

SAVE OUR LAGOON PROJECT PLAN FUNDED MUCK REMOVAL, BREVARD COUNTY, FLORIDA

Robert J. Wagner, P.E., D.NE¹, Matt Culver² and Lance Lumbard³

ABSTRACT

A thick layer of organic “muck” sediments cover much of the bottom of the Indian River Lagoon (IRL) in Brevard County, FL. These fine-grained nutrient-rich organic sediments with high water content, create shoreline water depths too shallow for boaters to navigate without disturbing the muck sediments. Suspended muck sediments cause several undesirable consequences. These include the deterioration of water quality and the covering of seagrass beds and the creation of anoxic benthic conditions negatively impacting the IRL’s infaunal communities and the basis of the aquatic ecosystem food chain. Furthermore, disturbed muck sediments create malodorous and aesthetically displeasing black plumes of muck, and damage to boat motor cooling systems from muck entrained in outboard engines. Due to both its hydrology and physiography, deeper portions of the IRL and areas near tributaries or estuaries often collect significant quantities of nutrient-rich, fine-grained, organic muck sediments. Within Brevard County, muck covers as much as 10% of the IRL bottom.

Both the IRL Comprehensive Conservation and Management Plan (CCMP) and the IRL Surface Water Improvement and Management Plan (SWIM) recommend removal of these muck sediments as an efficient means to improve water quality and natural resources within the overall IRL. The Florida Department of Environmental Protection (FDEP) also endorses the removal of muck sediments under its Total Maximum Daily Loads (TMDL) program, which works to remove the legacy loads of nutrients and pollutants associated with re-suspended muck sediments into the water column and the transport of muck into the IRL, negatively affecting seagrasses. The St. Johns River Water Management District (SJRWMD) serves as a funding partner to several IRL dredging projects including the removal of 458,733 cubic meters (600,000 cubic yards) of muck sediments from the 63 km (3.9-mile) long Eau Gallie River, a tributary of the IRL in Brevard County.

As a remedy to the Brevard County IRL muck sedimentation problems, the Brevard County Commission authorized Ordinance 2016-15 establishing a 10-year ½ cent sales tax-funded *Save Our Lagoon Project Plan*. Which in turn, funds local projects planned to meet water quality targets and improve the aesthetic appeal, health, productivity, and economic value of the IRL. Of particular note, Brevard County will use almost two-thirds of the total sales tax revenues (estimated at \$400,000,000) for direct muck sediment removal through dredging.

Keywords: Muck sediments, water quality, dredging, environmental restoration, seagrass

INTRODUCTION

The IRL is not a river in any real sense of the term. The IRL is, in fact, a shallow estuary, which is a body of water where freshwater draining from the land mixes with the ocean’s salt water. By definition, a river has a headwaters and flows to a mouth. The IRL has no such headwaters or any such mouth, and when it does “flow,” it often flows in many directions at the same time, with the direction of this “flow” dependent on winds, tides, and several other factors. Stormwater runoff is carried by creeks, rivers, canals, and ditches to the IRL. Ocean waters enter the IRL through ocean inlets. The primary freshwater sources for the IRL are direct rainfall onto the IRL and runoff from lands within the watershed of the IRL.

Lagoons are shallow, usually elongated, coastal bodies of water separated from the ocean by a series of barrier islands or reefs which lie parallel to the shoreline. Inlets, either human-made or natural, cut through the barrier islands and

¹ Senior Dredging Engineer, Wood Environment and Infrastructure Solutions, 6256 Greenland Road, Jacksonville, FL USA 32258 Phone: (904) 391-3741 E-Mail: joseph.wagner@woodplc.com

² Boating & Waterways Program Coordinator, Brevard County Natural Resources, 2725 Judge Fran Jamieson Way, Building A, Room 219, Viera, FL 32940 Phone: (321) 633-2016 E-Mail: matt.culver@brevardcounty.us

³ Senior Environmental Scientist, Wood Environment and Infrastructure Solutions, 75 East Amelia Street, Suite 200, Orlando, Florida 32801 Phone: (407) 253-5438 E-Mail: lance.lumbard@woodplc.com

permit tidal currents to transport water into and out of the lagoons. What's more, the term "lagoon" is usually limited to bodies of water with little or no appreciable freshwater inflow, and little or no tidal flow.

