Brevard County

Agenda Report

2725 Judge Fran Jamieson Way
Viera, FL 32940

New Business - Development and Environmental Services Group

J.1. 3/5/2020

Subject:

Adoption of the Save Our Indian River Lagoon Project Plan 2020 Update unanimously recommended by the Save Our Indian River Lagoon Citizens Oversight Committee

Fiscal Impact:

The recommended plan update recognizes an $8 million increase in total revenues to be generated by the Save Our Indian River Lagoon Surtax over its 10-year life (from $488 million to $494 million) and allocates $55,500,516 of previously unallocated revenue to projects. The increased allocation is broken down as follows:

- $0.6 million for wastewater treatment plant upgrades to reduce nutrients in reclaimed water;
- $3.1 million for nutrient reductions at wastewater infiltration basins and spray-fields;
- $0.5 million for smoke testing to find leaks in public and private sewer infrastructure;
- $28.1 million for additional septic to sewer projects;
- $7.7 million for upgrades to advanced septic where sewer service is not available;
- $8.1 million for new priority stormwater treatment projects;
- $1.9 million for muck removal;
- $3.1 million for treating interstitial water during muck removal; and
- $2.6 million as 5% contingency for the increased project allocations.

After accounting for actual collections to date, assuming 1.8% growth in revenue over the remaining life of the tax, allocating an additional $55.5 million in the 2020 update, and incorporating a 3.25% construction index rate for projects, $6 million remains unallocated and available to offset economic uncertainty or fund future project opportunities.

Dept/Office:

Natural Resources Management

Requested Action:

Adopt the Save Our Indian River Lagoon Project Plan 2020 Update, as recommended by the Save Our Indian River Lagoon Citizen Oversight Committee (Oversight Committee) on January 17, 2020, and authorize associated budget change requests for the current fiscal year.

Summary Explanation and Background:

Each year, in order to account for new information and opportunities, the Save Our Indian River Lagoon Citizen Oversight Committee is tasked with recommending an Update to the Save Our Indian River Lagoon Project Plan (SOIRLPP). The Committee has held monthly public meetings throughout the year to keep informed, gather ideas from the community, review potential changes, and recommend an annual plan update to the County Commission. The Committee's annually recommended SOIRLPP Updates are posted on the

Committee's webpage for public access at least 15 days prior to being brought to the County Commission for consideration. The County Commission may adopt or modify the Committee's recommended Plan Update.

A workshop was held with cities on August 26th, 2019 to review the process for submitting project requests to be considered for addition in the 2020 annual update. Project requests were due October 28th. Year 4 Project Submissions listed in the summary table (attached) were reviewed by the Committee during a December 13th public meeting. New projects that were recommended in December, as well as other changes based on new information gathered and analyzed throughout the year, were incorporated into the attached Draft Save Our Indian River Lagoon Project Plan 2020 Update, as recommended by the Committee on January 17th.

The 2020 Update (attached) includes 43 new projects bringing the total number of projects recommended for funding to 242. The plan also includes updates and refinements on a number of project types. To help readers find all areas of the SOIRLPP that contain proposed updates or modifications, the attached Draft 2020 Update uses yellow highlighted text, table and figure captions to indicate additions and revisions. Significant updates include:

- refinement of stormwater treatment priorities using updated loading estimates from more recent land use, rainfall, evapotranspiration data as well as updated catchment basin delineations and stormwater infrastructure geolocations;
- addition of vegetative harvesting as a method to reduce nutrient loads reaching the lagoon;
- information on an enhanced circulation pilot study being conducted by Florida Institute of Technology with funding from the Florida Legislature;
- information on physical and ecological modeling underway to evaluate the potential benefits of replacing some of the Highway 520 and 528 causeways with bridge spans;
- more detailed muck flux data at several priority sites;
- literature values for the nutrient removal benefits of clam aquaculture and harvest, making it possible to consider funding clam projects in the 2021 Update; and
- a detailed list in Table 9-8 of every funded project in the plan with its eligible cost share, nutrient reduction benefit and estimated cost effectiveness.

During fiscal year 18/19, tax collections were $47.4 million instead of the budgeted estimate of $46.6 million. This growth that exceeded the consumer price index led to consideration of whether the 10-year forecast of revenue collections should be increased. Using actual revenues collected in 2016 through 2019 and the state's latest consumer price index of 1.8%, the estimate of 10-year collections was increased in the 2020 Update from $486 million to $494 million. Revenue forecasting adjustments will continue to be considered as part of the annual Plan Update process.

The original distribution of funds between project types was guided by best available data in 2016 regarding the relative significance of nitrogen loading from each major contributing source of pollution to the Indian River Lagoon. The recommended changes in the 2020 update represent a continued shift in emphasis away from muck dredging and toward human wastewater related projects and stormwater treatment, as illustrated in the Adaptive Management Chart (attached). The original Save Our Indian River Lagoon Project Plan allocated 65% of the funding to muck removal projects. The 2020 Update reduces the proportion of funds for muck removal to 27% although 11% is allocated to stripping nutrients from the interstitial water. This shift in funding emphasis is also illustrated in the Figure 81 pie charts of the 2020 Update (attached).

Available funding is divided between projects that **reduce** the incoming load of new pollution, **remove** accumulations of old pollution, **restore** natural stabilization and filtration systems, or facilitate processes to **respond** to new information. In the 2020 Update, $182 million (45%, up from 24% in the original plan) is directed to projects that improve the treatment of human waste through upgraded treatment of reclaimed water, nutrient removal from treatment plant spray-fields and rapid infiltration basins, smoke testing to identify leaky sewer infrastructure, conversion of septic neighborhoods to sewer service, connection of septic homes to adjacent sewer lines, and upgrade of high-risk conventional septic to advanced septic systems. This focus on human waste sources of pollution is also illustrated in Figure 81.

The sum of the 2020 recommended changes brings the total Save Our Indian River Lagoon Project Plan cost to $488 million when a Construction Index of 3.25% is factored into the project costs for years 2 through 10 as shown in Table 99b from the 2020 Update. This represents a total cost of $429 million without inflation. Approximately $6 million of projected revenues over the 10-year life of the sales tax remain available for future allocation.

In 2019, the County Commission recommended that the Citizen Oversight Committee reduce the allocation to muck projects by approximately $100 million. About half that amount was reallocated in the adopted 2019 Update while $46.8 million was left to be allocated in the 2020 Update when additional data would be available and when county, municipal and community partners would have an opportunity to submit additional project requests. The 2020 Update, unanimously recommended by the Citizen Oversight Committee, fully allocates the remainder of the $100 million muck reduction, with the majority share going to wastewater treatment.

On December 13, 2019, the Citizen Oversight Committee also unanimously voted to endorse the County Commission creating an ordinance that would mandate the repair of leaky sewer laterals county-wide. Unless repairs are made, smoke testing to find infrastructure deficiencies is not an effective tool for reducing sewage overflows or groundwater pollution.

Clerk to the Board Instructions:

N/A

BREVARD County
BOARD OF COUNTY COMMISSIONERS

FLORIDA'S SPACE COAST

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March 6, 2020

MEMORANDUM

TO: Virginia Barker, Natural Resources Management Director

RE: Item J.1., Adoption of the Save Our Indian River Lagoon (SOIRL) Project Plan 2020 Update Unanimously Recommended by the SOIRL Citizens Oversight Committee (COC)

The Board of County Commissioners, in regular session on March 5, 2020, tabled consideration to adopt the SOIRL Project Plan 2020 update, unanimously recommended by the COC to the March 10, 2020, Board of County Commissioners meeting.

Your continued cooperation is greatly appreciated.

Sincerely yours,

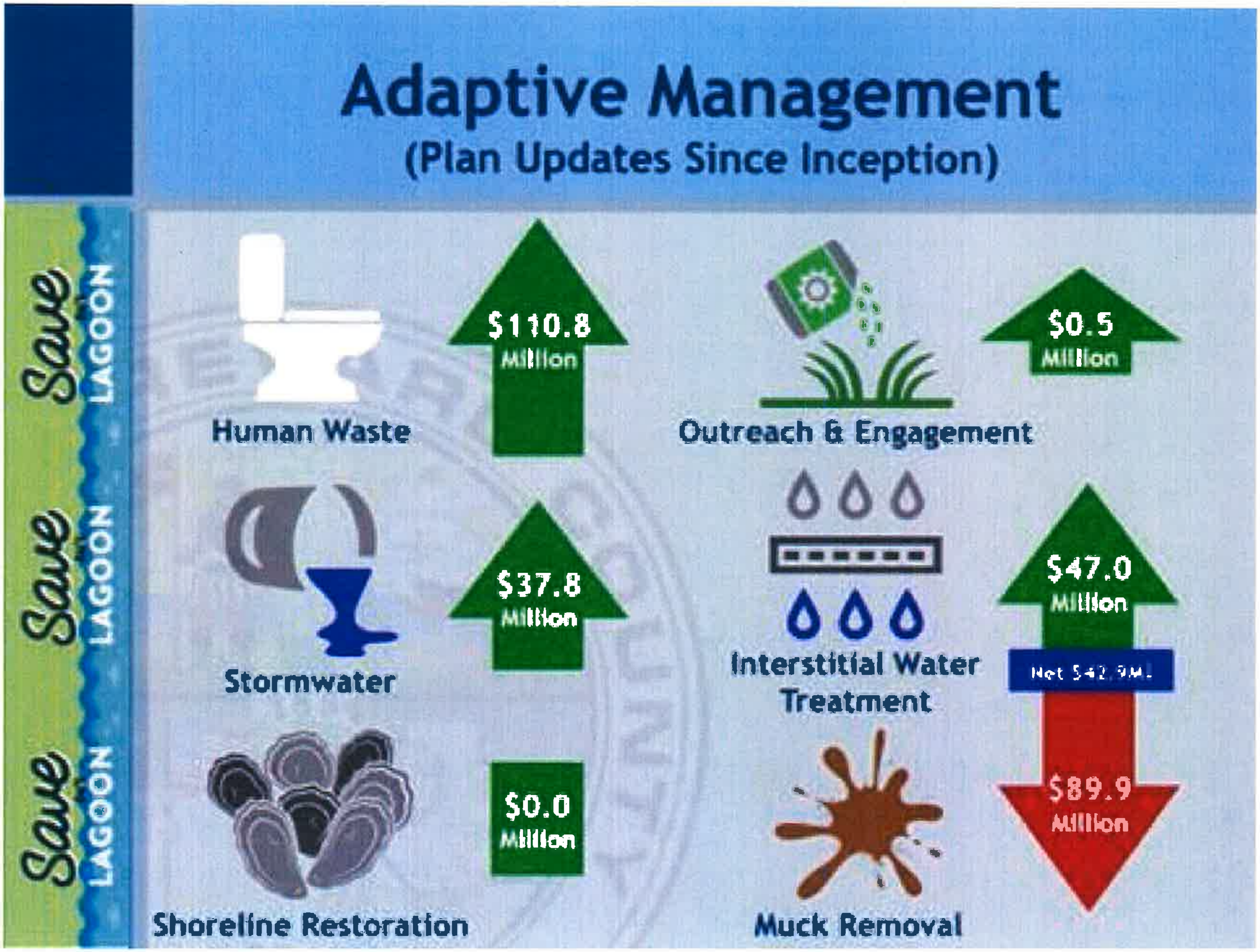
BOARD OF COUNTY COMMISSIONERS
SCOTT ELLIS, CLERK

Tammy Rowe

Tammy Rowe, Deputy Clerk

/ds

cc: County Manager
Finance
Budget


Adaptive Management
(Plan Updates Since Inception)
Save the LAGOON
Save the LAGOON
Save the LAGOON
Human Waste
$110.8
Million
Outreach & Engagement
$0.5
Million
Stormwater
$37.8
Million
Interstitial Water Treatment
$47.0
Million
Net $42.9M
$89.9
Million
Shoreline Restoration
$0.0
Million
Muck Removal

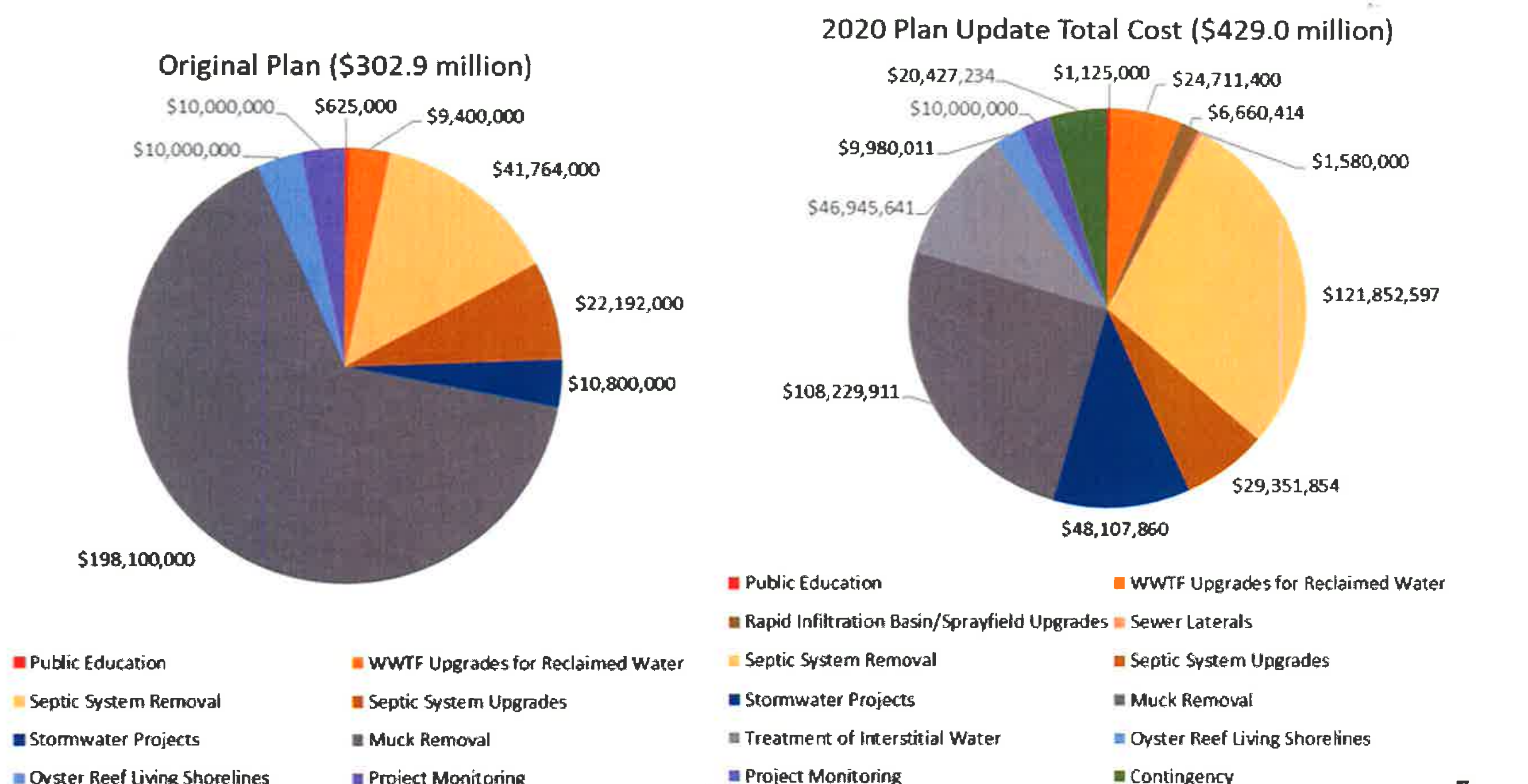


Figure 8-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2020 Plan Update Cost by Project Category (Right)

Section Break (Next Page)

Project Order	Project Number	Project Name	Jurisdiction	Project Type	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cumulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approved Amount	Difference from Previous Approved Amount	Recommended Action
1	26	Osprey Nutrient Removal Upgrade Phase 2	City of Titusville	WWTF Upgrades for Reclaimed Water	North Indian River Lagoon	4,426	$83	$300,000	$300,000	$83	$300,000	$ -	$1,916,750		-	$0				
2	111	Dree Field Vegetation Harvesting	City of Titusville	Vegetation Harvesting	North Indian River Lagoon	574	$87	$50,000	$50,000	$87	$350,000	$ -			-	$0				
3	109	Osprey Plant Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	606	$99	$60,000	$60,000	$99	$410,000	$ -			69	$879				
4	111	County Wide Stormwater Pond Harvesting	Brevard County Stormwater	Vegetation Harvesting	North Indian River Lagoon	140	$893	$125,000	$14,000	$100	$424,000	$ 37,500	$73,500	FDEP	28	$3,125				
5	113	Satellite Beach Intertidal Water Treatment	City of Satellite Beach	Treatment Intertidal Water	Banana River Lagoon	29,978	$136	$4,076,540	$3,057,756	$102	$3,481,756	$ -	$1,019,184		3,059	$1,333				
6	114	Barefoot Bay Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	864	$104	$90,000	$90,000	$104	$3,571,756	$ -			-	$0				
7	115	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	1,662	$120	$200,000	$200,000	$120	$3,771,756	$ -			-	$0				
8	116	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	2,042	$122	$250,000	$250,000	$122	$4,021,756	$ -			-	$0				
9	117	Basin 10 County Line Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	592	$215	$128,123	$72,773	$123	$4,094,529	$ 35,000	$20,452	Florida Legislative Funding	50	$1,034				
10	118	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	606	$215	$130,062	$73,830	$122	$4,168,359	$ 35,000	$21,232	Florida Legislative Funding	42	$1,035				
11	119	Basin 131 Fiveth Avenue Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	567	$220	$124,526	$69,174	$122	$4,237,533	$ 35,000	$20,452	Florida Legislative Funding	36	$1,040				
12	120	Dias Fine Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	256	$234	$60,000	$31,281	$122	$4,268,794	$ -	$28,719		30	$1,560				
13	121	Basin 2256 Babcock Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	Central Indian River Lagoon	412	$243	$100,780	$50,763	$123	$4,318,557	$ 35,000	$14,777	Florida Legislative Funding	47	$1,046				
14	122	Basin 22 Hunting Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	429	$314	$103,853	$40,077	$123	$4,358,634	$ 35,000	$28,776	Florida Legislative Funding	50	$2,390				
15	123	Roy Bullard WPF Stormwater Management Area	City of West Melbourne	Stormwater Projects	Central Indian River Lagoon	800	$2,190	$1,754,180	$97,800	$122	$4,456,434	$ -	$1,656,380		366	$4,650				
16	124	Floating Wetlands in Existing Stormwater Ponds	City of Cocoa	Stormwater Projects	North Indian River Lagoon	12	$4,073	$50,000	$1,467	$122	$4,458,171	$ -	$48,533		3	$13,433				
17	125	Diamond Square Stormwater Pond	City of Cocoa	Stormwater Projects	North Indian River Lagoon	45	$8,438	$549,643	$10,383	$123	$4,468,554	$ -	$539,260		24	$23,225				
~~18~~	~~126~~	~~South Central Lateral Smoke Testing~~	~~Brevard County Utility Services Department~~	~~Sewer Lateral Rehab~~	~~North Indian River Lagoon~~	~~[illegible]~~	~~$426~~	~~[illegible]~~	~~[illegible]~~	~~$426~~	~~$4,988,054~~	~~$ -~~			~~-~~	~~$0~~				
19	127	Basin 8 Dry Retention	Town of Indialantic	Stormwater Projects	North Indian River Lagoon	133	$507	$67,700	$16,680	$125	$5,001,234	$	$51,020		18	$3,762				
20	128	Jackson Ct. Stormwater Treatment Facility	City of Satellite Beach	Stormwater Projects	Banana River Lagoon	96	$7,257	$294,133	$8,166	$1??	$5,009,900	$ -	$285,967		8	$36,800				
21	129	Forrest Ave. 72-inch Outfall Baseflow Capture / Treatment	City of Cocoa	Stormwater Projects	North Indian River Lagoon	[illegible]	$13,[illegible]	$1,214,000	$11,[illegible]	$1??	$5,02[illegible]	$ -	$1,202,70[illegible]		13	$96,[illegible]				
22	130	Brevard Zoo Earth IRL Plant Project 2	Brevard Zoo	Living Shorelines	North Indian River Lagoon	41	$240	$9,840	$9,840	$240	$5,032,296	$ -			14	$703				
23	131	Brevard Zoo Central IRL Plant Project	Brevard Zoo	Living Shorelines	Central Indian River Lagoon	8	$240	$1,920	$1,920	$240	$5,034,216	$ -			3	$640				
24	132	Brevard Zoo Banana River Plant Project 3	Brevard Zoo	Living Shorelines	Banana River Lagoon	2	$240	$480	$480	$240	$5,034,696	$			1	$480				
25	133	Fisherman's Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	20	$250	$5,000	$4,800	$240	$5,039,496	$ -	$200		7	$714				
~~26~~	~~134~~	~~Riverside Landing~~	~~Marine Resources Council~~	~~Living Shorelines~~	~~Central Indian River Lagoon~~	~~20~~	~~$250~~	~~$5,000~~	~~$4,800~~	~~$240~~	~~$5,044,[illegible]~~	~~$~~	~~$200~~		~~7~~	~~$714~~				

2020 Save Our Indian River Lagoon Project Submissions

Project Order	Project Number	Project Name	Jurisdiction	Project Type	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cumulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approved Amount	Difference from Previous Approved Amount	Recommendation
27	124	Pelican Park	Marine Resources Council	Living Shoreline	Central Indian River Lagoon	38	$250	$5,000	$4,600	$244	$5,549,096	$ -	$200		7	$714				
~~26~~	~~63~~	~~Port St John Lateral Smoke Testing~~	~~Brevard County Utility Services Department~~	~~Sewer Lateral Rehab~~	~~North Indian River Lagoon~~	~~194~~	~~$284~~	~~$55,000~~	~~$55,000~~	~~$284~~	~~$5,104,096~~	~~$ -~~			~~-~~	~~$0~~				
29	130	Rex Bullard WRF Biological Nutrient Removal Upgrades	City of West Melbourne	WWTF Upgrades for Reclaimed Water	Central Indian River Lagoon	11,360	$572	$6,500,000	$4,260,000	$375	$9,364,096	$ -	$2,240,000		1,302	$4,514				
30	139	Brevard Zoo North IRL Oyster Project 2	Brevard Zoo	Oyster Reef	North Indian River Lagoon	841	$400	$336,400	$336,400	$400	$9,700,496	$ -			21	$16,019				
31	140	Brevard Zoo Central IRL Oyster Project 2	Brevard Zoo	Oyster Reef	Central Indian River Lagoon	677	$400	$270,800	$270,800	$400	$9,971,296	$ -			17	$15,929				
32	141	Brevard Zoo Banana River Oyster Project 2	Brevard Zoo	Oyster Reef	Banana River Lagoon	662	$400	$264,800	$264,800	$400	$10,236,096	$ -			17	$15,576				
33	142	Brevard Zoo Oyster Reef Adjustments North IRL	Brevard Zoo	Oyster Reef	North Indian River Lagoon	68	$400	$27,200	$27,200	$400	$10,263,296	$ -			2	$13,600				
34	143	Brevard Zoo Oyster Reef Adjustments Banana River	Brevard Zoo	Oyster Reef	Banana River Lagoon	32	$400	$12,800	$12,800	$400	$10,276,096	$ -			1	$12,800				
35	144	Satellite Beach Muck Dredging	City of Satellite Beach	Muck Removal	Banana River Lagoon	3,985	$1,060	$4,222,500	$1,884,225	$485	$12,160,321	$	$2,338,275		518	$8,154				
36	145	Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,292	$851	$1,100,000	$1,100,000	$851	$13,260,321	$ -			-	$0				
37	506	South Central E	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,146	$952	$4,900,000	$4,900,000	$952	$18,160,321	$ -			-	$0	Y	$ 4,672,080	$227,920	
38	128	Micco B	Brevard County Utility Services Department	Septic System Removal Extend	Central Indian River Lagoon	8,487	$1,060	$9,000,000	$9,000,000	$1,060	$27,160,321	$ -			-	$0				
39	146	Merritt Island C	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,250	$1,264	$1,580,000	$1,580,000	$1,264	$28,740,321	$ -			-	$0	Y	$ 7,854,670	-$1,294,670	
40	26	Micco Sewer Line Extension - Phase B	Brevard County	Septic System Removal Extend	Central Indian River Lagoon	453	$1,564	$709,743	$709,743	$1,564	$29,450,064	$				$0				
41	147	Sykes Creek R	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,924	$1,197	$3,500,000	$3,500,000	$1,197	$32,950,064	$ -			-	$0				
42	150	South Central D	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	3,387	$1,409	$4,774,500	$4,774,500	$1,409	$37,724,564	$ -			-	$0	Y	$ 2,703,133	$2,071,367	
43	148	North Merritt Island E	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,541	$1,431	$3,635,000	$3,635,000	$1,431	$41,359,564	$ -			-	$0				
44	151	Merritt Island B	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	11,278	$1,420	$16,000,000	$14,617,000	$1,300	$55,976,564	$ -	$1,383,000		-	$0				
45	152	Mangos R	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	2,682	$1,634	$4,400,000	$4,038,000	$1,500	$60,014,564	$	$362,000			$0				
46	153	Cocoa C	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	3,499	$1,715	$6,000,000	$5,248,500	$1,500	$65,263,064	$ -	$751,500		-	$0				
47	154	Sykes Creek U	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	1,028	$1,848	$1,900,000	$1,542,000	$1,500	$66,805,064	$ -	$358,000		-	$0				
48	155	North Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	830	$1,867	$1,550,000	$1,245,000	$1,500	$68,050,064	$ -	$305,000		-	$0				
49	156	North Merritt Island D	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	685	$1,880	$1,793,000	$1,027,500	$1,500	$69,077,564	$ -	$765,500		-	$0				
50	157	South Central AA	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	7,308	$1,906	$13,933,000	$10,963,000	$1,500	$80,040,564	$	$2,970,000			$0	Y	$ 3,370,572	$7,592,428	
51	158	Pineda	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	644	$1,951	$1,257,000	$966,000	$1,500	$81,006,564	$ -	$291,000		-	$0				
52	159	South Central RC	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	580	$2,300	$1,333,000	$871,000	$1,500	$81,876,564	$ -	$462,000		-	$0				

2020 Save Our Indian River Lagoon Project Submissions

Project Order	Project Number	Project Name	Jurisdiction	Project Type	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost Per lb/TN	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cumulative Eligible Tax Funding	Dollar Amount Secured (Grants)	Dollar Amount Local Cost Share	Sources Secured (Grants)	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approved Amount	Difference from Previous Approved Amount	Recommendation
[illegible]	160	South Banana A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,418	[illegible]	$3,023,000	$3,127,500	$2,500	$96,006,564	$ -	$896,000		-	$0				
34	162	North Merritt Island A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,321	[illegible]	$4,245,000	$3,731,500	$2,500	$88,727,066	$ -	$1,513,500		-	$0				
33	142	South Central I	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	779	[illegible]	$3,170,000	$1,124,000	$2,500	$89,995,064	$ -	$1,012,000		-	$0				
34	163	Sharpes A	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,148	[illegible]	$14,000,000	$7,872,000	$2,500	$97,757,064	$ -	$7,380,000		-	$0	Y	$ 6,207,192	$1,664,808	
37	144	Merritt Island H	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	$22,500,000	$8,196,000	$2,500	$105,963,064	$ -	$14,304,000		-	$0				
38	145	Sykes Creek S	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,384	[illegible]	$6,600,000	$2,376,000	$2,500	$108,339,064	$ -	$4,224,000		-	$0				
39	166	North Merritt Island B	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,088	$4,400	$4,690,000	$1,599,000	$2,500	$109,938,064	$ -	$3,091,000		-	$0				
40	167	Merritt Island A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	$16,700,000	$5,160,000	$2,500	$115,098,064	$ -	$11,540,000		-	$0				
		Totals				140,529		$ 175,593,967	$115,098,064						7,961					

Project Order	Number	Project Name	Jurisdiction	Project Type	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cumulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approved Amount	Difference from Previous Approved Amount	Recommendation
6	124	Barefoot Bay Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	464	$194	$90,000	$90,000	$194	$90,000	$ -			-	$0				
7	125	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	1,002	$200	$200,000	$200,000	$200	$290,000	$ -			-	$0				
8	126	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	2,042	$122	$250,000	$250,000	$122	$540,000	$ -			-	$0				
18	126	South Central Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	4,108	$125	$515,000	$515,000	$125	$1,055,000	$ -			-	$0				
26	127	Port St John Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	194	$284	$55,000	$55,000	$284	$1,110,000	$ -			-	$0				
		Sewer Lateral Rehab Total							$1,110,000											
5	118	Satellite Beach Intertidal Water Treatment	City of Satellite Beach	Treatment Intertidal Water	Banana River Lagoon	29,078	$136	$4,076,940	$3,057,756	$105	$3,057,756	$ -	$1,019,184		3,020	$1,333				
10	146	Satellite Beach Muck Dredging	City of Satellite Beach	Muck Removal	Banana River Lagoon	3,885	$1,087	$4,222,500	$1,884,225	$485	$4,941,981	$ -	$2,338,275		518	$8,151				
		Muck Removal Total							$4,941,981											
3	111	Draa Field Vegetation Harvesting	City of Titusville	Vegetation Harvesting	North Indian River Lagoon	574	$87	$50,000	$50,000	$87	$50,000	$ -			-	$0				
4	112	County Wide Stormwater Pond Harvesting	Brevard County Stormwater	Vegetation Harvesting	North Indian River Lagoon	140	$893	$125,000	$14,000	$100	$64,000	$ 37,500	$73,500	FDEP	28	$3,125				
		Vegetation Harvesting Total							$64,000											
1	29	Osprey Nutrient Removal Upgrade Phase 2	City of Titusville	WWTF Upgrades for Reclaimed Water	North Indian River Lagoon	3,626	$83	$300,000	$300,000	$83	$300,000	$ -	$1,819,750		-	$0				
29	138	Ray Bullard WRF Biological Nutrient Removal Upgrades	City of West Melbourne	WWTF Upgrades for Reclaimed Water	Central Indian River Lagoon	15,960	$572	$9,500,000	$4,280,000	$374	$4,580,000	$ -	$3,360,000		1,402	$1,516				
		WWTF Upgrades for Reclaimed Water Total							$4,580,000											
2	110	Osprey Plant Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	606	$99	$60,000	$60,000	$99	$60,000	$ -			38	$679				
9	117	Basin 10 County Line Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	597	$215	$128,225	$72,773	$122	$132,773	$ 35,000	$20,452	Florida Legislative Funding	40	$1,034				
10	118	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	605	$215	$130,062	$73,810	$122	$206,583	$ 35,000	$21,252	Florida Legislative Funding	42	$1,035				
11	115	Basin 131 Irwin Avenue Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	567	$220	$124,626	$69,174	$122	$275,757	$ 35,000	$20,452	Florida Legislative Funding	36	$1,045				
12	120	Draa Field Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	256	$234	$60,000	$31,281	$122	$307,038	$ -	$28,719		38	$1,563				
13	121	Basin 2254 Sykes Creek Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	Central Indian River Lagoon	412	$243	$99,980	$50,203	$122	$357,241	$ 35,000	$14,777	Florida Legislative Funding	47	$1,046				
14	119	Basin 77 Hunting Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	328	$268	$103,853	$40,077	$122	$397,318	$ 35,000	$28,776	Florida Legislative Funding	30	$1,391				
15	123	Ray Bullard WRF Stormwater Management Area	City of West Melbourne	Stormwater Projects	Central Indian River Lagoon	800	$2,130	$1,704,160	$97,600	$122	$494,918	$ -	$1,606,560		366	$4,656				
16	114	Floating Wetlands in Existing Stormwater Ponds	City of Cocoa	Stormwater Projects	North Indian River Lagoon	12	$4,075	$50,000	$1,497	$122	$496,415	$ -	$48,503		3	$16,43[illegible]				

17	12[illegible]	Diamond Square Stormwater Pond	City of Cocoa	Stormwater Projects	North Indian River Lagoon	45	$6,458	$549,643	$20,[illegible]	$2[illegible]	$506,7[illegible]	$ -	$539,2[illegible]		21	$24,22[illegible]				
19	127	[illegible]	Town of Indialantic	Stormwater Projects	North Indian River Lagoon	113	$[illegible]	$47,700	$16,0[illegible]	$[illegible]	$523,4[illegible]	$ -	$51,820		18	$3,782				
20	118	Jackson Ct. Stormwater Treatment Facility	City of Satellite Beach	Stormwater Projects	Banana River Lagoon	26	$[illegible]	$[illegible]	$8,[illegible]	$[illegible]	$[illegible]	$ -	$[illegible]		8	$[illegible]				
21	119	Forrest Ave. 72-inch Outfall Baseflow Capture / Treatment	City of Cocoa	Stormwater Projects	North Indian River Lagoon	94	$12,90[illegible]	$1,214,[illegible]	$13,[illegible]	$[illegible]	$545,700	$ -	$1,200,[illegible]		12	$96,993				
		Stormwater Projects Total							$[illegible]											
22	130	Brevard Zoo North IRL Plant Project 2	Brevard Zoo	Living Shorelines	North Indian River Lagoon	41	$[illegible]	$9,[illegible]	$9,[illegible]	$[illegible]	$9,[illegible]	$			14	$703				
23	131	Brevard Zoo Central IRL Plant Project	Brevard Zoo	Living Shorelines	Central Indian River Lagoon	8	$[illegible]	$1,[illegible]	$1,[illegible]	$[illegible]	$11,260	$ -			3	$640				
24	137	Brevard Zoo Banana River Plant Project 2	Brevard Zoo	Living Shorelines	Banana River Lagoon	2	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$ -			1	$480				
25	113	Fisherman's Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	30	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$17,040	$ -	$20[illegible]		7	$714				
26	114	Riverside Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	30	$[illegible]	$[illegible]	$4,800	$[illegible]	$21,840	$ -	$20[illegible]		7	$714				
27	115	[illegible] Park	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	30	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$26,640	$ -	$20[illegible]		7	$714				
		Living Shorelines Total							$[illegible]											
30	139	Brevard Zoo North IRL Oyster Project 2	Brevard Zoo	Oyster Reef	North Indian River Lagoon	841	$400	$336,400	$336,400	$400	$336,400	$			21	$16,0[illegible]				
31	140	Brevard Zoo Central IRL Oyster Project 2	Brevard Zoo	Oyster Reef	Central Indian River Lagoon	677	$400	$270,800	$270,800	$400	$607,200	$ -			17	$15,929				
32	141	Brevard Zoo Banana River Oyster Project 1	Brevard Zoo	Oyster Reef	Banana River Lagoon	662	$400	$264,800	$264,800	$400	$872,000	$ -			17	$15,57[illegible]				
33	142	Brevard Zoo Oyster Reef Adjustments North IRL	Brevard Zoo	Oyster Reef	North Indian River Lagoon	68	$400	$27,200	$27,200	$400	$899,200	$			2	$13,600				
34	143	Brevard Zoo Oyster Reef Adjustments Banana River	Brevard Zoo	Oyster Reef	Banana River Lagoon	32	$400	$12,800	$12,800	$400	$912,000	$ -			1	$12,80[illegible]				
		Oyster Reef Total							$912,000											
36	145	Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,292	$851	$1,100,000	$1,100,000	$851	$1,100,000	$ -			-	$0				
37	106	South Central C	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,146	$952	$4,900,000	$4,900,000	$952	$6,000,000	$ -			-	$0	Y	$ 4,672,080	$227,920	
38	116	Micco B	Brevard County Utility Services Department	Septic System Removal Extend	Central Indian River Lagoon	8,687	$1,036	$9,000,000	$9,000,000	$1,036	$15,000,000	$ -			-	$0				
39	146	Merritt Island C	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,059	$1,11[illegible]	$1,180,000	$1,180,000	$1,1[illegible]	$16,180,000	$ -			-	$0	Y	$ 2,936,620	-$1,756,620	
40	26	Micco Sewer Line Extension - Phase II	Brevard County	Septic System Removal Extend	Central Indian River Lagoon	618	$1,148	$709,745	$709,745	$1,148	$17,389,745	$ -			-	$0				
41	147	Sykes Creek R	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,092	$1,197	$2,500,000	$2,500,000	$1,197	$20,759,745	$ -			-	$0				
42	149	South Central D	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	3,357	$1,410	$4,734,500	$4,734,500	$1,410	$25,564,245	$ -			-	$0	Y	$ 2,711,132	$2,023,368	
43	148	North Merritt Island E	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,441	$1,487	$3,625,000	$3,625,000	$1,487	$29,189,245	$ -			-	$0				
44	151	Merritt Island D	Brevard County Utility Services Department	Septic System Removal Island	Banana River Lagoon	11,049	$1,625	$18,000,000	$16,617,000	$1,504	$45,806,245	$ -	$1,383,000		-	$0				
45	152	Sharpes B	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	2,602	$1,690	$4,400,000	$4,038,000	$1,500	$49,854,245	$ -	$362,000		-	$0				

46	115	Cocoa C	Brevard County Utility Services Department	Septic System Removal Sewer	North Indian River Lagoon	1,990	$1,715	$6,000,000	$5,349,500	$1,500	$22,102,745	$ -	$751,500		-	30					
47	154	Sykes Creek N	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	1,028	$1,848	$1,900,000	$1,542,000	$1,500	$36,644,745	$ -	$358,000		-	30					
48	155	North Merritt Island F	Brevard County Utility Services Department	Septic System Removal Island	Banana River Lagoon	930	$1,864	$1,116,500	$1,395,000	$1,400	$47,889,745	$ -	$280,000		-	30					
49	156	North Merritt Island D	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	685	$1,888	$1,293,000	$1,027,500	$1,500	$38,917,345	$ -	$265,500		-	30					
30	157	South Central AB	Brevard County Utility Services Department	Septic System Removal Island	North Indian River Lagoon	7,308	$1,906	$13,932,000	$10,962,000	$1,500	$49,879,245	$ -	$2,970,000		-	30	Y	$ 3,170,572	$7,561,428		
31	118	Pineda	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	644	$1,802	$1,157,000	$966,000	$1,500	$70,645,245	$ -	$291,000		-	30					
32	158	South Central BC	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	582	$2,100	$1,222,000	$873,000	$1,500	$71,718,245	$ -	$349,000		-	30					
33	160	South Banana A	Brevard County Utility Services Department	Septic System Removal Island	Banana River Lagoon	1,718	$2,128	$3,026,000	$2,131,000	$1,500	$73,845,245	$ -	$896,000		-	30					
34	161	North Merritt Island A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,821	$2,331	$4,245,000	$2,731,500	$1,500	$76,576,745	$	$1,513,500			30					
35	162	South Cocoa I	Brevard County Utility Services Department	Septic System Removal Island	North Indian River Lagoon	772	$2,811	$2,170,000	$1,118,000	$1,500	$77,734,745	$ -	$1,012,000		-	30					
36	163	Sharpes A	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,348	$2,839	$19,900,000	$7,872,000	$1,500	$85,606,745	$ -	$7,100,000		-	30	Y	$ 6,307,192	$1,664,808		
37	164	Merritt Island H	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	5,464	$4,116	$22,580,000	$8,196,000	$1,500	$93,802,745	$ -	$14,304,000		-	30					
38	165	Sykes Creek S	Brevard County Utility Services Department	Septic System Removal Island	Banana River Lagoon	1,584	$4,167	$6,600,000	$2,376,000	$1,500	$96,178,745	$ -	$4,224,000		-	30					
39	166	North Merritt Island B	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,066	$4,400	$4,690,000	$1,599,000	$1,500	$97,777,745	$	$3,091,000			30					
60	167	Merritt Island B	Brevard County Utility Services Department	Septic System Removal Island	Banana River Lagoon	3,440	$4,885	$16,700,000	$5,160,000	$1,500	$102,937,745	$ -	$11,540,000		-	30					
		Septic System Removal Extend Total							$102,937,745												
		Grand Total				87,082		$ 175,585,967	$113,098,066						4,136						
									$111,098,066												
									$113,098,066												

		2019 SOIRL Project Plan				339,373			34.37%														
1	[illegible]	[illegible] Phase 2	City of Titusville	WWTF Upgrades for Reclaimed Water	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]					
3	[illegible]	Draa Field Vegetation Harvesting	City of Titusville	Vegetation Harvesting	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]					
3	[illegible]	Osprey Plant Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	0.02%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$			48	[illegible]					
4	[illegible]	[illegible]	Brevard County Stormwater	Vegetation Harvesting	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
5	[illegible]	[illegible]	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]					
6	[illegible]	Basin 10 County Line Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]					
[illegible]	[illegible]	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]					
[illegible]	[illegible]	[illegible] Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	0.75%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]					
[illegible]	[illegible]	Draa Field Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	0.03%	35.72%	$60,000	[illegible]	[illegible]	[illegible]	$ -	[illegible]		[illegible]	[illegible]					
[illegible]	[illegible]	Basin 33 [illegible] Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]					
[illegible]	[illegible]	Floating Wetlands to Existing Stormwater Ponds	[illegible]	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	$50,000	[illegible]	[illegible]	[illegible]	$	[illegible]		[illegible]	[illegible]					
[illegible]	[illegible]	Diamond Square Stormwater Pond	[illegible]	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]					
[illegible]	[illegible]	South Central Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	35.65%	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]					
[illegible]	[illegible]	Basin 5 Dry Retention	Town of Indialantic	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	35.70%	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		[illegible]	[illegible]					
[illegible]	[illegible]	[illegible] 72 inch Outfall Baseflow Capture / Treatment	[illegible]	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$	[illegible]		[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]	Brevard Zoo	Living Shoreline	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			[illegible]	[illegible]					
[illegible]	[illegible]	Port St. John Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]					
[illegible]	[illegible]	Brevard Zoo North IRL Oyster Project 2	Brevard Zoo	Oyster Reef	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			[illegible]	[illegible]					
[illegible]	[illegible]	Brevard Zoo Oyster Reef Adjustments North IRL	Brevard Zoo	Oyster Reef	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$			[illegible]	[illegible]					
[illegible]	[illegible]	South Central C	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]	Y	[illegible]	[illegible]		
[illegible]	[illegible]	South Central D	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]	Y	[illegible]	[illegible]		
[illegible]	[illegible]	Sharpes [illegible]	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]					
[illegible]	[illegible]	Cocoa C	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$	[illegible]			[illegible]					
[illegible]	[illegible]	Sykes Creek II	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]					
[illegible]	[illegible]	South Central AB	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]	Y	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$	[illegible]			[illegible]					
[illegible]	[illegible]	South Central BC	Brevard County Utility Services Department	Septic System Removal Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$	[illegible]			[illegible]					

[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		-	[illegible]		$ [illegible]	[illegible]	
		Total				[illegible]				$ [illegible]	[illegible]						[illegible]					

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		2019 SOIRL Project Plan				676,014			34.90%													
5	[illegible]	Satellite Beach [illegible] Treatment	City of Satellite Beach	Treatment [illegible]	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	City of Satellite Beach	[illegible]	Banana River Lagoon	[illegible]	[illegible]	[illegible]	43.20%	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		[illegible]	[illegible]				
24	[illegible]	Brevard [illegible] Banana River [illegible]	[illegible]	[illegible]	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]				
[illegible]	[illegible]	[illegible]	Brevard Zoo	Oyster Reef	[illegible] Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]				
[illegible]	[illegible]	Brevard Zoo Oyster Reef [illegible] Banana River	Brevard Zoo	Oyster Reef	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-			[illegible]	[illegible]				
[illegible]	[illegible]	Satellite Beach Muck Dredging	City of Satellite Beach	Muck Removal	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	0.77%	[illegible]	$1,100,000	[illegible]	[illegible]	[illegible]					[illegible]				
[illegible]	[illegible]	[illegible] Island [illegible]	Brevard County Utility Services Department	Septic System Removal Extend	[illegible] Lagoon	[illegible]	[illegible]	[illegible]	44.77%	$1,500,000	$1,500,000	[illegible]	$7,508,32[illegible]	-			-	[illegible]		[illegible]	[illegible]	
[illegible]	[illegible]	Sykes Creek R	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	$1,107	[illegible]	[illegible]	$3,500,000	$3,500,000	$3,20[illegible]	$11,408,92[illegible]	-			-	[illegible]				
[illegible]	[illegible]	North Merritt Island E	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	$3,635,000	$3,535,000	[illegible]	$12,043,32[illegible]	-			-	[illegible]				
[illegible]	[illegible]	Merritt Island G	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	12,07[illegible]	$1,82[illegible]	[illegible]	[illegible]	$18,000,000	[illegible]	[illegible]	$31,553,32[illegible]		[illegible]			[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	[illegible] Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		-	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		-	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		-	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		-	[illegible]				
[illegible]	[illegible]	Sykes Creek S	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	56.67%	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		-	[illegible]				
[illegible]	[illegible]	North Merritt Island B	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]		-	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			[illegible]				
		Totals				[illegible]				[illegible]	[illegible]						[illegible]					

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total Cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	TP $/lb	[illegible]	[illegible]	[illegible]	[illegible]
		2019 SOIRL Project Plan				[illegible]			[illegible]													
6	[illegible]	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	[illegible]	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	$90,000	[illegible]	[illegible]	$90,000	$ -			-	$0				
7	[illegible]	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$250,000	$ -			-	$0				
3	[illegible]	Basin 2256 Babcock Road Woodchip Bioreactor	Brevard County Stormwater	[illegible]	[illegible]	[illegible]	[illegible]	0.06%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 25,000	[illegible]	[illegible]	[illegible]	[illegible]				
4	[illegible]	Roy Bullard WRF Stormwater [illegible]	City of West Melbourne	Stormwater Projects	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible] Project	Brevard Zoo	Living Shorelines	[illegible]	[illegible]	[illegible]	0.00%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible] Landing	Marine Resources Council	Living Shorelines	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible] Landing	Marine Resources Council	Living Shorelines	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$	$270		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	Marine Resources Council	Living Shorelines	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	$270		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	City of West Melbourne	WWTF Upgrades for Reclaimed Water	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	Brevard Zoo Community Oyster Project 2	Brevard Zoo	Oyster Reef	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			17	[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$				[illegible]				
[illegible]	[illegible]	[illegible]	Brevard County	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ -			-	[illegible]				
		Totals				[illegible]				$ [illegible]	[illegible]						[illegible]					

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
												$ [illegible]	[illegible]	[illegible]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
												$ [illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
												$ [illegible]		[redacted]						[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
												$ [illegible]		[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]		[illegible]	[illegible]				
												$ [illegible]		[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$			[illegible]	[illegible]				

[illegible]	[illegible]	Brevard Zoo Oyster Reef [illegible]	Brevard Zoo	Oyster Reef	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]	[illegible]		
												$ [illegible]		# Projects						
[illegible]	[illegible]	[illegible] Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -	[illegible]		[illegible]	[illegible]			
[illegible]	[illegible]	[illegible] Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -	[illegible]		[illegible]	[illegible]			
[illegible]	[illegible]	[illegible] Park	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -	[illegible]		[illegible]	[illegible]			
												$ [illegible]		# Projects						
[illegible]	[illegible]	County Wide Stormwater Weed Harvesting	Brevard County Stormwater	Vegetation Harvesting	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]		[illegible]	[illegible]			
[illegible]	[illegible]	[illegible] Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]			
[illegible]	[illegible]	Basin [illegible] County Line Road [illegible]	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]			
[illegible]	[illegible]	Basin [illegible]	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]			
[illegible]	[illegible]	Basin [illegible]	Brevard County Stormwater	Stormwater Projects	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]			
[illegible]	[illegible]	Basin [illegible] Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ [illegible]	[illegible]	Florida Legislative Funding	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible] Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible] Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	[illegible] River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]	$ [illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]	$ [illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	Brevard County	Septic System Removal	Central Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	North Indian River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$				[illegible]	$ [illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$ -			-	[illegible]			
[illegible]	[illegible]	[illegible]	Brevard County Utility Services Department	Septic System Removal	Banana River Lagoon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		$	[illegible]			[illegible]			
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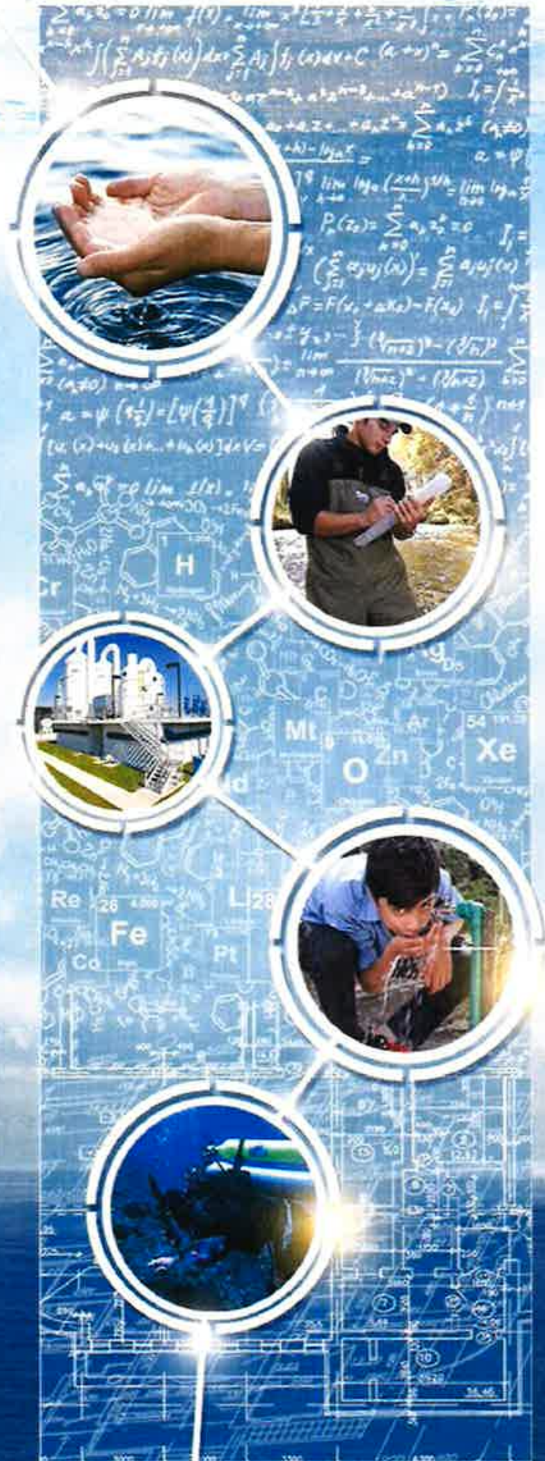

TETRA TECH

2020 Save Our Indian River Lagoon Project Plan Update Summary

January 17, 2020

Marcy Frick, Tetra Tech

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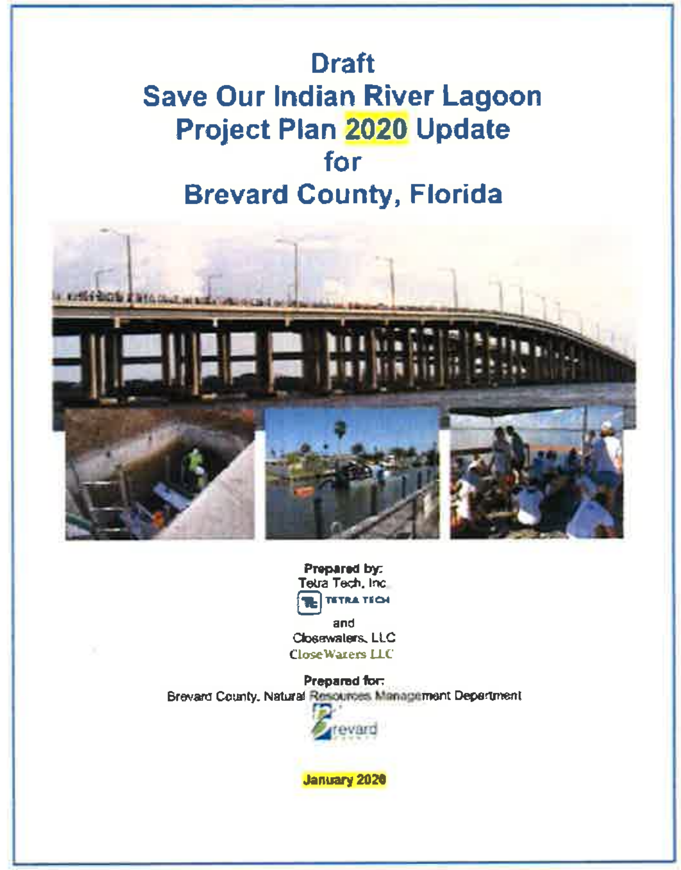
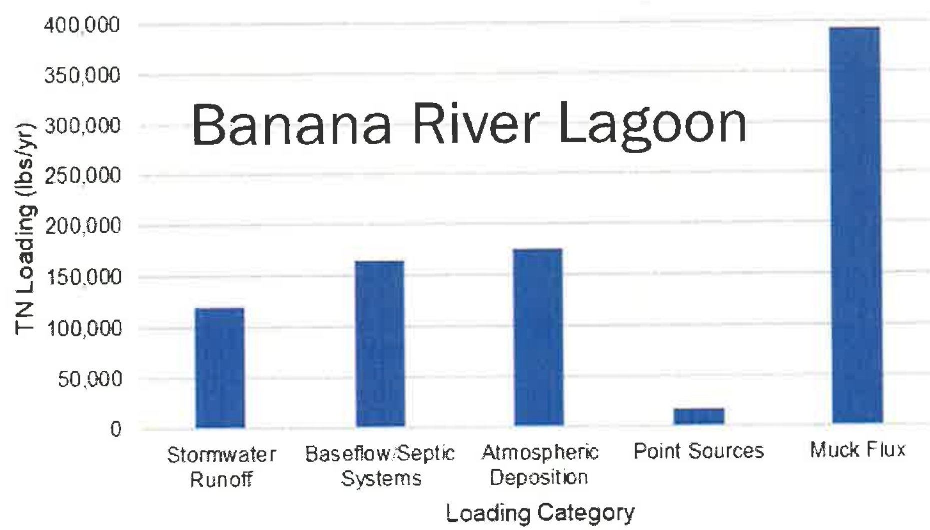
TETRA TECH



Sections 1 – 3 Summary of Changes

TETRA TECH

- Section 1. Background
  - Correct years on return on investment
- Section 2. Approach
  - Updated Table 2-1 with five-month loads for the Central SEB zone
- Section 3. Pollutant Sources in the IRL Watershed
  - Updated muck flux loading estimate in Table 3-1 and Figures 3-1 through 3-3 using latest data



Section 4.1 Reduce Project Changes

TETRA TECH

- 4.1.1 Public Education and Outreach
  - Added information on the Lagoon Loyal Program
- 4.1.2 WWTF Upgrades
  - Updated information on several facilities using the latest data
  - Removed the Cape Canaveral Air Force Station facility from the recommended list of upgrades
- 4.1.3 Sprayfield and Rapid Infiltration Basin Upgrades
  - Updated information on several facilities
  - Added three new sprayfield upgrade projects
- 4.1.4 Package Plant Removal and Upgrades
  - No changes
- 4.1.5 Sewer Laterals Rehabilitation
  - No changes (3 smoke testing projects added in 2020 Update Section)

Section 4.1 Reduce Project Changes, continued

TETRA TECH

- 4.1.6 Septic System Removal and Upgrades
  - Updated recommended list of projects using new information from Brevard County Utilities
- 4.1.5 Stormwater Treatment
  - Updated the efficiencies for the managed aquatic plant system project type
  - Clarified that other types of biosorption activated media may be used in projects
  - Updated the loading estimates through each stormwater ditch and outfall using more recent land use data, more recent rainfall and evapotranspiration data, and improved stormwater infrastructure mapping and topography
  - Revised the basins recommended for treatment

Section 4.2 Remove Project Changes

TETRA TECH

- 4.2.1 Muck Removal
  - Incorporated updated flux data from Florida Institute of Technology research
  - Added project near Patrick Air Force Base in Banana River Lagoon based on updated flux data
  - Replaced the Eau Gallie Northeast for the Eau Gallie Northwest project in the North IRL
- 4.2.2 Surface Water Remediation System
  - No changes

Section 4.2 Remove Project Changes, continued

TETRA TECH

- 4.2.3 Enhanced Circulation
  - Added information about the Florida Institute of Technology data and modeling for an enhanced circulation pilot project
  - Add information about the Florida Institute of Technology modeling for modifications to State Road 528 and 520 causeways and bridges
- 4.2.4 Vegetation Harvesting
  - New section
  - Provided background information and estimated cost-share of $110 per pound of TN removed

Section 4.3 Restore Project Changes

TETRA TECH

- 4.3.1 Oyster Restoration
  - Provided updated information and additional citations
- 4.3.2 Planted Shorelines
  - Provided updated information and additional citations
- 4.3.3 Seagrass Planting
  - Provided updated information and additional citations
- 4.3.4 Clam Restoration and Aquaculture
  - New section
  - Provided background information and estimated cost of $200 per pound of TN removed
  - Not currently funded in the plan (but text addition makes it possible to consider proposals next year)

Section 4.4 Respond Project Changes

- Section 4.4.1 Adaptive Management to Report, Reassess, and Respond
  - No changes
- Section 4.4.2 Responding to Implemented Projects
  - New table of tax funds expended on completed projects
  - Updated maps of completed projects
  - Updated information on project performance data
- Section 4.4.3 Research Needs
  - No changes

Sections 5, 6, 7 Changes

TETRA TECH

- Section 5. 2017 Plan Update
  - Updated pie chart colors
- Section 6. 2018 Plan Update
  - Added a note about referencing Section 8 for latest revenue projections
  - Updated pie chart colors
- Section 7. 2019 Plan Update
  - Moved unfunded project tables from this section to Section 8
  - Updated pie chart colors

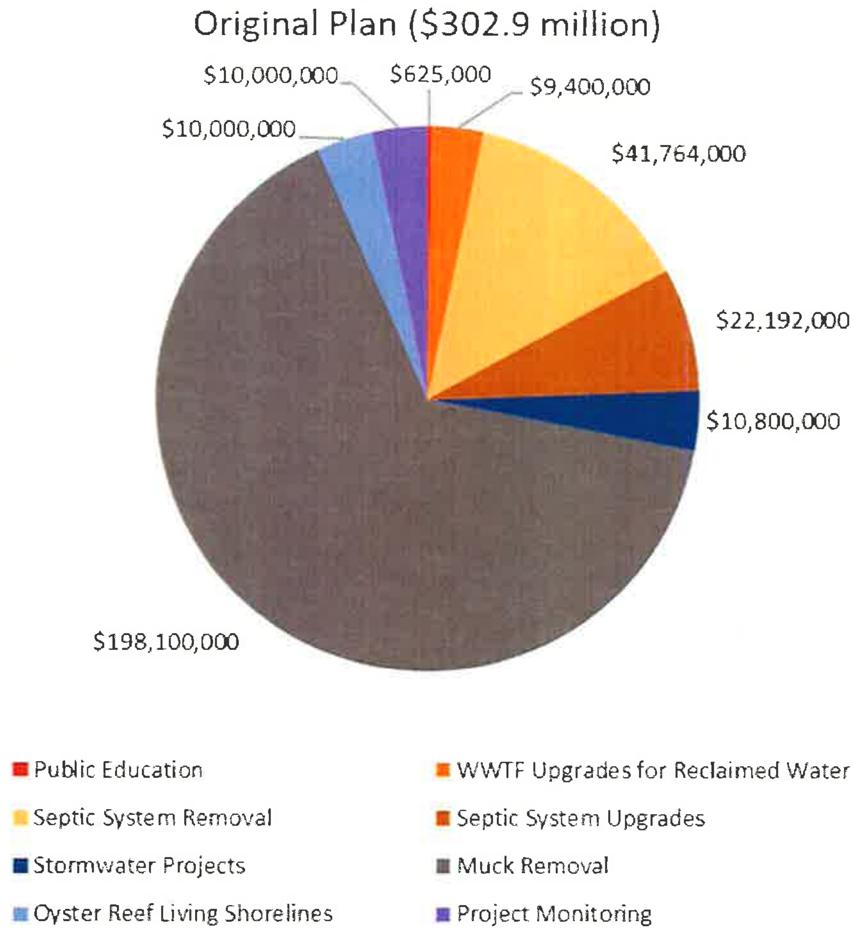
Section 8. 2020 Plan Update

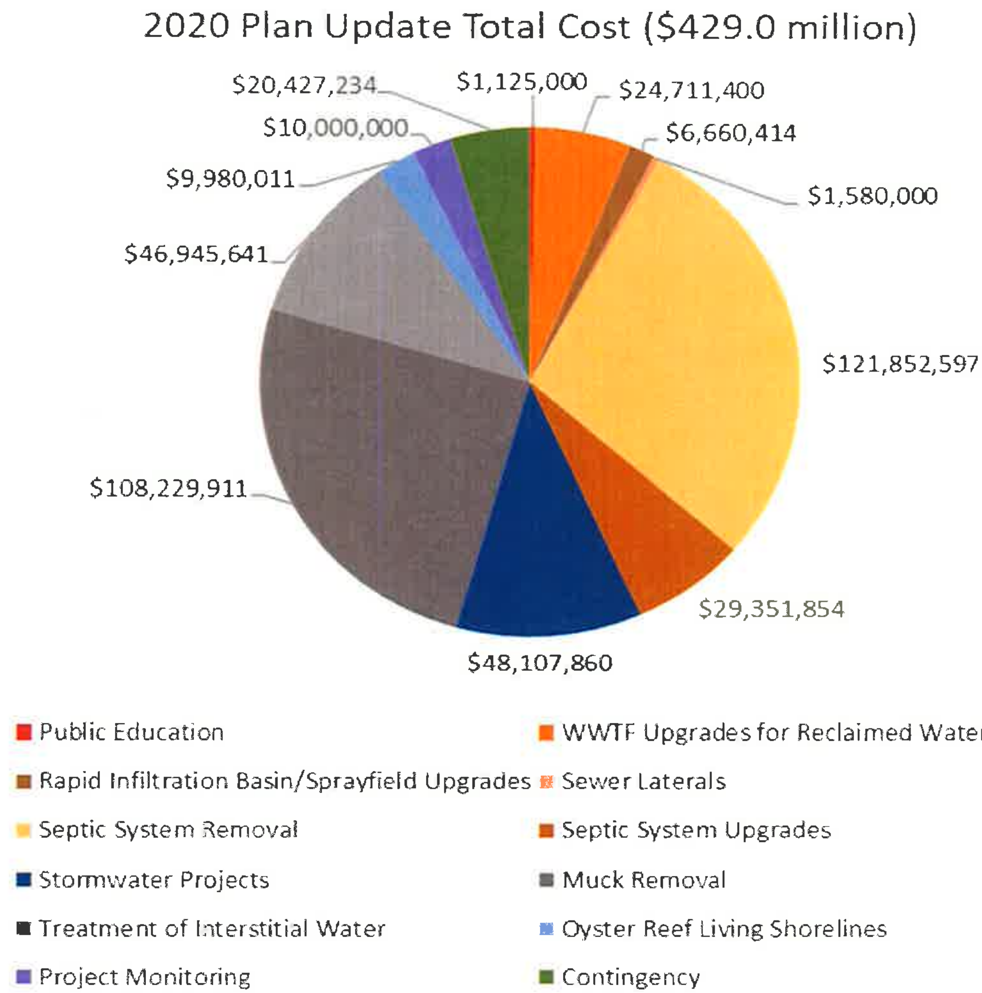
TETRA TECH

- Updated cost per pound of TN for cost-share eligibility
- Section 8.1 New Projects in the 2020 Plan Update
  - Table of new project requests added to plan
- Section 8.2 Project Changes
  - Table of project withdrawals
  - Table of project schedule revisions
  - Updated cost-share allocated to previously approved projects
- Section 8.3 Project Funding
  - Provided updated revenue projection of $494,309,707
- Section 8.4 Unfunded Projects
  - Tables of additional project opportunities if funding allows
  - Each table is sorted by cost-effectiveness

Comparison of Plan Costs

TETRA TECH





Section 9. Summary of the Plan through the 2020 Update

TETRA TECH

- Updated all tables comparing project reductions to draft TMDLs
- Updated table with reductions from Remove and Restore projects
- Updated table with summary of projects, estimated TN and TP reductions, and costs to include lines for each project
- Updated rainbow tables (2016 costs and inflated costs) and modified to show projects in separate rows

Appendices

TETRA TECH

- Appendix A: Funding Needs and Leveraging Opportunities
  - Updated list of potential funding options
- Appendix B: References
  - New references are highlighted
- Appendix C: Public Education and Outreach Supporting Information
  - No changes
- Appendix D: Septic System Removal and Upgrade Areas Identified in the Original Plan
  - No changes
- Appendix E: Summary of Stormwater Project Basins
  - Updated tables of recommended basins
- Appendix F: Seagrasses
  - Updated figures and added a new reference

TETRA TECH

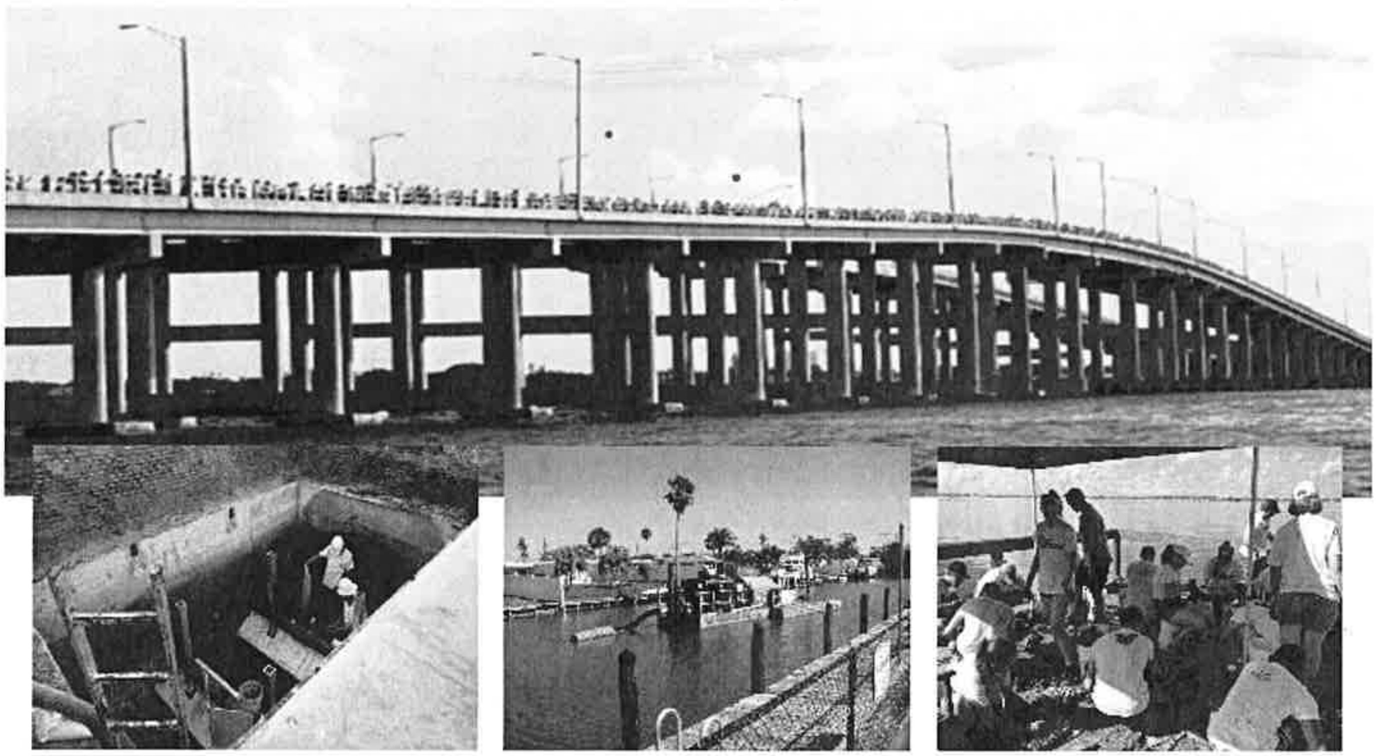
Next Steps

- 2021 Update will be fifth update to the plan
- Revise format to streamline sections to present only the current project information
- Delete sections detailing annual incremental changes
- Delete appendices with old plan information

TETRA TECH

Questions and Comments

Draft
Save Our Indian River Lagoon Project Plan 2020 Update for Brevard County, Florida



Prepared by:
Tetra Tech, Inc.
TETRA TECH
and
Closewaters, LLC
CloseWaters LLC

Prepared for:
Brevard County, Natural Resources Management Department
Brevard County

March 2020

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Acknowledgements

We would like to thank the following people who provided input in the development and update of this plan:

- **2020 Citizen Oversight Committee**:
  - David Lane (2018 Vice Chair, 2019 Chair), Tourism Member
  - Laurilee Thompson, Tourism Alternate
  - John Windsor (2019 Vice Chair), Lagoon Advocacy Member
  - Terry Casto, Lagoon Advocacy Alternate
  - Stephany Eley (2018 Chair), Education/Outreach Member
  - Melissa Martin, Education/Outreach Alternate
  - Lorraine Koss (2017 Chair), Science Member
  - Charles Venuto, Science Alternate
  - John Luznar, Technology Member
  - Vinnie Taranto, Technology Alternate
  - Courtney Barker, Finance Member
  - Todd Swingle, Finance Alternate
  - Jay Moynahan, Real Estate Member
  - Dennis Basile, Real Estate Alternate

- **Citizen Oversight Committee Past Members:**
  - Gene Artusa, Real Estate Member, First Term
  - Danielle Bowden, Real Estate Member, First Term, Partial Second Term
  - John Byron (2017 Vice Chair), Technology Member, First Term
  - John Durkee, Education/Outreach Alternate, First Term
  - Karen McLaughlin, Tourism Alternate, First Term

- **Guest Speakers at Citizen Oversight Committee Meetings:**
  - Holly Abeels, University of Florida Institute of Food and Agricultural Sciences
  - Scott Barber, City of Cocoa Beach
  - Drew Bartlett, Florida Department of Environmental Protection
  - Alix Bernard, City of Rockledge
  - Stephen Berry, Jones Edmunds & Associates
  - Robert Bolton, City of Vero Beach
  - Bill Buckman, ASAP Septic
  - Randy Burden, EcoSense
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  - Stacy Delano, Tourist Development Council
  - Dr. Melina Donnelly, University of Central Florida
  - Rich Dunkel, Irrigreen
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- Walter C. Wood, Marketing Talent Network Advertising
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- Jake Zehnder, Brevard Zoo

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  - Dr. Duane De Freese, Indian River Lagoon National Estuary Program and Indian River Lagoon Council Executive Director

- Dr. Richard (Grant) Gilmore, expert in Indian River Lagoon fisheries and ecology
- Dr. Charles Jacoby, St. Johns River Water Management District Supervising Environmental Scientist
- Dr. Kevin Johnson, Florida Institute of Technology Associate Professor, Marine and Environmental Systems
- Dr. Mitchell A Roffer, Florida Institute of Technology Adjunct Professor, President Roffer's Ocean Fishing Forecasting Service, Inc.
- Dr. Jonathan Shenker, Florida Institute of Technology Associate Professor of Marine Biology
- Dr. John Trefry, Florida Institute of Technology Professor of Marine and Environmental Systems
- Martin S. Smithson, Sebastian Inlet District Administrator
- Joel Steward, St. Johns River Water Management District Supervising Environmental Scientist (Retired)
- Dr. John Windsor, Florida Institute of Technology Oceanography and Environmental Science Professor Emeritus and Program Chair

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  - Herb Hiller, Brevard County Tourism Development Council Consultant on Ecotourism
  - Vince Lamb, Indian River Lagoon Council Management Board, Florida Master Naturalist, Entrepreneur
  - Dr. Michael H. Slotkin, Florida Institute of Technology Associate Professor, Nathan M. Bisk School of Business
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  - Jim Brandenburg, Brevard County Property Appraiser Information Technology

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  - Florida Department of Environmental Protection
  - St. Johns River Water Management District
  - Florida Department of Health
  - Space Coast Tourism Development Council
  - Space Coast Association of REALTORS®
  - Brevard County Natural Resources Management Department
  - Brevard County Utility Services Department
  - Brevard County Property Appraiser Information Technology
  - Brevard County Budget Office
  - City of Melbourne
  - City of Palm Bay
  - City of Titusville
  - City of West Melbourne

Photographs on cover:
Top from http://spacecoastdaily.com/2013/09/hands-across-lagoon-set-for-sept-28/
Bottom left from the Central Boulevard baffle box upgrade in the City of Cape Canaveral
Bottom middle from the muck dredging project in the City of Cocoa Beach
Bottom right from the Bomalaski oyster bar project in Merritt Island

List of Acronyms

IRL	Indian River Lagoon
lbs/yr	Pounds Per Year
TN	Total Nitrogen
TP	Total Phosphorus
WWTF	Wastewater Treatment Facility

Executive Summary

The Indian River Lagoon (IRL) system includes Mosquito Lagoon, Banana River Lagoon, and Indian River. This is a unique and diverse system that connects Volusia, Brevard, Indian River, St. Lucie, and Martin counties. The IRL is part of the National Estuary Program, one of 28 estuaries of National Significance, and has one of the greatest diversity of plants and animals in the nation. A large portion of the IRL system, 71% of its area and nearly half its length, is within Brevard County and provides County residents and visitors many opportunities and economic benefits.

However, the balance of this delicate ecosystem has been disturbed as development in the area has led to harmful impacts. Stormwater runoff from urban and agricultural areas, wastewater treatment facility (WWTF) discharges, septic systems, and excess fertilizer applications have led to harmful levels of nutrients and sediments entering the lagoon. These pollutants create cloudy conditions in the lagoon and feed algal blooms, both of which negatively affect the seagrass community that provides habitat for much of the lagoon's marine life. In addition, these pollutants lead to muck accumulation, which releases (fluxes) nutrients and hydrogen sulfide, depletes oxygen, and creates a lagoon bottom that is not hospitable to seagrass, shellfish, or other marine life.

Efforts have been ongoing for decades to address these sources of pollution. Despite significant load reductions, in the last five years, signs of human impact to the IRL system have been magnified. In 2011, the "superbloom" occurred, an intense algal bloom in the Mosquito Lagoon, Banana River Lagoon, and North IRL, as well as a secondary, less intense bloom in the Central IRL. There have also been recurring brown tides; unusual mortalities of dolphins, manatees, and shorebirds; and large fish kills due to low dissolved oxygen from decomposing algae.

Local governments and the St. Johns River Water Management District have been proactive in implementing projects over the last several decades. However, to restore the lagoon to health and prosperity, additional funds are needed to eliminate current excess loading and remove the legacy of previous excess loading. Therefore, the County placed a Save Our Indian River Lagoon ½ cent sales tax referendum on the ballot in November 2016, which passed and will provide a funding stream for the types of projects listed in this plan for Brevard County and its municipalities.

The Save Our Indian River Lagoon Project Plan outlines local projects planned to meet water quality targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. Implementation of these projects is contingent upon funding raised through the ½ cent sales tax. This sales tax funding would also allow the County to leverage additional dollars in match funding from state and federal grant programs because the IRL ecosystem is valued not only in Florida but also nationally. Funding implementation of this plan would help to restore this national treasure. Lagoon ecosystem response may lag several years behind completion of nutrient reductions; however, major steps must begin now to advance progress on the long road to recovery.

In the development of this plan, Subject Matter Experts were consulted to provide feedback on the plan elements. The experts all agreed that there is a "critical mass" of nutrient reductions that must be achieved to see a beneficial result in the IRL. This critical level of nutrient reduction will be achieved through the implementation of the projects in this plan. During plan development, it was estimated that the benefit of restoring the lagoon has a present value of $6 billion and a cost of $300 million. Therefore, implementing this plan to restore the IRL is an excellent investment in the future of Brevard County's community and economy with a benefit to cost ratio of 20:1.

In order to restore the lagoon's balance, Brevard County seeks to accelerate implementation of a multi-pronged approach to **Reduce** pollutant and nutrient inputs to the lagoon from fertilizer, reclaimed water from WWTFs, septic systems, and stormwater; **Remove** the accumulation of muck from the lagoon bottom; **Restore** water-filtering oysters and related lagoon ecosystem services; and monitor progress to **Respond** to changing conditions, technologies, and new information by amending the plan to include actions that will be most successful and cost-effective for significantly improving the health, productivity, and natural resilience of the IRL.

The portfolio of projects in this plan were selected as the most cost-effective suite of options to achieve water quality and biological targets for the lagoon system. Investment has been distributed among a set of project types with complimentary benefits to reduce future risk of failure. Nearly half (originally one-third) of the effort and expense is split among multiple projects to reduce incoming load to healthy levels, restore natural filtration, measure success, and respond with annual plan updates. Slightly more than half (originally two-thirds) of the effort and expense is directed toward muck removal to address decades of past excess nutrient loading. Nitrogen and phosphorus released each year as muck decays are now larger than any current source of nutrient pollution to lagoon waters.

The plan projects have been prioritized and ordered to deliver improvements to the lagoon in the most beneficial spatial and temporal sequence so that the implementation of this plan is expected to result in a healthy IRL system. If a future project is ready to move forward earlier than scheduled in the plan, if such advancement is consistent with temporal sequencing goals in the plan and is recommended by the Citizen Oversight Committee, and if there are sufficient Trust Fund dollars available, the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to adjust the project schedule at any time to ensure that approved projects funded in the plan move forward as soon as feasible.

This 2020 Update to the Save Our Indian River Lagoon Project Plan contains the fourth set of project updates, new approved projects, and schedule accelerations to the plan. Local stakeholders submitted projects to Brevard County for inclusion in the plan. The appointed Citizen Oversight Committee reviewed the submitted projects and made a recommendation to the Board of County Commissioners on which projects should be added to the Save Our Indian River Lagoon Project Plan. This update includes those projects that were reviewed by the Citizen Oversight Committee and approved for inclusion by the Board of County Commissioners.

A summary of the types of projects included in the plan, as well as the associated costs and total nitrogen (TN) and total phosphorus (TP) reduction benefits are shown in **Table ES-1**. The timing of the projects is shown in **Figure ES-1**. Despite the considerable cost of restoration, analysis demonstrates that the economic cost of inaction is double the cost of action. Furthermore, although there are many tangible and intangible benefits for saving the lagoon, the readily estimated return on investment for three benefits – tourism, waterfront property values, and commercial fisheries – is 10% to 26% depending on how quickly the actions in this plan can be completed.

