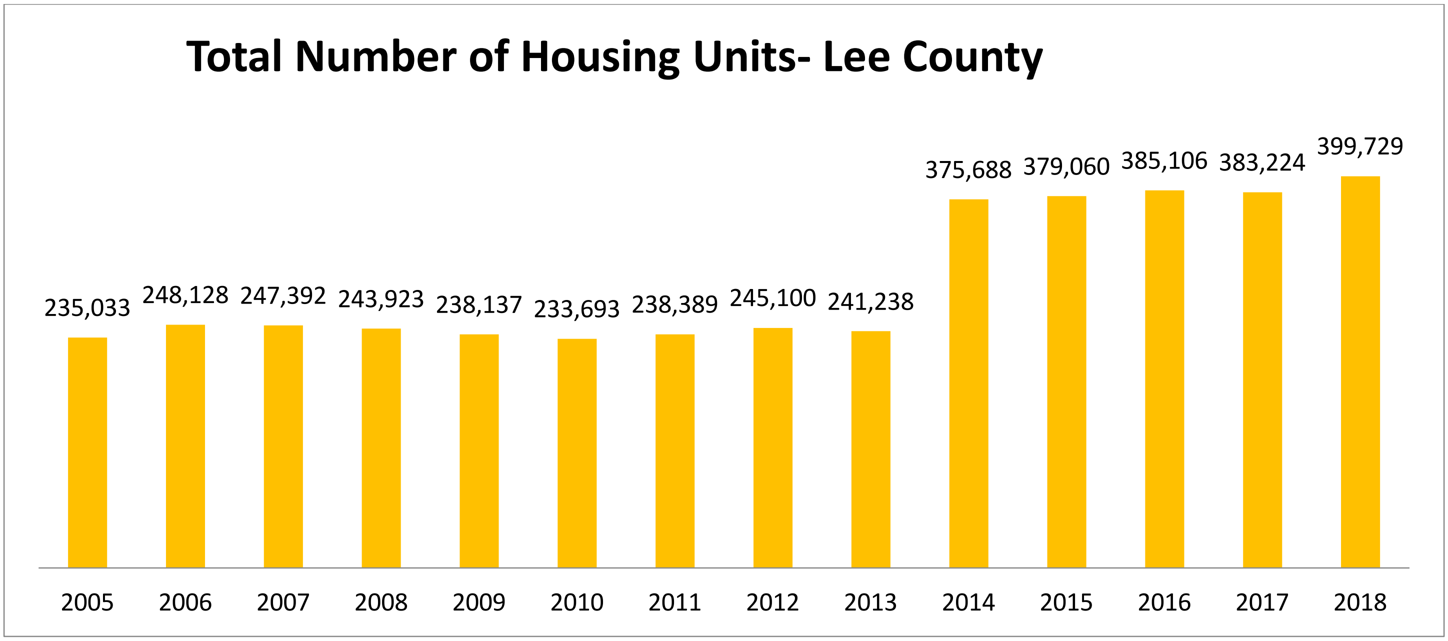
Vessel registrations in Lee County are dominated by recreational vessels that are less than 26 feet in length. Vessels from all over the region and from various parts of the US and Caribbean utilize and moor in the waters of Estero Bay, and many of these are not registered in Lee County, but in their home ports, so quantifying that level of utilization is very difficult. The figures below only reflect vessels that are registered in Lee County.

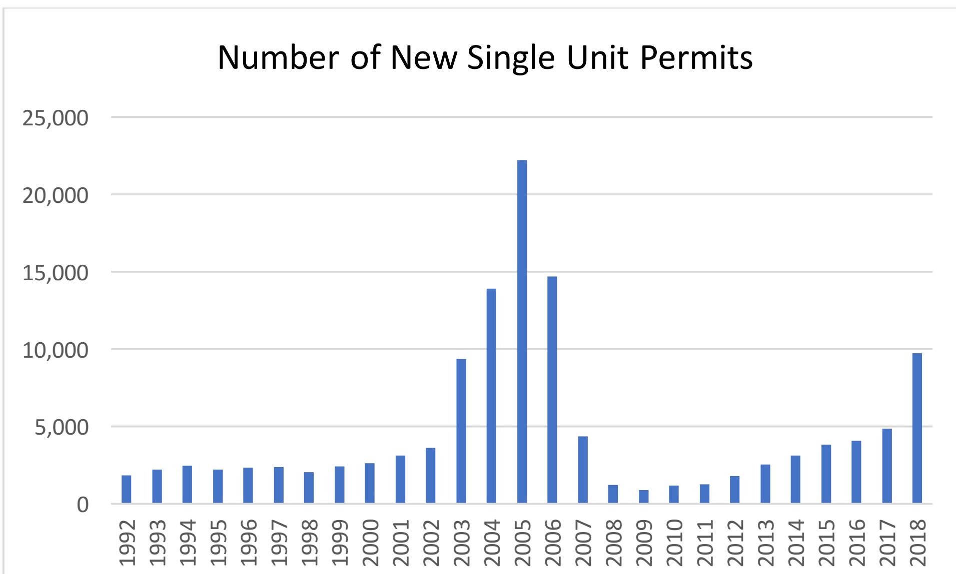
Trends in recreational vessel registrations generally reflect the state of the economy and available disposable income.