The IRL, occupying slightly more than 35% of Florida's east coast, is a critical part of one of the longest barrier island system in the whole of the United States. The IRL spans approximately 251.1 kilometers (156 miles) from Ponce de Leon Inlet in the Mosquito Lagoon in the north down to Jupiter Inlet near West Palm Beach in the south (**Figure 1**). The entire IRL is a complex mix of upland, wetland, open water, and estuarine ecosystems which come together to create a vital ecosystem mosaic with high habitat and biological diversity. The IRL has multiple channels, well-defined exchange with the ocean, and tends to show a net seaward transport of water. Wind patterns in this restricted lagoon can also cause surface currents to develop, thus helping to transport large volumes of water and nutrients downwind.



Figure 1. Map of the IRL.

Florida Atlantic University's Harbor Branch Oceanographic Institute website cites the IRL as among the most biologically diverse estuaries in North America. The website notes that the IRL straddles a warm-temperate climate to the north and a subtropical climate to the south and that the influence of these two distinct biogeographical provinces is one of the factors underlying the remarkable biodiversity found within the IRL. The presence of several diverse habitats, including seagrass meadows, mangrove forests, and saltmarshes, whose continued health is essential for a healthy IRL, also foster the IRL's high biodiversity. Various recent sources cite more than 2,100 different species of plants, along with more than 2,200 animal species, including some 700 fish and 310 bird species utilize the IRL region. Of that, there are approximately 50 threatened or endangered species, including 12 plants and 36 animals.

While the IRL's environmental importance is apparent, the IRL is also a vibrant economic engine, generating more than \$7.6 billion per year to the state of Florida, much of that within Brevard County. The majority of the IRL system, over 70% of its area and nearly 50% of its length, is located within Brevard County and provides Brevard County residents and visitors many opportunities. Within Brevard County, the IRL system includes Mosquito Lagoon, Banana River Lagoon, and Indian River. A 2016 Brevard County report estimated a \$2.01 billion favorable impact from the restoration of the IRL within Brevard County and \$4.29 billion in damages to the Brevard County economy if Brevard

County cannot bring the IRL back to health during the next decade. Independently, a 2016 East Central Florida Planning Council and the Treasure Coast Regional Planning Council study further concluded that there is a stunning 33-to-1 return on investment from a "productive and sustainable" IRL and that for every dollar invested in the lagoon's health, there is \$33 worth of economic benefit.

A HISTORY OF IMPAIRMENT

The IRL, once a sandy bottom estuary with a modest accumulation of organic detritus from the shoreline and aquatic vegetation loss, is now profoundly impacted by fine-grained nutrient-rich organic sediments with a high water content that has accumulated over years of excess sedimentation. Stormwater runoff from urban and agricultural areas, poorly treated wastewater treatment facility discharges, leaching from septic systems, and nitrification from excess fertilizer applications have all led to harmful levels of nutrients and sediments entering the IRL. These nutrient based pollutants also lead to muck accumulation on the IRL's bottom, which in turn fluxes nutrients and creates a lagoon bottom that is not conducive to seagrass, shellfish, or benthic invertebrate growth. The introduction of development in the area and the subsequent substantial nutrient loading has tipped the fragile balance of this delicate ecosystem, which has led to harmful impacts and a long history of impairment of the IRL.

Organic materials, sediment, and other fine particles carried in by tributaries, canals, and storm drains accumulate and break down on the bottom, forming a thick black liquid mud with the consistency of mayonnaise (**Figure 2**). This "black mayonnaise" builds up in channels and deep pockets where it has reached recorded depths of over 4.57 meters (15 feet) thick. These muck sediments are anoxic, store and release nutrients, and destroy natural benthic habitats (Beckett et al. 2016). The "black mayonnaise" blocks light from benthic grasses and organisms, and this "ooze" is a significant contributor to the lowering of the environmental health of the IRL within Brevard County. These muck sediments also serve as a legacy load that slowly releases nutrients (nitrogen and phosphorous) back into the water column.