Table ES-1: Summary of Project Types, Costs, and Nutrient Reductions in the 2020 Update of the Save Our Indian River Lagoon Project Plan (2016 dollars without inflation)

Project Category	Project Type	Estimated Total Project Cost	Nitrogen Reductions (lbs/yr)	Average Cost per Pound per Year of TN	Phosphorus Reductions (lbs/yr)	Average Cost per Pound per Year of TP
Reduce	Public Education	$1,125,000	30,423	$37	2,013	$559
Reduce	WWTF Upgrades for Reclaimed Water	$24,711,400	72,033	$343	13,760	$1,796
Reduce	Sewer Lateral Rehabilitation	$1,580,000	6,196	$255	188	$8,404
Reduce	Rapid Infiltration Basin/Sprayfield Upgrades	$6,660,414	49,136	$136	5,139	$1,296
Reduce	Septic System Removal by Sewer Extension	$110,572,597	94,298	$1,173	To be determined	To be determined
Reduce	Septic System Removal by Sewer Connection	$11,280,000	21,446	$487	To be determined	To be determined
Reduce	Septic System Upgrades	$29,351,854	38,108	$770	To be determined	To be determined
Reduce	Stormwater Projects	$48,107,860	277,534	$173	37,554	$1,281
Remove	Muck Removal	$108,229,911	207,990	$520	17,815	$6,075
Remove	Treatment of Muck Interstitial Water	$46,945,641	481,059	$98	28,361	$1,655
Restore	Oyster Bars	$9,887,876	24,921	$397	784	$12,612
Restore	Planted Shorelines	$92,135	384	$240	131	$703
Respond	Projects Monitoring	$10,000,000	-	-	-	-
Respond	Contingency	$20,427,234	-	-	-	-
Total	***Total***	***$428,971,922***	***1,303,528***	***$329 (average)***	***105,745***	***$4,057 (average)***

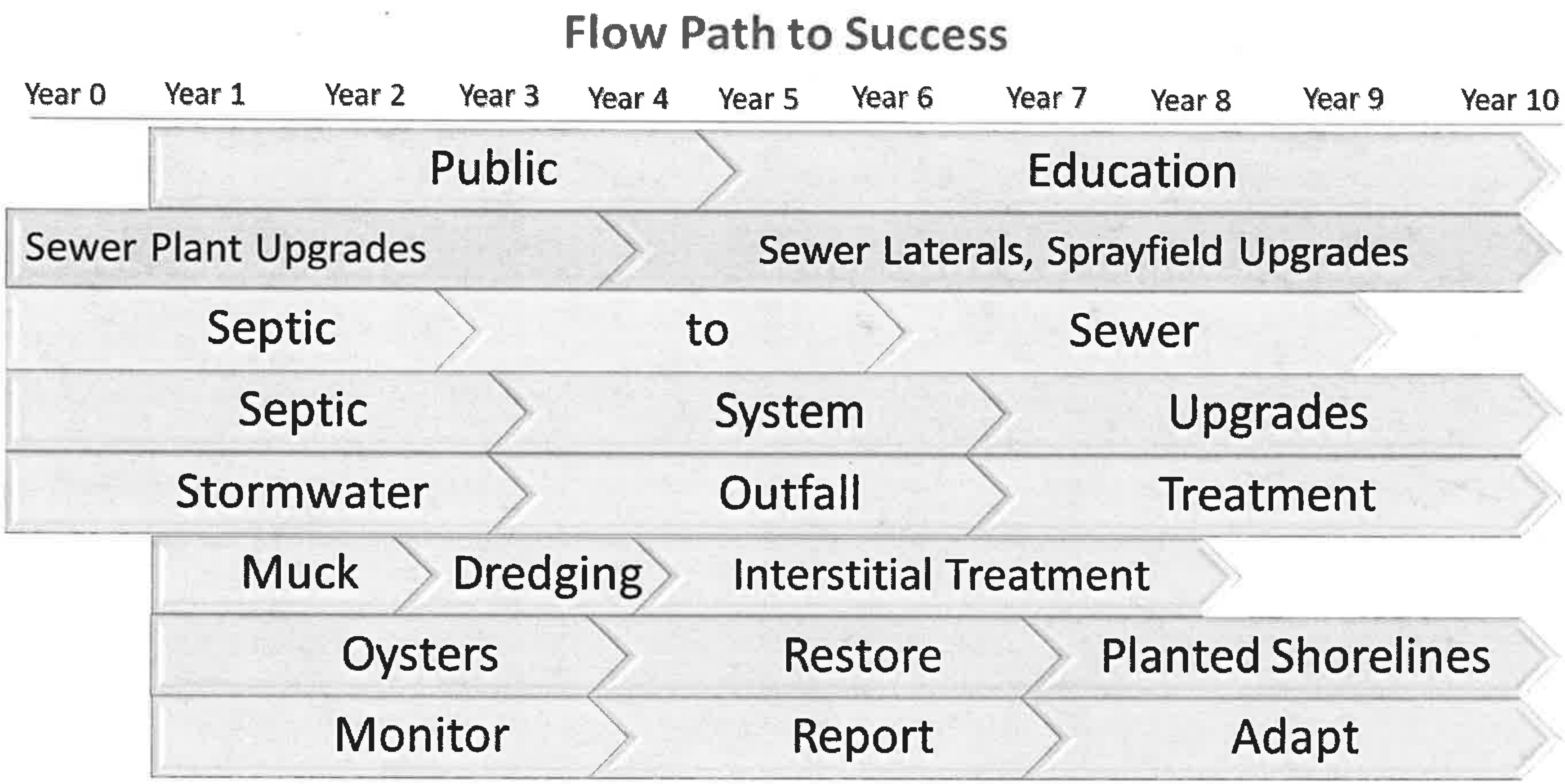


Figure ES-1: Save Our Indian River Lagoon Project Implementation Schedule

Section 1. Background

The Indian River Lagoon (IRL) system includes Mosquito Lagoon, Banana River Lagoon, and Indian River. A large portion of the IRL system, 71% of its area and nearly half its length, is within Brevard County (County) and provides County residents and visitors many opportunities.

However, the balance of this delicate ecosystem has been disturbed as development in the area has led to harmful impacts. Stormwater runoff from urban and agricultural areas, wastewater treatment facility (WWTF) discharges, septic systems, and excess fertilizer applications have led to harmful levels of nutrients and sediments entering the lagoon. In addition, these pollutants lead to muck accumulation on the lagoon bottom, which fluxes nutrients and creates a lagoon bottom that is not conducive to seagrass, shellfish, or benthic invertebrate growth.

Efforts have been ongoing to address these sources of pollution. The Indian River Lagoon System and Basin Act of 1990 (Chapter 90-262, Laws of Florida) was enacted to protect the IRL system from WWTF discharges and the improper use of septic tanks. The act includes three objectives: elimination of surface water discharges, investigation of feasibility of reuse, and centralization of wastewater collection and treatment facilities (Florida Department of Environmental Protection 2016). This act led to the removal of effluent discharges to the lagoon from more than 40 WWTFs (St. Johns River Water Management District 2016a).

Stormwater regulations were adopted in unincorporated Brevard County in 1978 and adopted statewide in 1989. Due to stormwater regulations, stormwater treatment systems were constructed along with all new development exceeding size thresholds. Privately owned and operated stormwater treatment systems have prevented more than a million pounds of sediments from entering the lagoon since 1989 (St. Johns River Water Management District 2016a). Stormwater treatment projects also reduce nutrient inputs to the lagoon. In addition, dredging projects have been ongoing since 1998 to remove muck from the lagoon and major tributaries, including Crane Creek, Turkey Creek, and St. Sebastian River (St. Johns River Water Management District 2016a). These stormwater treatment and muck removal projects contributed to significant improvements in water quality and water clarity in the lagoon, which allowed for a great expansion of seagrass from 2000-2010.

However, in the last five years, human impacts on the IRL system have been magnified. In 2011, the "superbloom" occurred, an intense algal bloom in the Mosquito Lagoon, Banana River Lagoon, and North IRL, as well as a secondary, less intense bloom in Central IRL. The extent and longevity of the bloom had a detrimental impact on seagrass. There have also been recurring brown tides; unusual mortalities of dolphins, manatees, and shorebirds; and large fish kills due to low dissolved oxygen from decomposing algae.

In 2009, to improve lagoon water quality and restore seagrass, the Florida Department of Environmental Protection adopted total maximum daily loads for total nitrogen (TN) and total phosphorus (TP) allowed to discharge to the Banana River Lagoon, North IRL, and Central IRL. The purpose of these total maximum daily loads 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 lagoon. To implement these total maximum daily loads, the Florida Department of Environmental Protection adopted three basin management action plans that outline responsibilities for reductions by the local stakeholders, list projects, and stipulate a timeline for implementation. The intent of the nutrient reductions is to provide water quality conditions that should result in seagrass growth in the lagoon at historical levels. Brevard County has a major responsibility in all three basin management action plans along with its 16 municipalities, Florida Department of Transportation District 5, Patrick Air Force Base, National Aeronautics and Space Administration – Kennedy Space Center, and agriculture.

Since 2012, Brevard County has led an effort with its municipalities, Florida Department of Transportation District 5, and Patrick Air Force Base to update the estimates of nutrient loadings to the lagoon. The County and its partners teamed with several consultants to develop the Spatial Watershed Iterative Loading model that revised the estimates of loading by source to the lagoon (refer to **Section 2** for more details) and to update the total maximum daily loads. The loading estimates and total maximum daily load targets referenced in this plan are from these efforts, as they are based on the most up-to-date data and analyses.

Damage to the lagoon has been occurring for decades and will require time and money to reverse. An important example is the accumulation of muck on the bottom of 10% of the IRL. This muck kills marine life and releases stored pollutants into the IRL. To address the damage to the IRL system, in 1990, Brevard County implemented a stormwater utility assessment, which established an annual assessment rate of $36 per year per equivalent residential unit that stayed at this level until 2014. The rate increased to $52/equivalent residential unit for 2014 and 2015 and increased to $64/equivalent residential unit in 2016. This raised collections from $3.4 million (in 2014) to $6.0 million (projected for 2016). Of the funding raised, a portion is available for capital improvement programs or other stormwater best management practices and is split between water quality improvement programs and flood control and mitigation programs. In addition, funding is spent on annual program operating expenses. Operation and maintenance includes 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.

While revenues from this stormwater assessment, over the last 10 years, have funded many projects, a significant portion of projects have been partially funded by grants. When applicable, federal water quality grants provide up to 60% matching funds, state total maximum daily load grants provide up to 50% match, and St. Johns River Water Management District cost-share grants fund up to 33% of construction. All these grant programs are highly competitive and subject to variable state and federal appropriations, as well as changing priorities.

Due to funding limitations and the continuing degradation of key indicators of health in the IRL, such as seagrass and fish, Brevard County identified a need for additional funding to implement projects identified as critical to lagoon restoration. Therefore, the County placed a Save Our Indian River Lagoon ½ cent sales tax referendum on the ballot in November 2016. This referendum passed by more than 60% of the votes and will provide a funding mechanism for the projects listed in this plan (or future annual updates) for the County and its municipalities. Revenue collection from the sales tax began in January 2017.

This Save Our Indian River Lagoon Project Plan outlines projects planned to meet updated total maximum daily load targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. Almost all these projects require sales tax funding for these projects to be implemented. Furthermore, the local sales tax funding could be used to leverage significantly more in match funding from state and federal grant programs. The IRL ecosystem is an asset valued not only in Florida but also nationally; therefore, implementation of this plan would help to restore this national treasure. If additional funding is provided through matching funds from other sources, additional projects may be implemented, which would increase the overall plan cost, and/or project timelines may be moved up to allow the benefits of those projects to occur earlier than planned. Response of the lagoon ecosystem may lag for several years behind completion of nutrient reduction implementation; however, action must be accelerated now to ensure restoration succeeds over time.

1.1. Return on Investment and Economic Value

The economic value of the lagoon system was evaluated during development of this plan. It was estimated that at least a total present value of $6 billion is tied to restoration of the Indian River Lagoon (IRL). There is approximately $2 billion in benefits from restoration and an estimated $4 billion in damages if the IRL is not brought back to health during the next decade. If viewing this project plan purely as a financial investment that pays the $2 billion in benefits alone (i.e. not counting the avoidance of the $4 billion loss), the projected pretax internal rate of return is 10%, if the plan takes 10 years to implement. However, if the County were to bond the sales tax revenue to accelerate implementation of this plan over 5 years instead of 10 years, the return on investment rises significantly to 26% because the benefits of restoration would begin to accrue much faster. Based on the sensitivity of the rate of return to the speed of plan implementation, it would be financially responsible and beneficial for the County to borrow money at a typical 4% annual bond rate to accelerate implementation to achieve the 26% return on investment. In annualized terms, borrowing $300 million at 4% to achieve a steady 26% annual return would contribute $63 million in annual positive cash flow; making bonding an excellent investment choice.

Table 1-1 documents projections of three economic engines likely to have significant economic impacts on Brevard County residents with positive impacts if the IRL is restored versus negative impacts if the IRL is not restored. Additional detail on each of these impacts is provided in **Section 1.1.1**. The upper part of the table lists the economic benefits for restoring a healthy IRL while the lower part of the table lists the economic costs of declining IRL health in the absence of restoration through plan implementation.

Economic impacts in the table are expressed both as annual cash flows and as the discounted expected present value of those cash flows over a 30-year financial plan period. Expected present value is an economic indicator used in business to express the present monetary value of a future stream of cash flows. This expected monetary value discounts the future stream by an interest rate and discounts it further by a probability factor to account for the uncertainty of future events. Therefore, the expected present value of IRL economic benefits shown in **Table 1-1** is much less than the sum of those future cash flows.

Table 1-1: Economic Impact Scenarios Based Upon the Condition of the IRL

Economic Benefits for Restoring a Healthy IRL and Costs of Declining IRL Health	Annual Cash Flow	Expected Present Value
Tourism and Recreation Growth Benefits	$95 million	$997 million
Property Value Growth Benefits	$81 million	$852 million
Rebirth of Commercial Fishing Benefits (excludes indirect benefits)	$15 million	$159 million
Healthy Residents and Tourists Benefits	Not quantified	Not quantified
Total Benefits	***$191 million***	***$2.01 billion***
Tourism and Recreation at Risk Damages	-$237 million	-$3 billion
Property Value at Risk Damages	-$92 million	-$1.2 billion
Decline of Commercial Fishing (excludes indirect impacts)	-$6 million	-$87 million
Potential Pathogen Impacts to Residents and Tourists	Not quantified	Not quantified
Total Damages	***-$335***	***-$4.29 billion***

Today there is a $6 billion decision point for the IRL. Despite unprecedented algae blooms and fish kills, conditions could become worse. If large-scale fish kills continue with increasing frequency, algae blooms continue or become toxic, or there is a pathogen outbreak, then real estate, tourism, and the quality of life and health for Brevard County residents would likely suffer.

1.1.1 Areas of Economic Value at Risk

Tourism and Recreation

Today's tourism revenue in Brevard County comes primarily from the beaches. To diversify the tourism base and increase revenue, Brevard County has developed a plan to increase ecotourism, a globally growing and high value sector of tourism that depends on restoration and maintenance of a healthy Indian River Lagoon (IRL). High value ecotourism relies on exceptional natural experiences including fishing, bird watching, kayaking, paddle boarding, camping, hiking, and nature tours. In the short-term, there are opportunities for tourists to participate in restoration experiences, such as collecting mangrove seeds by kayak or canoe, planting mangrove seedlings, or establishing colonies of clams, oysters, or mussels. A successful example of Brevard County ecotourism is the world famous annual Space Coast Birding and Wildlife Festival that brings $1.2 million annually to the County and attracts approximately 5,000 visitors.

Property Value

While the economic benefits of IRL restoration are likely to increase property value throughout the County, to be conservative this plan assessed the exposure only to properties with frontage on Mosquito Lagoon, IRL, Banana River Lagoon, Sykes Creek, and connected waterways. Approximately 11.2% of the County's $27 billion in taxable property value is directly on the IRL. Therefore, more than $3 billion in taxable property value is directly at risk with ongoing IRL issues, such algal blooms and fish kills. Furthermore, a weighted-average millage rate of 18.58 results in an estimated annual tax revenue of $56 million that is also at risk in the absence of IRL restoration. The $852 million of incremental expected present value assumes a 20% improvement in IRL frontage property value, which would be 90% likely after 10 years with the IRL restored.

Consultants for the County surveyed the Space Coast Association of REALTORS® to assess the likely impacts of IRL health on the waterfront property value. Approximately 170 REALTORS® most familiar with the waterfront market replied to the survey. These professionals assessed that waterfront IRL property values would increase 22% on average over five years if the IRL were healthy and would decrease by 25% over five years if the lagoon were not restored.

Commercial Fishing

IRL restoration is critical to the recovery of a once thriving, valuable, and world-class fishery, both commercial and recreational. In 1995, the commercial fish harvest in Brevard County was $22 million annually. While a 1995 ban on commercial net fishing marked economic decline, the degradation of the lagoon system contributed considerably to a severe reduction in value of only $6.7 million annually in 2015, based on Florida Fish and Wildlife Conservation Commission data (see **Figure 1-1**). These numbers do not include the many indirect benefits of a robust commercial fishing industry including fresh local fish for restaurants, employment, commerce of supplies and services for the industry, and benefits of local fresh fish for residents and visitors.

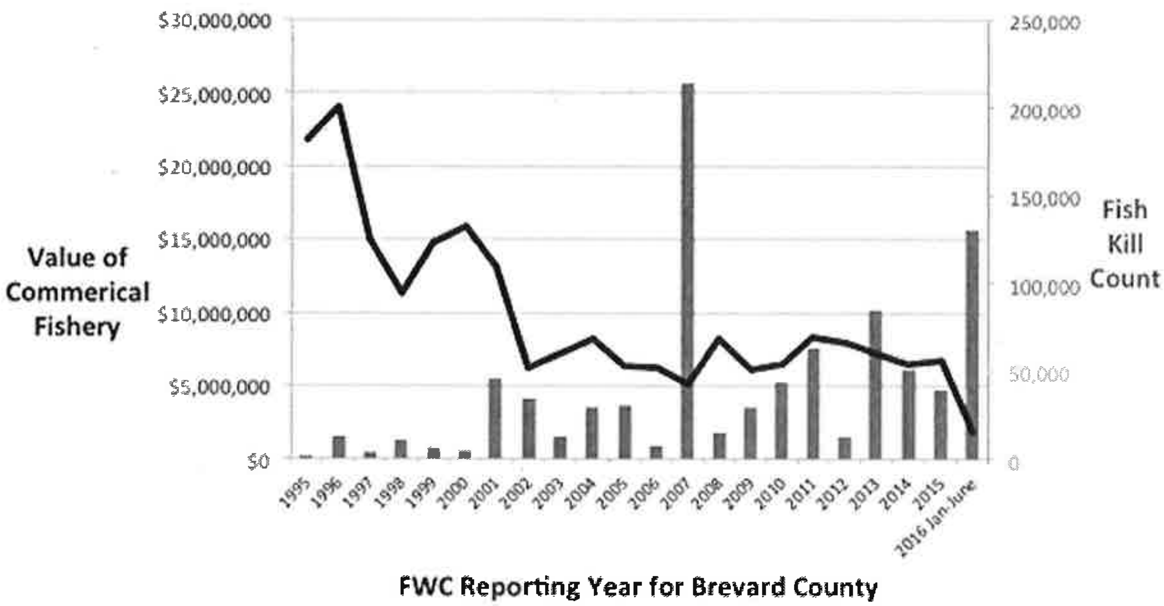


Figure 1-1: Decline of Commercial Fishing and Increasing Fish Kill Severity

Figure 1-1 Long Description

In addition, a healthy fish population is critical to the brand of any coastal community. Historically Brevard County was once home to a world-class abundance and diversity of rare and widespread species of fish, crabs, shrimp, and clams that made the IRL a global brand. That brand can be restored along with the fish and shellfish of the IRL.

Healthy Residents and Tourists

There are almost 82,000 permitted septic systems within Brevard County, of which nearly 59,500 septic systems pollute groundwater that migrates to the lagoon. This groundwater moves slowly toward the lagoon through soils that attenuate some but not all these pollutants. It would cost at least $1.19 billion to convert all 59,500 septic tanks to central sewage treatment. While total conversion is cost prohibitive, this plan targets the septic systems with the highest potential impacts to the lagoon. Targeted action includes connection to the central sewer system or upgrade to advanced treatment systems that remove significantly more nutrients and pathogens than traditional septic systems.

Although there are studies that have identified pathogens migrating from septic systems into waterways, it is not possible to estimate the economic impact of potential disease from these waterborne pathogens. The conversion of septic systems is expensive relative to other types of nutrient reduction projects; however, the additional health benefits associated with septic system upgrades make this option a priority beyond only the abatement of nutrients.

1.2. Maximizing Benefits and Managing Risk

There is much at stake with regard to both economic outcomes and the incremental funding critical to restoration; therefore, the County chose to address the unavoidable risks inherent in a multi-year, large-scale restoration plan in a transparent and objective manner. To help ensure objectivity, the County retained outside consultants to assess risk and to estimate potential positive or negative outcomes.

The approach for this plan to evaluate the different project options included using expected monetary value models; a decision science tool used in business to improve decision-making and planning in a context of unavoidable uncertainty. Expected monetary value is a financial model of probability-weighted outcomes expressed in quantified financial terms that are comparable across multi-year planning periods. To compare outcomes, expected present value was used as a key metric. Expected present value has the benefit of valuing future financial costs and benefits in common present day terms to take into account the value of time and to facilitate comparisons of initiatives spanning long periods of time.

As part of this methodology, consultants engaged Subject Matter Experts to assess the uncertainties of project scenarios. Subject Matter Experts include scientists, property value experts, tourism experts, lagoon advocates, and agency staff. Subject Matter Experts brought expertise in Indian River Lagoon (IRL) science, nutrient reduction technologies, waterborne pathogens, and relevant law or county financial and accounting parameters needed for the expected monetary value models. Information gathered during these assessments was used to document the key interdependence of initiatives, minimize risk, and maximize the likely return on investment.

1.2.1 Project Selection to Maximize Return on Investment

Assessment of risk by Subject Matter Experts determined that the amount and speed of nutrient reductions are the two most critical factors affecting the success of restoring Indian River Lagoon (IRL) health. Therefore, those projects with the greatest nutrient reduction benefit for the least cost are recommended for funding and, of those, the projects with the greatest benefits are planned for implementation first. Three other key criteria drove this plan:

1. Achieving sufficient nutrient abatement through a blend of options was a key success factor for restoration.
2. No one type of project alone could achieve an adequate nutrient abatement.
3. The target for nutrient reduction must be sufficient to minimize the need for recurring expensive muck removal, which is important for future cost avoidance.

The plan sequences a diversity of project types, implementing the highest nutrient reduction impact early and implementing other projects concurrently to achieve a multi-pronged blend of total nutrient abatement as quickly as possible with minimal risk. Another important consideration for project sequencing was how quickly projects could produce significant nutrient pollution reduction. For decades, man-made nutrient pollution from fertilizers, septic systems, and stormwater runoff have been introduced at varying distances from the IRL. The soils are still saturated with those nutrients. Therefore, if all sources of nutrient pollution ended today, groundwater would continue to transport nutrients accumulated in the soil into the IRL with every rain event for decades in the future. However, soils next to the IRL will purge themselves quickly, in days or weeks. Septic system conversions near the lagoon or near drainage conduits into the lagoon are likely to produce water quality and reduced pathogen benefits in the lagoon in weeks or months whereas septic conversions more distant from waterways are not anticipated to generate lagoon benefits for several decades. Therefore, whenever possible, project selection and sequencing scheduled nutrient abatements closest to the IRL first.

Undoing the damage to a unique and complex biological system as large as the IRL carries inherent risk. The County made the decision to be open and transparent about that risk. Assessing that risk diligently has allowed the County to mitigate and manage risk proactively in the development of this plan.

Two subjective risk assessments were conducted by an independent consultant working with top science Subject Matter Experts most knowledgeable about the IRL. The first assessment was conducted with individual Subject Matter Experts and occurred before plan projects were defined. These experts assessed that the likelihood of a healthy fish population in the IRL would begin to rise faster after reaching a critical point of nutrient reduction. Therefore, there is a "critical mass" of nutrient reduction needed to achieve significant and sustainable IRL health benefits. The Subject Matter Experts also assessed that the likelihood of recovery would continue to improve as more nutrients are removed from the IRL and then begin to decline if too many nutrients were removed. The result of that first risk assessment reinforced the objective of reducing nutrients in the IRL as quickly as possible through the definition and sequencing of the projects in this plan.

A second uncertainty assessment was conducted in a meeting at the Florida Institute of Technology with a group of water quality, toxicity, muck, fish, algae, invertebrates, and seagrass Subject Matter Experts. First, the experts were briefed about the projects proposed in this plan. The experts were then asked their subjective assessment of the likelihood of a healthy lagoon after this plan was implemented in each sub-lagoon. Sub-lagoons were assessed because the experts had commented previously that each sub-lagoon functioned differently. This group assessment indicated higher likelihoods of success than the first assessment. However, the scientists continued to voice concern about the restoration of the IRL in the absence of regulatory reform needed to prevent new development from adding more septic system and stormwater pollution to the lagoon. Therefore, updated regulations are needed as a complement to this plan to ensure timely and sustained success in restoring health to the IRL.

Figure 1-2 represents the input from the Subject Matter Experts.

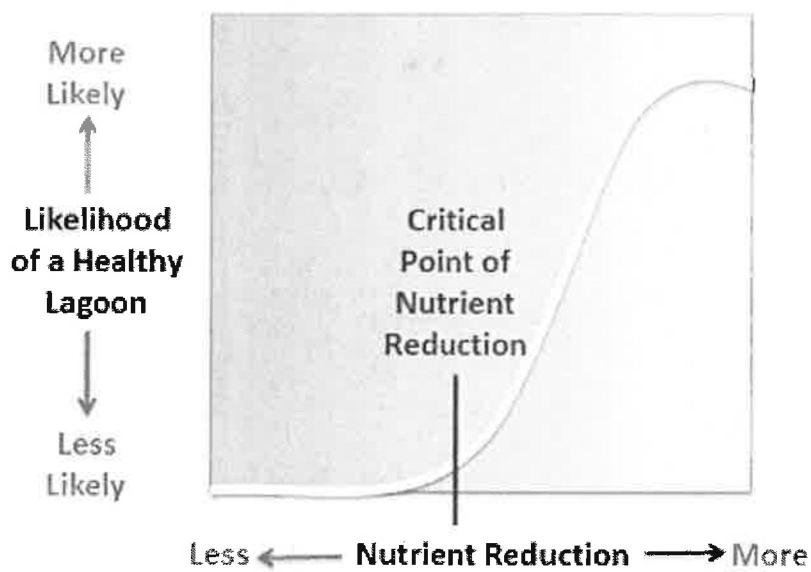


Figure 1-2: Likelihood of a Healthy IRL as Nutrients are Removed

There are other large-scale aquatic system restoration efforts that have been successful in achieving restoration. Some of these systems were damaged even more so than the IRL, but they have recovered through the implementation of extensive, multi-year, and multi-pronged restoration plans. These include the Chesapeake Bay, Cuyahoga River, Lake Erie, and Tampa Bay. These areas have reaped enormous economic and quality of life benefits as a result of dedicated investments in their restoration.

Section 2. Approach

The amount and distribution of nutrient loading from the sources described in **Section 3** were examined to determine the key locations where nutrient reduction projects are needed and the extent of reductions required from each source to achieve the County's proposed total maximum daily loads for each sub-lagoon. For each source, a reduction goal is set and projects are proposed to meet the goal. The estimated cost for each project is also included. Information on expected project efficiencies and project costs were gathered from data collected by the County in implementation of similar projects, as well as literature results from studies in Florida, where available, and across the country. The most cost-effective projects are selected and prioritized to maximize the nutrient reductions that can be achieved.

2.1. Plan Focus Area

This plan focuses on projects implemented in three sub-lagoons in the Indian River Lagoon (IRL) system: Banana River Lagoon, North IRL, and Central IRL. **Figure 2-1** shows the locations of these sub-lagoons. All the Banana River Lagoon watershed and the majority of the North IRL watershed are located within Brevard County. However, only a portion of the Central IRL watershed is located within the County. As shown in **Figure 2-1**, Central IRL Zone A is located entirely in Brevard, whereas Zone SEB straddles Brevard and Indian River Counties. For Zone SEB, the County has completed several projects in this area and the St. Johns River Water Management District is completing projects along the C-54 Canal and on the Wheeler property to treat the Sottile Canal. The reductions from these projects (in pounds per year [lbs/yr]) should be sufficient to meet the required reductions in the Brevard County portion of Zone SEB, as shown in **Table 2-1**. This plan includes some additional beneficial projects located in Zone SEB to help ensure that the necessary reductions are achieved throughout Brevard County; however, most of the projects proposed in this plan for the Central IRL fall within Central IRL Zone A.

Table 2-1: Summary of Load Reductions and Projects in Central IRL Zone SEB

Category	Annual TN Load (lbs/yr)	Five-Month TN Load (lbs/yr)	Annual TP Load (lbs/yr)	Five-Month TP Load (lbs/yr)
Stormwater and Baseflow Loading	248,233	79,956	34,901	11,242
Atmospheric Deposition Loading	22,371	7,206	404	130
Point Sources Loading	0	0	0	0
Total Loading	270,604	87,162	35,305	11,372
Total Maximum Daily Load Percent Reductions	18.0%	38.0%	16.0%	35.0%
Required Reductions	***48,709***	***33,121***	***5,649***	***3,980***
Completed County Projects (2010-February 2016)	29,890	12,454	9,643	4,018
C-54 Project	65,974	27,489	10,558	4,399
Wheeler Property Project	36,582	15,243	21,784	9,077
Total Project Reductions	***132,446***	***55,186***	***41,985***	***17,494***
% of Required Reductions Achieved	***271.9%***	***166.6%***	***743.2%***	***439.5%***

In addition, a small portion of the County is located within the Mosquito Lagoon. Brevard County does not have stormwater outfalls, septic systems, or point sources in this sub-lagoon.

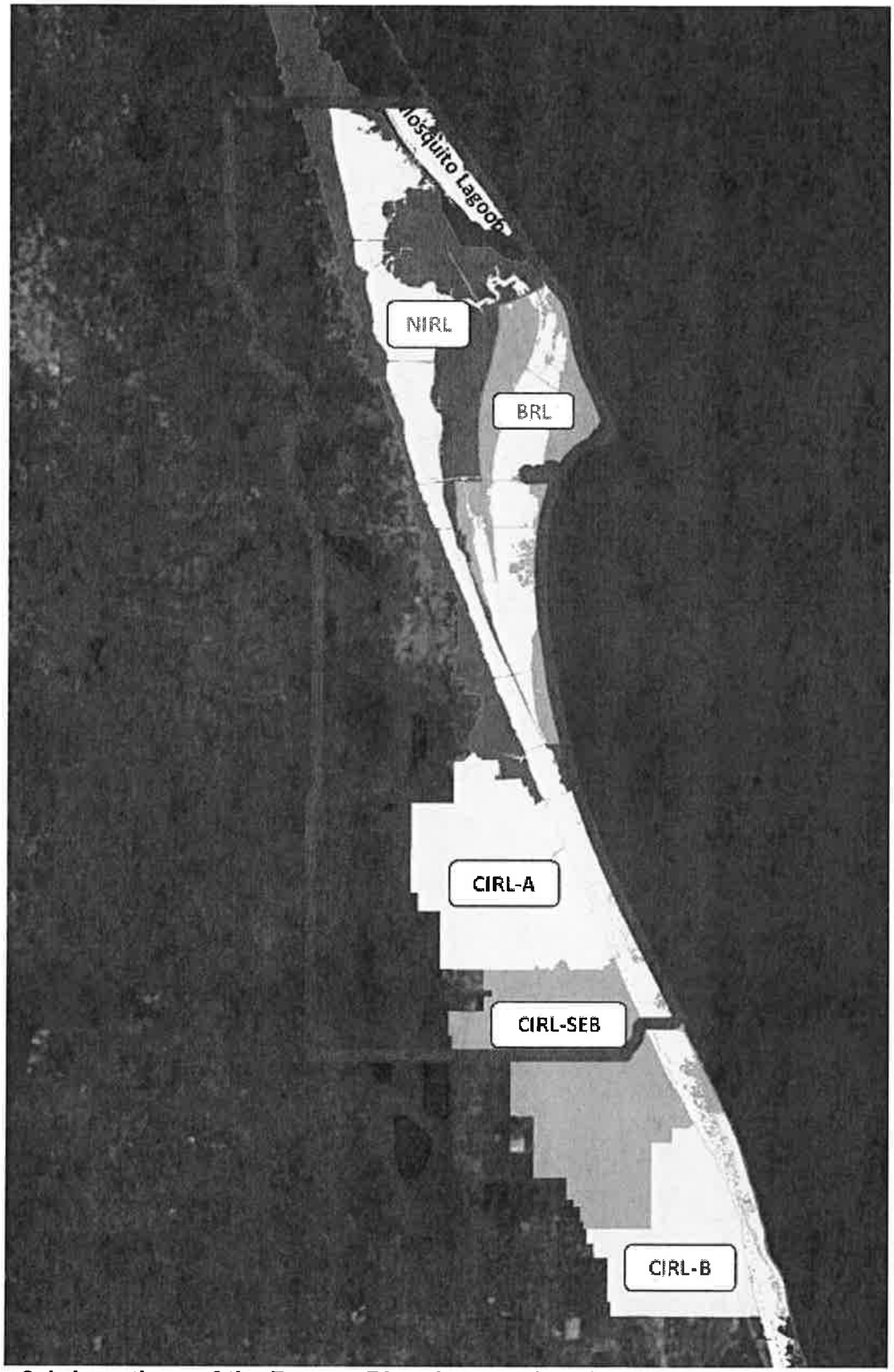


Figure 2-1: Locations of the Banana River Lagoon (BRL), North IRL (NIRL), and Central IRL (CIRL) Sub-lagoons

Section 3. Pollutant Sources in the IRL Watershed

Pollutant loads in the Indian River Lagoon (IRL) watershed are generated from multiple external sources that discharge to the lagoon. Excess loads also accumulate in nutrient sinks within the lagoon, which release nutrients to the water column during certain conditions.

External sources fall into the following major categories:

- Stormwater runoff that occurs when rainfall hits the land and cannot soak into the ground:
  - Urban stormwater runoff is generated by rainfall and excess irrigation on impervious areas associated with urban development. Urban runoff picks up and transports nutrient loading from fertilizers, grass clippings, and pet waste, as well as other pollutants including sediments, pesticides, oil, and grease. Stormwater ponds and baffle boxes reduce the nutrient loading in stormwater; however, proper maintenance of these systems is necessary to maintain their performance.
  - Agricultural stormwater runoff occurs on agricultural land and this runoff also carries nutrients from fertilizers, as well as livestock waste, pesticides, and herbicides. This source of stormwater runoff is not addressed in this plan as the County does not have jurisdiction over agricultural use. The Florida Department of Agriculture and Consumer Services has an agricultural best management practice program, and they work with agricultural producers to control the loading from this source.
  - Natural stormwater runoff comes from the natural lands in the basin. This source is not addressed by this plan as natural loading does not need be controlled.
- Baseflow is the groundwater flow that contributes loading to the IRL. Due to the sandy soils in the basin and excess irrigation, nutrients can soak quickly into the groundwater with little removal. This groundwater can recharge surface water in ditches, canals, tributaries, or the IRL.
  - Excess fertilizer that soaks into the ground past the root zones.
  - Septic systems, both functioning and failing, contribute nutrient loading to the groundwater.
  - Leaking sewer pipes located above the water table can contribute nutrient loading to the groundwater.
- Atmospheric deposition that falls on both the land and the lagoon itself:
  - Nutrients in the atmosphere fall into the basin largely during rainfall events. The sources of these nutrients are from power plants, cars, and other sources that burn fossil fuels. However, because of atmospheric conditions and weather patterns, not all the nutrients from atmospheric deposition are generated within the watershed. Atmospheric loading is not directly addressed by this plan as air quality and air emission standards are regulated by the federal Clean Air Act and are not within the County's control. However, the stormwater projects and in-lagoon projects will treat some of the nutrient loading from atmospheric deposition that falls on the land and lagoon surface.
- Point sources that treat collected sewage and discharge treated effluent:
  - The direct WWTF discharges to the lagoon have been largely removed, and most of the facilities in the basin use the treated effluent for reclaimed water irrigation. However, depending on the level of treatment at the WWTF, the reclaimed water can have an excessive concentration of nutrients that may contribute loading to the baseflow.

- There have been issues with inflow and infiltration into the sanitary sewer collection system. Large rain events can result in large amounts of water entering the sewer collection system, and this additional water can cause sewer overflows that contribute nutrients and bacteria to local waterbodies.

In addition to these external sources of loading to the lagoon, nutrients from muck (muck flux) is an internal source of loading within the lagoon itself. Muck is made up of organic materials from soil erosion on the land and from decay of organic matter (leaves, grass clippings, algae, and aquatic vegetation) in the lagoon. As these organic materials decay, they constantly flux nutrients into the water column above, where they add to the surplus of nutrients coming from external sources.

Table 3-1 summarizes the estimated loading from these sources in the Banana River Lagoon (including canals), North IRL, and Zone A of the Central IRL. The stormwater runoff and baseflow/septic systems loading estimates are from the Spatial Watershed Iterative Loading model, the point source loading estimates were based on the facility monthly operating reports and discharge monitoring reports, and the atmospheric deposition loads are from measured data at nearby stations. The muck flux load estimates are calculated based on the muck area in each portion of the lagoon and flux estimates from studies in the lagoon (refer to **Section 4.2.1** for more details). The loading from these sources is also shown graphically in **Figure 3-1, Figure 3-2**, and **Figure 3-3**.

Table 3-1: Loading from Different Sources in Each Sub-lagoon

Source	Banana River Lagoon TN (lbs/yr)	Banana River Lagoon TP (lbs/yr)	North IRL TN (lbs/yr)	North IRL TP (lbs/yr)	Central IRL Zone A TN (lbs/yr)	Central IRL Zone A TP (lbs/yr)
Stormwater Runoff	119,923	15,064	328,047	45,423	279,351	43,193
Baseflow/Septic, Leaking Sewer, Reclaimed Water	164,225	22,613	344,111	47,383	370,129	50,966
Atmospheric Deposition	175,388	3,222	301,977	5,505	49,456	892
Point Sources	17,484	3,370	14,711	1,029	0	0
Muck Flux	393,948	43,216	247,078	17,583	16,927	2,277

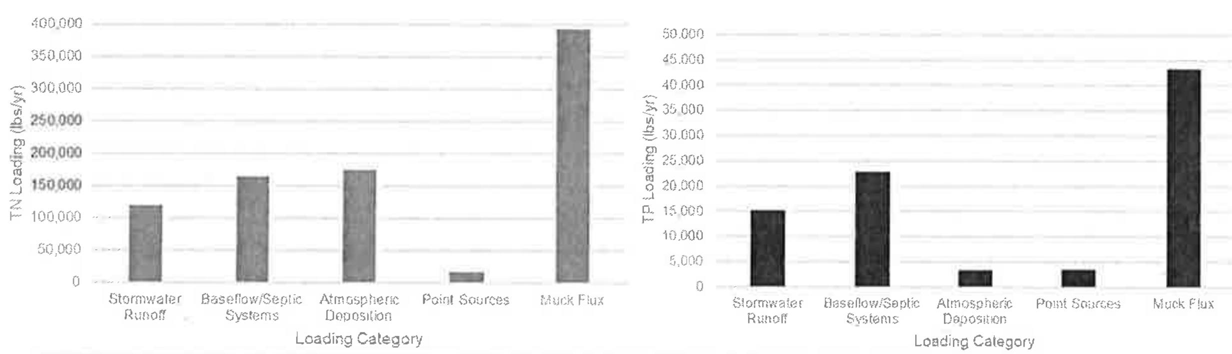


Figure 3-1: Banana River Lagoon TN (left) and TP (right) Annual Average Loads by Source

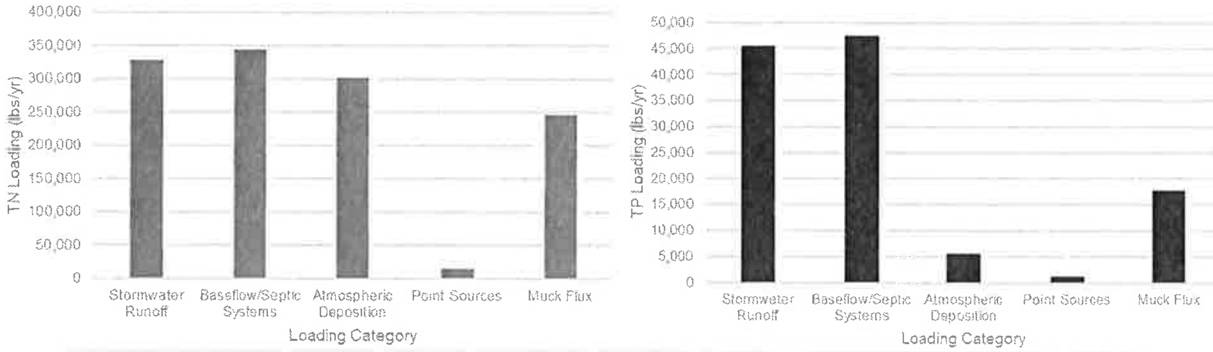


Figure 3-2: North IRL TN (left) and TP (right) Annual Average Loads by Source

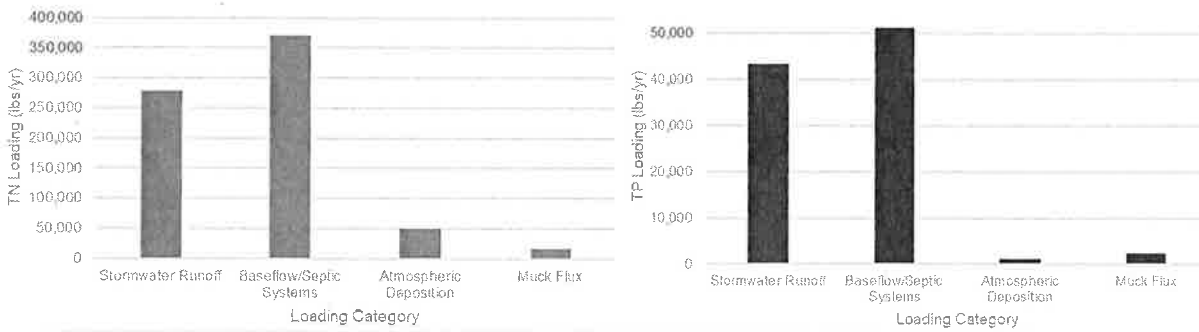


Figure 3-3: Central IRL TN (left) and TP (right) Annual Average Loads by Source

Section 4 includes information on projects to reduce the loading from urban stormwater runoff (including fertilizers and grass clippings), reclaimed water from WWTFs, and septic systems; to remove the internal cycling of loads accumulated in the muck deposits; and to restore natural filtration processes.

Section 4. Project Options

To restore the lagoon's balance, Brevard County has been implementing a multi-pronged approach to **Reduce** pollutant and nutrient inputs to the lagoon, **Remove** the accumulation of muck from the lagoon bottom, and **Restore** water-filtering oysters and related lagoon ecosystem services. This plan also recommends funding for project monitoring, needed for accountability and to **Respond** to changing conditions and opportunities. Response funds will be used to track progress, measure cost effectiveness, and report on performance. Each year, a Citizen Oversight Committee (additional details are included in **Section 4.4.1**) will review monitoring reports and make recommendations to the Brevard County Board of County Commissioners to redirect remaining plan funds to those efforts that will be most successful and cost-effective. Although research is important to better understand factors that significantly impact the health, productivity, and natural resilience of the Indian River Lagoon (IRL), funding for research is not included in this project plan.

Several goals were set to help select the projects for this plan. The goal for the **Reduce** projects is to achieve the proposed five-month total maximum daily load for each sub-lagoon (refer to **Section 9** for additional details on the total maximum daily loads). The goal for the **Remove** projects is to achieve at least a 25% reduction in estimated recycling of internal loads. The goals for the **Restore** projects are to filter the entire volume of the lagoon annually and to reduce shoreline erosion. The most cost-effective projects in each category were selected to maximize nutrient reductions, minimize lag time in lagoon response, reduce risk, and optimize the return on investment.

Section 4.1 through **Section 4.4** provide information on the proposed projects, estimated nutrient reduction benefits, and costs, as well as the ongoing research needed to measure and assess the project efficiencies and benefits to the lagoon system.

4.1. Projects to Reduce Pollutants

An important step in restoring the lagoon system is reducing the amount of pollutants that enter the Indian River Lagoon (IRL) through stormwater runoff and groundwater. Reduction efforts include source control (such as fertilizer reductions) to reduce the amount of pollutants generated, as well as treatment to reduce pollutants that have already been discharged before they are washed off in stormwater runoff or enter the groundwater system and ultimately discharge to the IRL. Monitoring of these projects will be performed to verify the estimated effectiveness of each project type implemented (refer to **Section 4.4**).

The benefits from fertilizer management and public education, WWTF upgrades for reclaimed water, and stormwater treatment are seen fairly quickly in the lagoon system. Public education about fertilizer and other sources of pollution addresses nutrients at their source and prevents these nutrients from entering the system. WWTF upgrades result in reduced nutrients in the treated effluent, which is then used throughout the basin for reclaimed water irrigation. The stormwater projects will capture and treat runoff, which is currently untreated or inadequately treated, before it reaches the lagoon.

While greatly beneficial, septic system removal or upgrade projects may take longer to result in a nutrient reduction to the lagoon. The septic systems in key areas must be removed or upgraded to see the full benefits. In addition, septic systems contribute nutrient loading to the lagoon through groundwater, and the travel time of the nutrient plumes through the groundwater to a waterbody vary throughout the basin depending on watershed conditions.

The following subsections summarize the fertilizer management and public education, septic system removal and upgrades, WWTF upgrades, sewer lateral rehabilitation, package plant removal or upgrades, and stormwater treatment projects that will be implemented to reduce nutrient loads to the IRL.

4.1.1 Public Outreach and Education

The education and outreach campaigns are summarized in the sections below. Additional details can be found in **Appendix C**.

Approximately 81,700 lbs/yr of TN and 4,200 lbs/yr of TP enter the lagoon watershed from excess fertilizer application.

Fertilizer Management

It is a common practice to apply fertilizer on urban and agricultural land uses. However, excessive and inappropriately applied fertilizer pollutes surrounding waters and stormwater. To help address fertilizer as a source of nutrient loading, local governments located within the watershed of a waterbody or water segment that is listed as impaired by nutrients are required to adopt, at a minimum, the Florida Department of Environmental Protection's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes (Section 403.067, Florida Statutes). Brevard County and its municipalities adopted fertilizer ordinances that included the required items from the Model Ordinance in December 2012, as well as additional provisions in 2013 and 2014. Local fertilizer ordinances are posted online at http://sfyl.ifas.ufl.edu/brevard/lawn-and-garden/fertilizer-ordinances/. These ordinances require zero phosphorus year-round, nitrogen to be at least 50% slow release, no nitrogen use during the rainy season, and variable surface water protection buffers.

Florida Department of Agriculture and Consumer Services compiles information on the fertilizer sales by county, as well as the estimated nutrients from those fertilizers. It is important to note that all fertilizer sold in a county may not be applied within that county because a portion of that fertilizer may be transported to another county. However, details on the amount of fertilizer transported between counties is not tracked. Therefore, the information in the Florida Department of Agriculture and Consumer Services reports is simply the best estimate of the amount of fertilizer used, and the associated nutrient content, in a county.

Based on the Florida Department of Agriculture and Consumer Services information, the lawn fertilizer sold in Brevard County in fiscal year 2014-2015 contained 408,220 lbs of nitrogen and 32,520 lbs of phosphorus. The fertilizer applied is attenuated through several naturally occurring physical, chemical, and biological processes including uptake by grass. The environmental attenuation/uptake for urban fertilizer is 80% for nitrogen (Florida Department of Environmental Protection 2014b) and 90% for phosphorus. The estimated nitrogen and phosphorus that is applied but is not naturally attenuated is shown in **Table 4-1**. It is important to note that not all the un-attenuated nutrients will migrate to the lagoon, either through runoff or baseflow (groundwater that enters ditches, canals, and tributaries), but these numbers provide an idea of the excess nutrients that could be reduced as a result of public education and changes in fertilizer use.

Table 4-1: Estimated TN and TP Not Attenuated in Fiscal Year 2014-2015

Parameter	Pounds Sold Fiscal Year 2014-15 (Lawn Only)	Environmental Attenuation (%)	Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation
TN	408,220	80%	81,644
TP	32,520	90%	3,252

When recent sales data are compared to the fertilizer sold in fiscal year 2013-2014, which is before adoption of the more protective amendments to the ordinance, significant reductions are observed. These reductions from the implementation of the ordinance are shown in **Table 4-2**.

Table 4-2: Reductions from Fertilizer Ordinance Compliance to Date

Parameter	Fiscal Year 2013-14 Pounds (Lawn Only) after Attenuation: Pre-Ordinance	Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation: Post-Ordinance	Reductions from Ordinance to Date (lbs/yr)
TN	127,540	81,644	45,896
TP	12,640	3,252	9,388

Based on studies by the University of Florida, approximately 0.03% of applied nitrogen ends up in runoff during establishment of sodded Bermudagrass on a 10% slope. Nitrogen leaching ranged from 8% to 12% of the amount applied (Trenholm and Sartain 2010). Therefore, nitrogen leaching from fertilizer into the groundwater is 300 to 400 times as much as the nitrogen running off in stormwater. To help address the leaching issue, the Brevard County fertilizer ordinance encourages the use of slow release nitrogen fertilizer. Slow release fertilizer decreases nitrogen leaching by about 30% (University of Florida-Institute of Food and Agricultural Sciences 2012). In addition, the ordinance requires that fertilizer with zero phosphorus is used.

The public education and outreach campaign will be expanded to include focus on slow release and zero phosphorus fertilizers. An important component of this will be to reach out to stores within the County to ensure they are making slow release and zero phosphorus fertilizers more visible and to add signage to let buyers know which fertilizers are compliant with all local ordinances. This would cost approximately $125,000 per year for a period of five years. If an additional 25% of fertilizer users switch to 50% slow release nitrogen and zero phosphorus formulations, compliant with the ordinance, this would result in a reduction of 6,123.3 lbs/yr of TN and 813.0 lbs/yr of TP (see **Table 4-3**).

Table 4-3: Estimated TN and TP Reductions and Costs from Additional Fertilizer Ordinance Compliance

Project	Cost	TN Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation	TN Reductions from Additional 25% Compliance (lbs/yr)	Cost per Pound per Year of TN Removed	TP Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation	TP Reductions from Additional 25% Compliance (lbs/yr)	Cost per Pound per Year of TP Removed
Expanded Fertilizer Education*	$625,000	81,644	6,123	$102	3,252	813	$769

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

In 2018, the Citizen Oversight Committee recommended extending the fertilizer education and outreach beyond the original plan recommendation of five years to all ten years of the plan. The $625,000 for this project will be redistributed as follows: (1) $125,000 in Year 1 to create the education campaign and begin implementation, (2) $50,000 per year to continue implementation in Years 2-10, and (3) an additional $50,000 in Year 6 (for a total of $100,000 in this year) to evaluate program success and update the outreach materials, as needed.

Grass Clippings (added in 2018)
Grass clippings contain nutrients and those nutrients are released in stormwater or the lagoon as they decompose (Brevard County 2017). St. Augustine grass contains 2.5% nitrogen and 0.2-0.5% (average of 0.5%) phosphorus and Bahia grass contains 2% nitrogen (University of Florida-Institute of Food and Agricultural Sciences 2015). According to Okaloosa County Extension, a 7,500-square foot lawn produces about 3,000 pounds of clippings per year. Unfortunately, the percentage of those total clippings that end up in stormwater is not known.

To estimate the potential nutrient reduction impact of a grass clippings campaign, it was assumed that the average home size is 10,000 square feet with a 100-foot by 100-foot boundary, 2,500 square feet of built space, and 7,500 square feet of lawn. University of Florida-Institute of Food and Agricultural Sciences has estimated that 3,000 pounds of grass clippings are produced annually from a healthy lawn of this size. It was assumed that most of the grass clippings in Brevard County are from St. Augustine grass, which means that 3,000 pounds of clippings contains approximately 75 pounds of TN and 10.5 pounds of TP. It was also assumed that the standard mower size is two feet wide. From one roadside pass along 100 feet of the average lawn with a two-foot wide mower, 200 square feet or 2.6% of the total lawn clippings could be cast into the road. This equals 0.02 pounds of TN and 0.0027 pounds of TP per foot per year left in the road. With about 3,800 miles of roads in the Indian River Lagoon (IRL) Basin within Brevard County, of which approximately 1,250 miles are paved with curb and gutter and are most likely to allow the ready transport of grass clippings to the lagoon in stormwater, the potential nutrient release from those grass clippings could be up to 260,000 lbs/yr of TN and 35,640 lbs/yr of TP from mowing along both sides of the road. If Brevard County expects a similar rate of awareness as Alachua County (24%), then a potential 200,000 lbs/yr of TN and 27,000 lbs/yr of TP may be entering the stormwater. If a successful grass clippings campaign in Brevard County can capture an increase of awareness similar to Alachua County (from 24% to 69%), then there is a potential reduction of 88,920 lbs/yr of TN and 12,189 lbs/yr of TP. In addition, assuming the environmental attenuation/uptake for grass clippings is similar to the urban fertilizer uptake of 80% for nitrogen and 90% for phosphorus, the estimated reductions would be 17,800 lbs/yr of TN and 1,200 lbs/yr of TP.

This estimate assumes a simplified worst-case scenario in which everyone leaves a portion of their clippings in the road; however, it does not take into account the number of driveways, sidewalks, medians, and other impervious surfaces that grass clippings could be falling or the grass clippings being directly cast into the IRL, canals, and other waterways. Using the available information, this provides an order of magnitude estimate of the potential benefits of a grass clippings campaign for the IRL.

The Marine Resources Council has proposed a partnership between the IRL Basin counties to pursue a grass clippings campaign similar to the Alachua County campaign. The Citizen Oversight Committee recommended contributing $20,000 in Year 1 of the plan towards the research and marketing to develop the campaign. This will be followed by an annual investment of $20,000 per year for Years 2 through 10 for media and promotional materials targeting Brevard County. Therefore, the total project cost is $200,000. **Table 4-4** summarizes the costs and benefits of implementing the grass clippings campaign.

Table 4-4: Estimated TN and TP Reductions and Costs from Grass Clippings Campaign

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per Year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Grass Clippings Campaign*	$200,000	17,800	$11	1,200	$167

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Market research needed to guide development of a grass clipping campaign was contracted through the Marine Resources Council to a community-based social marketing firm, Uppercase Inc. Survey results from 2018 are reported in **Section 4.4.2**.

Excess Irrigation (added in 2018)

Fertilizer nutrients are more susceptible to leaching if turfgrass is overwatered, carrying nutrients beyond the reach of the turf roots. During excess watering, soluble nutrients, such as highly mobile nitrate, wash through the soil from the root zone too quickly. Excess irrigation is easy to accomplish in Florida's sandy soils as these soils typically hold no more than 0.75 inches of water per foot of soil depth (Hochmuth et al. 2016). This excess irrigation is part of the baseflow contributing nutrient loading to the Indian River Lagoon (IRL).

From June 2015 to May 2016, 470,737 pounds of TN in fertilizer were sold within Brevard County. Florida Department of Agriculture and Consumer Services Urban Turf Fertilizer Rule (RE-1.003[2], Florida Administrative Code) does not specify a percentage of slow-released nitrogen in fertilizer or separately track slow-release nitrogen from all nitrogen sources. However, if it is assumed that 50% of fertilizer was soluble nitrogen (compliant with local fertilizer ordinances), then the total soluble nitrogen sold in Brevard County could be as high as 235,368 lbs/yr. If 13% of soluble nitrogen were leached, up to 30,597 lbs/yr of TN could potentially be entering the groundwater. If like South Florida survey respondents 50% of irrigation users in Brevard County are not over-irrigating, and if an outreach campaign can impact half of those who do over-irrigate, fertilizer leaching could be reduced by 7,649 lbs/yr of TN. As noted above, the environmental attenuation/uptake for urban fertilizer is 80% for nitrogen (Florida Department of Environmental Protection 2014b). Therefore, the total amount of TN that could be reduced by reducing excess irrigation is 1,530 lbs/yr.

Conducting an outreach campaign with an initial $50,000 social marketing research and development investment and $25,000 in annual implementation, the total 10-year budget would be $300,000. This results in an average of $196 per pound of TN reduced per year (see **Table 4-5**). Funding for this education campaign is not recommended at this time.

Table 4-5: Estimated TN Reductions and Costs from Reducing Excess Irrigation

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per year of TN Removed
Irrigation Education	$300,000	1,530	$196

Stormwater Pond Maintenance (added in 2018)

Wet detention ponds, also known as stormwater ponds, are one method used to remove nutrients from stormwater as mandated by Florida Statutes 403.0891. Retention/detention time of water in the pond accommodates the removal of accumulated nutrients by allowing material to settle and be absorbed. By itself, an optimally sized and properly maintained stormwater pond typically provides a 35-40% removal of nitrogen and 65% removal of phosphorus through settling (Florida Department of Environmental Protection and Water Management Districts 2010). Additional behaviors and technologies can be combined with ponds to increase removal rates. On the other hand, poor pond maintenance practices can decrease nutrient removal rates or worse yet, release nutrients to downstream waterbodies.

The stormwater pond maintenance program will initially focus on vegetative buffers and their appropriate maintenance to reduce stormwater pollution. Brevard County contains 4,175 stormwater ponds covering 13,276 acres with 6,976,338 linear feet of shoreline. The average size of a pond is 3.2 acres with 1,671 linear feet of shoreline. These numbers include ponds affiliated with both residential and commercial areas. The average load to stormwater ponds is 11.4 pounds of TN per acre of land surrounding the pond annually according to the Florida Department of Environmental Protection's Spreadsheet Tool for Estimating Pollutant Loads. Assuming that a 50-foot perimeter directly impacts the pond, there are 8,008 acres contributing 91,288 pounds of TN annually to the ponds. Of this, up to 40% of the TN is removed through retention in the pond leaving a potential 54,773 lbs/yr of TN to enter the lagoon. For TP, approximately 18,836 lbs/yr is entering the stormwater pond. Of this, up to 65% of the TP is removed through retention in the pond leaving a potential of 6,593 lbs/yr TP to enter the lagoon.

Creating a 10-foot-wide low-maintenance buffer zone of un-mowed ornamental grasses has the potential to remove about 25% of the TN and TP entering the pond (U.S Environmental Protection Agency 2005). This amount increases with the width of the buffer and the addition of woody vegetation. For the plan calculations, the assumption was made that convincing homeowners to not mow a 10-foot buffer is the easiest practice to achieve. The pond will remove up to 40% of the remaining TN. Assuming that the education campaign can reach at least half of the 48% of people unaware of what stormwater is, the reduction could be 3,286 lbs/yr of TN and 396 lbs/yr of TP.

Conducting an outreach campaign with an initial $50,000 social marketing research and development investment plus $25,000 in annual implementation, would require a 10-year total budget of $300,000. This would result in reductions at $91 per pound of TN and $750 per pound of TP (see **Table 4-6**). Additionally, during focus group research in the first year, it may be possible to identify other best management practices that homeowners' associations are willing to adopt that would further improve the performance of their stormwater pond. This would improve the cost effectiveness of this campaign. Funding for this education campaign is not recommended at this time.

Table 4-6: Estimated TN and TP Reductions and Costs from Stormwater Best Management Practice Maintenance

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound Per Year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Stormwater Best Management Practice Maintenance Education	$300,000	3,300	$91	400	$750

Septic Systems and Sewer Laterals Maintenance (added in 2018 and 2019)
Nationwide, 10-20% of septic systems are failing from overuse, improper maintenance, unsuitable drainfield conditions, and high-water tables. When septic systems are older and failing or are installed over poor soils close to the groundwater table or open water, they can be a major contributor of nutrients and bacterial and viral pathogens to the system (De and Toor 2017, USEPA 2002).

A properly functioning septic tank and drainfield system reduces TN by 30-40%. However, the reduction has been measured at 0-20% in adverse conditions. The best available studies estimate a 10% reduction in nitrogen within a properly maintained tank versus an improperly maintained tank. The remaining 20-30% of nitrogen removal occurs in a properly functioning drainfield (Anderson 2006). If 15% of systems are failing and failing systems attenuate 30% less of the nitrogen load, these systems may pose far greater impacts to the groundwater, tributaries, and lagoon than the average impact reported for properly functioning systems. Without the 30% reduction, the potential load to the Indian River Lagoon (IRL) and its tributaries is estimated to be 27.2 lbs/yr of TN for properties within 55 yards (instead of 19 lbs/yr of TN for functioning systems), 5.2 lbs/yr of TN for properties between 55 and 219 yards away (instead of 3.6 lbs TN/yr for functioning systems), and 1.1 lbs/yr of TN for properties more than 219 yards away (instead of 0.8 lbs/yr of TN for functioning systems).

There are an estimated 53,204 septic systems in Brevard County within the IRL Basin. As noted in **Section 4.1.6**, the total loading of septic systems within 55 yards of the IRL and its tributaries is calculated at 299,590 lbs/yr of TN, the total loading of systems between 55 and 219 yards is 86,575 lbs/yr of TN, and the total loading of septic systems further than 219 yards is 10,805 lbs/yr of TN. If the failure rate in Brevard County is about 15%, and if failing systems receive 30% less attenuation, then failing systems within 55 yards of open water are contributing 13,481 lbs/yr of TN, failing systems between 55 and 219 yards of open water are contributing 3,896 lbs/yr of TN, and failing tanks further than 219 yards are contributing 486 lbs/yr of TN. By factoring in this failure rate, the total additional loading to the IRL from failing septic systems is approximately 17,863 lbs/yr of TN.

A 10-year outreach campaign budget of $300,000, which includes $50,000 for research and campaign development and $25,000 per year for implementation to improve septic system maintenance, reduce excess use, and prevent harmful additives, would strive to reduce the number of failing systems countywide by 25%, thereby reducing the excess loading from failing systems by 4,466 lbs/yr of TN. This would result in average cost of $67 per pound of TN (see **Table 4-7**).

Table 4-7: Estimated TN Reductions and Costs from Septic System Maintenance

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per Year of TN Removed
Septic System Maintenance Education*	$300,000	4,466	$67

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Market research needed to guide development of a septic maintenance campaign was contracted with state grant funding through the Marine Resources Council to the University of Central Florida. Survey results from 2018 are reported in **Section 4.4.2**. In reaching out to citizens to participate in the survey, it was found that many people are unsure of whether they are on central sewer or a septic system. When developing the septic system maintenance education program, Brevard County will identify opportunities to educate people who are on central sewer about proper maintenance of their sewer laterals. Adding this education component to the septic system maintenance education campaign is not anticipated to require additional funding.

Lagoon Loyal Program (added in 2020)
Using funding from the fertilizer education and septic system maintenance education programs, the marketing company MTN Advertising was contracted to create an outreach campaign to engage Brevard citizens in IRL restoration efforts. The Lagoon Loyal campaign uses an incentive program to motivate positive actions that benefit the IRL. Citizens can create an online Lagoon Loyal profile that suggests various activities that benefit the lagoon. Completing each activity earns points, which can accumulate and be redeemed for discounts to local area businesses. The businesses providing discounts are given display materials that indicate their participation, which also advertises the program to their customers. Combined with social media marketing and traditional media advertising, the program uses the slogan "Let's Be Clear…" to share easy actions that citizens can take to reduce their contribution to lagoon pollution. Message selection is guided by focus groups and survey responses from citizens who either care for a yard or maintain a septic system. The program also maintains landing pages to facilitate the septic upgrade and removal grants available to the owners of eligible locations.

4.1.2 WWTF Upgrades

88% of the reclaimed water in the County is used in public access areas and for landscape irrigation.

Upgrades for Reclaimed Water
The direct WWTF discharges to the lagoon have been largely removed, and the majority of facilities in the basin use the treated effluent for reclaimed water irrigation. While the use of reclaimed water for irrigation is an excellent approach to conserving potable water, if the reclaimed water is high in nutrient concentrations, the application of the reclaimed water for irrigation can result in nutrients leaching into the groundwater. It is important to note that there are no regulations on the concentration of nutrients in reclaimed water that is used for irrigation. However, University of Florida-Institute of Food and Agricultural Sciences studies indicate that a nitrogen concentration of 5 to 9 milligrams per liter is optimal for turfgrass growth, and each year a maximum amount of 1 pound of nitrogen can be applied per 1,000 square feet of turf (University of Florida-Institute of Food and Agricultural Sciences 2013a and 2013b). Nitrogen leaching increases significantly when irrigation is greater than 2 centimeters per week (0.75 inches per week), even if the nitrogen concentrations are half of the maximum Institute of Food and Agricultural Sciences recommendation of 9 milligrams per liter.

In Brevard County, 88% of the reclaimed water is used in public access areas and for landscape irrigation. The total reclaimed water used countywide is approximately 18.5 million gallons per day, which is applied over 7,340 acres. The unincorporated County and city WWTFs with the reclaimed water flows and TN concentrations based on permit data are shown in **Table 4-8**. This table also summarizes the excess TN in the reclaimed water after environmental attenuation/uptake (75% for TN [Florida Department of Environmental Protection 2017]), for both the current TN effluent concentration and if the facility were upgraded to achieve a TN effluent concentration of 6 milligrams per liter (the City of Palm Bay Water Reclamation Facility update would achieve a TN effluent concentration of 7.5 milligrams per liter and the City of Melbourne Grant Street WWTF would achieve a TN effluent concentration of 5 milligrams per liter).

Table 4-8: TN Concentrations in WWTF Reclaimed Water

Facility	Permitted Capacity (million gallons per day)	Reclaimed Water Flow (million gallons per day)	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/year)	TN After Attenuation and Upgrade (lbs/year)
City of Palm Bay Water Reclamation Facility	4.0	1.20	29.4	27,305	6,966
City of Melbourne Grant Street WWTF	5.5	2.08	21.0	33,806	8,049
City of Titusville Osprey WWTF	2.75	1.67	12.7	16,415	7,755
Brevard County Port St. John WWTF	0.5	0.35	12.6	3,413	1,625
Cape Canaveral Air Force Station WWTF	0.8	0.80	11.9	7,368	3,714
City of West Melbourne Ray Bullard Water Reclamation Facility	2.5	0.85	11.1	7,302	3,947
Brevard County Barefoot Bay Water Reclamation Facility	0.9	0.48	10.3	3,826	2,229
Brevard County South Beaches WWTF	8.0	1.12	9.3	8,061	5,201
Brevard County North Regional WWTF	0.9	0.26	8.9	1,791	1,207
Rockledge WWTF	4.5	1.40	7.0	7,584	6,501
Brevard County South Central Regional WWTF	5.5	3.79	6.7	19,653	17,600
City of Titusville Blue Heron WWTF	4.0	0.84	4.8	4,993	Not applicable
City of Cape Canaveral Water Reclamation Facility	1.8	0.88	3.8	4,141	Not applicable
City of Cocoa Jerry Sellers Water Reclamation Facility	4.5	1.44	3.5	6,241	Not applicable
Brevard County Sykes Creek WWTF	6.0	1.48	3.4	3,895	Not applicable
City of Cocoa Beach Water Reclamation Facility	6.0	3.66	2.5	11,331	Not applicable

The estimated costs for the WWTF upgrade and the cost per pound of nitrogen removed as a result of the upgrade are shown in **Table 4-9**. Based on a 2007 study by U.S. Environmental Protection Agency, the cost to upgrade WWTFs to meet advanced wastewater treatment standards is approximately $4,200,000 per plant. This cost is in 2006 dollars, which, when inflated to 2016 dollars and costs are included for design and permitting, is approximately $6,000,000 per facility. Where cost estimates were available for facility upgrades, these costs were used instead of the U.S Environmental Protection Agency inflated estimated. Due to the high cost per pound of TN removed to upgrade some of these facilities compared to other projects in this plan, only those facilities highlighted in green are recommended for upgrades as part of this plan.

As part of the public education and outreach efforts, customers who use reclaimed water for irrigation should be informed of the nutrient content in the reuse water because they can and should eliminate or reduce the amount of fertilizer added to their lawn and landscaping. This information can be provided to the customers through their utility bill.

Table 4-9: Cost per Pound of TN Removed from WWTF Upgrades to Improve Reclaimed Water

Facility	Cost to Upgrade	TN Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TP Removed
City of Palm Bay Water Reclamation Facility *	$1,400,000	20,240	$69	102	$13,699
City of Melbourne Grant Street WWTF*	$6,000,000	18,052	$332	To be determined	To be determined
City of Titusville Osprey WWTF*	$8,000,000	8,660	$924	Not applicable	Not applicable
Cape Canaveral Air Force Station	$6,000,000	3,653	$1,642	To be determined	To be determined
City of West Melbourne Ray Bullard Water Reclamation Facility	$6,000,000	3,355	$1,788	To be determined	To be determined
Brevard County South Beaches WWTF	$6,000,000	2,860	$2,098	To be determined	To be determined
Brevard County South Central Regional WWTF	$6,000,000	2,053	$2,923	To be determined	To be determined
Port St. John WWTF	$6,000,000	1,788	$3,356	To be determined	To be determined
Rockledge WWTF	$6,000,000	1,084	$3,460	To be determined	To be determined
Barefoot Bay Water Reclamation Facility	$6,000,000	1,597	$5,535	To be determined	To be determined
North Regional WWTF	$6,000,000	584	$10,282	To be determined	To be determined

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

4.1.3 Sprayfield and Rapid Infiltration Basin Upgrades (added in 2019)

Another opportunity to reduce the nutrient loading from the WWTFs is to upgrade the disposal locations, either sprayfields or rapid infiltration basins, for the treated effluent. The sprayfields and rapid infiltration basins could be modified to include biosorption activated media to provide additional nutrient removal. Examples of biosorption activated media include mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols (Wanielista et al. 2011). Based on a pilot project in the City of DeLand, the potential removal of adding biosorption activated media to a sprayfield or rapid infiltration basin is 83% for TN and 66% for TP (City of DeLand and University of Central Florida 2018). The loads for the facilities in Brevard County that dispose of reclaimed water to a sprayfield or rapid infiltration basin were estimated based on permit and discharge monitoring report information (where available). Attenuation rates were based on ArcGIS-Based Nitrate Load Estimation Toolkit model results for each specific package plant location. Then the biosorption activated media efficiency rate was applied to determine the TN that could be removed. Costs were estimated for each upgrade and the upgrades that could be made for the least cost per pound of TN are recommended for pilot project funding as part of this plan (see **Table 4-10** and **Table 4-11**). Information on nutrient concentrations or the size of the sprayfield/rapid infiltration basin were missing from several facilities. As this information is gathered, additional upgrades may be found to be cost-effective.

Table 4-10: Cost per Pound of TN and TP Removed from Sprayfield or Rapid Infiltration Basin Upgrades for Public Facilities

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Port St John Wastewater Treatment Plant*	Rapid Infiltration Basin	0.3560	$980,100	12.55	10,374	8,610	$114	2.32	1,918	1,266	$774
Cape Canaveral Air Force Station Regional WWTF*	Rapid Infiltration Basin	0.8000	$5,227,200	11.90	22,104	18,346	$285	3.03	5,628	3,715	$1,407
Barefoot Bay Advanced	Sprayfield	0.4800	$26,136,000	10.33	166	138	$189,391	1.80	29	19	$1,375,579

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
** The TN concentration assumes that the facility has been upgraded to achieve an effluent concentration of 6 milligrams per liter.

Table 4-11: Cost per Pound of TN and TP Removed from Sprayfield or Rapid Infiltration Basin Upgrades for Private Facilities

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Indian River Shores Trailer Park WWTF*	Rapid Infiltration Basin	0.01	$38,145	17.21	212	176	$217	5.16	120	79	$483
Canebreaker Condo*	Sprayfield	0.008	$36,000	11	63	52	$688	To be determined	To be determined	To be determined	To be determined
River Forest Mobile Home Park WWTF*	Sprayfield	0.018	$78,405	10.56	134	111	$705	3.14	70	46	$1,704
Palm Harbor Mobile Home Park WWTF*	Sprayfield	0.014	$300,564	6.18	495	411	$732	2.88	50	33	$9,108
Cove At South Beaches Condominium Association WWTF	Sprayfield	0.01	$51,480	1.28	24	20	$2,584	7.03	87	57	$903
Riverview Mobile Home and Recreational Vehicle Park	Sprayfield	0.03	$333,234	4.88	121	100	$3,318	2.99	111	73	$4,565
Treetop Villas	Sprayfield	0.0056	$105,000	11.44	27	22	$4,685	3.47	24	16	$6,563
Enchanted Lakes Estates	Sprayfield	0.0055	$36,000	1.41	1	1	$43,373	To be determined	To be determined	To be determined	To be determined
Lighthouse Cove WWTF	Sprayfield	0.024	$120,000	1.17	2	2	$72,289	1.34	40	26	$4,615
Merritt Island Utility Company WWTF	Rapid Infiltration Basin	0.07	$495,277	0.18	3	2	$198,906	To be determined	To be determined	To be determined	To be determined
River Grove Mobile Home Village WWTF	Rapid Infiltration Basin	0.03	$182,299	0.3	1	1	$219,637	0.7	49	32	$5,697
Aquarina Beach Community WWTF	Sprayfield	0.099	To be determined	3.2	261	To be determined	To be determined	0.5	To be determined	To be determined	To be determined

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Camelot Recreational Vehicle Park Inc	Sprayfield	0.02	To be determined	4.01	202	To be determined	To be determined	3.14	To be determined	To be determined	To be determined
Housing Authority of Brevard County WWTF	Rapid Infiltration Basin	0.0099	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Oak Point Mobile Home Park WWTF	Rapid Infiltration Basin	0.015	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
South Shores Utility	Sprayfield	0.075	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Southern Comfort Mobile Home Park WWTF	Rapid Infiltration Basin	0.0075	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Space X Launch Complex 39A	Sprayfield	0.5	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Summit Cove Condominium	Rapid Infiltration Basin	0.03	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Tropical Trail Village WWTF	Rapid Infiltration Basin	0.0125	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Wingate Reserve Demineralization Concentrate	Rapid Infiltration Basin	0.007	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Sterling House Condominium WWTF	Sprayfield	0.015	$60,000	3.63	To be determined	To be determined	To be determined	1.64	31	20	$3,000
Pelican Bay Mobile Home WWTF	Rapid Infiltration Basin	0.035	$222,156	2.76	To be determined	To be determined	To be determined	2.92	237	157	$1,415
Harris Malabar Facility	Rapid Infiltration Basin	0.066	$2,085,000	12.6	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Long Point Recreational Park	Rapid Infiltration Basin	0.012	$60,000	0.22	To be determined	To be determined	To be determined	0.88	25	16	$3,750

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

4.1.4 Package Plant Removal and Upgrades (added in 2019)

Package plants are miniature wastewater treatment plants that serve small communities producing more than 2,000 gallons of effluent per day. The most common package plant treatment methods are extended aeration, sequencing batch reactors, and oxidation ditches; the same biological treatment methods used in larger wastewater treatment plants. The smallest package plants often use the same technology as advanced septic systems. Following this treatment, the effluent is disposed of in rapid infiltration basins (ponds), sprayfields, or drainfields (U.S Environmental Protection Agency 2000).

Most package plants were removed in the 1990s following the Indian River Lagoon System and Basin Act of 1990. However, opportunities still exist to address some of the worst remaining package plants by upgrading the existing plant, adding nutrient scrubbing technology, or preferably connecting them to central sewer where the wastewater will receive further treatment and disposal far from the lagoon. A few of these package plants are located along the Indian River Lagoon (IRL) and, therefore, pose a substantial nutrient risk due to their effluent concentration and disposal methods. **Table 4-12** lists the estimated TN reductions and costs to connect the package plants to the sewer system. Based on the information in this table, the cost to connect the package plants to the sewer are higher than the cost per pound of other projects in this plan; therefore, none of the package plant projects are recommended at this time.

Table 4-12: Estimated TN Reduction and Cost for Connecting Package Plants to the Sewer System

Facility Name	Number of Units	TN Load Reduction (lbs/yr)	Cost to Connect to Sewer	Cost per Pound Per Year of TN Removed
Palm Harbor Mobile Home Park WWTF	130	495	$782,530	$1,581
River Forest Mobile Home Park	130	134	$778,713	$5,818
Riverview Mobile Home and Recreational Vehicle Park	110	121	$717,593	$5,907
Canebreaker Condo WWTF	24	63	$504,692	$8,024
Merritt Island Utility Company WWTF	198	3	$1,393,916	$556,214
Enchanted Lakes Estates	190	1	$994,448	$1,921,749
Housing Authority of Brevard County WWTF	26	0	$499,892	Not applicable
Oak Point Mobile Home Park WWTF	130	0	$842,282	Not applicable
South Shores Utility	134	0	$955,344	Not applicable
Tropical Trail Village WWTF	74	0	$645,959	Not applicable
Willow Lakes Recreational Vehicle Park WWTF	280	0	$1,270,407	Not applicable
Aquarina Utilities WWTF	392	261	Insufficient Capacity	Insufficient Capacity
Indian River Shores Trailer Park WWTF	54	212	Insufficient Capacity	Insufficient Capacity
Camelot Recreational Vehicle Park Inc.	178	202	Insufficient Capacity	Insufficient Capacity
Treetop Villas	28	27	Insufficient Capacity	Insufficient Capacity
Cove At South Beaches Condominium Association WWTF	80	24	Insufficient Capacity	Insufficient Capacity
Lighthouse Cove WWTF	80	2	Insufficient Capacity	Insufficient Capacity

Facility Name	Number of Units	TN Load Reduction (lbs/yr)	Cost to Connect to Sewer	Cost per Pound Per Year of TN Removed
River Grove I & II Mobile Home Park	200	1	Insufficient Capacity	Insufficient Capacity
Pelican Bay Mobile Home (aka Riverview) WWTF	200	0	Insufficient Capacity	Insufficient Capacity
Southern Comfort Mobile Home Park	40	0	Insufficient Capacity	Insufficient Capacity
Sterling House Condominium WWTF	45	0	Insufficient Capacity	Insufficient Capacity
Summit Cove Condominium	84	0	Insufficient Capacity	Insufficient Capacity

4.1.5 Sewer Laterals Rehabilitation (added in 2018)

Sewage overflows following heavy rainfall events are an indicator of illegal connections or inadequate sewer asset conditions. There are three major components of wastewater flow in a sanitary sewer system: (1) base sanitary (or wastewater) flow, (2) groundwater infiltration, and (3) rainfall inflow. Virtually every sewer system has some infiltration and/or inflow. Historically, small amounts of infiltration and/or inflow are expected and tolerated. However, infiltration and/or inflow becomes excessive when it causes overflows, health, and/or environmental risks. Overflows from the South Beaches WWTF sewer system have occurred 7 of the last 13 years, including significant overflows following Hurricane Matthew in 2016 and Hurricane Irma in 2017. Less frequent overflows and line breaks have occurred in other sewer service areas.

In 2012, in recognition of aging infrastructure and increasingly frequent issues, the Brevard County Utilities Services Department engaged seven professional engineering firms to perform independent field evaluations of the condition of the sewage infrastructure assets located in each of the County's seven independent sewer service areas. The output of this investigation was identification of $134 million in specific capital improvement needs required over a ten-year period to bring County-owned sewer system assets up to a fully-functional, reliable, affordable, efficient, and maintainable condition (Brevard County Utilities Services 2013). The field evaluation results and corresponding 10-year Capital Improvement Program Plan were presented to the Brevard County Commission in 2013. In response, the Commission approved financing the entire Capital Improvement Program Plan and increased the County's sewer service rates to repay the debt. Plan implementation began in 2014 and projects are progressing quickly.

Because there was already a capital improvement plan and funding mechanism for updating the County's aging sewer system infrastructure, the original Save Our Indian River Lagoon Project Plan did not include analysis or funding for sewer system repairs. Unfortunately, even in areas where capital improvements have been made, infiltration and/or inflow continues to be a problem that contributes to overflows that discharge untreated wastewater into the Indian River Lagoon (IRL). This indicates the probability of problems outside the County-owned assets and could include illegal connections and/or leaks in the privately owned lateral connections of homes and businesses to the County sewer system.

Identifying problems on the customer side of the connection required smoke testing each building or private residence to determine if leaks or illegal connections are present. The extent of infiltration and/or inflow on the customer side of the connections is unknown and, therefore, the nutrient loading associated with these issues are also unknown. As a first step to determine the extent of infiltration and/or inflow problems with the sewer laterals, the County partnered with the City of Satellite Beach on a pilot project to perform smoke testing of more than 12,000 buildings and residences within the area of concern in March through July of 2018. Smoke testing results are included in **Section 4.4.2**.

