

Attachment B: Supporting Research

Research Review Phase of the IRC Lagoon Management Plan: Update 1

1. Annual Rainfall Data

Rainfall acts as one of the major contributors of freshwater into the Indian River Lagoon estuary system. It is important to monitor rainfall because of its impacts to the Lagoon, such as influencing salinity levels, increasing sediment runoff, and transporting other pollutants and nutrients from land to water. Excessive rainfall can cause flooding and damage to infrastructure such as stormwater or wastewater conveyance. The Lagoon, in its entirety, on average receives about 50 inches of rainfall per year, with the County's portion receiving approximately 52 inches per year. Annual rainfall data was gathered using the National Oceanic and Atmospheric Association's (NOAA) 16 historical and active weather stations across the County, with data from 1895 to present. The wettest months in the County historically have been June through September. Based on rainfall measurements, rainfall in the County is seeing an approximate decrease of 0.27 inches per decade. While we do not understand the specific, measurable impacts caused by this decrease, decreased rainfall in general impacts the Lagoon's inputs of freshwater. Salinity data will be examined during a future update, with the goal to better understand how rainfall and salinity levels combined affect the health of the Lagoon.

2. Best Management Practices

Best Management Practices (BMPs) are practices deemed to be an effective and practicable means of preventing or reducing water pollution generated from various activities and industries. Stormwater and Utilities departments within the County both utilize BMPs for their water treatment systems, which act as regional scale BMPs. For example, Stormwater's Egret Marsh is a pollution control facility that uses algae, large ponds, and a man-made wetland system to remove excess dissolved nutrients from water withdrawn from stormwater canals each day before it reenters the canal system leading to the Lagoon. These regional scale BMPs are accounted for in Basin Management Action Plan (BMAP) reporting to the Florida Department of Environmental Protection (FDEP). Regulatory agencies determined that the Lagoon's water quality was impaired due to excessive amounts of phosphorus and nitrogen, as well as low levels of dissolved oxygen (DO), as evidenced by the decrease in seagrass distributions. In 2007, FDEP added the main body of the Lagoon to the Verified List of impaired waters, which established the creation of allowable loadings of phosphorus and nitrogen to the Lagoon, known as Total Maximum Daily Loads (TMDL). TMDLs are scientifically derived levels of constituents that a body of water can receive while still meeting water quality standards. BMAPs are then created after a TMDL has been set for a waterbody. BMAPs act as "blueprints" for restoring impaired waters by reducing pollutant loadings to meet the allowable loadings in a TMDL. BMAPs utilize various strategies, from permit limits on wastewater facilities to urban and agricultural BMPs, to reach these pollutant reduction goals. Limits, or allocations, are assigned to stakeholders, and those limits are enforceable. The County falls within the Central Indian River Lagoon BMAP for the Indian River Lagoon Basin. The BMPs the County implements in these regional-scale projects contribute to reduced pollutant loadings reported in this BMAP.

The County enforces proper implementation of BMPs at construction sites, with the authority to issue citations of permit violations that can lead to fines and/or project shutdown. Education is also an

important component of the County's BMP efforts. Citizens and businesses are educated in a multitude of ways which cover stormwater pollution issues, such as utilizing proper lawn maintenance by following the 9 Principles of Florida-Friendly Landscaping, as well as proper recycling methods. Since 2013, the County has enforced a Fertilizer and Landscape Management Ordinance, in order to help protect the Lagoon from nutrient loading particularly during rainy months. While educational BMPs cannot be quantified into a number for pollution reduction, studies have shown that education is an essential tool for the proper implementation of BMPs.

Another major BMP industry in the County is agricultural BMPs. These BMPs are based on voluntary enrollment and self-regulatory reporting by entities with agricultural lands. The Florida Department of Agriculture and Consumer Services (FDACS) develops and adopts BMPs by rule for different types of agricultural operations. Implementing and maintaining verified FDACS-adopted BMPs means agricultural producers are aware they need to meet compliance with state water quality standards for the pollutants addressed in the specific BMP. While BMP enrollment is voluntary, it is enticing for producers to enroll in this program because it helps reduce costs while operating more efficiently, may assist in satisfying some water management district permitting requirements, and may make them eligible for cost-share programs available from various agencies. If an adopted BMAP includes agriculture as a component, producers must implement BMPs or conduct self-monitoring to show that they are not in violation of water quality standards.