Figure 2. "Black Mayonnaise" muck sediments found in the IRL.

Moreover, because the IRL is characteristically shallow, like most other lagoons, it is strongly influenced by precipitation, evaporation, and tidal, and tributary flows, which results in fluctuating water temperature and salinity. Given the unique nature of the IRL, it is not surprising that this fragile ecosystem is highly susceptible to pollution and nutrient loading effects from municipal, industrial and agricultural runoff. Urbanization, excessive freshwater releases, contaminant loading, degradation of water quality, loss of seagrasses and mangrove habitat, a fisheries decline, and emerging diseases in marine mammals have all negatively affected the health of the IRL.

Muck Sediments

Damage to the IRL has been occurring for decades and will require time and money to reverse. A notable example of this damage is the accumulation of muck sediments on the lagoon's bottom. These fine-grained nutrient-rich organic sediments create shoreline water depths too shallow for boaters to navigate without disturbing the muck sediments. Moreover, wind and waves can suspend muck sediments, creating particulates that cloud the water, reducing sunlight penetration and retarding plant and algal growth (Trefry et al. 2007).

Suspended muck sediments cause several unwanted outcomes. These include the deterioration of water quality and the covering of seagrass beds and the creation of anoxic benthic conditions negatively impacting the lagoon's infaunal communities and the basis of the aquatic ecosystem food chain. Furthermore, disturbed muck sediments create malodorous and aesthetically displeasing black plumes of muck sediments, and damage to boat motor cooling systems from muck sediments entrained in outboard engines. Due to both its hydrology and physiography, deeper portions of the IRL and areas near tributaries or estuaries often collect significant quantities of nutrient-rich, fine-grained, organic muck sediments. Trefry et al. speculate that muck sediments accumulation in the IRL has been ongoing for the past 40 to 60 years, with an acceleration from the early 70's to 90's (Trefry et al. 1990, Trefry et al. 2007). Within Brevard County, various sources have estimated that muck sediments now covers as much as 10% of the IRL bottom.

The restoration of the IRL depends on a reduction in the influx of nitrogen, phosphorus, and pollutant from sediments to the overlying water. Muck sediments carry large quantities of nutrients and potentially toxic substances that can create health problems or even death for many aquatic organisms. The effect of this excess nitrogen and phosphorous in the IRL waters and bottom is an alteration of the dominant plants in the seagrass meadow, marshes, and mangroves that make up the IRL in Brevard County. While the change has a harmful effect on native species, it also allows some species to thrive outside of their natural realm, many of them invasive. While efforts are ongoing to remove invasive plants from upland areas, aquatic invasions of fishes and invertebrates are often much more difficult or impossible to reverse, and can only be managed to prevent further range expansion. Aquatic invasive plants are especially problematic in Florida where they can obstruct navigation and flood control, spoil recreational water use, and produce breeding grounds for mosquitoes. Costing millions of dollars each year, management of invasive plants in Florida's natural areas and waterways is expensive and a never-ending chore, while eradication is just flat out impossible.

Coupled with decreases in the upland point-source and nonpoint-source runoff, large-scale dredging projects, could result in significant long-term reductions of muck sediments throughout the IRL. However, quantifying improvements associated with restoration efforts such as dredging is complicated by spatial and temporal variations in nutrient fluxes, the influence of significant storms and hurricanes, and inherent unknowns of any significant infrastructure project.

Nonetheless, recent results from an environmental restoration dredging effort in the Indian River County IRL do seem to validate why dredging IRL to remove undesirable sediments is the primary component of the overall restoration plan for the IRL. In hopes of determining the ultimate fate of the dredged material and its associated nutrient load throughout the dredging and dewatering operations, researchers monitored the dredging of a portion of the Intracoastal Waterway in the Indian River County IRL. Researchers observed the quantities and types of materials removed along with residual bedload and several critical biological indicators.

Maglio et al. (2016) noted that the project removed approximately 211,000 cubic meters (276,000 cubic yards) of dredged material. The authors estimated that this amounted to the removal of roughly 240 metric tons (260 short tons) of nitrogen and 130 metric tons (140 short tons) of phosphorous to a Florida Inland Navigation District (FIND) upland dredged material management area (DMMA), IR-2 (**Figure 3**).



