Managing Nutrients to Save Charlotte County's Estuaries and Economy:
A Report for: The Peace Myakka Waterkeeper

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Executive Summary

We are losing the battle for water quality statewide. We must have a strong, concise, and written goal, with county commitment, to achieve the estuary-specific water quality standards for Charlotte's estuaries. We cannot wait for TMDLs and BMAPS. As former Calusa Waterkeeper John Cassani says, that system has not brought a single water body out of impairment. (Cassani 2020)

The Charlotte Harbor estuary is the receiving water body for both the Peace River and Myakka River, hence the Peace Myakka Waterkeeper's mission of concern and action for upstream and downstream influences on water quality in our jurisdiction.

Charlotte County's estuaries are in decline and at a tipping point – past which restoration would be very costly and difficult, if not impossible.

Loss of our estuaries would be an economic and lifestyle tragedy, including devastating loss of real estate values, tourism dollars, and fish, birds and wildlife. A local fishing guide puts it this way: What's the point of living here if the reason we're living here disappears?

The cause of our estuaries' decline is water quality deterioration – triggered by human activities that upset the natural nutrient cycle in our waterways. The primary causes of our nutrient cycle imbalances are too many nutrient-laden stormwater and wastewater discharges into our canals, creeks, rivers and estuaries.

The solution to the long-term health of our estuaries, and their wealth of benefits to our economy, is to manage our stormwater and wastewater systems to meet state water quality goals – *at a minimum* – which are already established for each of our waterways by Florida law. These water quality goals (called numeric nutrient criteria or standards) were created with the help of regional and local scientists, resource managers and stakeholders and have broad based support and credibility. To date, these state standards have not been used effectively by our county to guide protection and restoration of our estuaries – and our economy. The state criteria for nutrients in our estuaries are shown in Table 1, on the following page.

Table 1: Florida Water Quality and Nutrient Criteria for Our Estuaries

***FL DEP Water Quality Standards (**https://www.flrules.org/gateway/ruleno.asp?id=62-302.532**)**

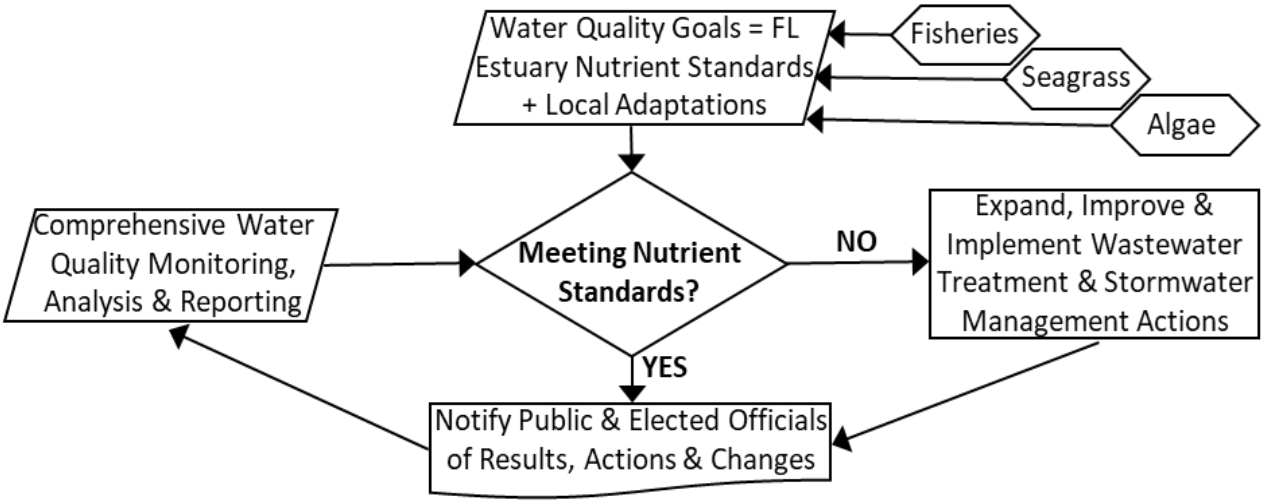
Analyzed as annual geometric means, not to be exceeded more than 1 time in 3 years.

Parameter	Tidal Myakka River (with Tippecanoe Bay)	Tidal Peace River	Charlotte Harbor Proper	Lower Lemon Bay
Total Phosphorus (TP)	0.31 mg/L	0.50 mg/L	0.19 mg/L	0.17 mg/L
Total Nitrogen (TN)	1.02 mg/L	1.08 mg/L	0.67 mg/L	0.62 mg/L
Chlorophyl*	11.7 µg/L	12.6 ug/L	6.1 µg/L	6.1 µgL

*Chlorophyl is a useful indicator of algae levels in water

In order to restore our estuaries before they pass that irreversible tipping point, Charlotte County must commit to achieving these established water quality standards *and* adopt a transparent, science-based process for managing stormwater and wastewater. A diagram of an effective science-based problem-solving process is outlined in Figure 1, below.

Figure 1: Science-Based Estuary Management Decision Process



While investments in upgrading our stormwater and wastewater will be substantial – our estuaries, economy and lifestyles are well-worth the cost. From experiences in other Florida communities, once an estuary is seriously degraded, it cannot be repaired in a timely or affordable way. We must make these investments *now* or risk losing our invaluable estuaries and our economic foundation.

How we can commit to and begin restoring our estuaries is detailed in the full report, that follows on these pages.

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Chapter 1: Introduction and Layout

The people and businesses of Charlotte County have a once-in-a-lifetime opportunity to preserve our economy, lifestyles, and property values – by managing and restoring our estuaries. Estuaries are those places in our waterways where fresh and saltwater meet, and which support most of the fish, birds, wildlife and aesthetics our economy depends on.

One and a half years ago, in February 2021, Charlotte County hired its first (ever) Water Quality Manager, Brandon Moody (Calvert, 2021). Mr. Moody quickly embarked on creating the most essential underlying element of an effective estuary management program – a comprehensive water quality monitoring and reporting system. This momentous task started with determining who is already sampling our waterways, including where, what, when and how – as well as where the data is recorded. It also involved deciding where and what else we must sample regularly to get a complete picture of our estuaries – to guide how we most efficiently invest our restoration tasks and dollars.

The purpose of this emerging water quality program is to establish a network of monitoring sites throughout the county needed to identify background water quality conditions and long-term trends. It is the intent of authors that the monitoring results will be presented to the public in a manner that clearly describes water quality conditions and trends relative to state and local water quality criteria. In spring 2022, monthly surface water sampling began prior to onset of the wet season. This fall 2022, Mr. Moody's schedule calls for contracts with external parties to conduct data analysis, review the current monitoring program, and recommend adjustments. (Moody, 2022).

Within the year, because of Mr. Moody's efforts to develop the water quality monitoring program, we will have additional estuary data to act on – to begin restoring our estuaries in the the most efficient and expedient way possible. But how will we (as a community) act? What should we do with all this information? These are complicated questions this report aims to provide cursory answers to in the following chapters.

Chapter 2: How do We Know Our Estuaries are at a Tipping Point? explains the crisis our estuaries face using overwhelming anecdotal and empirical evidence. It's important that readers understand that the problem we are facing is greater than just red tide (a major concern primarily in our salt waters) or blue green algae (a significant freshwater phenomenon) alone. We are talking about harmful conditions in our brackish, estuarine waters – such as "gunky seaweed" in our canals and bays, loss of essential seagrass and and declining fisheries – and how our estuaries are going beyond impairment toward ruin. The chapter describes tragic conditions in other parts of the state as a lesson about where our estuaries are headed if we don't take effective action now. The history lesson concludes that once estuaries are severely degraded, they cannot be repaired in a timely or affordable way – If ever.