Based on the information above, the County does a good job on implementing BMPs whenever possible in its own projects. However, it is not as easy to fully comprehend the scope of BMP implementation done by residents and businesses that are not under active construction. Since BMPs are not necessarily required practices, compliance with BMPs is usually self-monitored and it is up to the individual to keep records of the practices for compliance. This is also true of agricultural BMPs within the County. It would be beneficial to have a better understanding of the County-wide efforts in BMP implementation, from regional-scale to local-scale. While the County falls under the Indian River Lagoon Basin: Central Indian River Lagoon BMAP, there are currently no set limits mandated for the nutrient levels identified for the impaired waters, so the County cannot fully compare its efforts based on the mandated efforts. However, based on BMAP reporting, the County continues to go above and beyond in its BMP implementation and nutrient reductions when compared to other entities within the same basin.

3. Biosolids

Biosolids are solid, semi-solid, or liquid materials resulting from the treatment of domestic sewage sludge from wastewater treatment facilities. Biosolids are subject to differing processing levels by wastewater utilities, and as such, different classifications of biosolids are handled differently. The two major classifications of biosolids for discussion are Class B biosolids and Class AA biosolids. Class B biosolids are the least processed and require a permit for land application, while Class AA are processed to higher levels and are considered as fertilizer, and thus allowed to be applied to land without any permits or tracking of quantities. Both classes of biosolids contain nitrogen and phosphorus, among other constituents. Levels of nitrogen and phosphorus vary widely in biosolids based on the characteristics of the influent to the wastewater treatment facility (WWTF) generating them, as well as the processing steps within the WWTF. Biosolids can be used as an alternative to chemical fertilizers since they have concentrations of macro-nutrients (nitrogen and phosphorus) as well as micronutrients required for plant

growth. Within the State of Florida, approximately 25% of the biosolids produced at WWTFs are hauled off to landfills, while 45% of the biosolids are further processed into Class AA fertilizer and not tracked, and 30% of the biosolids remain in the Class B form and are applied to agricultural lands through the use of Florida Department of Environmental Protection (FDEP) site permits. There are approximately 130 permitted land application sites for Class B biosolids in Florida under FDEP permits. The permits work to allow land application of Class B biosolids so long as permit restrictions are met, such as requirements for site nutrient management plans; setback provisions; groundwater depth provisions; signage provisions; storage requirements; public access, grazing, and harvesting restrictions; runoff provisions; and record keeping/reporting requirements. Class AA biosolids applications are not covered under any of the restrictive permit requirements.

Within our own backyard of the Upper St. Johns River Basin, biosolid applications spiked starting in 2013 due to permit restrictions occurring throughout South Florida under the National Everglades Protection Act. Haulers started bringing the Class B biosolids from South Florida north to permitted sites in Osceola, Indian River, and Brevard Counties for land application. In 2018, Blue Cypress Lake experienced an algae bloom that damaged the ecosystem. Many believed the bloom was caused by the increase in biosolid applications in properties adjacent to the Lake, and studies were initiated to determine what factors were causing the bloom. SJRWMD looked at various parameters throughout the lake to find where changes occurred. No change in lake stage (water level) had occurred, and total nitrogen levels appeared to remain relatively unchanged. There were no trace metal trends, and land use remained relatively constant throughout the area. Total suspended solids, turbidity, and potassium levels were all found to be trending downward over the years, so changes in water quality were not attributed to erosion of soils or store-bought fertilizer applications. The biggest change discovered was a spike in phosphorus levels of the Lake. Comparison watershed assessments were conducted to compare phosphorus levels in a similar watershed that did not have biosolid applications, with the comparison site showing lower concentrations of phosphorus than Blue Cypress Lake. Therefore, the study concluded that there was a strong correlation between phosphorus levels in the lake compared to the amount of biosolids applied in the area.

In July 2018, the County passed an ordinance which placed a moratorium on the application of Class B biosolids within the unincorporated areas of the County. This stopped all new and existing applications of Class B biosolids in the unincorporated County, which was followed up by other municipalities within the County enacting their own similar ordinances. The moratorium started as a 180-day temporary moratorium on Class B biosolids land applications and has continued to be extended by the County as of present. Class B biosolid application is still allowed in areas of the State, but the current FDEP rule on Biosolids land applications is under review within the legislature, with tightening restrictions on future applications proposed.