Year	Number of Canoes Registered
2000	0
2001	86
2002	268
2003	309
2004	351
2005	367
2006	382
2007	410
2008	362
2009	443
2010	460
2011	468
2012	513
2013	522
2014	529
2015	568
2016	577
2017	560
2018	537

Factor: Building Permits





Discussion and Conclusions

By most measurements, growing human population continues to have an effect on Estero Bay and the natural environment of its watershed. There are many ongoing local initiatives to address indicators such as nutrients in surface waters and seagrass extent. Listed species continue to decrease in numbers and water quality, particularly with regard to nutrients, continues to degrade. Economic conditions for developers have recovered and intrusions into the DRGR and other areas of sensitive habitats have expanded the opportunity provided by the increased availability at reduced prices for conservation land acquisitions was missed and lost by policies that reduced land acquisition programs and raided their funds at a time critical. At the federal, state, and local level many protections for the environment and planning processes were continuing to be weakened or removed in favor of unrestrained development without plan.

There are some significant areas in improvement in water quality associated principally with the adoption and implementation of strict local government fertilizer ordinances and construction of filter marshes in the headwaters of tributaries leading to nutrient reduction principally in phosphorous; and increases in colonial bird nesting. Several parameters, such as fecal coliform and chlorophyll-a, that were available for comparison in the State of the Bay reviews are no longer collected as fecal coliform has been replaced by enterococci and when algae blooms are reported the organisms are sampled directly.

It is estimated that, in 1950, Estero Bay contained 3,769 acres of seagrasses. While seagrass acreage declined between 1950 and 1999, significant gains have been made since then. Persistence of seagrass has also been tracked. Persistence appears to be linked to water depth, with the most persistent areas being shallower and near-shore. It is estimated that Estero Bay contains 107 acres of seagrasses that have been lost and are not restorable. As of 2014, there were 3,683 acres of seagrasses of all species in Estero Bay and 7,167 acres in San Cartlos Bay, which includes Matanzas Pass and the areas south of Bunche Beach. There has not been an aerial survey of sea grass extents since then, although the EBAP monitor transects of seagrass occurance and health at estbalished stations.

Landings of economically important indicator species including spotted sea trout, mullet and blue crab have declined from 1998 to 2019. The number of trips taken to harvest these species has declined while landings per trip have declined for sea trout (-98.4%) and blue crab (-22.34%) but increased for mullet (-57.87%).

Wildlife dependent upon interior habitats of the basin including xeric (dry) communities and pine forests has declined significantly. Florida scrub jays were extirpated from the basin sometime in the middle 1990's. Red-cockaded woodpeckers disappeared in 2001. Significant amounts of gopher tortoise habitat have been eliminated from the basin while being mitigated in the Caloosahatchee River basin in the past and no longer being mitigated after relocation became the only conservation policy. Bald eagle nesting territories have decreased, and success rates are only reported variably.

In contrast water dependent bird species display increased nesting. The number of rookeries has increased 47%, and success rates at 133% over the first State of the Bay.

We were unable to find data from the work of the Southwest Florida Amphibian Monitoring Network form the period of time 2014-2019 of this report. Past work indicated that the calling intensity of the Cuban treefrog has increased, while a key native indicator species, the barking treefrog, appears to be declining.