Figure 3. Dredged Material Management Area IR-2.

Given potential plans to expand dredging efforts to remove muck along much of the IRL the authors and agency regulators analyzed the project for changes to seagrasses, fish, and aquatic macroinvertebrate abundance. The authors and agency regulators also observed not only for the potential discharge of turbid water from the IR-2 placement area into the IRL but also for possible secondary effects from the nutrients returned and suspended solids associated with the project. The concern was that nutrients might trigger algal production (phytoplankton, drift macroalgae, and epiphytic algae). A primary goal of this portion of the field sampling was to determine if water released from the DMMA IR-2 impacted the fauna in the nearshore region of the IRL near the discharge site. Since the DMMA never filled and did not release water into the IRL, it was not possible to evaluate any discharge effects (Maglio et al. 2016).

From a biological standpoint, although the seagrasses in the vicinity of the FIND DMMA IR-2 expressed no significant difference in growth than the control site, and the authors could not attribute changes in fish populations to the dredging the dredging removed a substantial amount of anthropogenic nutrients from the IRL, benefiting its overall environmental health.

LEGISLATIVE ACTION

Unincorporated Brevard County initially adopted stormwater runoff regulations under the Brevard County Code of Ordinances (Code 1979, § 20-6.1) back in the late 70's. These stormwater runoff regulations required developers to construct stormwater treatment systems along with all new development exceeding certain size thresholds. It has been estimated that privately owned and operated stormwater treatment systems have prevented more than a million pounds of sediments from entering the IRL since its implementation. With this reduction in overall sediment loads, stormwater treatment projects also reduce nutrient inputs to the IRL.

Later, to address the damage to the IRL, Brevard County implemented a stormwater utility assessment. In Brevard County, there are more than 1,500 stormwater outfalls to the IRL (Tetra Tech et al. 2016). The initial stormwater utility assessment established an annual assessment rate of \$36 per year per equivalent residential unit (ERU). In 2014 and 2015 the yearly assessment rate increased to \$52/ERU for and further increased to \$64/ERU in 2016, raising collections from \$3.4 million per annum in 2014 to \$6.0 million per annum for 2016 (FL Legislation. S.B. 784 2017). Of the funding raised, a portion is available for capital improvement programs or other stormwater best management practices (BMPs). The county splits these funds between water quality improvement programs and flood control and mitigation programs. Of course, funding must also cover annual program operating expenses. Operation and maintenance include National Pollutant Discharge Elimination System permit compliance activities (street sweeping, trap and box cleaning, and aquatic weed harvesting), outfall/ditch treatments, small-scale oyster restoration, as well as harvesting and replanting of floating vegetative islands.

The core of the 1996 IRL Comprehensive Conservation and Management Plan (CCMP) is a set of 68 recommended action items under four topic areas that guides all of the IRL NEP's work. The CCMP updated the initiative in 2008. While new issues and threats to the lagoon, including climate change, toxic algae, exotic invasive fauna and flora, etc. have emerged since the original CCMP's development, the central restoration plan remains unchanged. That is the removal of muck sediments as an efficient means to improve water quality and natural resources within the overall IRL (IRL NEP 2008). Similarly, the 2002 IRL Surface Water Improvement and Management Plan (SWIM) updates the 1988 interim plan, and again the pivotal restoration plan remains unchanged, removal of muck sediments to improve water quality and natural resources within the overall IRL (Steward et al. 2003).

The state of Florida has also had many ongoing efforts to address the sources of nutrification and pollution in the IRL. The IRL System and Basin Act of 1990 (Chapter 90-262, Laws of Florida) was enacted to protect the IRL from point-source wastewater treatment discharges, and the leaching from improper septic tanks use. The objectives of the act were (1) investigation of the feasibility of reuse whenever possible, (2) elimination of surface water discharges where practical and (3) centralization of wastewater collection and treatment facilities (FDEP 2016). Over the years, the implementation of IRL System and Basin Act of 1990 has led to large-scale restoration efforts. These include the purchase of 212.9 km² (52,600 acres) of environmentally endangered land within the IRL's watershed, the removal of effluent discharges to the IRL from more than 40 wastewater treatment facilities, and many others (SJRWMD 2016).