Chapter 3: What will We Lose if We Lose Our Estuaries? provides information on what is at stake if our estuaries are not restored to full health. This is important because correcting our problems will take significant investments – which would be funded, at least in part, with tax dollars. None of us like tax increases. But we – residents and businesses alike – must understand the costs associated with declining water quality, including: economic loss from declining fishing, boating and tourism industries; lifestyle degradation from foul-smelling algae clogging our boating, fishing, kayaking, wading, swimming, water views, etc.; and real estate value declines. If we are wise, we will realize it is better to invest now than to lose what cannot be recovered. Tax increases are better than losing everything.

Chapter 4: What are the Local Causes of Our Estuary Problems? gives us a basic understanding of the root causes of our declining estuary water quality, in terms of what we can control locally. While we must be familiar with external factors (such as Lake Okeechobee pollution reaching our estuaries and climate change), we can most directly and measurably fix what happens inside our county. Knowing local causes is important because without a full understanding, we cannot shape effective solutions. This chapter briefly explains how the natural nutrient cycle has been unbalanced by human activity in general, and by our wastewater and stormwater systems specifically.

Chapter 5: How Do We Manage Our Estuaries Locally to Meet Water Quality Goals? focuses on how we can, and must, reduce human-caused nutrients using a proactive, transparent, data driven and science-based process. The chapter begins with lessons learned and what we know doesn't work – including state programs to estimate pollutant loads and identify corrective actions (Total Maximum Daily Loads/TMDLs and Basin Management Action Plans/BMAPs, respectively). In fact, the Clean Water Act regulatory framework places much of the burden for compliance on the very stakeholders who contributed the criteria—a fact that is often overlooked in the dysfunctional relationship between a domineering but understaffed agency and a frustrated public. The state can't and won't achieve its own TMDLs, and personal communications with agency officials indicate that few or no TMDLs have been achieved. This situation cannot be allowed to continue.

We do have confidence that the state-established criteria are credible, because they were developed with considerable participation from regional and local scientists, resource managers and experts.

These already existing water quality criteria must serve as a scientifically-sound basis for our local goals for our estuaries – as well as a starting point for taking actions towards reaching those goals. Identifying the most effective actions needed requires creating and implementing a science-based decision process. This decision process uses measured pollutant levels, together with observations of fisheries, seagrasses and algae, to determine where the most critical sources of our water quality problems are occurring. This will allow us to allocate management activities and funding into the most needed, efficient and cost-effective stormwater and wastewater projects. It is important, for many reasons, to keep elected officials and the public informed about water quality problems, restoration plans, progress, successes and tax dollar expenditure – and adjustments that are made to the actions once successes have been accomplished.

Chapter 6: Summary and Conclusions highlights the recent first step the county has taken towards committing to restoring our estuaries by hiring a Water Quality Manager. Mr. Moody's accomplishments initiating the needed water quality monitoring and reporting program are important strides forward. However, these 2 actions must be followed-up with a credible plan for translating the water quality data into action – a plan for identifying and implementing the most critical stormwater and wastewater management projects – *as soon as possible*.

This chapter concludes with why Charlotte County must commit to a goal of achieving (or exceeding) established estuary nutrient standards, *and* implement a transparent, proactive, science-based process that manages stormwater and wastewater to restore and then preserve our estuaries. Finally, suggestions are included for actions we can each take to help with this time-sensitive mission.

Chapter 7: Are We on the Right Path or Heading Over an Irreversible Tipping Point? This chapter responds to the county's inadequate attempt to create a plan to assure the restoration of our estuaries. It explains the dangerous path the county is on and reinforces the need to take the straight path.

Chapter 2 How Do We Know Our Estuaries are at a Tipping Point?

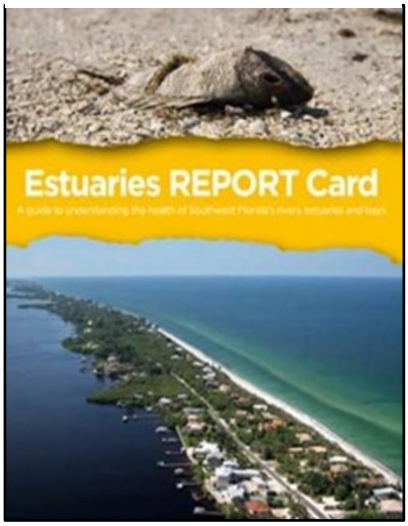
It is important for people to understand the sources of information that lead us to conclude that Charlotte County's estuaries are approaching a tipping point. Summarized below are 4 sources of information supporting this conclusion: Charlotte Harbor anecdotal evidence, empirical evidence, 10 years of macroalgae data from FL Fish and Wildlife Conservation Commission (FWC), and seagrass trends, and Indian River Lagoon lessons learned.

Anecdotal Evidence

Dr. Aaron Adams, Director of Science and Conservation at the Bonefish Tarpon Trust, describes the changes he noticed after being away from Charlotte Harbor for several years. "What used to be an expansive seagrass flat, is now a mix of open sand and thick algae. The cancer of too many nutrients is spreading throughout Charlotte Harbor. This does not bode well for the long-term future of its legendary fisheries. Without healthy habitats – and water is the most important habitat of all – our fisheries will continue to decline. The maximum amount of fisheries management won't be enough to make up for continuing habitat declines. As in the Indian River Lagoon, Charlotte Harbor's decline is from too many nutrients: leaky septic systems, fertilizer, outdated sewage infrastructure, stormwater runoff, industry effluent… the list goes on. That wasn't the trip I was hoping for. I'm devastated. You should be too." (Adam, 2021)

Empirical Evidence

Figure 2: Estuary Report Card



Four detailed reports describe the nature of the impairments (damages) in our estuaries:

1. In 2017, the Conservancy of Southwest Florida's Estuary Report Card gave Charlotte Harbor a C+ grade. The Estuary Report Card concluded that 54% of the Charlotte Harbor watershed waters (both estuary and fresh) are impaired for at least one parameter – the most pervasive being dissolved oxygen, nutrients, and metals (Conservancy of SW Florida, 2017).
2. In 2018, the Coastal and Heartland National Estuary Partnership (CHNEP) Water Quality Status Reports for our estuaries showed many waters impaired for nutrients, chlorophyll, dissolved oxygen and fecal coliform bacteria in the Tidal Myakka River, Tippecanoe Bay, greater Charlotte Harbor and Lemon Bay (CHNEP, 2018).
3. Using 2018-2020 water quality data, the Calusa WaterKeeper reported that Charlotte County had the fastest increasing rate of water quality impairments throughout southwest FL (Causa Waterkeeper, 2021).
4. In 2022, Florida's Impaired Waters Rule Assessment listed many areas of our estuaries have sub-standard water quality conditions, including:
   - Lower Peace River – impaired for nitrogen, phosphorus, chlorophyll[1] and macrophytes.
   - Lower Myakka – impaired for dissolved oxygen and nitrogen.
   - Charlotte Harbor Proper – impaired for nitrogen, phosphorus, and chlorophyll.
   - Lemon Bay – impaired for nitrogen, macrophytes, chlorophyll, and dissolved oxygen based on failing linear vegetation survey results. (FDEP, 2022)

[1] Chlorophyll is a green pigment used by plants, including algae, for photosynthesis. It is an indicator of algae levels in the water. While algae form the base of the aquatic food webs and help oxygenate water, too many algae cause oxygen levels to collapse as they decompose. Chlorophyll is a measure of photosynthetic by phytoplankton, so high levels of chlorophyll are associated with excess nutrients and degraded water quality. https://www.flrules.org/gateway/ruleNo.asp?id=62-302.300

Ten Years of Filamentous Algae Blooms in Charlotte Harbor

Historically, green filamentous algae was rarely seen in Charlotte Harbor before 2012. However, within the last ten years, FWC fisheries scientists observed a significant increase in macroalgae in the harbor. Starting in 2012, there have been numerous outbreaks of green filamentous algae in the Charlotte Harbor estuaries, including:

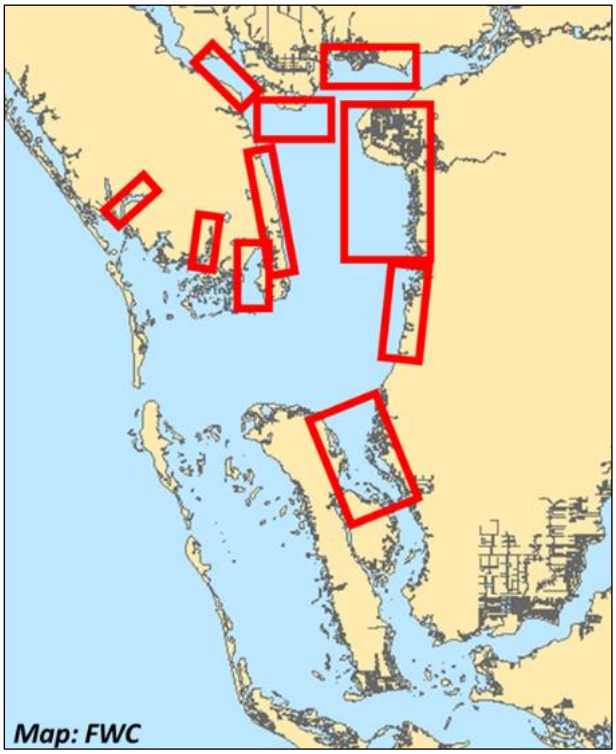
1. 2012: Tippecanoe Bay and Hog Island
2. 2019: Tippecanoe Bay, Hog Island, Grassy Point, and Charlotte Harbor western shoreline
3. 2019: Coral Creek
4. 2019-2020: Entire Charlotte Harbor eastern shoreline and northern Matlacha Pass
5. 2020-2022: Turtle Bay, Whidden Creek, and Charlotte Harbor western shoreline

Figure 3, below, shows the dense green filamentous algae blooms near Hog Island in northern Charlotte Harbor. Figure 4 shows the filamentous algae in Coral Creek up close. And Figure 5 is a map of recent filamentous algae outbreaks throughout the Harbor. Before now, we thought Charlotte Harbor was immune to these algae and water quality problems – but currently, they have become an unwelcome, common part of life in our estuaries.

Figure 3: Filamentous Algae Near Hog Island

Figure 4: Filamentous Algae in Coral Creek - Close Up

Figure 5: Locations of Large Filamentous Algae Outbreaks from 2012 to Present



Lessons Learned from Indian River Lagoon

Algae and water quality problems in our estuaries are following a similar, tragic patten as those in Indian River Lagoon near Melbourne, FL. Audubon reports the situation there as an ecological disaster, with deaths of pelicans, manatees, and dolphins, as well as outbreaks of harmful bacteria – making the water dangerous for wildlife and for human contact (Audubon, 2013). The scenes in Indian River Lagoon, like this one in Figure 6, below, of the infamous "guacamole bloom" from 2016, appear to be a harbinger of the filamentous algae blooms we are seeing now in our estuaries – unless we *act now*.

Figure 6 is an image that was circulating on the internet during the 2016 "guacamole bloom" in Stuart, FL. The image is courtesy of Dr Larry Brand from the University of Miami, Rosenstiel School of Marine and Atmospheric Science. It appears to in the St. Lucie estuary near the Roosevelt Bridge, which leads into the southern Indian River Lagoon.

Figure 6: "Guacamole Bloom" in Indian River Lagoon 2016

There are two important lessons to be learned from Indian River Lagoon:

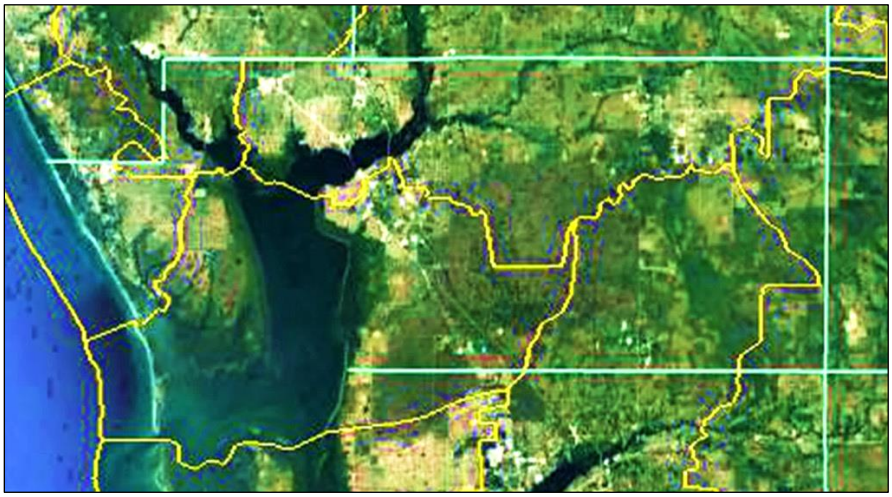
1. Chronic water quality problems can lead to irreparable "tipping points".
2. Once severely degraded, an estuary cannot be repaired in a timely or affordable way – If ever.

It also important for readers to understand that the water quality problems addressed in this report are greater than just red tide (a major concern, mostly in our salt waters) or blue green algae (a freshwater phenomenon) alone. We are talking about complex, damaging conditions in our brackish waters that lead to "gunky" macroalgae in our canals and open waters, declining seagrasses, less fish habitat, and loss of bird, mammal, and fish populations. Most of us did not move here to live among these tragic conditions. But, unfortunately, the damage has begun – it is measurable and it is real. Our essential estuaries will continue to worsen unless we act to reduce the nutrients we are delivering into our estuaries – *now*. Experience in other Florida estuaries has shown that once our invaluable estuaries become severely degraded, they cannot be repaired in a timely or affordable way – If ever.

Chapter 3: What will We Lose if We Lose Our Estuaries?

Did you know Charlotte County has more estuaries than beaches? And, while beaches are a major highlight of our region, estuaries cover about 1/3 of our county. Without healthy estuaries, our lifestyles, economy, and property values won't be maintainable. Some of the possible loses are briefly described below.

Figure 7: Estuaries Cover One Third of Charlotte County



Our Livelihoods, Economy, and Lifestyles – All Depend on Healthy Estuaries

Estuaries predominate our local geography - including Charlotte Harbor, Cape Haze, the Tidal Peace and Myakka Rivers, Lemon Bay, numerous creeks, and many tributaries. Estuaries are where much of our economic benefits and lifestyle enjoyments come from. Our estuaries are the reasons many, if not most of us, chose to live here. Table 2 highlights 5 major economic values of our estuaries.

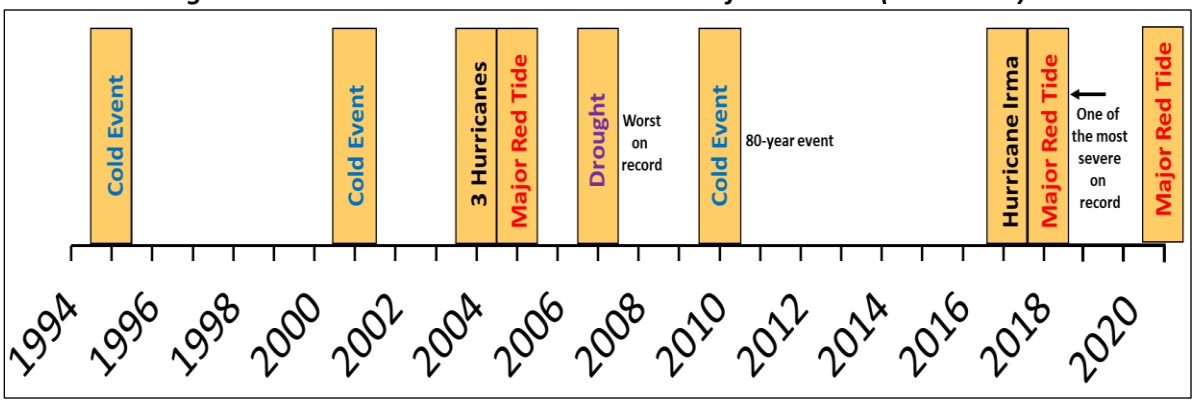
Table 2: Estuaries are Where Life Happens

Estuaries are Where:
• **Most Fish are Born & Raised**
• **Wildlife Thrives**
• **Locals & Tourist Recreate**
• **Aesthetic, Contemplative Enjoyment is Derived**
• **Marine, Seafood & Tourism Industries are Supported**

Sport Fish (and Many Other Species) – Need Healthy Estuaries for Survival

FWC studied how severe environmental disturbances in southwest Florida during the last three decades impacted fish populations. Figure 9, below, shows the timing of major weather and red tide events from 1994 – 2020.