While the ban of biosolids stemmed from an issue in the St. Johns River watershed, the biosolid moratorium also protects the Lagoon because runoff from biosolid application sites are not being transported through stormwater canals or via groundwater. Prior to the County's moratorium, Class B biosolids applied on the permitted sites within the County amounted to over 740,000 lbs. of nitrogen and 293,000 pounds of phosphorus being spread as fertilizers in 2017 alone. It is not fully understood what concentration of runoff nutrients have been saved from impacting the Lagoon due to this moratorium.

Studies within the County focus on biosolids related to Blue Cypress Lake, and not on implications to the Lagoon. The nutrient cycling, particularly of nitrogen, make it difficult to have a complete understanding of how biosolids impact groundwater, which may also provide a source for eutrophication of the Lagoon.

While this moratorium addresses Class B biosolids, Class A and Class AA have been exempted from regulations due to their fertilizer status. Once classified as fertilizer, Class AA biosolids are no longer accurately tracked by any regulatory agency, nor restricted for use on only permitted lands, therefore there is a large gap in knowledge about the impact Class AA biosolids are having on the environment as a whole. As a point of clarification, there are no Class A biosolids producers within the State since the level of additional processing to turn that into Class AA is minimal, and the removal of restrictions on placement of Class AA makes the additional steps worthwhile for many producers. Class AA biosolids can also be found in fertilizers sold at local home goods stores.

The state created a technical advisory committee for biosolids in order to address some of the state-wide issues with nutrient pollution. Their goals were to modify the permitting process to minimize impacts to waterbodies, increase frequency of inspections, develop site specific groundwater monitoring protocols, conduct more field research, and promote pilot projects that address alternative uses to biosolids. The state created a draft rule, which the County weighed-in heavily throughout the process. Revisions to the draft rule have been made, but a final ruling has not been established as of present. Pilot projects are currently being investigated on the feasibility of using biosolids to produce electricity, reuse water, and phosphate ash among other things. Utility Departments have expressed concerns about the cost and reliability of such innovative technologies since they are currently not shown to scale up to the sizes needed to address the volumes of biosolids being generated. It is important to encourage studies on alternative ways to use biosolids, since biosolid tonnage is continually produced and landfills do not have unlimited storage capacities.

4. Ecosystem Functions and Habitat Use (Part 1)

The Environmental Protection Agency classifies the Lagoon as one of 28 estuaries in the nation designated as an “Estuary of National Significance,” which sets the foundation to create a place-based program to protect and restore the water quality and ecological integrity of that estuary. Studies have shown that the Lagoon is used at some point throughout their life cycles by approximately 4,000 unique organisms, making it a biologically diverse ecosystem. Some utilize the Lagoon for their entire life while others for only a portion; both of which are equally important to our estuary. This update will focus on seagrasses, filter feeders, and finfish within the County’s portion of the Lagoon.

Seagrass mapping has and continues to occur throughout the Lagoon. SJRWMD maps seagrass every 2 to 3 years, starting in 1986, along with coverage from 1943. This data, when compared over time, allows us to understand the trends in local seagrass populations and distribution. Based on this data from SJRWMD, seagrass beds within the County appear to be doing better when compared to seagrasses as a whole for the Lagoon. Within the Northern Indian River Lagoon seagrass map data, where the County falls, seagrass loss was observed from 2009-2011, decreased in 2012, increased between 2013-2015, and again decreased in 2016 and in 2017. Estimates of mean percent coverage within the footprint of seagrass beds have decreased since 2001. From 2011 to present, the loss of coverage appears to be related to decreases in light transmissivity filtering through the water column possibly due to prolonged algae

blooms. Seagrass require light for survival and growth. As of 2017, northern portions of the County have approximately 1,239 acres, middle portions have approximately 669 acres, and southern portions have approximately 1,074 acres of seagrass. These acreages are higher than the majority of reported acreages for the rest of the Northern Indian River Lagoon. It will be important to note in future research the location and extent of seagrass beds in comparison with areas and amounts of nutrient fluxes. It will also be important in the future to note how harmful algal blooms have correlated to seagrass coverage within the County. While seagrass is mapped well within the County, we do not fully understand the species variation genetics of the individual seagrass beds; if monoculture beds are emerging, or if we have a genetic variety of types of seagrasses present. The Lagoon may also benefit in studying areas that had historical seagrass beds, but do not currently, and possibly looking into utilizing these areas for seagrass planting projects. In order for these projects to be successful, water quality, sediment quality, and shelter from strong currents must be sufficient for fragile new growth to survive in these areas where robust natural growth has died off.