Repair of privately-owned portions of the sewer system is not funded in the County's adopted Capital Improvement Program Plan for the Wastewater Utility; therefore, consideration has been given to the use of the Save Our Indian River Lagoon Tax funding. The Brevard County Utilities Services Department estimates that infiltration and/or inflow due to rainfall and flooding associated with Hurricane Irma, caused 1,835 lbs/yr of TN and 350 lbs/yr of TP to enter the lagoon from sewer overflowing from the South Beaches Regional WWTF sewer system. Staff reviewed 13 years of storm-related release data (2004-2017) to estimate the average annual nutrient load to the lagoon from emergency sewage overflows. If repairing private connections could prevent similar overflows in the future, then the average annual nitrogen reduction benefit of such repairs would be approximately 988 lbs/yr of TN. The average cost effectiveness of sewer expansion projects funded in the 2017 Plan Supplement was $852 per pound of nitrogen removed, thus the cost to reduce 988 lbs/yr of TN loading by implementing septic to sewer projects would be $841,842. Therefore, the 2018 Update allocated $840,000 to assist property owners with the cost to repair leaky sewer connections expected to be found through smoke testing (**Table 4-13**).

Table 4-13: Estimated Sewer Laterals Rehabilitation TN and TP Reductions and Costs

Project	Number of Buildings	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Satellite Beach Pilot Area*	5,400	$840,000	988	$850	188	$4,468

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

The Save Our Indian River Lagoon Trust Fund will also be used to conduct performance monitoring to measure the nutrient reduction benefits of repairing privately-owned leaky lateral connections. In addition to documenting less groundwater leaking into pipes and overwhelming the sewer infrastructure, monitoring will also seek to document improvement in groundwater quality that may occur when the leaks are repaired. The results of performance monitoring will be used to consider expansion of this program from the Satellite Beach pilot areas to other city and county sewer service areas. The lessons learned from this pilot study and a pilot study in Titusville (added in the 2019 Update) will be applied to future sewer lateral evaluation and repair projects.

4.1.6 Septic System Removal and Upgrades (updated in 2019)

Septic systems are commonly used where central sewer does not exist. When properly sited, designed, constructed, maintained, and operated, septic systems are often a safe means of disposing of domestic waste but still add nutrients to the system. However, when septic systems are older and failing or are installed over poor soils close to the groundwater table or open water, they can be a major contributor of nutrients and bacterial and viral pathogens to the system. As of 2018, there are an estimated 53,204 septic systems in Brevard County within the Indian River Lagoon (IRL) Basin (**Table 4-14**). To address this source, options for both septic system removal and septic system upgrades were evaluated. It is important to note that although the County is taking the lead on these projects, the Florida Department of Health is responsible for the regulation and permitting of septic systems. The County will coordinate with Florida Department of Health on the septic system projects recommended in this plan.

Table 4-14: Location of Septic Systems in Brevard County

Area	Number of Septic Systems
St. Johns River Basin	22,514
Banana River Lagoon	2,927
North IRL	13,381
Central IRL	36,896
Total	***75,718***

Septic System Removal by Sewer Extension

In 2018, Brevard County conducted a more detailed evaluation of septic system impacts to surface waters through both groundwater monitoring and modeling using the Florida Department of Environmental Protection-approved ArcGIS-Based Nitrate Load Estimation Toolkit. This evaluation found that groundwater conductance and soil types were more important for nitrogen transport from septic systems than was previously accounted for in the approach used for ranking in the original Save Our Indian River Lagoon Plan. Therefore, for the 2019 Update, the approach to prioritize areas for septic system connection to the sewer system was modified. The original approach is provided in **Appendix D**, and the updated approach and recommended projects are summarized below.

The updated approach to rank areas for septic system impacts used information on the potential nutrient contribution from the ArcGIS-Based Nitrate Load Estimation Toolkit. Potential nutrient contributions were determined based on numerous factors, but after testing model sensitivity to these factors, a simplified approach was developed for Brevard County that was based primarily on the spatial location of the septic system (i.e. Barrier Island, Merritt Island, Mainland, or Melbourne Tillman Water Control District), soil type (soil hydraulic conductance), and the minimum distance to waterbodies (Applied Ecology 2018).

A direct comparison between the previous model that adapted studies from Martin and St. Lucie counties (**Table 4-15**) and the new model tailored to Brevard County's soil and water (**Table 4-16**) is difficult. For loading, the previous study estimated TN, which is the sum of nitrate, nitrite, ammonia, and organic nitrogen, whereas the new approach using the ArcGIS-Based Nitrate Load Estimation Toolkit estimated only nitrate and ammonia. Through the detailed ArcGIS-Based Nitrate Load Estimation Toolkit analysis it was also determined that there are 6,260 fewer septic systems in the Indian River Lagoon (IRL) basin than estimated in the original plan.

Table 4-15: Original Estimate of TN Loading and Cost to Connect for Septic Systems

Septic System Distance from Surface Water	Number of Septic Systems	TN Load Per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,090	27.095	408,863	$20,000	$301,800,000	$738
Between 55 and 219 yards	25,987	6.865	178,395	$20,000	$519,740,000	$2,913
Greater than 219 yards	18,361	0.001	10	$20,000	$367,220,000	$37,624,010
Total in IRL Basin	***59,438***	***9.880 (average)***	***587,268***	***$20,000***	***$1,188,760,000***	***$2,024 (average)***

Table 4-16: Updated Estimate of TN Loading based on ArcGIS-Based Nitrate Load Estimation Toolkit and Updated Cost to Connect for Septic Systems

Septic System Distance from Surface Water	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,737	19.037	299,590	$33,372	$525,175,164	$1,753
Between 55 and 219 yards	23,969	3.612	86,575	$33,372	$799,893,468	$9,239
Greater than 219 yards	13,472	0.802	10,805	$33,372	$449,587,584	$41,611
Total in IRL Basin	***53,178***	***7.465 (average)***	***396,970***	***$33,372***	***$1,774,656,216***	***$4,471 (average)***

Those septic systems within 55 yards of surface waters were further analyzed by soil hydraulic conductivity since it was found to be a highly influential variable in nutrient loading from septic systems. Hydraulic conductance is the ability of water to move through pore space in the soil with sandy soils having a higher conductance compared to loamy and clay soils. As shown in **Table 4-17**, nitrogen loading is much higher in the very high and high conductivity soils compared to the average for all soils within 55 yards. Although only half of the septic systems are in very high and high conductance soils, these account for 76% of the nitrogen loading.

Table 4-17: Septic Systems by Soil Hydraulic Conductance Class within 55 Yards of Surface Waters

Hydraulic Conductivity of Septic Systems Within 55 yards of Surface Water	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Very High	1,899	34.926	66,324	$33,372	$63,373,428	$956
High	6,304	26.021	164,039	$33,372	$210,377,088	$1,283
Medium	3,230	12.198	39,401	$33,372	$107,791,560	$2,736
Low	3,396	5.930	20,141	$33,372	$113,331,312	$5,628
Very Low	908	10.664	9,683	$33,372	$30,301,776	$3,129
Total	***15,737***	***19.037 (average)***	***299,588***	***$33,372***	***$525,175,164***	***$1,753 (average)***

Table 4-18 shows those properties with septic systems in very high and high hydraulic conductance soils distributed by distance to surface waterbodies. Waterfront properties served by septic systems, including those properties adjacent to the lagoon, tributary rivers and creeks, or on canals or drainage ditches that discharge to the lagoon contribute 48% of all septic system loading in the IRL watershed in Brevard County. Changes proposed in the 2019 Plan Update shift septic to sewer and septic upgrade projects as much as feasible to areas of high conductivity soils located adjacent to waterways that contribute the greatest loading to the IRL.

Table 4-18: Septic Systems in Very High and High Hydraulic Conductance Soils Distributed by Distance to Surface Waters

Septic System Distance from Surface Water (yards)	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
0-11	5,584	33.838	188,956	$33,372	$186,349,248	$986
12-22	1,207	16.404	19,799	$33,372	$40,280,004	$2,034
23-33	465	17.466	8,121	$33,372	$15,517,980	$1,911
34-44	384	12.458	4,784	$33,372	$12,814,848	$2,679
45-55	563	15.456	8,702	$33,372	$18,788,436	$2,159
Total in IRL Basin	***8,203***	***28.083 (average)***	***230,362***	***$33,372***	***$273,750,516***	***$1,188***

For the funded opportunities that were identified using the new ranking method, the number of lots that could be connected, associated cost of the connection, and estimated TN reductions are shown in **Table 4-19** for the Banana River Lagoon, **Table 4-20** for the North IRL, and **Table 4-21** for the Central IRL. **Figure 4-9** through **Figure 4-13** show the location of each of these areas. These funded opportunities, including the quick connection projects described below, represent the connection of approximately 4% of the septic systems in Brevard County within the IRL Basin but reduce over 17% of the nutrient load contribution attributed to existing septic systems in Brevard.

Table 4-19: Opportunities for Septic System Removal in Banana River Lagoon

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Merritt Island – Zone F*	71	$1,100,000	1,292	$851
Sykes Creek - Zone N*	78	$2,603,016	2,784	$935
Sykes Creek - Zone M*	56	$1,868,832	1,798	$1,039
Merritt Island - Zone C*	43	$1,580,000	1,419	$1,113
Sykes Creek – Zone R*	192	$3,500,000	2,925	$1,197
North Merritt Island – Zone E*	195	$3,635,000	2,541	$1,431
Sykes Creek - Zone T*	148	$4,939,056	3,360	$1,470
South Banana - Zone B*	41	$1,368,252	915	$1,495
Total	***824***	***$20,594,156***	***17,034***	***$1,209 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-20: Opportunities for Septic System Removal in North IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of Rockledge*	15	$500,580	712	$703
City of Cocoa - Zone K*	36	$1,201,392	1,663	$722
City of Titusville - Zones A-G*	36	$1,201,392	1,563	$769
South Central - Zone A*	101	$3,370,572	3,655	$922
South Beaches - Zone A*	37	$1,234,764	1,306	$945
South Central - Zone C*	142	$4,900,000	5,146	$952
City of Cocoa - Zone J*	94	$3,136,968	3,259	$963
South Beaches - Zone O*	4	$133,488	136	$979
City of Melbourne*	26	$867,672	878	$988
South Central - Zone F*	51	$1,701,972	1,688	$1,008
South Beaches - Zone P*	15	$500,580	489	$1,024
Sharpes - Zone A*	186	$6,207,192	5,248	$1,183
City of Titusville - Zone H*	35	$1,168,020	910	$1,283
Rockledge - Zone B*	160	$5,339,520	4,037	$1,323
South Central - Zone D (Brevard)*	94	$4,774,500	3,387	$1,410
South Central – Zone D (Melbourne)	28	$265,500	177	$1,500
Total	***1,060***	***$36,504,112***	***34,254***	***$1,066 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-21: Opportunities for Septic System Removal in Central IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Micco – Zone B	540	$9,000,000	8,687	$1,036
Micco – Zone A Phase II	13	$709,745	618	$1,148
City of Palm Bay – Zone A*	77	$2,569,644	2,136	$1,203
City of Palm Bay – Zone B*	249	$8,309,628	6,809	$1,220
Total	***879***	***$20,589,017***	***18,250***	***$1,128 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Additional areas evaluated for septic to sewer system connection opportunities are listed in **Table 4-22**. These additional opportunities require more funding than is currently available and some require time and expense to build WWTF capacity and service infrastructure before connections would be feasible. Therefore, these systems are not recommended for funding as part of this plan. However, these areas have a large concentration of septic systems that are impacting the lagoon, and other funding options to address the septic systems in these areas could be explored in the future, if needed.

Table 4-22: Additional (Unfunded) Opportunities for Septic System Connections

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound Per Year
Grant-Valkaria – Zone G	30	$1,001,160	1,418	$706
Grant-Valkaria – Zone E	128	$4,271,616	5,862	$729
Grant-Valkaria – Zone B	34	$1,134,648	1,501	$756
Grant-Valkaria – Zone F	17	$567,324	688	$824
Grant-Valkaria – Zone D	18	$600,696	690	$871
Grant-Valkaria – Zone A	42	$1,401,624	1,296	$1,082
Malabar – Zone B	64	$2,135,808	1,929	$1,107
Grant-Valkaria – Zone C	30	$1,001,160	853	$1,173
Malabar – Zone A	430	$14,349,960	11,456	$1,253
Valkaria – Zone I	223	$7,441,956	5,380	$1,383
South Beaches – Zone F	3	$100,116	70	$1,435
Valkaria – Zone J	503	$16,786,116	11,507	$1,459
Malabar – Zone C	14	$467,208	289	$1,617
South Central – Zone B	180	$6,006,960	3,700	$1,623
Sharpes – Zone B	136	$4,538,592	2,692	$1,686
South Beaches – Zone E	387	$12,914,964	7,491	$1,724
Rockledge – Zone C	91	$3,036,852	1,736	$1,749
South Beaches – Zone K	21	$700,812	397	$1,765
North Merritt Island – Zone F	34	$1,550,000	830	$1,867
North Merritt Island – Zone D	29	$1,293,000	685	$1,888
City of West Melbourne	60	$2,002,320	1,041	$1,923
Pineda	27	$1,257,000	644	$1,952
Sykes Creek – Zone IJ	77	$1,900,000	962	$1,974
South Beaches – Zone L	178	$5,940,216	2,973	$1,998
Sykes Creek – Zone J	63	$2,102,436	1,028	$2,045
South Banana – Zone A	88	$3,025,000	1,444	$2,095
South Central – Zone BC	13	$1,222,000	582	$2,100
South Beaches – Zone G	112	$3,737,664	1,764	$2,119
City of West Melbourne – Zone B	60	$2,002,320	894	$2,240
Malabar – Zone D	24	$800,928	352	$2,278
North Merritt Island – Zone A	107	$4,245,000	1,821	$2,331
South Beaches – Zone D	89	$2,970,108	1,273	$2,333
South Central – Zone E	411	$13,715,892	5,761	$2,381
South Beaches – Zone M	334	$11,146,248	4,293	$2,596
Grant-Valkaria – Zone H	100	$3,337,200	1,272	$2,624
Malabar – Zone F	14	$467,208	174	$2,683
Melbourne Village – Zone B	224	$7,475,328	2,705	$2,763
Sykes Creek – Zone H	74	$2,469,528	887	$2,783
South Central – Zone I	72	$2,170,000	772	$2,811
Sykes Creek – Zone G	52	$1,735,344	602	$2,881
South Beaches – Zone N	103	$3,437,316	1,193	$2,882
Sykes Creek – Zone C	81	$2,703,132	929	$2,909
Melbourne Village – Zone A	85	$2,836,620	918	$3,091
South Central – Zone H	165	$5,506,380	1,779	$3,096
South Central – Zone G	196	$6,540,912	2,090	$3,129
North Merritt Island – Zone C	71	$2,369,412	737	$3,217
Merritt Island – Zone H	285	$22,500,000	5,464	$4,118

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound Per Year
Sykes Creek – Zone S	164	$6,600,000	1,584	$4,167
North Merritt Island – Zone B	56	$4,690,000	1,066	$4,399
Merritt Island – Zone A	249	$16,700,000	3,440	$4,855
South Beaches – Zone C	118	$3,937,896	683	$5,763
Total	***6,166***	***$232,843,980***	***111,598***	***$2,086 (average)***

Another opportunity for removing septic systems is to use a hybrid septic tank effluent pumping system. In this system, effluent from the septic tank is connected to sewer pressure lines. Small-diameter pipes, which can be installed relatively quickly, are used instead of the gravity sewer system. A high pressure ½ horse power pump (115 volt) pumps the effluent from the septic system to a force main or gravity sewer system. The City of Vero Beach is installing these systems and they are leaving the drainfields in place, which saves money and allows for a backup in the event that a power outage affects the septic tank effluent pumping system. If the drainfield is not left in place, a 500-gallon pump chamber is installed to allow enough reserve capacity to address power outages. Each septic tank effluent pumping system also has an emergency generator receptacle to address long-term power outages associated with hurricanes. The estimated cost per connection is $6,000 to $10,000, which includes the cost of the pipes. The City of Vero Beach maintains the septic tank effluent pumping system and pumps out the septic tank when needed. The customer pays the electrical costs to operate the pump for this system.

For highly ranked properties located within the vicinity of a pressure line or gravity sewer system, the septic tank effluent pumping system may be a good option instead of the septic system upgrades described below. If septic tank effluent pumping systems are selected as a preferred option anywhere in Brevard County, specific locations for septic tank effluent pumping system installation can be submitted for funding consideration through the annual project funding request and plan update process.

Septic System Removal by Sewer Connection

The detailed septic analysis also identified 4,496 properties located within 30 feet of existing sewer infrastructure. The highest loading "quick connect" opportunities are included in **Table 4-23** based on their ability to connect to gravity or force main sewer and are shown in **Figure 4-14** through **Figure 4-16**.

Table 4-23: Opportunities for Septic System Removal by Sewer Connection

Sub-lagoon	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Banana Quick Connects*	144	$1,908,000	3,224	$592
North IRL Quick Connects*	463	$6,018,000	11,339	$531
Central IRL Quick Connects*	269	$3,354,000	6,883	$487
Total Quick Connects	***876***	***$11,280,000***	***21,446***	***$526 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

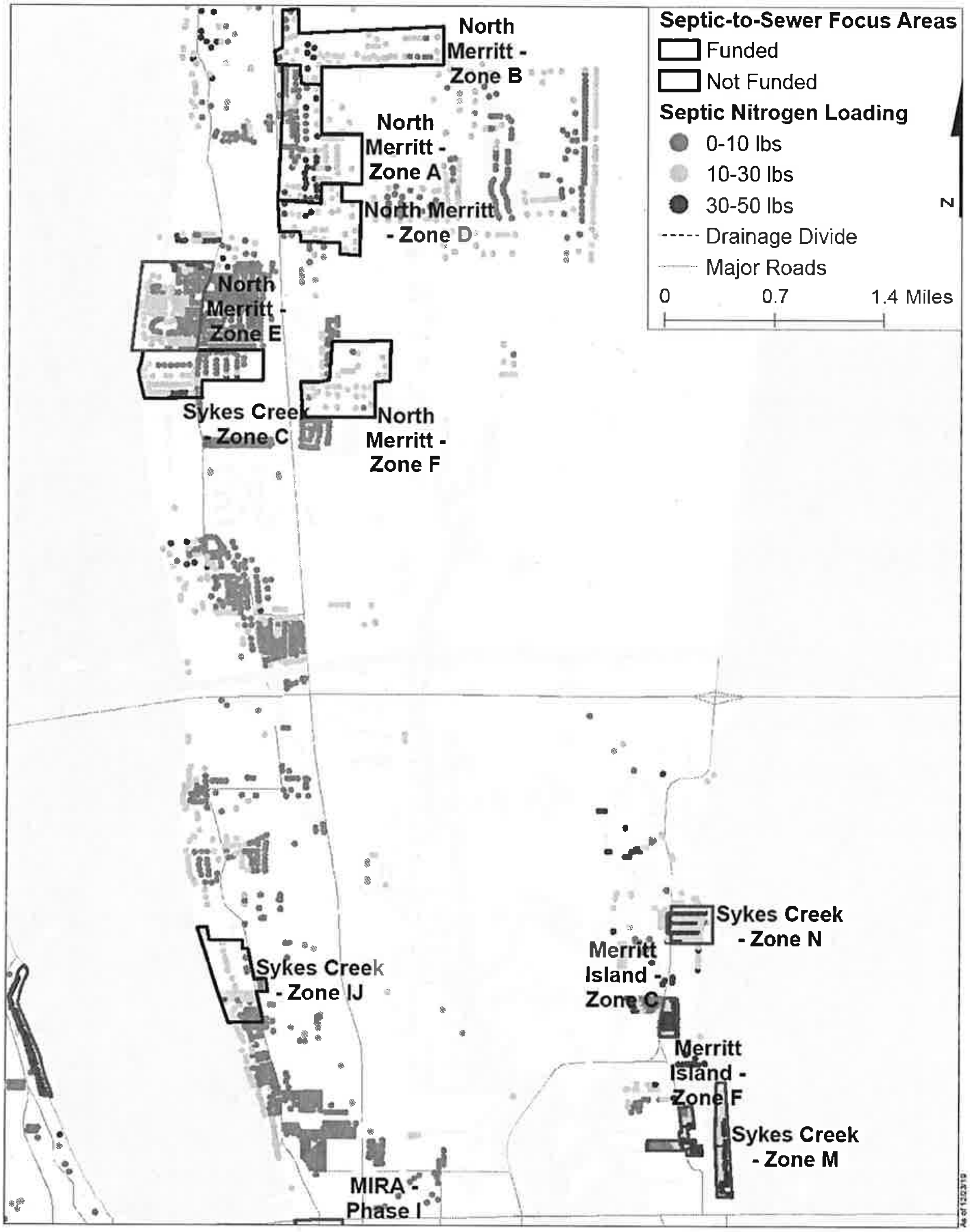


Figure 4-1: Map of Locations for Septic System Removal Projects in Northern Banana River Lagoon

Figure 4-1 Long Description

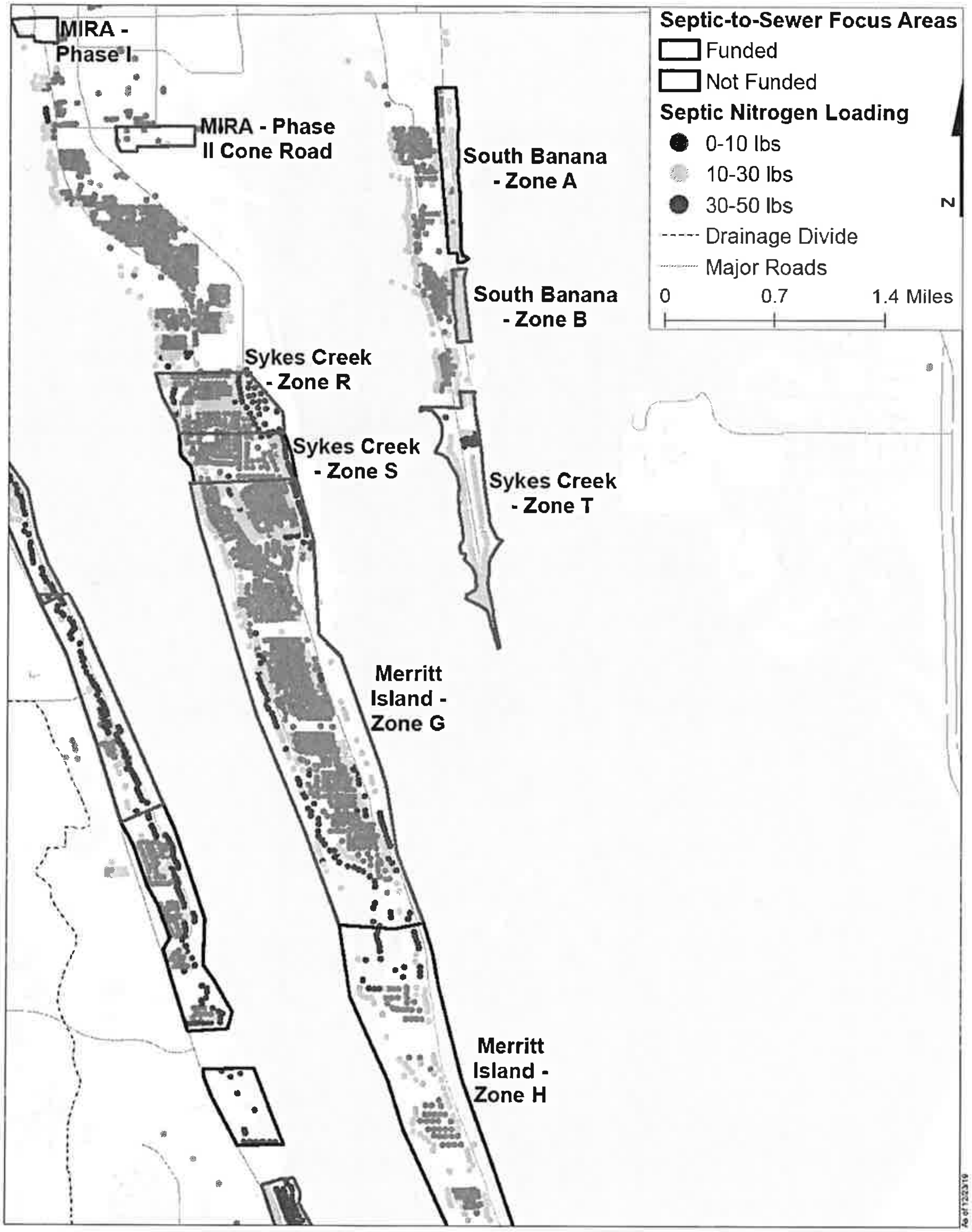


Figure 4-2: Map of Locations for Septic System Removal Projects in Central Banana River Lagoon

Figure 4-2 Long Description

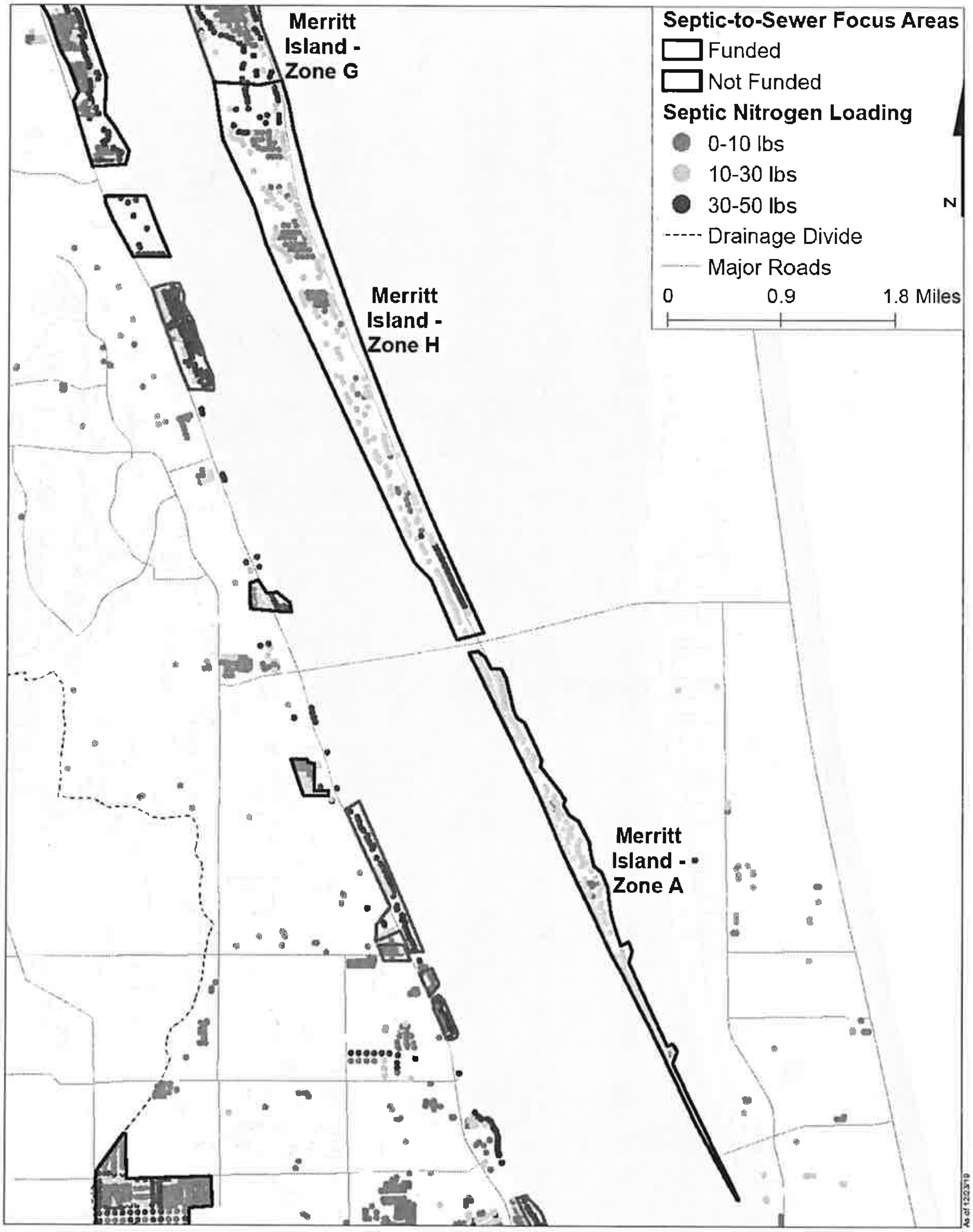


Figure 4-3: Map of Locations for Septic System Removal Projects in Southern Banana River Lagoon

Figure 4-3 Long Description

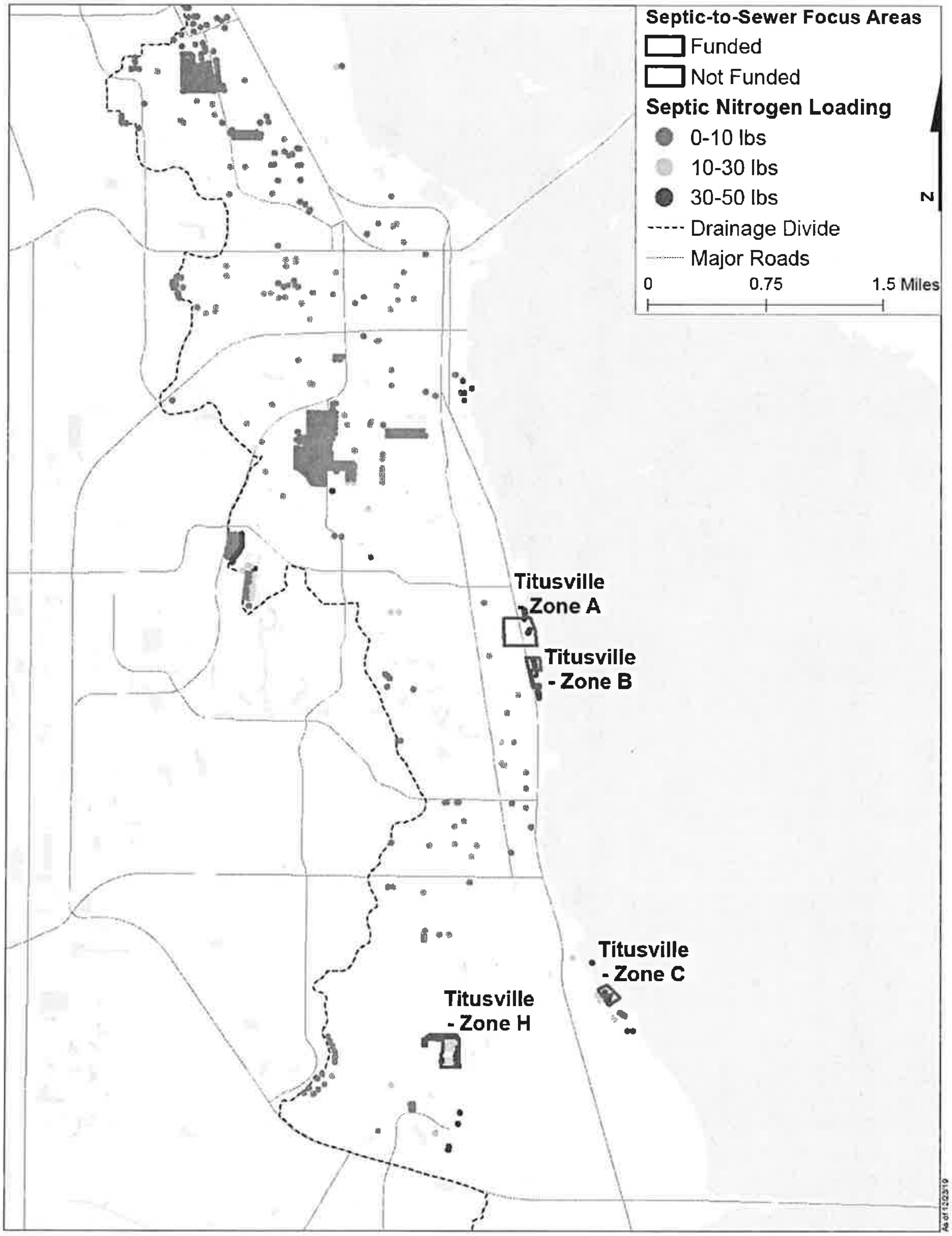


Figure 4-4: Map of Locations for Septic System Removal Projects in Northern North IRL

Figure 4-4 Long Description

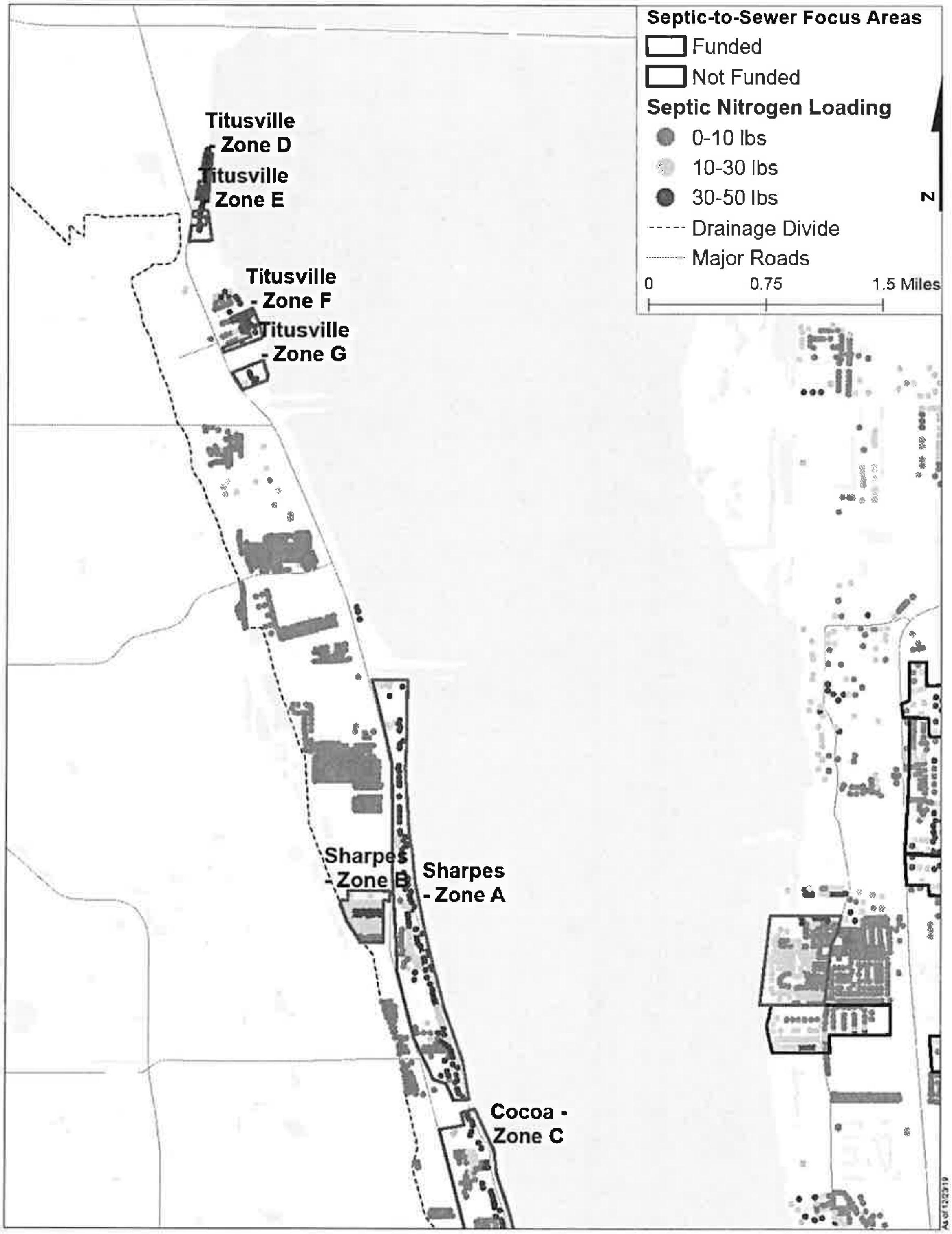


Figure 4-5: Map of Locations for Septic System Removal Projects in North-Central North IRL

Figure 4-5 Long Description

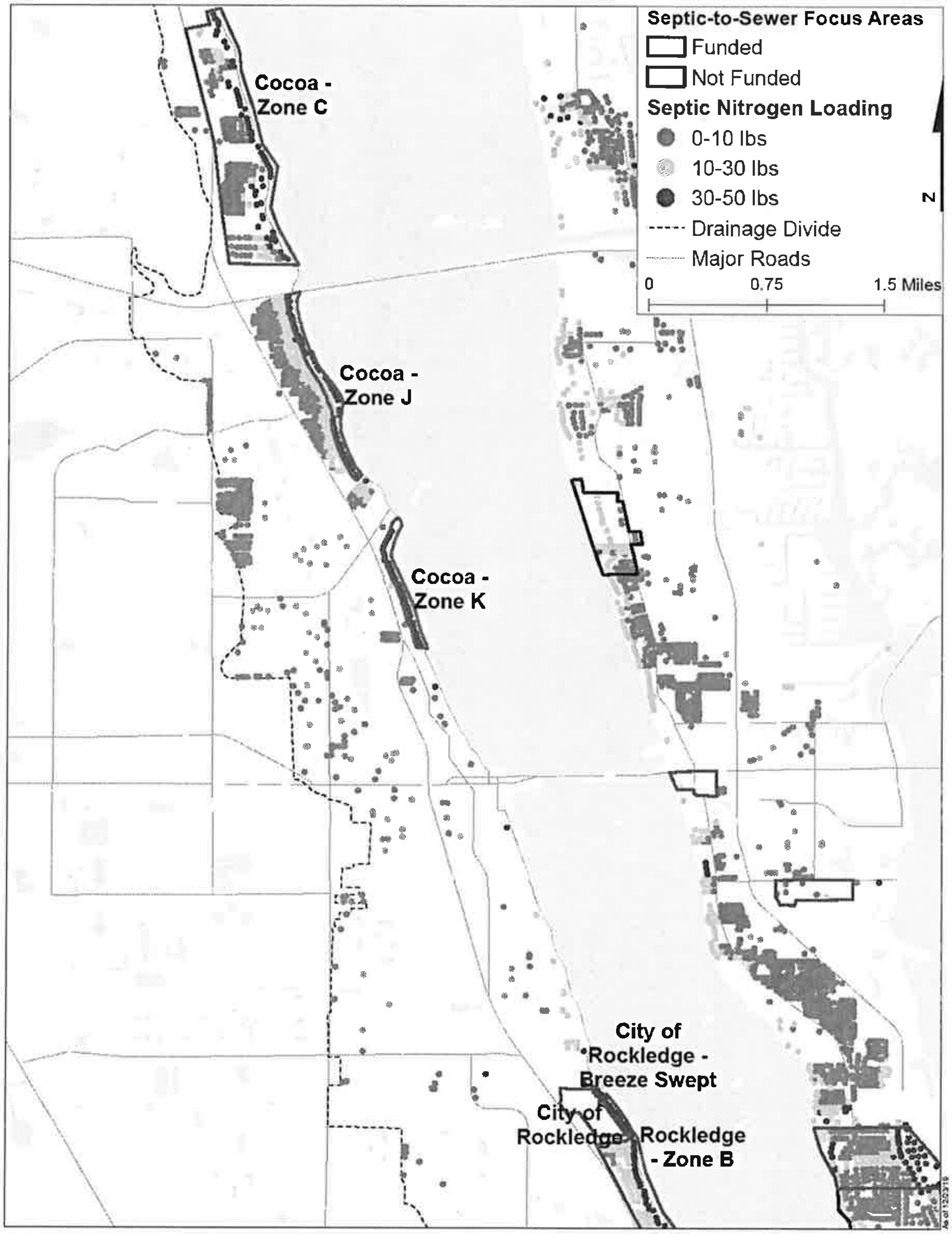


Figure 4-6: Map of Locations for Septic System Removal Projects in Central North IRL

Figure 4-6 Long Description

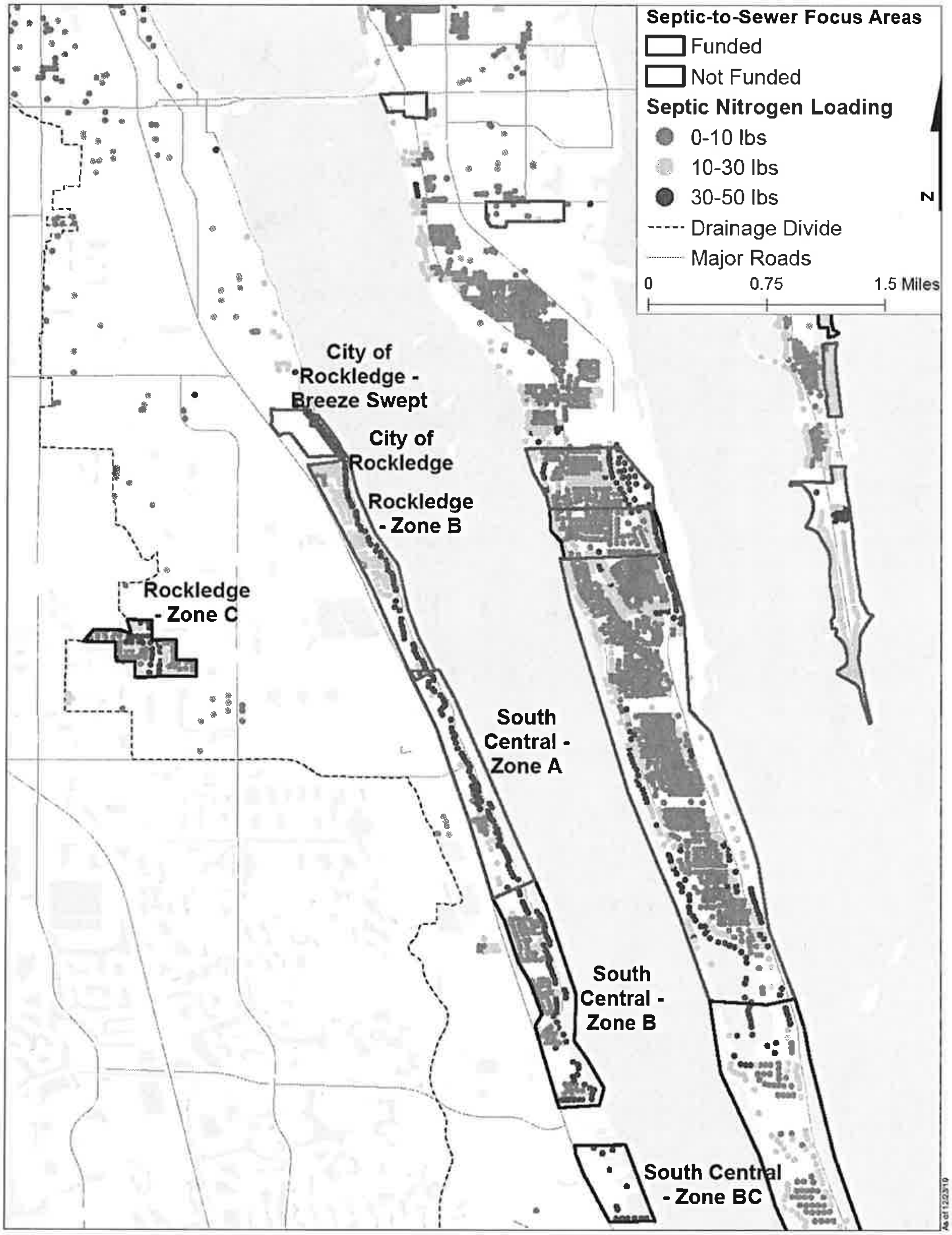


Figure 4-7: Map of Locations for Septic System Removal Projects in South-Central North IRL

Figure 4-7 Long Description

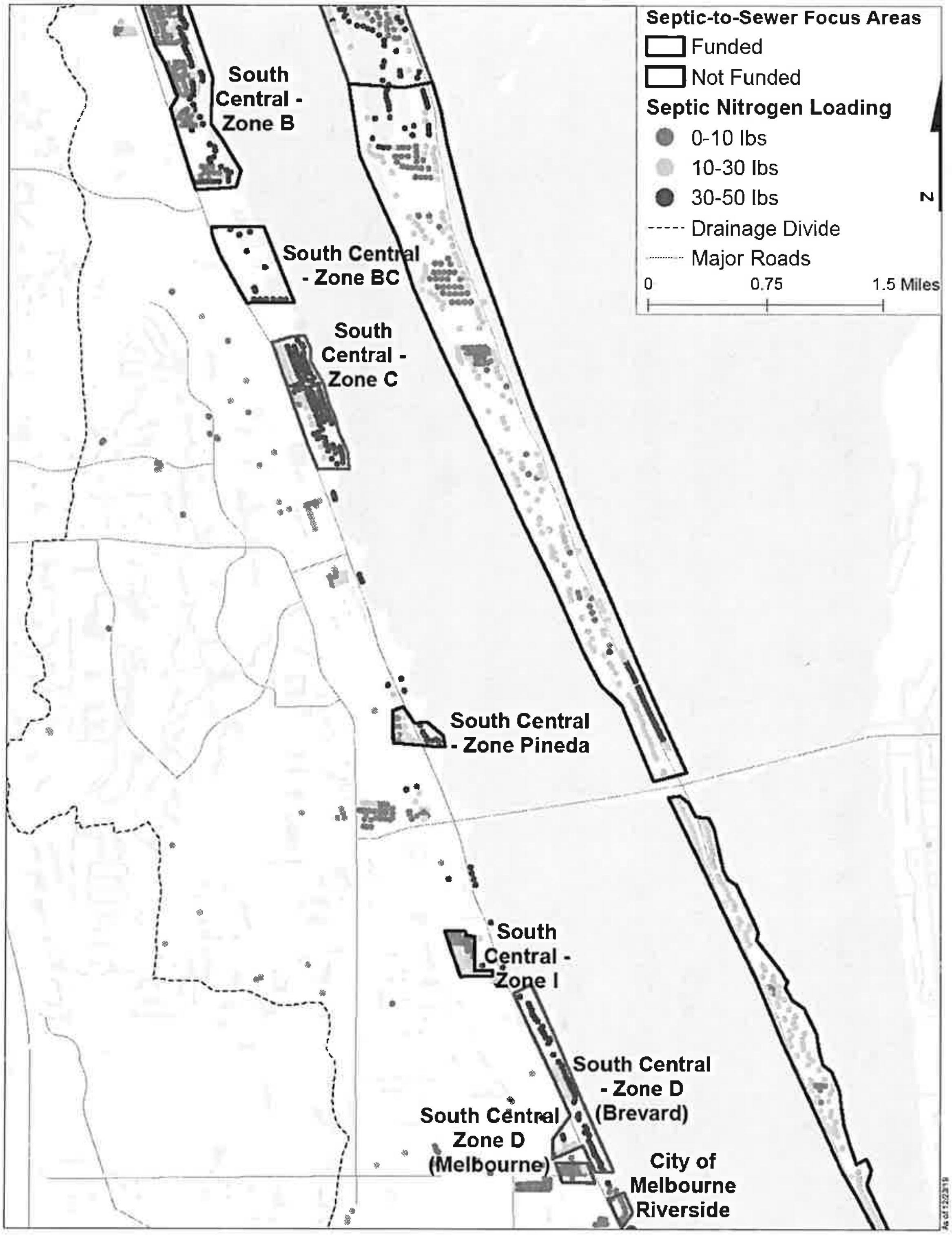


Figure 4-8: Map of Locations for Septic System Removal Projects in Southern North IRL

Figure 4-8 Long Description

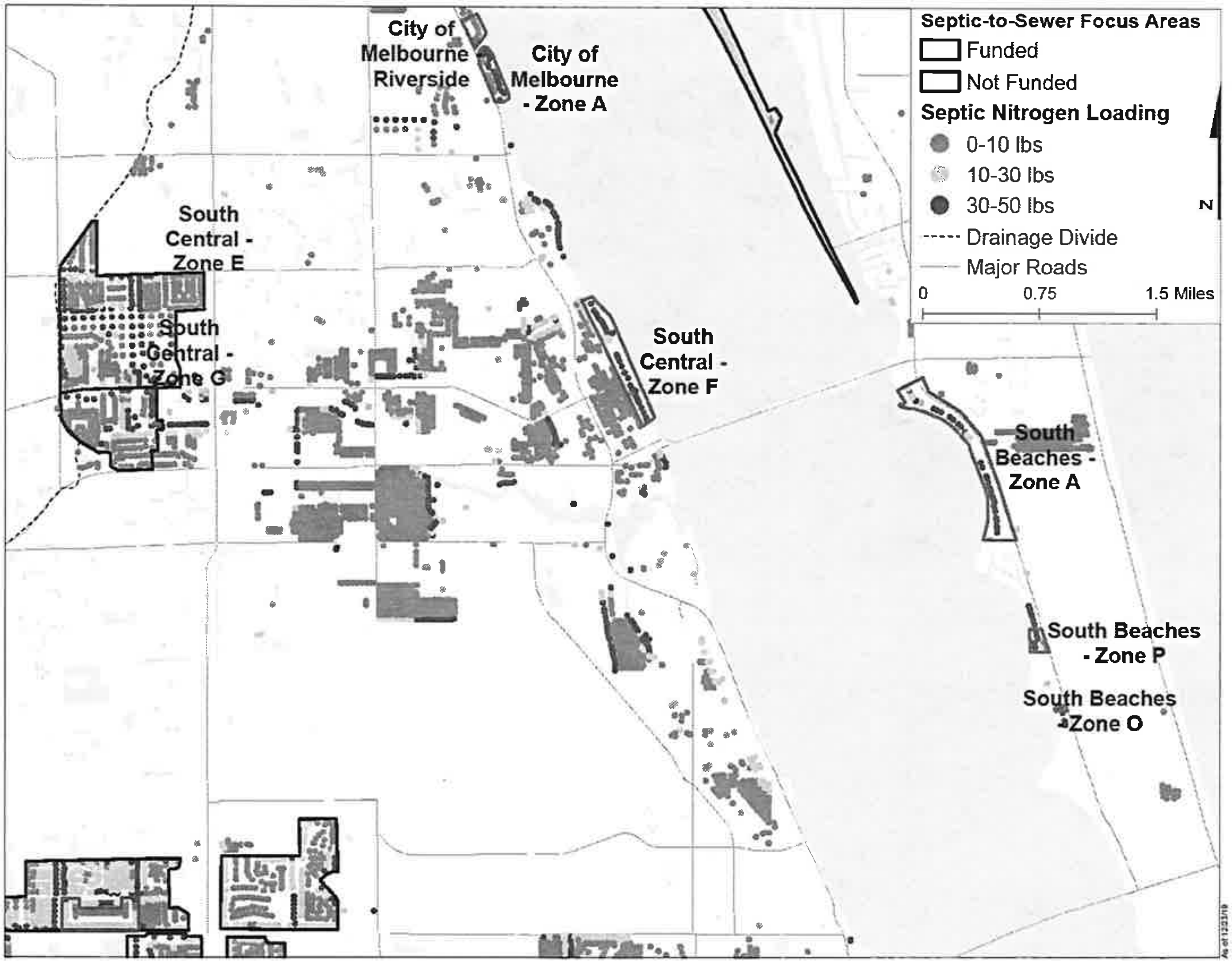


Figure 4-9: Map of Locations for Septic System Removal Projects in South North IRL

Figure 4-9 Long Description

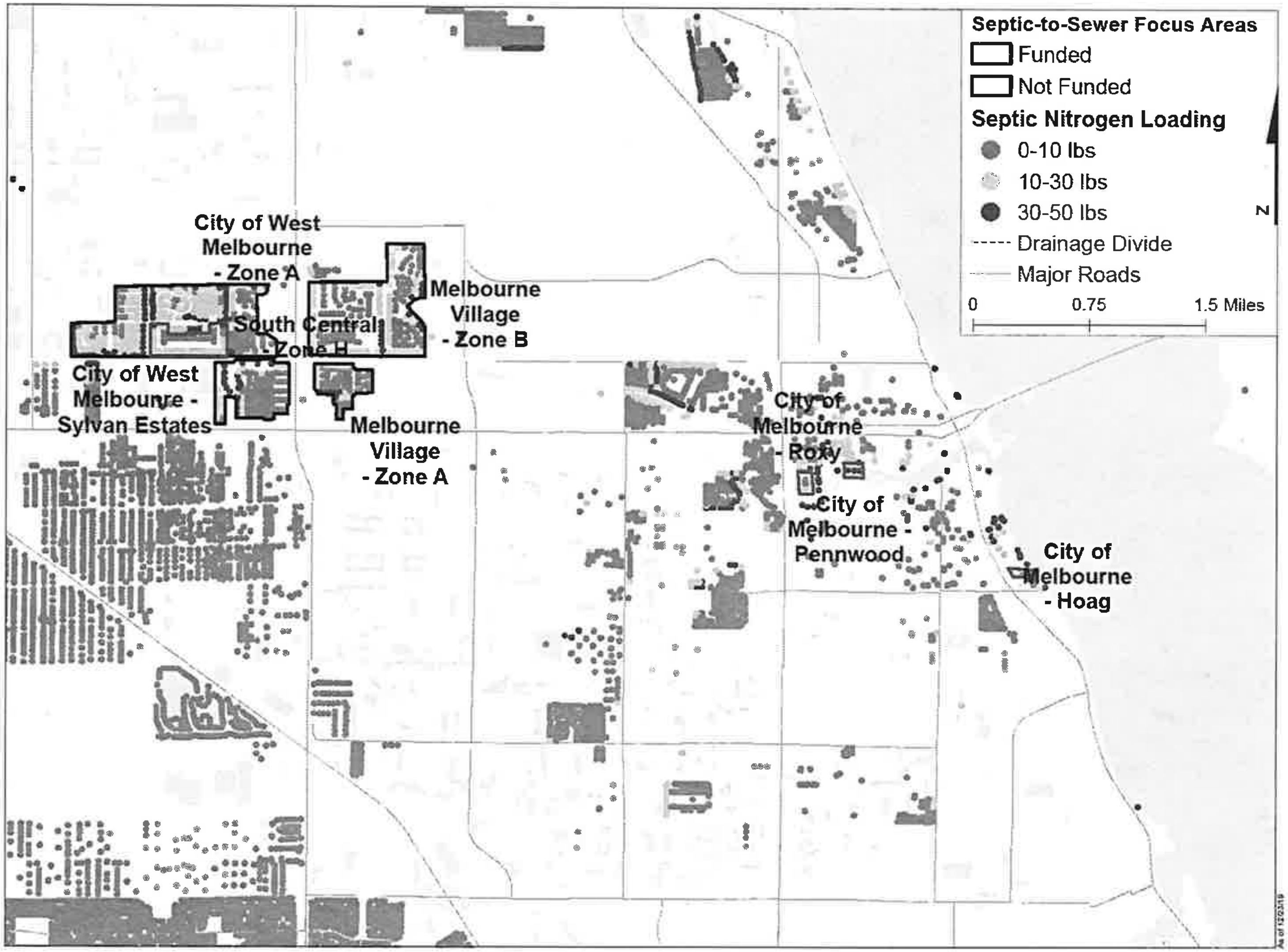


Figure 4-10: Map of Locations for Septic System Removal Projects in Northern Central IRL

Figure 4-10 Long Description

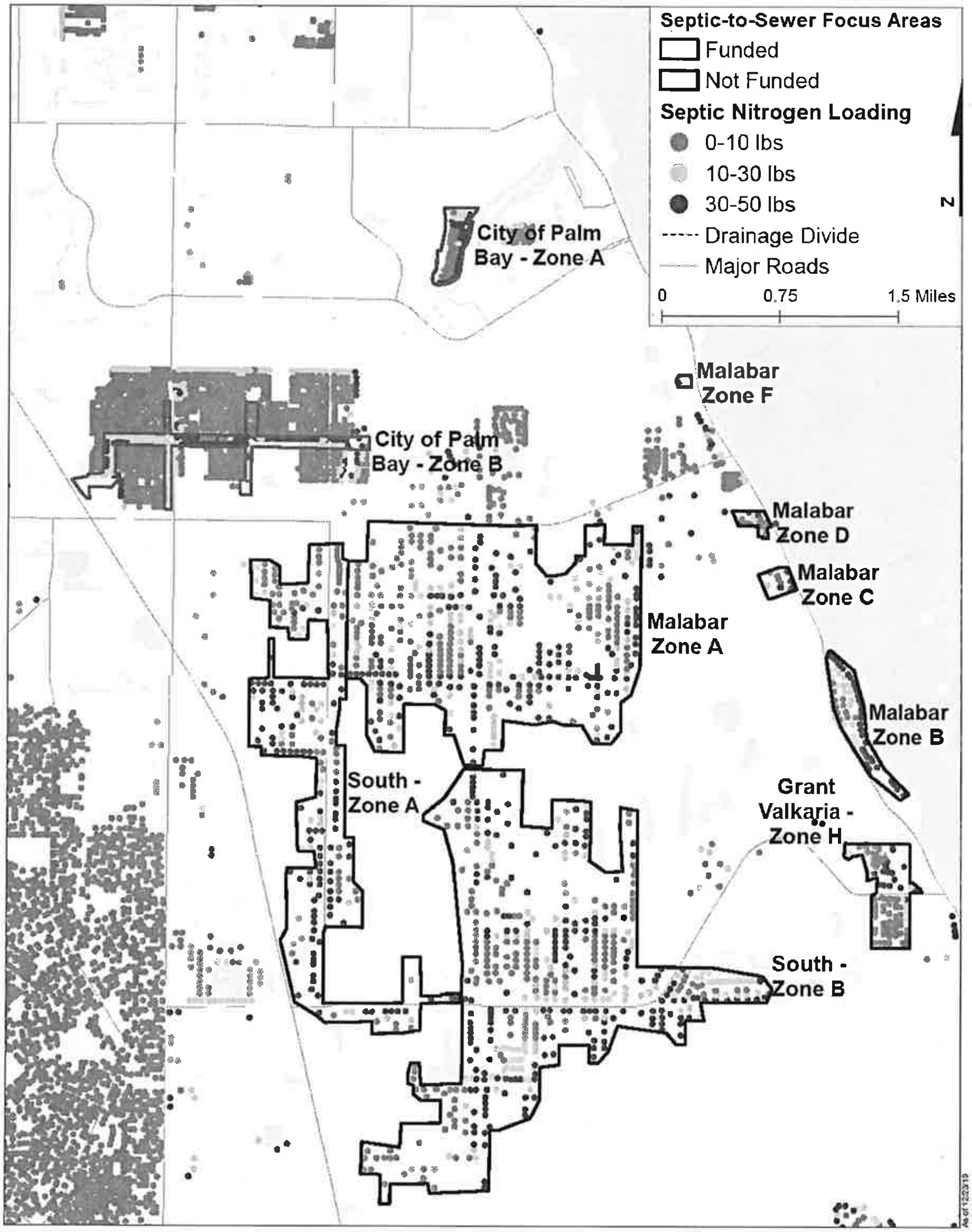


Figure 4-11: Map of Locations for Septic System Removal Projects in North-Central Central IRL

Figure 4-11 Long Description

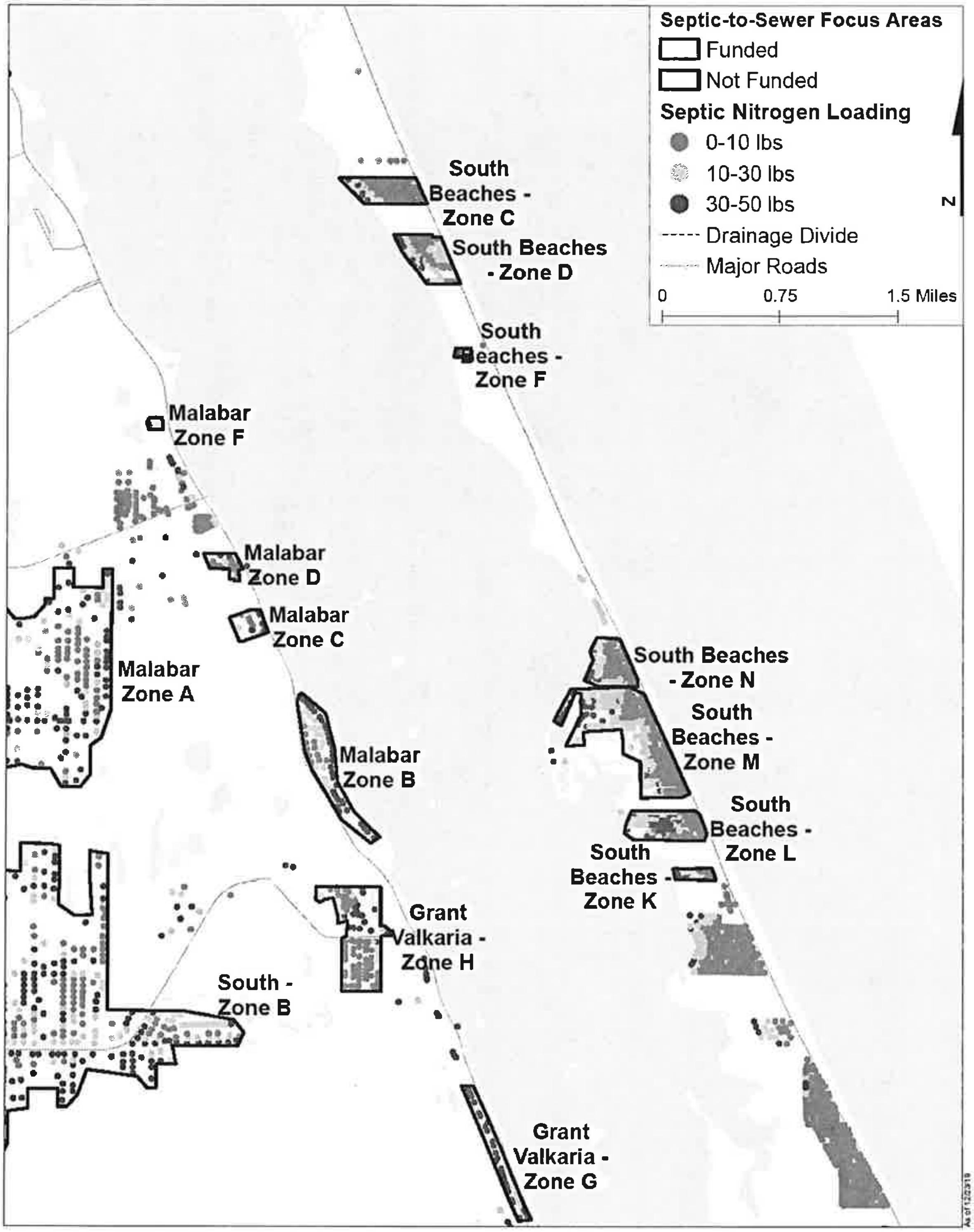


Figure 4-12: Map of Locations for Septic System Removal Projects in South-Central Central IRL

Figure 4-12 Long Description

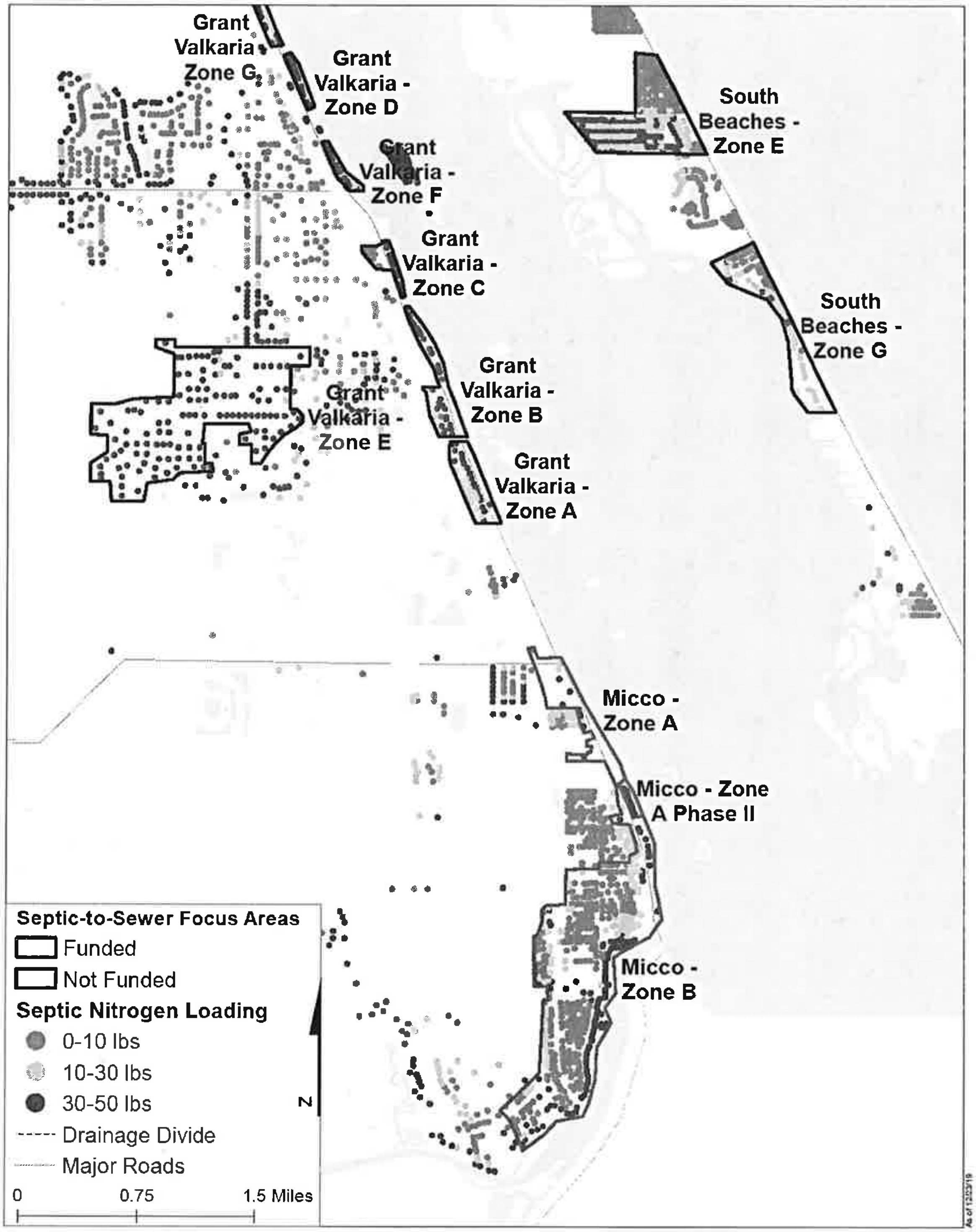


Figure 4-13: Map of Locations for Septic System Removal Projects in South Central IRL

Figure 4-13 Long Description

Figure 4-14: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in North Brevard County

Figure 4-14 Long Description

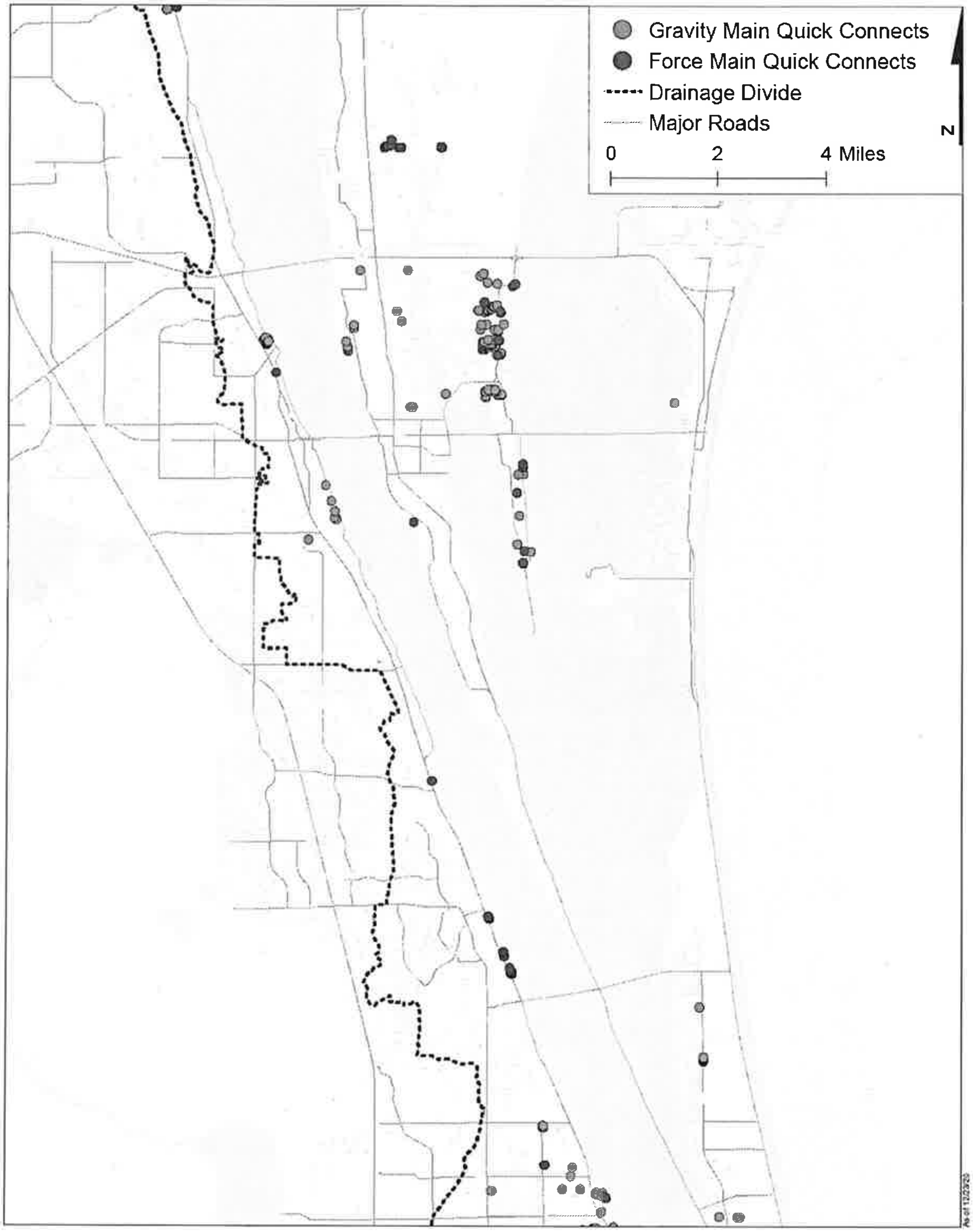


Figure 4-15: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in Central Brevard County

Figure 4-15 Long Description

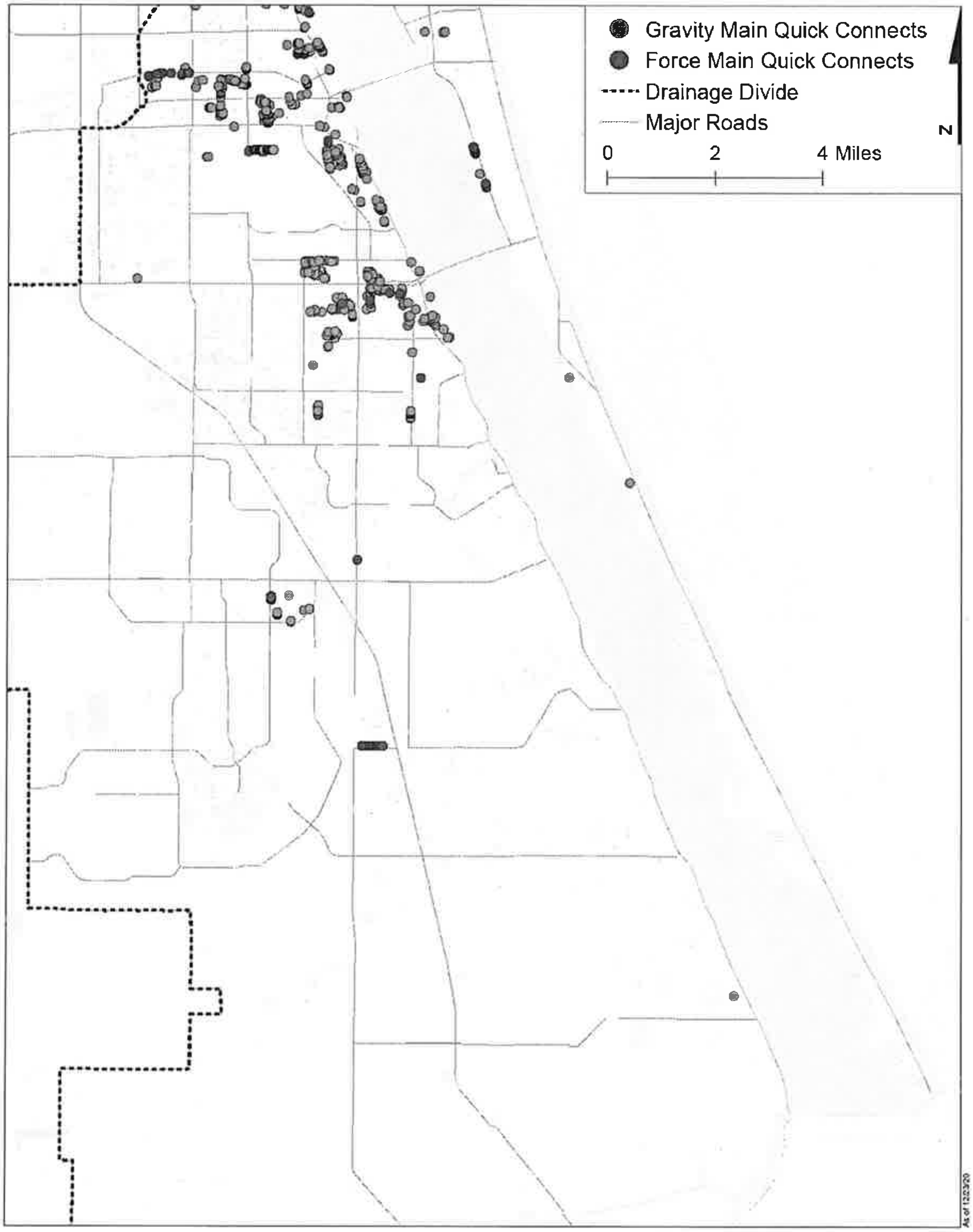


Figure 4-16: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in South Brevard County

Figure 4-16 Long Description

Septic System Upgrades
In locations where providing sewer service is not feasible due to distance from sewer infrastructure, facility capacity, or insufficient density of high-risk systems, there are options to upgrade the highest risk septic systems to increase the nutrient and pathogen removal efficiency. In recent years, research has been conducted on passive treatment systems, which provide significant treatment efficiencies without monthly sewer fees or highly complex maintenance needs for mechanical features.

In July 2018, Florida Department of Health adopted new rules that allow for In-Ground Nitrogen-Reducing Biofilters under the drainfield of septic systems (**Figure 4-17**). This passive nitrogen-reducing technology is a result of the Florida Onsite Sewage Nitrogen Reduction Strategies project and the Springs and Aquifer Protection Act. Pilot projects to install this new system are currently in progress throughout the state and Brevard County is a participating partner in these initial installations. This passive INRB is expected to remove 65% of nitrogen from the effluent and cost an extra $4,000 above the typical costs of a conventional septic system. This system requires 51" of soil above the groundwater and, therefore, may not be appropriate in areas with shallow groundwater.

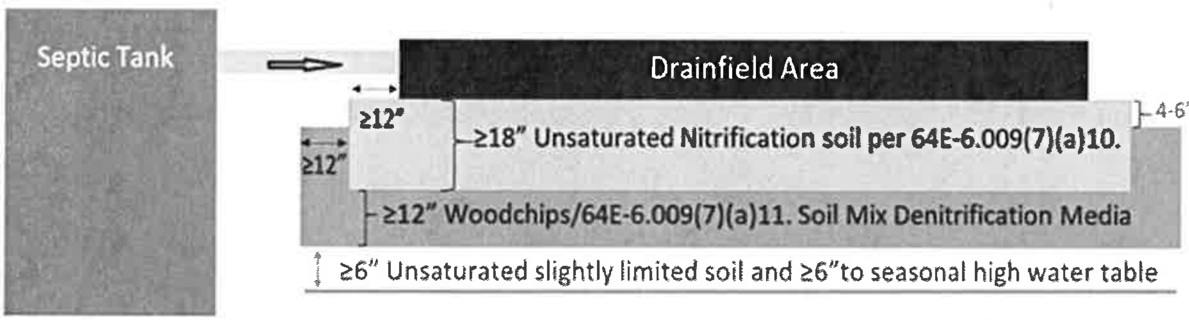


Figure 4-17: Example In-Ground Nitrogen-Reducing Biofilters Septic System

The current ruling by Florida Department of Health only allows woodchips within the denitrification layer of this system; however, other biosorption activated media can also enhance nutrient and bacterial removal before the effluent reaches the drainfield or groundwater and potentially remove more than 65% of nitrogen from effluent. A test of the biosorption activated media removal capacity was conducted at Florida's Showcase Green Envirohome in Indialantic, Florida. This test location is a residential site built with stormwater, graywater, and wastewater treatment in a compact footprint onsite (Wanielista et al. 2011). The media used in this study was Bold & Gold®, which is a patented blend of mineral materials, sand, and clay. In this study, the effluent to the septic tank was evenly divided between a sorption filter media bed/conventional drainfield (innovative system) and to a conventional drainfield. The study found that the TN and TP removal efficiencies were 76.9% and 73.6%, respectively, for the Bold & Gold plus drainfield system, which was significantly higher than the 45.5% TN removal and 32.1% TP removal from a conventional drainfield alone.

In areas where septic systems are in close proximity to a surface waterbody but are not in a location where connection to the sewer system is feasible, adding biosorption activated media to the drainfield or upgrading to the passive nitrogen removing systems could be used to retrofit the existing septic systems. The estimated cost for these retrofits was increased from $16,000 per septic system in the original plan to $18,000 each in the 2019 Plan Update. Any operations and maintenance costs associated with these upgrades, once installed, will be the responsibility of the owner. To be conservative and to match the Florida Department of Health rule, the estimates of the TN reductions that could be achieved are based on an efficiency of 65%

removal, which is the average efficiency from the two studies described above that tested biosorption activated media in the drainfield.

In areas where the In-Ground Nitrogen-Reducing Biofilters system or biosorption activated media retrofits are not appropriate, National Sanitation Foundation 245 certified aerobic treatment units would be the best option. National Sanitation Foundation 245 certification verifies that these advanced septic systems remove at least 50% of nitrogen within the septic tank, although some systems have been shown to remove up to 80% of nitrogen. The drainfield is credited with removing another 15% of nitrogen, which brings the total nitrogen removed by the advanced septic system to 65%. Due to the electrical plumbing requirements of aerobic treatment units, the owner is required to have a maintenance agreement with a septic company and an operating permit from the Florida Department of Health.

There are options for other types of distributed onsite sewage treatment systems that are approved by the Florida Department of Environmental Protection as miniature sewage treatment plants sized for residential and commercial use. These systems provide additional opportunities to improve nutrient removal from sites where connection to central sewer is not feasible and are eligible options for septic system upgrades as part of this plan. Both the Save Our Indian River Lagoon Project Plan and Springs and Aquifer Protection Act have highlighted the need for other wastewater options that have less impact on surface water and groundwater. Brevard County will continue to vet these options as they become available in Florida.

To prioritize the septic systems for upgrade, the scoring matrix used in the original Save Our Indian River Lagoon Project Plan (see **Appendix D**) was replaced in the 2019 Update based on ArcGIS-Based Nitrate Load Estimation Toolkit modeling performed during determination of the Nitrogen Reduction Overlay area adopted in the Countywide Septic Ordinance, as noted above.

The 400 septic systems with the highest loading in each sub-lagoon are recommended for retrofit upgrades to reduce the impacts of these septic systems on the waterbodies. The costs and nutrient reductions by sub-lagoon are shown in **Table 4-24**. The locations of these septic system upgrades are shown in **Figure 4-18**, **Figure 4-19**, and **Figure 4-20**. This upgrade opportunity addresses 2% of the septic systems in the IRL drainage basin.

In some circumstances, properties qualified for septic system upgrade funding may be near a sewer line. These septic upgrade funds can be used to connect the qualified property to sewer as this option results in a greater reduction in nitrogen loading to the lagoon.