Figure 8: Environmental Disturbance Timeline for Fisheries (1994-2020)



The FWC fisheries biologists found that sportfish populations (including, snook, tarpon, redfish, spotted seatrout, and sheepshead) will recover from acute natural disturbances such as hurricanes, red tide, cold events, droughts, and hurricanes. However, fisheries resilience to chronic water quality problems is significantly less, and populations may not recover in degraded estuaries – especially with continual algae blooms, such as Indian River Lagoon. As an example, following the 2010 freeze, snook populations in both Tampa Bay and Charlotte Harbor recovered within 2-3 years, and in Ten Thousand Island they recovered in 4-5 years. However, snook in northern Indian River Lagoon still have not recovered, more than 10 years later. (Blewett, 2020, Stevens, 2016)

Our Property Values Decline as Water Quality Declines

In 2015, the Florida Realtors studied the relationship between home values and water clarity and quality in neighborhood waterways. Several measures of water quality were used in the study. One important measure was the amount of chlorophyll in the water. Remember, chlorophyll is an indicator of algae levels in waterways and a measure of algae contributions to discoloring and clouding our estuaries. Another measure used in the FL Realtors' study was dissolved oxygen. Low oxygen in the water is often the result of decaying algae blooms and indicates excess nutrients. If dissolved oxygen levels remain too low for too long, different species of aquatic life will become stressed and move away or die off – resulting in fish kills and other "unpleasant" sights and odors that discourage potential homebuyers from investing in the property. Recall that both high levels of chlorophyll and low levels of dissolved oxygen are causes of impairments in the Charlotte Harbor estuaries.

The Florida Realtors study found that water quality problems in Marin County, including Indian River Lagoon, resulted in negative impacts on home values. Similarly, Lee County home values fell in areas were water quality declined. Conversely, the study found a significant positive economic impact on home values in Lee County where water clarity was improved – as much as a 15% increase in property value with 1 foot of increased water clarity. In areas with increased water quality, the increased property values also provide additional revenue for city and county governments. These results strongly supports the idea that water quality plays an important role in determining of home values. (Florida Realtors, 2015)

Our health is at serious risk.

In addition to economic costs, waterways choked with algae can be harmful to human and fish and wildlife health. A variety of toxins in blue-green algae species, some of which accumulate close to shore and even in canals are increasingly being linked with diseases such as ALS, Parkinson's, and premature Alzheimer's. (Bennet Williams 2020).

The red-tide organism (Karenia brevis) in saltwater can cause acute respiratory distress, as well as additional alarming health trends. Roskamp (Sarasota) Institute scientists, in collaboration with the Gulf of Mexico Coastal Ocean and Observing System (GCOOS), have been conducting a clinical research study to understand the potential impact of red tide organism (Karenia brevis) on brain health. The team recently published findings from their study in the peer-reviewed journal *Harmful Algae*. The study provides new evidence that red tide exposure can affect human brain health. This study suggests that certain individuals are susceptible to the neurological effects of airborne exposure from red tide blooms. (Abdullah L, et al. 2022)

Speaking at the Congregational United Church of Christ in Punta Gorda Dr. Larry Brand (University of Miami's Rosenstiel School of Marine Biology & Ecology) told the audience those toxins from algae- whether in fresh water, salt water, or in our estuaries- move up the food chain, endangering not only sea life but humans. (Brand, 2020)

Bottom Line: Restoring Our Estuaries is Worth the Investment – Even if it Costs a Lot

It is clear that estuaries are so valuable to our community that they must be saved – at any expense. Too much is at stake: the local economy, our lifestyle, real estate values, sportfish, marine life, aesthetic enjoyment, and our health. We will need to consider increasing our taxes to fix our water quality problems – before our estuaries pass their tipping points.

Chapter 4: What are the Local Causes of Our Estuary Problems?

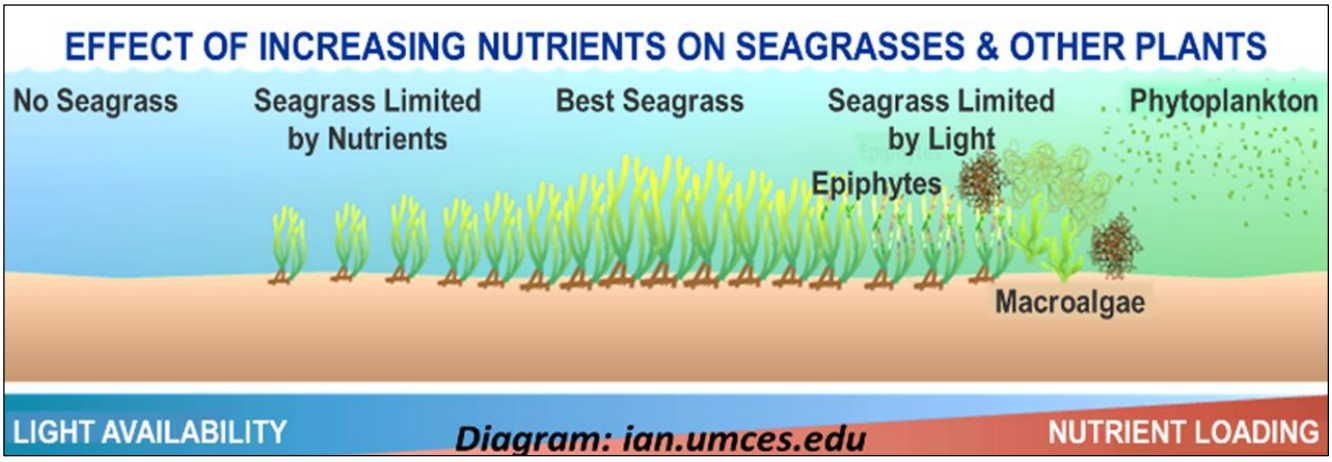
It is essential that we understand the root causes of our declining estuary water quality, especially relating to what we can fix locally. While we must have a grasp on external factors reaching our county boundaries (such as Lake Okeechobee discharges and pollution), we can only directly and measurably manage what happens within our county. We must work with neighboring cities and counties, and the state government, to coordinate ecological actions to benefit the region. But the focus of this report is on what we can and must do here in Charlotte County.

Unbalanced Nutrient Cycle

The underlying cause of our water quality problems is an imbalance in the natural nutrient cycle in our estuaries. While some nutrients are essential for seagrasses, fish, and wildlife, too many nutrients are harmful.

Figure 9, below, shows the relationship between nutrients, light and seagrass populations – seagrasses are the basis of our estuary food webs. As shown in the diagram, as nutrients in the water increase, macroalgae – the "seaweed" you can see without a microscope – increases (both free-floating and attached macroalgaes). As these macroalgaes shade sunlight from the seagrasses, the seagrasses decline and the nutrients they no longer sequester become available for phytoplankton (microscopic algae) to bloom.