Filter feeders, such as oysters and clams, play an important role in water column filtration throughout the Lagoon. Adult oysters in our portion of the Lagoon are able to filter between 10 to 20 gallons of water every day. Oysters filter sediments, detritus, small phytoplankton, and particulate-bound nitrogen and phosphorus from estuarine waters. Changing conditions in the Lagoon are impacting filter feeders through poor water quality, poor sediment quality, harmful algal blooms, changes in food types and availability, changes in predator populations, salinity changes, overexploitation, and ocean acidification. The relationship between filter feeders and all these variables is complex and influence species differently at their various life stages. Filter feeders have direct impacts on improving water quality through their filtration abilities. Not only do they filter water, they also act as breakwaters and dissipaters of wave energy along shorelines. This can help decrease shoreline erosion. They act as an important component of living shoreline projects, with the County currently having a stockpile of loose oyster shells ready to be used for restoration projects in the Lagoon. Oyster beds and bars also serve as habitats for numerous organisms.

There are currently two areas in the County that allow, or once did allow, for shellfish harvesting, per FDACS. Shellfish harvesting area #70 occurs in southern County starting from Prang Island to Round Island. Clams are present in this area and it has had a restricted classification since June 18, 1997. Shellfish harvesting area #72 occurs in northern County starting at Coconut Point to Paul's Island. Clams are present in this area and it has had a conditional approved status since September 5, 2019. However, this area is closed when two-day cumulative rainfall measured by NOAA exceeds 2.54 inches. When populations were abundant in the Lagoon, having shellfish present in the Lagoon benefited the local economy through harvesting.

Currently, the County has oyster populations near the North Relief Canal and Spoil Island IR-43 in the Lagoon, and populations in the mouth of the Saint Sebastian River, a tributary to the Lagoon. Oyster growth also occurs in abundance on mangrove roots or along seawalls in the central and southern parts of the Lagoon. However, these oysters are not usually included in traditional mapping reports because these efforts rely on aerial photography. Mapping of oysters living on mangroves has to be done on-site, which requires more effort and time than aerial mapping. In the shoreline mapping recommendation

above, presence of oysters on mangrove roots along the shoreline could also be noted so that the County receives a better understanding of this matter.

Historical shellfish populations are not well understood throughout the Lagoon, although shell middens and buried shells indicate more extensive reefs existed in the past. Shell middens are heaps of clam, oyster, whelk, or mussel shells associated with past human occupation. It would be beneficial for the County to understand where historical shellfish populations resided so that they could be evaluated as potential areas for restoration. Also, it would be beneficial to understand what types of shellfish were present versus the types present today to see how changing conditions have influenced species types. However, historical knowledge on these topics seems to be limited to local knowledge and there does not seem to be widely completed historical surveys of these populations. While we may not be successful at mapping historical filter feeder populations, it would be beneficial to conduct mapping of current populations and the conditions they live in for future understanding. Monitoring indicators of oyster reef health and environmental variables allows the comparison of various parameters to oyster reef metrics. Another recommendation is for the County to establish spat (oyster larva) monitoring locations throughout the region to best understand areas of recruitment and survivorship for future populations of oysters. It would also benefit the County to partner with agencies and groups with clam stocks, such as FWC, in order to complete pilot projects of living shorelines with clam components. Clams have not been widely used in restoration projects for the County as of present, so it may be beneficial to diversify the types of filter feeders used.

Fish are an important economic and ecological part of the Lagoon system. However, fish populations and abundance have declined from historical populations. The causes of this decline includes overfishing, habitat degradation, and the introduction of invasive species. For example, recent studies have shown invasive lionfish species are starting to encroach into the Lagoon, even though these species prefer oceanic waters. Lionfish populations have been detrimental to native oceanic fish species, so it is expected that they will also negatively impact native estuarine fish species. Wetlands act as important habitats for the critical life stages of many important fishery species, so their vulnerability to changing conditions in the Lagoon are negatively impacting fisheries as a whole. Also, fish found within the Lagoon serve as an essential food resource for commercially and recreationally important fish and other species of Lagoon wildlife, such as migratory bird populations. Decreasing populations of important fish within the Lagoon will negatively impact the survivability and presence of numerous types of wildlife.