Table 4-24: Septic Tank Upgrades and Costs for Highest Priority Septic Systems

Sub-lagoon	Number of Lots	Cost	TN Load (lbs/yr)	TN Reductions (lbs/yr)	Cost per Pound per Year of TN
Banana River Lagoon*	100	$1,800,000	3,868	1,934	$930
North IRL*	586	$10,548,000	27,713	13,857	$761
Central IRL*	939	$16,902,000	44,380	22,190	$762
Total	***1,625***	***$29,250,000***	***75,961***	***37,980***	***$770 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

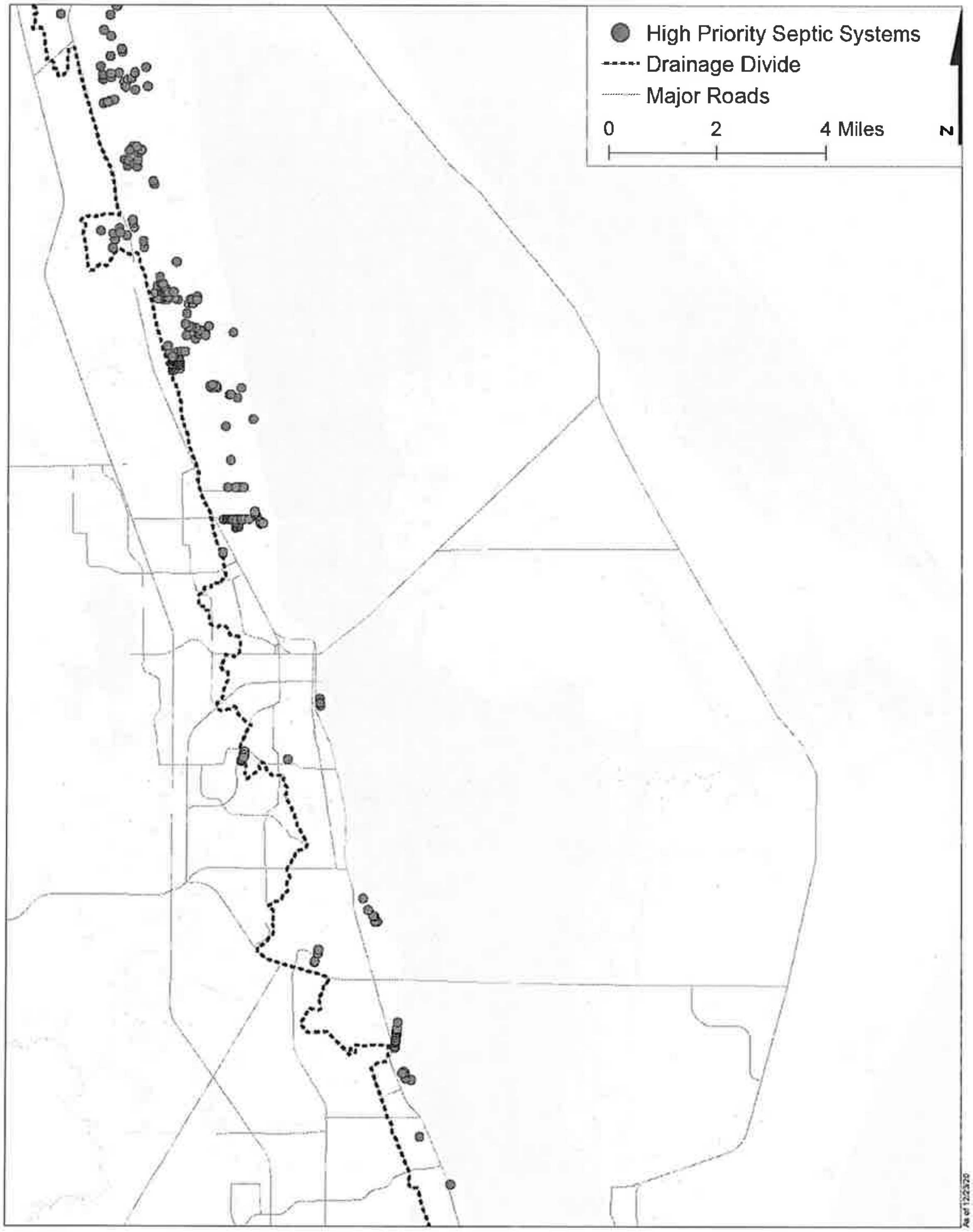


Figure 4-18: Map of Locations for Septic System Upgrades in North Brevard County

Figure 4-18 Long Description

Figure 4-19: Map of Locations for Septic System Upgrades in Central Brevard County

Figure 4-19 Long Description

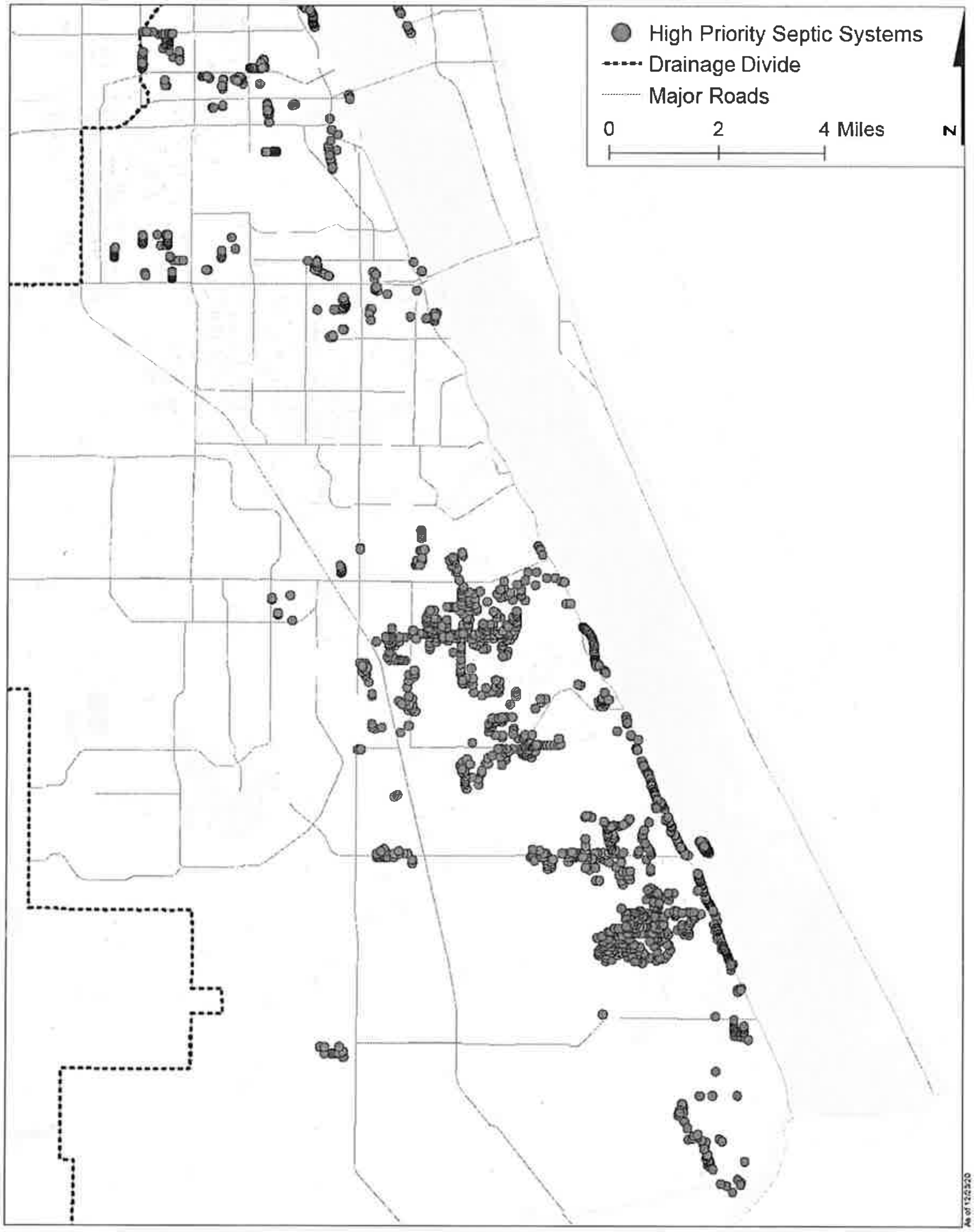


Figure 4-20: Map of Locations for Septic System Upgrades in South Brevard County

Figure 4-20 Long Description

4.1.7 Stormwater Treatment

Stormwater runoff contributes 33.6% of the external TN loading and 43.4% of the external TP loading to the lagoon annually.

Stormwater runoff from urban areas carries pollutants that affect surface waters and groundwater. These pollutants include nutrients, pesticides, oil and grease, debris and litter, and sediments. In Brevard County, there are more than 1,500 stormwater outfalls to the IRL.

There are a variety of best management practices that can be used to capture and treat stormwater to remove or reduce these pollutants before the stormwater runoff reaches a waterbody or infiltrates to the groundwater. Potential stormwater best management practices that could help restore the IRL system include:

- Traditional best management practices – These best management practices are the typical practices that are used to treat stormwater runoff and include wet detention ponds, retention, swales, dry detention, baffle boxes, stormwater reuse, alum injection, street sweeping, catch basin inserts/inlet filters, floating islands/managed aquatic plant systems. Descriptions of these traditional best management practices and expected TN and TP efficiencies are shown in **Table 4-25**.
- Low impact development/green infrastructure – These types of best management practices use natural stormwater management techniques to minimize runoff and help prevent pollutants from getting into stormwater runoff. These best management practices address the pollutants at the source so implementing them can help decrease the size of traditional retention and detention basins and can be less costly than traditional best management practices (Institute of Food and Agricultural Sciences 2016). Descriptions of low impact development and green infrastructure best management practices and estimated efficiencies are shown in **Table 4-26**.
- Denitrification best management practices – These best management practices use a soil media, known as biosorption activated media to increase the amount of denitrification that occurs, which increases the amount of TN and TP removed. Biosorption activated media includes mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols. Additional details about denitrification best management practices are included below.
- Best management practices to reduce baseflow intrusion – These projects are modifications to existing best management practices help reduce intrusion of captured groundwater baseflow into stormwater drainage systems. These best management practices include backfilling canals so that they do not cut through the baseflow, modifying canal cross-sections to maintain the same storage capacity while limiting the depth, installing weirs to control the water levels in the best management practice, or adding a cutoff wall to prevent movement into the baseflow.
- Re-diversion to the St. Johns River – There are portions of the current IRL Basin that historically flowed towards the St. Johns River. By re-diverting these flows back to the St. Johns River, the excess stormwater runoff, as well as the additional freshwater inputs, to the IRL would be removed. The re-diversion projects would include a treatment component so that the runoff is treated before being discharged to the St. Johns River. The St. Johns River Water Management District has taken the lead on large-scale projects while the County has re-diverted more than 400 acres in the Crane Creek basin and partnered with the St. Johns River Water Management District to increase re-diversion from the Melbourne-Tillman Water Control District canal system.

Table 4-25: Traditional Stormwater Best Management Practices with TN and TP Removal Efficiencies

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Wet detention ponds	Permanently wet ponds that are designed to slowly release a portion of the collected stormwater runoff through an outlet structure. Recommended for sites with moderate to high water table conditions. Provide removal of both dissolved and suspended pollutants through physical, chemical, and biological processes.	8%-44%	45%-75%	Florida Department of Environmental Protection et al. 2010
Off-line retention	Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does not flow into the retention system storing the initial volume of stormwater.	40%-84%	40%-84%	Harper et al. 2007
On-line retention and swales	Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does flow through the retention system that stores the initial volume of stormwater.	30%-74%	30%-74%	Harper et al. 2007
Dry detention	Designed to store a defined quantity of runoff and slowly release it through an outlet structure to adjacent surface waters. After drawdown of the stored runoff is completed, the storage basin does not hold any water. Used in areas where the soil infiltration properties or seasonal high-water table elevation will not allow the use of a retention basin.	10%	10%	Harper et al. 2007
2nd generation baffle box	Box chambers with partitions connected to a storm drain. Water flows into the first section of the box where most pollutants settle out. Overflows into the next section to allow further settling. Water ultimately overflows to the stormwater pipe. Floating trays capture leaves, grass clippings, and litter to prevent them from dissolving in the stormwater.	19.05%	15.5%	GPI 2010
Stormwater reuse	Reuse of stormwater from wet ponds for irrigation. Compare volume going to reuse to total volume of annual runoff to pond.	Amount of water not discharged annually	Amount of water not discharged annually	Not applicable
Alum injection	Chemical treatment systems that inject aluminum sulfate into stormwater systems to cause coagulation of pollutants.	50%	90%	Harper et al. 2007
Street sweeping	Cleaning of pavement surfaces to remove sediments, debris, and trash deposited by vehicle traffic. Prevents these materials from being introduced into the stormwater system.	TN content in dry weight of material collected annually	TP content in dry weight of material collected annually	University of Florida 2011
Catch basin inserts/inlet filters	Devices installed in storm drain inlets to provide water quality treatment through filtration of organic debris and litter, settling of sediment, and adsorption of hydrocarbon by replaceable filters.	TN content in dry weight of material collected annually	TP content in dry weight of material collected annually	University of Florida 2011

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Managed Aquatic Plant System	Aquatic plant-based best management practices that remove nutrients through a variety of processes related to nutrient uptake, transformation, and microbial activities.	10% with 5% pond coverage	10% with 5% pond coverage	Florida Department of Environmental Protection 2018

Table 4-26: Low Impact Development and Green Infrastructure Best Management Practices and TN and TP Removal Efficiencies

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Permeable pavement	Hard, yet penetrable, surfaces reduce runoff by allowing water to move through them into groundwater below (Institute of Food and Agricultural Sciences 2016).	30%-74%	30%-74%	Harper et al. 2007
Bioswales	An alternative to curb and gutter systems, bioswales convey water, slow runoff, and promote infiltration. Swales may be installed along residential streets, highways, or parking lot medians (Institute of Food and Agricultural Sciences 2016). Must be designed for conveyance, greater in length than width, have shallow slopes, and include proper landscaping.	38%-89%	9%-80%	Florida Department of Environmental Protection 2014
Green roofs	These systems can significantly reduce the rate and quantity of runoff from a roof and provide buildings with thermal insulation and improved aesthetics (Institute of Food and Agricultural Sciences 2016). Retention best management practice covered with growing media and vegetation that enables rainfall infiltration and evapotranspiration of stored water. Including a cistern capture, retain, and reuse water adds to effectiveness.	45% (without cistern) 60%-85% (with cistern)	Not applicable	Florida Department of Environmental Protection 2014
Bioretention basins/rain gardens	Small vegetated depressions in the landscape collect and filter stormwater into the soil (Institute of Food and Agricultural Sciences 2016). Constructed adjacent to roof runoff and impervious areas.	30%-50%	30%-90%	Florida Department of Environmental Protection 2014
Tree boxes	Bioretention systems with vertical concrete walls designed to collect/retain specified volume of stormwater runoff from sidewalks, parking lots and/or streets. Consists of a container filled with a soil mixture, a mulch layer, under-drain system, and shrub or tree (Florida Department of Environmental Protection 2014).	38%-65%	50%-80%	Florida Department of Environmental Protection 2014

Due to the importance of treating dry season baseflow to the lagoon, Brevard County has found that ditch denitrification is the most cost-effective best management practice. Biosorption activated media can be added in existing best management practices or to new best management practices to improve the nutrient removal efficiency. The removal efficiencies of using biosorption activated media in various stormwater treatment projects (Wanielista 2015) are summarized in **Table 4-27**. While the efficiencies in **Table 4-27** are only for Bold & Gold, other types of biosorption activated media may be used in a project, if there is Florida-specific information available on the removal efficiencies for that media.

Table 4-27: TN and TP Removal Efficiencies for Biosorption Activated Media

Location in Best Management Practice Treatment Train	Material	TN Removal Efficiency	TP Removal Efficiency
Bold & Gold as a first best management practice, example up-flow filter in baffle box and a constructed wetland	Expanded Clay Tire Chips	55%	65%
Bold & Gold in up-flow filter at wet pond and dry basin outflow	Organics Tire Chips Expanded Clay	45%	45%
Bold & Gold in inter-event flow using up-flow filter at wet pond and down-flow filter at dry basin	Expanded Clay Tire Chips	25%	25%
Bold & Gold down-flow filters 12-inch depth at wet pond or dry basin pervious pavement, tree well, rain garden, swale, and strips	Clay Tire Crumb Sand and Topsoil	60%	90%

Note: From Wanielista 2015

The County's proposed total maximum daily loads include two components: (1) a total maximum daily load for the five-month period (January – May) that is critical for seagrass growth, and (2) a total maximum daily load for the remaining seven months of the year to avoid algal blooms and protect healthy dissolved oxygen levels. In 2019, Brevard County updated the estimates for nutrient loading entering the lagoon through each stormwater ditch and outfall. The update incorporated more recent land use data, more recent rainfall and evapotranspiration data, and improved stormwater infrastructure mapping and topography. There are more than 2,000 hydrologically distinct catchment basin areas within the lagoon watershed countywide. These connect to the lagoon through more than 1,500 stormwater ditches and structural outfalls. For the purpose of maximizing seagrass response to stormwater treatment, these new loading estimates for catchment basins were prioritized based on the amount of nutrients migrating into the stormwater system as groundwater baseflow during a five-month season found to be most critical to annual seagrass expansion or loss.

The stormwater project benefits were estimated, as follows, to ensure both components of the total maximum daily load are adequately addressed. The five-month total maximum daily load covers the dry season in this area when there is minimal rainfall and stormwater runoff; therefore, the benefits of stormwater biosorption activated media projects during this period were based only on January – May baseflow loading estimates from the Spatial Watershed Iterative Loading model. The estimated project treatment efficiencies used for January to May baseflow only are 55% for TN and 65% for TP. These projects also reduce nutrient loads during the remaining seven months of the year. To estimate annual load reduction benefits, the annual baseflow and stormwater loading estimates from the Spatial Watershed Iterative Loading model were used with a project efficiency of 45% for TN and 45% for TP. The estimated TN and TP reductions accomplished by using biosorption activated media upstream of these priority outfalls are summarized in **Table 4-28**, as well as the estimated cost per pound of TN or TP removed. A detailed list of stormwater projects, which was revised as part of this 2019 Update, is included in

Appendix E. The locations of the basins to be treated are shown in **Figure 4-21**, **Figure 4-22**, and **Figure 4-23**.

Table 4-28: Estimated TN and TP Reductions and Costs for Biosorption Activated Media Projects

Sub-lagoon	Number of Basins	Estimated Total Project Cost	TN Reductions (lbs/yr)	Cost per Pound Per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
Banana River Lagoon*	67	$14,403,300	63,737	$226	8,421	$1,710
North IRL*	98	$23,584,400	121,815	$194	16,152	$1,460
Central IRL*	10	$3,995,300	24,166	$165	3,182	$1,256
Total	***175***	***$41,983,000***	***209,718***	***$200***	***27,755***	***$1,512***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

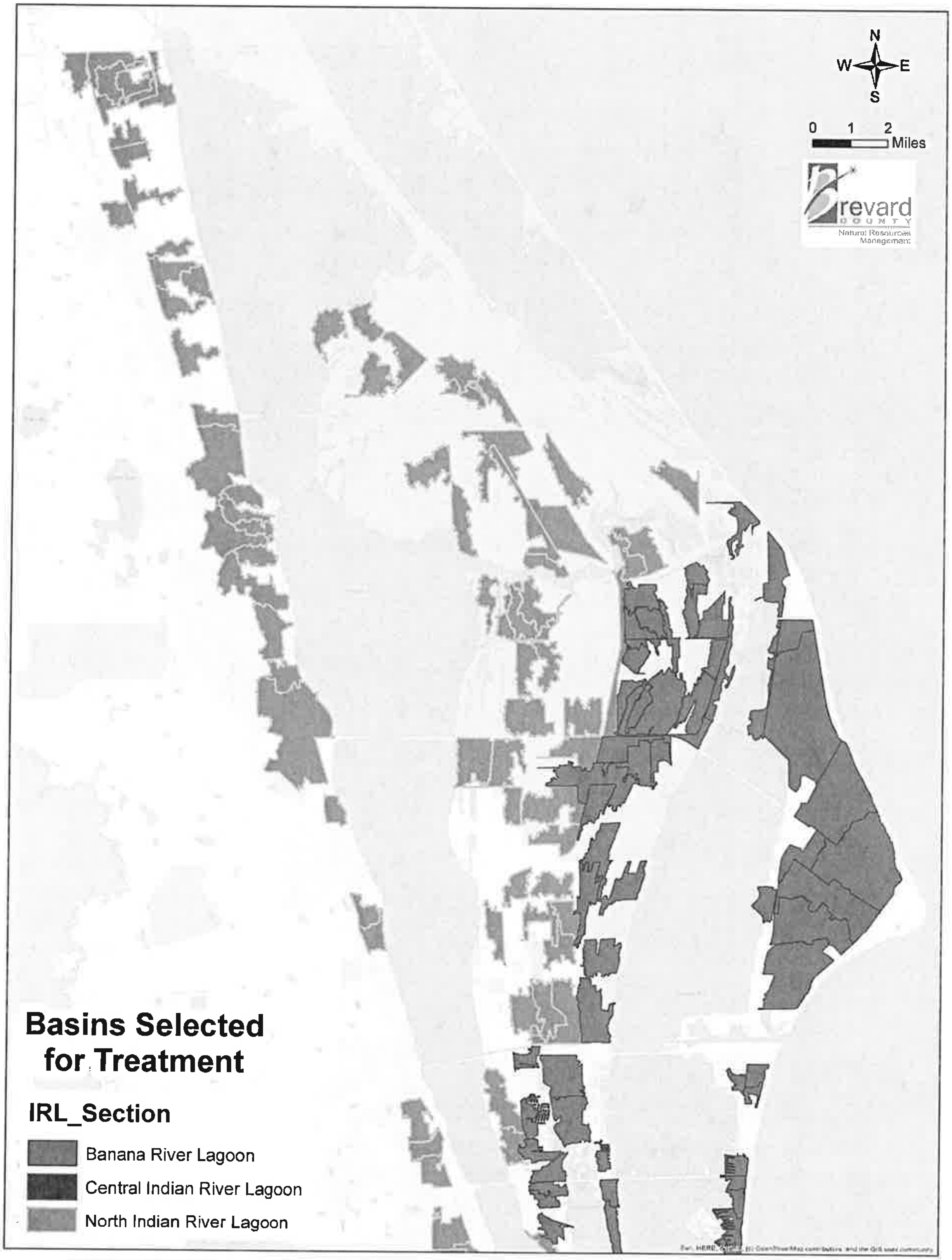


Figure 4-21: Map of Selected Stormwater Projects in North Brevard County

Figure 4-21 Long Description

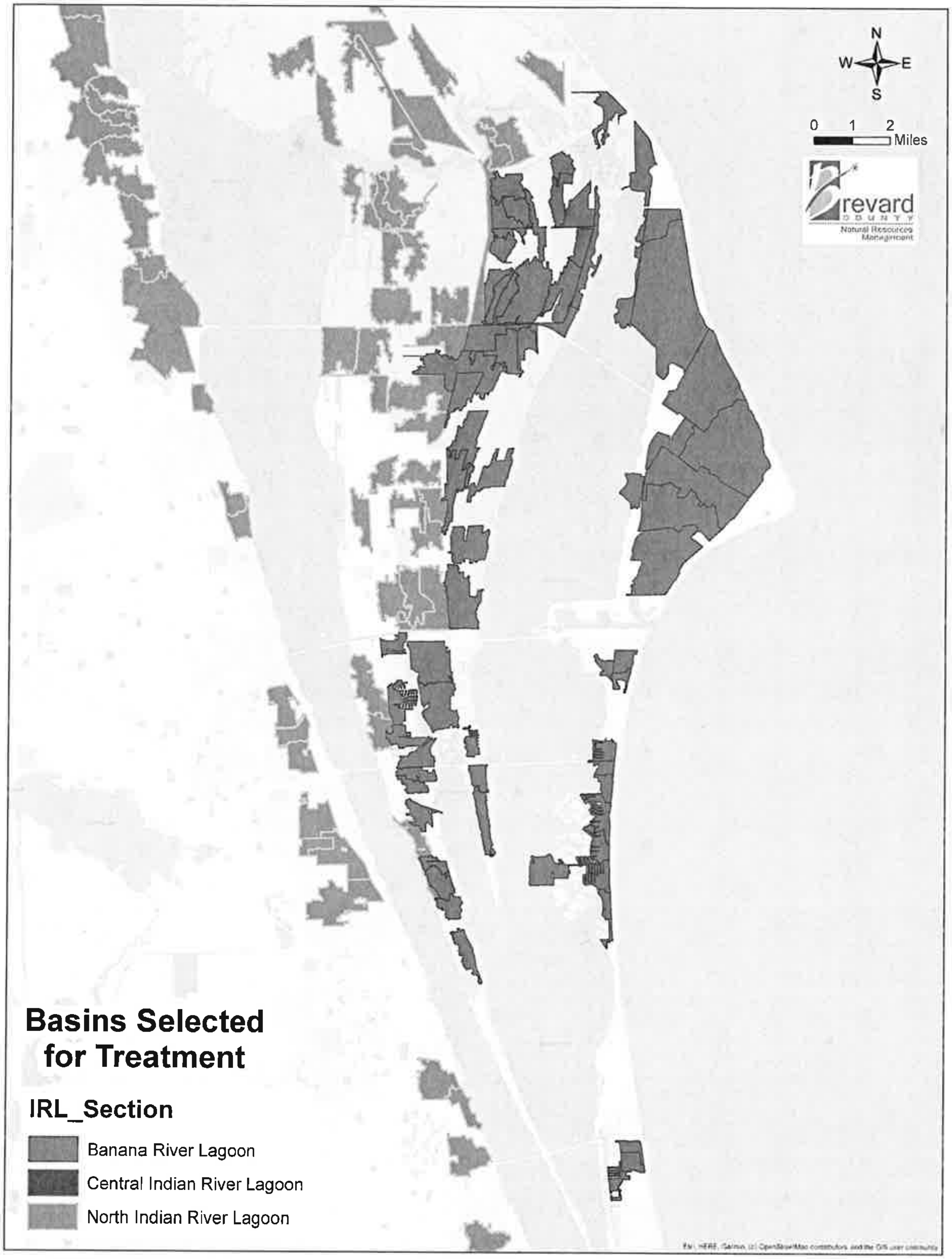


Figure 4-22: Map of Selected Stormwater Projects in Central Brevard County

Figure 4-22 Long Description

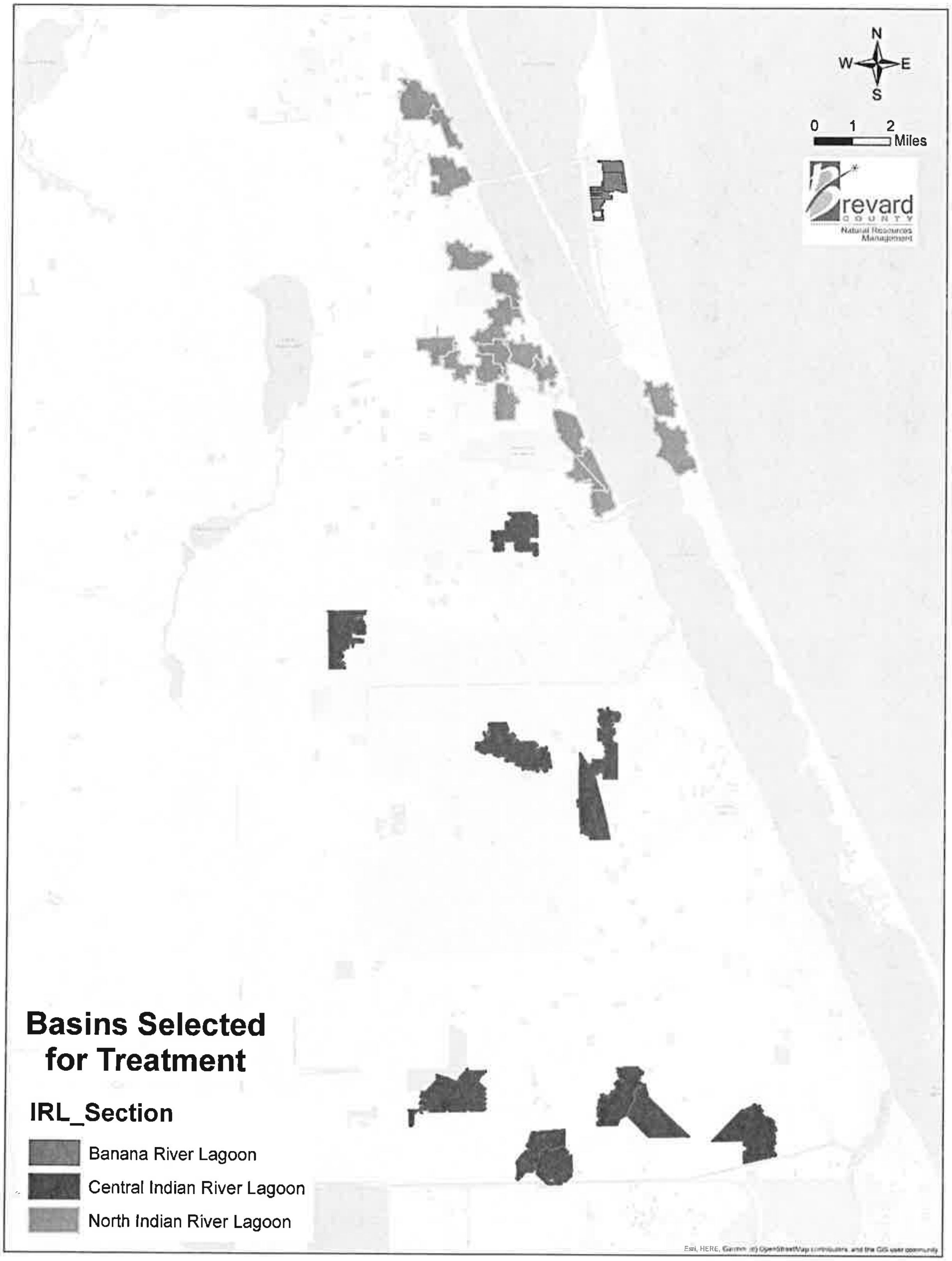


Figure 4-23: Map of Selected Stormwater Projects in South Brevard County

Figure 4-23 Long Description

4.2. Projects to Remove Pollutants

The purpose of the projects in this section is to remove pollutants that have accumulated in the lagoon. Brevard County has already begun to remove deep accumulations of muck from the lagoon bottom. Dredging to remove muck in other locations of the lagoon will continue, as well as treatment of the interstitial water when feasible. These muck removal projects have more immediate benefits on the lagoon water quality than external reduction projects because the nutrient flux is reduced as soon as muck is dredged from the system whereas it takes time for the external load reduction benefits to reach the lagoon. The County is also evaluating opportunities to use new treatment technologies to provide surface water remediation. In addition, the St. Johns River Water Management District, IRL National Estuary Program, and Florida Institute of Technology are evaluating opportunities for enhanced circulation projects, which will allow additional water to flow into the lagoon system to help remove the built-up sediments and muck.

The following sections describe the County's proposed muck removal projects, scrubbing of muck interstitial water, as well as potential surface water remediation and potential circulation enhancement projects.

4.2.1 Muck Removal (updated in 2019)

Muck flux contributes 45% of the TN and 49% of TP load to the Banana River Lagoon each year.

The muck in the lagoon increases turbidity, inhibits seagrass growth, promotes oxygen depletion in sediments and the water above, stores and releases nutrients, covers the natural bottom, and destroys healthy communities of benthic organisms (Trefry 2013). When muck is suspended within the water column due to wind or human activities such as boating, these suspended solids limit light availability and suppress seagrass growth. Even for deeper water areas without seagrass growth, muck remains a nutrient source that potentially affects a broader area of the lagoon through nutrient flux and resuspension of fine sediments and their subsequent transport. As shown in **Table 3-1,** the annual release of nutrients from decaying muck is almost as much as the annual external loading delivered by stormwater and groundwater baseflow combined. The muck deposits cover an estimated 6,700 acres of the lagoon system bottom in Brevard County (Trefry 2018).

The muck deposits in the lagoon flux nutrients that enter the water column and contribute to algal blooms and growth of macroalgae. Muck flux rates for nitrogen and phosphorus have been estimated through studies in the IRL system. For this plan, the average flux rates used are 150 pounds of TN per acre per year and 20 pounds of TP per acre per year (Trefry 2018) except where specific measurements indicate otherwise.

The focus of the muck removal projects for this plan was on large deposits of muck in big, open water sites within the lagoon itself. Several of the canal systems that directly connect to the lagoon are also included for muck removal. The goal of the muck removal is to reduce TN and TP muck flux loads by 25%, which should result in a significant improvement in water quality and seagrass extent, as well as a reduced risk of massive algal blooms and fish kills. A 70% efficiency for muck removal projects was applied. This efficiency accounts for two factors: (1) each target dredge area has less than 100% muck cover, and (2) some pockets of muck within dredged areas will inevitably be left behind regardless of the dredge technology used. In 2018 and 2019, the Florida Institute of Technology conducted evaluations of the muck deposits throughout the lagoon system for Brevard County. The updated muck acreage estimates are shown in **Table 4-29**.

Table 4-29: Muck Acreages in the IRL System

Muck Reduction Targets	Open Banana	Banana Canals	North IRL	North IRL Canals	Central IRL	Central IRL Canals	Mosquito Lagoon
Muck area (acres)	1,276	752	3,035	51	59	37	398
Muck flux (pounds of TN per year)	281,148	112,800	233,992	7,650	40,226	5,550	7,164
Funded dredging sites (acres)	223	0	251	0	0	0	0
Flux from funded dredging sites (pounds of TN per year)	123,723	0	85,325	0	0	0	0
Flux reduction from funded sites (pounds of TN per year)	86,606	0	59,728	0	0	0	0
Percent of total flux reduced by dredging the funded sites	31%	0%	26%	0%	0%	0%	0%

Using the information from the Florida Institute of Technology, Brevard County reevaluated the priority muck locations for dredging. The costs, estimated TN and TP reductions using average flux rates for Brevard County or site-specific data collected by the Florida Institute of Technology where available, and cost per pound of nutrient removed for the proposed muck dredging projects are shown in **Table 4-30** for the Banana River Lagoon, **Table 4-31** for the North IRL, and **Table 4-32** for the Central IRL. **Table 4-33** provides a summary of recommended projects. The locations of these projects are shown in **Figure 4-24** through **Figure 4-25**.

As dredging proceeds, upland input of muck components must be reduced to prevent new muck accumulation. Therefore, land-based source control measures for nutrients, organic waste, and erosion are needed. Without source controls, muck removal will need to be frequently repeated, which is neither cost-effective nor beneficial to the lagoon's health. Public awareness and commitment are needed to control future muck accumulation. Activities that contribute organic debris and sediment to stormwater and open water must be curtailed. Additional scientific assessment should be carried out to evaluate and optimize the dredging process.

Table 4-30: Banana River Lagoon Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Port Canaveral South*	420,000	55	$14,700,000	919	35,382	$415	50	1,925	$7,636
Pineda Banana River Lagoon*	195,000	28	$6,825,000	767	15,033	$454	35	686	$9,949
Patrick Air Force Base*	205,000	26	$7,175,000	357	6,497	$1,104	21	382	$18,773
Cocoa Beach Golf*^	975,000	140	$34,125,000	303	29,694	$1,149	21	2,058	$16,582
Kent Drive	50,000	13	$1,750,000	150	1,365	$1,282	20	182	$9,615
National Aeronautics and Space Administration Area	2,800,000	657	$98,000,000	150	68,985	$1,421	20	9,198	$10,654
528 East	35,000	8	$1,225,000	150	840	$1,458	20	112	$10,938
Newfound Harbor East	45,000	10	$1,575,000	150	1,050	$1,500	20	140	$11,250
70% of Banana Venetian Collector Canals/Channels	2,575,000	570	$90,125,000	150	59,850	$1,506	21	8,379	$10,756
30% of Venetian Canals/Channels	825,000	182	$28,875,000	150	19,110	$1,511	20	2,548	$11,332
Patrick Air Force Base Borrow Pit-2	135,000	29	$4,725,000	150	3,045	$1,552	20	406	$11,638
Newfound Harbor South	135,000	29	$4,725,000	150	3,045	$1,552	20	406	$11,638
Mathers Bridge Area	350,000	75	$12,250,000	150	7,875	$1,556	20	1,050	$11,667
Newfound Harbor North	90,000	19	$3,150,000	150	1,995	$1,579	20	266	$11,842
Cocoa Beach High School	195,000	41	$6,825,000	150	4,305	$1,585	20	574	$11,890
Brightwaters	235,000	48	$8,225,000	150	5,040	$1,632	20	672	$12,240
Patrick Air Force Base Borrow Pit-4	15,000	3	$525,000	150	315	$1,667	20	42	$12,500
Sunset Café	110,000	22	$3,850,000	150	2,310	$1,667	20	308	$12,500
520 Borrow Pit-1	40,000	8	$1,400,000	150	840	$1,667	20	112	$12,500

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Cape Canaveral Hospital	60,000	12	$2,100,000	150	1,260	$1,667	20	168	$12,500
520 Borrow Pit-2	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
520 Borrow Pit-3	15,000	3	$525,000	150	315	$1,667	20	42	$12,500
520 Borrow Pit-4	40,000	8	$1,400,000	150	840	$1,667	20	112	$12,500
520 Borrow Pit-5	30,000	6	$1,050,000	150	630	$1,667	20	84	$12,500
520 Borrow Pit-6	15,000	3	$525,000	150	315	$1,667	20	42	$12,500
520 Borrow Pit-7	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
Port Canaveral	265,000	25	$9,275,000	285	4,988	$1,860	14	245	$37,857

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ The Cocoa Beach Golf project is not fully funded at this time. A total of $21,350,000 is available and Brevard County is looking for options to fund the remaining $12,775,000 for dredging plus associated interstitial water treatment.

Table 4-31: North IRL Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Titusville Railroad West*	90,000	70	$3,150,000	294	14,406	$219	12	588	$5,357
National Aeronautics and Space Administration Causeway East*	285,000	34	$9,975,000	919	21,872	$456	44	1,047	$9,525
Rockledge A*	125,000	38	$4,375,000	285	7,581	$577	31	825	$5,306
Titusville Railroad East*	115,000	36	$4,025,000	214	5,393	$746	9	227	$17,747
Eau Gallie Northeast*	250,000	73	$8,750,000	205	10,476	$835	29	1,482	$5,905
Pineda to Eau Gallie	875,000	1,110	$30,625,000	45	34,965	$876	2	1,554	$19,707
520 to Pineda	900,000	1120	$31,500,000	45	35,280	$893	2	1,568	$20,089
National Aeronautics and Space Administration Causeway West	125,000	25	$4,375,000	223	3,903	$1,121	11	193	$22,727
Pineda	150,000	37	$5,250,000	178	4,610	$1,139	19	492	$10,669
30% of Venetian Canals/Channels	225,000	51	$7,875,000	150	5,355	$1,471	20	714	$11,029
70% of North IRL Venetian Collector Canals/Channels	160,000	36	$5,600,000	151	3,805	$1,472	21	529	$10,586
Max Brewer Causeway	80,000	17	$2,800,000	150	1,785	$1,569	20	238	$11,765
Warwick Drive	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
Crab Shack	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
Cocoa South	150,000	26	$5,250,000	107	1,947	$2,696	10	182	$28,846
National Aeronautics and Space Administration Causeway to 528	475,000	149	$16,625,000	45	4,694	$3,542	3	313	$53,132
Rockledge B	845,000	141	$29,575,000	82	8,093	$3,654	12	1,184	$24,970
Eau Gallie Northwest	547,000	58	$19,145,000	79	3,207	$5,969	6	244	$78,592
Cocoa 520 to 528	110,000	19	$3,850,000	45	599	$6,433	3	40	$96,491
Eau Gallie South	1,150,000	74	$40,250,000	80	4,144	$9,713	15	777	$51,802

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-32: Central IRL Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Goat Creek	10,000	7	$350,000	150	735	$476	20	98	$3,571
Mullet Creek Islands Area	130,000	41	$4,550,000	150	4,305	$1,057	20	574	$7,927
30% of Venetian Canals/Channels	50,000	10	$1,750,000	150	1,050	$1,667	20	140	$12,500
70% of Central IRL Venetian Collector Canals/Channels	130,000	27	$4,550,000	151	2,854	$1,594	21	397	$11,461
Trout Creek	5,000	1	$175,000	150	105	$1,667	20	14	$12,500
Melbourne Causeway North	25,000	5	$875,000	150	525	$1,667	20	70	$12,500
Front Street Park	25,000	5	$875,000	150	525	$1,667	20	70	$12,500
Turkey Creek	140,000	10	$4,900,000	250	1,750	$2,800	33	231	$21,212

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-33: Summary of Funded Muck Removal Projects

Sub-Lagoon	Location	Cost Estimate	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Banana	Port Canaveral South*	$14,700,000	35,382	$415	1,925	$7,636
Banana	Pineda Banana River Lagoon*	$6,825,000	15,033	$454	686	$9,949
Banana	Patrick Air Force Base*	$7,175,000	6,497	$1,104	382	$18,783
Banana	Cocoa Beach Golf*^	$21,350,000	29,694	$719	2,058	$10,374
North IRL	Titusville Railroad West*	$3,150,000	14,406	$219	588	$5,357
North IRL	National Aeronautics and Space Administration Causeway East*	$9,975,000	21,872	$456	1,047	$9,527
North IRL	Rockledge A*	$4,375,000	7,581	$577	825	$5,303
North IRL	Titusville Railroad East*	$4,025,000	5,393	$746	227	$17,731
North IRL	Eau Gallie Northeast*	$8,750,000	10,476	$835	1,482	$5,904
Total	***Total***	***$80,325,000***	***146,334***	***$549 (average)***	***9,220***	***$8,712 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ The Cocoa Beach Golf project is not fully funded at this time. A total of $21,350,000 is available and Brevard County is looking for options to fund the remaining $12,775,000 for dredging plus associated interstitial water treatment.

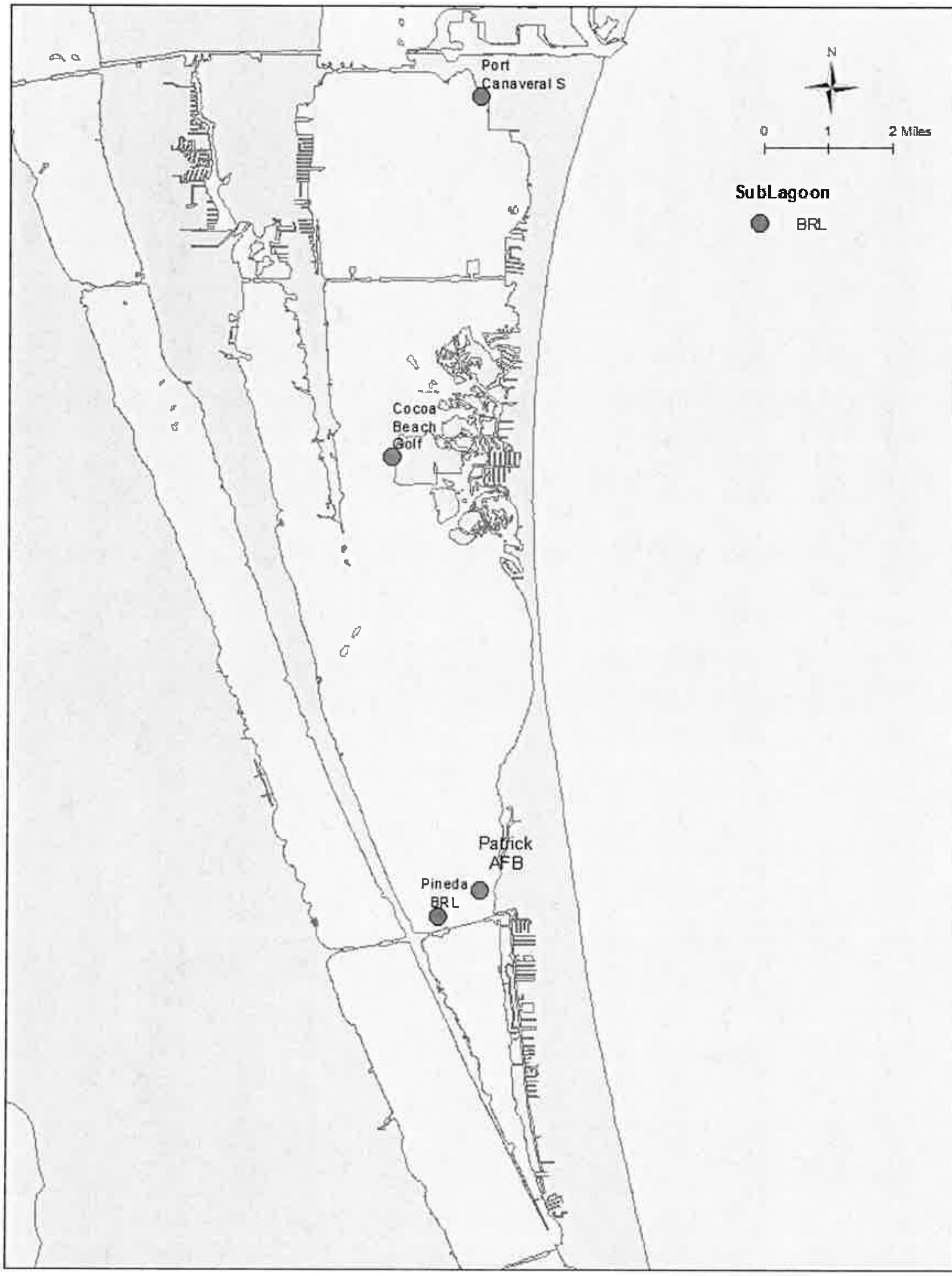


Figure 4-24: Location of Muck Removal Projects in Banana River Lagoon

Figure 4-24 Long Description

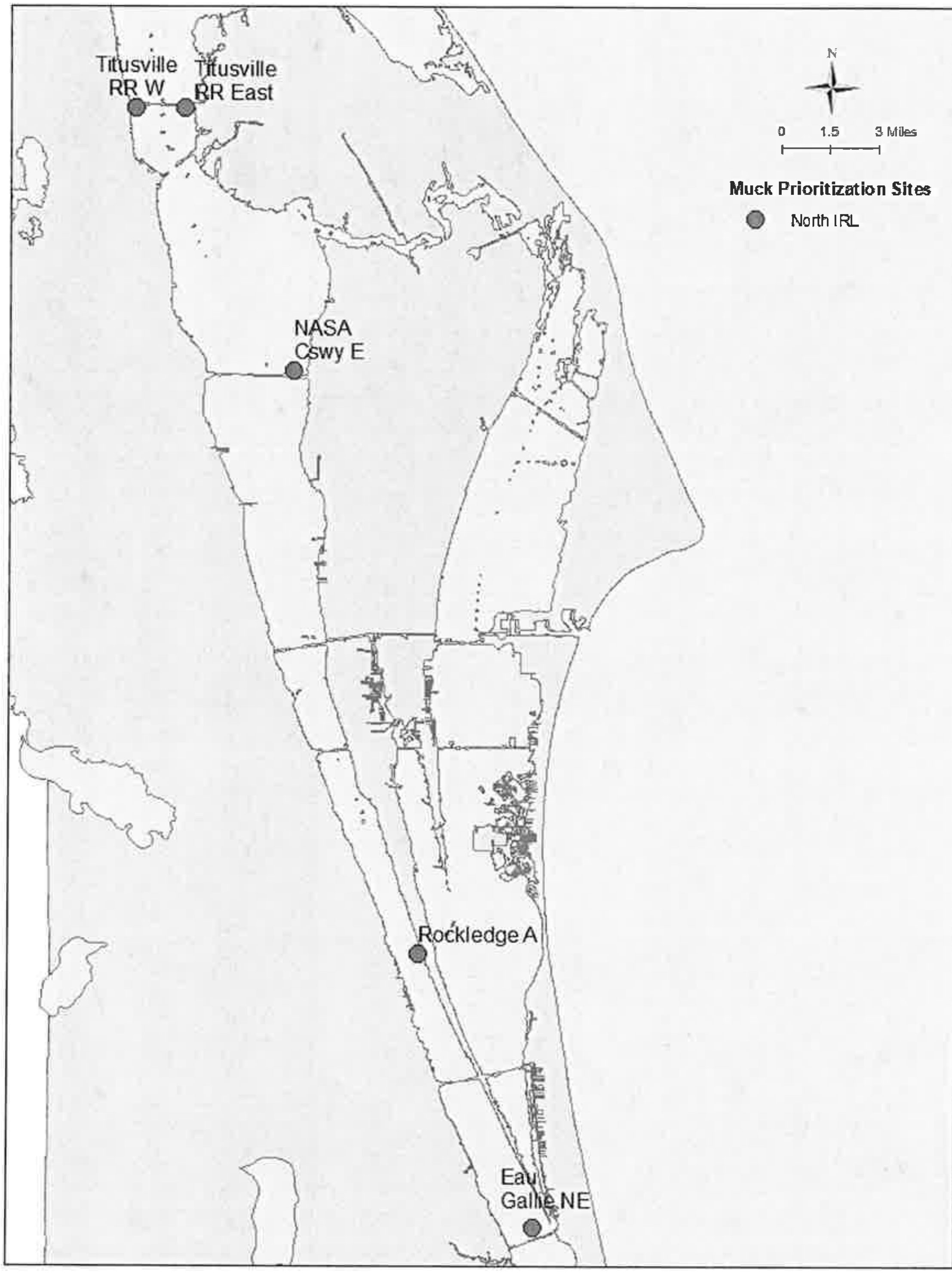


Figure 4-25: Location of Muck Removal Projects in North IRL

Figure 4-25 Long Description

Treatment of Muck Interstitial Water (added in 2018)
Interstitial water refers to the water content that is present within the muck material. Sampling and testing conducted by Florida Institute of Technology researchers has shown that the majority of nutrients are bound to solid particles in the muck; however, the interstitial water also contains a significant amount of dissolved nutrients. When the muck material is dredged, interstitial water nutrients are pumped with the muck and lagoon water in a slurry to the dredged material management area. At the dredged material management area, the muck slurry is processed in a settling pond where sediments settle out and overflow water is returned to the IRL. Treatment of this overflow water represents a significant opportunity to prevent return of these nutrients to the IRL.

Working with the dredging industry, sewage treatment industry, stormwater treatment entrepreneurs and industrial waste treatment engineers, feasible and reasonably cost-effective concentration targets for return water to the IRL have been identified as 2,000–3,000 parts per billion for TN and 75–100 parts per billion for TP. Treatment options for TP were demonstrated during the state-funded initial dredging of Turkey Creek, with Florida Institute of Technology researchers providing independent third-party verification of performance levels. These targets can be achieved through a variety of technologies including, but not limited to, coagulants, polymers, biosorption activated media, or a combination of these technologies. Costs associated with these technologies vary by technology, target nutrient reduction levels, and interstitial nutrient concentrations. Open market costs were collected through three bid solicitations: (1) Mims Boat Ramp muck removal project, (2) Sykes Creek muck removal project, and (3) Grand Canal muck removal project.

To encourage partnering entities and applicants for Save Our Indian River Lagoon Trust Fund dollars to take advantage of this opportunity to enhance the performance of muck removal projects by removing interstitial water nutrients from the dredge slurry during muck dredging operations whenever project configuration allows, a separate cost-share has been developed to account for this added cost and associated nutrient reduction benefit. Using available cost information from Turkey Creek, Mims, and Sykes Creek, County staff considered how to incentivize the addition of this processing step as soon as possible into permitted muck removal projects, as well as future projects. When the substitute project request form was distributed to the public in 2018, staff estimated that a cost-share of $200 per pound of TN removed would be sufficient to entice most partners to agree to stipulate a specific condition in their bids and dredging contracts that return water not exceed 3,000 parts per billion of TN nor 100 parts per billion of TP. However, based on recent bids for nutrient mitigation alternatives for sediment dewatering for Sykes Creek (Tetra Tech 2015), Grand Canal, and Mims, the cost-share used for County projects in the 2019 Plan Update was reduced to $50 per pound of TN removed. This cost will remain volatile until a contractor meets the concentration targets long enough to more accurately determine cost.

The recommended locations for interstitial water treatment are show in **Table 4-34** for Banana River Lagoon, **Table 4-35** for North IRL, and **Table 4-36** for Central IRL. **Table 4-37** provides a summary of recommended projects.

Table 4-34: Banana River Lagoon Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Port Canaveral South*	420,000	289,001,736	$2,134,419	42,688	$50	3,887	$549
Pineda Banana River Lagoon*	195,000	134,179,378	$990,980	19,820	$50	1,804	$549
Patrick Air Force Base*	205,000	141,060,371	$1,041,800	20,836	$50	1,897	$549
Cocoa Beach Golf*^	975,000	670,896,888	$4,954,900	99,098	$50	9,022	$549
Kent Drive	50,000	34,404,969	$254,097	5,082	$50	463	$549
National Aeronautics and Space Administration Area	2,800,000	1,926,678,242	$14,229,457	284,589	$50	25,910	$549
528 East	35,000	24,083,478	$177,868	3,557	$50	324	$549
Newfound Harbor East	45,000	30,964,472	$228,688	4,574	$50	416	$549
70% of Banana Venetian Collector Canals/Channels	2,575,000	1,771,855,883	$13,086,019	261,720	$50	23,828	$549
30% of Venetian Canals/Channels	825,000	567,681,982	$4,192,608	83,852	$50	7,634	$549
Patrick Air Force Base Borrow Pit-2	135,000	92,893,415	$686,063	13,721	$50	1,249	$549
Newfound Harbor South	135,000	92,893,415	$686,063	13,721	$50	1,249	$549
Mathers Bridge Area	350,000	240,834,780	$1,778,682	35,574	$50	3,239	$549
Newfound Harbor North	90,000	61,928,943	$457,375	9,148	$50	833	$549
Cocoa Beach High School	195,000	134,179,378	$990,980	19,820	$50	1,804	$549
Brightwaters	235,000	161,703,352	$1,194,258	23,885	$50	2,175	$549
Patrick Air Force Base Borrow Pit-4	15,000	10,321,491	$76,229	1,525	$50	139	$549
Sunset Café	110,000	75,690,931	$559,014	11,180	$50	1,018	$549
520 Borrow Pit-1	40,000	27,523,975	$203,278	4,066	$50	370	$549
Cape Canaveral Hospital	60,000	41,285,962	$304,917	6,098	$50	555	$549
520 Borrow Pit-2	20,000	13,761,987	$101,639	2,033	$50	185	$549
520 Borrow Pit-3	15,000	10,321,491	$76,229	1,525	$50	139	$549
520 Borrow Pit-4	40,000	27,523,975	$203,278	4,066	$50	370	$549
520 Borrow Pit-5	30,000	20,642,981	$152,458	3,049	$50	278	$549
520 Borrow Pit-6	15,000	10,321,491	$76,229	1,525	$50	139	$549
520 Borrow Pit-7	20,000	13,761,987	$101,639	2,033	$50	185	$549
Port Canaveral	265,000	182,346,334	$1,346,716	26,934	$50	2,452	$549

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ The Cocoa Beach Golf project is not fully funded at this time. A total of $3,013,100 is available and Brevard County is looking for options to fund the remaining $1,941,800.

Table 4-35: North IRL Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Titusville Railroad West*	90,000	61,928,943	$457,375	9,148	$50	833	$549
National Aeronautics and Space Administration Causeway East*	285,000	196,108,321	$1,448,355	28,967	$50	2,637	$549
Rockledge A*	125,000	86,012,422	$635,244	12,705	$50	1,157	$549
Titusville Railroad East*	115,000	79,131,428	$584,424	11,688	$50	1,064	$549
Eau Gallie Northeast*	250,000	172,024,843	$1,270,487	25,410	$50	2,313	$549
Pineda to Eau Gallie	875,000	602,086,951	$4,446,705	88,934	$50	8,097	$549
520 to Pineda	900,000	619,289,435	$4,573,754	91,475	$50	8,328	$549
National Aeronautics and Space Administration Causeway West	125,000	86,012,422	$635,244	12,705	$50	1,157	$549
Pineda	150,000	103,214,906	$762,292	15,246	$50	1,388	$549
30% of Venetian Canals/Channels	225,000	154,822,359	$1,143,439	22,869	$50	2,082	$549
70% of North IRL Venetian Collector Canals/Channels	160,000	110,095,900	$813,112	16,262	$50	1,481	$549
Max Brewer Causeway	80,000	55,047,950	$406,556	8,131	$50	740	$549
Warwick Drive	20,000	13,761,987	$101,639	2,033	$50	185	$549
Crab Shack	20,000	13,761,987	$101,639	2,033	$50	185	$549
Cocoa South	150,000	103,214,906	$762,292	15,246	$50	1,388	$549
National Aeronautics and Space Administration Causeway to 528	475,000	326,847,202	$2,413,926	48,279	$50	4,396	$549
Rockledge B	845,000	581,443,970	$4,294,247	85,885	$50	7,819	$549
Eau Gallie Northwest	547,000	376,390,357	$2,779,826	55,597	$50	5,062	$549
Cocoa 520 to 528	110,000	75,690,931	$559,014	11,180	$50	1,018	$549
Eau Gallie South	1,150,000	791,314,278	$5,844,241	116,885	$50	10,642	$549

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-36: Central IRL Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Goat Creek	10,000	6,880,994	$50,819	1,016	$50	93	$549
Mullet Creek Islands Area	130,000	89,452,918	$660,653	13,213	$51	1,203	$549
30% of Venetian Canals/Channels	50,000	34,404,969	$254,097	5,082	$52	463	$549
70% of Central IRL Venetian Collector Canals/Channels	130,000	89,452,918	$660,653	13,213	$53	1,203	$549
Trout Creek	5,000	3,440,497	$25,410	508	$54	46	$549
Melbourne Causeway North	25,000	17,202,484	$127,049	2,541	$55	231	$549
Front Street Park	25,000	17,202,484	$127,049	2,541	$56	231	$549
Turkey Creek	140,000	96,333,912	$711,473	14,229	$57	1,296	$549

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-37: Summary of Funded Treatment of Interstitial Water Projects

Sub-lagoon	Location	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Banana	Port Canaveral South*	$2,134,419	42,688	$50	3,887	$549
Banana	Pineda Banana River Lagoon*	$990,980	19,820	$50	1,804	$549
Banana	Patrick Air Force Base*	$1,041,800	20,836	$50	1,897	$549
Banana	Cocoa Beach Golf*^	$3,013,100	99,098	$30	9,022	$334
North IRL	Titusville Railroad West*	$457,375	9,148	$50	833	$549
North IRL	National Aeronautics and Space Administration Causeway East*	$1,448,355	28,967	$50	2,637	$549
North IRL	Rockledge A*	$635,244	12,705	$50	1,157	$549
North IRL	Titusville Railroad East*	$584,424	11,688	$50	1,064	$549
North IRL	Eau Gallie Northeast*	$1,270,487	25,410	$50	2,313	$549
Total	***Total***	***$11,576,184***	***270,360***	***$43 (average)***	***24,614***	***$470 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ The Cocoa Beach Golf project is not fully funded at this time. A total of $3,013,100 is available and Brevard County is looking for options to fund the remaining $1,941,800.

Spoil Management Areas (added in 2019)

As Brevard County seeks to execute muck dredging projects, the availability of upland processing areas for the treatment of dredge spoils has become a growing concern. These working sites, referred to as temporary spoil management areas or in the industry as dredged material management areas, are upland parcels of land that can be used as needed for the temporary processing of dredge spoils until such time as the materials can be moved offsite to a permanent beneficial use or disposal location.

To move muck dredging projects forward in a timely manner, initial project locations were selected to make use of existing dredged material management areas through the County's long-standing partnership with the Florida Inland Navigation District. The Florida Inland Navigation District manages Florida's Intracoastal Waterway for which it has acquired eight dredged material management area sites distributed from north to south along the 72 miles of the IRL (not the Banana River) in Brevard County. Only three of these Florida Inland Navigation District dredged material management areas are presently developed; however, the County is working on partnership agreements with the Florida Inland Navigation District to construct dredged material management area facilities at their remaining sites.

The eight Florida Inland Navigation District sites are insufficient to meet the volume and timing of muck dredging projects included in this plan. As the distance between dredging sites and dredged material management areas increase, more booster pumps are required. Booster pumps can complicate project operations and increase cost, particularly as multiple boosters become necessary. Booster pumps are required as project pump distances approach one-mile and are required at one-mile intervals thereafter. Each booster pump adds approximately $1 per cubic yard of material dredged. Pump distances for the Eau Gallie and Sykes Creek projects have five- to seven-mile pump distances to the Florida Inland Navigation District sites and project amounts in excess of 400,000 cubic yards each.

As a supplement to the Florida Inland Navigation District sites, Brevard County staff investigated lease and purchase options for the development of additional multi-use spoil management areas. Lease options for parcels of interest resulted in unfavorable cost-benefit ratios on these short-term investments due to the up-front costs of site development including design, permitting, mitigation, and construction. Similar cost effectiveness issues arise from depending on private sector contractors to provide a temporary dredged material management area as part of construction costs. The contractor passes along most or all the costs of providing a dredged material management area, but the County does not have the benefit of using the site multiple times over the 10-year timespan of this plan or thereafter.

Fee simple purchase and development of spoil management areas, designed with multi-use options for the implementation of regional surface water or stormwater treatment projects, emerges as the most cost-effective long-term option. Through fee simple site acquisition and a prescribed site use and management plan, investments in acquisition and development costs, including required mitigation, can be recovered. For example, the acquisition of a spoil management site four miles closer than the nearest Florida Inland Navigation District site could reduce booster pump costs by $1.6 million dollars on a single 400,000 cubic yard muck removal project. This savings can offset site acquisition and development costs associated with the parcel.

Publicly owned dredged material management area sites could be used for stormwater or surface water treatment, when not being used for dredging. These additional uses can be factored into site selection and design to provide supplementary lagoon benefits. Therefore, land acquisition shall be considered an eligible muck management project cost, particularly when the site can be designed to provide multi-use regional surface water or stormwater treatment alongside or intermittently between usages for muck management. A preliminary project design and construction layout with cost evaluation (comparison to an existing, more distant dredged material management area) shall be part of the site selection and land acquisition decision process.

Another factor to consider when evaluating long-term operations and the feasibility of muck dredging projects is the strategy for final disposal and the development of permanent beneficial use or disposal locations. Often left to the contractor as part of their construction and implementation plan, a final disposition strategy is in many cases not part of the dredging project plan. The dependency on private sector contractors to provide a final disposition strategy and permanent material disposal site can have consequences that a managed permanent disposal site can avoid. These consequences can increase the contractor's risk and drive up project costs.

A managed disposal site would consider the fiscal, environmental, and social implications of the site. A final disposition strategy evaluates the appropriateness of the disposal site in terms of the local community and future development, the environmental proximity to surface waters and runoff potential, groundwater protection, hauling costs, and minimizing risk by providing a defined disposal site. A defined material disposal site, laid-out in the project design, provides a level of security at the time of project bidding that reduces risk to the contractor and potentially lowers the project cost. Staff investigation into the purchase, use and reclamation of existing borrow pits are an example of final disposal areas that are being considered. Similar to what is seen with the development of temporary spoil management areas, the most cost-effective long-term option for the disposal of muck material should include the evaluation of fee simple purchase options and the development of spoil disposal areas.

4.2.2 Surface Water Remediation System

AquaFiber Technologies Corporation has a technology that would treat up to 25 cubic feet per second (16 million gallons per day) of water from Turkey Creek, which is a major tributary to the Central IRL. This project would reduce total suspended solids by more than 90%, remove algal blooms and cyanobacteria to improve the lagoon's color and clarity, improve the dissolved oxygen concentration by returning water with near 100% oxygen saturation, and produce a biomass that can be processed into fertilizer pellets or used as a feedstock for waste-to-energy utilities to produce electricity.

This project would remove an estimated 35,633 lbs/yr of TN and 2,132 lbs/yr of TP from the watershed. The facility would cost $19,720,760 for design, permitting, construction, and use of a technology to destroy the biomass onsite. The cost to operate and maintain the remediation facility is estimated to be $6,271,200 per year. **Table 4-38** summarizes the benefits and the costs of nutrient removal for this project for a 10-year period. On an annual basis, the yearly costs would be $8,243,276, which would result in an annual cost per pound per year of TN removed of $231 and cost per pound per year of TP removed of $3,867.

Brevard County also received information from Phosphorus Free Water Solutions, which has a pay for performance treatment technology to reduce phosphorus, nitrogen, color, and turbidity in surface waters. Phosphorus Free evaluated a project to treat 50 cubic feet per second of water from Turkey Creek. Based on the measured concentrations in Turkey Creek, Phosphorus Free Water Solutions provided two options for treating nitrogen. The measured phosphorus concentration in Turkey Creek is very low and it would not be cost-effective to remove additional phosphorus from the system through this technology. The first option would use the basic nitrogen removal process, which would remove a portion of the dissolved organic nitrogen. This option would reduce TN by 53% or 50,353 lbs/yr at a cost of $6,797,000 or $135 per pound of TN removed. The second option would include an additional treatment step to increase the removal of dissolved organic nitrogen. This option would reduce TN by 86% or 81,469 lbs/yr at a cost of $13,035,000 or $160 per pound of TN removed (**Table 4-38**). The costs for each scenario do not include the capital costs to construct the treatment facility, only the annual pay for performance cost estimates for a ten-year contract for treatment.

Table 4-38: Summary of Annual Benefits and Ten-Year Costs of a Surface Water Remediation System

Project	Ten-Year Project Cost	TN Reduction (lbs/yr)	Cost per pound per Year of TN Removed	TP Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
AquaFiber	$82,432,760	35,633	$2,313	2,132	$38,665
Phosphorus Free Option 1	$67,970,000	50,353	$1,350	To be determined	To be determined
Phosphorus Free Option 2	$130,350,000	81,469	$1,600	To be determined	To be determined

These technologies have not yet been tested in estuarine systems; therefore, these remediation systems are not recommended at this time. However, these types of treatment technologies offer additional benefits that should be more thoroughly explored to better assess the total value to restoring and maintaining lagoon health. Brevard County continues to investigate potential surface water remediation technologies and a portion of the Respond funding may be used to incentivize pilot testing. As feasible technologies are proven, projects may be added to future plan updates.

4.2.3 Enhanced Circulation

The 2011 superbloom occurred in the Banana River Lagoon, North IRL, and southern Mosquito Lagoon. These areas have long residence times, which means that water in these areas stagnates and nutrients can build up leading to additional algal blooms. Options to address this condition are to increase circulation by replacing causeways with bridges, installing culverts under causeways, or increasing ocean exchange by adding culverts, pump stations, or inlets to provide new connections to the ocean. Addressing manmade causeways that interfere with natural circulation should be beneficial without unintended consequences and modeling can help prioritize actions, but implementation is costly and requires participation by the Florida Department of Transportation.

New artificial ocean exchange projects introduce a lot of unknowns. While the residence time of water in the IRL system would decrease, the input ocean water with its complement of marine life has the potential to alter the lagoon ecosystem. Whether the amount of ocean exchange needed to have a beneficial impact on the system can be achieved without causing unintended harm to the lagoon is unknown. Artificial ocean exchange projects are costly with significant social implications and permitting hurdles to overcome. For these reasons, causeway replacements are encouraged while ocean exchange projects are not a recommended component of this plan. Other entities are taking the lead on evaluating options. The results of evaluations by the St. Johns River Water Management District and the IRL National Estuary Program are summarized below.

The St. Johns River Water Management District contracted with CDM Smith and Taylor Engineering to identify potential locations where enhanced circulation projects would be beneficial. The first phase of the project (CDM Smith et al. 2014) involved a literature review and geographic information system desktop analysis. All the locations considered in Phase I, including the top ranked locations, are shown in **Figure 4-26**. From this first phase, ten locations were identified for future evaluation as shown in **Table 4-39**. The external projects are those that could potentially connect the IRL system with the Atlantic Ocean whereas internal projects are connections within the IRL (CDM Smith et al. 2015).

Table 4-39: Phase I Top Ranked Potential Enhanced Circulation Project Locations

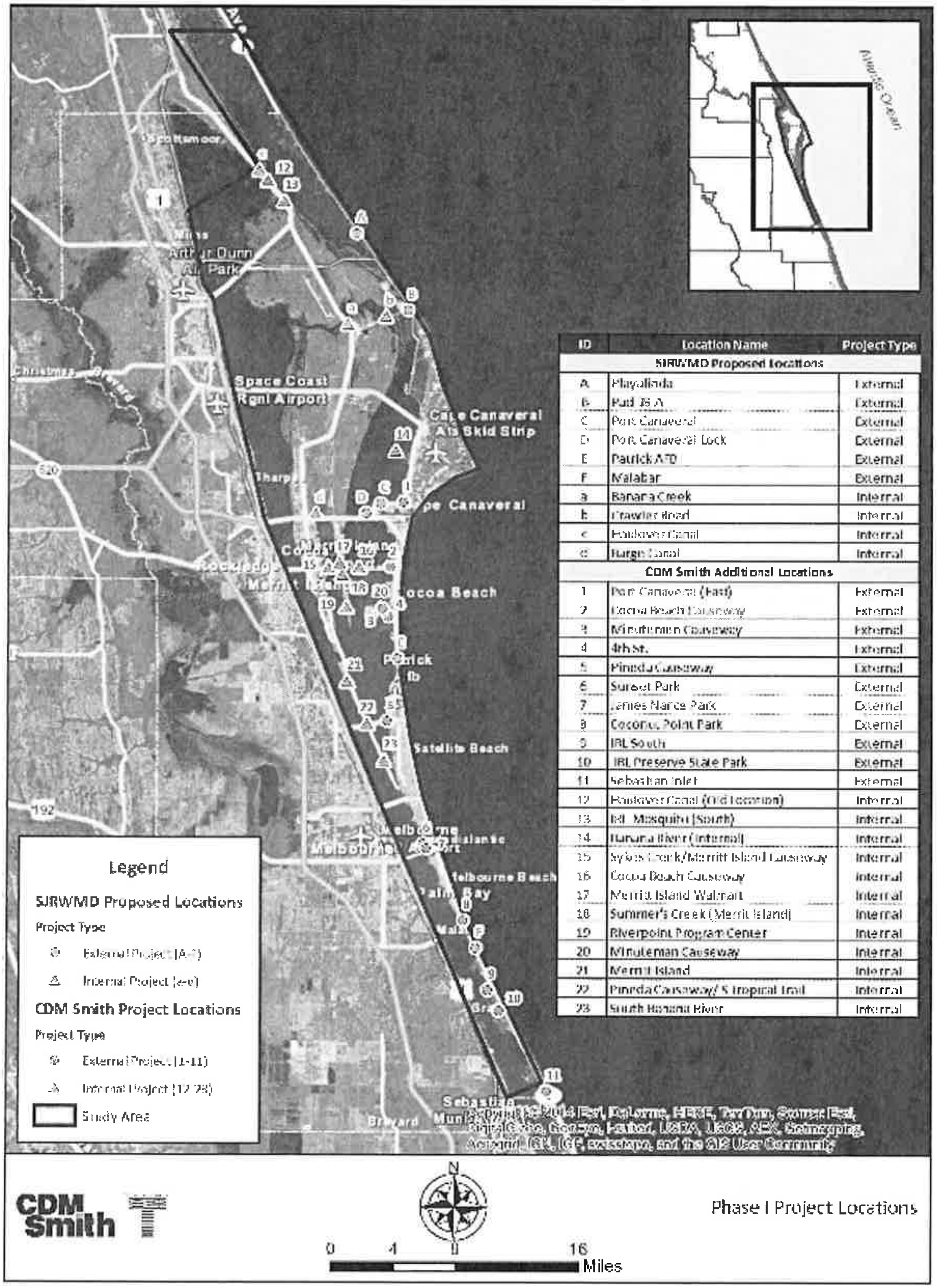
Project Site	Project Description	Zone	Project Type	Rank
D	Canaveral Lock*	Banana River Lagoon	External	1
C	Port Canaveral*	Banana River Lagoon	External	2
15	Sykes Creek/Merritt Island Causeway*	Banana River Lagoon	Internal	3
B	Pad 39-A*	Banana River Lagoon	External	4
16	Cocoa Beach Causeway	Banana River Lagoon	Internal	5
23	South Banana River	Banana River Lagoon	Internal	6
E	Patrick Air Force Base *	Banana River Lagoon	External	7
20	Minuteman Causeway	Banana River Lagoon	Internal	8
1	Port Canaveral (East)	Banana River Lagoon	External	9
8	Coconut Point Park*	Central and Southern Portion of IRL Study Area	External	10

Source: CDM Smith et al. 2015.
* Sites evaluated in Phase 2 of the CDM Smith and Taylor Engineering project for the St. Johns River Water Management District.

As part of the second phase of the project, six of the top ranked sites were further evaluated to assess the water volumes. These sites are noted in **Table 4-39**. Based on the initial evaluation of the sites, CDM Smith and Taylor Engineering determined that a project at the Sykes Creek/Merritt Island Causeway was not feasible. This location had a relatively new bridge crossing with built-up abutment protection that precludes construction of culverts and the increase of bridge openings. In addition, this connection would only provide an internal connection in the IRL and would not increase the tidal exchange. The five remaining sites were evaluated for the following types of connections (additional information in **Figure 4-26** Long Description

Table 4-40):

- Port Canaveral (Project Site C) – Culvert connection
- Pad 39-A (Project Site B) – Culvert connection
- Patrick Air Force Base (Project Site E) – Culvert connection
- Canaveral Lock (Project Site D) – Open channel flow by keeping the Canaveral Lock open over extended periods. Additional maintenance dredging may be needed to remove sediment deposition near the gates.
- Coconut Point Park (Project Site 8) – Culvert connection
- Coconut Point Park (Project Site 8) – Inlet connection with an inlet that is at least 1,350-feet long, with an average depth of about 25 feet below mean sea level.



Source: CDM Smith et al. 2015.

Figure 4-26: Phase I Potential Enhanced Circulation Project Locations

Figure 4-26 Long Description

Table 4-40: Computed Hydraulics for Connections at Select Locations

Site/Potential Project	Flood Prism (million cubic feet)	Ebb Prism (million cubic feet)	Maximum Flow (cubic feet per second)	Estimated Impacted Area for 0.27 Foot Tide Range (acres)
Port Canaveral Culvert (Project Site C)	1.51	-1.08	89	92 to 128
Pad 39-A Culvert (Project Site B) (estimated)	1.38 to 1.51	-1.08 to -1.59	Not applicable	92 to 135
Patrick Air Force Base Culvert (Project Site E) (estimated)	1.38 to 1.51	-1.08 to -1.59	Not applicable	92 to 135
Canaveral Lock Open Channel Flow (Project Site D)	68.67	-83.03	-4,670	5,839 to 7,060
Coconut Point Park Culvert (Project Site 8)	1.38	-1.59	-94	117 to 135
Coconut Point Park Inlet (Project Site 8)	1,890	Not applicable	111,000	160,698

Source: CDM Smith et al. 2015.
Note: Positive flow is towards the IRL.

A screening matrix was used to evaluate the costs and benefits of the project based on the criteria for the tidal prism, area affected, land acquisition, relative costs, ease of construction, seagrass loss, and benefit to cost ratio. The top ranked project from this evaluation is the Port Canaveral culvert (CDM et al. 2015). It is important to note that a culvert will likely not provide the amount of exchange needed to provide a significant benefit to the lagoon. The size of the lagoon in Brevard County is more than 150,000 acres. The second ranked project is the Canaveral Lock open channel. This option may have challenges moving forward based on past experience with sediment blocking submarines from using the port after the lock was held open for an extended period of time. In addition, there are limited data for estimating the water quality benefits and unintended ecological consequences that could result from keeping the lock open.

In 2019, Florida Institute of Technology received $800,000 in funding from the Florida Legislature, which is administered by the Florida Department of Education, to plan and perform studies at sites within the lagoon and along the coast to restore lagoon inflow. The first phase of the study will gather baseline data and perform modeling on existing water quality, biological parameters, and hydrologic conditions at potential locations for future temporary permitted inflow test structures. The Phase 1 modeling and engineering project research will be conducted in parallel with the biological and water quality monitoring to gather data for an enhanced circulation pilot project. The results from the first phase of the project will be available in June 2020.

Temporary Inlet: Another potential option for ocean exchange is when a large storm creates an opening. Instead of immediately filling in the new opening, an evaluation should be completed using available models to determine the potential benefits of temporarily stabilizing the opening long enough to provide significant ocean exchange for short-term water quality benefits, but not long enough to excessively alter beach erosion and sand transport into the lagoon.

Causeway Modification: In 2018, the IRL National Estuary Program, in partnership with the Canaveral Port Authority, worked with the Florida Institute of Technology to assess the potential for modifications of the State Road 528 and State Road 520 causeways and bridge structures to enhance circulation in the northern portion of the Banana River Lagoon and adjacent North IRL. The Florida Institute of Technology used the U.S. Army Corps of Engineers Coastal Modeling System for this evaluation (Zarillo 2018).

The model was set up to reproduce the physical conditions of 2015 to ensure the model was well calibrated. Measured data, including water levels, freshwater inflows, wind velocity, and topography, were used to drive the model. Nine model tests were performed to represent current conditions and scenarios with hypothetical bridge spans over the Banana River Lagoon and North IRL. Three of the model tests included flow relief structures embedded in the State Road 528 and State Road 520 causeways. The tests were run using numerical tracer dye concentration throughout the model domain to track the dye concentration reduction throughout the model simulation. Circulation in the model occurred through ocean exchanges though the Sebastian Inlet, freshwater inflows, and wind (Zarillo 2018).

The model results indicated that modifying the bridge and causeway structures would have a detectible influence on exchange rates within the Banana River Lagoon and North IRL. Longer bridge spans over the Banana River Lagoon along State Road 528 combined with longer bridge spans over State Road 520 resulted in a 10% net reduction in the dye concentration in the Banana River Lagoon between State Road 528 and State Road 520 at the end of the 340-day model run. The net improvement in exchange in the Banana River Lagoon immediately to the north of State Road 528 was predicted to be 5%, if bridge spans are present on both state roads. The study concluded that a significant improvement in exchange in the Banana River Lagoon study area and adjacent North IRL would require bridge spans on both State Road 520 and State Road 528 (Zarillo 2018). Implementation of these modifications to the State Road 520 and State Road 528 bridges and causeways would be the responsibility of the Florida Department of Transportation.

In 2019, Dr. Zarillo expanded his circulation model to include Mosquito Lagoon and the ocean inlet at New Smyrna instead of a closed boundary at Haulover Canal. This expanded model was run again to estimate the impact of causeways on residence time in various compartments of the IRL. In this study, longer bridge spans over the Banana River Lagoon along State Road 528 and State Road 520 resulted in a 17% net reduction in the dye concentration in the Banana River Lagoon between State Road 528 and State Road 520 at the end of the 340-day model run. The net improvement in exchange in the Banana River Lagoon immediately to the north of State Road 528 was predicted to be 8% and exchange within Sykes Creek improved by 20% (Zarillo 2019).

In response to the 2019 model results, the St. Johns River Water Management District offered to use their state-of-the-art ecological modeling tools to quantify water quality improvements and algal bloom reductions anticipated from the proposed causeway modifications. At the request of Brevard County, Port Canaveral, and IRL National Estuary Program, the Florida Department of Transportation agreed to pause their causeway widening project for six months until the ecological impacts could be estimated and evaluated. Results are anticipated in February 2020.

4.2.4 Vegetation Harvesting (added in 2020)

Mechanical removal or harvest of aquatic vegetation rather than treatment with herbicides or other control mechanisms may be one method of reducing nutrient loads to the IRL and its tributaries. The use of aquatic plants for nutrient management has been considered since at least the 1960s (Boyd 1970). The harvest of aquatic vegetation removes nutrients from the waterbody rather than recycling them through decomposition and settlement of the plant material into the sediment. Most freshwater plants do not tolerate the salinity of the IRL and, upon release (such as floating plants washed out of canals) to the lagoon, will die and decompose adding a nutrient load directly to the IRL.