In 2009, to improve IRL water quality and restore seagrass, the FDEP adopted Total Maximum Daily Loads (TMDLs) for total nitrogen and total phosphorus allowed to discharge to the Banana River Lagoon, Northern IRL, and Central IRL. A TMDL for an impaired waterbody, like the IRL, is the sum of the individual waste load allocations for point sources and the nonpoint sources load allocations plus the natural background for a particular waterbody. Waste load

allocations are pollutant loads attributable to existing and foreseeable future point sources. Load allocations are pollutant loads attributable to existing and future nonpoint sources. Point sources are discernible, confined, and discrete conveyances including pipes, ditches, and tunnels. Nonpoint sources are unconfined sources that include runoff from agricultural lands or residential areas. The purpose of these TMDLs is to reduce nutrients that lead to algae growth, which block sunlight from seagrass and create low dissolved oxygen conditions that affect fish in the IRL.

To implement these TMDLs, FDEP has adopted three Basin Management Action Plans (BMAPs) that outline responsibilities for reductions by the local stakeholders, list projects, and stipulate a timeline for implementation. The FDEP is the lead agency in coordinating the development and implementation of TMDLs and BMAPs are one of the primary mechanisms the FDEP uses to achieve TMDLs. BMAPs use existing planning tools to address the entire pollution load, including point and nonpoint discharges, for a watershed. Generally, the FDEP will establish a BMAP as part of the development and implementation of a TMDL for a specific waterbody, such as the IRL. The BMAP establishes the schedule for implementing projects along with the activities necessary to meet the pollution reduction allocations. The BMAP development process provides an opportunity for local governments, local stakeholders, community leaders, and the public to determine collectively and share water quality clean-up responsibilities. Brevard County, along with its 16 municipalities, Florida Department of Transportation (FDOT) District 5, Patrick Air Force Base (AFB), and National Aeronautics and Space Administration (NASA) - Kennedy Space Center have a significant responsibility in all three BMAPs.

Soon after the implementation of these new BMAPs the IRL was the focus of international attention due to harmful phytoplankton in 2010 and 2011 and several large die-off events of not only seagrasses but also fish and marine mammals. According to Morris et al. (2016), a mix of cyanobacteria, diatoms, and dinoflagellates dominated the 2010 bloom. As the first bloom continued, a second bloom, began in the spring of 2011 and reached immense proportions in the Mosquito Lagoon, Banana River Lagoon, and Northern IRL, as well as a secondary, less intense bloom in the Central IRL. As the 2011 event expanded local media labeled the new algae bloom a “super bloom.” By the end of summer 2011, the loss of seagrass, die-off of benthos, and even marine mammals were enormous. Evidence suggests that the loss of seagrasses resulted primarily from decreased light penetration during and after the super bloom, but other events may have played an essential role in creating the observed conditions (Morris et al., 2016). There were recurring brown tides; unusual mortalities of dolphins, manatees, and shorebirds; and fish kills due to low dissolved oxygen from decomposing algae. The two separate yet concurrent events led to a significant decline in the IRL.

Since 2012, Brevard County, along with its 16 municipalities, has led an effort with both FDOT District 5 and Patrick AFB to update the estimates of nutrient loadings discharged directly to the IRL. For example, in January 2013, FDEP adopted IRL BAMPs for stakeholders to implement actions toward achieving the nutrient TMDLs. A consortium of Brevard County and its 16 municipalities, independently engaged a team of consultants to study IRL pollutant loads and causative biological impacts, which included the development of a custom geographic information system (GIS) based Spatial Watershed Iterative Loading (SWIL) model. The SWIL model uses real-time satellite data to calculate evapotranspiration volumes, develops hydrologic mass balances to estimate base flow volumes and loadings to IRL. As predicted, a biological analysis showed low causative relationships between nutrients and seagrass coverage (Tetra Tech et al. 2016).