Existing water quality can be interpreted in many different ways and the trends vary by location and parameter. Our analysis of 2013 water quality data indicating a positive reduction in some nutrient parameters is evident since the adoption and 2009 implementation of the Lee County, Fort Myers Beach, and Bonita Springs fertilizer ordinances, all of which are stricter than the base State of Florida standard. This trend has continued in regard to total phosphorus.

Unfortunately, in regard to total nitrogen the flushing of the entire Estero Bay watershed in the rain events in August and Hurricane Irma in 2017 coupled with expanding development in the watershed reversed the improvement trends in all the estuarine systems and freshwater Mullock Creek and freshwater Spring Creek. In 2019 for the first time Estero Bay proper was listed as impaired for total nitrogen.

There had been an improvement in chlorophyll-a standards in Estero Bay and all the tributaries except Six-Mile Cypress and tidal Spring Creek up to 2014, but this reversed for all the estuarine areas except estuarine Estero River and, estuarine Spring Creek. Between 2014 and 2016, average annual chlorophyll-a dropped in freshwater Six-Mile Cypress, Spring Creek, and Imperial River; and average annual chlorophyll-a increased in freshwater Ten Mile Canal, Hendry Creek, and Mullock Creek.

Between 2014 and 2019, average dissolved oxygen decreased in Estero Bay, estuarine Mullock Creek and estuarine Imperial River; and it increased in estuarine Hendry Creek, estuarine Estero River, and estuarine Spring Creek. The monthly minimum dissolved oxygen increased in all estuarine segments but estuarine Mullock Creek which decreased and estuarine Spring Creek which remained the same. Between 2014 and 2019, average annual dissolved oxygen increased in freshwater Hendry Creek, freshwater Imperial River, and freshwater Estero River; and decreased in Six-Mile Cypress, Ten-Mile Canal and freshwater Spring Creek. The monthly minimum dissolved oxygen decreased in Six-Mile Cypress, Hendry Creek, Ten-Mile Canal and Spring Creek; increased in Estero River; and stayed the same in the Imperial River. In the period of this report dissolved oxygen minimum standards were not met in all the watershed segments of the Estero Bay watershed. FDEP Water Quality Impairments for DO had been assigned to the fresh and estuarine reaches of all the tributaries of Estero Bay. including Hendry Creek, the Imperial River, the Estero River, Six-Mile Cypress, Mullock Creek and Ten Mile Canal; but not in the Bay itself. In 2019 only estuarine Imperial River is listed as impaired.

Between 2014 and 2016, average fecal coliform increased in Estero Bay and Estero River and decreased in all the other estuarine tributaries. There was however a major jump in Mullock Creek fecal coliform levels in the year 2014 that has begun to decline. Between 2014 and 2016, average fecal coliform increased in Estero River, Mullock Creek, and Spring Creek; and decreased in Six-Mile Cypress, Ten Mile Canal, Hendry Creek, and Imperial River. FDEP stopped assessing for coliform types in 2016. With the change to measure enterococci for estuarine waters in Estero River, Mullock Creek, Spring Creek, and Imperial River are considered impaired. For freshwater Escherichia coli is now the measured standard resulting in Mullock Creek and Imperial River being considered as impaired.

Between 2014 and 2019, average annual total nitrogen increased in all estuarine segments, however the geometric mean nitrogen standards were not exceeded. The peak monthly nitrogen decreased in Mullock Creek, Hendry Creek, Spring Creek, and Imperial River; increased in Estero Bay; and stayed the same in Estero River. Between 2014 and 2019, average annual total nitrogen increased in freshwater Mullock Creek and freshwater Spring Creek and decreased in all other freshwater segments. Overall, the average decrease was small at -.97%.

The peak monthly total nitrogen decreased in all freshwater segments. It is interesting given the data that FDEP in 2019 has designated Estero Bay, estuarine Spring Creek, estuarine Imperial River and a coastal estuarine WBID 3258A1 as impaired for total nitrogen and Mullock Creek as impaired for nutrients based on macrophytic algae blooms.