Figure 9: Effect of Increasing Nutrients on Seagrasses



Seagrasses are flowering plants, macroalgae are multicellular marine plants easily observed by the unaided eye, and phytoplankton are microscopic algae. All 3 plant forms contain chlorophyll and require sunlight to grow, survive and thrive (Littler, 2016). In a balanced ecosystem, phytoplankton provide food for a wide range of marine organisms including shrimp, snails, and jellyfish. These marine plants, when in balance, are the main source of dissolved oxygen in the water needed to support diverse marine life. When too many nutrients are available in a waterbody, phytoplankton grow out of control and cause oxygen crashes as the overabundance of plants decomposes. Some species of phytoplankton form harmful algal blooms (HABs) which produce extremely toxic compounds that are harmful to fish, shellfish, mammals, birds, and humans. (NOAA, 2021). You probably have seen an algae bloom around our waterways recently – visualize how these excess phytoplankton limit sunlight and reduce oxygen – not a good situation for our fish and marine life – or us.

Dr. Christine Angelini from the University of FL's Center for Coastal Solutions, spoke at Charlotte County's Water Quality Summit in March 2022. She explained that as of 2005, nutrient loadings to our estuaries are at least three times greater than during the 1800s. As our area's population doubled from 1990 to 2020, and continues to grow daily, associated nutrients will be delivered to our waterways and will lead to significantly higher phytoplankton levels and lower dissolved oxygen conditions – without serious resource management intervention – *now*. It is past time to act if we are to keep our estuaries from passing their tipping point, as we discuss in the next chapter on solutions. (Turner, 2006).

Here, we will discuss where our excess nutrients are coming from. In Charlotte County, our specific sources are stormwater and wastewater. Although agriculture is also a source to some extent (greater in less urban areas), our most direct sources of nutrients are urbanized areas adjacent to our waterways where nutrients from stormwater and wastewater have a short distance to travel to ground or surface water.

Stormwater

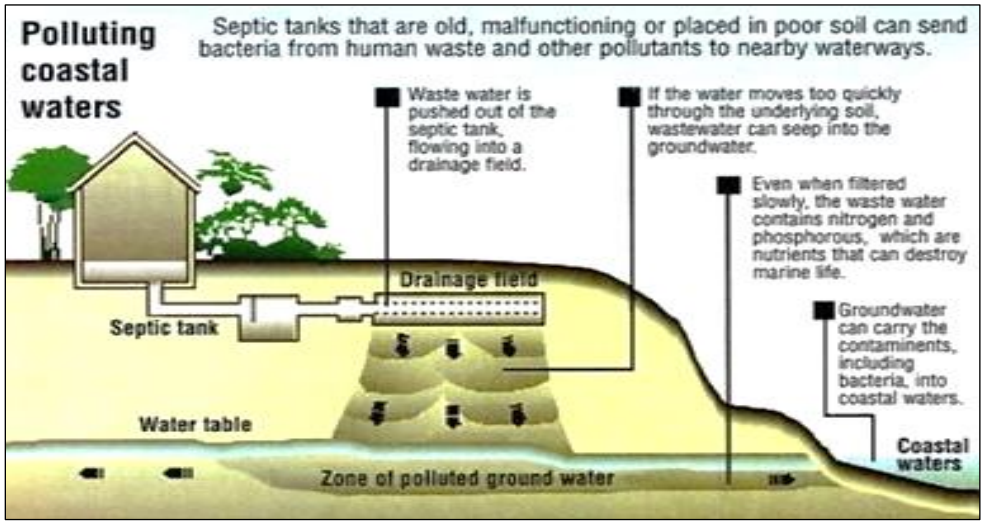
In the natural world, rain falls on the ground and eventually soaks into the soil, is absorbed by plants and hydrates animals. In the developed, paved and hardened world, rain and irrigation fall mostly on impervious surfaces such as roofs, driveways, streets, parking lots, and sidewalks. As the rainwater flows via gravity, it picks up nutrients from fertilizer, yard clippings, organic matter, and other pollutants – the faster it travels, the more sediment and pollutants it carries. The runoff heads downstream into curbs and gutters, swales, drains and outfall pipes – and out into our waterways, as shown in Figure 10, below. The diagram illustrates how rainwater turns into nutrient laden storm water delivered to our estuaries.

Figure 10: Stormwater Routes of Nutrients and Pollutants to our Estuaries

Wastewater

Most resource managers and scientists, and many citizens, understand that Florida's sandy soils and high water tables are not suitable for septic systems – they don't provide adequate filtering or retention of our wastewater on its way to groundwater and streams. Figure 11, below, shows the route of septic system discharges on their way to receiving waters.

Figure 11: Septic System Route of Nutrients and Pollutants to Our Estuaries



In May 2017, Dr. Brian LaPointe from Florida Atlantic University spoke at a Water Quality seminar held at the Charlotte County Extension Office. Dr. LaPointe told the audience that septic systems, even **if** permitted to code and maintained, are not suitable for Florida's geology. They provide excess nutrients to our waterways, which trigger algae blooms, shade out seagrasses, reduce dissolved oxygen and create dead zones.

Reducing nutrients from wastewater is a ***must do*** resource management action required for restoring our estuaries. However, conversions from septic to sewers alone will not assure that nutrients from our wastewater won't continue reach our estuaries. Aging and undersized sewer systems and infrastructure don't work as originally designed. They can, and do, leak – especially when they are compromised by major storm events. In addition, recycled wastewater, intended for irrigation, can provide very large volumes of nutrients if not sufficiently treated, managed and monitored.

Outside Influences – They Matter – to an Extent

We must acknowledge that other factors influence our water quality as well, including:

- Landscape-scale phosphate mining and fertilizer manufacturing upstream
- Lake Okeechobee and Caloosahatchee River flows
- pollution from neighboring counties
- global warming[2]

While we do not have direct control over these outside influences, we do need to contribute to their solutions. However, for the task at hand and this report, we are focusing on what we can control and fix here within Charlotte County.

Bottom Line: We must Focus on Proactive Management of Local Stormwater and Wastewater

Inadequately treated stormwater and wastewater are the local causes of our water quality problems and nutrient imbalances – and that's what we must begin solving immediately. That, in itself is a daunting challenge.

[2] While climate change is a global phenomenon, we can do something about it locally. More information about causes, solutions and what we can each do to reduce our contributions is available through the references at the end of this report.

Chapter 5: How do We Manage Our Estuaries Locally to Meet Water Quality Goals?

Previously, we discussed the causes of our water quality problems. Now we will describe the solutions which will help us manage and reduce excess human-caused nutrients to our estuaries. As Dr. Angelini said at the 2022 Charlotte County Water Quality Summit, without management intervention our estuaries will soon be overcome by algae blooms and not have sufficient oxygen for fish and other marine life to live and thrive.

We will begin with lessons learned. We know what doesn't work and which management options to avoid. We also have confidence in the established water quality criteria for our estuaries – because they were developed by local and regional scientists, resource managers and experts – based on local seagrass, water clarity and nutrient relationships. Next we provide a suggested data-driven, science-based process for allocating our limited staff and funding into the most efficient restoration and maintenance of our estuaries. We end the chapter with explanations of how this process could work and who should be responsible for putting it into action.

Lesson 1. What Doesn't Work – State Pollutant Loading Estimate and Management Plan Programs

Florida Department of Environmental Protection's (FDEP) Basin Management Action Plans (BMAPs) are designed as a framework for water quality restoration. The BMAPs include local and state commitments to reduce pollutant loading through identified current and future projects and strategies. Each BMAP contains a comprehensive set of solutions intended to achieve the pollutant load reductions required by established Total Maximum Daily Load (TMDL) calculations. Example actions include: permit limits on wastewater facilities, urban and agricultural best management practices, and conservation programs. Developing these broad-based plans includes invitations to local stakeholders to provide input of local knowledge and commitment to implementing the recommendations of the plan. BMAPs are adopted by FDEP Secretarial Order and are legally enforceable. (FDEP, 2022).