While there does not seem to be a lot of fish population studies done in the County's portion of the Lagoon, FWC's Rich Paperno has been doing Lagoon-wide stratified random sampling collections monthly. He was able to provide data for fish hauls within the County from 1996 to 2018, which identified the number and types of fish pulled each month. Based on this information, historical fish numbers peak in November to March with 304 different species of fish identified. These trends need to be further studied in comparison to other Lagoon variables in order to better understand how one may be influencing the other. Also, the data is arranged by month, and not year, so we cannot currently understand what the annual fluctuations of fish populations may be. Throughout the Lagoon, fisheries independent monitoring is done by FWC to understand general populations and community structures of recreational and commercial fisheries. Lagoon-wide, fisheries stocks appear stable, but smaller than historical numbers according to their data. Fisheries dependent monitoring is also done at boat ramps,

which includes looking at trip tickets from commercial fisheries to understand the numbers, sizes, and types of commercial fish.

Fisheries need to be studied in order to better understand population dynamics between organisms within the Lagoon, and to show impacts identified in the types of fish present. The County may consider partnering with FWC, other local organizations, and local fishermen to understand current fish populations and their preferred habitats in order to track the status and population trends of species, especially species of concern. Identification of these habitats would assist in water quality and habitat restoration strategies for projects in the Lagoon. It may be helpful to study zooplankton populations and ecology within the Lagoon as well, since these are important food sources for many fish populations.

5. Sea Level Rise

Sea level rise plays an important role in the health of the Lagoon in our area due to its direct connections to manmade and maintained inlets. Our portion of the Lagoon is directly influenced by two inlets, the Sebastian Inlet to the north and the Fort Pierce Inlet to the south, both of which are considered tidal inlets. A rise in sea level will increase the water level in the Lagoon. As sea level rises, tides will also become more extreme, with higher rates of ocean water being exchanged within the Lagoon. Another lesser understood impact to the Lagoon from sea level rise is the infiltration of saltwater into the freshwater aquifer below the land's surface. The relationship of the aquifer to the Lagoon will be researched at a greater extent during the hydrology and hydrodynamics update.

Seas in our area have been rising at approximately 3.54 mm/year since the 1970's, which is equivalent to 1.16 feet in 100 years. These measurements are based off of NOAA's sea level monitoring station at the Lake Worth Pier. After discussing this topic with Dr. Randall Parkinson, a climate change expert and professor at Florida International University (FIU), he concluded that the Lake Worth Pier was an appropriate representation of conditions for the County for sea level changes. Specific County measurements of sea level rise on the Lagoon-side versus the barrier-island side were not readily available, and these data would be influenced by other factors such as rainfall and inputs from channelized surface flows. Sea level rise impacts to the Lagoon will not only be felt within the system itself, but also impacts the overall health of the ecosystem, critical infrastructure, and development. The general land form of the County is a coastal low land, which means that most of the coastal areas are less than 25 feet above sea level. This puts these coastal areas at a greater risk for potential flooding and inundation from sea level rise. Based on the Intermediate United States Army Corps of Engineers Projection Summary, it is anticipated that 7 of the 50 stormwater outfalls to the Lagoon which drain the County will be under water by 2040. These outfalls not only include County outfalls, but also include Florida Department of Transportation (FDOT) outfalls.

As for ecological functions, rising sea levels will have impacts on the health and distribution of seagrasses. As water levels rise, the areas of optimal light transmittance for seagrass and other keystone species survivorship will change. Mangroves and marshes will naturally try to retreat landward, but with development or hardened structures on the landward side of these natural buffer habitats landward recruitment is minimized, making natural protection from such features sparse or weak. It is important for the Lagoon and areas landward of the Lagoon to have natural protection to act as a buffer against excess energy from events such as storms and wave action. Without that protection, the shoreline will erode away at far faster rates, which will be detrimental for infrastructure built along the shoreline. This

lack of natural protection will also increase sedimentation and nutrient releases to the Lagoon. Not only do these natural areas provide protection and pollution prevention, they also act as important habitats for numerous organisms during some portion of their lives. Finally, mangroves act as sinks for organic carbon, which means they store carbon inside their structure instead of releasing it to the atmosphere. If large mangrove forests die off because of sea level rise, this carbon will be released and act as a negative feedback for drivers of climate change. Such die-offs would have the potential to speed up rates of climate change. Sea level rise will change the current patterns and flow rates of the Lagoon and tributaries, which in turn will modify estuarine habitats and their primary and secondary productivity.