In contrast to the 2008 State of the Bay Report when USEPA standards for total phosphorus were exceeded in Estero Bay and all reaches of all tributaries with the exception of fresh Spring Creek. between 2009 and 2013, average annual total phosphorus dropped in all estuarine segments and average annual total phosphorus dropped in all freshwater segments except Hendry Creek. However, between 2015 and 2019, average annual total phosphorus increased in all estuarine segments except Hendry Creek which decreased and Spring Creek which remained the same. The peak monthly total phosphorus increased in all estuarine segments except Imperial River, Hendry Creek, and Spring Creek. Data for 2014 was not available for all estuarine segments. Between 2014 and 2019, average annual total phosphorus increased in Ten Mile Canal and in freshwater Spring Creek it remained the same. Between 2015 and 2019, average annual total phosphorous increased in all other freshwater segments. The peak monthly total phosphorus dropped in all freshwater segments except Mullock Creek and Imperial River. In all tributaries the geometric mean standard was achieved after adoption of the fertilizer ordinances. The Lee County fertilizer ordinance is proven as effective in regard to phosphorous.

Between 2014 and 2019, average annual turbidity increased in Estero Bay and Hendry Creek; and decreased in all other estuarine segments. The same trend was found for annual peak turbidity in the estuarine segments. Between 2014 and 2019, average annual turbidity increased in Six-Mile Cypress, Ten Mile Canal, and freshwater Hendry Creek; and decreased in freshwater Mullock Creek, freshwater Spring Creek, and freshwater Imperial River. The peak monthly turbidity increased in Six-Mile Canal, Ten Mile Canal, Hendry Creek, and Imperial River; and decreased in Mullock Creek and Spring Creek. All waterbody segments meet turbidity standards.

There is was a rising trend of salinity for Estero Bay until 2012. Salinity then began to decline in annual average and minimums although it slightly increased in peaks. Of note is the contrast between annual minimums and annual peaks. In the period of record, 2005 had the lowest peak, while 2015 had the lowest minimum. The highest minimum occurred in 2007. The highest peak occurred in 2011. In the 2014 - 2018 period, the average salinity dropped by 3.5%, the peak decreased by -6.9%. and the minimum increased 41,6% from 2009 values.

Continuing urban development has led to flashier hydrology. The Estero Bay basin has shown water quality degradation even though most of the area has been designated an Outstanding Florida Water during most of the trends period.

It is vital that improved nutrient management be achieved in order to reverse the pollution trends in the Estero Bay and its watersheds. The solutions to the harmful nutrient and human waste problems are known, and these were identified in the 1970s. Many scientists and managers know this solution and have worked toward it over these many years. It is not just one thing and it is not a technological or man-made chemical fix that allows pollution with impunity and then cleaning up the mess. It is called nutrient source reduction at the source. It involves every nutrient pollution source being responsible for their own pollution and retaining and treating it themselves. It is stricter stormwater management systems than the current basis of review and Harper method standards, it is stricter fertilizer ordinances than the weak State and Federal rules. It provides no exemptions to anyone: not to agriculture; not to government; not to golf course; not to the politically connected. It involves strict monitoring, enforcement, and requires repairs and upgrades to all forms of waste treatment plants (septic, package plants, central systems). It involves moving to Advanced Tertiary Treatment of sewage. It involves not allowing reuse water used for irrigation to flow into adjacent water bodies. It involves full land-based pump-out of all vessels including private boats, cruise liners and commercial shipping with no free discharges to open waters with no exempted open water discharges including grey water. It includes the complete filtering at incinerators and power plants to scrub nitrogen and mercury emissions. It includes native landscaping of public and private landscapes. It includes conservation acquisition and protection of the river and creek floodplains and moving all forms of agriculture, particularly feed lots and land spreading of waste solids, out of those floodplains. Basically, this is sustainable agriculture, land use, and lifestyle in Florida with proper nutrient management.

Solving problems with habitat loss, alterations in hydrology, and declines in fisheries and wildlife will require more than nutrient management. The past economic downturn has been significantly reversed and the increased rate of growth in the watershed, during the period of this study, 25,585 residential single unit building permits were issued, indicating a very high rate of growth and development across Lee County. The Lee County Mitigation Plan is the type of integrated restoration and acquisition plan that can address issues of biodiversity, hydrology, and water quality. The solution to pollution in the Estero Bay basin will occur on a landscape scale, requiring Smart Growth, and including areas without growth (such as the Density Reduction Groundwater Recharge (DRGR) area, that allow the Estero Bay ecosystem to provide the many invaluable natural functions and services that provide clean water, natural hydrology and fish and wildlife resources.

The Estero Bay Agency on Bay Management will continue participate in these important public private partnerships for nutrient management, biodiversity, hydrologic and water quality restoration. If these projects are successfully implemented, we anticipate an improved State of the Bay when the next report is issued in 2025.

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