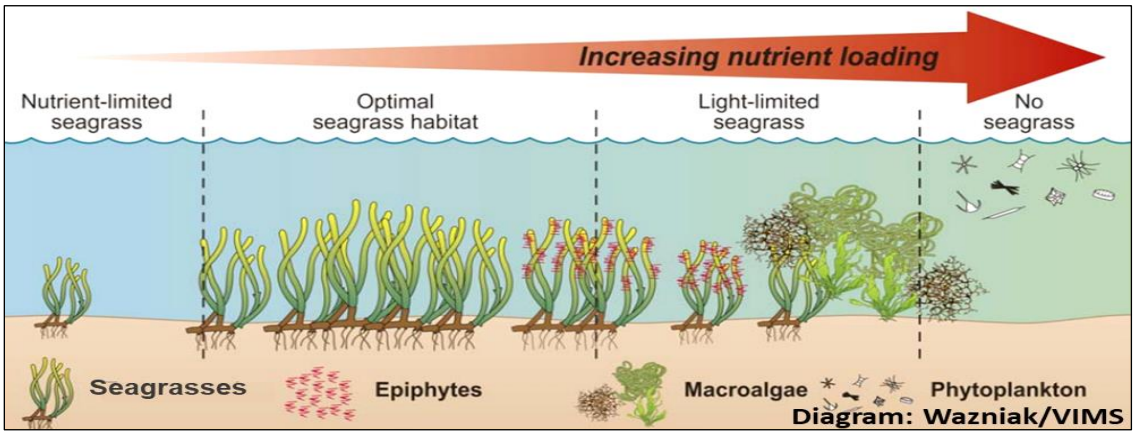
However, implementation and enforcement of recommendations is often weak. Treasure Coast Newspapers investigated the effectiveness of BMAPs and found that FL isn't enforcing them beyond warning letters. (Czyzon and Chesnes, 2022). Indian River Lagoon has a BMAP (DEP Water Quality Restoration Program, 2021) – but we know it isn't working, because the estuary is in crisis.

Additionally, BMAPs and TMDLs are not put into place until considerable damage has already been done – making it difficult to succeed. Brandon Moody, Charlotte County's Water Quality Manager explained the BMAP process at a public meeting January 19, 2022. BMPs are not initiated until water bodies have been impaired for some time. Mr. Moody estimated that Charlotte County estuaries will not be subject to TMDLs or BMAPs for at least five years. Our waters are at a tipping point now – we need action now. Waiting 5 years to begin a restoration process is unreasonable, ineffective and costly. Indian River Lagoon lessons repeat themselves – chronic water quality problems can lead to irreversible tipping points that cannot be repaired in a timely or affordable way – if ever.

Lesson 2. What Does Work – Seagrass Based Numeric Nutrient Criteria

Thanks in large part to local scientists and agencies, water quality criteria tailored to our estuaries (Lemon Bay, Charlotte Harbor, and Tidal Peace and Myakka Rivers) were developed starting in 2009. These estuary specific numeric nutrient criteria were adopted by state and federal governments over a decade ago. The science behind developing the criteria is complex, interesting and reassuring. The scientists based the criteria on seagrass water clarity requirements and the nutrient levels needed to achieve that water clarity. Figure 12, that follows, shows the relationship between seagrass health, water clarity and nutrient levels.

Figure 12: Seagrass Light Requirements and Nutrient Loading Relationships – Used to Develop Criteria



During the process of developing the criteria, the scientists determined what light (water clarity), algae (chlorophyll) and nutrient levels were needed to support optimal seagrass conditions. These seagrass-defined nutrient levels are also associated with low macroalgae ("seaweed") and phytoplankton (microalgae) levels. These relationships allowed scientists to quantify healthy nutrient levels for each of our estuaries and express those levels as quantitative numeric nutrient criteria. The proposed criteria were presented to FDEP (Janicki, 2011) and adopted into state law as Numeric Nutrient Criteria in 2011 (FDEP, 2011). The NNC for our estuaries are shown in Table 3, below.

Table 3: FL Water Quality & Nutrient Standards for Charlotte Harbor Estuaries

***FL DEP Water Quality Standards (**https://www.flrules.org/gateway/ruleno.asp?id=62-302.532 **)**

Analyzed as annual geometric means, not to be exceeded more than 1 time in 3 years.

Parameter	Tidal Myakka River (with Tippecanoe Bay)	Tidal Peace River	Charlotte Harbor Proper	Lower Lemon Bay
Total Phosphorus (TP)	0.31 mg/L	0.50 mg/L	0.19 mg/L	0.17 mg/L
Total Nitrogen (TN)	1.02 mg/L	1.08 mg/L	0.67 mg/L	0.62 mg/L
Chlorophyl*	11.7 µg/L	12.6 ug/L	6.1 µg/L	6.1 µgL

*Chlorophyl is a useful indicator of algae levels in water

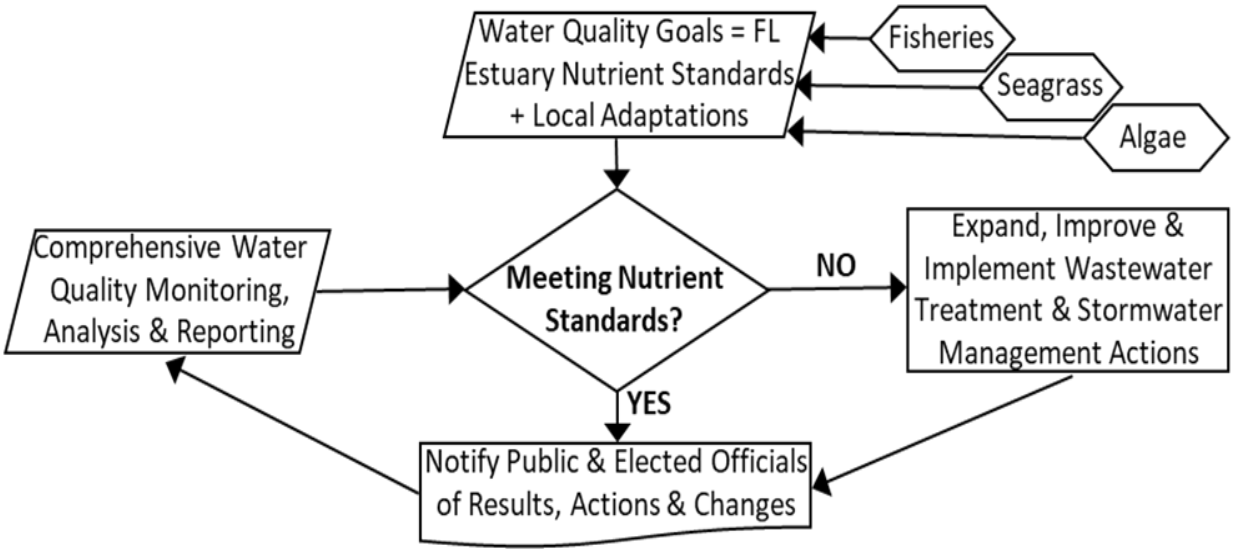
Note in Table 3 that the criteria are different for each of our estuaries. Seagrasses thrive differently in each estuary and nutrient levels are tolerated differently in each estuary. It makes sense that we should follow the science and aim to help nature achieve the nutrient levels that sustains our marine life. As the county's Water Quality Manager Brandon Moody said in October 2021 at a Team Punta Gorda Event, "If we maintain those nutrients levels, we will maintain healthy seagrass." (Sutphin 2021).

We want to manage to achieve these standards. Local stakeholders have ownership in these standards. We believe these numeric criteria can and should form the basis for active management for the purpose of restoring, then maintaining our valuable estuaries. The state has additional criteria for other parameters which are important for human and ecosystem health, such as bacteria and metals. But this report focuses on managing nutrients – the most critical problem. Information and criteria for parameters other than nutrients are available in Appendix A of this report and on the FDEP and other websites.