The Indian River Lagoon National Estuary Program (IRLNEP) is currently studying sea level rise using a risk-based vulnerability assessment of the Lagoon to climate change following the US Environmental Protection Agency's (EPA) workbook *Being Prepared for Climate Change*. The first half of the study determined the biggest stressor associated with sea level rise, was found in the impaired waters categories (water quality). Sea level rise will be a major stressor to the risk of impaired waters because it is a permanent change, whereas the other stressors, such as precipitation and storms, provide temporary risks. Comparing lagoon-wide historical trends from 1980-2008, decreasing trends were found in dissolved oxygen concentrations, pH (becoming more acidic), and salinity. The only increasing trend in the study was found in temperature measurements. Now that phase one of their study is complete, the IRLNEP will work on phase two, which includes an action plan to help the Lagoon as a whole. These metrics will be considered when creating the Lagoon Management Plan for the County.

Based on the information above, it appears that the County may benefit from taking part in a shoreline mapping project. There appears to be a data gap in the mapped extent of mangrove and marsh habitats, as well as their landward uses for the County. Data gaps also occur in understanding the rates of sediment accumulation within the Lagoon. Historically, sea level rise has been offset by natural rates of sediment accumulation along habitats. However, data now suggests that sedimentation rates are not able to keep up with current rates of sea level rise. As mentioned previously, sea level rise trends and predictions were based off of data collected from the Lake Worth Pier. There seems to be a gap in understanding of the specific sea level rise rates occurring in the County.

6. Land Use Changes (Part 1)

Determining past and future land use changes are important in understanding current issues in the Lagoon and determining resiliency for the future. Past land use changes need to be understood to account for possible nutrient leaching impacts to the Lagoon. For example, studies in South Florida showed how phosphorus leaching from the soil due to past chemical management was still occurring 30 years after the retirement of orchards (agriculture use) and impacting the quality of nearby waterbodies. As the County historically was a widespread agricultural community, it is important to understand where those agricultural practices took place to understand how that might impact nutrient leaching levels in the future. While the impact to the Lagoon is not well understood currently, as more data becomes available it will then be incorporated into recommendations. It is also important to note where vacant lands are in the County and to identify what they are zoned for in order to understand how they may be used in the future. Monitoring of Environmental Resource Permits (ERP) issued by state agencies will allow the County to anticipate changes that may actively occur in the future and plan accordingly.

Future land use changes are identified by the County in each comprehensive plan published by the Community Development Department. This document is regularly updated in order to designate the appropriate location for future land uses and sets forth the policies regulating growth and development within the County. These policies are not just limited to density and intensity of appropriate land uses, but also address other factors, including the timing and location of future development. Future development is important to understand for the whole watershed of the Lagoon. Within the watershed, waters ultimately make their way to the Lagoon, so even if a property is not adjacent to the coast, it can still impact the Lagoon through other factors, such as runoff and groundwater pollution.

Past land use changes were determined based on the Florida Land Use and Cover Classification System (FLUCCS) using a one-mile buffer around the Lagoon shoreline. These codes were retrieved from SJRWMD. No significant changes were found using the data pulled from 1999, 2004, and 2014. Previous years were not able to be used because they changed photo-interpretation standards for the aerial photography of land use and land cover, and there is no way to transform data from before 1999 to make it representative of current standards. As of the most recent 2014 data, using the one-mile buffer around the Lagoon for the County, urban and built-up lands accounted for approximately 34%, agriculture accounted for approximately 4%, rangeland accounted for approximately 6%, upland forest accounted for approximately 6%, water accounted for approximately 37%, wetlands accounted for approximately 11%, barren lands accounted for approximately 0.4%, and transportation, communication, and utilities accounted for approximately 2% of the total land cover. The County currently enforces a 50-foot shoreline protection buffer for un-platted parcels and a 25-foot buffer for existing platted lots measured from the mean high water line. However, the buffer should not exceed more than 20% of the parcel or lot depth perpendicular to the Lagoon. No development is permitted within this buffer, other than docks, boat ramps, pervious walkways, and elevated walkways. Native vegetation must remain unaltered in these buffer areas and shoreline alteration is prohibited, unless it is in the public interest, prevents erosion damage, or provides reasonable access to the water. It is important to maintain these standards in the future so that the Lagoon continues to have a direct buffer between activities on the shoreline that may be detrimental to its health. This is also why it would benefit the County in having County-wide shoreline mapping completed, in order to understand the limits of mangroves and marshes and understand how future development may impact the survival rates. It would also benefit the County to encourage the use of BMPs in future land use changes so as to not change the size and drainage patterns of the Lagoon's watershed. These impacts are most pronounced along the Lagoon shoreline where dredge and fill activities, hardened shorelines, and coastal development have altered natural upland-wetland-lagoon connections.