While revenues from stormwater assessments had funded many projects, a significant portion of projects relied on federal water quality grants that provide up to 60% matching funds, state TMDL grants that provided up to 50% match, and SJRWMD cost-share grants that might fund up to 33% of construction cost. All of these grant programs are highly competitive, subject to variable state and federal appropriations, as well as to changing priorities. Due to funding constraints, a significant portion of projects are at least partially grant funded, and the continuing degradation of key indicators of health in the IRL, Brevard County citizens recognized the need for additional funding to implement projects identified as critical to IRL restoration. and

The tipping point might have been the almost annual fish kills, such as the massive March 2016 algae bloom’s death toll pictured in **Figure 4**. That 2016 fish kill choked the Banana River, Sykes Creek, the Indian River and the Mosquito Lagoon with hundreds of thousands of fish corpses. An estimated 30 metric tons (65,000 pounds) of dead fish were skimmed off the water in just a two week period. While the national media chided, the “Space Coast waterways have been transformed into rotting cauldrons of dead marine life,” Brevard County Commissioners listened for hours in public hearing as local citizens pleaded to them to enact measures that could save the IRL (Miami Herald 2016).



Figure 4. Photo of Dead Fish clogging the Banana River in Cocoa Beach, Fla (Florida Today)

Save Our Lagoon Project Plan

With the memory of the massive dieoff fresh in their minds, organizations such as Brevard Indian River Lagoon Coalition, a registered 501(c)3 non-profit, as well as nearly 30 other independent organizations, pushed for legislation to fund what became known as the Save Our Lagoon Project Plan (Nature Conservancy 2016). The final Save Our Lagoon Project Plan outlined a four-step process to *remove* the muck; *restrict* the flow of septic, fertilizer, stormwater, and pollutants; *restore* the oysters, clams, and seagrasses; and *report* and adjust as new data comes in.



Figure 5. Save Our Lagoon lawn signs appeared all around Brevard County in 2016 (Florida Today)

Following a relentless citizen-led campaign (Figure 5), in November 2016 Brevard County residents overwhelmingly voted for the ½ cent sales tax to fund the projects in the Save Our Lagoon Project Plan. This referendum provided a detailed funding mechanism for Brevard County’s anticipated portion of all the projects listed in the plan (Tetra Tech et al. 2016) and in future annual updates (Tetra Tech et al. 2017). Revenue collection began in 2017. Brevard County and independent economists initially estimated the Save Our Lagoon Project Plan would cost roughly \$302 million over ten years, with the ½ cent sales tax generating approximately \$34 million annually. More recent projections by the Save Our Lagoon Citizen Oversight Committee project revenue closer to \$40 million annually. This projection is slightly more than half of the revenue needed for projects in each plan year. These projects are contingent upon additional fundraising. Furthermore, supplemental local funding could be used to leverage significantly more in match funding from state and federal grant programs. To implement the projects promptly, Brevard County will seek to use

funds generated from the referendum to leverage matching funding from grants and appropriations and pay debt service on bonds.

The Save Our Lagoon Project Plan, as adopted, outlines projects planned to meet updated TMDL targets and improve the health, productivity, aesthetic appeal, and economic value of the IRL. While the Save Our Lagoon Citizen Oversight Committee has formally recognized that restoration of the IRL ecosystem will lag for several years behind the completion of nutrient reduction implementation, they understand that action must be accelerated now to ensure success over time.

Funding programs include (Tetra Tech et al. 2016):