Next Lesson: Develop a Data Driven, Science-Based Estuary Management Process

How: A diagram of a potential science-based estuary management decision process is shown in Figure 13, below. The starting point for the decision process is the comprehensive water quality monitoring and reporting program, shown at the 9 O'clock position below. Data collection, analysis and reporting are essential components of effectively managing and improving water quality in our estuaries. A broad county water quality monitoring program is being initiated as this report is being written (Moody, 2021). The monitoring program serves as the basis for all other decisions and actions in the process.

Figure 13: Science-Based Estuary Management Decision Process



Another essential component of an effective decision process are the desired water quality goals – shown as Estuary Nutrient Standards in the diagram, at the 12 O'clock position.

Use State Standards at a Minimum: The state nutrient criteria for our estuaries may need to be strengthened in some areas of our estuaries which are currently healthy – to avoid future deterioration. Recognize that this decision process also considers what fisheries, seagrasses and macroalgae conditions, which are indicators of the health of the estuaries. Generally speaking, in areas where fish are stressed, seagrasses are waning and/or macroalgae is rampant, water quality impairments have already been identified – including high levels of nitrogen, phosphorus and/or chlorophyll. In some conditions, if water quality standards are being met but fish, seagrass and/or microalgae show signs of decline, we may need to adopt localized, more stringent criteria.

At the center of the decision process is the question: Are we meeting our water quality goals (nutrient standards)? This is the core of an effective management process. For each of our waterways being sampled through the monitoring program, the determination will be made – based on analysis of the data – whether the water quality standards are being met or not.

If the data shows that the *waterbody is meeting our water quality goals*, the results get published for the public and elected officials to understand, and future sampling will be conducted according to a planned schedule.

If the location *is not meeting our water quality goals* – which we can anticipate will happen in many of our waterways – then actions must be taken and reported to the public and elected officials. This assures that elected officials and the public are aware of problems and corrective actions taken. Examples include: what is being done to fix or upgrade the wastewater and/or stormwater systems, how much it costs and how it will be paid for. Most importantly, actions will be continued until water quality monitoring in the area indicates standards are being met.

Who: Charlotte County is the primary (only) entity with the jurisdiction and resources to put these estuary restoration processes into action. The county controls most wastewater and stormwater systems, land use codes and regulations, and revenues that impact on our estuaries. FDEP is lax, understaffed and underfunded.

The county must be proactive and take initiative *now* – before our estuaries reach their tipping point and start to look like Indian River Lagoon. As Captain Van Hubbard, a well-regarded local fishing guide, says pointedly: "What's the point of living in Florida if the reason we're living here disappears?" We must, in his view, reverse the downward spiral and bring our estuary waters back from impairment. This is necessary to preserve our quality of life. Van urges our commissioners and other county leaders to take a proactive, rather than reactive, approach. (Hubbard, 2021).

To stop this downward spiral and bring our estuaries back from a tipping point *requires that the county government commits to meeting or exceeding the state nutrient standards* (Table 3) and *implements a transparent, proactive, data driven, science-based process* (Figure 13).

Wakeup Call: In 2014, Charlotte County initiated a septic to sewer conversion project in an old neighborhood along the Peace River (Calvert, 2019). The project included monitoring of nitrogen levels, using grant funding. Before the conversion project, nitrogen levels in the area were over 40 milligrams per liter. Immediately after the project, groundwater nitrogen levels dropped to below 20 milligrams per liter - and then the grant ran out. County staff continued sampling in 2015 and found that nitrogen levels had dropped below 5 milligrams per liter. This seems a remarkable improvement, which we would expect by the removal of the septic systems. However – remember that the water quality criteria for nitrogen in this area of the Tidal Peace River is 1.08 milligrams per liter – 1/4 of the levels found in the ground water after converting to sewer. And, this is just one area in a big county – there is a long way to go, and time is wasting.

Adoption and implementation of this process will be challenging and costly. Investments will include: 1) transitioning priority septic systems to sewer; 2) upgrading existing wastewater infrastructure; 3) upgrading to advanced wastewater treatment to reduce or virtually eliminate nutrients in reclaimed water; 4) retrofitting priority stormwater systems to hold and filter rain and irrigation water before it reaches our estuaries; and 5) designing stormwater systems for new development that use natural absorption/filtering of rainwater and can accommodate future flashier rainfalls.

These actions will be expensive indeed. But considering the alternative losses of our economic base, lifestyles, and property values – caused by more "gunky seaweed" and less fish – it is worth the investment. As Captain Hubbard says: "What's the point of living here if the reason we're living here disappears?"

Chapter 6: Summary and Conclusions

Charlotte County's invaluable estuaries – the places we call home, where most marine life originates and the basis of our economy and lifestyles – are in a downward spiral. The cause of the problem is a nutrient cycle thrown out of balance by human activities. Unless we work together to solve our nutrient and water quality problems very soon, we face the unthinkable: "guacamole" algae and "gunky seaweed" blooms in our canals and estuaries, stressed and dying seagrasses, fish and marine mammals, and plummeting real estate values.

We know the primary specific causes of our estuary impairments – nutrients from wastewater and stormwater. And, we understand the numeric quantities of nutrients that allow our marine life to thrive (vs barely survive or decline). So we can – and must – manage and reduce our human nutrient contributions to restore our estuaries, and then maintain them for the long term.

Fortunately, the first necessary step is already being implemented. Under the direction of the county's Water Quality Manager, the Comprehensive Water Quality Monitoring, Analysis, and Reporting System has begun to gather data.

What must happen next, is for Charlotte County to commit to:

1. Establishing the existing estuary nutrient standards (Table 3) as water quality goals for our estuaries.
2. Managing wastewater and stormwater systems so that our waterways meet those standards – most effectively using a proactive, data-driven, science-based decision process (Figure 13).
3. Keeping elected officials and the public up to date about what and where the problems are, what solutions are implemented where, what the results and success are and how much the actions cost.
4. Sustain and periodically upgrade budgetary support for the above water quality programs.

This will be an expensive process, because significant infrastructure will require upgrading and retrofitting to get nutrients under control. But the investments are necessary to preserve our estuaries and their wealth of benefits to our economy, lifestyles, aesthetics and fish and wildlife. As Captain Van Hubbard says, no sense living here if our way of life disappears. *Time to act is now* – because our estuaries are rapidly reaching their tipping point. We have learned that once severely degraded, an estuary cannot be repaired in a timely or affordable way – If ever. Our estuaries can't wait.

What We Can Each Do

1. **Tell our commissioners to get proactive.** Join Captain Van Hubbard in letting the commissioners know you want them to commit to establishing water quality goals for our estuaries – based on existing state standards. And then manage county wastewater and stormwater systems so those water quality standards are achieved. Tell the commissioners to create a transparent, data-driven, and science-based process and put into action as soon as possible. Let the commissioners know that you are looking forward to being kept up to date about what is being done, what the results are and how much it costs. And tell them you expect taxes to be increased to fund these investments in our future.

   Important Note: As of April, 2023 the commissioners are on a different path than the one recommended. They will need our continual, collective nudging to adopt and committee to an effective approach that will keep us from heading over an irreversible tipping point (see Chapter 7).

2. **Support the Peace and Myakka Waterkeepers and other organizations working to protect and restore our estuaries.** PMWK aims to preserve and protect water quality and ecological integrity in the watersheds and estuaries of the Peace and Myakka Rivers of Florida. Get involved with PMWK and/or donate to at https://www.pmwk.org/. Other organizations with complimentary missions include: Heal Our Harbor, Coastal and Heartland National Estuary Partnership (CHNEP), Friends of Charlotte Harbor Aquatic Preserves, Lemon Bay Conservancy, Charlotte Harbor Environmental Center, Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network, and many others.
3. **Focus on solving our highest priority to reduce nutrients** – but learn about other factors contributing to the decline of health of our estuaries (like climate change) and choose actions you can take to contribute

to solutions. Much additional information is available from the references used for this report, and much more is available from reputable organizations and on the internet. Do some sleuthing and take action – for yourself, your children and your grandchildren.