Aquatic vegetation can occur either in mixed stands or as large monocultures. It is not uncommon for invasive plants to form largely monotypic stands. The plant material can form dense floating mats that prevent light diffusion into the water column, thus shading the bottom and limiting benthic habitat. The dense layer of vegetation also limits exchange of gases across the water surface and can cause depletion of dissolved oxygen under the mat. At greater densities, vegetation may also form floating islands or tussocks and incorporate woody plants.

Common invasive plants present in waterways that connect to the IRL are hydrilla, water lettuce, duck weed, and water hyacinth, and these plants present the greatest opportunity for harvest and removal of nutrients through plant biomass. However, native vegetation can be intermixed with exotics. Examples of common native aquatic vegetation that may also be removed includes cattails, fanwort, coontail, bladderwort, and water lilies.

The removal of aquatic vegetation may be accomplished in several ways. For canals or waterbodies with small surface area, booms laid across the water surface can divert flow to screening and sorting facilities for removal of floating vegetation. Also, in canals, drag lines or back hoes can be used for removal of submerged vegetation or modified front end loaders with baskets can collect floating plant material. There are also specifically designed harvesters and shredders that move through the water and cut and remove vegetation (Florida Department of Environmental Protection 2012).

The cost-share for vegetation harvesting was based on actual annualized costs and laboratory analyses of the nutrient content of plant material removed from floating vegetative islands in eight Brevard County stormwater ponds (see **Table 4-41**). Cost-share reimbursement of approved projects will be based on laboratory analysis of plant material to determine true nitrogen removal. Eligible cost-share will be adjusted as additional cost and nutrient removal benefit data are collected.

Table 4-41: Estimated Costs and Nutrient Reductions for Vegetation Harvesting

Project	Annualized Cost	Annualized TN Reductions (lbs/yr)	Cost per Pound per Year of TN Reduction	Annualized TP Reductions (lbs/yr)	Cost per Pound per Year of TP Reduction
Vegetation Harvesting	$198,868	1,812	$110	191	$1,041

4.3. Projects to Restore the Lagoon

Another component of this plan is to implement projects that will restore important, filtering ecosystem services within and adjacent to the lagoon to improve water quality and resilience. Oyster reefs provide ecosystem services including: improved water quality, shoreline stabilization, carbon burial, and habitat (summarized in Grabowski et al. 2012). Creating oyster bars and planting shorelines with natural vegetation will help to filter excess nutrients and suspended solids from the lagoon (Grizzle et al. 2008; Reidenbach et al. 2013), which will improve water quality, allowing for seagrass growth (Newell and Koch 2004) and may reduce the number and severity of algal blooms in the lagoon system. Oyster bars and planted shorelines also create habitat for more than 300 different lagoon species. These types of projects take years before the full benefits are seen in the lagoon as it takes some time for the oysters and vegetation to grow and become established.

The sections below summarize the oyster restoration and planted shoreline projects that are proposed, as well as considerations for seagrass planting.

4.3.1 Oyster Restoration

> *The primary mechanism by which oyster bars remove nitrogen is by increasing local denitrification rates.*

In addition to the fisheries value of oysters, they provide a variety of nonmarket ecosystem services, with a combined estimated economic value between $5,500 and $99,000 per hectare per year (Grabowski et al. 2012). Restored oyster bars have been shown to result in a positive net effect on the removal and sequestration of nitrogen compared to unrestored sites. As nitrogen is a major contributor to algal blooms and resulting increased turbidity, removal of nitrogen from the system often yields water quality benefits. The nitrogen is removed through three pathways: (1) assimilation of the nitrogen in the shell and tissues of the oysters, (2) enhanced burial of nitrogen into the sediments surrounding oyster bars, and (3) conversion to gaseous form with return to the atmosphere through microbe-related denitrification (zu Ermgassen 2016).

The primary mechanism by which oysters remove nitrogen from the system is by increasing local denitrification rates (Grabowski et al. 2012). While the impacts of oyster bars may be localized, they also influence the larger ecosystem. For example, a study by Sharma et al. 2016 found that even with limited bio-filtration and nonsignificant reef effects on water velocity, there was a "shadow" effect on seagrass beds between the reef and shoreline, which resulted in higher localized seagrass area five years after deployment relative to other nearby areas. Further, in a study by Kroeger (2012), it was noted that the eastern section of Mobile Bay had experienced harmful algal blooms that caused fish kills. These conditions occur in the summer months when denitrification by restored oysters would be highest. Therefore, the nitrogen removal associated with the oyster bar project in the bay may make a noticeable contribution to the local water quality by avoiding peak nitrogen concentrations that may trigger algal blooms. In a study by Kellogg et al. (2013), the denitrification rates associated with oyster bars from various studies were documented. Based on these studies, the average effect of denitrification rate is 291 micromoles of TN per square meter per hour, which equates to 0.04 pounds of TN per square meter per year (161.9 pounds of TN per acre per year). A 2017 study was also conducted in the Mosquito Lagoon to determine the local benefits from oyster bed restoration. This study found that the average denitrification rate is 450 kilograms of TN per hectare per year (401.5 pounds of TN per acre per year) and measured nitrogen sequestration in oyster tissues and shells is 0.04 pounds of TN per square foot, which equates to 4,741.1 pounds of TN per acre per year (Schmidt and Gallagher 2017).

The focus for oyster restoration in the IRL system is to provide filtration, sequestration, denitrification, and scour protection along the shoreline (see **Section 4.3.2** for details on scour protection). The goal is not to restore historic oysters in the system because information is not available on where oysters were historically located. In addition, seagrass are a more critical component of the system, so restoration efforts aim to utilize the beneficial aspects of oysters in protecting seagrass from waves and increasing light availability (Newell and Koch 2004) while minimizing the competition for space. Therefore, sites are evaluated for relative seagrass and oyster habitat requirements such as salinity, depth, and bottom type. Further detailed metrics for site selection and success criteria are currently under development. Oyster bars may be constructed in submerged areas deeper than seagrass or as narrow bars along the shoreline to act as a living wave break to reduce erosion. The benefits of oyster bars are shown in **Section 4.3.2**.

Most of the IRL system in Brevard County no longer has a sufficient oyster population to allow for natural recruitment of oysters to suitable substrate (Futch 1967). Therefore, to create the oyster bars, the oysters must be grown and then carefully placed on appropriate substrate in the selected locations. To help grow the oyster population, in fiscal year 2013-2014, the Board of County Commissioners approved $150,000 to launch the Oyster Gardening Program. This program is a citizen-based oyster propagation program where juvenile oysters are raised under lagoon-front homeowners' docks for about six months before being used to populate constructed oyster bar sites. Oyster Gardening participants receive spat-on-shell oysters plus all supplies needed to care for their oysters. The Oyster Gardening Program is executed in partnership with the Brevard Zoo. The project continued during fiscal year 2014-2015 with funding from the state and in fiscal year 2015-2016 with funding from the County. The County plans to continue funding this program annually.

The oysters from the Oyster Gardening Program have been used to develop several pilot bars and demonstration sites in the IRL. In fiscal year 2014-2015, the County received a $410,000 appropriation from the Florida Legislature for the Indian River Lagoon Oyster Restoration Project. This pilot study was completed in fall 2016. The design of oyster wave breaks funded by the Save Our Indian River Lagoon tax is based on monitoring results from the pilot bars and wave tank studies at Florida Institute of Technology that tested the oyster bar stability and wave attenuation of different designs. From these studies the importance of reef location and seasonal water depth (Anderson 2016) as well as the ability of the reef to act as a wave break (Weaver et al. 2017) were highlighted.

4.3.2 Planted Shorelines

Typically, efforts to protect shorelines have involved hardened structures, such as seawalls, rock revetments, or bulkheads, to dampen or reflect wave energy. Although these types of structures may mitigate shoreline retreat, they accelerate scour and the ecological damages that result can be great (Scyphers et al. 2011). The planted shoreline approach incorporates natural habitats into a shoreline stabilization design; maintains the connectivity between aquatic, intertidal, and terrestrial habitats; and minimizes the adverse impacts of shoreline stabilization on the estuarine system. These efforts range from maintaining or transplanting natural shoreline vegetation without additional structural components to incorporating shoreline vegetation with hardened features, such as rock sills or oyster bars, in settings with higher wave energy (Currin et al. 2010). Selection of the most appropriate management system begins with a site analysis to evaluate the type of shoreline, amount of energy that a shoreline experiences, sediment transport forces, type and location of ecological resources, and adjacent land uses (Restore America's Estuaries 2015).

Oyster bars can function as natural breakwaters, in addition to providing nutrient removal benefits through denitrification, as noted in **Section 4.3.1**. The rate of vertical oyster bar growth on unharvested bars (2–6.7 centimeters per year) is greater than predicted sea-level rise rate (2–6 millimeters per year); therefore, bars could serve as natural protection against shoreline erosion, shoreline habitat loss, and property damage and loss along many estuarine shorelines (Ridge et al. 2017). Oyster bars reduce erosion of other estuarine habitats such as salt marshes and submerged aquatic vegetation by serving as a living breakwater that attenuates wave energy and stabilizes sediments (Grabowski et al. 2012).

As part of a study for the Chesapeake Bay, Forand et al. (2014) evaluated the pollutant load reductions from planted shoreline projects in the area. The results of this evaluation are shown in **Table 4-42**, and were used to update the U.S. Environmental Protection Agency Chesapeake

Bay Program Office estimate of the TN and TP reductions per foot of planted shoreline. It is important to note that the information in this table is from states up north where temperatures become much cooler for longer periods of time than what occurs in Brevard County. Therefore, the benefits associated with planted shorelines in the IRL system will likely be greater than those estimated here.

Table 4-42: Pollutant Load Reductions for Shoreline Management Practices

Source	TN (pounds per foot per year)	TP (pounds per foot per year)	Study Location
Ibison 1990	1.65	1.27	Virginia
Ibison 1992	0.81	0.66	Virginia
Proctor 2012	Not applicable	0.38 or 0.29	Virginia
Maryland Department of the Environment 2011	0.16	0.11	Maryland
Baltimore County mean (Forand 2013)	0.27	0.18	Maryland
Chesapeake Bay Program Office Scenario Builder 2012	0.02	0.0025	Chesapeake Bay Program policy threshold that comes from one stream restoration site in Maryland
New Interim Chesapeake Bay Program Office Rate (Expert Panel, 2013)	***0.20***	***0.068***	***Chesapeake Bay Program Office policy thresholds that comes from six stream restoration sites***

Note: Table is from Forand et al. 2014.

Brevard County

To create enough oyster bar area to filter the volume of lagoon water annually, approximately 20 miles (105,600 feet) of oyster bars is needed with a width of six feet. These bars will be placed throughout the IRL system along mosquito impoundments, parks, and private properties where owners want to participate. Based on the pilot project costs and knowing that larger bars will be constructed more efficiently (using information from the pilot projects), it is estimated that the 20 miles of oyster bars could be constructed at a cost of $10 million.

With the recent study on oyster bars in the IRL system (Schmidt and Gallagher 2017), the benefits associated with oyster bars versus planted shorelines could be delineated. For the proposed oyster bar along 20 miles (105,600 feet) of shoreline with a width of six feet (total of 633,600 square feet of oyster bar), the estimated reductions are 25,344 lbs/yr of TN and 906 lbs/yr of TP (see **Table 4-43**). These estimates are based on the estimated TN reduction rate of 0.04 pounds of TN per square foot of oyster bar from Schmidt and Gallagher 2017 and the estimated TP reduction rate of 0.001 pounds of TP per square foot of oyster bar from Kellogg et al. 2013.

Table 4-43: 2018 Updated Estimated Oyster Bar TN and TP Reductions and Costs

Project	Total Area (square feet)	Cost Estimate	TN Reductions (lbs/yr)	Cost per Pound per Year of TN Reduction	TP Reductions (lbs/yr)	Cost per Pound per Year of TP Reduction
Oyster bars*	633,600	$10,000,000	25,344	$395	906	$11,034

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

The estimated nutrient reductions from planted shorelines can be calculated using Chesapeake Bay Program Office recommended rates of 0.2 pounds of TN per linear foot and 0.068 pounds of TP per linear foot (Forand et al. 2014.), which is for an average planting width of 24 feet. These values were adjusted for the proposed average planting width of eight feet, which results in a reduction of 0.067 pounds of TN per linear foot and 0.023 pounds of TP per linear foot. Shoreline planting projects can be combined with oyster bar breakwater projects or they may be conducted along separate stretches of shoreline. At this time, the plan does not recommend a total length of planted shoreline. Planted shoreline projects will be considered for funding annually as partners submit projects for the plan. A cost-share of $16 per linear foot of shoreline, planted in eight-foot wide swaths, was established by using typical nursery installation costs and standard canopy dimensions for native shoreline species found in Brevard County. This equates to $240 per pound of nitrogen reduced by shoreline plantings.

The County conducted a survey of the shorelines, in conjunction with the University of Central Florida, to determine if the shoreline included a bulkhead/seawall, hardened slope/riprap, or no structure to help identify potential locations for future oyster bars and planted shorelines (Donnelly et al. 2018) (**Figure 4-27**).

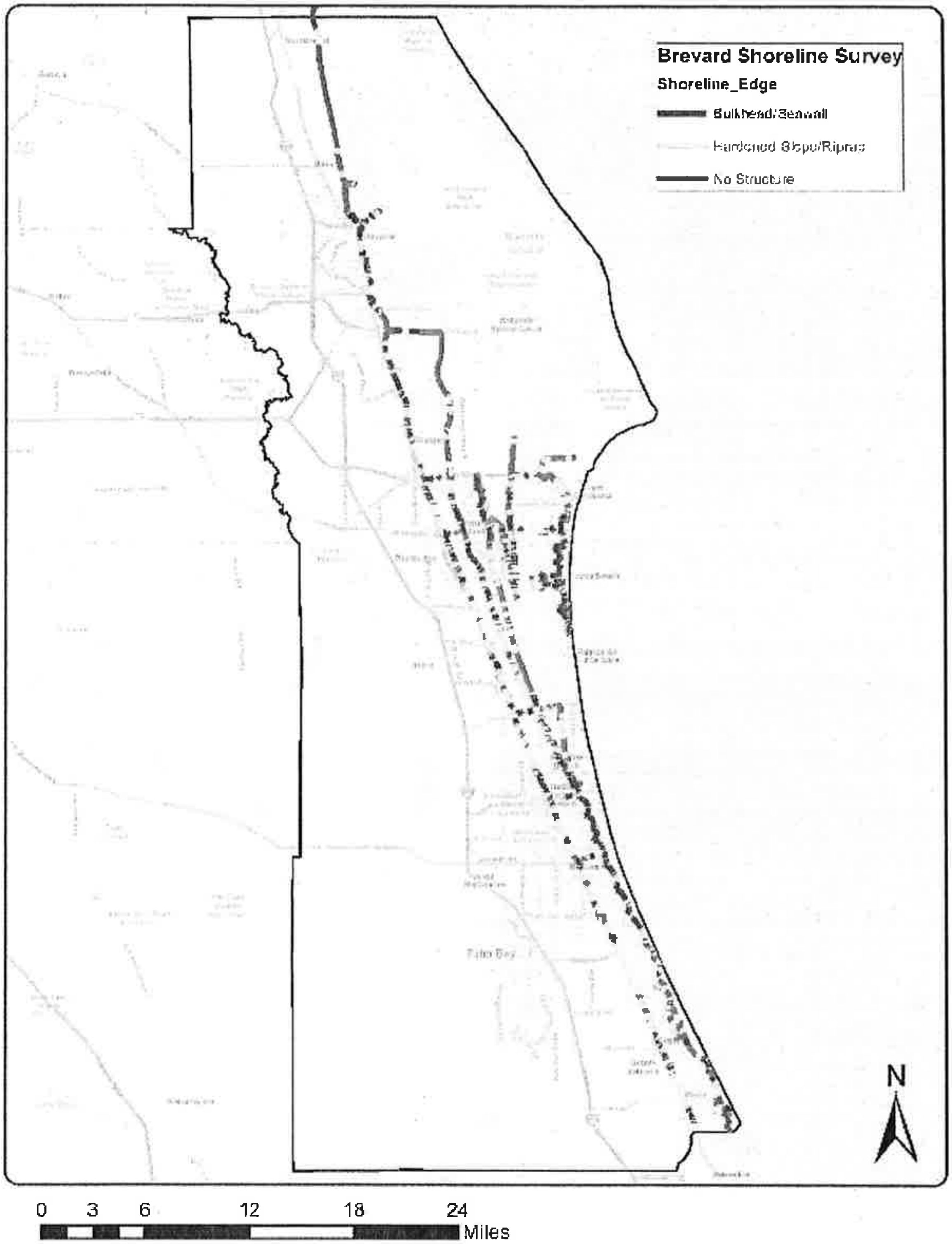


Figure 4-27: Shoreline Survey to Identify Locations Appropriate for Oyster Bars and Planted Shorelines

Figure 4-27 Long Description

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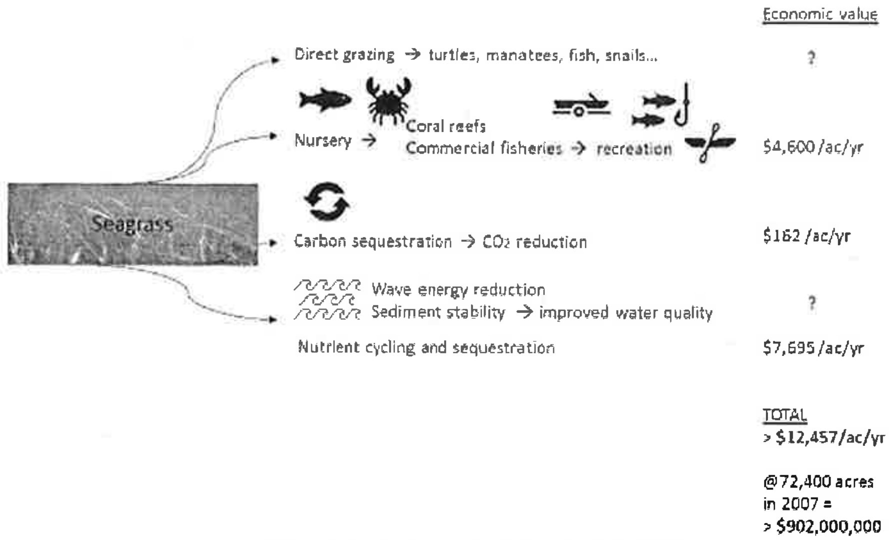
4.3.3 Seagrass Planting (added in 2018)

The original IRL Surface Water Improvement and Management Plan of 1989, as well as subsequent management plans up to and including the current basin management action plans, target a healthy, estuarine ecosystem populated by seagrasses. Seagrasses provide crucial benefits to Florida's estuaries by providing food and shelter to a variety of animals, improving water quality, and preventing erosion of sediment (Orth et al. 2006). In total, the lagoon's 72,000 acres of seagrass could provide an economic benefit of more than $900 million per year (**Figure 4-28**, Dewsbury et al. 2016).



Note: Adapted from Dewsbury et al. 2016

Figure 4-28: Estimated Economic Value of Some Seagrass Services

Figure 4-28 Long Description

One key ecological role for seagrasses is to absorb and cycle nitrogen and phosphorus (Romero et al. 2006). Seagrasses do not remove these nutrients permanently, but they compete for them against phytoplankton and macroalgae and hold them longer. By stabilizing the cycling of nutrients, seagrasses can increase a system's ability to absorb nutrient loads without the initiation of detrimental blooms of phytoplankton or macroalgae (Schmidt et al. 2012). The contribution of seagrasses can be evaluated by examining the quantity of nutrients bound in its aboveground and belowground structures (its mass of biological material or biomass), with this approach treating uptake and release of nutrients as offsetting components of the nutrient cycle (**Table 4-44**).

Table 4-44: Average Nutrients in Seagrass from 1996-2009

Sub-lagoon	Acres	Seagrass (pounds per 100 acres)	Nitrogen (pounds per 100 acres)	Phosphorus (pounds per 100 acres)
Southern Mosquito Lagoon	14,000	45,000	1,000	100
Banana River Lagoon	21,000	45,000	1,000	100
North IRL	19,000	37,000	900	90
Central IRL	7,000	36,000	900	90

Seagrass restoration may be necessary because more than 30,000 acres of seagrasses were shaded to the point of loss during the superbloom in 2011, recovery has been limited, and the brown tide in 2016 exacerbated the situation. In fact, the Banana River Lagoon in Brevard County experienced the largest initial losses of seagrass (**Appendix F**). Beyond the reduction in light arising from repeated, intense phytoplankton blooms, the absence of seagrasses has made the sediments less stable, which will hamper future colonization and spread. After the loss of seagrass, nitrogen and phosphorus became available to phytoplankton, drift algae, and other primary producers (**Table 4-45**). In summary, seagrasses may need some help to recover in the short-term, with more rapid recovery helping to stabilize nutrient cycling in the IRL and reducing the amount of nutrients available to phytoplankton. Measures that could help seagrasses recover could include protecting existing seagrass to promote expansion or protecting areas from waves to reduce the movement of sediment and allow seagrasses to colonize. Planting *Halodule wrightii* would be the initial focus because planting may accelerate recovery, as *Halodule wrightii* is the most common species in the lagoon (Dawes et al. 1995), and this species is a successful pioneer due to its relatively rapid growth and tolerance of varying conditions.

Table 4-45: Average Seagrass Lost and Nutrients Made Available to Other Primary Producers in 2015

Sub-lagoon	Reduction in Acres	Seagrass Reduction* (pounds per 100 acres)	Nitrogen Reduction (pounds per 100 acres)	Phosphorus Reduction (pounds per 100 acres)
Southern Mosquito Lagoon	0	15,000	300	30
Banana River Lagoon	12,000	37,000	900	90
North IRL	1,000	8,000	200	20
Central IRL	4,000	20,000	500	50

* Changes in seagrass cover yield changes in biomass of seagrass within the same number of acres.

Planting seagrass is not a trivial undertaking; it requires considerable planning, resources, and time. For example, having suitable conditions is critical as shown in Tampa Bay where stakeholders invested more than $500 million in projects to reduce nutrient pollution before they saw any return from planting seagrass (Lewis et al. 1999). Costs documented during a workshop on seagrass restoration ranged upward of $1.4 million per acre for larger scale projects (Treat and Lewis 2006). Some of the lessons learned from past projects are selecting sites that will support seagrass growth, employing optimal methods for planting (e.g., type of planting units, use of chemicals to enhance growth, and density of initial planting), and protecting newly planted seagrass from disturbance (e.g., grazing, waves, exposure, and low salinity) until it is established. These factors must be tailored to a specific location; therefore, one or more robust pilot studies are needed prior to attempting full-scale seagrass restoration in the IRL.

A proposed two-year pilot study would evaluate 10 acres of seagrass using three planting techniques with the goal of sequestering 80 lbs/yr of TN and 8 lbs/yr of TP. The costs for this pilot study are summarized in **Table 4-46**, and the three planting techniques that would be evaluated are shown in **Figure 4-29**. The first technique is the Jeb unit in which approximately three to five shoots with their rhizomes in a biodegradable pellet filled with a growth medium would be installed by hand or planted mechanically. The encapsulated rhizomes resist uprooting, and they can be produced in large quantities relatively quickly and transported easily. The second technique is the peat pot in which approximately 25 shoots will be rooted in a four-inch pot. The relatively large pot and well-rooted shoots yield protection from uprooting due to grazing or loss due to moving sediment. However, the units take more time to grow and plant.

The third technique is the safe pot in which approximately 25 shoots will be wrapped in a three-inch coconut coir pot. The unit provides protection from grazing pressure and sediment transport.

Similar or more complex pilot studies could be designed to investigate other key components of successful restoration. Overall, the successful planting of seagrass at the scale of tens of thousands of acres will benefit from strategic investment in optimizing techniques. **Appendix F** includes additional details about seagrass. The seagrass planting pilot project is not recommended at this time due to inadequate water quality conditions throughout much of the lagoon. As conditions improve, opportunities to test seagrass planting techniques will be evaluated.

Table 4-46: Costs for Pilot Study to Evaluate Seagrass Planting Techniques

Task	Quantity	Unit Cost	Total Cost
Design and permit	1	$50,000	$50,000
Install linear feet of breakwater	100	$550	$55,000
Deploy planting units	-	-	-
Technique 1: Jeb units	30,000	$4	$120,000
Technique 2: Peat pots	1,940	$5	$9,700
Technique 3: Safe pots	2,420	$9	$21,780
Herbivore excluders	220	$369	$81,180
Install herbivore excluders	1	$37,000	$37,000
Remove herbivore excluders	220	$44	$9,680
Maintain sites and enhance sediment monthly	24	$14,080	$337,920
Monitor quarterly	8	$1,000	$8,000
Final report	1	$3,000	$3,000
Total	***Not applicable***	***Not applicable***	***$733,260***

Figure 4-29: Types of Seagrass Planting Units for Pilot Study, Jeb Unit (left), Peat Pot (middle), and Safe Pot (right)

4.3.4 Clam Restoration and Aquaculture (added in 2020)

Another potential tool for nutrient extraction, scour prevention, and water filtration in the IRL is through clam aquaculture and restoration. Like oysters, clams can remove nitrogen from a system by burying it in sediments and enhancing the denitrification process through increased microbial activity in biodeposits (Clements and Comeau 2019). The harvesting of clam shells and tissues can also extract nitrogen, as bivalves directly incorporate nitrogen (i.e., from consumption of phytoplankton and detritus; not dissolved nitrogen in the water) into their tissues and shells (Clements and Comeau 2019).

Studies suggest that bivalve aquaculture has the potential to stimulate rates of denitrification equal to that of wild oyster beds and that the impacts of biodeposition from aquaculture are minimal (Clements and Comeau 2019). The culture gear (bags, cover netting) used by growers creates a favorable environment for a myriad of plants and animals, such as juvenile fish and crabs, by providing habitat, substrate, and protection. This is especially significant since shellfish aquaculture leases can only be located in areas of the lagoon that undergo a resource survey to ensure the site is devoid of seagrasses and other marine life.

The exploration of clam aquaculture in Brevard County as a mitigation tool to extract excess nutrients from the IRL is warranted. According to the University of Florida Clam Farm Benefits Calculator, a single littleneck clam can filter 4.5 gallons of seawater per day and remove 0.09 grams of nitrogen when harvested. A clam farmer harvesting 100,000 clams removes an estimated 20 pounds of sequestered nitrogen. Production cost for the farmer is approximately $0.04 per clam, which includes the cost of seed, netting and other materials, fuel, and labor (Salup personal communication). At the production cost of approximately $0.04 per clam, the theoretical nitrogen removal cost would be $200 per pound:

100,000 clams harvested x $0.04 per clam = $4,000 production cost

$4,000/20 pounds of nitrogen removed = $200 per pound of nitrogen

Allocating funds to stimulate bivalve aquaculture in Brevard County could materialize as providing seed stock for local farmers or other incentives to credit nitrogen removal based on harvest numbers. Education directed toward awareness of local aquaculture industries and their dependence on water quality creates mindfulness of the effects of eutrophication in a visceral, practical way.

A statewide partnership aims to restore clams in the IRL using genetic stock able to withstand the unfavorable condition of an algae bloom-ridden lagoon. The IRL Clam Restoration project is a cooperative venture between the Coastal Conservation Association, Florida Fish and Wildlife Conservation Commission, University of Florida Whitney Lab, and other private partners. The plan is to collect brood stock living in the IRL, spawn them and conduct outplanting of these superior hatchery-reared clams in bags or under cover netting to strategic locations in the IRL (based upon historical sites and current water quality trends) including existing partner habitat restoration and commercial lease areas, and fate-track survivorship and growth. One final goal is to establish brood stock that will serve as the optimized variety (phenotype) lines for further stock enhancement.

Although not currently funded in the Save Our Indian River Lagoon Plan, the IRL Clam Restoration project may lead to opportunities for successful partnerships with local clam farmers while public sentiment toward clam restoration is positive and the nutrient-removal aspects of shellfish aquaculture align with the Plan's goals. Furthermore, bivalve aquaculture can provide a number of other ecosystem services alongside nutrient removal, including enhancing bottom habitat and regulating other environmental parameters.

4.4. Respond

The funding raised from the Save Our Indian River Lagoon sales tax will go towards the projects listed in the sections above that will reduce or remove pollutants and restore the lagoon. In addition, $10 million of the funding, over a period of 10 years, will go towards monitoring efforts to measure the success, nutrient removal efficiency, and cost effectiveness of projects included in this plan or in future updates of this plan. Measuring effectiveness is important for reporting progress toward total load reduction targets and for refining project designs to be more effective with each iteration. The monitoring data will be used to determine which projects are providing the most benefit in the most cost-effective manner so that the plan can be updated, as needed. The data will also be used to ensure the lagoon is responding as anticipated to the reductions made so that changes to the plan can be implemented if the lagoon is not responding as expected.

4.4.1 Adaptive Management to Report, Reassess, and Respond

The IRL is located along the Space Coast, which is also known as a global center for exploration, innovation, and development of cutting edge technology. With a dedicated funding source and a brilliant community dedicated to meeting the challenges of today and tomorrow, it is wise to have a process that allows this plan to be updated and revised as new opportunities and better solutions are developed. The intent of the proposed adaptive management strategy is to provide a process that not only allows but also fosters the development and implementation of better tools and techniques and allows the tax rate to be reduced accordingly or retired ahead of schedule.

Although this plan was developed with the best information available in 2016, identifying the sources of water quality pollution and pairing those problems with the most timely and cost-effective solutions is a rapidly changing field of knowledge. To respond to change and take advantage of future opportunities, monitoring is necessary. Even without change in the industry, monitoring will provide data to support and refine the application of existing technology. An adaptive management approach will be used to provide a mechanism to make adjustments to the plan based on new information. As projects from this plan are implemented, the actual costs and nutrient reduction benefits will be tracked, and the plan will be modified, as needed, as project performance in the lagoon basin is better understood.

This plan will be updated approximately annually with information from implemented projects and adjustments to the remaining projects. A volunteer committee of diversely skilled citizens has been assembled to assist the County with the annual plan updates. The Citizen Oversight Committee consists of seven representatives and seven alternates that represent the following fields of expertise: science, technology, economics/finance, real estate, education/outreach, tourism, and lagoon advocacy. The League of Cities nominated representatives for three fields of expertise and nominated alternates for the remaining four fields of expertise. The Brevard County Board of County Commissioners nominated representatives for the other four fields of expertise and alternates for the remaining three fields of expertise. All Citizen Oversight Committee representatives and alternates were appointed by the Brevard County Board of County Commissioners. Appointees serve for two-year terms, after which time they may be considered for reappointment or replacement. The first term ended in February 2019. The Committee's recommendations for plan updates will be presented at least annually to the Board of County Commissioners, and changes to the plan will be approved by the Board of County Commissioners.

Brevard County staff will provide project monitoring reports to the Citizen Oversight Committee and will work with them to recommend adjusting the planned projects, as needed. The adaptive management process allows for alternative projects to be submitted by the county, municipalities, and other community partners to be reviewed by the Citizen Oversight Committee for inclusion in the next annual update to this plan. Projects that deliver comparable nutrient removal benefits may be approved for inclusion in the plan. If a new approved project costs more than the average cost per pound of TN for that project type listed in this plan at the time of project submittal, the requesting partner must provide the balance of the costs. The requesting partner will be allowed reasonable overhead cost to manage the project from design and permitting through construction completion.

As projects are implemented, progress toward meeting the five-month and full-year total maximum daily loads are being tracked. Adjustments to the types and locations of projects implemented will be made to ensure that total maximum daily loads can be achieved in all Brevard County portions of the lagoon.

4.4.2 Responding to Implemented Projects

During the first years of plan implementation, several projects have been completed throughout the IRL system as shown in **Figure 4-30** and **Figure 4-31**. The implementation of these projects provided new cost information that was used to update the cost-share for the 2020 Plan Update. The project costs and Save Our Indian River Lagoon Tax Fund money expended on completed projects are shown in **Table 4-47**. This table does not include dozens of active projects that are in design, permitting, or construction phases but are not yet complete. In addition, public outreach surveys, project monitoring, and water quality monitoring efforts have occurred, as described in the sub-sections below, which will help to improve the projects in this plan and its implementation.

Table 4-47: Save Our Indian River Lagoon Tax Funds Expended on Completed Projects

* Other phases not yet completed.

** Cost estimate only since project was constructed in-house by Brevard County staff

*** Not paid due to not meeting contract requirements

Project	Project Type	Estimated Total Cost	Final Total Cost	Eligible Save Our Indian River Lagoon Cost	Final Save Our Indian River Lagoon Cost
Grass Clippings Campaign Phase 1	Education	$20,000.00	$20,000.00	$20,000.00	$20,000.00
Long Point Park Denitrification**	Septic Upgrade	$101,854.00	$22,206.73	$101,854.00	$22,206.73
Breeze Swept Septic to Sewer	Septic to Sewer	$3,400,000.00	$3,400,000.00	$880,530.00	$880,530.00
Merritt Island Redevelopment Agency Phase 1 Septic to Sewer*	Septic to Sewer	$3,138,098.00	To be determined	*$320,000.00	$128,874.70
Bayfront Stormwater Ponds	Stormwater	$630,955.97	$635,702.00	$30,624.00	$30,624.00
Central Blvd Baffle Box	Stormwater	$41,700.00	$43,700.00	$34,700.00	$34,700.00
Church Street Baffle Box	Stormwater	$233,455.00	$233,455.00	$88,045.00	$20,856.00
Gleason Park Reuse Expansion	Stormwater	$11,000	$7,193.40	$4,224.00	$4,224.00
Coleman Pond Managed Aquatic Plant System	Stormwater	$35,000	Pending	$35,000.00	Pending
St. Teresa	Stormwater	$375,250.00	Pending	$272,800.00	Pending
South Street	Stormwater	$475,125.00	Pending	$86,856.00	Pending
La Paloma	Stormwater	$375,250.00	Pending	$208,296.00	Pending
Turkey Creek Hurricane Dredge	Muck Removal	$1,545,522.00	$1,098,630.71	$215,000.00	$137,328.81
Cocoa Beach Muck Dredging Phase II	Muck Removal	$3,109,817.57	To be determined	$1,376,305.00	Pending
Mims Muck Dredging Interstitial Treatment***	Interstitial Treatment	$2,162,286.00	To be determined	$400,000.00	$0.00
Riverview Senior Oyster Bar	Oyster	$30,304.00	$30,304.00	$30,400.00	$30,304.00

Project	Project Type	Estimated Total Cost	Final Total Cost	Eligible Save Our Indian River Lagoon Cost	Final Save Our Indian River Lagoon Cost
Bomalaksi Oyster Bar	Oyster	$8,900.00	$8,900.00	$8,900.00	$8,900.00
Bettinger Oyster Bar	Oyster	$10,680.00	$10,680.00	$10,680.00	$10,680.00
Gitlin Oyster Bar	Oyster	$16,020.00	$16,020.00	$16,020.00	$16,020.00
Marina Isles Oyster Restoration	Oyster	$26,700.00	$26,700.00	$26,700.00	Requested reimbursement
Cocoa Beach Country Club Living Shoreline	Living Shoreline	$16,080.00	$16,080.00	$16,080.00	$16,080.00
Lagoon House Living Shoreline	Living Shoreline	$24,000.00	$24,000.00	$24,000.00	$24,000.00
Applied Ecology Septic Modeling Countywide	Respond	$81,490.00	$81,490.00	$81,490.00	$81,490.00
Breeze Swept Performance Monitoring	Respond	$48,845.00	$39,630.25	$39,630.25	$39,630.25
Tetra Tech Save Our Indian River Lagoon Project Plan Updates – 2017 and 2018	Respond	$80,364.62	$55,970.62	$55,970.62	$55,970.62
Florida Institute of Technology Muck Prioritization – Initial Reports	Research	$2,500,000.00	$2,498,996.00	$0.00	Not paid with tax funds
Total	-	***$18,498,697.16***	***$8,269,754.71***	***$4,064,104.87***	***$1,562,419.11***

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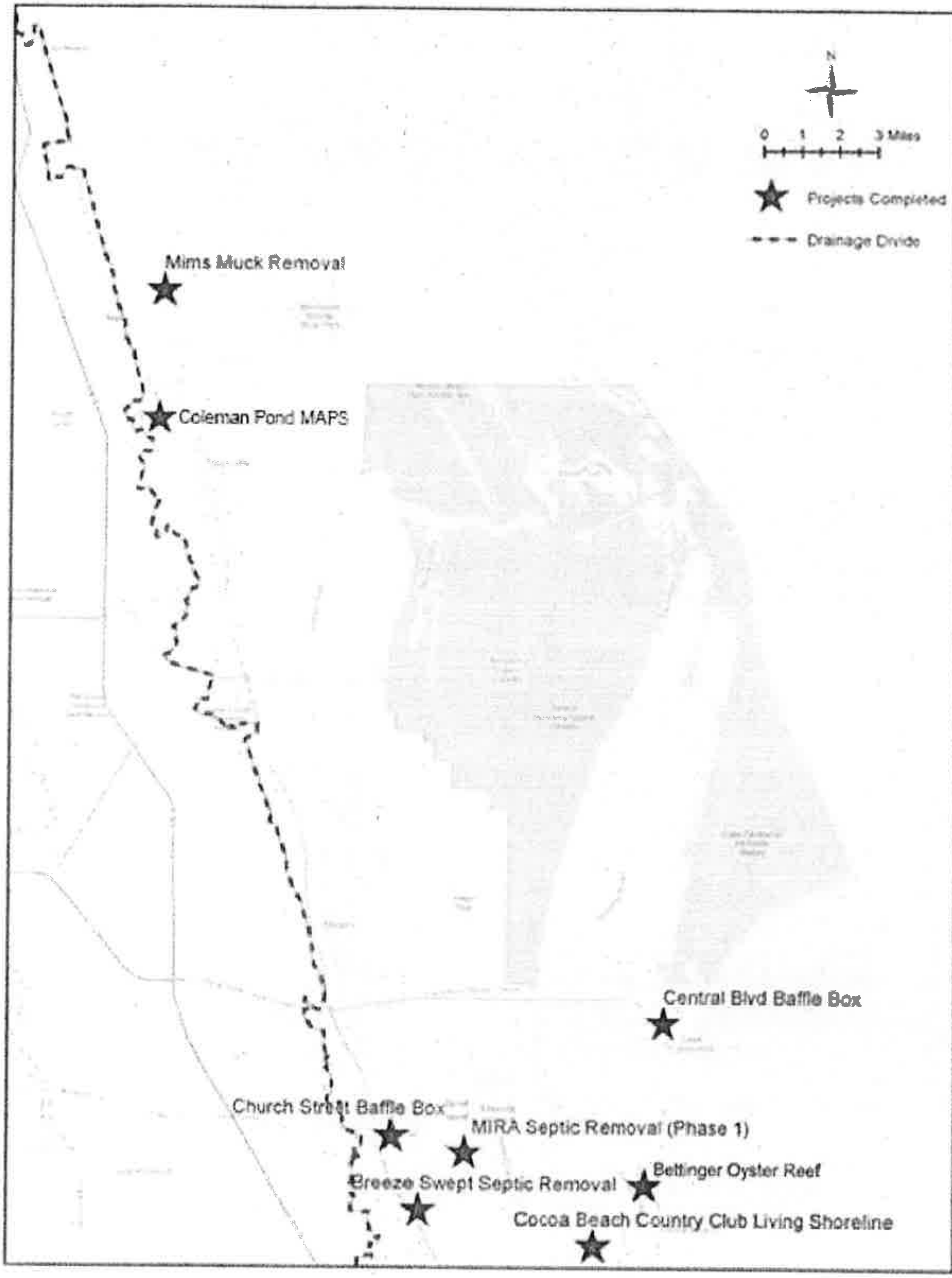

Figure 4-30: Completed Projects in North Brevard County

Figure 4-30 Long Description

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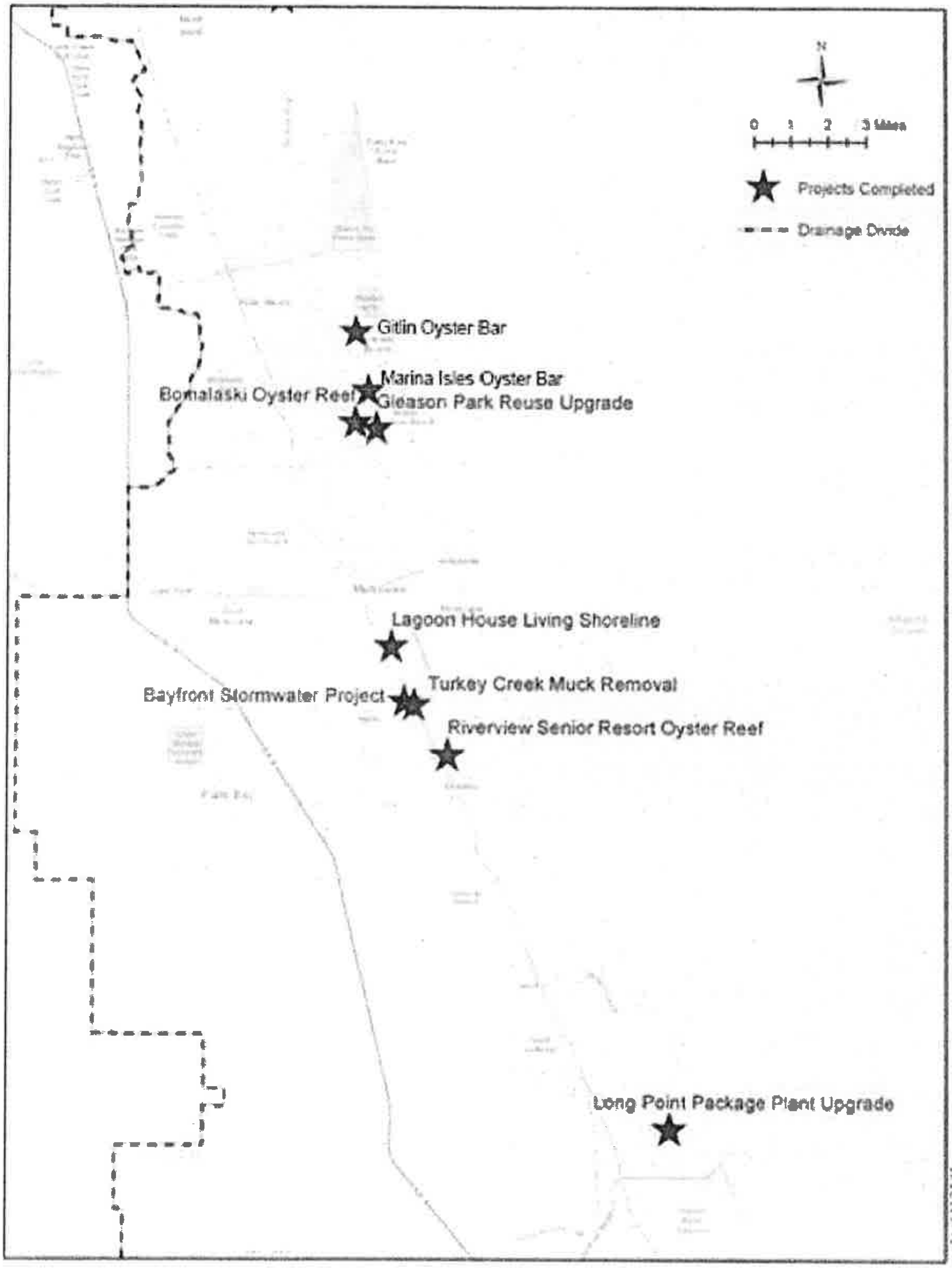

Figure 4-31: Completed Projects in South Brevard County

Figure 4-31 Long Description

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Grass Clipping Outreach

Uppercase, Inc. conducted a survey between September 9, 2018 and November 11, 2018 reaching out to citizens of Brevard, Martin, and Volusia Counties through ads on social media sites, in popular mobile apps, on google ads, in instant messenger and other online and app platforms, as well as on the counties' social media pages. The survey received 733 responses from the three counties. When asked which items in the list provided are pollutants, 61% of respondents said grass clippings were a pollutant and 50% said leaves were a pollutant. Landscape professionals were more likely to say grass clippings were a pollutant (65%). About 48% of respondents maintained their own yards and 36% used a lawn care company. When asking those respondents who maintain their own yards what they do with grass clippings, 68% say they "seldom" or "never" leave the clippings where they land. 70% of respondents say they "always" or "usually" blow clippings back into their yard, 94% said they “never” or “seldom” blow clippings into the middle of the road, 97% said they “seldom” or “never” blow clippings toward a storm drain, and 97% say they “never” or “seldom” blow grass clippings toward a waterbody. The survey also tested taglines and images to encourage keeping grass clippings out of the street and waterbodies, and the best communication channels to provide this information (Uppercase 2018). The results from this survey will be used to guide the grass clipping campaign.

Septic System and Sewer Lateral Maintenance Outreach

The University of Central Florida conducted a survey of Brevard County residents to gather information on septic system-related topics. The survey was conducted between May 2018 and September 2018 through phone calls and door-to-door visits, resulting in a total of 404 completed surveys. Most respondents (70%) said that they have had their septic system pumped out, of which most (39.1%) had their system pumped out in the last 2-4 years or within the last 12 months (38%). Most respondents (51%) answered that they have had their current septic system inspected although many (42%) answered that they have not had their septic system inspected. Of those who responded that their septic systems had been inspected, most were inspected within the past 12 months (41.8%) followed by within the past 2-4 years (37.2%). Most residents (53%) did not receive any information regarding the home's septic system when they moved into the home. Of the total respondents, 55.8% strongly agreed with the statement “I restrict what I flush in toilets to prevent damage.” The participants strongly agree (44.8%) and agree (42.8%) with the statement “I avoid pouring chemicals and solvents down the sink" (Olive et al. 2018). The results from this survey will be used to help guide implementation of the septic system maintenance education program.

Sewer Lateral Rehabilitation

Brevard County Utilities hired Kimley-Horn to conduct a sanitary sewer system smoke testing pilot study within the South Beaches service area in Satellite Beach. The intent of the study was to use smoke testing to identify major contributors of stormwater into the sanitary sewer system and identify the necessary repairs. A smoke blowing machine that produces a non-toxic artificial “smoke” is used to pump smoke into the sewer system through an open manhole. As the smoke travels through the sanitary sewer system, it rises to the surface through any deficiencies in the lateral lines, such as cracks, leaks, and breaks. The South Beaches service area was selected because it had been experiencing elevated sanitary flow rates during storm events due to stormwater flow into the sanitary sewer through broken or missing infrastructure. Smoke testing was performed for the Phase 1 area in April and May 2018 for 5,165 properties. The testing identified 99 deficiencies of which there were 87 broken/missing cleanout caps, 9 broken lateral pipes, 2 damaged gravity sewer pipes, and 1 damaged manhole. Smoke testing was performed for the Phase 2 area in May and July 2018 for 7,592 properties. The testing identified 190 deficiencies of which there were 163 broken or missing cleanout caps, 21 broken lateral pipes, 1 storm connection, and 5 damaged manholes/gravity mains. The County purchased cleanout caps and replaced the damaged or missing caps that were identified, and which were accessible and had no damage to the cleanout port (Kimley Horn 2018a and 2018b).

Based on the data collected during the pilot study, the Save Our Indian River Lagoon Trust Fund will cover the costs to repair up to 250 broken cleanout ports or missing caps and 30 broken private lateral lines. The estimated cost is well below the $840,000 budgeted for this project. The lessons learned from this pilot study will be applied to future sewer lateral evaluation and repair projects.

The preliminary results from this area noted that the groundwater sampled at seven of the eight lateral sites had evidence of sewage leaking out of the lateral when the groundwater table was low. Additional sampling will be conducted after repairs are complete to verify improvements.

Septic System Removal

The Breeze Swept septic-to-sewer project in the City of Rockledge removed 143 septic systems installed between 1958 and 1967. This was the first septic-to-sewer conversion project to be undertaken as a strategic measure to reduce the nutrient loading to the IRL. During construction, the contractor noticed that many septic systems were already failing, which posed an increased health and environmental risk. The City of Rockledge authorized Applied Ecology to install five shallow groundwater monitoring wells in June 2017, three within the Breeze Swept community and two additional reference (i.e., control) wells in an adjacent septic community. Post-construction monitoring continued through summer 2019. There were 18 sampling events with a total of 90 samples collected. All samples were sent to a certified lab and analyzed for ammonia, nitrate-nitrite, total Kjeldahl nitrogen, and fecal coliform. The median ammonia, nitrate-nitrite, total Kjeldahl nitrogen, and mean TN concentrations from the post-construction samples taken from wells within the Breeze Swept community decreased with a statistically significant difference while the control wells showed no significant differences in median concentrations of nitrate-nitrite, total Kjeldahl nitrogen, and TN concentrations during the sampling period. These data provide a better understanding of the impact of septic systems on local water quality and help inform future septic-to-sewer conversion projects.

Construction costs for septic-to-sewer projects increased significantly since the original plan was developed in 2016. At that time, the estimated cost per lot for connection to gravity sewer was $20,000. This estimate included construction of the public and private side of the sewer, abandonment of the septic tank, connection fee, and restoration of the site. Based on actual and budgeted costs from within Brevard County and surrounding counties, the new estimated cost per lot is $33,372.

Costs vary widely depending on the conditions of the specific area. This is exhibited by two projects currently in design. The Micco project is estimated at $82,000 per lot, while the West Melbourne project is estimated at $28,800 per lot. The project in the Breeze Swept community in the City of Rockledge, completed in 2017, cost $23,800 per lot. Indian River County experienced a similar increase in costs for a sewer project in West Wabasso. Phase 1 of West Wabasso was approved in 2011 with an estimated cost of $20,348 per lot. Following construction in 2014, actual costs were $22,942 per lot. For phase 2 of West Wabasso, cost estimates are $46,269 per lot.

There are many opportunities to remove septic systems in areas with existing sewer lines. The plan currently allocates $12,000 to these connection opportunities. Connection costs to gravity were found to be consistent with this estimate; however, connection to force main sewer costs more. In the 2019 Plan Update, connection costs to force main sewer have been increased to $18,000 to more accurately cover the cost of a grinder pump, the pump's electrical connection, directional drilling of the lateral line, abandonment of the septic tank, connection fee, and restoration of the site.

The average cost of an upgraded septic system has been increased from $16,000 to $18,000 to more accurately reflect the cost to safely decommission the old tank and install the new tank and drainfield, electrical costs, and restoration of the site. Many of the oldest septic systems that are contributing the most loading to the lagoon do not comply with modern setbacks established by the Florida Department of Health. Bringing these septic systems to current standards in small lots is contributing to the higher average upgrade costs. The estimate of $16,000 is more accurate for new construction.

Measuring Performance
Groundwater monitoring wells have been installed to measure the pre-project pollution levels in multiple project areas. This includes areas where upgrades are underway for the reduction of nutrients in the reclaimed water supplied by two wastewater treatment plants, in several septic areas where permitting is underway to provide sewer service, in sewer areas to estimate pollution from leaky infrastructure, and at three septic upgrade pilot projects. Sampling continues at a pilot stormwater project that is comparing the performance of three denitrification media types. Pre-project muck flux data have been collected by researchers at Florida Institute of Technology for more than 20 potential muck dredging sites. These data were considered with other available data to reprioritize muck dredging areas in the 2019 Plan Update. The University of Central Florida is collecting data at completed living shoreline projects to measure the success of oyster bar and planted shoreline projects.

4.4.3 Research Needs

Although this project plan does not fund research, it should be recognized that many important research questions need attention. Universities, state agencies, and non-profit organizations are currently leading lagoon research efforts. This plan acknowledges the research needs identified in the Florida Department of Environmental Protection basin management action plans, St. Johns River Water Management District 2011 Superbloom Report, and IRL National Estuary Program Comprehensive Conservation and Management Plan Update, which are summarized below.

- Research needs identified in the basin management action plans (Florida Department of Environmental Protection 2013a, 2013b, and 2013c):
  - Collect new bathymetry data for the IRL Basin, which would be used in the seagrass depth limit evaluations.
  - Continue and increase the frequency of the monitoring along the existing seagrass transects to track seagrass composition, density, and extent.
  - Implement phytoplankton, drift algae, and macroalgae monitoring in the basin.
  - Track watershed loads by monitoring inflow and outflow nutrient concentrations for each jurisdiction.
  - Verify the best management practice effectiveness values used in the basin management action plans, as needed.
  - Test/verify the TN, TP, and seagrass depth regression equations using the seagrass data collected since 1999.
  - Collect groundwater load contribution data and conduct groundwater modeling.
  - Implement storm event monitoring at the major outfalls.

- Assess potential impacts to seagrass from sediment resuspension due to high boat traffic in parts of the lagoon.
- Collect data on nutrient flux/internal recycling of legacy nutrient loads held within the IRL sediments and exchanged with the water column.

- Research needs identified in 2011 Superbloom Report (St. Johns River Water Management District 2016b):
  - Garner an improved understanding of the ideal biological and physiological conditions and tolerances of picocyanobacteria (small cyanobacteria) and Pedinophyceae (green microflagellate), including their ability to use organic forms of nutrients, their ability to fix nitrogen, their nutrient uptake rates, their reproductive rates, and their defenses against grazers.
  - Maintain or expand water quality sampling to ensure spatiotemporal variations are captured adequately, which could include continuous monitoring of various parameters to fill gaps between monthly samples.
  - Develop an improved understanding of the physiological tolerances of drift algae and seagrasses, especially manmade conditions that could be mitigated to improve health or natural resilience.
  - Maintain or expand surveys of drift algae and seagrasses to improve the capacity to evaluate their role in nutrient cycles.
  - Improve the ability to model bottom-up influences from external and internal nutrient loads, including atmospheric deposition, surface water runoff, groundwater inputs, diffusive flux from muck, decomposition of drift algae, and cycling and transformation of nitrogen and phosphorus.
  - Enhance surveys of bacterioplankton to improve the understanding of nutrient cycling.
  - Improve surveys of potential zooplanktonic, infaunal, epifaunal, and fish grazers to enhance the understanding of spatiotemporal variation in top-down control of phytoplankton blooms.
  - Evaluate grazing pressure exerted by common species to enhance the understanding of top-down control of phytoplankton blooms.

- Research needs identified in the Comprehensive Conservation and Management Plan revision (IRL National Estuary Program 2019):
  - Research, identify, and recommend funding sources and alternatives for upgrading WWTF infrastructure and to reduce or remove domestic and industrial effluents.
  - Undertake further studies to quantify the impacts of septic systems on the IRL with a focus on identifying high priority "problem" and "potential problem" areas.
  - Develop, improve, and implement best management practices and education programs for stormwater management and freshwater discharges.
  - Determine the impacts of atmospheric deposition of nutrients and other pollutants on the nutrient budget, water quality, and resources of the IRL.
  - Support implementation, review, and update of IRL total maximum daily loads as needed and as best available science evolves.
  - Evaluate opportunities to incentivize, monetize, and expedite nutrient reduction policies and actions including water quality credit trading.
  - Work to continue, expand, update, and improve the IRL species inventory.
  - Develop a Habitat Restoration Plan for the IRL system.
  - Research and develop new and improved wetland best management practices with a focus on understanding wetland responses to sea level rise and climate change.

- Continue to support and expand research initiatives and coordinated finfish and shellfish management strategies specific to the IRL.
- Prepare a Risk-Based Vulnerability Assessment and Adaptation Plan for the IRL.
- Develop and implement an IRL National Estuary Program Communication Plan.
- Implement public education programs including the "One Community - One Voice" initiative to promote community place-based identities and Lagoon-Friendly behaviors.
- Develop a finance plan for Comprehensive Conservation and Management Plan development and implementation, project and program funding, and program delivery with a focus on restoration, scientific research, monitoring, and citizen engagement.
- Develop a comprehensive IRL monitoring plan.
- Advance the ten research priorities in the 2018 Looking Ahead – Science 2030 Report.
- Provide support for a "State of the Lagoon Technical Report."
- Update the IRL economic analysis produced by the Treasure Coast and East Central Florida Regional Planning Councils every five years.
- Support advancements in hydrological model development, verification, and application.
- Continue evaluation of options to enhance water flow through engineering solutions that have well defined water quality and ecological outcomes.
- Complete muck mapping of the entire IRL, prioritize muck dredging projects and site selection for seagrass and filter feeder restoration projects, and reduce source contributions of sediment and biomass that result in muck formation.
- Track emerging technologies, innovative approaches or alternatives to dredging, muck capping, upstream controls of muck transport, more efficient approaches to dewatering, enhanced pollutant removal in post-dredge water, and enhanced muck management to improve process efficiency and identify beneficial uses of muck.
- Monitor and research to better understand contaminants of emerging concern within the IRL system.
- Research spatially explicit data on the extent and condition of existing filter feeder habitat.
- Research and report on science-based siting, planning, design, and construction criteria for living shorelines.
- Support research and assessment to identify and map suitable habitats and spawning habitats for forage fishes and track population size and health.

Section 5. 2017 Plan Update

Local municipalities and partners were invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits at similar costs as those projects listed in the original plan for each sub-lagoon. To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 5-1** for that project type. The costs shown in **Table 5-1** are an average of the cost per pound of TN removed from the projects listed in the original plan.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were presented to the Brevard County Board of County Commissioners for approval to include in this plan supplement.

Table 5-1: Cost-share per Pound of TN Removed by Project Type for the 2017 Plan Supplement

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$214
Septic System Removal	$852
Septic System Upgrades	$802
Stormwater Projects	$88
Muck Removal	$408
Oyster Bar/Planted Shorelines	$473

5.1. New Projects in the 2017 Plan Supplement

The approved projects for inclusion in the 2017 Save Our Indian River Lagoon Supplement are summarized in **Table 5-2**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund funding that is being applied to each project.

Of the 42 projects approved for funding, 13 were later withdrawn by the project applicants. Projects were withdrawn for a variety of reasons including adverse site conditions and insufficient matching funds. Withdrawn projects are noted with an asterisks (*) and are further discussed in **Section 6.4**. Funding from the Save Our Indian River Lagoon Trust Fund that were not used by the withdrawn projects are available to restore funding to the most cost-effective or shovel-ready approved projects of the same type currently in the unfunded projects list (**Table 5-3**).

Table 5-2: Summary of New Projects Added in the 2017 Save Our Indian River Lagoon Project Plan Supplement

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Breeze Swept Septic to Sewer Connection	City of Rockledge	Breeze Swept is a neighborhood that consists of 143 single family lots that were constructed between 1958 and 1967. The City of Rockledge has undertaken the process of converting the entire neighborhood from septic to sewer. All the major infrastructure has been installed and the sewer pipe has been stubbed out to each lot. The next phase will be to abandon the septic tanks and hook up to sewer. Most homes have two tanks that need to be abandoned. While the contractor has been laying the sewer lines, it has been evident that the septic tanks have been failing.	North IRL	2,002	Not applicable	$880,530
Merritt Island Septic Phase Out Project	Merritt Island Redevelopment Agency	This project consists of three phases: (1) septic phase out in South Tropical Trail, (2) sanitary sewer construction along Cone Road, and (3) septic phase out in the Cone Road Industrial Park. This project proposes to connect approximately 80 properties to a central sewer system. In the Phase 1 area, there are approximately 20 properties that remain on septic systems and are experiencing financial difficulties in paying for the construction and connection costs associated with the hook up to the existing public sanitary sewer system. Many of these remaining properties contain commercial and/or multi-family apartments that require multiple hook ups and higher impact fees. Phase 2 includes the design and construction of the roadway improvements that allow for the installation of the sanitary sewer gravity system and stormwater treatment. Phase 3 consists of the connection of approximately 60 heavy commercial and industrial parcels to the newly constructed public sewer system. A large majority of the existing septic systems were constructed between 1950 and 1985, and the property owners will experience financial hardships relating to the cost of hook up. The funding will assist with the impact fees associated with hook up.	North IRL	2,501	Not applicable	$320,000

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Micco Sewer Line Extension	Sebastian Inlet Marina	Connecting 34 businesses and homes to sewer.	Central IRL	1,633	Not applicable	$1,391,316
Hoag Sewer Conversion	City of Melbourne	Installation of 4-inch force main to allow for 7 existing homes and potential 5 others to tie into municipal sewer and either come off existing septic tanks or, once lots are built, never install septic tanks.	Central IRL	101	Not applicable	$86,031
Penwood Sewer Conversion	City of Melbourne	Installation of 4-inch force main to allow for 4 existing homes and 8 potential homes to tie into municipal sewer and either come off existing septic tanks or, once lots are built, never install septic tanks.	Central IRL	48	Not applicable	$40,632
Long Point Park Upgrade	Brevard County Parks Department	This will be a denitrification wall to remove nitrogen from the groundwater flowing from the Long Point campground rapid infiltration wet pond to the IRL. An 18-inch to 24-inch denitrification wall will be constructed around the outside perimeter fence of the existing system.	Central IRL	127	Not applicable	$101,854
Cocoa Palms Low Impact Development	City of Cape Canaveral	Exfiltration with treatment train.	Banana	13	10	$1,144
Carver Cove Swale	City of Cape Canaveral	Dry retention with treatment train.	Banana	32	9	$2,816
Holman Road Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	71	2	$6,248
Center Street Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	297	9	$26,136
International Drive Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	443	4	$34,700
Angel Isles Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	131	3	$11,528
Central Boulevard Baffle Box	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	481	14	$34,700
Church Street Type II Baffle Box	City of Cocoa	Retrofitting the Church Street discharge point with a Type 2 Nutrient Separating Baffle Box will be the third component of a complete neighborhood restoration and water quality project. The Church Street outfall currently discharges untreated, urban stormwater from a total area of approximately 73 acres.	North IRL	237	29	$20,856

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Bayfront Stormwater Project	City of Palm Bay	The project will construct a wet detention pond to provide treatment and attenuation of stormwater runoff from U.S. 1 (a state roadway) and a 311-acre watershed. The project is a component of the treatment train for the watershed with an existing wet detention and check dam conveyance channel constructed upstream. The project will reduce detrimental effects of untreated stormwater on the IRL seagrasses. The land has been purchased and the site is located 1,063 feet from the waters of Palm Bay and 2,077 feet from the convergence with the IRL. This project provides for the retrofit of 311 acres in added retention treatment. Currently the basin flows untreated into the IRL.	Central IRL	348	83	$30,624
Gleason Park Reuse	City of Indian Harbour Beach	Gleason Park is a central recreational feature and includes a large wet detention pond that treats the runoff from 128.9 acres. The City initiated an effort to reuse the stormwater from this wet pond in 2014 and installed three systems with the ability of drawing 58,200 gallons per week. The proposed project will expand the reuse potential of Gleason Park by adding two additional systems and rerouting the water to the south and southwestern portions of the surrounding park. This project should double the current capacity of the reuse in the park and draw an additional 9.29 acre-feet per year. This project would remove an additional 4.53% of TN and TP loading from several large stormwater basins.	Banana	48	9	$4,224
Denitrification Retrofit of Johns Road Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	1,199	Not applicable	$105,512
St. Teresa Basin Treatment	City of Titusville	Stormwater treatment in the St. Teresa basin before discharging to the IRL.	North IRL	3,100	459	$272,800

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Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
South Street Basin Treatment	City of Titusville	This project includes the installation of three 2nd generation baffle boxes fitted with nutrient reducing media within the 235-acre South St. basin prior to the IRL outfall. Three boxes within this basin are needed due to the high flow along the main pipe line. By installing these boxes within sections prior to the main 72-inch pipe line, the nutrient reducing media will have more contact with the stormwater providing more removal.	North IRL	987	156	$86,856
La Paloma Basin Treatment	City of Titusville	This project includes the installation of an 2nd generation baffle box fitted with nutrient reducing media within a 60-foot stormwater pipe run at the end of the 488 acre La Paloma basin prior to the IRL outfall.	North IRL	2,367	346	$208,296
Kingsmill-Aurora Phase Two	Brevard County	A traditional stormwater pond on major tributary to Eau Gallie River. The project prevents nutrients and sediment from reaching the lagoon.	North IRL	4,176	814	$367,488
Denitrification Retrofit of Huntington Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	1,190	Not applicable	$104,720
Denitrification Retrofit of Flounder Creek Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	856	Not applicable	$75,328
L1 Canal Bank Stabilization*	Brevard County	Repair and stabilize channel banks to prevent further bank erosion with associated sediment and nutrient load.	North IRL	995	383	$87,560
Norwood Baffle Box Retrofit*	City of Palm Bay	The project will retrofit or replace two existing baffle box structures for the existing drainage canal serving approximately 507 acres, improving treatment of the drainage basin by enhancing the treatment train with these structures. The structures will improve nutrient removal process from entering the Melbourne Tillman Canal C-1, which leads to Turkey Creek and IRL.	Central IRL	1,631	254	$143,528
Victoria Pond*	City of Palm Bay	The project will install a baffle box structure for the existing drainage canal serving approximately 122 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structures will improve nutrient removal process from entering the IRL.	Central IRL	267	42	$23,486

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Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Goode Park*	City of Palm Bay	The project will retrofit or replace the existing outfall weir structure for the existing basin drainage which drains two drainage ponds serving approximately 254 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structures will improve nutrient removal upstream of Turkey Creek and IRL.	Central IRL	794	121	$69,872
Florin Pond*	City of Palm Bay	The project will retrofit or replace the existing outfall structure for the existing drainage pond serving approximately 18.28 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structure will improve nutrient removal upstream of Turkey Creek and IRL.	Central IRL	75	11	$6,600
Cherie Down Park Swale*	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	27	9	$2,376
Cape Shores Swales	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	31	15	$2,746
Justamere Road Swale	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	6	3	$528
Hitching Post Berms	City of Cape Canaveral	Construction of a berm/swale system with Bold & Gold filter media.	Banana	29	22	$2,552
Cliff Creek Baffle Box	City of Melbourne	Installation of a 2nd generation baffle box with biosorption activated media.	North IRL	3,952	797	$347,781
Thrush Drive Baffle Box	City of Melbourne	Installation of a 2nd generation baffle box with biosorption activated media.	North IRL	3,661	773	$322,200
Airport Boulevard Dry Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention pond.	North IRL	99	23	$8,718
Nasa Boulevard Pond Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention pond.	Central IRL	1,097	157	$96,532
General Aviation Drive Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention swale.	Central IRL	158	10	$13,937
Stewart Road Dry Retrofit	City of Melbourne	Installation of Bold & Gold under an existing dry retention swale.	North IRL	208	47	$18,344
Mims Muck Removal: Outflow Water Nutrient Removal	Brevard County	The treatment of muck dredging spoil site out-flow water for the removal of nitrogen and phosphorus.	North IRL	2,803	244	$400,000

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Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Grand Canal Muck Dredging	Brevard County	Dredging and outflow nutrient reduction of approximately 605,000 cubic yards of muck sediments from an area of 97 acres within the Grand Canal system.	Banana	27,802	2,447	$10,000,000
Sykes Creek Muck Dredging	Brevard County	Dredging and outflow water nutrient reduction of approximately 660,000 cubic yards of muck sediments from an area of 187 acres within Sykes Creek.	Banana	30,693	2,722	$10,000,000
Turkey Creek Shoreline Restoration	City of Palm Bay	Construct a planted shoreline of 1,200 linear feet.	Central IRL	240	82	$113,500
Total	-	-	-	***96,956***	***10,109***	***$25,874,599***

* Projects withdrawn as part of 2018 Update. See **Section 6.4**.

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5.2. Unfunded Projects in the 2017 Plan Supplement

To include the new projects approved as part of the 2017 Supplement, the funding had to be shifted from the least cost-effective or shovel-ready projects of the same or similar type that were listed in the original plan. This balance is shown in **Figure 5-1**. The projects listed in **Table 5-3** were unfunded in the 2017 annual update process. However, if additional funding is obtained from other sources, such as grants or legislative appropriations, these projects could be added back to the plan tables through a streamlined approval process. Since these projects were previously approved for inclusion in the Save Our Indian River Lagoon Project Plan, if additional funds become available during the fiscal year, individual projects in **Table 5-3** could be funded with Trust Fund dollars, if their reinsertion is recommended by the Citizen Oversight Committee and if a budget change request for such projects is approved by the Board of County Commissioners. This accelerated process would not need to wait for the next annual plan update. Reinsertion of these projects into the funded Save Our Indian River Lagoon Project Plan would be reflected retroactively in the next annual update to the plan.

Table 5-3: Summary of Unfunded Projects from the 2017 Save Our Indian River Lagoon Project Plan Supplement

Sub-lagoon	Project Name	Cost	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
North IRL	Sykes Creek C septic system removal	$1,700,000	1,426	Not applicable
Central IRL	112 septic system upgrades	$1,792,000	2,233	Not applicable
Banana River Lagoon	Stormwater project in Basin 754	$100,000	734	95
Banana River Lagoon	Stormwater project in Basin 602	$100,000	1,068	109
North IRL	Stormwater project in Basin 1434	$125,000.00	932	112
North IRL	Stormwater project in Basin 1151	$125,000.00	1,057	141
North IRL	Stormwater project in Basin 1078	$125,000.00	1,250	187
North IRL	Stormwater project in Basin 1399	$125,000.00	1,570	256
North IRL	Stormwater project in Basin 1301	$125,000.00	1,025	154
North IRL	Stormwater project in Basin 1368	$125,000.00	1,311	200
North IRL	Stormwater project in Basin 408	$125,000.00	1,179	170
North IRL	Stormwater project in Basin 338	$125,000.00	1,902	188
North IRL	Stormwater project in Basin 1367	$100,000.00	1,042	146
North IRL	Stormwater project in Basin 1384	$100,000.00	923	142
North IRL	Stormwater project in Basin 1318	$100,000.00	1,124	148
North IRL	Stormwater project in Basin 155	$100,000.00	1,149	122
North IRL	Stormwater project in Basin 289	$100,000.00	1,112	223
North IRL	Stormwater project in Basin 193	$100,000.00	1,316	198
North IRL	Stormwater project in Basin 1441	$100,000.00	1,034	149
North IRL	Stormwater project in Basin 660	$100,000.00	844	212
North IRL	Stormwater project in Basin 952	$100,000.00	1,251	212
Banana River Lagoon	29% Sykes Creek dredging	$7,000,000	12,536	1,112
Banana River Lagoon	38% Cape Canaveral Area dredging	$10,000,000	33,051	5,026
North IRL	29% Grand Canal dredging	$7,000,000	11,356	1,000
North IRL	38% Eau Gallie dredging	$10,000,000	33,512	5,023
Total	***Total***	***$39,592,000***	***115,937***	***15,325***

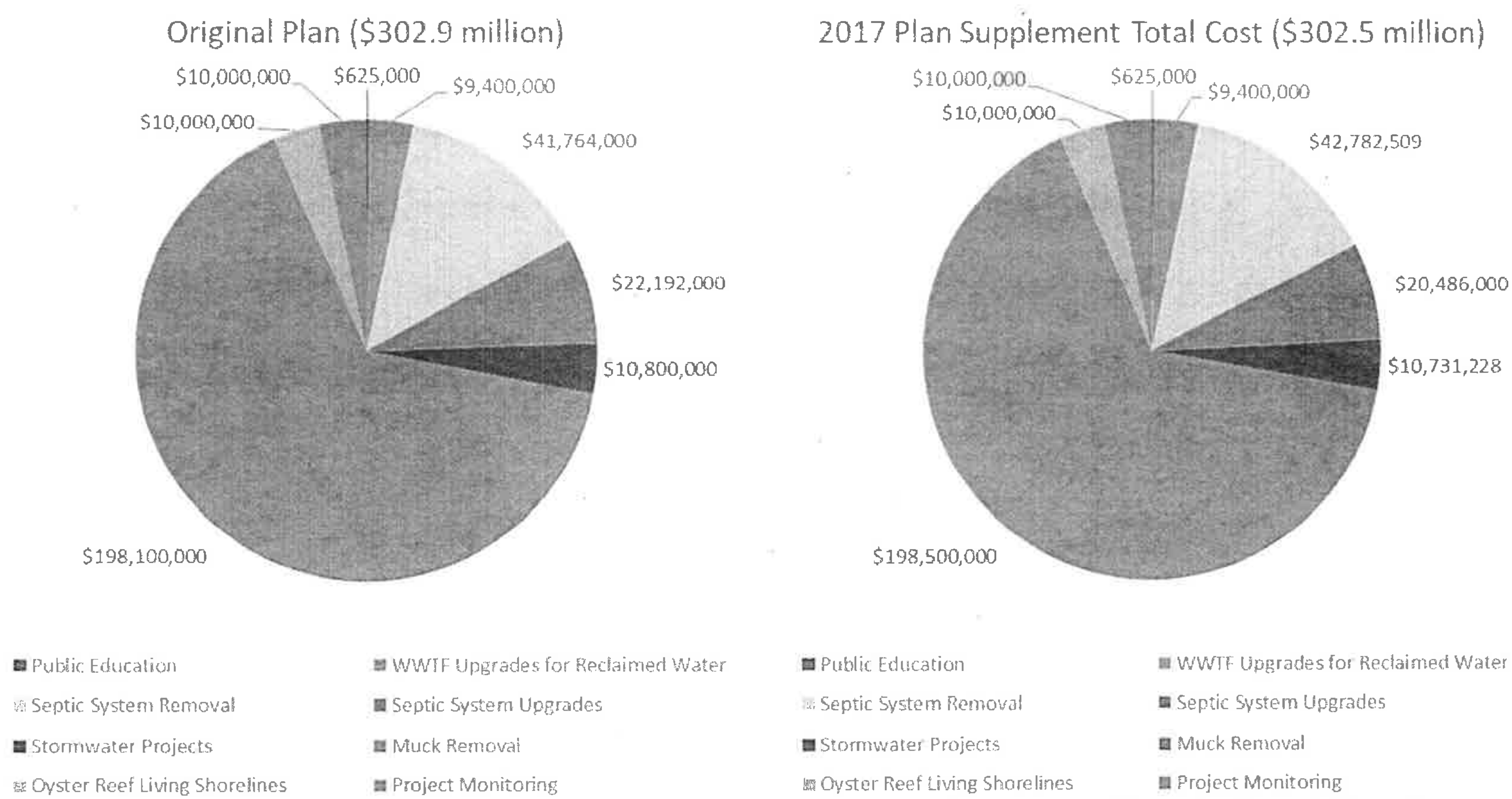

Figure 5-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2017 Plan Supplement Cost by Project Category (Right)

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Section 6. 2018 Plan Update

For the 2018 Plan Update, local municipalities and partners were once again invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits at similar costs as those projects listed in the original plan for each sub-lagoon.

To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 6-1** for that project type. The costs shown in **Table 6-1** are an average of the cost per pound of TN removed from the projects listed in the Save Our Indian River Lagoon Project Plan, as amended. Based on a recommendation from the Citizen Oversight Committee, instead of having one allowable cost per pound per year of TN for stormwater projects, as was the case for the 2017 Plan Supplement, there are now three allowable costs based on the project location. Separate allowable costs are now provided for septic system removal by sewer extension (expanding the sanitary sewer collection system to connect septic systems) and by sewer connection (connecting septic systems to existing sanitary sewer collection system infrastructure). Cost-share for a new project, muck interstitial water treatment, was also added. In addition, based on new information about the reductions associated with oyster bars versus planted shoreline, separate allowable costs are included for each of these types of living shorelines.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were presented to the Brevard County Board of County Commissioners for approval to include in this plan update.

Table 6-1: Costs-share per Pound of TN Removed by Project Type for the 2018 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$231
Septic System Removal by Sewer Extension	$872
Septic System Removal by Sewer Connection	$443
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$88
Merritt Island	$89
Barrier Island	$99
Muck Removal	$403
Treatment of Muck Interstitial Water	$175
Oyster Bar	$392
Planted Shorelines	$180

6.1. Additional Project Benefits

Although the eligible Save Our Indian River Lagoon Trust Fund contribution to new projects is determined based on the amount of TN removed, the benefits of implementing these projects

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include reductions in other pollutant sources, as well. These projects will reduce a multitude of different contaminates to meet water quality targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. These additional benefits vary according to project design and site-specific conditions but often include significant reduction of pathogenic bacteria, viruses, human and animal wastes, chemicals, metals, plastics, and sediments (see **Table 6-2**).

Table 6-2: Pollutants Removed by Different Project Types

Stormwater	Septic System Removal	Septic System Upgrade	Muck Removal
Nitrogen Phosphorus Sediments Escherichia coli Viruses Fecal coliform Pesticides Metals Oil Litter	Nitrogen Phosphorus Escherichia coli Viruses Fecal coliform Pharmaceuticals Biochemical Oxygen Demand	Nitrogen Phosphorus Escherichia coli Viruses Fecal coliform Biochemical Oxygen Demand	Nitrogen Phosphorus Clay sediments Hydrogen sulfide Biochemical Oxygen Demand

This Save Our Indian River Lagoon Project Plan is an adaptable document informed by science and under supervision of the community. As monitoring updates our understanding of IRL pollutants, the plan projects will target funds to the most successful and cost-effective projects.

6.2. Project Funding

6.2.1 Revenue Projection Update

The County calculated a new estimate for Save Our Indian River Lagoon Sales Tax revenues based on the median of collections in the first 12 months of the sales tax with the current consumer price index for inflation of 2.13% compounded over the life of the tax. The new estimate for the period of 2017 through 2026 is $486,392,368.53, or on average $48.6 million per year. This current estimate is $14.6 million per year more than the $34 million per year estimate in the original Save Our Indian River Lagoon Plan, which was based on 2016 dollars. This new estimate allows for the implementation of additional projects. Please see the latest update in **Section 8.3.1**.

6.2.2 Contingency Fund Reserve

A Contingency Fund Reserve will be included with the development and adoption of the County's budget each fiscal year and will amount to 5% of the total Trust Fund dollars that are budgeted for all approved projects scheduled to occur or move ahead in that fiscal year. This includes projects in the Save Our Indian River Lagoon Project Plan, including additions captured in annual updates or Plan Supplements. The purpose of the reserve is to fund emergency response to harmful algal blooms and major fish kills or to cover reasonable funding shortfalls that may occur during project implementation and would delay implementation or completion of that project unless a ready source of funds is on hand.

If the cost increase for an individual project is less than 10% of the estimated cost or eligible amount of Trust Fund cost-share stated in the Save Our Indian River Lagoon Project Plan or update, then additional funding from the contingency reserve may be allocated to the project, as needed, in accordance with Brevard County policies and administrative orders. For projects that are contracted with municipalities or other partners and encounter cost overruns, the cost-share agreement may be increased up to 10% over the eligible cost-share amount stated in Attachment E of the cost-share contract. This amendment will be executed by the Chairman of the County Commission and the appropriate municipal representative or authorized agent of a partnering organization.

For project cost increases that are more than 10% above the estimated cost or eligible amount of Trust Fund cost-share stated in the Save Our Indian River Lagoon Project Plan or update, County staff will evaluate the project circumstances and present findings and a recommendation to the Citizen Oversight Committee. The Committee will make a recommendation to the County Manager or County Commission (based on respective signature authority adopted in County contracting policy) on whether the project should proceed.

6.3. New Projects in the 2018 Plan Update

The approved projects for inclusion in the 2018 Plan Update are summarized in **Table 6-3**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund funding that is being applied to each project. Once the 2018 Plan Update is approved by the County Commission, the projects are part of the Save Our Indian River Lagoon Project Plan and are reflected in the updated plan tables shown in **Section 9**.

New project types added as part of the 2018 Update include:

- Expanded public education and outreach to address grass clippings, excess irrigation, stormwater pond maintenance, and septic system maintenance.
- Sewer laterals rehabilitation.
- Treatment of muck interstitial water.
- Refinement of benefits for oyster bars versus planted shorelines.