- Clean Water State Revolving Fund (SRF) loan program – This program provides low-interest loans to local governments to plan, design, and build or upgrade wastewater, stormwater, and nonpoint source pollution prevention projects. Interest rates on loans are below market rates and vary based on the economic means of the community. The Clean Water SRF is Florida’s principal and most significant financial assistance program for water infrastructure.
- Community Budget Issue Request – The Florida Legislature solicits applications directly for projects, including water projects, in anticipation of upcoming legislative sessions. This process is an opportunity to secure congressional sponsorship of project funding through the state budget.
- Florida Rural Water Association Loan Program – This program provides a low-interest bond or bank financing for community utility projects in coordination with FDEP’s SRF program. Other financial assistance also is available.
- IRL National Estuary Program (NEP) – The IRL Council funds projects, that support restoration, each year through their work plan process (www.irlcouncil.com/irl-council.html).
- Rural Development Funding – The U. S. Department of Agriculture provides funds that will cover the repair and maintenance of private septic systems. The number of funds available, as well as the specific purposes for which grants are intended, changes from year to year. See the Department of Agriculture’s website for more details (www.rurdev.usda.gov/Home.html).
- Rural Development Rural Utilities Service Guaranteed and Direct Loans and Grants – The U.S. Department of Agriculture’s program provides a combination of grants and loans for wastewater, water, and solid waste projects to rural communities and small incorporated municipalities.
- Section 319 grant program – FDEP administers funds received from the United States Environmental Protection Agency (EPA) to implement projects or programs that reduce nonpoint sources of pollution. Projects or programs must benefit a specific Florida impaired waters. Local sponsors must provide at least a 40% grant match or some form of in-kind contribution. Eligible activities include stormwater retrofits, demonstration and evaluation of urban and agricultural stormwater BMPs, and public education.
- Small Cities Community Development Block Grant Program – The Florida Department of Economic Opportunity makes funds available annually for water and sewer projects that benefit low- and moderate-income persons.
- State Housing Initiatives Partnership Program – Florida Housing administers the program, which in turn provides funds to local governments as an incentive to create partnerships that produce and preserve affordable homeownership and multifamily housing. The program is designed to deliver help for emergency repairs; new construction; rehabilitation; down payment and closing cost assistance; impact fees; acquisition of property for affordable housing; matching dollars for federal housing grants and programs construction and gap financing; mortgage buy-downs; and homeownership counseling (www.floridahousing.org/HousingPartners/LocalGovernments).
- TMDL grants – Funding for projects related to the implementation of TMDLs are available through periodic legislative appropriations to FDEP. When funds are available, the program prioritizes stormwater retrofit projects to benefit impaired waters, similar to the Section 319 grant program.
- Water management district funding - Florida’s five regional water management districts (the Brevard County portion of the IRL lies within the SJRWMD) offer financial assistance for a variety of water-related projects, for water supply development, water resource development, and surface water restoration. Support provided from ad valorem tax revenues or periodic legislative appropriations for alternative water supply development and SWIM projects. The amount of funding available, matching requirements, and types of assistance varies from year to year.

Of the roughly \$302 million over ten years (recently adjusted to ~\$400 million) projected to be raised by the ½ cent sales tax, the Save Our Lagoon Citizen Oversight Committee wishes to fund around \$260 million towards \$500 million in environmental restoration based dredging projects. The Save Our Lagoon Citizen Oversight Committee has determined that these project should receive the lions-share of the funding because they are expected to remove the majority of nitrogen and phosphorus from the IRL system. These proposed environmental restoration based dredging projects will specifically target *removing* muck sediments from broad expanses of shallow-water ecosystems. Brevard County will further enhance the muck removal by *reducing* the generation of new muck sediments by working to eliminate excess fertilizer applications, curbing stormwater runoff, improving failing septic systems, and removing wastewater treatment facility discharges. Subsequent endeavors will include *restoring* acres of new submerge aquatic vegetation and oyster reefs. Finally, the County proposes to document their citizen’s return on their investment through a series educational *reporting* efforts.

ENVIRONMENTAL RESTORATION BASED DREDGING

Recently, dredging projects in isolated areas of the IRL, including the St. Sebastian River, Turkey Creek, and Crane Creek, have successfully removed thousands of cubic meters of muck, along with harmful chemicals like pesticides incorporated into the sediments (Trefry et al. 2002). (Figure 6)



Figure 6. Brevard County IRL Dredging Projects (SJRWMD)

Before November 2016 various agencies, municipalities, Brevard County itself had removed well over 3,000,000 cubic meters or 3,925,000 cubic yards of muck sediments from the IRL. For example, projects have removed:

- Approximately 76,456 cubic meters (100,000 cubic yards) of muck from Melbourne’s Crane Creek in 1998