4. Support the Clean and Healthy Water amendment. The Florida Rights of Nature Network has made clear that the current system of water protection in Florida has failed; the state executive branch is not enforcing clean water legislation according to environmental laws, legislative intent, and constitutional policy. Although a right to clean water already exists by statute, it defers too much to state executive agencies to guard against harm. The proof of dysfunction frequently makes national news, with routine harmful algal blooms, fish and wildlife mortality events and public notices of pathogenic or toxic contamination of our waters. It's not okay. People suffer, wildlife suffers, property values suffer, businesses suffer, communities suffer. Waiting for political solutions in a system that favors pollution industries financing those politics – is a fool's game. We need a clear, simple, legal solution to restore the necessary checks and balances for such a critical necessity to all lives – water.

What does the amendment do? It creates a fundamental right to clean and healthy waters, clarifies prohibited actions and inactions that harm (or threaten to harm) waters, and defines important terms. It also allows Floridians to enforce this right through the ability to sue state executive agencies that violate this right, empowering courts to look at the science and truth (and not politics) of what's going on before awarding equitable relief to the situation. (Florida Rights of Nature Network 2023).

What type of support?

A. Sign your petition and get ***at least five others*** to sign theirs.
B. Mail your signed petitions to 13300 S. Cleveland Ave, Suite 56, Fort Myers, FL 33907 or sign/drop them off at a Petition Location near you.
C. Register here to help.
D. Donate by mailing a check to the address above, or online (PayPal / Venmo).
E. Keep sharing this Call to Action with everyone you know, asking for their support.

Chapter 7 Are We on the Right Path or Heading Over an Irreversible Tipping Point?

Since this report was first drafted (Fall, 2022), Charlotte County has taken some action toward recognizing our water quality issues. According to County Administrator Hector Flores (Flores, 2022*)*, the county will create a plan this year (2023) to use water quality data collected by County Water Quality Manager Brandon Moody's monitoring and reporting system. This could be a major step in towards saving our estuaries, if done right. However, what the county has in mind – as of this update – is distressingly inadequate.

The county's recent Scope of Work (SOW) (Cunningham and Friedrich, 2023) for the plan sets the underwhelming goal of "establishing mechanisms for reducing anthropogenic impacts in the county's waters." Our situation is too urgent to spend valuable time on weak and abstract objectives. **We must have a strong, concise, and written goal, with county commitment, to achieve the estuary specific water quality standards for Charlotte's estuaries.** These standards were established a decade ago by the state with support from local experts. We must aim to achieve these legal water quality standards with urgency, or our estuaries will pass a tipping point for which we cannot recover – no matter how much funding and effort we apply. The SOW focuses on projects that can be funded by grants – without requiring county commitment of resources. The major infrastructure upgrades we need to stop the flow of nutrients into our estuaries from our inadequate stormwater and wastewater systems cannot be accomplished without major investments.

The current county path does not make water quality a strategic priority and provides no hope of restoring the estuaries that are vital to our economy and lifestyles – before it is too late.

What can we do to keep our commissioners from jumping over an irreversible tipping point? Tell them to abandon – or make major revisions to – the proposed One Charlotte One Water scope of work so it establishes our estuaries as the real, fully funded priority. This means:

1) setting existing estuary nutrient standards as our water quality goals for our estuaries;

2) managing wastewater and stormwater systems so that our waterways meet those standards – most effectively using a proactive, data-driven, science-based decision process;

3) keeping elected officials and the public up-to-date about problem types and locations, solutions implemented, results and successes of implemented solutions, and costs of solutions and actions;

4) sustaining and periodically upgrading budgetary support for these water quality programs; and

5) inspiring and fostering deep community involvement and ownership in the process of making Charlotte County a standout in the state.

References

Note to Readers: To make clear who our sources of information are, and where the material may be found, you will find parenthetical references in the text noting the author and year of the reference. Each of those references is listed here in alphabetical order of the author's (or organization's) last name. When the references are available online, the link is provided below and in the text of the report, as well, for quick access.

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Appendix- Numeric Nutrient Standards for Charlotte County's Valuable Estuaries

Nutrient Data will be analyzed as annual geometric means and are **not to be exceeded more than once in 3 years.**				
	Tidal Myakka (& Tippecanoe Bay)	Tidal Peace River	Charlotte Harbor Proper	Lower Lemon Bay
Total phosphorus	0.31 mg/L	0.50 mg/L	0.19 mg/L	0.17 mg/L
Total nitrogen	1.02 mg/L	1.08 mg/L	0.67 mg/L	0.62 mg/L
chlorophyll a	11.7 µg/L	12.6 ug/L	6.1 µg/L	6.1 µg/L

Total phosphorus (TP): milligrams per liter (mg/L); equivalent to parts per million (ppm). Although TP is used for plant growth, excess phosphorus is often an indicator of pollution. Sources of TP include wastewater, watershed and agriculture runoff, and/or leaching and resuspension of phosphorus rich sediments.

Total nitrogen (TN): milligrams per liter (mg/L); is calculated as the sum of total Kjeldahl nitrogen (TKN) plus nitrate and nitrite (NOX). Nitrogen is an element necessary for plant growth; low levels of nitrogen or phosphorus may limit plant growth in surface waters; high levels may cause excess plant and phytoplankton growth; common inorganic forms needed for plants: ammonia (NH_3), nitrate (NO_3) and nitrite (NO_2). High levels of nitrogen are often an indicator of pollution. Sources of nitrogen include wastewater, watershed runoff, agriculture and fertilizer runoff, and atmospheric deposition.

Chlorophyll a (Chl a): micrograms per liter (µg/L). Chlorophyll a is a green pigment used by plants for photosynthesis and is a useful indicator of algae levels in the water; important because algae form the base of the food chain and help in oxygenating the water, but too much algae can cause oxygen levels to collapse. Measures the amount of photosynthetic (phytoplankton/plant) productivity in the water. Excess chlorophyll can be used as an indicator of nutrient enrichment or degraded water quality.

For **fecal coliform, in all waterbodies:**

- Monthly average must not exceed 200 cfu/100ml.
- 10% of samples must not exceed 400 cfu/100ml
- Must not exceed 800 cfu/100ml on any given day

Fecal coliform bacteria (FC): number of colonies per 100 milliliters (CFU/100ml). Fecal coliform bacteria are rod-shaped bacteria that can grow in elevated temperatures and are usually associated with the fecal material of warm-blooded animals; includes E. coli and can serve as an indicator of other pathogens that can cause serious human health risks.

The daily average percent of **Dissolved Oxygen in all waterbodies:** saturation shall not be below 42 percent saturation in more than 10 percent of the values.

Dissolved oxygen (DO): milligrams per liter (mg/L) or saturation (%). Measures the concentration of oxygen contained in the water; it is influenced by water temperature and salinity (the higher the temperature or salinity, the lower the amount of oxygen that can dissolve in the water); it is necessary for organisms to breathe; at low levels, fish and other animals can become stressed or even die. In terms of DO saturation, this measures the percent of dissolved gas molecules. High photosynthetic activity or rapid temperature change can cause DO saturation readings above 100%

Turbidity in all waterbodies must not exceed 29 NTU or above natural background conditions.

Turbidity: Nephelometric Turbidity Units (NTU). Turbidity measures how cloudy water is; influenced by plankton, sediment, water color; may limit plant growth if sunlight cannot penetrate. Sources of turbidity include resuspension of organic material and solids, watershed runoff, and erosion.

Source: Florida DEP Surface Water Quality Standards/Estuary Specific

https://www.flrules.org/gateway/ruleno.asp?id=62-302.532