Table 6-3: Summary of New Projects for the Save Our Indian River Lagoon Plan 2018 Update

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1-10	Expanded Outreach	Brevard County	See details in **Section 4.1.1**.	All	105,165	To be determined	$1,100,000
2	Grant Street Water Reclamation Facility Nutrient Removal Improvements	City of Melbourne	Biological nutrient removal processes added at Water Reclamation Facility by replacing the trickling filter and oxidation ditch with biological nutrient removal process with anoxic/aerobic tankage.	Central IRL	25,627	9,671	$5,919,837
2	Sylvan Estates Septic-to-Sewer Conversion	City of West Melbourne	Connection of 59 residences (currently on septic) to new sewer extension.	Central IRL	1,073	Not applicable	$935,656
1	Riverside Drive Septic-to-Sewer Conversion	City of Melbourne	Installation of force main to tie into an existing manhole. Each home would be required to install a small grinder pump system and then connect to the City's force main.	North IRL	305	Not applicable	$265,960
2	Roxy Avenue Septic-to-Sewer Conversion	City of Melbourne	Installation of force main to tie into an existing manhole. Each home would be required to install a small grinder pump system and then connect to the City's force main.	North IRL	102	Not applicable	$88,944
1	Sewer Lateral Repair/ Replacement	Brevard County	See details in **Section 4.1.5**.	All	To be determined	To be determined	$840,000
2	Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	City of Cocoa Beach	Stormwater-low impact development treatment train consisting of high infiltration PaveDrain permeable pavers flowing to a native plant bioswale along a residential road discharging to the Banana River Lagoon. There is currently no treatment for stormwater in this basin, developed in the late 1950s. System reduces runoff volume (thereby reducing pollutants) as stormwater flows downstream over a high infiltration paver system, which then flows to the native landscape bioswale. The bioswale will use native grasses and oak tree canopy to provide additional runoff and pollutant reduction through vegetative nutrient uptake. Design will evaluate whether biosorption activated media will improve efficiency of this treatment train system. Monitoring will be evaluated as a means of determining actual built TN and TP removal of system. Adjacent neighborhood park provides an excellent opportunity for public education and outreach.	Banana	30	3	$2,922

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2	Stormwater Low Impact Development Convair Cove 2 – Dempsey Drive	City of Cocoa Beach	Stormwater-low impact development treatment train consisting of high infiltration PaveDrain permeable pavers flowing to a native plant bioswale along a residential road discharging to the Banana River Lagoon. There is currently no treatment for stormwater in this basin, developed in the late 1950s. System reduces runoff volume (thereby reducing pollutants) as stormwater flows downstream over a high infiltration paver system, which then flows to the native landscape bioswale. The bioswale will use native grasses and oak tree canopy to provide additional runoff and pollutant reduction through vegetative nutrient uptake. Design will evaluate whether biosorption activated media will improve efficiency of this treatment train system. Monitoring will be evaluated as a means of determining actual built TN and TP removal of system. Adjacent neighborhood park provides an excellent opportunity for public education and outreach.	Banana	29	3	$2,842
1	Big Muddy at Cynthia Baffle Box	City of Indian Harbour Beach	Nutrient separating baffle box with Bold & Gold media.	Banana	269	48	$26,637
2	Grant Place Baffle Box	City of Melbourne	Installation of 2nd generation baffle box with Bold & Gold.	Central IRL	937	193	$82,481
2	Crane Creek/M-1 Canal Flow Restoration	St. Johns River Water Management District	Treat and restore flows from an approximately 5,300-acre watershed, which was diverted from the Upper St. Johns River Basin to the IRL when the M-1 Canal was constructed in the early 20th century. Work will include construction of an operable water control structure in the M-1 Canal near Evans Road, a pump station and pipeline near I-95, and a stormwater treatment area west of I-95, to remove nutrients prior to discharge to the Upper St. Johns River.	Central IRL	23,113	2,719	$2,033,944
2	Apollo/GA Baffle Box	City of Melbourne	Installation of 2nd generation baffle box with Bold & Gold within the existing ditch line that runs parallel to Apollo Boulevard near General Aviation Drive.	North IRL	3,381	479	$297,522
1	Cocoa Beach Muck Dredging – Phase III	City of Cocoa Beach	Dredge muck from 13 residential canals (39 acres of muck).	Banana	2,435	366	$981,305
1	Cocoa Beach Muck Dredging – Phase III Interstitial*	City of Cocoa Beach	Scrub nutrients from the return water associated with dredging 13 canal areas in the City of Cocoa Beach, which have extensive muck accumulated and are impacting the Banana River Lagoon's water quality. The sites include all canals that are directly connected to the Banana River Lagoon. Survey of muck area and depths has been completed and a permit has been approved for the muck dredging.	Banana	2,942	To be determined	$514,809

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Merritt Island Muck Removal – Phase 1	Brevard County	The removal of accumulated muck from 30 canals on central Merritt Island.	Banana	4,805	722	$1,936,415
1	Muck Removal of Indian Harbour Beach Canals	City of Indian Harbour Beach	Dredge muck from 12 canal areas (36 acres of muck).	Banana	2,257	339	$909,571
1	Muck Interstitial Water Treatment for Indian Harbour Beach Canals	City of Indian Harbour Beach	Scrub nutrients from the return water associated with dredging 12 canal areas in the City of Indian Harbour Beach, which have extensive muck accumulated and are impacting the Banana River Lagoon's water quality. The sites include all canals that are directly connected to the Banana River Lagoon, including all the Grand Canal located within the City. Survey of muck area and depths has been completed and permitting is ongoing.	Banana	27,418	To be determined	$4,798,197
1	Muck Re-dredging in Turkey Creek	Brevard County	Dredge 11 acres of Turkey Creek where muck was re-deposited after Hurricane Irma.	Central	981	147	$215,000
1	Muck Interstitial Water Treatment for Turkey Creek	Brevard County	Scrub nutrients from the return water associated with the re-dredging of Turkey Creek.	Central	Not applicable	688	Not applicable
1	Eden Isles Lane Oyster Bar	Brevard Zoo	Three adjacent properties on Eden Isles Lane on Merritt Island have some mangroves in place and a low sloping, sandy shoreline. The water depth 10 feet from shore is shallow, so the design may need to be modified somewhat to obtain the same reduction benefits to the water quality. The project will construct a 245-foot oyster bar along the three properties. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	49	17	$21,805
1	Marina Isles Oyster Bar	Brevard Zoo	The gated community of Marina Isles is in Indian Harbour Beach. The property manager is interested in adding an oyster bar to the existing mangrove shoreline. The water depth 10 feet from shore varies from about 1-2 feet. The project will construct 300 feet of oyster bar on this property. The bar will be constructed using a proven design research and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	60	20	$26,700

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Bettinger Oyster Bar	Brevard Zoo	The Bettingers own property on Bali Road in Cocoa Beach. There is a seawall on the property and the project would construct an oyster bar of 120 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	24	8	$10,680
1	Cocoa Beach Country Club Planted Shoreline	Marine Resources Council	Planting three-year-old mangroves on 5-foot centers along western lagoon shoreline with Spartina in two rows. Additional native plants will be added, as needed, to fill in areas.	Banana	67	23	$16,014
1	Lagoon House Shoreline Restoration Planting	Marine Resources Council	Planting three-year-old mangroves on 5-foot centers along western lagoon shoreline with Spartina in two rows. Additional native plants will be added, as needed, to fill in areas.	Central IRL	100	34	$23,961
1	McNabb Park Oyster Bar	City of Cocoa Beach	Construct 360 feet of living shoreline comprised of oyster shell bags. Location is on an arterial waterway at the end of a residential canal in the North Thousand Islands. This will be a pilot project to test the suitability for oyster restoration in this portion of the lagoon. McNabb Park is a neighborhood park/playground that will provide an opportunity for a public education kiosk on living shorelines and stormwater management.	Banana	72	24	$34,056
1	McNabb Park Planted Shoreline	City of Cocoa Beach	Construct 360 feet of living shoreline comprised of red mangrove and Spartina. Location is on an arterial waterway at the end of a residential canal in the North Thousand Islands. McNabb Park is a neighborhood park/playground that will provide an opportunity for a public education kiosk on living shorelines and stormwater management.	Banana	24	8	$5,760
1	Gitlin Oyster Bar	Brevard Zoo	Ms. Gitlin owns canal property on Cinnamon Court. There is a seawall with a water depth of about 3 feet. The project would construct an oyster bar of 180 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	36	12	$16,020

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Coconut Point/Environmentally Endangered Lands Oyster Bar	Brevard Zoo	The Environmentally Endangered Lands properties at Coconut Point Sanctuary, Hog Point Cove Sanctuary, and Maritime Hammock Sanctuary all have shorelines that are good candidates for an oyster bar. The project would be three phases and to construct an oyster bar in a total of 5,425 feet. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Central IRL	1,085	369	$509,950
1	Wexford Oyster Bar	Brevard Zoo	Wexford is a gated community located in Melbourne Beach. The property has a seawall with a water depth of about one to two feet. The project would construct an oyster bar of 350 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Central IRL	70	24	$31,150
1	Riverview Park Oyster Bar	City of Melbourne	Retrofitting approximately 1,150 linear feet of existing shoreline by means of a living shoreline oyster bar.	Central IRL	230	78	$108,790
1	Riverview Park Planted Shoreline	City of Melbourne	Retrofitting approximately 1,150 linear feet of existing shoreline by means of a vegetated living shoreline.	Central IRL	77	26	$18,480
1	Bomalaski Oyster Bar	Brevard Zoo	Ms. Bomalaski owns property on Dragon Point Drive on Merritt Island. The property has a steep shoreline made up of coquina riprap. The water depth at 10 feet from the shoreline is about 3 feet. The project will construct a 100-foot oyster bar. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	North IRL	20	7	$8,900

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Oliver Oyster Bar	Brevard Zoo	The Olivers, Swanns, and Hermanson own property on Swann Grove Lane on Merritt Island. All three want an oyster bar built along their shorelines on their three adjacent properties. The shoreline is made up mostly of coquina riprap and has a depth of about one foot at 10 feet from the shoreline. The project will build 580 feet of oyster bar on these adjoining properties. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	North IRL	116	39	$51,620
1	RiverView Senior Resort Oyster Bar	Brevard County	320 linear feet of oyster bar.	Central IRL	77	2	$30,304
1	Indian River Drive Oyster Bar**	Brevard County	1,900 linear feet (11,400 square feet) of oyster bar.	North IRL	456	11	$179,930
1	Indian River Drive Planted Shoreline**	Brevard County	1,900 linear feet of planted shoreline.	North IRL	127	44	$22,860
1	Oyster Bar	Brevard County	500 linear feet of oyster bar.	Banana	120	3	$47,350
-	***Total***	-	-	-	***203,679***	***16,127***	***$21,116,372***

* Project withdrawn as part of 2019 Update. See **Section 7.2.1.**
** Projects modified as part of 2019 Update. See **Section 7.2.1.**

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6.4. Project Changes

6.4.1 Withdrawals

Some of the projects submitted by the local governments as part of the 2017 Plan Supplement were determined to not be cost-effective and/or feasible to implement after further investigation. Therefore, the local governments requested that these projects be removed from the Save Our Indian River Lagoon Project Plan so that the funding could be used for other projects. **Table 6-4** lists the projects that have been removed from the plan at the request of the responsible entity.

Table 6-4: Summary of Year 0 and Year 1 Project Withdrawals

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Holman Road Baffle Box	City of Cape Canaveral	Banana	71	2	$6,248
Center Street Baffle Box	City of Cape Canaveral	Banana	297	9	$26,136
International Drive Baffle Box	City of Cape Canaveral	Banana	443	4	$34,700
Angel Isles Baffle Box	City of Cape Canaveral	Banana	131	3	$11,528
Cherie Down Park Swale	City of Cape Canaveral	Banana	27	9	$2,376
Norwood Baffle Box Retrofit	City of Palm Bay	Central IRL	1,631	254	$143,528
Victoria Pond	City of Palm Bay	Central IRL	267	42	$23,486
Goode Park	City of Palm Bay	Central IRL	794	121	$69,872
Florin Pond	City of Palm Bay	Central IRL	75	11	$6,600
Airport Boulevard Dry Retrofit	City of Melbourne	North IRL	99	23	$8,718
Nasa Boulevard Pond Retrofit	City of Melbourne	Central IRL	1,097	157	$96,532
General Aviation Drive Retrofit	City of Melbourne	Central IRL	158	10	$13,937
L-1 Canal Bank Stabilization	Brevard County	North IRL	995	383	$87,560
Total	-	-	***6,085***	***1,028***	***$531,221***

In addition, Brevard County reviewed the basins proposed for stormwater treatment in the original plan and identified those basins that should be removed because they could not be easily treated or are basins where the County already has projects. These basins are summarized in **Table 6-5**.

Table 6-5: Summary of Stormwater Basin Withdrawals

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 979	3,275	448	$225,000
Banana	Stormwater project in Basin 1280	1,735	236	$175,000
Banana	Stormwater project in Basin 1317	1,679	290	$125,000
Banana	Stormwater project in Basin 1063	1,235	192	$100,000
Banana	Stormwater project in Basin 970	1,092	185	$100,000
Banana	Stormwater project in Basin 995	1,048	169	$100,000
Banana	Stormwater project in Basin 998	1,196	189	$100,000
Banana	Stormwater project in Basin 1309	1,016	152	$100,000
Banana	Stormwater project in Basin 754	734	95	$100,000
Banana	Stormwater project in Basin 602	1,068	109	$100,000
North IRL	Stormwater project in Basin 1430	2,255	335	$175,000
North IRL	Stormwater project in Basin 327	1,999	283	$125,000
Central IRL	Stormwater project in Basin 1582	2,402	443	$200,000
Total	-	***20,734***	***3,126***	***$1,725,000***

6.4.2 Revisions

The Brevard County Long Point Park project was completed in Year 0 instead of Year 1. This project constructed a denitrification wall to remove nitrogen from the groundwater flowing from the Long Point campground rapid infiltration wet pond to the IRL. The City of Melbourne Stewart Road dry retention swale retrofit project was incorrectly shown in the 2017 Plan Supplement as located in the Central IRL, and the location has been corrected to the North IRL as part of the 2018 Plan Update. The Brevard County Denitrification Retrofit of Johns Road Pond was incorrectly shown in the 2017 Plan Supplement as located in the Banana River Lagoon, and the location has been corrected to the North IRL as part of the 2018 Plan Update. In addition, the Brevard County Grand Canal muck dredging project was incorrectly shown in the 2017 Plan Supplement as located in the North IRL, and the location has been corrected to the Banana River Lagoon as part of the 2018 Plan Update.

All the unfunded projects from the 2017 Plan Supplement were added back to the plan, except for Banana River Lagoon stormwater projects in basins 754 and 602 (withdrawn as noted above), as part of the 2018 Plan Update. A portion of both the Sykes Creek dredging project and Grand Canal dredging project in Banana River Lagoon were unfunded in the 2017 Plan Supplement. The funding restored as part of this plan update was revised based on updated cost estimates that include treatment of the muck interstitial water (**Table 6-6**).

In addition, the Turkey Creek muck removal project required dredging as a result of impacts caused by Hurricane Irma in September 2017. The County is pursuing Federal Emergency Management Agency reimbursement for this project where state and federal disaster recovery funding would cover 87.5% of the total cost of additional dredging and the interstitial water treatment and the Save Our Indian River Lagoon Tax Fund would cover the remaining 12.5% of the costs (see **Table 6-3**).

Table 6-6: Updates to Sykes Creek and Grand Canal Dredging Projects

Category	Sykes Creek TN Reductions (lbs/yr)	Sykes Creek TP Reductions (lbs/yr)	Sykes Creek Cost	Grand Canal TN Reductions (lbs/yr)	Grand Canal TP Reductions (lbs/yr)	Grand Canal Cost
Muck Removal	11,676	1,754	$4,705,428	6,057	910	$2,440,971
Treatment of Interstitial Water	64,278	Not applicable	$11,248,704	89,025	Not applicable	$15,579,397
Total	***75,954***	***1,754***	***$15,954,132***	***95,082***	***910***	***$18,020,368***

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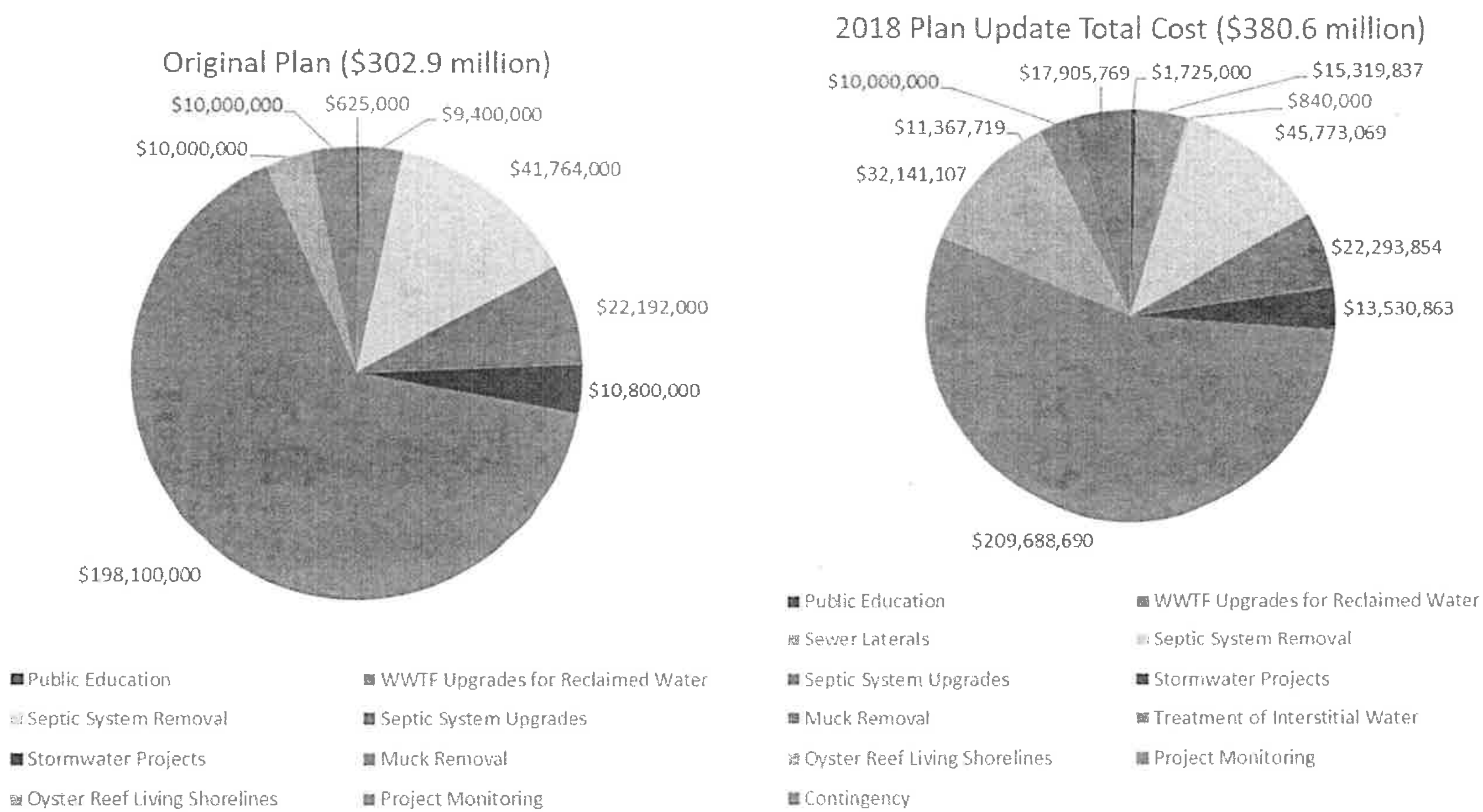

Figure 6-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2018 Plan Update Cost by Project Category (Right)

Section 7. 2019 Plan Update

For the 2019 Plan Update, local municipalities and partners were once again invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits as those projects listed in the original plan for each sub-lagoon.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were included in the draft plan update presented to the Brevard County Board of County Commissioners for approval.

To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 7-1** for that project type. The costs shown in **Table 7-1** were included in the application form provided to the partners in September 2018, and were an average of the actual or engineer's estimate of cost per pound of TN removed from the projects previously listed in the Save Our Indian River Lagoon Project Plan, as amended or comparable projects recently planned or completed elsewhere in the IRL watershed. An erroneous cost-share in the Project Submittal Request Form for muck removal was corrected from $1,609 to $957 during the application process, before projects were presented to the Citizens Oversight Committee and recommended for inclusion in the 2019 Plan Update.

Table 7-1: Cost-share Offered for Project Requests Submitted for the 2019 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$300
Sewer Lateral Rehabilitation Pilot	$450
Septic System Removal by Sewer Extension	$1,455
Septic System Removal by Sewer Connection	$443
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$94
Merritt Island	$177
Barrier Island	$155
Muck Removal	$957
Treatment of Muck Interstitial Water	$200
Oyster Bar	$395
Planted Shorelines	$240

The application for 2019 Substitute Projects set cost-share based on the best available data at the time that the project request form was published. Additional studies and reports on project costs and nutrient removal, as well as project additions and substitutions in this plan update culminate in the modification of several values as shown in **Table 7-2**. The average cost per pound of nitrogen removed by septic systems removed by sewer extensions reduced from $1,455 to $1,123 due to swapping out some projects for more cost-effective areas. The average

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cost per pound of nitrogen removed by septic system connected to adjacent sewer lines increased from $443 to $530 due to selecting more of the next most cost-effective opportunities for quick connections. Stormwater cost-share changed from $94 to $122 on the mainland, from $177 to $163 on Merritt Island, and from $155 to $150 on the Barrier Island due to the addition of 129 stormwater basins and the deletion of seven stormwater basins in these geographic areas. The cost for muck removal decreased from $957 to $531 based on updated flux values and the revised locations proposed for dredging as part of this update. The treatment of muck interstitial water decreased from $200 per pound per year based on recent bids indicating this amount may be lowered to $50 per pound per year.

Table 7-2: Average Cost-Share by Project Type in the 2019 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$300
Sewer Lateral Rehabilitation Pilot	$450
Septic System Removal by Sewer Extension	$1,123
Septic System Removal by Sewer Connection	$530
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$122
Merritt Island	$163
Barrier Island	$150
Muck Removal	$531
Treatment of Muck Interstitial Water	$50
Oyster Bar	$395
Planted Shorelines	$240

7.1. New Projects in the 2019 Plan Update

The approved projects for inclusion in the 2019 Plan Update are summarized in **Table 7-3**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund dollars allocated to each project. Once the 2019 Plan Update is approved by the County Commission, the projects are part of the Save Our Indian River Lagoon Project Plan and are reflected in the updated plan tables shown in **Section 9**.

Table 7-3: Summary of New Projects for the Save Our Indian River Lagoon Plan 2019 Update

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Big Muddy at Cynthia Baffle Box Expansion	City of Indian Harbour Beach	Nutrient Separating Baffle Box with Bold & Gold media. Expansion of treated area to 63.8 acres from 32 acres of previously approved project.	Banana	167	10	$25,837
2019	Basin 1304 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	Banana	958	127	$90,000
2019	M1 Canal Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	1,433	191	$66,300
2019	Fleming Grant Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	602	91	$16,800
2019	Espanola Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	Central IRL	1119	148	$105,186
2019	Basin 1298 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	North IRL	917	116	$86,198
2019	Johns Road Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	245	37	$23,030
2019	Burkholm Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	685	104	$64,390
2019	Carter Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	665	101	$62,510
2019	Wiley Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	954	144	$82,735
2019	Broadway Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	456	69	$42,864
2019	Cherry Street Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	980	174	$92,120
2019	Spring Creek Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	1057	232	$99,358
2019	Titusville High School Baffle Box	City of Titusville	Installation of 2nd generation baffle box with Bold & Gold media filter.	North IRL	1,190	166	$111,813
2019	Coleman Pond Managed Aquatic Plant System	City of Titusville	Installation of floating islands within a one-acre city-owned pond located within the Chain of Lakes basin.	North IRL	1,240	198	$35,000

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Cocoa Beach Water Reclamation Facility Upgrade	City of Cocoa Beach	Upgrade to systems to avoid the potential for plant overflows during power outages and/or storm flow conditions. Various improvements that include emergency power, automatic post-anoxic bypass and 6.0 million gallons per day filter upgrades.	Banana	3,278	1,092	$983,400
2019	Osprey Basin Lateral Repair Project	City of Titusville	Smoke testing of gravity system and private sewer lateral repairs.	North IRL	640	0	$200,000
2019	Cocoa Beach Muck Dredging Phase II-B	City of Cocoa Beach	Dredge 12 residential canals.	Banana	6,300	840	$5,917,650
2019	Brevard Zoo Banana River Plant Project	Brevard Zoo	Plant 195 feet of qualifying shoreline vegetation within the Tortoise Island homeowners' association.	Banana	13	4	$3,120
2019	Brevard Zoo North IRL Plant Project	Brevard Zoo	Plant 50 feet of qualifying shoreline vegetation at St. Mark's School.	North IRL	3	1	$720
2019	Brevard Zoo Banana River Oyster Project	Brevard Zoo	Construct 36,894 square feet of oyster projects in the Banana River. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Banana	1,476	37	$583,020
2019	Brevard Zoo Central IRL Oyster Project	Brevard Zoo	Construct 10,200 square feet of oyster projects in the Central IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Central IRL	408	10	$161,160
2019	Brevard Zoo North IRL Oyster Project	Brevard Zoo	Construct 21,600 square feet of oyster projects in the North IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	North IRL	864	22	$341,280
-	***Total***	-	-	-	***25,650***	***3,914***	***$9,194,491***

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7.2. Project Changes

7.2.1 Withdrawals

Some of the projects submitted by the local governments as part of previous plan updates were determined to not be cost-effective and/or feasible to implement after further investigation. Therefore, the local governments requested that these projects be removed from the Save Our Indian River Lagoon Project Plan so that the funding could be used for other projects. **Table 7-4** lists the projects that have been removed from the plan at the request of the responsible entity.

Table 7-4: Summary of Project Withdrawals

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Cocoa Beach Muck Dredging – Phase III Interstitial	City of Cocoa Beach	Banana	2,942	To be determined	$514,809
Indian River Drive Oyster Bar (reduction from 1,900 to 140 feet)	Brevard County	North IRL	422	10	$166,672
Indian River Drive Planted Shoreline (reduction from 1,900 to 140 feet)	Brevard County	North IRL	118	41	$20,620
Mims Muck Removal: Outflow Water Nutrient Removal	Brevard County	North IRL	2,803	244	$400,000
Total	-	-	***6,285***	***295***	***$1,102,101***

In addition, Brevard County reviewed the basins proposed for stormwater treatment in the original plan and identified those basins that should be removed because they could not be easily treated or are basins where the County already has projects. These basins are summarized in **Table 7-5**.

Table 7-5: Summary of Stormwater Basin Withdrawals

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 905	1,143	178	$150,000
Banana	Stormwater project in Basin 492	1,020	117	$100,000
Banana	Stormwater project in Basin 522	795	110	$125,000
Banana	Stormwater project in Basin 705	650	95	$100,000
Banana	Stormwater project in Basin 821	627	123	$100,000
Banana	Stormwater project in Basin 820	597	112	$100,000
North IRL	Stormwater project in Basin 338	4,226	188	$125,000
North IRL	Stormwater project in Basin 155	2,553	122	$100,000
North IRL	Stormwater project in Basin 47	1,348	139	$125,000
North IRL	Stormwater project in Basin 219	956	113	$125,000
Total	-	***13,915***	***1,297***	***$1,150,000***

7.2.2 Revisions

Two of the stormwater projects removed from the 2018 Update were determined to be viable options and are added back to the plan as part of the 2019 Update. These two projects are shown below in **Table 7-6**.

Table 7-6: Stormwater Projects Added Back into the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1317	1,679	143	$125,000
Banana	Stormwater project in Basin 998	1,196	189	$100,000

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In addition, the County identified additional stormwater basins to substitute for stormwater projects previously removed or withdrawn from the plan. Sufficient basins are added, as shown in **Table 7-7** through **Table 7-9**, to restore stormwater nutrient reductions in each sub-lagoon to the levels proposed in the original plan.

Table 7-7: New Banana River Lagoon Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1002	1,181	159	$100,000
Banana	Stormwater project in Basin 1033	1,113	152	$100,000
Banana	Stormwater project in Basin 1026	1,073	180	$100,000
Banana	Stormwater project in Basin 912	1,025	34	$100,000
Banana	Stormwater project in Basin 981	993	179	$100,000
Banana	Stormwater project in Basin 1016	920	136	$100,000
Banana	Stormwater project in Basin 997	915	149	$100,000
Banana	Stormwater project in Basin 980	836	127	$100,000
Banana	Stormwater project in Basin 940	816	106	$100,000
Banana	Stormwater project in Basin 1334	795	130	$100,000
Banana	Stormwater project in Basin 1378	744	104	$100,000
Banana	Stormwater project in Basin 1372	720	113	$100,000
Banana	Stormwater project in Basin 1039	708	104	$100,000
Banana	Stormwater project in Basin 1104	701	106	$100,000
Banana	Stormwater project in Basin 1124	681	99	$100,000
Banana	Stormwater project in Basin 1187	662	82	$100,000
Banana	Stormwater project in Basin 982	642	68	$100,000
Banana	Stormwater project in Basin 990	634	102	$100,000
Banana	Stormwater project in Basin 829	630	145	$100,000
Banana	Stormwater project in Basin 988	621	108	$100,000
Banana	Stormwater project in Basin 1328	617	89	$100,000
Banana	Stormwater project in Basin 944	614	83	$100,000
Banana	Stormwater project in Basin 1024	609	106	$100,000
Banana	Stormwater project in Basin 957	586	53	$100,000
Banana	Stormwater project in Basin 1310	583	106	$100,000
Banana	Stormwater project in Basin 984	569	60	$100,000
Banana	Stormwater project in Basin 1133	562	90	$100,000
Banana	Stormwater project in Basin 1223	561	86	$100,000
Banana	Stormwater project in Basin 977	558	59	$100,000
Banana	Stormwater project in Basin 889	539	85	$100,000
Banana	Stormwater project in Basin 960	537	80	$100,000
Banana	Stormwater project in Basin 1142	534	73	$100,000
Banana	Stormwater project in Basin 1037	533	105	$100,000
Banana	Stormwater project in Basin 969	528	78	$100,000
Banana	Stormwater project in Basin 955	522	60	$100,000
Banana	Stormwater project in Basin 975	521	75	$100,000
Banana	Stormwater project in Basin 1362	476	71	$100,000
Banana	Stormwater project in Basin 1336	470	68	$100,000
Banana	Stormwater project in Basin 1067	463	67	$100,000
Banana	Stormwater project in Basin 865	454	151	$100,000
Banana	Stormwater project in Basin 1251	448	66	$100,000
Banana	Stormwater project in Basin 1262	443	80	$100,000
Banana	Stormwater project in Basin 961	431	57	$100,000
Banana	Stormwater project in Basin 938	424	160	$100,000
Banana	Stormwater project in Basin 1001	401	54	$100,000

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Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1220	396	61	$100,000
Banana	Stormwater project in Basin 1175	394	42	$100,000
Banana	Stormwater project in Basin 1018	389	54	$100,000
Banana	Stormwater project in Basin 1010	374	55	$100,000
Banana	Stormwater project in Basin 934	365	42	$100,000
Banana	Stormwater project in Basin 1198	365	62	$100,000
Banana	Stormwater project in Basin 1327	352	52	$100,000
Banana	Stormwater project in Basin 2421	343	49	$100,000
Banana	Stormwater project in Basin 1098	341	53	$100,000
Banana	Stormwater project in Basin 1357	338	56	$100,000
Banana	Stormwater project in Basin 1014	333	50	$100,000
Banana	Stormwater project in Basin 1120	313	50	$100,000
Banana	Stormwater project in Basin 1125	307	51	$100,000
Banana	Stormwater project in Basin 1248	306	46	$100,000
Banana	Stormwater project in Basin 929	304	41	$100,000
Banana	Stormwater project in Basin 1332	303	47	$100,000
Banana	Stormwater project in Basin 933	302	38	$100,000
Banana	Stormwater project in Basin 1231	300	58	$100,000
Banana	Stormwater project in Basin 1117	282	43	$100,000
Banana	Stormwater project in Basin 1000	277	40	$100,000
Banana	Stormwater project in Basin 1371	273	39	$100,000
Banana	Stormwater project in Basin 1041	273	47	$100,000
Banana	Stormwater project in Basin 1183	272	39	$100,000
Banana	Stormwater project in Basin 1082	264	39	$100,000
Banana	Stormwater project in Basin 925	261	20	$100,000
Banana	Stormwater project in Basin 1338	256	37	$100,000
Banana	Stormwater project in Basin 1152	245	30	$100,000
Banana	Stormwater project in Basin 1296	241	48	$100,000
Banana	Stormwater project in Basin 1346	189	28	$100,000
Banana	Stormwater project in Basin 1250	188	26	$100,000
Banana	Stormwater project in Basin 1270	187	28	$100,000
Banana	Stormwater project in Basin 1121	186	27	$100,000
Banana	Stormwater project in Basin 1167	180	28	$100,000
Banana	Stormwater project in Basin 1302	172	25	$100,000
Banana	Stormwater project in Basin 1314	170	26	$100,000
Banana	Stormwater project in Basin 1303	166	24	$100,000
Banana	Stormwater project in Basin 1188	166	29	$100,000
Banana	Stormwater project in Basin 958	164	26	$100,000
Banana	Stormwater project in Basin 1038	157	25	$100,000
Banana	Stormwater project in Basin 1159	134	20	$100,000
Banana	Stormwater project in Basin 1351	129	19	$100,000
Banana	Stormwater project in Basin 1225	122	19	$100,000
Banana	Stormwater project in Basin 1305	119	25	$100,000
Banana	Stormwater project in Basin 1319	117	16	$100,000
Banana	Stormwater project in Basin 1070	113	12	$100,000
Banana	Stormwater project in Basin 1048	107	20	$100,000
Banana	***Total***	***40,928***	***6,157***	***$9,100,000***

Table 7-8: New North IRL Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 1463	1,321	195	$100,000
North IRL	Stormwater project in Basin 1081	1,281	210	$100,000
North IRL	Stormwater project in Basin 1392	1,256	197	$100,000
North IRL	Stormwater project in Basin 992	1,244	195	$100,000
North IRL	Stormwater project in Basin 911	1,238	147	$100,000
North IRL	Stormwater project in Basin 335	1,187	206	$100,000
North IRL	Stormwater project in Basin 1002	1,181	159	$100,000
North IRL	Stormwater project in Basin 1396	1,160	169	$100,000
North IRL	Stormwater project in Basin 895	1,138	122	$100,000
North IRL	Stormwater project in Basin 513	1,137	183	$100,000
North IRL	Stormwater project in Basin 1381	1,116	172	$100,000
North IRL	Stormwater project in Basin 290	1,116	193	$100,000
North IRL	Stormwater project in Basin 1387	1,113	179	$100,000
North IRL	Stormwater project in Basin 1033	1,113	152	$100,000
North IRL	Stormwater project in Basin 987	1,099	172	$100,000
North IRL	Stormwater project in Basin 1071	1,082	144	$100,000
North IRL	Stormwater project in Basin 1112	1,032	166	$100,000
North IRL	Stormwater project in Basin 1458	1,024	135	$100,000
North IRL	Stormwater project in Basin 89	1,023	147	$100,000
North IRL	Stormwater project in Basin 833	1,007	185	$100,000
North IRL	Stormwater project in Basin 1331	1,000	159	$100,000
North IRL	Stormwater project in Basin 1456	978	137	$100,000
North IRL	Stormwater project in Basin 1401	953	147	$100,000
North IRL	Stormwater project in Basin 1380	929	134	$100,000
North IRL	Stormwater project in Basin 94	925	136	$100,000
North IRL	Stormwater project in Basin 1016	920	136	$100,000
North IRL	Stormwater project in Basin 1213	904	131	$100,000
North IRL	Stormwater project in Basin 1034	902	132	$100,000
North IRL	Stormwater project in Basin 1459	895	132	$100,000
North IRL	Stormwater project in Basin 1222	888	171	$100,000
North IRL	Stormwater project in Basin 100	888	115	$100,000
North IRL	Stormwater project in Basin 1359	887	142	$100,000
North IRL	Stormwater project in Basin 1391	887	142	$100,000
North IRL	Stormwater project in Basin 1464	884	122	$100,000
North IRL	Stormwater project in Basin 832	872	147	$100,000
North IRL	Stormwater project in Basin 1080	861	134	$100,000
North IRL	Stormwater project in Basin 624	860	134	$100,000
North IRL	Stormwater project in Basin 1339	857	103	$100,000
North IRL	Stormwater project in Basin 26	854	129	$100,000
North IRL	Stormwater project in Basin 1172	852	123	$100,000
North IRL	Stormwater project in Basin 392	840	155	$100,000
North IRL	Stormwater project in Basin 980	836	127	$100,000
North IRL	Stormwater project in Basin 594	833	135	$100,000
North IRL	Stormwater project in Basin 1418	832	111	$100,000
North IRL	Stormwater project in Basin 1389	822	134	$100,000
North IRL	Stormwater project in Basin 115	821	175	$100,000
North IRL	Stormwater project in Basin 940	816	106	$100,000
North IRL	Stormwater project in Basin 1295	800	121	$100,000
North IRL	Stormwater project in Basin 597	800	142	$100,000
North IRL	Stormwater project in Basin 262	794	126	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 894	794	116	$100,000
North IRL	Stormwater project in Basin 72	790	140	$100,000
North IRL	Stormwater project in Basin 1417	771	117	$100,000
North IRL	Stormwater project in Basin 1395	768	114	$100,000
North IRL	Stormwater project in Basin 141	761	124	$100,000
North IRL	Stormwater project in Basin 1378	744	104	$100,000
North IRL	Stormwater project in Basin 921	743	96	$100,000
North IRL	Stormwater project in Basin 288	732	78	$100,000
North IRL	Stormwater project in Basin 1214	727	84	$100,000
North IRL	Stormwater project in Basin 1348	723	102	$100,000
North IRL	Stormwater project in Basin 1372	720	113	$100,000
North IRL	Stormwater project in Basin 1426	720	116	$100,000
North IRL	Stormwater project in Basin 1032	719	115	$100,000
North IRL	Stormwater project in Basin 1363	715	123	$100,000
North IRL	Stormwater project in Basin 677	709	136	$100,000
North IRL	Stormwater project in Basin 1039	708	104	$100,000
North IRL	Stormwater project in Basin 212	693	89	$100,000
North IRL	Stormwater project in Basin 1425	690	113	$100,000
North IRL	Stormwater project in Basin 985	687	99	$100,000
North IRL	Stormwater project in Basin 644	686	94	$100,000
North IRL	Stormwater project in Basin 1029	685	93	$100,000
North IRL	Stormwater project in Basin 228	684	131	$100,000
North IRL	Stormwater project in Basin 1124	681	99	$100,000
North IRL	Stormwater project in Basin 838	658	135	$100,000
North IRL	Stormwater project in Basin 10	648	97	$100,000
North IRL	Stormwater project in Basin 805	645	94	$100,000
North IRL	Stormwater project in Basin 6	645	72	$100,000
North IRL	Stormwater project in Basin 1491	641	93	$100,000
North IRL	Stormwater project in Basin 1330	639	89	$100,000
North IRL	Stormwater project in Basin 796	639	98	$100,000
North IRL	Stormwater project in Basin 827	639	96	$100,000
North IRL	Stormwater project in Basin 1240	638	100	$100,000
North IRL	Stormwater project in Basin 903	631	88	$100,000
North IRL	Stormwater project in Basin 829	630	145	$100,000
North IRL	Stormwater project in Basin 1294	628	94	$100,000
North IRL	Stormwater project in Basin 544	624	98	$100,000
North IRL	Stormwater project in Basin 806	622	100	$100,000
North IRL	Stormwater project in Basin 1382	622	88	$100,000
North IRL	Stormwater project in Basin 840	619	84	$100,000
North IRL	Stormwater project in Basin 1313	619	92	$100,000
North IRL	Stormwater project in Basin 759	614	98	$100,000
North IRL	Stormwater project in Basin 1390	612	92	$100,000
North IRL	Stormwater project in Basin 993	611	93	$100,000
North IRL	Stormwater project in Basin 1197	609	82	$100,000
North IRL	Stormwater project in Basin 1233	605	101	$100,000
North IRL	Stormwater project in Basin 922	601	107	$100,000
North IRL	Stormwater project in Basin 1354	597	86	$100,000
North IRL	Stormwater project in Basin 1076	595	91	$100,000
North IRL	Stormwater project in Basin 510	586	92	$100,000
North IRL	Stormwater project in Basin 1241	584	83	$100,000
North IRL	Stormwater project in Basin 896	581	123	$100,000
North IRL	Stormwater project in Basin 1244	576	78	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 1027	560	84	$100,000
North IRL	Stormwater project in Basin 1403	558	88	$100,000
North IRL	Stormwater project in Basin 1316	557	68	$100,000
North IRL	Stormwater project in Basin 354	555	115	$100,000
North IRL	Stormwater project in Basin 294	551	84	$100,000
North IRL	Stormwater project in Basin 1312	549	120	$100,000
North IRL	Stormwater project in Basin 105	549	72	$100,000
North IRL	Stormwater project in Basin 1221	545	85	$100,000
North IRL	Stormwater project in Basin 889	539	85	$100,000
North IRL	Stormwater project in Basin 960	537	80	$100,000
North IRL	Stormwater project in Basin 568	534	85	$100,000
North IRL	Stormwater project in Basin 890	533	110	$100,000
North IRL	Stormwater project in Basin 1037	533	105	$100,000
North IRL	Stormwater project in Basin 751	532	121	$100,000
North IRL	Stormwater project in Basin 1413	528	78	$100,000
North IRL	Stormwater project in Basin 962	527	75	$100,000
North IRL	Stormwater project in Basin 1361	524	79	$100,000
North IRL	Stormwater project in Basin 1291	518	79	$100,000
North IRL	Stormwater project in Basin 1219	512	60	$100,000
North IRL	Stormwater project in Basin 920	511	87	$100,000
North IRL	Stormwater project in Basin 939	502	71	$100,000
North IRL	Stormwater project in Basin 1228	501	83	$100,000
North IRL	Stormwater project in Basin 353	497	86	$100,000
North IRL	Stormwater project in Basin 1423	487	73	$100,000
North IRL	Stormwater project in Basin 291	485	82	$100,000
North IRL	Stormwater project in Basin 1498	483	74	$100,000
North IRL	Stormwater project in Basin 1429	477	55	$100,000
North IRL	Stormwater project in Basin 1150	476	57	$100,000
North IRL	Stormwater project in Basin 263	469	65	$100,000
North IRL	Stormwater project in Basin 1067	463	67	$100,000
North IRL	Stormwater project in Basin 1293	461	67	$100,000
North IRL	Stormwater project in Basin 1344	459	61	$100,000
North IRL	Stormwater project in Basin 83	452	61	$100,000
North IRL	Stormwater project in Basin 2420	450	121	$100,000
North IRL	Stormwater project in Basin 1259	450	106	$100,000
North IRL	Stormwater project in Basin 1398	449	74	$100,000
North IRL	Stormwater project in Basin 1251	448	66	$100,000
North IRL	Stormwater project in Basin 1262	443	80	$100,000
North IRL	Stormwater project in Basin 1428	440	65	$100,000
North IRL	Stormwater project in Basin 884	437	68	$100,000
North IRL	Stormwater project in Basin 1307	431	47	$100,000
North IRL	Stormwater project in Basin 578	430	68	$100,000
North IRL	Stormwater project in Basin 1073	428	61	$100,000
North IRL	Stormwater project in Basin 938	424	160	$100,000
North IRL	Stormwater project in Basin 1113	416	93	$100,000
North IRL	Stormwater project in Basin 862	416	72	$100,000
North IRL	Stormwater project in Basin 1224	401	111	$100,000
North IRL	Stormwater project in Basin 1220	396	61	$100,000
North IRL	Stormwater project in Basin 1292	386	60	$100,000
North IRL	Stormwater project in Basin 1215	382	52	$100,000
North IRL	Stormwater project in Basin 2419	381	43	$100,000
North IRL	Stormwater project in Basin 1253	379	54	$100,000

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Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 871	366	53	$100,000
North IRL	Stormwater project in Basin 512	364	53	$100,000
North IRL	Stormwater project in Basin 1245	356	49	$100,000
North IRL	Stormwater project in Basin 2421	343	49	$100,000
North IRL	Stormwater project in Basin 1435	328	43	$100,000
North IRL	Stormwater project in Basin 1231	300	58	$100,000
North IRL	Stormwater project in Basin 1128	279	77	$100,000
North IRL	Stormwater project in Basin 902	276	35	$100,000
North IRL	***Total***	***111,229***	***17,296***	***$16,200,000***

Table 7-9: New Central IRL Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Central IRL	Stormwater project in Basin 1470	2,813	452	$200,000
Central IRL	Stormwater project in Basin 1511	2,490	381	$200,000
Central IRL	Stormwater project in Basin 1508	2,459	356	$200,000
Central IRL	Stormwater project in Basin 1803	2,227	318	$200,000
Central IRL	Stormwater project in Basin 1825	1,896	394	$200,000
Central IRL	Stormwater project in Basin 1445	1,493	198	$200,000
Central IRL	Stormwater project in Basin 1439	1,413	183	$200,000
Central IRL	***Total***	***14,791***	***2,282***	***$1,400,000***

In addition, the estimated nutrient reduction benefits for three muck dredging projects were updated based on the new flux data that were collected. The updated reductions are shown in **Table 7-10**.

Table 7-10: Updated Muck Dredging Project Reductions

Category	Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN Removed	TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Sykes Creek	$4,705,428	19,635	$240	2,618	$1,797
Grand Canal	$2,440,971	10,185	$240	1,358	$1,797
Turkey Creek Re-dredging	$215,000	5,691	$38	221	$973

7.2.3 Updated Cost-Share Funding

Several stakeholders requested updated cost-share funding based on the 2019 Update cost-share rates. Some stakeholders were also able to modify their project to increase the amount of nitrogen and phosphorous removed. The projects, their previous cost-share funding amount, and updated funding eligibility are shown in **Table 7-11**.

Table 7-11: Projects with Updated Cost-Share Funding

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Original Plan Funding	Updated Plan Funding
Muck Removal of Indian Harbour Beach Canals	City of Indian Harbour Beach	Banana	3,780*	720*	$909,571	$3,631,815
Muck Interstitial Water Treatment for Indian Harbour Beach Canals	City of Indian Harbour Beach	Banana	27,418	To be determined	$4,798,197	$5,483,600
Big Muddy at Cynthia Baffle Box	City of Indian Harbour Beach	Banana	269	48	$26,637	$41,695

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Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Original Plan Funding	Updated Plan Funding
Cocoa Beach Muck Dredging – Phase III	City of Cocoa Beach	Banana	4,095*	780*	$981,305	$1,376,305
Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	City of Cocoa Beach	Banana	30	3	$2,922	$4,650
Stormwater Low Impact Development Convair Cove 2 – Dempsey Drive	City of Cocoa Beach	Banana	29	3	$2,842	$4,495
Merritt Island Muck Removal – Phase 1	Brevard County	Banana	8,085*	1,540*	$1,936,415	$7,733,517
Church Street Type II Baffle Box	City of Cocoa	North IRL	937*	135*	$20,856	$88,045
Sylvan Estates Septic-to-Sewer Conversion	City of West Melbourne	Central IRL	1,073	Not applicable	$935,656	$1,561,215
Grant Street Water Reclamation Facility Nutrient Removal Improvements	City of Melbourne	Central IRL	25,627	9,671	$5,919,837	$7,688,100
Micco Sewer Line Extension	Sebastian Inlet Marina	Central IRL	1,359*	Not applicable	$1,391,316	$1,977,345
Turkey Creek Shoreline Restoration – Oysters	City of Palm Bay	Central IRL	309*	8*	$113,500	$122,055
Turkey Creek Shoreline Restoration – Planted	City of Palm Bay	Central IRL	104*	36*	Included in above	$24,960
Total	-	-	***73,115***	***12,944***	***$17,039,054***	***$29,737,797***

* Updated nutrient reduction estimate.

7.3. Project Funding

The 2018 Plan Update added a Contingency Fund Reserve in the amount of 5% of the total Trust Fund dollars budgeted for approved projects in each fiscal year. The purpose of this reserve is to fund emergency response to harmful algal blooms, major fish kills, or to cover reasonable funding shortfalls that may occur during project implementation.

The previously approved Contingency Fund Reserve may also be used to increase funding for approved projects that encounter cost-effective opportunities for value added modifications that could occur swiftly if funding could be made available before the next plan update. If a project can be expanded or altered to provide greater nutrient reduction benefits than planned, contingency funds can be allocated at the rate for that project type established in the most recently adopted plan update in the table titled "Cost-share per Pound of TN Removed by Project Type." In no case shall the total cost-share from the Trust Fund exceed the total project costs, minus other grants or donations for that project. Amendment approvals would follow one of the three approval processes below:

1. If the amount of funds to be added to the cost-share contract exceeds the signature authority of the County Manager, the funding request will be brought to the Citizen Oversight Committee for a recommendation and to the County Commission for authorization to execute a contract amendment.
2. If the amount of funds to be added to the cost-share contract is within the signature authority of the County Manager but exceeds 10% of the original contract amount, the funding request will be brought to the Citizen Oversight Committee for a recommendation to the County Manager to process a contract amendment.

3. If the amount of funds to be added to the cost-share contract is within the signature authority for the County Manager and less than 10% over the original contract amount, staff will process a contract amendment in accordance with Brevard County contracting policies and administrative orders.

In addition to the Contingency Fund Reserve, if a future project is ready to move forward earlier than scheduled in the plan, if such advancement is consistent with temporal sequencing goals in the plan and is recommended by the Citizen Oversight Committee, and if there are sufficient Trust Fund dollars available, the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to adjust the project schedule at any time to ensure that approved projects funded in the plan move forward as soon as feasible. This authority allows projects to move forward as soon as they are ready and funding is available without waiting for an annual plan update to modify the schedule. If a project schedule is updated between plan updates, this schedule change will be reflected in the next annual plan update.

If a project is not able to be completed as initially approved in the plan due to extenuating circumstances, such as permitting restrictions, loss of additional funding, or other situations beyond the managing entity's control, but is able to be downsized instead of fully withdrawn and is recommended by the Citizen Oversight Committee, then the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to reduce the project funding. The revised funding amount will be based on the pounds of nitrogen removal estimated for the reduced project multiplied by the eligible cost-share per pound of TN removed that is adopted for that project type in the most recent Save Our Indian River Lagoon Project Plan. If a project is downsized between plan updates, the revised plan costs and nutrient load reductions will be reflected in the next annual plan update.

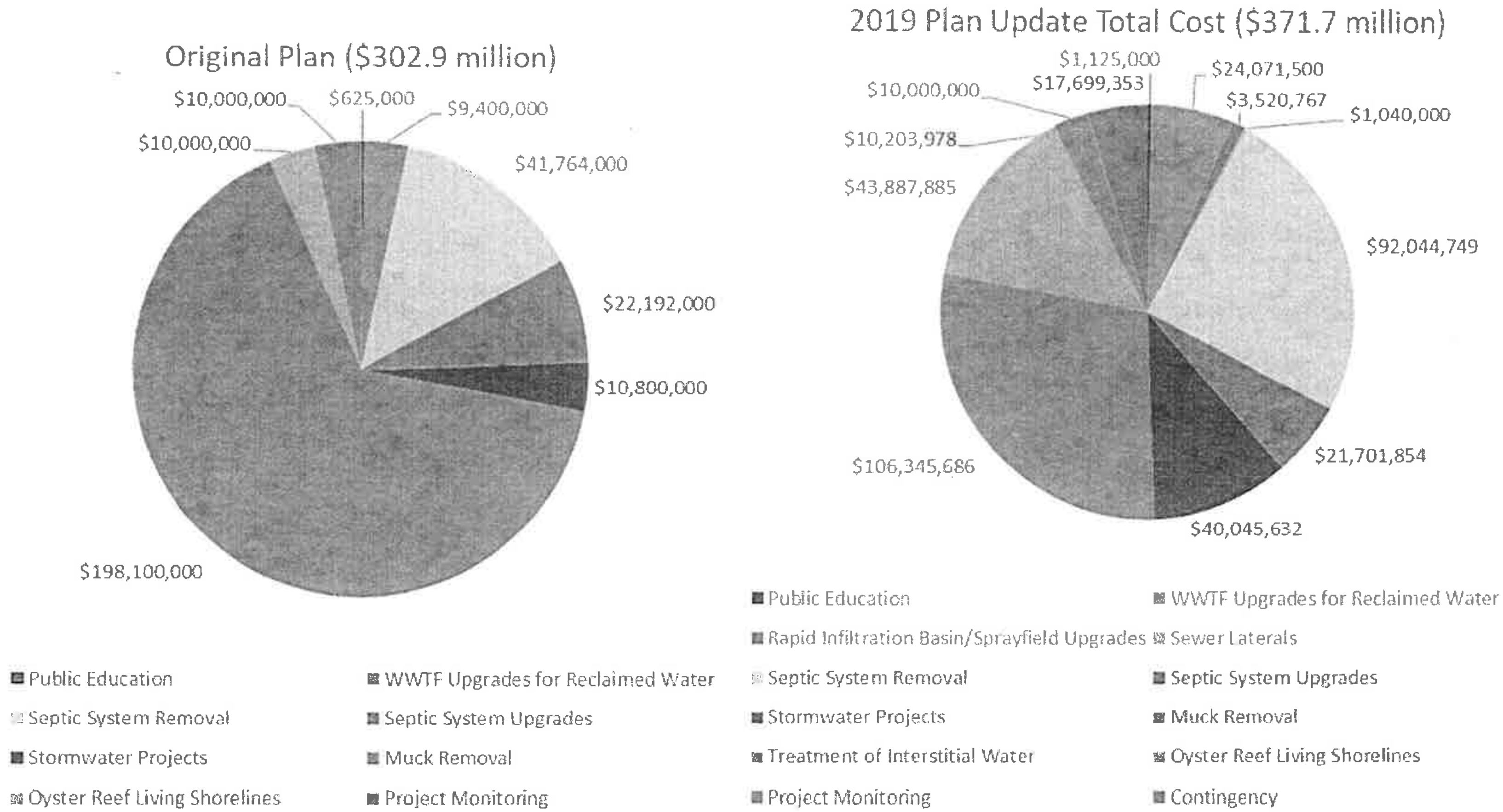

Figure 7-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2019 Plan Update Cost by Project Category (Right)

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Section 8. 2020 Plan Update

For the 2020 Plan Update, local municipalities and partners were once again invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits as those projects listed in the original plan and plan updates for each sub-lagoon.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request" to Brevard County for review of the proposed projects. The project requests were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were included in the draft plan update presented to the Brevard County Board of County Commissioners for approval.

To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 8-1** for that project type. The costs shown in **Table 8-1** were included in the application instructions provided to the partners in September 2019 and were an average of the actual or engineer's estimate of cost per pound of TN removed from the projects previously listed in the Save Our Indian River Lagoon Project Plan, as amended, or comparable projects recently planned or completed elsewhere in the IRL watershed.

Table 8-1: Cost-share Offered for Project Requests Submitted for the 2020 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$375
Sewer Lateral Rehabilitation	$639
Rapid Infiltration Basin/Sprayfield Upgrades	$73
Septic System Removal by Sewer Extension	$1,500
Septic System Removal by Sewer Connection	$500
Septic System Upgrades	$860
Stormwater Projects	-
Mainland	$122
Merritt Island	$164
Barrier Island	$148
Vegetation Harvesting	$110
Muck Removal	$485
Treatment of Muck Interstitial Water	$102
Oyster Bar	$400
Planted Shorelines	$240

8.1. New Projects in the 2020 Plan Update

The approved projects for inclusion in the 2020 Plan Update are summarized in **Table 8-2**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund dollars allocated to each project. Once the 2020 Plan Update is approved by the County Commission, the projects are part of the Save Our Indian River Lagoon Project Plan and are reflected in the updated plan tables shown in **Section 9**.

Table 8-2: Summary of New Projects for the Save Our Indian River Lagoon Plan 2020 Update

Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2b	Osprey Nutrient Removal Upgrade Phase 2	City of Titusville	The intent of Phase 1 of the Nutrient Removal Upgrade Project was to develop and construct biological, chemical and physical process upgrades throughout the Osprey Water Reclamation Facility directed toward an effluent TN concentration of 6 milligrams per liter and an effluent TP concentration of 1 milligram per liter. During design of Phase 1 it was discovered that with the addition of an internal recirculation process, the TN in the reclaimed water can reliably be lowered from 6 milligrams per liter to 3 milligrams per liter as an annual average. Phase 2 of the project will consist of the construction and implementation of the internal recirculation process during the construction of Phase 1.	North IRL	3,626	-	$300,000
111	Draa Field Vegetation Harvesting	City of Titusville	Vegetation harvesting within a 3-acre pond that leads to the IRL. Removal of invasive and nuisance plant species within the pond. The harvest of aquatic vegetation removes nutrients from the waterbody rather than recycling them through decomposition and sedimentation of the plant material into the sediment. Most freshwater plants do not tolerate the salinity of the IRL and upon release from tributaries will die and decompose adding a nutrient load directly to the IRL.	North IRL	574	-	$50,000
110	Osprey Plant Pond Managed Aquatic Plant Systems	City of Titusville	Installation of floating islands within a 2.3-acre city-owned pond located within the Marina Basin.	North IRL	606	88	$60,000
112	County Wide Stormwater Pond Harvesting	Brevard County Stormwater	Mechanical harvesting of 30 stormwater ponds.	North IRL	140	28	$14,000
113	Satellite Beach Interstitial Water Treatment	City of Satellite Beach	Alongside the dredging of the City of Satellite Beach portion of the Grand Canal and finger canals, interstitial water treatment will play a vital role in the health of the IRL. A permitted county spoil site exists in the area to deposit the muck and treat the interstitial water.	Banana	29,978	3,059	$3,057,756
114	Barefoot Bay Lateral Smoke Testing	Brevard County Utility Services Department	Smoke testing of the Barefoot Bay collection system.	Central IRL	864	-	$90,000
115	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	Smoke testing of the South Beaches collection system.	Central IRL	1,662	-	$200,000

Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
116	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	Smoke testing of the Merritt Island collection system.	North IRL	2,042	-	$250,000
117	Basin 10 County Line Road Woodchip Bioreactor	Brevard County Stormwater	Check dam to divert existing water flow in the ditch through a woodchip bioreactor capable of reducing nutrient loading.	North IRL	597	90	$72,773
118	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Check dam to divert existing water flow in the ditch through a woodchip bioreactor capable of reducing nutrient loading.	North IRL	605	92	$73,810
119	Basin 141 Irwin Avenue Woodchip Bioreactor	Brevard County Stormwater	Check dam to divert existing water flow in the ditch through a woodchip bioreactor capable of reducing nutrient loading.	North IRL	567	86	$69,174
120	Draa Field Pond Managed Aquatic Plant Systems	City of Titusville	Installation of floating islands within a 3-acre city-owned pond located within the Draa Field basin, which is part of the overall Marina Basin.	North IRL	256	38	$31,281
121	Basin 2258 Babcock Road Woodchip Bioreactor	Brevard County Stormwater	Check dam to divert existing water flow in the ditch through a woodchip bioreactor capable of reducing nutrient loading.	Central IRL	412	62	$50,203
122	Basin 22 Hunting Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Check dam to divert existing water flow in the ditch through a woodchip bioreactor capable of reducing nutrient loading.	North IRL	329	50	$40,077
123	Ray Bullard Water Reclamation Facility Stormwater Management Area	City of West Melbourne	New wet detention pond that will intercept the first flush of stormwater flows from the downstream end of Canal C1E. The new wet detention pond will be constructed at the city's wastewater treatment facility, in place of the existing lined reclaim water pond. The lined pond, and the surrounding areas, are no longer in use and currently serve no purpose. This project is located where Canal C1E splits into Canals C10 and C1, which allows the new system to intercept the entirety of flows from the upstream 450-acre basin prior to the flows splitting into two separate canals (both of which flow to the Central IRL). Two concrete diversion structures will be constructed at the upstream ends of Canals C10 and C11, which will divert the first flush of stormwater flow into the new wet detention pond. Check valves will be installed on the intake piping for the wet detention pond to prevent backflow of the first flush into the canal system. The new wet detention pond will allow for treatment of TN and TP and will also provide additional stormwater storage, which will aid with flooding of upstream areas during heavy rainfall events.	Central IRL	800	366	$97,600

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Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
124	Floating Wetlands to Existing Stormwater Ponds	City of Cocoa	Add floating wetlands in various locations to be determined around the City of Cocoa in different stormwater ponds.	North IRL	12	3	$1,497
125	Diamond Square Stormwater Pond	City of Cocoa	A wet pond to be excavated east of the Diamond Square Community Redevelopment Agency. This project is an essential component for improving the drainage abilities of Diamond Square and thus address flooding issues that have been experienced in the past.	North IRL	85	23	$10,383
127	Basin 5 Dry Retention	Town of Indialantic	Construct new dry retention facility and diversion structure near outfall	North IRL	113	18	$16,680
128	Jackson Court Stormwater Treatment Facility	City of Satellite Beach	A treatment train approach for reducing nutrient loading from three basins. Runoff will flow from dry retention in the form of swales or exfiltration, to a wet detention pond, and through a nutrient removal filter structure before discharging to the river.	Banana	56	8	$8,266
129	Forrest Avenue 72-inch Outfall Baseflow Capture/Treatment	City of Cocoa	A dry detention pond in a vacant lot that will have a biosorption activated media underdrain filtration system to prevent infiltration of water in the area despite an increase in the volume of water being stored for treatment. The project would simultaneously treat baseflow from Bracco as well as effluent from the adjacent drainage basin and reduce infiltration in the immediate area.	North IRL	94	12	$13,956
130	Brevard Zoo North IRL Plant Project 2	Brevard Zoo	Brevard Zoo intends to plant 610 linear feet of qualifying shoreline vegetation in the North IRL.	North IRL	41	14	$9,840
131	Brevard Zoo Central IRL Plant Project	Brevard Zoo	Brevard Zoo intends to plant 124 linear feet of qualifying shoreline vegetation in the Central IRL.	Central IRL	8	3	$1,920
132	Brevard Zoo Banana River Plant Project 2	Brevard Zoo	Brevard Zoo intends to plant 25 linear feet of qualifying shoreline vegetation in the Banana River.	Banana	2	1	$480
133	Fisherman's Landing	Marine Resources Council	Mangroves will be planted along the north section of Fisherman's Landing which has approximately 500 feet of lagoon front shoreline. Some existing vegetation exists with open pockets of shoreline that will be filled in with 60 mangroves.	Central IRL	20	7	$4,800
135	Rotary Park	Marine Resources Council	Mangroves will be planted along the north section of Suntree Rotary Park which has approximately 500 feet of lagoon front shoreline. Some existing vegetation exists with open pockets of shoreline that will be filled in with 60 mangroves.	Central IRL	20	7	$4,800

Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
138	Ray Bullard Water Reclamation Facility Biological Nutrient Removal Upgrades	City of West Melbourne	The City completed a preliminary feasibility analysis to identify an approach to implement biological nutrient removal at the facility. Monthly grab sampling of the approximately 800,000 gallon per day average reclaimed water flow shows the TN concentration averaging 23.51 milligrams per liter and the TP concentration averaging 6.38 milligrams per liter from January 2018 through June 2019. The city will modify the existing conventional activated sludge treatment system into a three-stage type biological nutrient removal activated sludge treatment system. This process will include an anaerobic basin to provide biological phosphorus removal followed by an anoxic basin and aerobic basin with internal recycle flows. Treating the wastewater through this process is expected to achieve a TN concentration of approximately 5 milligrams per liter and a TP concentration of approximately 1 milligrams per liter. To properly control the performance of the biological nutrient removal activated sludge treatment system to achieve low nutrient levels, the project will include replacement of the existing centrifugal blowers with new energy efficient hybrid blowers operated using variable frequency drives and related air piping replacement. The blowers would be operated in such a way as to control the dissolved oxygen concentration within the aeration basins to a narrow operating range to achieve the reduced nutrient levels.	Central IRL	11,360	3,302	$4,260,000
139	Brevard Zoo North IRL Oyster Project 2	Brevard Zoo	Brevard Zoo intends to construct 21,030 square feet of oyster projects in the North IRL. Reached out to property owners in the locations we intend to put these projects and have their support to move forward. The design will be site specific and will be approved by the county before construction begins. We will consult with the county to determine whether or not live oysters need to be added to each specific location.	North IRL	841	21	$336,400

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Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
140	Brevard Zoo Central IRL Oyster Project 2	Brevard Zoo	Brevard Zoo intends to construct 16,932 square feet of oyster projects in the Central IRL. Reached out to property owners in the locations we intend to put these projects and have their support to move forward. The design will be site specific and will be approved by the county before construction begins. We will consult with the county to determine whether or not live oysters need to be added to each specific location.	Central IRL	677	17	$270,800
141	Brevard Zoo Banana River Oyster Project 2	Brevard Zoo	Brevard Zoo intends to construct 16,560 square feet of oyster projects in the Banana River Basin of the IRL. Reached out to property owners in the locations we intend to put these projects and have their support to move forward. The design will be site specific and will be approved by the county before construction begins. We will consult with the county to determine whether or not live oysters need to be added to each specific location.	Banana	662	17	$264,800
142	Brevard Zoo Oyster Reef Adjustments North IRL	Brevard Zoo	Brevard Zoo intends to make adjustments to 1,700 square feet of already existing oyster reef in the North IRL. The design will be site specific and will be approved by the county before construction begins. We will consult with the county to determine whether or not live oysters need to be added to each specific location.	North IRL	68	2	$27,200
143	Brevard Zoo Oyster Reef Adjustments Banana River	Brevard Zoo	Brevard Zoo intends to make adjustments to 800 square feet of already existing oyster reef in the Banana River. The design will be site specific and will be approved by the county before construction begins. We will consult with the county to determine whether or not live oysters need to be added to each specific location.	Banana	32	1	$12,800
144	Satellite Beach Muck Dredging	City of Satellite Beach	By removing the muck via hydraulic dredging from the Grand Canal along the City of Satellite Beach, this project will alleviate an estimated 37 acres of muck from the Satellite Beach portion of the Grand Canal and its finger canals in the IRL. A permitted county spoil site exists in the area to deposit the muck and treat the interstitial water from the operations.	Banana	3,885	518	$1,884,225
145	Merritt Island - Zone F	Brevard County Utility Services Department	Septic to sewer conversion of 71 lots. Project includes gravity sewer, connections, and force main connections to county system.	Banana	1,292	-	$1,100,000

Project Number	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
50b	South Central - Zone C	Brevard County Utility Services Department	Septic to sewer conversion of 142 parcels. Project includes gravity sewer, connections, and force main.	North IRL	5,146	-	$4,900,000
136	Micco - Zone B	Brevard County Utility Services Department	Septic to sewer conversion of 540 parcels. Project includes gravity sewer, connections, and force main.	Central IRL	8,687	-	$9,000,000
146	Merritt Island - Zone C	Brevard County Utility Services Department	Septic to sewer conversion of 43 lots. Project includes gravity sewer, connections, and force main connections to county system.	Banana	1,419	-	$1,580,000
3b	Micco Sewer Line Extension - Phase II	Brevard County	The original project was submitted and accepted as a substitute project for the 2017 Plan Update. In order to capture additional waterfront septic systems and capitalize on sewer line expansion in the Micco area, an additional 13 residential properties are submitted as a Phase II to the original Micco Sewer Line Extension Project.	Central IRL	618	-	$709,745
147	Sykes Creek - Zone R	Brevard County Utility Services Department	Septic to sewer conversion of 192 lots. Project includes gravity sewer, connections, and force main connection to county system.	Banana	2,925	-	$3,500,000
150	South Central - Zone D	Brevard County Utility Services Department	Septic to sewer for 94 lots. Project includes force main, gravity sewer, and connections.	North IRL	3,387	-	$4,774,500
148	North Merritt Island - Zone E	Brevard County Utility Services Department	Septic to sewer conversion of 195 lots. Project includes gravity sewer, connections, and force main connection to county system.	Banana	2,541	-	$3,635,000
151	Merritt Island - Zone G	Brevard County Utility Services Department	Septic to sewer conversion of 1,146 lots. Project includes gravity sewer, connections, and force main connection to county system.	Banana	11,078	-	$16,617,000
152	Sharpes - Zone B	Brevard County Utility Services Department	Septic to sewer conversion of 136 lots. Project includes gravity sewer, force main, connections, and lift stations.	North IRL	2,692	-	$4,038,000
153	Cocoa - Zone C	Brevard County Utility Services Department	Septic to sewer conversion of 273 lots. Project includes gravity sewer, force main, connections, and lift stations.	North IRL	3,499	-	$5,248,500
-	***Total***	-	-	-	***104,318***	***7,933***	***$66,688,266***

8.2. Project Changes

8.2.1 Withdrawals

Some of the projects submitted by the local community as part of previous plan updates were determined to not be cost-effective and/or feasible to implement after further investigation. Therefore, requesting entities asked that these projects be removed from the Save Our Indian River Lagoon Project Plan so that the funding could be used for other projects. **Table 8-3** lists the projects that have been removed from the plan at the request of the responsible entity.

Table 8-3: Summary of Project Withdrawals

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Cape Canaveral Air Force Station WWTF Upgrade	Cape Canaveral Air Force Station	Banana	25,627	To be determined	$6,000,000
Malabar - Zone B	Brevard County	Central IRL	1,929	Not applicable	$2,135,808
Malabar - Zone A	Brevard County	Central IRL	11,456	Not applicable	$14,349,960
South Beaches - Zone F	Brevard County	Central IRL	70	Not applicable	$100,116
Carver Cove Swale	City of Cape Canaveral	Banana	32	9	$2,816
Cocoa Palms Low Impact Development	City of Cape Canaveral	Banana	13	10	$1,144
M1 Canal Biosorption Activated Media	Brevard County	Central IRL	1,433	191	$66,300
Oliver Oyster Bar	Brevard Zoo	North IRL	116	39	$51,620
Coconut Point/Environmentally Endangered Lands Oyster Bar (reduction from 27,125 square feet to 2,400 square feet)	Brevard Zoo	Central IRL	989	367	$464,830
Turkey Creek Shoreline Restoration – Oysters	City of Palm Bay	Central IRL	309	8	$122,055
Eden Isles Lane Oyster Bar	Brevard Zoo	Banana	49	17	$21,805
Turkey Creek Shoreline Restoration – Planted	City of Palm Bay	Central IRL	104	36	$24,960
Total	**-**	**-**	***42,127***	***677***	***$23,341,414***

8.2.2 Revisions

The City of Cocoa Beach requested a change in schedule for the Convair Cove 1 – Blakey Boulevard and Convair Cove 2 – Dempsey Drive stormwater projects, as well as the McNabb Park oyster bar and planted shoreline projects. The city received funding from the Florida Department of Environmental Protection that will not be available until October 2020. This funding is a large portion of the funding needed to construct these projects. The updated schedule for these four projects is shown in **Table 8-4**.

Table 8-4: Project Schedule Changes

Project Name	Responsible Entity	Sub-lagoon	Plan Funding	Original Schedule	Revised Schedule
Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	City of Cocoa Beach	Banana	$4,650	Fiscal Year 2018-2019	Fiscal Year 2020-2021
Stormwater Low Impact Development Convair Cove 2 – Dempsey Drive	City of Cocoa Beach	Banana	$4,495	Fiscal Year 2018-2019	Fiscal Year 2020-2021
McNabb Park Oyster Bar	City of Cocoa Beach	Banana	$34,056	Fiscal Year 2017-2018	Fiscal Year 2020-2021
McNabb Park Planted Shoreline	City of Cocoa Beach	Banana	$5,760	Fiscal Year 2017-2018	Fiscal Year 2020-2021
Penwood Sewer Conversion	City of Melbourne	Central IRL	$40,632	March 2020 (completion)	August 2021 (completion)
Riverside Drive Septic-to-Sewer Conversion	City of Melbourne	North IRL	$265,960	December 2020 (completion)	August 2021 (completion)

8.2.3 Updated Cost-Share Funding

Several stakeholders requested updated cost-share funding based on the 2020 Update cost-share rates. Some stakeholders were also able to modify their project to increase the amount of nitrogen and phosphorous removed. The projects, their previous cost-share funding amount, and updated funding eligibility are shown in **Table 8-5**.

Table 8-5: Projects with Updated Cost-Share Funding

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Original Plan Funding	Updated Plan Funding
Cocoa Beach Water Reclamation Facility Upgrade	City of Cocoa Beach	Banana	2,520*	685*	$983,400	$945,000
City of Titusville Osprey WWTF	City of Titusville	North IRL	8,660	Not applicable	$8,000,000	$8,800,000
City of Palm Bay Water Reclamation Facility	City of Palm Bay	Central IRL	20,240	102	$1,400,000	$3,636,900
Grant Street Water Reclamation Facility Nutrient Removal Improvements	City of Melbourne	Central IRL	18,052*	9,671	$7,688,100	$6,769,500
Micco Sewer Line Extension	Sebastian Inlet Marina	Central IRL	1,359	Not applicable	$1,977,345	$2,038,500
South Central – Zone C	Brevard County	North IRL	5,146	Not applicable	$4,900,000	$6,600,000
Fleming Grant Biosorption Activated Media	Brevard County	Central IRL	602	91	$16,800	$56,588
Total	-	-	***56,579***	***10,549***	***$24,965,645***	***$28,846,488***

* Updated nutrient reduction estimate.

8.3. Project Funding

8.3.1 Revenue Projection Update

The County calculated a new estimate for Save Our Indian River Lagoon Sales Tax revenues. This estimate is based on the actual revenues for 2017, 2018, and the first nine months of 2019. The 2019 revenues for the first nine months were also used to estimate the revenue from the remaining three months of 2019. The estimate then uses the current consumer price index for

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inflation of 1.8% compounded over the remaining life of the tax. The new estimate for the total tax revenue is $494,309,707, or an average of $49.4 million per year. This current estimate is $15.4 million per year more than the $34 million per year estimate in the original Save Our Indian River Lagoon Plan, which was based on 2016 dollars. This new estimate allows for the implementation of additional projects.

8.4. Unfunded Projects

Throughout this plan, there are projects listed that are currently not recommended due to limited funding. If some of the recommended projects in the plan receive funding from outside sources, such as grants or legislative appropriations, additional projects could be implemented using the Save Our Lagoon Trust Fund. If funding becomes available, the projects listed in **Table 8-6** through **Table 8-11** include numerous unfunded opportunities sorted by the next most cost-effective projects available for each major type of pollution reduction strategy.