- More than 290,531 cubic meters (380,000 cubic yards) of muck were removed from Turkey Creek from 1999 to 2001
- About 1,529,110 cubic meters (2 million cubic yards) were removed from the St. Sebastian River from 2006 to 2009
- Currently, Brevard County is removing more than 542,834 cubic meters (710,000 cubic yards) of muck from priority locations throughout the county
 - the Mims Boat Ramp
 - Cocoa Beach
 - Grand Canal
 - Turkey Creek
- Additionally, Brevard County is currently removing more 483,199 cubic meters (632,000 cubic yards) of muck from the Eau Gallie River (**Figure 7**)

The Brevard County Board of Commissioners is presently advertising a request for proposals for the dredging of the Sykes Creek Environmental Restoration Muck Dredging Project (489,315 cubic meters or 640,000 cubic yards) of muck as part of the Save Our Lagoon Project Plan to improve the health and water quality of the IRL.

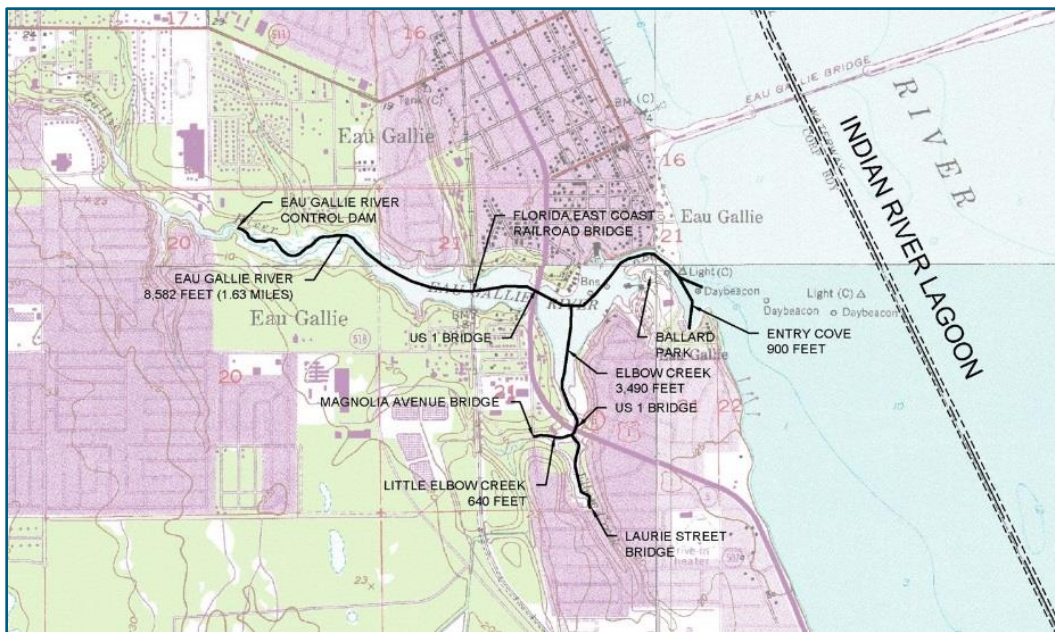


Figure 7. Eau Gallie River and Elbow Creek Restoration Dredging Project (SJRWMD)

CONCLUSIONS

It has taken at least five decades to reach this point of muck build-up in the IRL, and it is going to take us many years to clean it up and to restore the waterway to a fraction of its former productivity and health. The citizens of Brevard County, with the help of numerous local and state level agencies, have undertaken a bold plan to do just that.

The Save Our Lagoon Project Plan calls for the restoration of the IRL, which depends on a reduction influx of nitrogen, phosphorus, and pollutant from sediments to the overlying water, so it is no accident that Brevard County is directing the majority of the funds into restoration dredging efforts.

With the implementation of the Save Our Lagoon Project Plan, Brevard County continues conducting an aggressive restoration strategy for the IRL. The plan focusses on the reduction of excess nutrient inputs, the removal of the legacy loads of muck, restoration of the IRL's natural filtration systems (oysters, clams, and wetlands), and ensuring sound research is the basis of these efforts. The Brevard County's Save Our Lagoon Project Plan calls for the removal of a legacy of pollution stored in muck deposits as critical to the overall success of Brevard County's IRL restoration strategy. Brevard County plans to remove 4,327,381 cubic meters (5,660,000 cubic yards) accumulations of muck from the IRL by dredging (Tetra Tech et al. 2016).

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