Table 8-6. Unfunded Public Outreach and Education Projects

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Irrigation Education	$300,000	1,530	$196	Not applicable	Not applicable
Stormwater Pond Best Management Practice Maintenance Education	$300,000	3,300	$91	400	$750
Total	***$600,000***	***4,830***	***$124 (average)***	***400***	***$1,500 (average)***

Table 8-7: Unfunded WWTF Reclaimed Water Upgrade Projects

Facility	Cost to Upgrade	TN Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TP Removed
Cape Canaveral Air Force Station	$6,000,000	3,653	$1,642	To be determined	To be determined
Brevard County South Beaches WWTF	$6,000,000	2,860	$2,098	To be determined	To be determined
Brevard County South Central Regional WWTF	$6,000,000	2,053	$2,923	To be determined	To be determined
Port St. John WWTF	$6,000,000	1,788	$3,356	To be determined	To be determined
Rockledge WWTF	$6,000,000	1,084	$3,460	To be determined	To be determined
Barefoot Bay Water Reclamation Facility	$6,000,000	1,597	$5,535	To be determined	To be determined
North Regional WWTF	$6,000,000	584	$10,282	To be determined	To be determined
Total	***$42,000,000***	***13,619***	***$3,084 (average)***	***To be determined***	***To be determined***

Table 8-8: Unfunded Package Plant Connection Projects

Facility Name	Number of Units	Cost to Connect to Sewer	TN Load Reduction (lbs/yr)	Cost per Pound Per Year of TN Removed
Palm Harbor Mobile Home Park WWTF	130	$782,530	495	$1,581
River Forest Mobile Home Park	130	$778,713	134	$5,818
Riverview Mobile Home and Recreational Vehicle Park	110	$717,593	121	$5,907
Canebreaker Condo WWTF	24	$504,692	63	$8,024
Merritt Island Utility Company WWTF	198	$1,393,916	3	$556,214
Enchanted Lakes Estates	190	$994,448	1	$1,921,749
Total	***782***	***$5,171,892***	***817***	***$6,330 (average)***

Table 8-9: Unfunded Sprayfield or Rapid Infiltration Basin Upgrade Projects

Facility	Type	Estimated Cost to Upgrade	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Cove At South Beaches Condominium Association WWTF	Sprayfield	$51,480	20	$2,584	57	$903
Riverview Mobile Home and Recreational Vehicle Park	Sprayfield	$333,234	100	$3,318	73	$4,565
Treetop Villas	Sprayfield	$105,000	22	$4,685	16	$6,563
Enchanted Lakes Estates	Sprayfield	$36,000	1	$43,373	To be determined	To be determined
Lighthouse Cove WWTF	Sprayfield	$120,000	2	$72,289	26	$4,615
Merritt Island Utility Company WWTF	Rapid Infiltration Basin	$495,277	2	$198,906	To be determined	To be determined
River Grove Mobile Home Village WWTF	Rapid Infiltration Basin	$182,299	1	$219,637	32	$5,697
Aquarina Beach Community WWTF	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Camelot Recreational Vehicle Park Inc	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Housing Authority of Brevard County WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Oak Point Mobile Home Park WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
South Shores Utility	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Southern Comfort Mobile Home Park WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Space X Launch Complex 39A	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Summit Cove Condominium	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Tropical Trail Village WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Wingate Reserve Demineralization Concentrate	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Sterling House Condominium WWTF	Sprayfield	$60,000	To be determined	To be determined	20	$3,000
Pelican Bay Mobile Home WWTF	Rapid Infiltration Basin	$222,156	To be determined	To be determined	157	$1,415
Harris Malabar Facility	Rapid Infiltration Basin	$2,085,000	To be determined	To be determined	To be determined	To be determined
Long Point Recreational Park	Rapid Infiltration Basin	$60,000	To be determined	To be determined	16	$3,750
Barefoot Bay Advanced	Sprayfield	$26,136,000	138	$189,391	19	$1,375,579
Total	-	***$29,886,446***	***286***	***$104,498 (average)***	***416***	***$71,842 (average)***

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Table 8-10: Unfunded Septic to Sewer Projects

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound Per Year
Grant-Valkaria – Zone G	30	$1,001,160	1,418	$706
Grant-Valkaria – Zone E	128	$4,271,616	5,862	$729
Grant-Valkaria – Zone B	34	$1,134,648	1,501	$756
Grant-Valkaria – Zone F	17	$567,324	688	$824
Grant-Valkaria – Zone D	18	$600,696	690	$871
Grant-Valkaria – Zone A	42	$1,401,624	1,296	$1,082
Malabar – Zone B	64	$2,135,808	1,929	$1,107
Grant-Valkaria – Zone C	30	$1,001,160	853	$1,173
Malabar – Zone A	430	$14,349,960	11,456	$1,253
Valkaria – Zone I	223	$7,441,956	5,380	$1,383
South Beaches – Zone F	3	$100,116	70	$1,435
Valkaria – Zone J	503	$16,786,116	11,507	$1,459
Malabar – Zone C	14	$467,208	289	$1,617
South Central – Zone B	180	$6,006,960	3,700	$1,623
Sharpes – Zone B	136	$4,538,592	2,692	$1,686
South Beaches – Zone E	387	$12,914,964	7,491	$1,724
Rockledge – Zone C	91	$3,036,852	1,736	$1,749
South Beaches – Zone K	21	$700,812	397	$1,765
North Merritt Island – Zone F	34	$1,550,000	830	$1,867
North Merritt Island – Zone D	29	$1,293,000	685	$1,888
City of West Melbourne	60	$2,002,320	1,041	$1,923
Pineda	27	$1,257,000	644	$1,952
Sykes Creek – Zone IJ	77	$1,900,000	62	$1,974
South Beaches – Zone L	178	$5,940,216	2,973	$1,998
Sykes Creek – Zone J	63	$2,102,436	1,028	$2,045
South Banana – Zone A	88	$3,025,000	1,444	$2,095
South Central – Zone BC	13	$1,222,000	582	$2,100
South Beaches – Zone G	112	$3,737,664	1,764	$2,119
City of West Melbourne – Zone B	60	$2,002,320	894	$2,240
Malabar – Zone D	24	$800,928	352	$2,278
North Merritt Island – Zone A	107	$4,245,000	1,821	$2,331
South Beaches – Zone D	89	$2,970,108	1,273	$2,333
South Central – Zone E	411	$13,715,892	5,761	$2,381
South Beaches – Zone M	334	$11,146,248	4,293	$2,596
Grant-Valkaria – Zone H	100	$3,337,200	1,272	$2,624
Malabar – Zone F	14	$467,208	174	$2,683
Melbourne Village – Zone B	224	$7,475,328	2,705	$2,763
Sykes Creek – Zone H	74	$2,469,528	887	$2,783
South Central – Zone I	72	$2,170,000	772	$2,811
Sykes Creek – Zone G	52	$1,735,344	602	$2,881
South Beaches – Zone N	103	$3,437,316	1,193	$2,882
Sykes Creek – Zone C	81	$2,703,132	929	$2,909
Melbourne Village – Zone A	85	$2,836,620	918	$3,091
South Central – Zone H	165	$5,506,380	1,779	$3,096
South Central – Zone G	196	$6,540,912	2,090	$3,129
North Merritt Island – Zone C	71	$2,369,412	737	$3,217
Merritt Island – Zone H	285	$22,500,000	5,464	$4,118
Sykes Creek – Zone S	164	$6,600,000	1,584	$4,167
North Merritt Island – Zone B	56	$4,690,000	1,066	$4,399
Merritt Island – Zone A	249	$16,700,000	3,440	$4,855
South Beaches – Zone C	118	$3,937,896	683	$5,763
Total	***6,166***	***$232,843,980***	***111,598***	***$2,086 (average)***

Table 8-11: Unfunded Muck Dredging and Interstitial Treatment Projects

Sub-Lagoon	IRL Muck Sites	Cost Estimate	Interstitial Water Treatment Cost	Total Cost	TN Reduction (lbs/yr)	Cost per Pound of TN Removed	TP Reduction (lbs/yr)	Cost per Pound of TP Removed
Banana	Cocoa Beach Golf*	$12,775,000	$1,941,800	$14,716,800	Not applicable	Not applicable	Not applicable	Not applicable
Central IRL	Goat Creek	$350,000	$50,819	$400,819	735	$476	98	$3,571
North IRL	Pineda to Eau Gallie	$30,625,000	$4,446,705	$35,071,705	34,965	$876	1,554	$19,707
North IRL	520 to Pineda	$31,500,000	$4,573,754	$36,073,754	35,280	$893	1,568	$20,089
Central IRL	Mullet Creek Islands Area	$4,550,000	$660,653	$5,210,653	4,305	$1,057	574	$7,927
North IRL	NASA Cswy W	$4,375,000	$635,244	$5,010,244	3,903	$1,121	193	$22,727
North IRL	Pineda	$5,250,000	$762,292	$6,012,292	4,610	$1,139	492	$10,669
Banana	Kent Dr	$1,750,000	$254,097	$2,004,097	1,365	$1,282	182	$9,615
Banana	NASA Area	$98,000,000	$14,229,457	$112,229,457	68,985	$1,421	9,198	$10,654
Banana	528 East	$1,225,000	$177,868	$1,402,868	840	$1,458	112	$10,938
North IRL	30% of Venetian Canals/Channels	$7,875,000	$1,143,439	$9,018,439	5,355	$1,471	714	$11,029
North IRL	70% of North IRL Venetian Collector Canals/Channels	$5,600,000	$813,112	$6,413,112	3,805	$1,472	529	$10,586
Banana	Newfound Harbor E	$1,575,000	$228,688	$1,803,688	1,050	$1,500	140	$11,250
Banana	70% of Banana Venetian Collector Canals/Channels	$90,125,000	$13,086,019	$103,211,019	59,850	$1,506	8,379	$10,756
Banana	30% of Venetian Canals/Channels	$28,875,000	$4,192,608	$33,067,608	19,110	$1,511	2,548	$11,332
Banana	Patrick AFB Borrow Pit-2	$4,725,000	$686,063	$5,411,063	3,045	$1,552	406	$11,638
Banana	Newfound Harbor S	$4,725,000	$686,063	$5,411,063	3,045	$1,552	406	$11,638
Banana	Mathers Bridge Area	$12,250,000	$1,778,682	$14,028,682	7,875	$1,556	1,050	$11,667
North IRL	Max Brewer Cswy	$2,800,000	$406,556	$3,206,556	1,785	$1,569	238	$11,765
Banana	Newfound Harbor N	$3,150,000	$457,375	$3,607,375	1,995	$1,579	266	$11,842
Banana	Cocoa Beach High School	$6,825,000	$990,980	$7,815,980	4,305	$1,585	574	$11,890
Central IRL	70% of Central IRL Venetian Collector Canals/Channels	$4,550,000	$660,653	$5,210,653	2,854	$1,594	397	$11,461
Banana	Brightwaters	$8,225,000	$1,194,258	$9,419,258	5,040	$1,632	672	$12,240
Banana	Patrick AFB Borrow Pit-4	$525,000	$76,229	$601,229	315	$1,667	42	$12,500
Banana	Sunset Café	$3,850,000	$559,014	$4,409,014	2,310	$1,667	308	$12,500
Banana	520 Borrow Pit-1	$1,400,000	$203,278	$1,603,278	840	$1,667	112	$12,500
Banana	Cape Canaveral Hospital	$2,100,000	$304,917	$2,404,917	1,260	$1,667	168	$12,500
Banana	520 Borrow Pit-2	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
Banana	520 Borrow Pit-3	$525,000	$76,229	$601,229	315	$1,667	42	$12,500
Banana	520 Borrow Pit-4	$1,400,000	$203,278	$1,603,278	840	$1,667	112	$12,500
Banana	520 Borrow Pit-5	$1,050,000	$152,458	$1,202,458	630	$1,667	84	$12,500
Banana	520 Borrow Pit-6	$525,000	$76,229	$601,229	315	$1,667	42	$12,500
Banana	520 Borrow Pit-7	$700,000	$101,639	$801,639	420	$1,667	56	$12,500

Sub-Lagoon	IRL Muck Sites	Cost Estimate	Interstitial Water Treatment Cost	Total Cost	TN Reduction (lbs/yr)	Cost per Pound of TN Removed	TP Reduction (lbs/yr)	Cost per Pound of TP Removed
Central IRL	30% of Venetian Canals/Channels	$1,750,000	$254,097	$2,004,097	1,050	$1,667	140	$12,500
Central IRL	Trout Creek	$175,000	$25,410	$200,410	105	$1,667	14	$12,500
Central IRL	Melbourne Cswy N	$875,000	$127,049	$1,002,049	525	$1,667	70	$12,500
Central IRL	Front St Park	$875,000	$127,049	$1,002,049	525	$1,667	70	$12,500
North IRL	Warwick Dr	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
North IRL	Crab Shack	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
Banana	Port Canaveral	$9,275,000	$1,346,716	$10,621,716	4,988	$1,860	245	$37,857
North IRL	Cocoa South	$5,250,000	$762,292	$6,012,292	1,947	$2,696	182	$28,846
Central IRL	Turkey Creek	$4,900,000	$711,473	$5,611,473	1,750	$2,800	231	$21,212
North IRL	NASA Cswy to 528	$16,625,000	$2,413,926	$19,038,926	4,694	$3,542	313	$53,132
North IRL	Rockledge B	$29,575,000	$4,294,247	$33,869,247	8,093	$3,654	1,184	$24,970
North IRL	Eau Gallie NW	$19,145,000	$2,779,826	$21,924,826	3,207	$5,969	244	$78,592
North IRL	Cocoa 520-528	$3,850,000	$559,014	$4,409,014	599	$6,433	40	$96,491
North IRL	Eau Gallie South	$40,250,000	$5,844,241	$46,094,241	4,144	$9,713	777	$51,802
Central IRL	Goat Creek	$350,000	$50,819	$400,819	735	$476	98	$3,571
-	***Total***	***$518,770,000***	***$75,411,532***	***$594,181,532***	***314,969***	***$1,886 (average)***	***35,032***	***$16,961 (average)***

*Note: The funding for the Cocoa Beach Golf project is the balance of funding needed to fully implement this project. Brevard County is looking for sources of funding for this balance.

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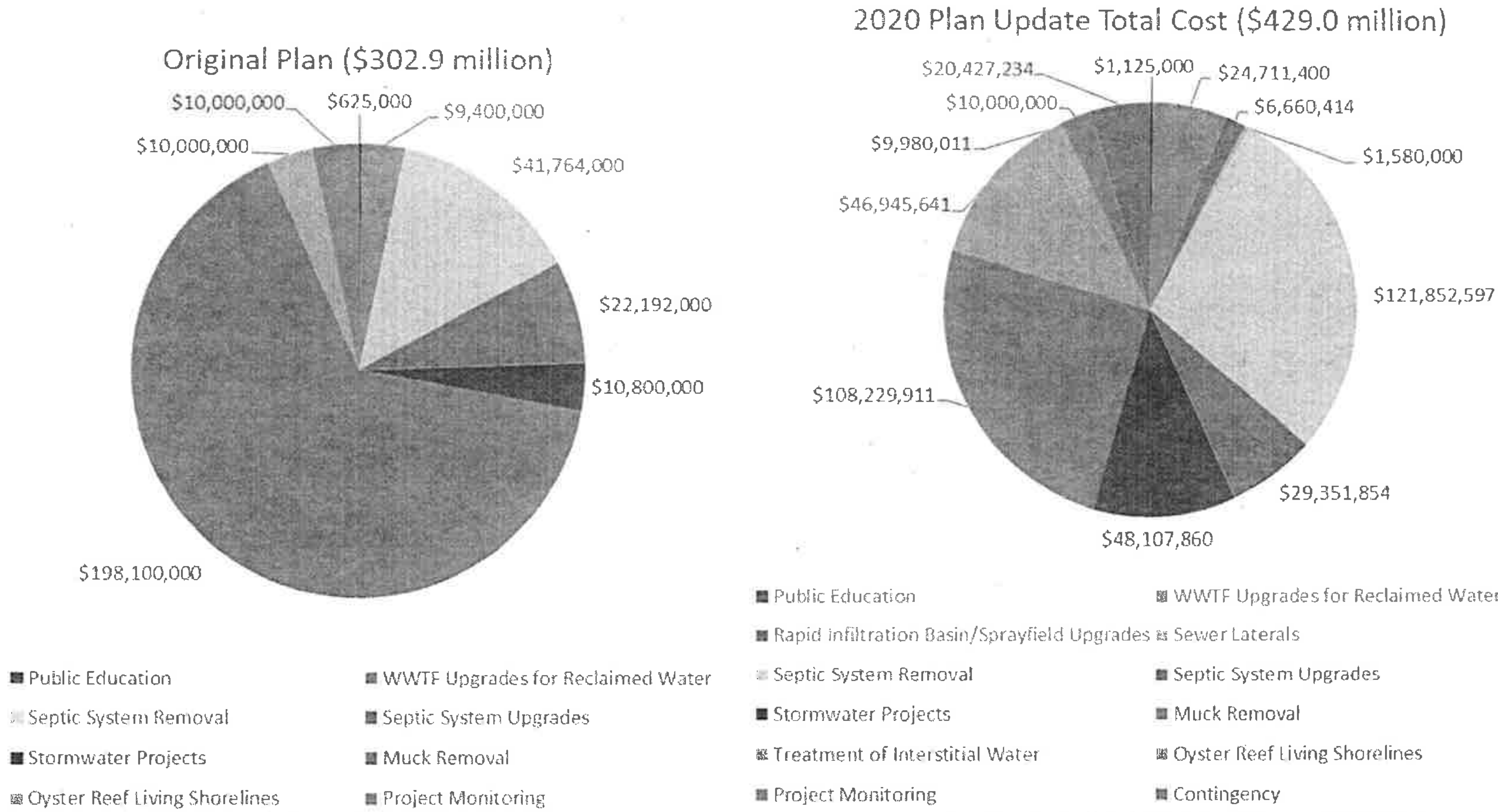

Figure 8-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2020 Plan Update Cost by Project Category (Right)

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Section 9. Summary of the Plan through the 2020 Update

9.1. Plan Outputs and Outcomes

There are several outcomes expected from implementation of the plan. The plan outputs represent the project types included to Reduce external loads to the lagoon, Remove internal sources from the lagoon, Restore the natural filtration systems, and Respond to the changing conditions and opportunities. The outcomes from these outputs are the results, impacts, and accomplishments that will occur due to plan implementation (**Figure 9-2**). The timeframes for reaching various outcomes may be impacted by many factors outside Brevard County control, including federal and state legislation and weather; however, division of outcomes into short-term, mid-term, and long-term categories is meant to illustrate the sequence and approximate schedule of anticipated natural recovery.

9.2. Progress Toward the Total Maximum Daily Loads

The County has been working with its municipalities, Florida Department of Transportation District 5, and Patrick Air Force Base to update total loading estimates to the lagoon and revise the total maximum daily loads for nitrogen and phosphorus using the best available data and more detailed modeling than previously available. Based on this process, five-month total maximum daily loads, which target the load reductions needed during the seagrass growing period (January – May), were proposed in addition to annual total maximum daily loads that protect water quality year-round. These load reductions specifically target water quality conditions needed for restoring lagoon seagrass beds to provide crucial habitat for fish and other marine life. Therefore, as this Save Our Indian River Lagoon Project Plan was developed, the TN and TP reductions from the project types that **Reduce** incoming load were compared to the proposed five-month total maximum daily loads for each sub-lagoon. After satisfying the five-month total maximum daily loads, annual load reductions for each project were compared to the 12-month total maximum daily loads. In all cases, the projects identified to meet the five-month total maximum daily loads were sufficient to meet the proposed 12-month total maximum daily loads. As projects are implemented, progress toward meeting the five-month and full-year total maximum daily loads are being tracked.

Figure 7-1 shows the distribution of funding in the original plan versus the 2020 Update for each type of project that reduces incoming loading. Most of the funds dedicated to reducing incoming load are directed at projects that improve the treatment of human waste (**Figure 9-1**). These projects include several types such as greater treatment of reclaimed water, upgrade of septic systems onsite, conversion from septic to sewer when feasible, and repair of leaky sewer laterals.

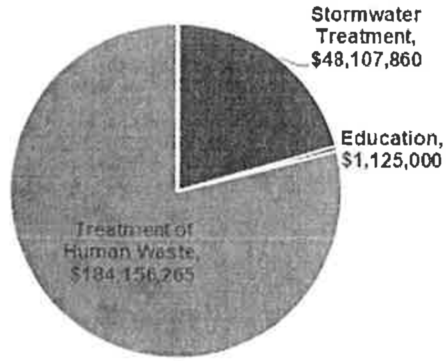

Figure 9-1: Funding for Reduce Projects

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Figure 9-2. Summary of the Save Our Indian River Lagoon Outputs and Outcomes

Figure 9-2 Long Description

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Only the projects that reduce external loading to the lagoon, not muck removal or living shorelines, were used to meet the total maximum daily loads. Even though decades of treatment projects to reduce nutrient loads have been completed to date, only the reductions associated with basin management action plan projects that were completed between January 1, 2010 (the last year of the Spatial Watershed Iterative Loading model period) and February 29, 2016 (the end of the last basin management action plan reporting period when the Save Our Indian River Lagoon Project Plan was developed) were included in the load reduction calculations as these projects also provide nutrient load reductions that have occurred after the period of record used to develop the proposed total maximum daily load updates. In Zone A of the Central IRL, the reductions from the St. Johns River Water Management District's C-1 re-diversion project, which was implemented with cost-share funding from the Florida Department of Environmental Protection and Brevard County, were also included as this project results in significant load reductions that were not included in the February 29, 2016 basin management action plan annual progress report. As shown in **Table 9-1**, **Table 9-3**, and **Table 9-5**, the projects proposed in this plan plus the recently completed basin management action plan projects and C-1 re-diversion project exceed the five-month reductions called for by the proposed total maximum daily load updates.

The total project reductions were also compared to the full year estimated loading to the lagoon from the Spatial Watershed Iterative Loading model. As shown in **Table 9-2**, **Table 9-4**, and **Table 9-6**, the proposed projects in this plan, as well as the recently completed basin management action plan projects and C-1 re-diversion project, achieve significant reductions of the overall loading to the lagoon and exceed the full year reductions called for by the proposed total maximum daily load updates.

Table 9-1: Banana River Lagoon Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	2,945	603
Future Education	1,952	129
WWTF Upgrade for Reclaimed Water	1,050	285
Sewer Laterals	412	78
Rapid Infiltration Basin/Sprayfield	16,573	1,548
Septic System Removal	13,057	0
Septic System Upgrade	806	0
Stormwater Projects	14,143	2,528
Basin Management Action Plan Projects (2010-February 2016)	5,303	1,440
Total	***56,241***	***6,611***
Proposed Total Maximum Daily Load Reductions (five-month)	***30,337***	***2,737***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***185.4%***	***241.5%***

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Table 9-2: Banana River Lagoon Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	7,068	1,446
Future Education	4,685	310
WWTF Upgrade for Reclaimed Water	2,520	685
Sewer Laterals	988	188
Rapid Infiltration Basin/Sprayfield	39,776	3,715
Septic System Removal	31,336	0
Septic System Upgrade	1,934	0
Stormwater Projects	65,841	8,683
Basin Management Action Plan Projects (2010-February 2016)	12,726	3,456
Total	***166,874***	***18,483***
Starting Load (full year)	***477,020***	***44,269***
Percent of Starting Load Reduced	***35.0%***	***41.8%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***9.0%***	***9.6%***

Table 9-3: North IRL Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	8,070	1,651
Future Education	5,350	354
WWTF Upgrade for Reclaimed Water	5,119	To be determined
Sewer Laterals	1,118	To be determined
Rapid Infiltration Basin/Sprayfield	3,827	560
Septic System Removal	23,623	0
Septic System Upgrade	9,246	0
Stormwater Projects	38,397	6,094
Basin Management Action Plan Projects (2010-February 2016)	16,983	3,180
Total	***111,733***	***11,839***
Proposed Total Maximum Daily Load Reductions (five-month)	***61,447***	***7,410***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***181.8%***	***159.8%***

Table 9-4: North IRL Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	19,368	3,962
Future Education	12,839	849
WWTF Upgrade for Reclaimed Water	12,286	To be determined
Sewer Laterals	2,682	To be determined
Rapid Infiltration Basin/Sprayfield	9,184	1,345
Septic System Removal	56,694	0
Septic System Upgrade	22,190	0
Stormwater Projects	160,196	22,027
Basin Management Action Plan Projects (2010-February 2016)	40,758	7,632
Total	***336,197***	***35,815***
Starting Load (full year)	***988,847***	***99,340***
Percent of Starting Load Reduced	***34.0%***	***36.1%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***11.4%***	***11.4%***

Table 9-5: Central IRL Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	8,108	1,659
Future Education	5,375	356
WWTF Upgrade for Reclaimed Water	23,845	5,448
Rapid Infiltration Basin/Sprayfield	73	33
Septic System Removal	11,548	0
Septic System Upgrade	5,827	0
Stormwater Projects	15,623	2,215
C-1 Re-Diversion	53,892	6,295
Basin Management Action Plan Projects (2010-February 2016)	378	243
Total	***124,669***	***16,249***
Proposed Total Maximum Daily Load Reductions (five-month) *	***67,547***	***8,151***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***184.6%***	***199.4%***

* The total maximum daily load reductions are for Zone A only; however, some of the septic system projects are in Zone SEB. There are sufficient projects to achieve the Zone A reductions without the Zone SEB projects (refer to **Section 2.1**).

Table 9-6: Central IRL Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	19,460	3,981
Future Education	12,899	854
WWTF Upgrade for Reclaimed Water	57,227	13,075
Rapid Infiltration Basin/Sprayfield	176	79
Septic System Removal	27,714	0
Septic System Upgrade	13,984	0
Stormwater Projects	51,497	6,844
C-1 Re-Diversion	129,341	15,108
Basin Management Action Plan Projects (2010-February 2016)	908	582
Total	***313,206***	***40,523***
Starting Load (full year) *	***698,937***	***95,051***
Percent of Starting Load Reduced	***44.8%***	***42.6%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***17.8%***	***16.3%***

* The total maximum daily load reductions are for Zone A only; however, some of the septic system are in Zone SEB. There are sufficient projects to achieve the Zone A reductions without the Zone SEB projects (refer to **Section 2.1**).

In addition to the projects that address the external nutrient loading summarized above, the plan includes muck flux, interstitial water treatment, oyster bars, and planted shoreline projects that will significantly reduce internal nutrient loading within the lagoon itself. The annual reductions from these projects are summarized in **Table 9-7**, along with the percentage of nutrients from 2018 estimates of muck flux that would be reduced by these projects.

Table 9-7: Annual Muck Flux, Muck Interstitial Water, Oyster Bar, and Planted Shoreline Project Benefits Compared to Annual Nutrient Loadings from Muck Flux

Project Type	Banana River Lagoon TN (lbs/yr)	Banana River Lagoon TP (lbs/yr)	North IRL TN (lbs/yr)	North IRL TP (lbs/yr)	Central A TN (lbs/yr)	Central A TP (lbs/yr)
Muck Flux Reduction	142,571	13,425	59,728	4,169	5,691	221
Average Annual Removal of Nutrients from Interstitial Water	39,314	1,967	8,792	800	0	69
Oyster Bars	10,698	343	10,945	281	3,327	177
Planted Shorelines	106	36	53	18	225	77
Total Project Reductions	***192,689***	***15,771***	***79,518***	***5,268***	***9,243***	***544***
Estimated Muck Flux Loading	***393,948***	***43,216***	***247,078***	***17,583***	***16,927***	***2,277***
Percent of Muck Flux Reduced	***48.9%***	***36.5%***	***32.2%***	***30.0%***	***54.6%***	***23.9%***

9.3. Plan Summary

Table 9-8 summarizes all the project types, as well as their estimated costs, TN and TP reductions, and costs per pound of TN and TP removed. The information from this table on the project reductions and cost effectiveness was used to determine the schedule for implementing the projects (see **Table 9-9**). Projects that could achieve large reductions quickly, such as fertilizer reductions and WWTF upgrades, as well as the most cost-effective septic to sewer, and stormwater projects were prioritized for earliest implementation. This prioritization allows for the reductions to occur as quickly as possible while best using available funding sources. Project scheduling also considered the timing of upstream reductions with downstream removals, where feasible.

The timeline in **Table 9-9** is shown in years after funding from the Save Our Indian River Lagoon sales tax became available. Each year corresponds to the County's fiscal year, which is October 1st through September 30th. Year 1 started on October 1, 2017, which was just before revenues would have begun to accrue if the funding source had been a property tax, as initially considered. When the referendum approved by the voters was a sales tax, collections began in January 2017 and the first revenue check was received by the County in March 2017. Therefore, a plan update was adopted in March 2017 to begin plan implementation in Year 0. **Table 9-9a** includes the cost estimates based on 2016 dollars, which were used to develop the plan, or cost estimates provided in the year new or substitute projects were added to the plan. **Table 8-9b** includes the original cost estimates with inflation starting in Year 2 of the plan. The construction index of 3.25% was used for the inflation value.

As noted in **Section 4.4.1**, an adaptive management approach is being used in the implementation of this plan. As projects are completed and information on the actual construction costs, timeline, and reductions are obtained, the plan will continue to be adjusted, as needed, to ensure that the most cost-effective projects are being used to meet the IRL restoration goals.

Table 9-8: Summary of Projects, Estimated TN and TP Reductions, and Costs (no inflation)

Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
-	**Public Education**	-	-	-	-	-
58	Expanded Fertilizer Education	$625,000	6,123	$102	813	$769
58	Grass Clippings Campaign	$200,000	17,800	$11	1,200	$167
58	Septic System Maintenance Education	$300,000	6,500	$46	To be determined	To be determined
-	**WWTF Upgrades for Reclaimed Water**	-	-	-	-	-
99	Cocoa Beach Water Reclamation Facility Upgrade	$945,000	2,520	$375	685	$1,380
-	City of Titusville Osprey WWTF	$8,800,000	8,660	$1,016	To be determined	To be determined
-	City of Palm Bay Water Reclamation Facility	$3,636,900	20,240	$180	102	$35,656
59	City of Melbourne Grant Street Water Reclamation Facility	$6,769,500	25,627	$264	9,671	$700
2b	City of Titusville Osprey Nutrient Removal Upgrade Phase 2	$300,000	3,626	$83	To be determined	To be determined
138	Ray Bullard Water Reclamation Facility Biological Nutrient Removal Upgrades	$4,260,000	11,360	$375	3,302	$1,290
-	**Sewer Laterals**	-	-	-	-	-
63	Satellite Beach Pilot Project	$840,000	988	$850	188	$4,468
100	Osprey Basin Lateral Repair Project	$200,000	640	$313	To be determined	To be determined
114	Barefoot Bay Lateral Smoke Testing	$90,000	864	$104	To be determined	To be determined
115	South Beaches Lateral Smoke Testing	$200,000	1,662	$120	To be determined	To be determined
116	Merritt Island Lateral Smoke Testing	$250,000	2,042	$122	To be determined	To be determined
-	**Rapid Infiltration Basin/Sprayfield Upgrades**	-	-	-	-	-
-	Cape Canaveral Air Force Station Regional WWTF	$5,227,200	39,776	$131	3,715	$1,407
-	Port St John Wastewater Treatment Plant	$980,100	8,610	$114	1,266	$774
-	Canebreaker Condo	$36,000	52	$692	To be determined	To be determined
-	River Forest Mobile Home Park WWTF	$78,405	111	$706	46	$1,704
-	Palm Harbor Mobile Home Park WWTF	$300,564	411	$731	33	$9,108
-	Indian River Shores Trailer Park WWTF	$38,145	176	$217	79	$483
-	**Septic System Removal by Sewer Extension**	-	-	-	-	-
-	Sykes Creek - Zone M	$1,868,832	1,798	$1,039	To be determined	To be determined
-	Sykes Creek - Zone N	$2,603,016	2,784	$935	To be determined	To be determined
146	Merritt Island - Zone C	$1,580,000	1,419	$1,113	To be determined	To be determined
-	Sykes Creek - Zone T	$4,939,056	3,360	$1,470	To be determined	To be determined
-	South Banana - Zone B	$1,368,252	915	$1,495	To be determined	To be determined
145	Merritt Island - Zone F	$1,100,000	1,292	$851	To be determined	To be determined

Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
147	Sykes Creek - Zone R	$3,500,000	2,925	$1,197	To be determined	To be determined
148	North Merritt Island - Zone E	$3,635,000	2,541	$1,431	To be determined	To be determined
151	Merritt Island - Zone G	$16,617,000	11,078	$1,500	To be determined	To be determined
-	City of Rockledge	$500,580	712	$703	To be determined	To be determined
-	City of Cocoa - Zone K	$1,201,392	1,663	$722	To be determined	To be determined
109	City of Titusville - Zones A-G	$1,201,392	1,563	$769	To be determined	To be determined
150	South Central - Zone D (Brevard County)	$4,774,500	3,387	$1,410	To be determined	To be determined
-	South Central - Zone D (Melbourne)	$265,500	177	$1,500	To be determined	To be determined
-	South Central - Zone C	$6,600,000	5,146	$1,283	To be determined	To be determined
-	South Central - Zone A	$3,370,572	3,655	$922	To be determined	To be determined
-	City of Cocoa - Zone J	$3,136,968	3,259	$963	To be determined	To be determined
-	City of Melbourne	$867,672	878	$988	To be determined	To be determined
-	South Central - Zone F	$1,701,972	1,688	$1,008	To be determined	To be determined
-	Sharpes - Zone A	$6,207,192	5,248	$1,183	To be determined	To be determined
-	South Beaches - Zone A	$1,234,764	1,306	$945	To be determined	To be determined
-	South Beaches - Zone O	$133,488	136	$982	To be determined	To be determined
-	South Beaches - Zone P	$500,580	489	$1,024	To be determined	To be determined
-	City of Titusville - Zone H	$1,168,020	910	$1,284	To be determined	To be determined
-	Rockledge - Zone B	$5,339,520	4,037	$1,323	To be determined	To be determined
1	Breeze Swept Septic to Sewer Connection	$880,530	2,002	$440	To be determined	To be determined
2	Merritt Island Septic Phase Out Project	$320,000	2,501	$128	To be determined	To be determined
61	Riverside Drive Septic-to-Sewer Conversion	$265,960	305	$872	To be determined	To be determined
62	Roxy Avenue Septic-to-Sewer Conversion	$88,944	102	$872	To be determined	To be determined
152	Sharpes - Zone B	$4,038,000	2,692	$1,500	To be determined	To be determined
153	Cocoa - Zone C	$5,248,500	3,499	$1,500	To be determined	To be determined
-	City of Palm Bay – Zone A	$2,569,644	2,136	$1,203	To be determined	To be determined
-	City of Palm Bay – Zone B	$8,309,628	6,809	$1,220	To be determined	To be determined
3	Micco Sewer Line Extension	$2,038,500	1,359	$1,500	To be determined	To be determined
4	Hoag Sewer Conversion	$86,031	101	$852	To be determined	To be determined
5	Penwood Sewer Conversion	$40,632	48	$847	To be determined	To be determined
60	Sylvan Estates Septic-to-Sewer Conversion	$1,561,215	1,073	$1,455	To be determined	To be determined
136	Micco - Zone B	$9,000,000	8,687	$1,036	To be determined	To be determined
3b	Micco Sewer Line Extension - Phase II	$709,745	618	$1,148	To be determined	To be determined
-	**Septic System Removal by Sewer Connection**	-	-	-	-	-
-	Banana Septic System 144 Quick Connections	$1,908,000	3,224	$592	To be determined	To be determined
-	North IRL Septic System 463 Quick Connections	$6,018,000	11,339	$531	To be determined	To be determined

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Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
-	Central IRL Septic System 269 Quick Connections	$3,354,000	6,883	$487	To be determined	To be determined
-	**Septic System Upgrades**	-	-	-	-	-
-	Banana River Lagoon 100 Septic System Upgrades	$1,800,000	1,934	$931	To be determined	To be determined
-	North IRL 586 Septic System Upgrades	$10,548,000	13,857	$761	To be determined	To be determined
-	Central IRL 939 Septic System Upgrades	$16,902,000	22,190	$762	To be determined	To be determined
6	Long Point Park Upgrade	$101,854	127	$802	To be determined	To be determined
-	**Stormwater Projects**	-	-	-	-	-
-	Banana River Lagoon 67 Basin Projects	$14,403,300	63,737	$226	8,421	$1,710
13	Central Boulevard Baffle Box	$34,700	481	$72	14	$2,479
16	Gleason Park Reuse	$4,224	48	$88	9	$469
31	Cape Shores Swales	$2,746	31	$89	15	$183
32	Justamere Road Swale	$528	6	$88	3	$176
33	Hitching Post Berms	$2,552	29	$88	22	$116
64	Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	$4,650	30	$155	3	$1,550
65	Stormwater Low Impact Development Convair Cove 2- Dempsey Drive	$4,495	29	$155	3	$1,498
66	Big Muddy at Cynthia Baffle Box	$41,695	269	$155	48	$869
66b	Big Muddy at Cynthia Baffle Box Expansion	$25,837	167	$155	10	$2,584
85	Basin 1304 Bioreactor	$90,000	958	$94	127	$709
128	Jackson Court Stormwater Treatment Facility	$8,266	56	$148	8	$1,033
-	North IRL 98 Basin Projects	$23,584,400	121,815	$194	16,152	$1,460
18	Denitrification Retrofit of Johns Road Pond	$105,512	1,199	$88	To be determined	To be determined
39	Stewart Road Dry Retrofit	$18,344	208	$88	47	$390
14	Church Street Type II Baffle Box	$88,045	937	$94	135	$652
19	St. Teresa Basin Treatment	$272,800	3,100	$88	459	$594
20	South Street Basin Treatment	$86,856	987	$88	156	$557
21	La Paloma Basin Treatment	$208,296	2,367	$88	346	$602
22	Kingsmill-Aurora Phase Two	$367,488	4,176	$88	814	$451
23	Denitrification Retrofit of Huntington Pond	$104,720	1,190	$88	To be determined	To be determined
24	Denitrification Retrofit of Flounder Creek Pond	$75,328	856	$88	To be determined	To be determined
34	Cliff Creek Baffle Box	$347,781	3,952	$88	797	$436
35	Thrush Drive Baffle Box	$322,200	3,661	$88	773	$417
69	Apollo/GA Baffle Box	$297,522	3,381	$88	479	$621
89	Basin 1298 Bioreactor	$86,198	917	$94	116	$743

Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
90	Johns Road Pond Biosorption Activated Media	$23,030	245	$94	37	$622
91	Burkholm Road Biosorption Activated Media	$64,390	685	$94	104	$619
92	Carter Road Biosorption Activated Media	$62,510	665	$94	101	$619
93	Wiley Road Biosorption Activated Media	$82,735	954	$87	144	$575
94	Broadway Pond Biosorption Activated Media	$42,864	456	$94	69	$621
95	Cherry Street Baffle Box	$92,120	980	$94	174	$529
96	Spring Creek Baffle Box	$99,358	1,057	$94	232	$428
97	Titusville High School Baffle Box	$111,813	1,190	$94	166	$674
98	Coleman Pond Managed Aquatic Plant System	$35,000	1,240	$28	198	$177
111	Draa Field Vegetation Harvesting	$50,000	574	$87	To be determined	To be determined
110	Osprey Plant Pond Managed Aquatic Plant Systems	$60,000	606	$99	88	$682
112	County Wide Stormwater Pond Harvesting	$14,000	140	$100	28	$500
117	Basin 10 County Line Road Woodchip Bioreactor	$72,773	597	$122	90	$809
118	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	$73,810	605	$122	92	$802
119	Basin 141 Irwin Avenue Woodchip Bioreactor	$69,174	567	$122	86	$804
120	Draa Field Pond Managed Aquatic Plant Systems	$31,281	256	$122	38	$823
122	Basin 22 Hunting Road Serenity Park Woodchip Bioreactor	$40,077	329	$122	50	$802
124	Floating Wetlands to Existing Stormwater Ponds	$1,497	12	$125	3	$499
125	Diamond Square Stormwater Pond	$10,383	85	$122	23	$451
127	Basin 5 Dry Retention	$16,680	113	$148	18	$927
129	Forrest Avenue 72-inch Outfall Baseflow Capture/Treatment	$13,956	94	$148	12	$1,163
-	Central IRL 10 Basin Projects	$3,995,300	24,166	$165	3,182	$1,256
15	Bayfront Stormwater Project	$30,624	348	$88	83	$369
67	Grant Place Baffle Box	$82,481	937	$88	193	$427
68	Crane Creek/M-1 Canal Flow Restoration	$2,033,944	23,113	$88	2,719	$748
87	Fleming Grant Biosorption Activated Media	$56,588	602	$94	91	$622
88	Espanola Baffle Box	$105,186	1,119	$94	148	$711
121	Basin 2258 Babcock Road Woodchip Bioreactor	$50,203	412	$122	62	$810
123	Ray Bullard Water Reclamation Facility Stormwater Management Area	$97,600	800	$122	366	$267
-	**Muck Removal**	-	-	-	-	-
-	Port Canaveral South	$14,700,000	35,382	$415	1,925	$7,636
-	Pineda Banana River Lagoon	$6,825,000	15,033	$454	686	$9,[illegible]

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Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
-	Patrick Air Force Base	$7,175,000	6,497	$1,104	382	$18,783
-	Cocoa Beach Golf	$21,350,000	29,694	$719	2,058	$10,374
41	Grand Canal Muck	$2,440,971	10,185	$240	1,358	$1,797
42	Sykes Creek Muck	$4,705,428	19,635	$240	2,618	$1,797
70a	Cocoa Beach Muck Dredging – Phase III	$1,376,305	4,095	$336	780	$1,764
71	Merritt Island Muck Removal – Phase 1	$7,733,517	8,085	$957	1,540	$5,022
72a	Muck Removal of Indian Harbour Beach Canals	$3,631,815	3,780	$961	720	$5,044
101	Cocoa Beach Muck Dredging Phase II-B	$5,917,650	6,300	$939	840	$7,045
144	Satellite Beach Muck Dredging	$1,884,225	3,885	$485	518	$3,638
-	Titusville Railroad West	$3,150,000	14,406	$219	588	$5,357
-	National Aeronautics and Space Administration Causeway East	$9,975,000	21,872	$456	1,047	$9,527
-	Rockledge A	$4,375,000	7,581	$577	825	$5,303
-	Titusville Railroad East	$4,025,000	5,393	$746	227	$17,731
-	Eau Gallie Northeast	$8,750,000	10,476	$835	1,482	$5,904
-	Muck Re-dredging in Turkey Creek	$215,000	5,691	$38	221	$973
-	**Treatment of Interstitial Water**	-	-	-	-	-
-	Port Canaveral South	$2,134,419	42,688	$50	3,887	$549
-	Pineda	$990,980	19,820	$50	1,804	$549
-	Patrick Air Force Base	$1,041,800	20,836	$50	1,897	
-	Cocoa Beach Golf	$3,013,100	99,098	$30	9,022	$334
-	Grand Canal Interstitial	$15,579,397	89,025	$175	To be determined	To be determined
-	Sykes Creek Interstitial	$11,248,704	64,278	$175	To be determined	To be determined
72b	Muck Interstitial Water Treatment for Indian Harbour Beach Canals	$5,483,600	27,418	$200	To be determined	To be determined
113	Satellite Beach Interstitial Water Treatment	$3,057,756	29,978	$102	3,059	$1,000
-	Titusville Railroad West	$457,375	9,148	$50	833	$549
-	National Aeronautics and Space Administration Causeway East	$1,448,355	28,967	$50	2,637	$549
-	Rockledge A	$635,244	12,705	$50	1,157	$549
-	Titusville Railroad East	$584,424	11,688	$50	1,064	$549
-	Eau Gallie Northeast	$1,270,487	25,410	$50	2,313	$549
-	Muck Interstitial Water Treatment for Turkey Creek	Included in muck project	Not applicable	Not applicable	688	Not applicable
-	**Oyster Bars**	-	-	-	-	-
-	Banana River Lagoon County Oyster Bars	$3,222,538	8,167	$395	204	$15,797

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Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
75	Marina Isles Oyster Bar	$26,700	60	$445	20	$1,335
76	Bettinger Oyster Bar	$10,680	24	$445	8	$1,335
78a	McNabb Park Oyster Bar	$34,056	72	$473	24	$1,419
79	Gitlin Oyster Bar	$16,020	36	$445	12	$1,335
-	Banana River Lagoon County Oyster Bars Year 1	$47,350	120	$395	3	$15,783
104	Brevard Zoo Banana River Oyster Project	$583,020	1,476	$395	37	$15,757
141	Brevard Zoo Banana River Oyster Project 2	$264,800	662	$400	17	$15,576
143	Brevard Zoo Oyster Reef Adjustments Banana River	$12,800	32	$400	1	$12,800
-	North IRL County Oyster Bars	$3,597,633	9,118	$395	228	$15,779
83	Bomalaski Oyster Bar	$8,900	20	$445	7	$1,271
-	Indian River Drive Oyster Bar	$13,258	34	$390	1	$13,258
106	Brevard Zoo North IRL Oyster Project	$341,280	864	$395	22	$15,513
139	Brevard Zoo North IRL Oyster Project 2	$336,400	841	$400	21	$16,019
142	Brevard Zoo Oyster Reef Adjustments North IRL	$27,200	68	$400	2	$13,600
-	Central IRL County Oyster Bars	$697,917	1,769	$395	44	$15,862
80	Coconut Point/Environmentally Endangered Lands Oyster Bar	$45,120	96	$470	2	$22,560
81	Wexford Oyster Bar	$31,150	70	$445	24	$1,298
82a	Riverview Park Oyster Bar	$108,790	230	$473	78	$1,395
	RiverView Senior Resort Oyster Bar	$30,304	77	$394	2	$15,152
105	Brevard Zoo Central IRL Oyster Project	$161,160	408	$395	10	$16,116
140	Brevard Zoo Central IRL Oyster Project 2	$270,800	677	$400	17	$15,929
-	**Planted Shorelines**	-	-	-	-	-
77a	Cocoa Beach Country Club Planted Shoreline	$16,014	67	$239	23	$696
78b	McNabb Park Planted Shoreline	$5,760	24	$240	8	$720
102	Brevard Zoo Banana River Plant Project	$3,120	13	$240	4	$780
131	Brevard Zoo Banana River Plant Project 2	$480	2	$240	1	$480
-	Indian River Drive Planted Shoreline	$2,240	9	$249	3	$747
103	Brevard Zoo North IRL Plant Project	$720	3	$240	1	$720
129	Brevard Zoo North IRL Plant Project 2	$9,840	41	$240	14	$703
77b	Lagoon House Shoreline Restoration Planting	$23,961	100	$240	34	$705
82b	Riverview Park Planted Shoreline	$18,480	77	$240	26	$711
131	Brevard Zoo Central IRL Plant Project	$1,920	8	$240	3	$640
133	Fisherman's Landing	$4,800	20	$240	7	$686
135	Rotary Park	$4,800	20	$240	7	$686

Project Number	Project	Save Our Lagoon Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
-	Projects Monitoring	$10,000,000	-	-	-	-
-	Contingency	$20,427,234	-	-	-	-
-	*Total*	***$428,971,922***	***1,303,528***	***$329 (average)***	***105,745***	***$4,057 (average)***

Table 9-9a: Timeline for Funding Needs (Table 46 in the Original Save Our Indian River Lagoon Project Plan)

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Public Education	-	-	-	-	-	-	-	-	-	-	-
Fertilizer Management	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$625,000	-	$125,000	$50,000	$50,000	$50,000	$50,000	**$100,000**	**$50,000**	**$50,000**	$50,000	$50,000
Grass Clippings	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$200,000	-	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Septic System Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$300,000	-	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WWTF Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach	-	-	-	-	-	-	-	-
$945,000	-	-	$945,000	-	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville Osprey Design and Permitting	Titusville Osprey Design and Start Construction	Titusville Osprey Construction	-	-	-	-	-
$8,800,000	-	-	-	$1,000,000	$3,000,000	$4,800,000	-	-	-	-	-
North IRL	-	-	-	-	Osprey Nutrient Upgrade Phase 2	-	-	-	-	-	-
$300,000	-	-	-	-	$300,000	-	-	-	-	-	-
Central IRL	-	Palm Bay Permit and Engineering	Palm Bay Construction	Palm Bay Construction	-	-	-	-	-	-	-
$3,636,900	-	$200,000	$1,200,000	$2,236,900	-	-	-	-	-	-	-
Central IRL	-	-	-	Melbourne Grant Street	-	-	-	-	-	-	-
$6,769,500	-	-	-	$6,769,500	-	-	-	-	-	-	-
Central IRL	-	-	-	Ray Bullard Biological Nutrient Removal	-	-	-	-	-	-	-
$4,260,000				$4,260,000							
Sewer Laterals	-	-	-	-	-	-	-	-	-	-	-
Satellite Beach Pilot	-	Satellite Beach Pilot Project	-	-	-	-	-	-	-	-	-
$840,000	-	$840,000	-	-	-	-	-	-	-	-	-
Titusville Osprey Pilot	-	-	Titusville Osprey Pilot Project	-	-	-	-	-	-	-	-
$200,000	-	-	$200,000	-	-	-	-	-	-	-	-
Merritt Island Lateral	-	-	-	Merritt Island Lateral Smoke Testing	-	-	-	-	-	-	-
$250,000	-	-	-	**$250,000**	-	-	-	-	-	-	-
Barefoot Bay Lateral	-	-	-	Barefoot Bay Lateral Smoke Testing	-	-	-	-	-	-	-
$90,000	-	-	-	**$90,000**	-	-	-	-	-	-	-
South Beaches Lateral	-	-	-	South Beaches Lateral Smoke Testing	-	-	-	-	-	-	-
$200,000	-	-	-	$200,000	-	-	-	-	-	-	-
Rapid Infiltration Basin/ Sprayfield Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-
$5,227,200	-	-	-	-	-	-	-	$5,227,200	-	-	-
North IRL	-	-	-	-	Port St John	-	-	-	-	-	-
$980,100	-	-	-	-	$980,100	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	-	-	-	Canebreaker Condo
$36,000	-	-	-	-	-	-	-	-	-	-	$36,000
North IRL	-	-	-	-	-	-	-	-	-	-	River Forest Mobile Home Park WWTF
$78,405	-	-	-	-	-	-	-	-	-	-	$78,405

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	-	-	-	-	-	-	-	-	-	Palm Harbor Mobile Home Park WWTF
$300,564	-	-	-	-	-	-	-	-	-	-	$300,564
Central IRL	-	-	-	-	-	-	-	-	-	-	Indian River Shores Trailer Park
$38,145	-	-	-	-	-	-	-	-	-	-	$38,145
Septic Removal	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes M Engineering	-	Sykes Creek M	-	-	-	-	-	-	-	-
$1,868,832	$250,000	-	$1,618,832	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Sykes Creek N	-	-	-	-	-	-	-	-	-
$2,603,016	-	$2,603,016	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes T Engineering	-	-	Sykes Creek T	-	-	-	-	-	-	-
$4,939,056	$250,000	-	-	$4,689,056	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	South Banana B Engineering	South Banana B	-	-	-	-	-
$1,368,252	-	-	-	-	$275,000	$1,093,252	-	-	-	-	-
Banana River Lagoon	-	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-	-	-	-
$1,908,000	-	-	-	$190,800	$572,400	$572,400	$572,400	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island C Engineering	Merritt Island C	Merritt Island C	-	-	-	-
$1,580,000	-	-	-	-	$145,000	$717,500	$717,500	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island F Engineering	-	Merritt Island F	-	-	-	-
$1,100,000	-	-	-	-	$100,000	-	$1,000,000	-	-	-	-
Banana River Lagoon	-	-	-	-	Sykes Creek R Engineering	-	-	Sykes Creek R	-	-	-
$3,500,000	-	-	-	-	$320,000	-	-	$3,180,000	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island G Engineering	-	-	-	-	Merritt Island G	-
$16,617,000	-	-	-	-	$1,650,000	-	-	-	-	$14,967,000	-
Banana River Lagoon	-	-	-	-	North Merritt Island E Engineering	-	North Merritt Island E	-	-	-	-
$3,635,000	-	-	-	-	$727,000	-	$2,908,000	-	-	-	-
North IRL	South Central C Engineering	South Central C	-	-	South Central C	-	-	-	-	-	-
$6,600,000	$450,000	$4,222,080	-	-	$1,927,920	-	-	-	-	-	-
North IRL	Breeze Swept	-	-	-	-	-	-	-	-	-	-
$880,530	$880,530	-	-	-	-	-	-	-	-	-	-
North IRL	Merritt Island Redevelopment Agency	-	-	-	-	-	-	-	-	-	-
$320,000	$320,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	Riverside Drive	-	-	-	-	-	-	-	-
$265,960	-	-	$265,960	-	-	-	-	-	-	-	-
North IRL	-	-	Cocoa K	-	-	-	-	-	-	-	-
$1,201,392	-	-	$1,201,392	-	-	-	-	-	-	-	-
North IRL	-	-	Roxy Avenue	-	-	-	-	-	-	-	-
$88,944	-	-	$88,944	-	-	-	-	-	-	-	-
North IRL	-	-	-	Cocoa J	-	-	-	-	-	-	-
$3,136,968	-	-	-	$3,136,968	-	-	-	-	-	-	-
North IRL	-	-	-	Rockledge	-	-	-	-	-	-	-
$500,580	-	-	-	$500,580	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville A-G	-	-	-	-	-	-	-
$1,201,392	-	-	-	$1,201,392	-	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	Titusville H	-	-	-
$1,168,020	-	-	-	-	-	-	-	$1,168,020	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-
$6,018,000	-	-	$300,900	$300,900	$902,700	$902,700	$902,700	$902,700	$902,700	$902,700	-
North IRL	-	-	-	-	South Central D (Brevard) Engineering	South Central D (Brevard)	-	-	-	-	-
$4,774,500	-	-	-	-	$955,000	$3,819,500	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Central D (Melbourne)	-	-	-	-
$265,500	-	-	-	-	-	-	$265,500	-	-	-	-
North IRL	-	-	-	-	South Central A Engineering	South Central A	-	-	-	-	-
$3,370,572	-	-	-	-	$675,000	$2,695,572	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Beaches A	-	-	-	-
$1,234,764	-	-	-	-	-	-	$1,234,764	-	-	-	-
North IRL	-	-	-	-	-	-	South Central F	-	-	-	-
$1,701,972	-	-	-	-	-	-	$1,701,972	-	-	-	-
North IRL	-	-	-	South Beaches O	-	-	-	-	-	-	-
$133,488	-	-	-	$133,488	-	-	-	-	-	-	-
North IRL	-	-	-	South Beaches P	-	-	-	-	-	-	-
$500,580	-	-	-	$500,580	-	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	Melbourne	-	-	-
$867,672	-	-	-	-	-	-	-	$867,672	-	-	-
North IRL	-	-	-	-	Sharpes A Engineering	-	-	-	Sharpes A	-	-
$6,207,192	-	-	-	-	$1,245,000	-	-	-	$4,962,192	-	-
North IRL	-	-	-	-	-	-	-	-	-	Rockledge Zone B	-
$5,339,520	-	-	-	-	-	-	-	-	-	$5,339,520	-
North IRL	-	-	-	-	Sharpes B Engineering	-	-	-	Sharpes B	-	-
$4,038,000	-	-	-	-	$810,000	-	-	-	$3,228,000	-	-
North IRL	-	-	-	-	Cocoa C Engineering	-	-	-	-	Cocoa C	-
$5,248,500	-	-	-	-	$1,050,000	-	-	-	-	$4,198,500	-
Central IRL	Micco	-	-	Micco	-	-	-	-	-	-	-
$2,038,500	$1,977,345	-	-	$61,155	-	-	-	-	-	-	-
Central IRL	-	-	-	Micco Phase II	-	-	-	-	-	-	-
$709,745	-	-	-	$709,745	-	-	-	-	-	-	-
Central IRL	Hoag	-	-	-	-	-	-	-	-	-	-
$86,031	$86,031	-	-	-	-	-	-	-	-	-	-
Central IRL	Penwood	-	-	-	-	-	-	-	-	-	-
$40,632	$40,632	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay B	-	-	-	-	-	-
$8,309,628	-	-	-	-	$8,309,628	-	-	-	-	-	-
Central IRL	-	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-
$3,354,000	-	-	-	$254,400	$516,600	$516,600	$516,600	$516,600	$516,600	$516,600	-
Central IRL	-	Sylvan Estates	-	-	-	-	-	-	-	-	-
$1,561,215	-	$1,561,215	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay A	-	-	-	-	-	-
$2,569,644	-	-	-	-	$2,569,644	-	-	-	-	-	-
Central IRL	-	-	-	-	Micco B Engineering	-	Micco B	Micco B	-	-	-
$9,000,000	-	-	-	-	$815,000	-	$5,000,000	$3,185,000	-	-	-
Septic Upgrades											
Banana River Lagoon	-	-	-	20 Upgrades	20 Upgrades	20 Upgrades	20 Upgrades	20 Upgrades	-	-	-
$1,800,000	-	-	-	$360,000	$360,000	$360,000	$360,000	$360,000	-	-	-
North IRL	-	-	-	40 Upgrades	70 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	76 Upgrades
$10,548,000	-	-	-	$720,000	$1,260,000	$1,440,000	$1,440,000	$1,440,000	$1,440,000	$1,440,000	$1,368,000
Central IRL	Long Point	-	-	-	-	-	-	-	-	-	-
$101,854	$101,854	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	40 Upgrades	75 Upgrades	100 Upgrades	145 Upgrades	145 Upgrades	145 Upgrades	145 Upgrades	144 Upgrades
$16,902,000	-	-	-	$720,000	$1,350,000	$1,800,000	$2,610,000	$2,610,000	$2,610,000	$2,610,000	$2,592,000
Stormwater Projects											
Banana - Cape Canaveral	-	Cape Shores Swales	-	-	-	-	-	-	-	-	-
$2,746	-	$2,746	-	-	-	-	-	-	-	-	-

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Banana - Cape Canaveral	-	Juslamere Road Swale	-	-	-	-	-	-	-	-	-
$528	-	$528	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Central Boulevard Baffle Box	Hitching Post Berms	-	-	-	-	-	-	-	-	-
$37,252	$34,700	$2,552	-	-	-	-	-	-	-	-	-
Banana - Indian Harbour Beach	Gleason Park Reuse	Big Muddy at Cynthia Baffle Box	Big Muddy Expansion	-	-	-	-	-	-	-	-
$71,756	$4,224	$41,695	$25,837	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	-	-	Convair Cove 1 – Blakey Blvd	-	-	-	-	-	-
$4,650	-	-	-	-	$4,650	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	-	-	Convair Cove 2- Dempsey Drive	-	-	-	-	-	-
$4,495	-	-	-	-	$4,495	-	-	-	-	-	-
Banana - Satellite Beach	-	-	-	Jackson Court	-	-	-	-	-	-	-
$8,266	-	-	-	$8,266	-	-	-	-	-	-	-
Banana - Brevard	-	-	Basin 1304 Bioreactor	-	-	-	-	-	-	-	-
$90,000	-	-	$90,000	-	-	-	-	-	-	-	-
Banana - Brevard	-	-	-	4 Projects - Pioneer	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects
$14,403,300	-	-	-	$951,700	$1,858,400	$3,053,600	$2,529,700	$1,961,300	$1,438,400	$1,300,600	$1,309,600
North IRL - Cocoa	Church Street Type II Baffle Box	-	-	Floating Wetlands	-		-	-	-	-	-
$89,542	$88,045	-	-	$1,497	-	-	-	-	-	-	-
North IRL - Cocoa	-	-	-	Diamond Square Pond	-	-	-	-	-	-	-
$10,383	-	-	-	$10,383	-	-	-	-	-	-	-
North IRL - Cocoa	-	-	-	Forrest Avenue Outfall	-	-	-	-	-	-	-
$13,956	-	-	-	$13,956	-	-	-	-	-	-	-
North IRL - Titusville	-	St. Teresa Basin Treatment	Titusville High School Baffle Box	Draa Field Vegetation Harvesting	-	-	-	-	-	-	-
$434,613	-	$272,800	$111,813	$50,000	-	-	-	-	-	-	-
North IRL - Titusville	-	South Street Basin Treatment	Coleman Pond Managed Aquatic Plant System	Osprey Plant Managed Aquatic Plant Systems	-	-	-	-	-	-	-
$181,856	-	$86,856	$35,000	$60,000	-	-	-	-	-	-	-
North IRL - Titusville	-	La Paloma Basin Treatment	-	Draa Pond Managed Aquatic Plant Systems	-	-	-	-	-	-	-
$239,577	-	$208,296	-	$31,281	-	-	-	-	-	-	-
North IRL - Melbourne	-	Cliff Creek Baffle Box	Apollo/GA Baffle Box	-	-	-	-	-	-	-	-
$645,303	-	$347,781	$297,522	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Thrush Drive Baffle Box	Cherry Street Baffle Box	-	-	-	-	-	-	-	-
$414,320	-	$322,200	$92,120	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Stewart Road Dry Retrofit	Spring Creek Baffle Box	-	-	-	-	-	-	-	-
$117,702	-	$18,344	$99,358	-	-	-	-	-	-	-	-
North IRL - Indialantic	-	-	-	Basin 5 Dry Retention	-	-	-	-	-	-	-
$16,680	-	-	-	$16,680	-	-	-	-	-	-	-
North IRL - Brevard	-	Kingsmill-Aurora Phase Two	Basin 1298 Bioreactor	County Wide Pond Harvesting	-	-	-	-	-	-	-
$467,686	-	$367,488	$86,198	$14,000	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Huntington Pond	Johns Road Pond	Basin 10 County Line Road Bioreactor	-	-	-	-	-	-	-
$200,523	-	$104,720	$23,030	$72,773	-	-	-	-	-	-	-

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL - Brevard	-	Denitrification Retrofit of Flounder Creek Pond	Burkholm Road	Basin 26 Sunset Road Serenity Park Bioreactor	-	-	-	-	-	-	-
$213,528	-	$75,328	$64,390	$73,810	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Johns Road Pond	Carter Road	Basin 141 Irwin Avenue Woodchip Bioreactor	-	-	-	-	-	-	-
$237,196	-	$105,512	$62,510	$69,174	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Wiley Road	Basin 22 Hunting Road Serenity Park Bioreactor	-	-	-	-	-	-	-
$122,812	-	-	$82,735	$40,077	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Broadway Pond	-	-	-	-	-	-	-	-
$42,864	-	-	$42,864	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	-	7 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects
$23,584,400	-	-	-	$1,026,000	$5,184,600	$3,285,200	$3,070,000	$3,105,700	$2,379,400	$2,802,800	$2,730,700
Central IRL - Palm Bay	Bayfront Stormwater Project	-	-	-	-	-	-	-	-	-	-
$30,624	$30,624	-	-	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Grant Place Baffle Box	Ray Bullard Stormwater Management Area	-	-	-	-	-	-	-
$180,081	-	-	$82,481	$97,600	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Espanola Baffle Box								
$105,186	-	-	$105,186								
Central - St. Johns River Water Management District	-	-	Crane Creek/M-1 Canal Flow Restoration	-	-	-	-	-	-	-	-
$2,033,944	-	-	$2,033,944	-	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	Fleming Grant	Basin 2258 Babcock Road Bioreactor							
$106,791	-	-	$56,588	$50,203							
Central IRL - Brevard	-	-	-	1 Project	1 Project	2 Projects	1 Project	1 Project	2 Projects	1 Project	1 Project
$3,995,300	-	-	-	$407,500	$196,200	$916,100	$486,400	$276,900	$975,400	$326,500	$410,300
Muck Removal & Interstitial Treatment	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach Phase III	Cocoa Beach Ph II-B	-	-	-	-	-	-	-
$7,293,955	-	-	$1,376,305	$5,917,650	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Merritt Island Canals								
$7,733,517	-	-	$7,733,517								
Banana River Lagoon	-	-	-	Indian Harbour Beach	Indian Harbour Beach						
$9,115,415	-	-	-	$500,000	$8,615,415						
Banana River Lagoon	-	-	29% Sykes Creek	-	71% Sykes Creek	-	-	-	-	-	-
$15,954,132	-	-	$5,954,132	-	$10,000,000	-	-	-	-	-	-
Banana River Lagoon	-	-	20% Grand Canal	25% Grand Canal	55% Grand Canal	-	-	-	-	-	-
$18,020,368	-	-	$3,020,368	$5,000,000	$10,000,000	-	-	-	-	-	-
Banana River Lagoon	-	-	-	1% Cocoa Beach Golf	1% Cocoa Beach Golf	8% Cocoa Beach Golf	16% Cocoa Beach Golf	30% Cocoa Beach Golf	-	-	-
$24,363,100	-	-	-	$500,000	$500,000	$3,500,000	$6,863,100	$13,000,000	-	-	-
Banana River Lagoon	-	-	-	-	-	2% Port Canaveral South	25% Port Canaveral South	48% Port Canaveral South	25% Port Canaveral South	-	-
$16,834,419	-	-	-	-	-	$400,000	$4,208,605	$8,017,209	$4,208,605	-	-
Banana River Lagoon	-	-	-	-	-	3% Pineda	47% Pineda	50% Pineda	-	-	-
$7,815,980	-	-	-	-	-	$200,000	$3,707,990	$3,907,990	-	-	-
Banana River Lagoon	-	-	-	-	-	Patrick Air Force Base	-	-	-	-	-
$8,216,800	-	-	-	-	-	$8,216,800	-	-	-	-	-
Banana River Lagoon	-	-	-	Satellite Beach	Satellite Beach	-	-	-	-	-	-

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$4,941,981	-	-	-	$500,000	$4,441,981	-	-	-	-	-	-
North IRL	-	-	2% Eau Gallie Northeast	49% Eau Gallie Northeast	49% Eau Gallie Northeast	-	-	-	-	-	-
$10,020,488	-	-	$200,410	$4,910,039	$4,910,039	-	-	-	-	-	-
North IRL	-	1% Titusville East	4% Titusville East	4% Titusville East	21% Titusville East	30% Titusville East	40% Titusville East	-	-	-	-
$4,609,424	-	$46,094	$184,377	$184,377	$967,979	$1,382,827	$1,843,770				
North IRL	-	1% Titusville West	4% Titusville West	4% Titusville West	21% Titusville West	30% Titusville West	40% Titusville West	-	-	-	-
$3,607,375	-	$36,074	$144,295	$144,295	$757,549	$1,082,212	$1,442,950	-		-	-
North IRL	-	1% National Aeronautics and Space Administration East	4% National Aeronautics and Space Administration East	-	25% National Aeronautics and Space Administration East	30% National Aeronautics and Space Administration East	40% National Aeronautics and Space Administration East	-	-	-	-
$11,423,355	-	$114,234	$456,934	-	$2,855,839	$3,427,006	$4,569,342	-	-	-	-
North IRL	-	-	-	4% Rockledge A	48% Rockledge A	48% Rockledge A	-	-	-	-	-
$5,010,244	-	-	-	$200,000	$2,405,122	$2,405,122	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$215,000	-	$215,000	-	-	-	-	-	-	-	-	-
Oyster Bars	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Marina Isles	-	-	-	-	-	-	-	-	-
$26,700	-	$26,700	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Bettinger	-	-	-	-	-	-	-	-	-
$10,680	-	$10,680	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	McNabb	-	-	-	-	-	-
$34,056	-	-	-	-	$34,056	-	-	-	-	-	-
Banana River Lagoon	-	Gillin	-	-	-	-	-	-	-	-	-
$16,020	-	$16,020	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Brevard	-	-	-	-	-	-	-	-	-
$47,350	-	$47,350	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$583,020	-	-	$583,020	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Banana River Oyster Project 2	-	-	-	-	-	-	-
$264,800	-	-	-	$264,800	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Oyster Reef Adjustments	-	-	-	-	-	-	-
$12,800	-	-	-	$12,800	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	29,169 square feet Oysters	29,169 square feet Oysters	29,169 square feet Oysters	29,169 square feet Oysters	29,168 square feet Oysters	29,168 square feet Oysters	29,168 square feet Oysters
$3,222,538	-	-	-	-	$460,363	$460,363	$460,363	$460,363	$460,362	$460,362	$460,362
North IRL	-	Bomalaski	-	-	-	-	-	-	-	-	-
$8,900	-	$8,900	-	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$13,258	-	$13,258	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$341,280	-	-	$341,280	-	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo North IRL Oyster Project 2	-	-	-	-	-	-	-
$336,400	-	-	-	$336,400	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo Oyster Reef Adjustments	-	-	-	-	-	-	-
$27,200	-	-	-	$27,200	-	-	-	-	-	-	-
North IRL	-	-	-	-	32,564 square feet Oysters	32,564 square feet Oysters	32,564 square feet Oysters	32,564 square feet Oysters	32,564 square feet Oysters	32,563 square feet Oysters	32,563 square feet Oysters
$3,597,633	-	-	-	-	$513,948	$513,948	$513,948	$513,948	$513,947	$513,947	$513,947
Central IRL	-	Coconut Point	-	-	-	-	-	-	-	-	-

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
$45,120	-	$45,120	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$108,790	-	$108,790	-	-	-	-	-	-	-	-	-
Central IRL	-	Wexford	-	-	-	-	-	-	-	-	-
$31,150	-	$31,150	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Senior Resort	-	-	-	-	-	-	-	-	-
$30,304	-	$30,304	-	-	-	-	-	-	-	-	-
Central IRL	-	-	Brevard Zoo Central IRL	-	-	-	-	-	-	-	-
$161,160	-	-	$161,160	-	-	-	-	-	-	-	-
Central IRL	-	-	-	Brevard Zoo Central IRL Oyster Project 2	-	-	-	-	-	-	-
$270,800	-	-	-	$270,800	-	-	-	-	-	-	-
Central IRL	-	-	-	-	6,318 square feet Oysters	6,317 square feet Oysters	6,317 square feet Oysters	6,317 square feet Oysters	6,317 square feet Oysters	6,317 square feet Oysters	6,317 square feet Oysters
$697,917	-	-	-	-	$99,703	$99,703	$99,703	$99,702	$99,702	$99,702	$99,702
Planted Shorelines	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Cocoa Beach	-	-	-	-	-	-	-	-	-
$16,014	-	$16,014	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	McNabb	-	-	-	-	-	-
$5,760	-	-	-	-	$5,760	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$3,120	-	-	$3,120	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Banana River Plant Project 2	-	-	-	-	-	-	-
$480	-	-	-	$480	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$2,240	-	$2,240	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$720	-	-	$720	-	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo North IRL Plant Project 2	-	-	-	-	-	-	-
$9,840	-	-	-	$9,840	-	-	-	-	-	-	-
Central IRL	-	Lagoon House	-	-	-	-	-	-	-	-	-
$23,961	-	$23,961	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$18,480	-	$18,480	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	Brevard Zoo Central IRL Plant Project	-	-	-	-	-	-	-
$1,920	-	-	-	$1,920	-	-	-	-	-	-	-
Central IRL	-	-	-	Fisherman's Landing	-	-	-	-	-	-	-
$4,800	-	-	-	$4,800	-	-	-	-	-	-	-
Central IRL	-	-	-	Rotary Park	-	-	-	-	-	-	-
$4,800	-	-	-	$4,800	-	-	-	-	-	-	-
Project Monitoring	-	Year 1 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 4 Monitoring	Year 5 Monitoring	Year 6 Monitoring	Year 7 Monitoring	Year 8 Monitoring	Year 9 Monitoring	Year 10 Monitoring
$10,000,000	-	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Contingency	Year 0 Contingency	Year 1 Contingency	Year 2 Contingency	Year 3 Contingency	Year 4 Contingency	Year 5 Contingency	Year 6 Contingency	Year 7 Contingency	Year 8 Contingency	Year 9 Contingency	Year 10 Contingency
$20,427,233	$225,699	$670,676	$1,523,362	$2,558,278	$4,286,355	$2,437,770	$2,508,515	$2,594,765	$1,241,515	$1,828,662	$551,636
$428,971,922	***$4,739,684***	***$14,084,202***	***$31,990,604***	***$53,723,843***	***$90,013,446***	***$51,193,175***	***$52,678,822***	***$54,490,069***	***$26,071,823***	***$38,401,893***	***$11,584,361***

Table 9-9b: Timeline for Funding Needs (Table 46 in the Original Save Our Indian River Lagoon Project Plan) with inflation

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Public Education	-	-	-	-	-	-	-	-	-	-	-
Fertilizer Management	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$713,508	-	$125,000	$51,625	$53,303	$55,035	$56,824	$117,341	$60,577	$62,546	$64,579	$66,678
Grass Clippings	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$231,935	-	$20,000	$20,650	$21,321	$22,014	$22,730	$23,468	$24,231	$25,018	$25,832	$26,671
Septic System Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,518	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
WWTF Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach	-	-	-	-	-	-	-	-
$975,713	-	-	$975,713	-	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville Osprey Design and Permitting	Titusville Osprey Design and Start Construction	Titusville Osprey Construction	-	-	-	-	-
$10,000,540	-	-	-	$1,066,056	$3,302,109	$5,632,375	-	-	-	-	-
North IRL	-	-	-	-	Osprey Nutrient Upgrade Phase 2	-	-	-	-	-	-
$330,211	-	-	-	-	$330,211	-	-	-	-	-	-
Central IRL	-	Palm Bay Permit and Engineering	Palm Bay Construction	Palm Bay Construction	-	-	-	-	-	-	-
$3,823,661	-	$200,000	$1,239,000	$2,384,661	-	-	-	-	-	-	-
Central IRL	-	-	-	Melbourne Grant Street	-	-	-	-	-	-	-
$7,216,668	-	-	-	$7,216,668	-	-	-	-	-	-	-
Central IRL	-	-	-	Ray Bullard Biological Nutrient Removal	-	-	-	-	-	-	-
$4,541,400				$4,541,400							
Sewer Laterals	-	-	-	-	-	-	-	-	-	-	-
Satellite Beach Pilot	-	Satellite Beach Pilot Project	-	-	-	-	-	-	-	-	-
$840,000	-	$840,000	-	-	-	-	-	-	-	-	-
Titusville Osprey Pilot	-	-	Titusville Osprey Pilot Project	-	-	-	-	-	-	-	-
$206,500	-	-	$206,500	-	-	-	-	-	-	-	-
Merritt Island Lateral	-	-	-	Merritt Island Lateral Smoke Testing	-	-	-	-	-	-	-
$266,514	-	-	-	$266,514	-	-	-	-	-	-	-
Barefoot Bay Lateral	-	-	-	Barefoot Bay Lateral Smoke Testing	-	-	-	-	-	-	-
$95,945	-	-	-	$95,945	-	-	-	-	-	-	-
South Beaches Lateral	-	-	-	South Beaches Lateral Smoke Testing	-	-	-	-	-	-	-
$213,211	-	-	-	$213,211	-	-	-	-	-	-	-
Rapid Infiltration Basin/ Sprayfield Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-
$6,333,000	-	-	-	-	-	-	-	$6,333,000	-	-	-
North IRL	-	-	-	-	Port St John	-	-	-	-	-	-
$1,078,799	-	-	-	-	$1,078,799	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	-	-	-	Canebreaker Condo
$48,008	-	-	-	-	-	-	-	-	-	-	$48,008
North IRL	-	-	-	-	-	-	-	-	-	-	River Forest Mobile Home Park WWTF
$104,557	-	-	-	-	-	-	-	-	-	-	$104,557
North IRL	-	-	-	-	-	-	-	-	-	-	Palm Harbor Mobile Home Park WWTF
$400,818	-	-	-	-	-	-	-	-	-	-	$400,818

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Central IRL	-	-	-	-	-	-	-	-	-	-	Indian River Shores Trailer Park
$50,868	-	-	-	-	-	-	-	-	-	-	$50,868
Septic Removal	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes M Engineering	-	Sykes Creek M	-	-	-	-	-	-	-	-
$1,921,444	$250,000	-	$1,671,444	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Sykes Creek N	-	-	-	-	-	-	-	-	-
$2,603,016	-	$2,603,016	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes T Engineering	-	-	Sykes Creek T	-	-	-	-	-	-	-
$5,248,797	$250,000	-	-	$4,998,797	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	South Banana B Engineering	South Banana B	-	-	-	-	-
$1,545,148	-	-	-	-	$302,693	$1,242,455	-	-	-	-	-
Banana River Lagoon	-	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-	-	-	-
$2,155,625	-	-	-	$203,404	$630,042	$650,519	$671,661	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island C Engineering	Merritt Island C	Merritt Island C	-	-	-	-
$1,816,946	-	-	-	-	$159,602	$815,421	$841,923	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island F Engineering	-	Merritt Island F	-	-	-	-
$1,283,482	-	-	-	-	$110,070	-	$1,173,411	-	-	-	-
Banana River Lagoon	-	-	-	-	Sykes Creek R Engineering	-	-	Sykes Creek R	-	-	-
$4,204,945	-	-	-	-	$352,225	-	-	$3,852,720	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island G Engineering	-	-	-	-	Merritt Island G	-
$21,147,201	-	-	-	-	$1,816,160	-	-	-	-	$19,331,041	-
Banana River Lagoon	-	-	-	-	North Merritt Island E Engineering	-	North Merritt Island E	-	-	-	-
$4,212,491	-	-	-	-	$800,211	-	$3,412,280	-	-	-	-
North IRL	South Central C Engineering	South Central C	-	-	South Central C	-	-	-	-	-	-
$6,794,147	$450,000	$4,222,080	-	-	$2,122,067	-	-	-	-	-	-
North IRL	Breeze Swept	-	-	-	-	-	-	-	-	-	-
$880,530	$880,530	-	-	-	-	-	-	-	-	-	-
North IRL	Merritt Island Redevelopment Agency	-	-	-	-	-	-	-	-	-	-
$320,000	$320,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	Riverside Drive	-	-	-	-	-	-	-	-
$274,604	-	-	$274,604	-	-	-	-	-	-	-	-
North IRL	-	-	Cocoa K	-	-	-	-	-	-	-	-
$1,240,437	-	-	$1,240,437	-	-	-	-	-	-	-	-
North IRL	-	-	Roxy Avenue	-	-	-	-	-	-	-	-
$91,835	-	-	$91,835	-	-	-	-	-	-	-	-
North IRL	-	-	-	Cocoa J	-	-	-	-	-	-	-
$3,344,184	-	-	-	$3,344,184	-	-	-	-	-	-	-
North IRL	-	-	-	Rockledge	-	-	-	-	-	-	-
$533,646	-	-	-	$533,646	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville A-G	-	-	-	-	-	-	-
$1,280,751	-	-	-	$1,280,751	-	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	Titusville H	-	-	-
$1,415,111	-	-	-	-	-	-	-	$1,415,111	-	-	-
North IRL	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-
$7,098,974	-	-	$310,679	$320,776	$993,605	$1,025,897	$1,059,238	$1,093,664	$1,129,208	$1,165,907	-
North IRL	-	-	-	-	South Central D (Brevard) Engineering	South Central D (Brevard)	-	-	-	-	-
$5,391,941	-	-	-	-	$1,051,171	$4,340,770	-	-	-	-	-

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	-	-	-	-	-	South Central D (Melbourne)	-	-	-	-
$311,541	-	-	-	-	-	-	$311,541	-	-	-	-
North IRL	-	-	-	-	South Central A Engineering	South Central A	-	-	-	-	-
$3,806,427	-	-	-	-	$742,975	$3,063,453	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Beaches A	-	-	-	-
$1,448,886	-	-	-	-	-	-	$1,448,886	-	-	-	-
North IRL	-	-	-	-	-	-	South Central F	-	-	-	-
$1,997,113	-	-	-	-	-	-	$1,997,113	-	-	-	-
North IRL	-	-	-	South Beaches O	-	-	-	-	-	-	-
$142,306	-	-	-	$142,306	-	-	-	-	-	-	-
North IRL	-	-	-	South Beaches P	-	-	-	-	-	-	-
$533,646	-	-	-	$533,646	-	-	-	-	-	-	-
North IRL	-	-	-	-	-	-	-	Melbourne	-	-	-
$1,051,226	-	-	-	-	-	-	-	$1,051,226	-	-	-
North IRL	-	-	-	-	Sharpes A Engineering	-	-	-	Sharpes A	-	-
$7,577,693	-	-	-	-	$1,370,375	-	-	-	$6,207,318	-	-
North IRL	-	-	-	-	-	-	-	-	-	Rockledge Zone B	-
$6,896,404	-	-	-	-	-	-	-	-	-	$6,896,404	-
North IRL	-	-	-	-	Sharpes B Engineering	-	-	-	Sharpes B	-	-
$4,929,547	-	-	-	-	$891,569	-	-	-	$4,037,978	-	-
North IRL	-	-	-	-	Cocoa C Engineering	-	-	-	-	Cocoa C	-
$6,578,427	-	-	-	-	$1,155,738	-	-	-	-	$5,422,688	-
Central IRL	Micco	-	-	Micco	-	-	-	-	-	-	-
$2,042,540	$1,977,345	-	-	$65,195	-	-	-	-	-	-	-
Central IRL	-	-	-	Micco Phase II	-	-	-	-	-	-	-
$756,628	-	-	-	$756,628	-	-	-	-	-	-	-
Central IRL	Hoag	-	-	-	-	-	-	-	-	-	-
$86,031	$86,031	-	-	-	-	-	-	-	-	-	-
Central IRL	Penwood	-	-	-	-	-	-	-	-	-	-
$40,632	$40,632	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay B	-	-	-	-	-	-
$9,146,433	-	-	-	-	$9,146,433	-	-	-	-	-	-
Central IRL	-	-	-	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	Quick Connects	-
$3,972,457	-	-	-	$271,205	$568,623	$587,103	$606,184	$625,885	$646,227	$667,229	-
Central IRL	-	Sylvan Estates	-	-	-	-	-	-	-	-	-
$1,561,215	-	$1,561,215	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay A	-	-	-	-	-	-
$2,828,415	-	-	-	-	$2,828,415	-	-	-	-	-	-
Central IRL	-	-	-	-	Micco B Engineering	-	Micco B	Micco B	-	-	-
$10,622,908	-	-	-	-	$897,073	-	$5,867,057	$3,858,778	-	-	-
Septic Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	20 Upgrades	20 Upgrades	20 Upgrades	20 Upgrades	20 Upgrades	-	-	-
$2,047,750	-	-	-	$383,780	$396,253	$409,131	$422,428	$436,157	-	-	-
North IRL	-	-	-	40 Upgrades	70 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	80 Upgrades	76 Upgrades
$12,710,814	-	-	-	$767,561	$1,386,886	$1,636,525	$1,689,712	$1,744,628	$1,801,328	$1,859,872	$1,824,302
Central IRL	Long Point	-	-	-	-	-	-	-	-	-	-
$101,854	$101,854	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	40 Upgrades	75 Upgrades	100 Upgrades	145 Upgrades	145 Upgrades	145 Upgrades	145 Upgrades	144 Upgrades
$16,902,000	-	-	-	$720,000	$1,350,000	$1,800,000	$2,610,000	$2,610,000	$2,610,000	$2,610,000	$2,592,000
Stormwater Projects	-	-	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	-	Cape Shores Swales	-	-	-	-	-	-	-	-	-
$2,746	-	$2,746	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	-	Justamere Road Swale	-	-	-	-	-	-	-	-	-
$528	-	$528	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Central Boulevard Baffle Box	Hitching Post Berms	-	-	-	-	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
$37,252	$34,700	$2,552	-	-	-	-	-	-	-	-	-
Banana - Indian Harbour Beach	Gleason Park Reuse	Big Muddy at Cynthia Baffle Box	Big Muddy Expansion	-	-	-	-	-	-	-	-
$72,596	$4,224	$41,695	$26,677	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	-	-	Convair Cove 1 – Blakey Blvd	-	-	-	-	-	-
$5,118	-	-	-	-	$5,118	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	-	-	Convair Cove 2- Dempsey Drive	-	-	-	-	-	-
$4,948	-	-	-	-	$4,948	-	-	-	-	-	-
Banana - Satellite Beach	-	-	-	Jackson Court	-	-	-	-	-	-	-
$8,812	-	-	-	$8,812	-	-	-	-	-	-	-
Banana - Satellite Beach	-	-	Basin 1304 Bioreactor	-	-	-	-	-	-	-	-
$92,925	-	-	$92,925	-	-	-	-	-	-	-	-
Banana - Brevard	-	-	-	4 Projects - Pioneer	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects	7 Projects
$17,100,616	-	-	-	$1,014,566	$2,045,547	$3,470,343	$2,968,379	$2,376,208	$1,799,327	$1,679,826	$1,746,422
North IRL - Cocoa	Church Street Type II Baffle Box	-	-	Floating Wetlands	-	-	-	-	-	-	-
$89,641	$88,045	-	-	$1,596	-	-	-	-	-	-	-
North IRL - Cocoa	-	-	-	**Diamond Square Pond**	-	-	-	-	-	-	-
$11,069	-	-	-	$11,069	-	-	-	-	-	-	-
North IRL - Cocoa	-	-	-	Forrest Avenue Outfall	-	-	-	-	-	-	-
$14,878	-	-	-	$14,878	-	-	-	-	-	-	-
North IRL - Titusville	-	St. Teresa Basin Treatment	Titusville High School Baffle Box	Draa Field Vegetation Harvesting	-	-	-	-	-	-	-
$441,550	-	$272,800	$115,447	$53,303	-	-	-	-	-	-	-
North IRL - Titusville	-	South Street Basin Treatment	Coleman Pond Managed Aquatic Plant System	Osprey Plant Managed Aquatic Plant Systems	-	-	-	-	-	-	-
$186,957	-	$86,856	$36,138	$63,963	-	-	-	-	-	-	-
North IRL - Titusville	-	La Paloma Basin Treatment	-	Draa Pond Managed Aquatic Plant Systems	-	-	-	-	-	-	-
$241,643	-	$208,296	-	$33,347	-	-	-	-	-	-	-
North IRL - Melbourne	-	Cliff Creek Baffle Box	Apollo/GA Baffle Box	-	-	-	-	-	-	-	-
$654,972	-	$347,781	$307,191	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Thrush Drive Baffle Box	Cherry Street Baffle Box	-	-	-	-	-	-	-	-
$417,314	-	$322,200	$95,114	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Stewart Road Dry Retrofit	Spring Creek Baffle Box	-	-	-	-	-	-	-	-
$120,931	-	$18,344	$102,587	-	-	-	-	-	-	-	-
North IRL - Indialantic	-	-	-	Basin 5 Dry Retention	-	-	-	-	-	-	-
$17,782	-	-	-	$17,782	-	-	-	-	-	-	-
North IRL - Brevard	-	Kingsmill-Aurora Phase Two	Basin 1298 Bioreactor	County Wide Pond Harvesting	-	-	-	-	-	-	-
$471,412	-	$367,488	$88,999	$14,925	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Huntington Pond	Johns Road Pond	Basin 10 County Line Road Bioreactor	-	-	-	-	-	-	-
$206,079	-	$104,720	$23,778	$77,580	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Flounder Creek Pond	Burkholm Road	Basin 26 Sunset Road Serenity Park Bioreactor	-	-	-	-	-	-	-
$220,496	-	$75,328	$66,483	$78,686	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Johns Road Pond	Carter Road	Basin 141 Irwin Avenue Woodchip Bioreactor	-	-	-	-	-	-	-
$243,797	-	$105,512	$64,542	$73,743	-	-	-	-	-	-	-

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL - Brevard	-	-	Wiley Road	Basin 22 Hunting Road Serenity Park Bioreactor	-	-	-	-	-	-	-
$128,148	-	-	$85,424	$42,724	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Broadway Pond	-	-	-	-	-	-	-	-
$44,257	-	-	$44,257	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	-	7 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects	13 Projects
$28,137,119	-	-	-	$1,093,774	$5,706,705	$3,733,551	$3,602,373	$3,762,702	$2,976,445	$3,620,034	$3,641,535
Central IRL - Palm Bay	Bayfront Stormwater Project	-	-	-	-	-	-	-	-	-	-
$30,624	$30,624	-	-	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Grant Place Baffle Box	Ray Bullard Stormwater Management Area	-	-	-	-	-	-	-
$189,209	-	-	$85,162	$104,047	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Espanola Baffle Box	-	-	-	-	-	-	-	-
$108,605	-	-	$108,605	-	-	-	-	-	-	-	-
Central - St. Johns River Water Management District	-	-	Crane Creek/M-1 Canal Flow Restoration	-	-	-	-	-	-	-	-
$2,100,047	-	-	$2,100,047	-	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	Fleming Grant	Basin 2258 Babcock Road Bioreactor	-	-	-	-	-	-	-
$111,946	-	-	$58,427	$53,519	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	-	1 Project	1 Project	2 Projects	1 Project	1 Project	2 Projects	1 Project	1 Project
$4,786,733	-	-	-	$434,418	$215,958	$1,041,126	$570,747	$335,477	$1,220,150	$421,700	$547,157
Muck Removal & Interstitial Treatment	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach Phase III	Cocoa Beach Ph II-B	-	-	-	-	-	-	-
$7,729,583	-	-	$1,421,035	$6,308,548	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Merritt Island Canals								
$7,984,856	-	-	$7,984,856								
Banana River Lagoon	-	-	-	Indian Harbour Beach	Indian Harbour Beach						
$10,016,042	-	-	-	$533,028	$9,483,014						
Banana River Lagoon	-	-	29% Sykes Creek	-	71% Sykes Creek	-	-	-	-	-	-
$17,154,672	-	-	$6,147,641	-	$11,007,031	-	-	-	-	-	-
Banana River Lagoon	-	-	20% Grand Canal	25% Grand Canal	55% Grand Canal	-	-	-	-	-	-
$19,455,842	-	-	$3,118,530	$5,330,281	$11,007,031	-	-	-	-	-	-
Banana River Lagoon	-	-	-	1% Cocoa Beach Golf	1% Cocoa Beach Golf	8% Cocoa Beach Golf	16% Cocoa Beach Golf	30% Cocoa Beach Golf	-	-	-
$28,864,400	-	-	-	$533,028	$550,352	$3,977,666	$8,053,240	$15,750,114	-	-	-
Banana River Lagoon	-	-	-	-	-	2% Port Canaveral South	25% Port Canaveral South	48% Port Canaveral South	25% Port Canaveral South	-	-
$20,370,882	-	-	-	-	-	$454,590	$4,938,425	$9,713,228	$5,264,639	-	-
Banana River Lagoon	-	-	-	-	-	3% Pineda	47% Pineda	50% Pineda	-	-	-
$9,313,008	-	-	-	-	-	$227,295	$4,350,998	$4,734,715	-	-	-
Banana River Lagoon	-	-	-	-	-	Patrick Air Force Base	-	-	-	-	-
$9,338,195	-	-	-	-	-	$9,338,195	-	-	-	-	-
Banana River Lagoon	-	-	-	Satellite Beach	Satellite Beach	-	-	-	-	-	-
$5,422,330	-	-	-	$533,028	$4,889,302	-	-	-	-	-	-
North IRL	-	-	2% Eau Gallie Northeast	49% Eau Gallie Northeast	49% Eau Gallie Northeast	-	-	-	-	-	-
$10,845,796	-	-	$206,923	$5,234,378	$5,404,495	-	-	-	-	-	-
North IRL	-	1% Titusville East	4% Titusville East	4% Titusville East	21% Titusville East	30% Titusville East	40% Titusville East	-	-	-	-
$5,233,516	-	$46,094	$190,369	$196,556	$1,065,446	$1,571,550	$2,163,501	-	-	-	-
North IRL	-	1% Titusville West	4% Titusville West	4% Titusville West	21% Titusville West	30% Titusville West	40% Titusville West	-	-	-	-
$3,845,580	-	$36,074	$148,985	$153,827	$833,837	$1,229,908	$1,442,950	-	-	-	-

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Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	1% National Aeronautics and Space Administration East	4% National Aeronautics and Space Administration East	-	25% National Aeronautics and Space Administration East	30% National Aeronautics and Space Administration East	40% National Aeronautics and Space Administration East	-	-	-	-
$12,985,877	-	$114,234	$471,784	-	$3,143,431	$3,894,710	$5,361,718	-	-	-	-
North IRL	-	-	-	4% Rockledge A	48% Rockledge A	48% Rockledge A	-	-	-	-	-
$5,593,900	-	-	-	$213,211	$2,647,325	$2,733,363	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$215,000	-	$215,000	-	-	-	-	-	-	-	-	-
Oyster Bars	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Marina Isles	-	-	-	-	-	-	-	-	-
$26,700	-	$26,700	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Bettinger	-	-	-	-	-	-	-	-	-
$10,680	-	$10,680	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	McNabb	-	-	-	-	-	-
$37,486	-	-	-	-	$37,486	-	-	-	-	-	-
Banana River Lagoon	-	Gitlin	-	-	-	-	-	-	-	-	-
$16,020	-	$16,020	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Brevard	-	-	-	-	-	-	-	-	-
$47,350	-	$47,350	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$601,968	-	-	$601,968	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Banana River Oyster Project 2	-	-	-	-	-	-	-
$282,292	-	-	-	$282,292	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Oyster Reef Adjustments	-	-	-	-	-	-	-
$13,646	-	-	-	$13,646	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	25,523 square feet Oysters	25,523 square feet Oysters	25,523 square feet Oysters	25,523 square feet Oysters	25,522 square feet Oysters	25,522 square feet Oysters	25,522 square feet Oysters	25,522 square feet Oysters
$3,852,644	-	-	-	$429,427	$443,383	$457,792	$472,670	$488,032	$503,893	$520,269	$537,178
North IRL	-	Bomalaski	-	-	-	-	-	-	-	-	-
$8,900	-	$8,900	-	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$13,258	-	$13,258	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$352,372	-	-	$352,372	-	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo North IRL Oyster Project 2	-	-	-	-	-	-	-
$358,621	-	-	-	$358,621	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo Oyster Reef Adjustments	-	-	-	-	-	-	-
$28,997	-	-	-	$28,997	-	-	-	-	-	-	-
North IRL	-	-	-	28,494 square feet Oysters	28,494 square feet Oysters	28,493 square feet Oysters	28,493 square feet Oysters	28,493 square feet Oysters	28,493 square feet Oysters	28,493 square feet Oysters	28,493 square feet Oysters
$4,301,082	-	-	-	$479,411	$494,991	$511,078	$527,688	$544,838	$562,545	$580,828	$599,704
Central IRL	-	Coconut Point	-	-	-	-	-	-	-	-	-
$45,120	-	$45,120	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$108,790	-	$108,790	-	-	-	-	-	-	-	-	-
Central IRL	-	Wexford	-	-	-	-	-	-	-	-	-
$31,150	-	$31,150	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Senior Resort	-	-	-	-	-	-	-	-	-
$30,304	-	$30,304	-	-	-	-	-	-	-	-	-
Central IRL	-	-	Brevard Zoo Central IRL	-	-	-	-	-	-	-	-
$166,398	-	-	$166,398	-	-	-	-	-	-	-	-

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Central IRL	-	-	-	Brevard Zoo Central IRL Oyster Project 2	-	-	-	-	-	-	-
$288,688	-	-	-	$288,688	-	-	-	-	-	-	-
Central IRL	-	-	-	5,528 square feet Oysters	5,528 square feet Oysters	5,528 square feet Oysters	5,528 square feet Oysters	5,527 square feet Oysters	5,527 square feet Oysters	5,527 square feet Oysters	5,527 square feet Oysters
$834,381	-	-	-	$93,003	$96,025	$99,146	$102,368	$105,695	$109,129	$112,676	$116,338
Planted Shorelines	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Cocoa Beach	-	-	-	-	-	-	-	-	-
$16,014	-	$16,014	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	McNabb	-	-	-	-	-	-
$6,340	-	-	-	-	$6,340	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$3,221	-	-	$3,221	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	Brevard Zoo Banana River Plant Project 2	-	-	-	-	-	-	-
$512	-	-	-	$512	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$2,240	-	$2,240	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$743	-	-	$743	-	-	-	-	-	-	-	-
North IRL	-	-	-	Brevard Zoo North IRL Plant Project 2	-	-	-	-	-	-	-
$10,490	-	-	-	$10,490	-	-	-	-	-	-	-
Central IRL	-	Lagoon House	-	-	-	-	-	-	-	-	-
$23,961	-	$23,961	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$18,480	-	$18,480	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	Brevard Zoo Central IRL Plant Project	-	-	-	-	-	-	-
$2,047	-	-	-	$2,047	-	-	-	-	-	-	-
Central IRL	-	-	-	Fisherman's Landing	-	-	-	-	-	-	-
$5,117	-	-	-	$5,117	-	-	-	-	-	-	-
Central IRL	-	-	-	Rotary Park	-	-	-	-	-	-	-
$5,117	-	-	-	$5,117	-	-	-	-	-	-	-
Project Monitoring	-	Year 1 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 4 Monitoring	Year 5 Monitoring	Year 6 Monitoring	Year 7 Monitoring	Year 8 Monitoring	Year 9 Monitoring	Year 10 Monitoring
$11,596,748	-	$1,000,000	$1,032,500	$1,066,056	$1,100,703	$1,136,476	$1,173,411	$1,211,547	$1,250,923	$1,291,578	$1,333,554
Contingency	Year 0 Contingency	Year 1 Contingency	Year 2 Contingency	Year 3 Contingency	Year 4 Contingency	Year 5 Contingency	Year 6 Contingency	Year 7 Contingency	Year 8 Contingency	Year 9 Contingency	Year 10 Contingency
$23,226,401	$225,699	$670,676	$1,572,871	$2,774,983	$4,703,817	$2,759,420	$2,900,502	$3,107,941	$1,511,897	$2,315,138	$683,457
$487,754,431	***$4,739,684***	***$14,084,202***	***$33,030,298***	***$58,274,633***	***$98,780,158***	***$57,947,822***	***$60,910,550***	***$65,266,764***	***$31,749,844***	***$48,617,889***	***$14,352,587***

Appendix A: Funding Needs and Leveraging Opportunities

Brevard County explored a variety of possible mechanisms to fund the IRL projects in this plan, including:

- Special Taxing District approved by referendum to allow an ad valorem tax levy and bonds
- Special Act by the legislature allowing ad valorem tax levy by referendum to issue bonds
- Local government surtax (0.5 cent sales tax)
- Altering legislation to allow for Tourist Development Council funding to be used for lagoon restoration
- Municipal Service Taxing Unit/Special District
- Increased stormwater utility assessment

The County placed a referendum on the November 8, 2016 ballot for the 0.5 cent sales tax, and this referendum passed by more than 60% of the vote. The Save Our Indian River Lagoon 0.5 cent sales tax will generate approximately $34 million per year. The proposed 1 mill increase would have generated approximately $32 million per year, whereas the proposed increase in 0.5 mill would have only generated $16 million per year. To implement the projects in a timely manner according to the schedule in **Table 9-9**, and to accelerate the projects where possible, the County will seek to use funds generated from the sales tax to leverage matching funding from grants and appropriations and/or pay debt service on bonds. If additional funding is provided through matching funds from other sources, additional projects may be implemented, which would increase the overall plan cost, and/or project timelines may be moved up to allow the benefits of those projects to occur earlier than planned.

Examples of other funding programs (many from Florida Department of Environmental Protection 2019) are:

- Section 319 grant program – The Florida Department of Environmental Protection administers funds received from U.S Environmental Protection Agency to implement projects or programs that reduce nonpoint sources of pollution. Projects or programs must benefit Florida's impaired waters, and local sponsors must provide at least a 40% match or in-kind contribution. Eligible activities include demonstration and evaluation of urban and agricultural stormwater best management practices, stormwater retrofits, and public education.
- State water quality assistance grants – Funding may be available through periodic legislative appropriations to the Florida Department of Environmental Protection. When funds are available, the program prioritizes stormwater construction projects to benefit impaired waters, similar to the Section 319 grant program.
- Water management district funding - Florida's five regional water management districts offer financial assistance for a variety of water-related projects, for water supply development, water resource development, and surface water restoration. Assistance may be provided from ad valorem tax revenues or from periodic legislative appropriations for alternative water supply development, springs restoration, and Surface Water Improvement and Management projects. The amount of funding available, matching requirements, and types of assistance may vary from year to year.
- IRL National Estuary Program – The IRL Council funds projects each year through their work plan process (http://www.irlcouncil.com/irl-council.html).

- Tourism + Lagoon Grant Program – The Brevard County Tourism Development Council has approved funding for the development of projects that demonstrate a benefit to the health of the IRL and a positive impact to Brevard County for litter control along shorelines and causeways/entryways, restoration and protection of living shorelines, habitat restoration to support fish and wildlife viewing, and waterway destinations and access for improved and sustainable recreational waterway access.
- Budget Appropriation – The Florida Legislature may solicit applications directly for projects, including water projects, in anticipation of upcoming legislative sessions. This process is an opportunity to secure legislative sponsorship of project funding through the state budget.
- Clean Water State Revolving Fund 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. Discounted assistance for small communities is available. Interest rates on loans are below market rates and vary based on the economic wherewithal of the community. The Clean Water State Revolving Fund is Florida's largest financial assistance program for water infrastructure.
- Florida Resilient Coastlines Program – The Florida Department of Environmental Protection offers technical assistance and funding to coastal communities dealing with increasingly complex flooding, erosion, and habitat shifts.
- Florida Rural Water Association Loan Program – This program provides low-interest bond or bank financing for community utility projects in coordination with the Florida Department of Environmental Protection's State Revolving Fund program. Other financial assistance may also be available.
- Rural Development Rural Utilities Service Guaranteed and Direct Loans and Grants – The U.S. Department of Agriculture's program provides a combination of loans and grants for water, wastewater, and solid waste projects to rural communities and small incorporated municipalities.
- 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 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 provide very low, low, and moderate income families with assistance. Funding may be used for emergency repairs, new construction, rehabilitation, down payment and closing cost assistance, impact fees, construction and gap financing, mortgage buy-downs, acquisition of property for affordable housing, matching dollars for federal housing grants and programs, and homeownership counseling (http://www.floridahousing.org/HousingPartners/LocalGovernments/).
- Rural Development Funding – The U. S. Department of Agriculture provides funds that will cover the repair and maintenance of private septic systems. The amount of funds available, as well as the specific purposes for which grants are intended, changes from year to year. Additional details are posted on the Department of Agriculture's website (http://www.rurdev.usda.gov/Home.html).

Appendix B: References

Alachua County. 2012. Keeping Grass off the Streets Campaign Social Marketing Public Outreach Campaign Final Report. Alachua County Environmental Protection Department.

Anderson, Damann L. 2006. A Review of Nitrogen Loading and Treatment Performance Recommendation for Onsite Wastewater Treatment Systems in the Wekiva Study Area. Hazen and Sawyer, P.C.

Anderson, D. L. 2016. A Review of Nitrogen Loading and Treatment Performance Recommendations for Onsite Wastewater Treatment Systems (OWTS) in the Wekiva Study Area. Wekiva Issue Paper R:\40391-001.

Applied Ecology. 2018. Parcel-, Modified Focus Area, and Community-Based OSTDS Prioritization Analysis in Support of an Updated SOIRL Septic System Conversion and/or Replacement Projects. Prepared for Brevard County Natural Resources Management Department.

Arnade, L. J. 1999. Seasonal correlation of well contamination and septic tank distance. Ground Water 37: 920-923.

Ayres Associates. 1993. An Investigation of the Surface Water Contamination Potential From On-Site Sewage Disposal Systems (OSDS) in the Turkey Creek Sub-Basin of the Indian River Lagoon Basin. St. Johns River Water Management District SWIM Project IR-1-110.1-D. Report to the Florida Department of Health and Rehabilitative Services under Contract No. LP114 and LP596.

Barile, P. 2018. Widespread sewage pollution of the Indian River Lagoon system, Florida (USA) resolved by spatial analyses of macroalgal biogeochemistry. Marine Pollution Bulletin 128:557–574.

Bilskie, M. V. Bacopoulos, P., Hagen, S. C., 1990. Astronomic tides and nonlinear tidal dispersion for a tropical coastal estuary with engineered features (causeways): Indian River Lagoon system. Estuarine, Coastal and Shelf Science 216:54-70.

Blue Life Program. Website: https://brevardzoo.org/conservation-programs/blue-life-florida/.

Bostater, C. & Rotkiske, T. 2016. Movement Measurements of Muck and Fluidized Mud at Dredge Sites. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Bostater, C. & Rotkiske, T. 2018. Moving Muck & Fluidized Mud & Tributary Bedload Measurements at Dredge Sites. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Boyd, C. 1969. The nutritive value of three species of water weeds. Economic Botany 23(2): 123-127.

Brehm, J. M., Pasko, D. K., Eisenhauer, B.W. 2013. Identifying key factors in homeowner's adoption of water quality best management practices. Environmental Management. 52, 113–122.

Brevard County Natural Resources Management Department. 2017. Today's Leaves and Grass Clippings, Tomorrow's Indian River Lagoon Muck.

Brevard County Utility Services. 2013. Infrastructure Asset Evaluation.

Carsey, T. P., Ferry, R., Goodwin, K. D., Ortner, P. B., Proni, J., Swart, P. K., Zhang, J. Z. 2005. Brevard County Near Shore Ocean Nutrification Analysis. NOAA/Brevard County Near Shore Nutrification Analysis Project Final Report.

Caschetto, M., Robertson, W., Petitta, M., Aravena, R. 2018. Partial nitrification enhances natural attenuation of nitrogen in a septic system plume. Science of the Total Environment 625: 801–808.

CDM Smith and Taylor Engineering. 2014. Preliminary Concept Design for Artificial Flushing Projects in the Indian River Lagoon. Phase I – Literature Review/Preliminary Site Selection. Prepared for the St. Johns River Water Management District.

CDM Smith and Taylor Engineering. 2015. Preliminary Concept Design for Artificial Flushing Projects in the Indian River Lagoon. Phase II – Conceptual Design/Project Refinement. Prepared for the St. Johns River Water Management District.

Chang, N., Wanielista, M., Daranpob, A., Xuan, Z., and Hossain, F. 2010. New Performance-Based Passive Septic Tank Underground Drainfield for Nutrient and Pathogen Removal Using Sorption Media. Environmental Engineering Science, Volume: 27 Issue: 6, p. 469-482. doi: 10.1089/ees.2009.0387.

City of DeLand and University of Central Florida. 2018. Final Report Bio-sorption Activated Media for Nitrogen Removal in a Rapid Infiltration Basin – Monitoring Project. Prepared for Florida Department of Environmental Protection: Project Agreement No. NS 003.

Clark, L. B., Gobler, C. J., Sañudo-Wilhelm, S. A. 2006. Spatial and Temporal Dynamics of Dissolved Trace Metals, Organic Carbon, Mineral Nutrients, and Phytoplankton in a Coastal Lagoon: Great South Bay, New York. Estuaries and Coasts 29:841–854.

Clements, Jeff C. and Comeau, Luc A. 2019. Nitrogen removal potential of shellfish aquaculture harvests in eastern Canada: A comparison of culture methods. Aquaculture Reports. Volume 13, March 2019, 100183.

Cogger, C. G., Hajjar, L. M., Moe, C. L., Sobsey, M. D. 1988. Septic System Performance on a Coastal Barrier Island. Journal of Environmental Quality 17:401-408.

Cowan, J. L., Boynton, W. R. 1996. Sediment-water oxygen and nutrient exchanges along the longitudinal axis of chesapeake bay: Seasonal Patterns, controlling factors and ecological significance. Estuaries 19:562-580.

Currin, C.A., Chappell, W.S, and Deaton, A. 2010. Developing alternative shoreline armoring strategies: The living shoreline approach in North Carolina, in Shipman, H., Dethier, M.N., Gelfenbaum, G., Fresh, K.L., and Dinicola, R.S., eds., 2010, Puget Sound Shorelines and the Impacts of Armoring—Proceedings of a State of the Science Workshop, May 2009: U.S. Geological Survey Scientific Investigations Report 2010-5254, p. 91-102.

Dawes, C.J., D. Hanisak, and J.W. Kenworthy. 1995. Seagrass biodiversity in the Indian River Lagoon. Bulletin of Marine Science 57: 59–66.

De, M., and Toor, G.S. 2017. Nitrogen transformations in the mounded drainfields of drip dispersal and gravel trench septic systems. Ecological Engineering. 102. 352-360.

Dea, M., Toor, G. S., Nitrogen transformations in the mounded drainfields of drip dispersal and gravel trench septic systems. Ecological Engineering 102: 352–360.

Dewsbury, B.M., M. Bhat, and J.W. Fourqurean. 2016. A review of seagrass economic valuations: gaps and progress in valuation approaches. Ecosystem Services 18: 68–77.

Dietz, M. E, Clausen, J. C., Filchak, K. K. 2004. Education and changes in residential nonpoint source pollution. Environmental Management 34(5), 684–690.

Donnelly, M., Shaffer, M., Connor, S., and Walters, L. 2018. Shoreline Characterization in the northern Indian River Lagoon. CEELAB Research Data. 2.

Fisher, T. R., Carlson, P. R., Barber, R. T. 1982. Sediment nutrient regeneration in three North Carolina estuaries. Estuarine, Coastal and Shelf Science 14:101-116.

Fisher, T. R., Gilbert, P. M., Hagy, J.D., Harding, L. W., Houde, E. D., Kimmel, D. G., Miller, W. D., Newell, R. I. E., Roman M. R., Smith, E. M., Stevenson, J. C. 2005. Eutrophication of Chesapeake Bay: historical trends and ecological interactions. Marine Ecology Progress Series 303:1-29.

Florida Department of Agriculture and Consumer Services. Detail Fertilizer Summary by County. From July 2011 to June 2012. http://www.freshfromflorida.com/content/download/3526/22077/Detail_Fert_Sum_by_County_Jul11_June12.pdf.

Florida Department of Agriculture and Consumer Services. Total Fertilizer and Nutrients by County. From July 2011 to June 2012. http://www.freshfromflorida.com/content/download/2963/18699/Total_fertilizer_Nutrients_by_County_Jul11_June12.pdf.

Florida Department of Agriculture and Consumer Services. Total Fertilizer and Nutrients for Brevard County for Fiscal Year 2012-2013, Fiscal Year 2013-2014, Fiscal Year 2014-2015, and Fiscal Year 2015-2016. Personal communication on May 17, 2016.

Florida Department of Environmental Protection. 2010. Florida Friendly Best Management Practices for Protection of Water Resources by the Green Industries. http://fyn.ifas.ufl.edu/pdf/GIBMP_Manual_Web_English_2015.pdf.

Florida Department of Environmental Protection. 2012. Removal of Aquatic Vegetation for Nutrient Credits in the Indian River Lagoon (IRL) Basin.

Florida Department of Environmental Protection. 2013a. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Indian River Lagoon Basin, Central Indian River Lagoon.

Florida Department of Environmental Protection. 2013b. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Indian River Lagoon Basin, Banana River Lagoon.

Florida Department of Environmental Protection. 2013c. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Indian River Lagoon Basin, North Indian River Lagoon.

Florida Department of Environmental Protection. 2014. Presentation: Indian River Lagoon Basin Management Action Plan New Project Idea Feedback.

Florida Department of Environmental Protection. 2018. Statewide Best Management Practice (BMP) Efficiencies for Nonpoint Source Management of Surface Waters. Draft – January 2018.

Florida Department of Environmental Protection. 2019. Water Resources Funding in Florida. Prepared by the Division of Water Restoration Assistance.

Florida Department of Environmental Protection. 2016. Reuse Statutory Authority. http://www.dep.state.fl.us/water/reuse/statauth.htm.

Florida Department of Environmental Protection. 2017. Nitrogen Source Inventory and Loading Estimates for the Contributing Areas of Homosassa Springs Group and Chassahowitzka Springs Group. Division of Environmental Assessment and Restoration, Water Quality Evaluation and Total Maximum Daily Loads Program, Ground Water Management Section.

Florida Department of Environmental Protection and Water Management Districts. 2010. Draft Environmental Resource Permit Stormwater Quality Applicant's Handbook: Design Requirements for Stormwater Treatment Systems in Florida.

Florida Department of Health. 2015. Florida Onsite Sewage Nitrogen Reduction Strategies Study, Final Report.

Forand, Nathan, DuBois, Kevin, Halka, Jeff, Hardaway, Scott, Janek, George, Karrh, Lee, Koch, Eva, Linker, Lewis, Mason, Pam, Morgereth, Ed, Proctor, Daniel, Smith, Kevin, Stack, Bill, Stewart, Steve, and Wolinski, Bill. 2014. Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects. Submitted to: Urban Stormwater Work Group Chesapeake Bay Partnership.

Fox, A. L. Trefry, J. H., 2018. Environmental Dredging to Remove Fine-Grained, Organic-Rich Sediments and Reduce Inputs of Nitrogen and Phosphorus to a Subtropical Estuary. Marine Technology Society Journal 52:42-57.

Fox, A. L. & Trefry J. H. 2019. Lagoon-Wide Application of the Quick-Flux Technique to Determine Sediment Nitrogen and Phosphorus Fluxes (Subtask 4). Impacts of Environmental Muck Dredging 2017-2018. Florida Institute of Technology.

Futch, Charles R. 1967. A Survey of the Oyster Resources of Brevard County, Florida. Florida Board of Conservation, Marine Laboratory.

Gao, Y., Cornwell, J. C., Stocker, D. K., Owens, M. S. 2012. Effects of cyanobacterial-driven pH increases on sediment nutrient fluxes and coupled nitrification denitrification in a shallow fresh water estuary. Biogeosciences 9:2697-2710.

Gehl, R. J., Schmidt, J. P., Stone, L. R., Schlegel, A. J., Clark, G. A. 2005. In Situ Measurements of Nitrate Leaching Implicate Poor Nitrogen and Irrigation Management on Sandy Soils. Journal of Environmental Quality 34:2243–2254.

Geza, M., Lowe K. S., McCray, J. E. 2014. STUMOD—a Tool for Predicting Fate and Transport of Nitrogen in Soil Treatment Units. Environ Model Assess 19:243–256.

Giblin, A. E. & Gaines, A. G. 1990. Nitrogen inputs to a marine embayment: the importance of groundwater. Biogeochemistry 10:309-328.

Gilliom, R. J., Patmont, C. R. 1983. Lake Phosphorus Loading from Septic Systems by Seasonally Perched Groundwater. Water Pollution Control Federation 55:1297-1305.

GPI Southeast. 2010. Final Report Baffle Box Effectiveness Monitoring Project. DEP Contract No. S0236. Prepared for Florida Department of Environmental Protection and Sarasota County Board of County Commissioners.

Grabowski, Jonathan H., Brumbaugh, Robert D., Conrad, Robert F., Keeler, Andrew G., Opaluch, James J., Peterson, Charles H., Piehler, Michael F., Powers, Sean P., and Smyth, Ashley R. 2012. Economic Valuation of Ecosystem Services Provided by Oyster Reefs. BioScience, Volume 62 No. 10, p. 900-909. doi:10.1525/bio.2012.62.10.10.

Griffin, D. W., Gibson, C. J., Lipp, E. K., Riley, K. 1999. Detection of Viral Pathogens by Reverse Transcriptase PCR and of Microbial Indicators by Standard Methods in the Canals of the Florida Keys. Applied and Environmental Microbiology 65:4118-4125.

Grizzle, R.E., Greene, J.K., and Coen, L.D. 2008. Seston removal by natural and contructed intertidal eastern oyster (Crassostrea virginica) reefs: A comparison with previous laboratory studies, and the value of in situ methods. Estuaries and Coasts 31:1208-1220.

Harden, H. H., Roeder, E., Hooks, M., Chanton, J. P. 2008. Evaluation of onsite sewage treatment and disposal systems in shallow karst terrain. Water Research 42: 2585 – 2597.

Harden, H. H., Chanton, J. P., Hicks, R., Wade, E., Wakulla County Septic Tank Study Phase II Report on Performance Based Treatment Systems. The Florida State University Department of Earth, Ocean and Atmospheric Science. FDEP Agreement No: WM926.

Harper, Harvey H. and Baker, David M. 2007. Evaluation of Current Stormwater Design Criteria within the State of Florida. Prepared for Florida Department of Environmental Protection, Contract No. S0108.

Harris, P. J. 1995. Water quality impacts from on-site waste disposal systems to coastal areas through groundwater discharge. Environmental Geology 26:262-268.

Harrison, M., Stanwyck, E., Beckingham, B., Starry, O., Hanlon, B., Newcomer, J. 2012. Smart growth and the septic tank: Wastewater treatment and growth management in the Baltimore region. Land Use Policy 29:483– 492.

Hazen and Sawyer. 2015. Evaluation of Full Scale Prototype Passive Nitrogen Reduction Systems (PNRS) and Recommendations for Future Implementation. Report to the Florida Department of Health. Report: http://www.floridahealth.gov/environmental-health/onsitesewage/research/_documents/rrac/hazensawyervolireportrmall.pdf. Appendices: http://www.floridahealth.gov/environmental-health/onsitesewage/research/_documents/rrac/hazensawyervol0iireportrappend.pdf.

Hochmuth, et al. 2016. Managing Landscape Irrigation to Avoid Soil and Nutrient Losses. EDIS Publication: SL384. http://edis.ifas.ufl.edu/pdffiles/SS/SS58600.pdf.

Indian River Lagoon (IRL) Clam Restoration Project. 2019. Coastal Conservation Association, University of Florida Whitney Lab, Florida Fish and Wildlife Conservation Commission. https://www.irlclamproject.com/.

Indian River Lagoon (IRL) National Estuary Program. 2019. Looking Ahead to 2030: A 10-Year Comprehensive Conservation and Management Plan for the Indian River Lagoon, Florida.

Johnson, K. 2017. Biological Responses to Muck Dredging in the Indian River Lagoon, Part I. Seagrass Monitoring and Infaunal Surveys. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Johnson, K. & Shenker, S. 2016. Biological Responses to Muck Removal. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Katz, B. G., Griffi, D. W., McMahon, P. B., Harden, H. S., Wade, E., Hicks, R. W., Chanton, J. P., 2010. Fate of Effluent-Borne Contaminants beneath Septic Tank Drainfields Overlying a Karst Aquifer. Journal of Environmental Quality 39:1181–1195.

Kellogg, M. Lisa, Luckenbach, Mark W., Brown, Bonnie L., Carmichael, Ruth H., Cornwell, Jeffrey C., Piehler, Michael F., and Owens, Michael S. 2013. Quantifying Nitrogen Removal by Oysters Workshop Report. Submitted to: NOAA Chesapeake Bay Office.

Kelly, J. R., Nixon, S. W. 1984. Experimental studies of the effect of organic deposition on the metabolism of a coastal marine bottom community. Marine Ecology Progress Series 17:157-169.

Kemp, W. M., Boynton, W. R. 1984. Spatial and temporal coupling of nutrient inputs to estuarine primary production. The role of particulate transport and decomposition. Bulletin of Marine Science 35:242-247.

Kemp, W. M., Boynton, W. R., Adolf, J. E., Boesch, D. F., Boicourt, W. C., Brush, G., Cornwell, J. C., Fisher, T. R., Gilbert, P. M., Hagy, J.D., Harding, L. W., Houde, E. D., Kimmel, D. G., Miller, W. D., Newell, R. I. E., Roman M. R., Smith, E. M., Stevenson, J. C. 2005. Eutrophication of Chesapeake Bay: historical trends and ecological interactions. Marine Ecology Progress Series 303:1-29.

Kendal, C., McDonnel, J. J. 1998. Isotope Tracers in Catchment Hydrology. Elsevier Science B.V., Amsterdam, 839 p.

Kimley Horn. 2018a. South Beaches Phase 1 Smoke Testing Report. Prepared for Brevard County Utility Services Department.

Kimley Horn. 2018b. South Beaches Phase 2 Smoke Testing Report. Prepared for Brevard County Utility Services Department.

Kroeger, Timm. 2012. Dollars and Sense: Economic Benefits and Impacts from two Oyster Reef Restoration Projects in the Northern Gulf of Mexico. The Nature Conservancy.

Koop, K., Boynton, W. R., Wulff, F., Carman, R. 1990. Sediment-water oxygen and nutrient exchanges along a depth gradient in the Baltic Sea. Marine Ecology Progress Series 63:65-77.

Lambert, M. R., Giller, J. S. J., Skelly, D. K., Bribiescas, R. G., 2016. Septic systems, but not sanitary sewer lines, are associated with elevated estradiol in male frog metamorphs from suburban ponds. General and Comparative Endocrinology 232:109–114.

Lancellotti, B. V., Loomis, J. W., Hoyt, K. P., Avizinis, E., Amador, J. A. 2017. Evaluation of Nitrogen Concentration in Final Effluent of Advanced Nitrogen-Removal Onsite Wastewater Treatment Systems (OWTS). Water Air Soil Pollution 228: 383.

Lapointe, B. E., Brewton, R. A., Wilking, L. E. 2018. Microbial Source Tracking of Bacterial Pollution in the North Fork of the St. Lucie River. Harbor Branch Oceanographic Institute Report.

Lapointe, B. E., Herren, L. W., Debortoli, D. D., Vogel, M. A. 2015. Evidence of sewage-driven eutrophication and harmful algal blooms in Florida's Indian River Lagoon. Harmful Algae 43:82–102.

Lapointe, B. E., Herren, L. W., Paule, A. L., Septic systems contribute to nutrient pollution and harmful algal blooms in the St. Lucie Estuary, Southeast Florida, USA. Harmful Algae 70:1–22.

Lazarus, S. 2017. Wind and microclimate analysis improved site characterization in support of environmental flow modeling. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Lefebvre1, L. W., Provancha, J. A., Slone, D. H., Kenworthy, W. J. 2017. Manatee grazing impacts on a mixed species seagrass bed. Marine Ecology Progress Series 564:29-45.

Lewis, R.R. III, P.A. Clark, W.K. Fehring, H.S. Greening, R.O. Johansson, and R.T. Paul. 1999. The rehabilitation of the Tampa Bay Estuary, Florida, USA, as an example of successful integrated coastal management. Marine Pollution Bulletin 37: 468–473.

Li, L., Spoelstra, J., Robertson, W. D., Schiff, S. L., Elgood, R. J. 2014. Nitrous Oxide as an Indicator of Nitrogen Transformation in a Septic System Plume. Journal of Hydrology 519:1882-1894.

Lusk, M., Toor, G. S., Obreza, T. 2011. Onsite Sewage Treatment and Disposal Systems: Phosphorus. UF/IFAS Publication SL349.

Mallin, M. A., McIver, M. R. 2012. Pollutant impacts to Cape Hatteras National Seashore from urban runoff and septic leachate. Marine Pollution Bulletin 64: 1356–1366.

Mallin, M. A. 2013. Septic Systems in the Coastal Environment: Multiple Water Quality Problems in Many Areas. Monitoring Water Quality, http://dx.doi.org/10.1016/B978-0-444-59395-5.00004-2.

Meeroff, D. E., Bloetscher, F., Bocca, T., Morin, F. 2008. Evaluation of Water Quality Impacts of On-site Treatment and Disposal Systems on Urban Coastal Waters. Water Air Soil Pollution 192:11–24.

Meile, C., Porubsky, W. P., Walker, R. L., Payne, K. 2010. Natural attenuation of nitrogen loading from septic effluents: Spatial and environmental controls. Water Research 44:1399-1408.

Morton, T. G., A. J. Gold, and W. M. Sullivan., 1988. Influence of Overwatering and Fertilization on Nitrogen Losses from Home Lawns. Journal of Environmental Quality. vol 17 pg 124-130. doi:10.2134/jeq1988.00472425001700010019x.

Newell, R.I.E. and Koch, E.W. 2004. Modeling seagrass density and distribution in response to changes in turbidity stemming from bivalve filtration and seagrass sediment stabilization. Estuaries 27(5): 793-806.

Odera, E., Martin, E., and Lamm, A. J. 2015. Southern Florida High Water Users' Public Opinions of Water in Florida. PIE2013/14-11. Gainesville, FL: University of Florida/Institute of Food and Agricultural Sciences Center for Public Issues Education.

Okaloosa County Extension. http://okaloosa.ifas.ufl.edu/mowing_your_lawn.shtml. Accessed: October 5, 2017.

Olive, M., Daniel, L., and Donley, A. 2018. Septic Tank Survey: 2018. University of Central Florida Institute for Social and Behavioral Sciences. Presented to the Marine Resources Council.

Orth, R.J., Carruthers, T.J.B., Dennison, W.C., Duarte, C.M., Fourqurean, J.W., Heck Jr., K.L., Hughes, R., Kendrick, G.A., Kenworthy, J., Olyarnik, S., Short, F.T., Waycott, M., Williams, S.L. 2006. A global crisis for seagrass ecosystems. BioScience 56:987-996.

Otis, R., Kreissl, J., Frederick, R., Goo, R., Casey, P., Tonning, B., 2002. Onsite Wastewater Treatment Systems Manual. EPA/625/R-00/008.

Ott, E., Monaghan, P., Wells, O. 2015. Strategies to Encourage Adoption of Stormwater Pond Best Management Practices by Homeowners. University of Florida-Institute of Food and Agricultural Sciences.

Ouyang, Y., Zhang, J. 2012. Quantification of Shallow Groundwater Nutrient Dynamics in Septic Areas. Water, Air, & Soil Pollution 223:3181-3193.

Paperno, R., Dutka-Gianelli, J., Tremain, D. Seasonal Variation in Nekton Assemblages in Tidal and Nontidal Tributaries in a Barrier Island Lagoon System. Estuaries and Coasts 41:1821–1833.

Paterson, R. G., Burby, R. J., Nelson, A. C. 1991. Sewering the Coast: Bane or Blessing to Marine Water Quality. Coastal Management 19:239-252

Phillips, P. J., Schubert, C., Argue, D., Fisher, I., Furlong, E. T., Foreman, W., Gray, J., Chalmers, A. 2015. Concentrations of Hormones, Pharmaceuticals and Other Micropollutants in Groundwater Affected by Septic Systems in New England and New York. Science of the Total Environment 512:43-54.

Praecipio Economics Finance Statistics. 2016. The Blue Life Campaign and its Impact on Stormwater-Related Knowledge, Familiarity, Information and Behavior: Evidence from a Survey-Based Analysis of Brevard County Residents (2012 and 2015). Prepared for the Brevard County Board of County Commissioners.

Reidenbach, M.A., Berg, P., Hume, A., Hansen, J.C.R., and Whitman, E.R. 2013. Hydrodynamics of intertidal oyster reefs: The influence of boundary layer flow processes on sediment and oxygen exchange. Fluids and Environments 3: 225-239.

Restore America's Estuaries. 2015. Living Shorelines: From Barriers to Opportunities. Arlington, VA.

Richards, S., Paterson, E., Withers, P. J., Stutter, M. 2016. Septic Tank Discharges as Multi-Pollutant Hotspots in Catchments. Science of the Total Environment 542:854-863.

Ridge, J.T., Rodriguez, A.B., Fodrie, F.J. 2017. Evidence of exceptional oyster-reef resilience to fluctuations in sea level. Ecology and Evolution 7: 10409-10420.

Rios, J. F., Ye, M., Wang, L., Lee, P. Z., Davis, H., Hicks, R. 2013. ArcNLET: A GIS-based Software to Simulate Groundwater Nitrate Load from Septic Systems to Surface Water Bodies. Computers & Geosciences 52:108-116.

Robertson, W. D. 1995. Development of steady-state phosphate concentrations in septic system plumes. Journal of Contaminant Hydrology 19:289-305.

Robertson, W. D. 2008. Irreversible Phosphorus Sorption in Septic System Plumes? Ground Water 46:51-60.

Robertson, W. D., Cherry, J. A., Sudicky, E. A. 1991. Ground-water Contamination from Two Small Septic Systems on Sand Aquifers. Groundwater 29:82-92.

Robertson, W. D., Schiff, S. L., Ptacek, C. J. 1998. Review of Phosphate Mobility and Persistence in 10 Septic System Plumes. Round Water 36:1000-1010.

Roeder, E. 2008. Revised Estimates of Nitrogen Inputs and Nitrogen Loads in the Wekiva Study Area. Bureau of Onsite Sewage Programs Florida Department of Health.

Romero, J., Lee, K., Perez, M., Mateo, M.A., Alcoverro, T. 2006. Nutrient dynamics in seagrass ecosystems. P. 227-254. In A.W.D. Larkum, R.J. Orth, and C.M. Duarte [eds.], Seagrasses: Biology, ecology and conservation. Springer.

Rosen, J., Gibson. M., Bartrand, T., 2010. Assessment of the Extra-Enteric Behavior of Fecal Indicator Organisms in Ambient Waters. EPA Office of Water (4305T).

Salup, Nick. Personal communication. December 31, 2019.

Sayemuzzaman, Mohammad and Ming Ye. August 2015. Estimation of Nitrogen Loading from Converted Septic Systems (2013-14 and 2014-15) to Surface Waterbodies in Port St. Lucie, FL. Department of Scientific Computing, Florida State University. Prepared for the Florida Department of Environmental Protection. Tallahassee, Florida.

Schmidt, A.L, Wysmyk, J.K.C., Craig, S.E., Lotze, H.K. 2012. Regional-scale effects of eutrophication on ecosystem structure and services of seagrass beds. Limnology and Oceanography 57(5): 1389-1402.

Schmidt, Casey and Gallagher, Sean. 2017. The denitrification potential and ecosystem services from ten years of oyster bed restoration in the Indian River Lagoon.

Scyphers SB, Powers SP, Heck KL Jr, Byron D. 2011. Oyster Reefs as Natural Breakwaters Mitigate Shoreline Loss and Facilitate Fisheries. PLoS ONE 6(8):e22396. doi:10.1371/journal.pone.0022396.

Seevers, B., Graham, D., Gamon, J., and Conklin, N. 1997. Education through cooperative extension. Albany, NY: Delmar Publishers.

Sharma, S., Goff, J., Moody, R.M., Byron, D. Heck Jr., K.L., Powers, S.P., Ferraro, C., Cebrian, J. 2016. Do restored oyster reefs benefit seagrass? An experimental study in the Northern Gulf of Mexico. Restoration Ecology doi: 10.1111/rec.12329.

Shenker, J. 2018. Biological Responses to Muck Dredging in the Indian River Lagoon, Part II: Fish Populations and Sea Grass Transplanting Experment. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Souto, L. 2018. Source to Slime Study in Indian River Lagoon, Leesa Souto. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report. (Draft in Review).

St. Johns River Water Management District. 2016a. Indian River Lagoon: background and history. http://www.sjrwmd.com/indianriverlagoon/history.html.

St. Johns River Water Management District. 2016b. 2011 Superbloom Report; Evaluating Effects and Possible Causes with Available Data. Prepared by: Indian River Lagoon 2011 Consortium.

Swann, C. P. 2000. A survey of nutrient behavior among residents in the Chesapeake Bay watershed. In: National conference on tools for urban water resource management and protection., (pp 230-237). Chicago, IL, United States Environmental Protection Agency.

Swain, E. D., Prinos, S. T. 2018. Using Heat as a Tracer to Determine Groundwater Seepage in the Indian River Lagoon, Florida, April–November 2017. USGS Open-File Report 2018–1151.

Tetra Tech. 2015. Letter Report: Nutrient Mitigation Alternatives for Sediment Dewatering. Prepared for Brevard County Natural Resources Management Department.

Tran, K. C., Euan, J., Isla, M. L. 2002. Public Perception of Development Issues: Impact of Water Pollution on a Small Coastal Community. Ocean & Coastal Management 45:405-420.

Treat, S.F. and R.R. Lewis III (eds). 2006. Seagrass restoration: success, failure, and the cost of both. Lewis Environmental Services, Inc. 175 pp.

Trenholm, Laurie E. and Sartain, Jerry B. 2010. Turf Nutrient Leaching and Best Management Practices in Florida. HortTechnology, vol. 20, no. 1, 107-110. Prepared by the University of Florida.

Trefry, John H. 2013. Presentation on Sediment Accumulation and Removal in the Indian River Lagoon. Presentation to the Environmental Preservation and Conservation Senate Committee. Marine and Environmental Systems, Florida Institute of Technology.

Trefry, John H. 2018. Personal communication.

Trefry, J. H., Trocine, R. P., Fox, A. L., Fox, S. L., Voelker, J. E., Beckett, K. M. 2016. The Efficiency of Muck Removal from the Indian River Lagoon and Water Quality after Muck Removal. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Trefry, J. H., Trocine, R. P., Fox, A. L., Fox, S. L., Voelker, J. E., Beckett, K. M. 2016. Determining the Effectiveness of Muck Removal on Sediment and Water Quality in the Indian River Lagoon, Florida. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Trefry, J. H., Trocine, R. P., Fox, A. L., Fox, S. L., Voelker, J. E., Beckett, K. M. 2017. Inputs of Nitrogen and Phosphours from Major Tributaries to the Indian River Lagoon. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Trefry, J. H., Fox, A. L., Trocine, R. P., Fox, S.L., and Beckett, K.M. 2019. Trends for Inputs of Muck Components from Rivers, Creeks and Outfalls to the Indian River Lagoon (Subtask 3). Impacts of Environmental Muck Dredging 2017-2018. Florida Institute of Technology.

Trefry, J.H., Johnson, K.B., Fox, A.L., and Ma, X. 2019. Optimizing Selection of Sites for Environmental Dredging in the Indian River Lagoon System (Subtask 5). Impacts of Environmental Muck Dredging 2017-2018. Florida Institute of Technology.

University of Florida College of Engineering. 2011. Quantifying Nutrient Loads Associated with Urban Particulate Matter, and Biogenic/Litter Recovery through Current Municipal Separate Storm Sewer System Source Control and Maintenance Practices. Prepared for Florida Stormwater Association Educational Foundation.

University of Florida Institute of Food and Agricultural Sciences. 2012. Warm-Season Turfgrass N Rates and Irrigation Best Management Practice Verification. Prepared for the Florida Department of Environmental Protection.

University of Florida Institute of Food and Agricultural Sciences. 2013a. Using Reclaimed Water to Irrigate Turfgrass – Lessons Learned from Research with Nitrogen. Document SL389.

University of Florida Institute of Food and Agricultural Sciences. 2013b. Urban Turf Fertilizer Rule for Home Lawn Fertilization. Document ENH1089. http://edis.ifas.ufl.edu/ep353.

University of Florida Institute of Food and Agricultural Sciences. 2017. EDIS SL181-B. Tissue Testing and Interpretation for Florida Turfgrasses. http://edis.ifas.ufl.edu/ep539.

University of Florida Institute of Food and Agricultural Sciences. 2016. Florida Friendly Landscaping, Low Impact Development. http://fyn.ifas.ufl.edu/lowimpactdev.htm.

University of Florida Institute of Food and Agricultural Sciences. Online Resource Guide for Florida Shellfish Aquaculture. c2014-2015. Accessed December 2019. http://shellfish.ifas.ufl.edu/environmental-benefits/.

United States Census Bureau. 2015. Persons per household, 2010-2014. http://www.census.gov/quickfacts/table/PST045215/00.

United States Environmental Protection Agency. 2002. Onsite Wastewater Treatment Manual. EPA 625/R-00/008. National Risk Management Research Laboratory, Office of Water, U.S. Environmental Protection Agency. Washington, DC.

United State Environmental Protection Agency. 2005. Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness.

United States Environmental Protection Agency. 2007. Biological Nutrient Removal Processes and Costs. Fact Sheet EPA823-R-07-002. Office of Water.

United States Environmental Protection Agency. 2000. Wastewater Technology Fact Sheet: Package Plants. EPA 832-F-00-016. https://www3.epa.gov/npdes/pubs/package_plant.pdf.

Uppercase, Inc. 2018. Martin, Brevard & Volusia Grass Clippings Campaign Survey Research 2018 Draft Report.

Valiela, I., Costa, J. E. 1988. Eutrophication of Buttermilk Bay, a Cape Cod Coastal Embayment: Concentrations of Nutrients and Watershed Nutrient Budgets. Environmental Management 12:539-553.

Valiela, I., Collins, G., Kremer, J., Lajtha, K., Geist, M., Seely, B., Brawley, J., Sham, C. H. 1997. Nitrogen Loading from Coastal Watersheds to Receiving Estuaries: New Method and Application. Ecological Applications 7:358-380.

Valiela, I., Geist, M., McClelland, J., Tomasky, G. 2000. Nitrogen Loading from Watersheds to Estuaries: Verification of the Waquoit Bay Nitrogen Loading Model. Biogeochemistry 49:277-293.

Waite, H. 2017. Investigating the Quantity and Types of Microplastics in the Organic Tissue of Oysters and Crabs in the Indian River Lagoon. Honors in the Major Theses. 157.

Wang, L., Ye, M., Rios, J. F., Fernandes, R., Lee, P. Z., Hicks, R. W. 2013. Estimation of Nitrate Load from Septic Systems to Surface Water Bodies Using an ArcGIS-based Software. Environmental earth sciences 70:1911-1926.

Wanielista, Marty, Goolsby, Matt, Chopra, Manoj, Chang, Ni-Bin, and Hardin, Mike. 2011. Green Residential Stormwater Management Demonstration: An Integrated Stormwater Management and Graywater System to Reduce the Quantity and Improve the Quality of Residential Water Discharges. University of Central Florida Stormwater Management Academy. Prepared for the Florida Department of Environmental Protection.

Wanielista, Marty. 2015. A Biosorption Activated Media Called Bold & Gold to Reduce Nutrients in Stormwater. Presentation. University of Central Florida.

Weaver, R. J., Waite, T. D. 2018. Feasibility of muck removal at fixed locations in the IRL watershed and subsequent ferrate treatment to remove nutrients and contaminants. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Windsor, J. G., Bostater, C., Johnson, K. B., Shenker, J., Trefry, J. H., Zarillo. G. A., Impacts of Environmental Muck Dredging 2014-2015 Final Project Report to Brevard County Natural Resources Management Department, Funding provided by the Florida legislature as part of DEP Grant Agreement No. S0714 – Brevard County Muck Dredging, Indian River Lagoon Research Institute, Florida Institute of Technology, Melbourne, Florida.

Withers, P. J. A., Jarvie, H. P., Stoate, C. 2011. Quantifying the Impact of Septic Tank Systems on Eutrophication Risk in Rural Headwaters. Environment International 37:644-653.

Withers, P. J. A., May, L., Jarvie, H. P., Jordan, P., Doody, D., Foy, R. H., Bechmann, M., Cooksley, S., Dils, R., Deal, N., 2012. Nutrient Emissions to Water from Septic Tank Systems in Rural Catchments: Uncertainties and Implications for Policy. Environmental Science & Policy 24:71-82.

Withers, P. J., Jordan, P., May, L., Jarvie, H. P., Deal, N. E. 2014. Do Septic Tank Systems Pose a Hidden Threat to Water Quality? Frontiers in Ecology and the Environment 12:123-130.

Xiao, H., Wang, D., Hagen, S. C., Medeiros, S. C., Hall, C. R. 2016. Assessing the Impacts of Sea-level Rise and Precipitation Change on the Surficial Aquifer in the Low-lying Coastal Alluvial Plains and Barrier Islands, East-central Florida (USA). Hydrogeology Journal 24:1791-1806.

Zanini, L., Robertson, W. D., Ptacek, C. J., Schiff, S. L., Mayer, T. 1998. Phosphorus characterization in sediments impacted by septic effluent at four sites in central Canada. Journal of Contaminant Hydrology 33:405–429.

Zarillo, Gary. 2018. Numerical Flushing Experiments Final Report. Submitted to the Indian River Lagoon National Estuary Program and Canaveral Port Authority. Florida Institute of Technology, Melbourne, FL.

Zarillo, Gary. 2019. Numerical Model Flushing Experiments Addendum Report. Submitted to the Indian River Lagoon National Estuary Program and Canaveral Port Authority. Florida Institute of Technology, Melbourne, FL.

Zarillo, G. & Listopad, C. 2016. Hydrologic and Water Quality Model for Management and Forecasting within Brevard County Waters. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Zarillo, G. & Listopad, C. 2017. Hydrologic and Water Quality Model for Management and Forecasting within Brevard County Waters. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report.

Zarillo, G.A., Listopad, C. 2019. Sediment & Water Quality Modeling for Nutrients, Muck and Water Clarity Scenario Assessments. Impacts of Environmental Muck Dredging at Florida Institute of Technology Annual Report. (Draft in Review)

Zhang, X., Liu, X., Zhang, M., Dahlgren, R. A., Eitzel, M. 2010. A Review of Vegetated Buffers and a Meta-analysis of Their Mitigation Efficacy in Reducing Nonpoint Source Pollution. Journal of Environmental Quality 39:76-84.

Zhu, Y., Ye, M., Roeder, E., Hicks, R. W., Shi, L., Yang, J. 2016. Estimating Ammonium and Nitrate Load from Septic Systems to Surface Water Bodies within ArcGIS Environments. Journal of Hydrology 532:177-192.

zu Ermgassen, P., Hancock, B., DeAngelis, B., Greene, J., Schuster, E., Spalding, M., Brumbaugh, R. 2016. Setting objectives for oyster habitat restoration using ecosystem services: A manager's guide. The Nature Conservancy, Arlington VA. 76pp.

Appendix C: Public Education and Outreach Supporting Information

Fertilizer Management

It is a common practice to apply fertilizer on urban and agricultural land uses. However, excessive and inappropriately applied fertilizer pollutes surrounding waters and stormwater. Florida Department of Agriculture and Consumer Services compiles information on the fertilizer sales by county, as well as the estimated nutrients from those fertilizers. It is important to note that all fertilizer sold in a county may not be applied within that county because a portion of that fertilizer may be transported to another county. However, details on the amount of fertilizer transported between counties is not tracked. Therefore, the information in the Florida Department of Agriculture and Consumer Services reports is simply the best estimate of the amount of fertilizer used, and the associated nutrient content, in a county.

Table C-1 and **Figure C-1** summarize the nutrients in the lawn fertilizer sold in Brevard County, according to Florida Department of Agriculture and Consumer Services records. This information was organized by fiscal year. The figure shows a decrease in the amount of nitrogen and phosphorus fertilizer being sold in the County after the fertilizer ordinance was adopted in 2013.

Table C-1: Nutrients in Lawn Fertilizer Sold in Brevard County by Fiscal Year

Fiscal Year	Lawn Fertilizer Nitrogen (tons per year)	Lawn Fertilizer Nitrogen (lbs/yr)	Lawn Fertilizer Phosphorus (tons per year)	Lawn Fertilizer Phosphorus (lbs/yr)
2012-2013	1,673	3,346,140	61	122,740
2013-2014	319	637,700	63	126,400
2014-2015	204	408,220	16	32,520

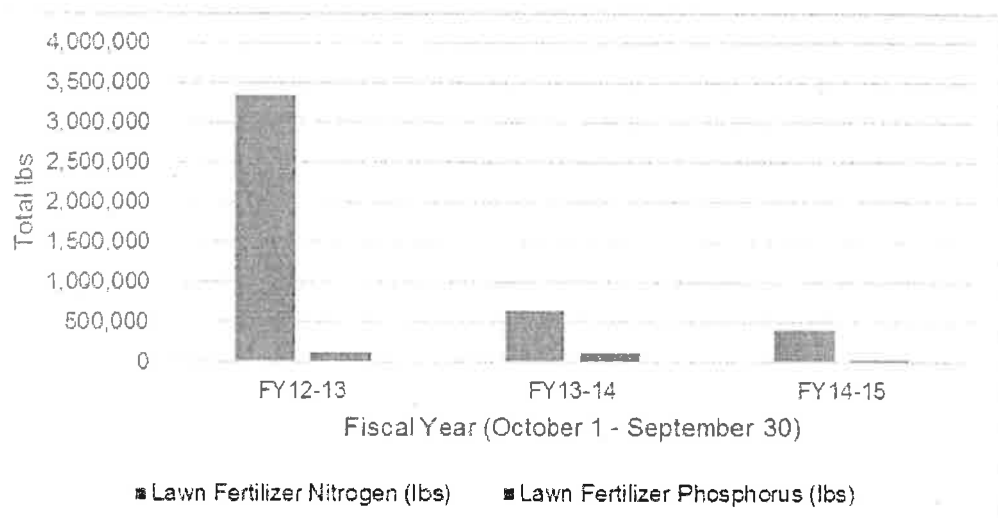

Figure C-1: TN and TP in Lawn Fertilizer Sold in Brevard County by Fiscal Year

To help address fertilizer as a source of nutrient loading, local governments located within the watershed of a waterbody or water segment that is listed as impaired by nutrients are required to adopt, at a minimum, the Florida Department of Environmental Protection's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes (Section 403.067, Florida Statutes). Brevard County and its municipalities adopted fertilizer ordinances that included the required items from the Model Ordinance in December 2012, as well as additional provisions in 2013 and

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2014. The County's fertilizer ordinance is found in Chapter 46, Article VIII, Section 46-335 through Section 46-349. This ordinance "regulates and promotes the proper use of fertilizers by any applicator; requires proper training of commercial and institutional fertilizer applicators; establishes training and licensing requirements; establishes a prohibited application period; specifies allowable fertilizer application rates and methods; fertilizer-free zones; low maintenance zones; and exemptions. The Ordinance requires the use of best management practices which provide specific management guidelines to minimize negative secondary and cumulative environmental effects associated with the misuse of fertilizers."

The County's ordinance prohibits the application of fertilizer that contains nitrogen and/or phosphorus during the period of June 1 through September 30, as well as when heavy rain is likely (including a watch or warning for a flood, tropical storm, or hurricane). Fertilizer application is also prohibited within 15 feet of any surface waterbodies, to limit the likelihood that fertilizer will run off into a waterbody. Fertilizer applied within the County must not contain phosphorus, unless a soil or plant tissue test indicates a need. Fertilizer with nitrogen should contain at least 50% in the form of slow release, controlled release, timed release, slowly available, or water insoluble nitrogen. When applying fertilizer, the ordinance requires deflectors on broadcast spreaders and removal of any fertilizer spilled on an impervious surface, which can then runoff into the stormwater system.

The ordinance also requires grass and vegetation clippings not to be swept, washed, or blown off into surface waterbodies or the stormwater system. Commercial applicators, must complete a training program and carry evidence that they have completed the training. The ordinance only applies to use of urban fertilizer, and not fertilizer applied to a bona fide farm operation.

In addition to the fertilizer ordinance, Brevard County, nine municipalities, Good Education Solutions, and the Brevard Zoo created a public education campaign called "Blue Life" in 2012. The purpose of this campaign is to provide information to the public about sources of pollution and what actions people can take to protect and improve water quality. The campaign is a combination of public service announcements; TV, radio, and billboard advertisements; social media; community forums and talks; workshops; school programs; and other printed informational materials. The information includes details on fertilizer and pesticide use and management, proper lawn and garden maintenance, pet waste management, proper car washing and maintenance, waste management, and litter control.

To determine the effectiveness of this educational campaign on behavior changes, the County contracted with Praecipio Economics Finance Statistics to conduct a survey before the campaign implementation in 2012 and after the campaign was in place for two years in 2015. A similar survey was used in both 2012 and 2015, although the 2015 survey included additional questions about the Blue Life campaign, fertilizer bans, and state of the IRL. The survey was mailed to about 50,000 households who receive water from the City of Melbourne utility. A total of 1,470 usable surveys were obtained for 2012 and 1,572 usable surveys were obtained for 2015. The results were tabulated and analyzed to compare the pre- versus post-Blue Life campaign responses (Praecipio Economics Finance Statistics 2016).

When comparing the results from the 2012 and 2015 surveys, Praecipio Economics Finance Statistics (2016) found that the study unambiguously showed that people in 2015 were better informed about stormwater issues than in 2012, and that behavior that affects water quality in the area has, in general, improved:

- The 2015 population received more information about stormwater runoff and were better informed about stormwater runoff issues. The proportion of respondents who received "a lot" or "some" information about stormwater runoff issues increased by 6% and 19%, respectively. Perceptions about water quality became much more negative, increasing by 10% for "very poor" and 18% for "poor." Lawn and garden fertilizer was identified as the single biggest source of water pollution by 7.6% more respondents.
- Significant improvements in behavioral traits associated with lawn maintenance (lawn clippings, fertilizer application, pesticide application, frequency of fertilizer applications, and fertilizer types) occurred between 2012 and 2015. The percentage of people who leave the lawn clippings on their grass after it is mowed rose by 3.5% (from 77% in 2012). The percentage of people who report that they do not apply fertilizer and/or pesticides increased by 6.4% and 6.5%. Of those who do fertilize their lawns, the proportion who fertilize their lawn once or twice a year rose by 5.3%. Persons who used desirable fertilizer types (no phosphorus, slow release, and/or dry/granulated fertilizer) rose by 7.6%.
- Significant improvements in where a vehicle is washed and the pickup of dog waste occurred between 2012 and 2015. There was a 5.1% increase in the proportion of people who take their vehicle to a commercial car wash (instead of washing their car at home) and a 5.9% increase in the proportion of people who "always" pick up their dog's waste.

Praecipio Economics Finance Statistics (2016) also included an evaluation of the 2015 survey results for those people who were exposed to the Blue Life campaign versus those who had not seen campaign materials. The people who were exposed to the Blue Life campaign were more familiar with the environmental problems of the IRL and were knowledgeable about the fertilizer ordinances:

- People in the Blue Life subgroup reported greater familiarity with the pollution problems in the IRL (17.4% higher) and recently enacted fertilizer ordinances (11.6% higher) than persons in the non-Blue Life subgroup.
- About 25% of the 2015 sample population remembered being exposed to Blue Life promotional materials, with water bill inserts and farmer's market outreach representing the two largest pathways.

The results of the surveys show that the Blue Life campaign, as well as other educational efforts in the County, had a beneficial impact on people's behaviors and knowledge of the IRL problems. Continuation of this campaign, or other similar public education and outreach efforts, would have a benefit in reducing sources of the pollution to the lagoon (fertilizers, pesticides, pet waste, oil and grease from cars).

The County, city, and grant funding spent on the Blue Life campaign is summarized in **Table C-2**. This funding helped contribute to the results seen in the survey.

Table C-2: Brevard County Funding for the Blue Life Campaign by Fiscal Year

Fiscal Year (October 1 – September 30)	Costs
2012-2013	$83,124
2013-2014	$112,812
2014-2015	$182,482
2015-2016	$83,412
2016-2017	$83,412
2017-2018	$98,791
Total	***$644,033***

The Blue Life campaign is continuing its education and outreach efforts including digital billboards (see **Figure C-2**), radio advertisements, *Florida Today* sticky note (see **Figure C-3**), and water bill insert for the City of Cocoa and City of Melbourne customers.

Figure C-2: Blue Life Digital Billboard

Figure C-3: *Florida Today* Sticky Note

The University of Florida-Institute of Food and Agricultural Sciences Extension Office in Brevard County also implements programs and activities that focus on proper fertilizer application and water quality/conservations measures. The anticipated outcomes of these programs are that participants will gain knowledge, and most importantly, will adopt practices that result in behavior change.

Two horticultural faculty plan, implement, and evaluate the Florida Friendly Landscaping™ program, which includes the following:

> My Brevard Yard – This is a hands-on program delivered through classroom training and/or one-on-one onsite consultations. In the classroom training, participants learn about their local fertilizer ordinance, how their lawn practices impact the IRL, and how to implement fertilizer and irrigation best management practices for turfgrass management. The site consultations involve a trained Master Gardener volunteer or Extension faculty visit to the participants' home to conduct an analysis of the lawn. Turf issues are addressed, problem areas are identified, and solutions are offered. Fertilizer spreaders are calibrated and fertilizer recommendations are made after the soil test results are received. If the homeowner uses a landscape service, the faculty member will work with

the landscaper to develop a fertilizer program that meets the fertilizer ordinance requirements and follows best management practices.

Master Gardener Volunteer Program – Master Gardeners are University of Florida-Institute of Food and Agricultural Sciences Extension trained volunteers who educate participants about Florida Friendly Landscaping™ principles. Master Gardeners deliver educational programs, My Brevard Yard program site consultations, exhibits at events and festivals, and by speaking to community groups.

Brevard Botanical Garden –A five-acre garden is being developed on the Extension campus. The garden will be an outdoor, hands-on laboratory for educating homeowners, green industry professionals, government employees, Master Gardeners, and youth.

University of Florida-Institute of Food and Agricultural Sciences Space Coast Golf and Turf Association Workshops – This program is targeted to golf course superintendents and turfgrass managers, especially athletic field managers. The commercial horticulture faculty member collaborates with University of Florida scientists to provide the latest research on turf management such as weed management, fertilizer, and irrigation.

Landscape Management Program – Green industry professionals and government employees are the primary target audiences for this program. The program provides the state mandated Green Industry Best Management Practice Certification training, pesticide license exam preparation, and pesticide applicators' continuing education units. Many of the program participants are contracted with homeowner associations throughout the county, so their practices usually impact a significant amount of square footage.

Homeowner Association and Property Manager Education Program – This program began in 2016. The target audience is property managers, realtors, homeowner/condominium association boards, and developers. This program educates the participants about best management practices for lawns and ponds.

Retail Garden Center Employee Education – This program began in 2016. The target audience for this program is retail garden center employees and managers. Employees typically lack the training needed to make decisions that positively impact water quality, and they are often unfamiliar with fertilizer ordinances. Participants in this program will learn the basics of fertilizers and ordinances and will be given resources to share with their customers that will help them make good decisions. This will be part of the upcoming fertilizer education focus, as described in the section below.

University of Florida-Institute of Food and Agricultural Sciences also provides education to the agriculture industry including the following:

Urban and Sustainable Agricultural Production – The 2012 Agriculture Census reported more than 500 small farms in Brevard County. This program works with small farms to educate producers on water quality best management practices, technical production assistance, and pesticide management.

Livestock and Pasture Management – This program works with livestock operations on best management practices and technical expertise. Participants learn how to manage pastures and horse manure to reduce runoff pollution, as well as backyard chicken education.

University of Florida-Institute of Food and Agricultural Sciences participates in programs through the Florida Sea Grant:

Oyster Gardening – University of Florida-Institute of Food and Agricultural Sciences partners with Brevard County Natural Resources and the Brevard Zoo to implement the oyster gardening program (**Section 4.3.1** has more details).

Microplastic Awareness – This is a new program that raises participants' awareness of microplastic pollution in waterbodies. Citizens learn how to collect samples and filter the water to view the microplastics. The goal is help citizens make better choices when selecting health and beauty products to reduce microplastic pollution.

Florida Master Naturalist Program – This program is a collection of modules that educate participants about natural resources and the environment. After completing all the modules, participants are awarded a certificate from the University of Florida. Once certified, participants are encouraged to become involved in the Space Coast Chapter of Florida Master Naturalist, which provides outreach and educational programs to Brevard County residents.

Ecotourism Certification (new program in 2016) – University of Florida-Institute of Food and Agricultural Sciences partnered with the Tourism Development Office and Parks and Recreation to provide a certification program for ecotourism organizations. Through this certification, participants will learn about their impact on waterways, as well as how to educate their customers about the County's natural resources, protecting water quality, and reducing their environmental footprint.

In addition, there are several community development programs:

Sustainable Floridians[SM] Program – This 10-week program teaches participants about conserving energy and water, climate change science, local food systems, recycling, and transportation issues. The IRL is a major focus of the program.

Brevard Water Summit – The summit was a collaborative effort between Brevard County Natural Resources, Marine Resources Council, and City of Melbourne. The target audience is elected officials, decision makers, and community leaders. Participants learned from local and University of Florida experts about Brevard County-specific water issues such as water supply, water quality, agricultural water, wastewater, and low impact development.

Grass Clippings (added in 2018)

The Brevard County fertilizer ordinance includes a paragraph concerning the management of grass clippings: "In no case shall grass clippings, vegetative material, and/or vegetative debris be washed, swept, or blown off into surface waters, stormwater drains, ditches, conveyances, watercourses, water bodies, wetlands, sidewalks or roadways. Any material that is accidentally so deposited shall be immediately removed to the maximum extent practicable" (Brevard County Section 46-343. Management of grass clippings and vegetative matter). Most municipalities have the exact or nearly similar wording for their local ordinances (Cape

Canaveral, Cocoa, Cocoa Beach, Grant-Valkaria, Indian Harbour Beach, Malabar, Melbourne, Palm Bay, Palm Shores, Rockledge, Titusville, and West Melbourne). A few municipalities have altered the language slightly, including Indialantic, Melbourne Beach, and Satellite Beach.

The enforcement language for all local jurisdictions in Brevard County is identical: "Whenever in this Code any act is prohibited or is made or declared to be unlawful or an offense, or whenever the doing of any act is required or the failure to do any act is declared to be unlawful, where no specific penalty is provided therefor, the violation of any such provision of this Code shall be punished by a fine not exceeding $500.00 or imprisonment for a term not exceeding 60 days, or by both such fine and imprisonment. Each day a violation of any provision of this Code shall continue shall constitute a separate offense, and each act in violation of the provisions of this Code shall be considered a separate and distinct offense."

Current enforcement efforts are mostly reactive and educational. However, there are good examples in the state that can be followed by Brevard County to improve compliance with the grass clippings portion of the fertilizer ordinance.

The Green Industries-Best Management Practice Course is a science-based educational program developed by University of Florida-Institute of Food and Agricultural Sciences, Florida Department of Environmental Protection, and industry representatives for green industry workers. This program teaches environmentally safe landscaping practices and is required for professionals to obtain and maintain a Commercial Fertilizer Applicator license in the State of Florida. The best management practices are wide in scope and cover the importance of removing grass clippings from hard surfaces; however, management of yard waste and grass clippings is included as a small lesson in the program. The lesson includes pictures and the statement: "Clippings contain nutrients and should be recycled on the lawn. The nutrients in clippings are pollutants when they end up in stormwater systems and waterbodies (Florida Department of Environmental Protection 2010)." Another principle that is taught in the course is "Right Plant, Right Place," which recommends replacing grass with plants and mulch in areas where grass may be inappropriate. Highway medians are an example of where grass poses safety challenges associated with preventing grass clippings from being left in the pavement.

Another example is the Alachua County Public Outreach program, which includes radio spots, videos, posters, yard signs, and vehicle magnets. Alachua County has partnered with University of Florida-Institute of Food and Agricultural Sciences staff to present their campaign during the Green Industries-Best Management Practice Course. Alachua County attempted to estimate an increase in ordinance compliance due to their campaign by through phone surveys conducted before and after the first year of the campaign. The phone surveys showed an increase in the awareness of grass clippings as pollution from 24% to 69% of respondents. The Alachua County program cost $40,000 for the initial setup with a recurring annual cost of $20,000.

Appendix D: Septic System Removal and Upgrade Areas Identified in the Original Plan

Septic System Removal

To identify potential locations for septic system removal through connection to the central sewer system, the County prioritized those areas with septic systems in close proximity to surface waters (ditches, canals, creeks, and the IRL). As shown below in **Table D-3**, septic systems within 55 yards of a surface water have the greatest impact and systems more than 219 yards from a surface water contribute very little TN loading. In addition, the County also inventoried existing sewer service areas for available capacity. The existing service areas include:

- Brevard County North Brevard (Mims)
- Brevard County Port St. John
- Brevard County Sykes Creek (Merritt Island)
- Brevard County South Central (Suntree and Viera)
- Brevard County South Beaches (Patrick Air Force Base to Melbourne Beach)
- Brevard County Barefoot Bay
- City of Cape Canaveral
- City of Cocoa
- City of Cocoa Beach
- City of Melbourne
- City of Palm Bay
- City of Rockledge
- City of Titusville
- City of West Melbourne

The estimated cost per lot for connection to central sewer lines is $20,000 and includes electrical work, plumbing, removing the septic tank, and sewer connection fees. The actual cost per lot will vary depending on site conditions. This amount of funding would offset most, if not the entire, cost per customer.

The estimated nutrient loads from the septic systems that will travel through the groundwater and intersect with a surface waterbody (tributaries, canals, and the lagoon itself) were estimated using typical septic system effluent concentrations and decay rates from U.S Environmental Protection Agency (2002) (**Table D-1**). This information is for a single family residential property. For projects with septic systems for other buildings (apartments, commercial, etc.), loading estimates can be scaled by comparing the flow data for that property to the average flow volume for single family residential. The estimated travel times based on the distance from the septic system to a waterbody are shown in **Table D-2** and is based on an interpretation of the results from a recent study in the City of Port St. Lucie by Sayemuzzaman and Ye 2015. The concentration of each parameter for each buffer zone was calculated using the effluent concentration and decay rates in **Table D-1** and the travel times in **Table D-2**. The concentrations used in the estimates for this plan are shown in **Table D-3**.

Table D-1: Septic System Effluent Concentrations and Decay Rates

Parameter	Effluent Concentration (milligrams per liter)	Decay Rate (1/day)
TN	70	0.1
Organic N	0.458	0.1
Ammonia	10.5	0.1
Nitrate + Nitrite	59.3	0.0011
Organic P*	0.3	0.014
Orthophosphate*	0	0.014

* Assumes that 90% of phosphorus is sorbed to sediment.

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Table D-2: Travel Time Based on Distance from Septic System to Waterbody

Buffer Zone	Travel Distance (yards)	Average Velocity (yards/day)	Average Travel Time (days)	Average Travel Time (years)
1	Less than 55	0.199	137.6	0.4
2	Between 55 and 219	0.138	1,385.7	3.8
3	More than 219	0.066	9,641.0	26.4

Table D-3: Parameter Concentrations from Each Buffer Zone

Parameter	Buffer Zone 1 Concentration (milligrams per liter)	Buffer Zone 2 Concentration (milligrams per liter)	Buffer Zone 3 Concentration (milligrams per liter)
Organic N	0.000	0.000	0.000
Ammonia	0.000	0.000	0.000
Nitrate + Nitrite	50.971	12.914	0.001
Organic P	0.044	0.000	0.000
Orthophosphate	0.000	0.000	0.000

The cost for connection of all the septic systems in the County within the IRL watershed would be approximately $1.2 billion (see **Table D-4**). Therefore, this plan focuses on the locations where reductions through septic system removal are the most cost-effective.

Table D-4: Cost to Remove Septic Systems Based on Distance from a Surface Waterbody

Septic System Distance from Surface Water	Number of Septic Systems	TN (lbs/yr per system)	TN (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,090	27.095	408,863	$20,000	$301,800,000	$738
Between 55 and 219 yards	25,987	6.865	178,395	$20,000	$519,740,000	$2,913
Greater than 219 yards	18,361	0.001	10	$20,000	$367,220,000	$37,624,010
Total in IRL Basin	***59,438***	***Not applicable***	***587,268***	***$20,000***	***$1,188,760,000***	***$2,024 (average)***

Short-term and long-term opportunities for septic system removal were then identified. Short-term opportunities are neighborhoods with more than 50% of the septic systems being less than 55 yards from a surface water directly connected to the lagoon, and that only require limited extensions of infrastructure from existing service areas to connect to sewer service. In addition, short-term opportunities included areas where there are existing sewer lines and the buildings on septic systems only needed to be connected to the sewer system. The County identified these locations using data from the Florida Department of Health, which were updated using the most current information from the cities. The Florida Department of Health data likely still require updates and corrections; therefore, this plan provides the flexibility for projects to address field verified septic systems that are having the greatest impact on the lagoon (within 55 yards of a surface waterbody).

For the short-term opportunities, the number of lots that could be connected, associated cost of the connection, and estimated TN reductions are shown in **Table D-5** for the Banana River Lagoon, **Table D-6** for the North IRL, and **Table D-7** for the Central IRL. Based on the cost per pound of TN removed, it was determined that the most cost-effective sewer connection projects were those that cost less than $1,200 per pound. The areas that could be connected for this cost are highlighted in green, and these highlighted areas are recommended for connection as part of the plan. These short-term opportunities represent the connection of approximately 3.9% of the septic systems in Brevard County within the IRL Basin. In Palm Bay, an opportunity exists to hook up many lots to existing sewer lines for $12,000 per connection. This is recommended for high priority septic systems located within 55 yards of an open water connection to the lagoon.

Table D-5: Short-Term Opportunities for Septic System Removal in Banana River Lagoon

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Sykes Creek - Zone N	86	$1,720,000	2,330	$738
Sykes Creek - Zone M	58	$1,160,000	1,572	$738
Sykes Creek - Zone T	139	$2,780,000	3,685	$754
Sykes Creek - Zone X	14	$280,000	359	$780
Sykes Creek - Zone V	98	$1,960,000	1,927	$1,017
Sykes Creek - Zone U	145	$2,900,000	2,573	$1,127
Sykes Creek - Zone Z	73	$1,460,000	1,290	$1,132
Sykes Creek - Zone W	142	$2,840,000	1,923	$1,477
Sykes Creek - Zone R	206	$4,120,000	2,686	$1,534
Sykes Creek - Zone Q	186	$3,720,000	2,319	$1,604
Sykes Creek - Zone S	163	$3,260,000	1,407	$2,317

Note: The projects highlighted in green are the most cost-effective and are recommended as part of this plan.

Table D-6: Short-Term Opportunities for Septic System Removal in North IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of Cocoa – Zone K	34	$680,000	921	$738
City of Melbourne	12	$240,000	325	$738
City of Rockledge	16	$320,000	434	$738
South Beaches - Zone A	42	$840,000	1,098	$765
City of Titusville	33	$660,000	833	$792
City of Cocoa – Zone J	78	$1,560,000	1,891	$825
South Central - Zone C	132	$2,640,000	3,132	$843
South Central - Zone A	115	$2,300,000	2,239	$1,027
South Central - Zone D	94	$1,880,000	1,730	$1,087
Sykes Creek - Zone C	85	$1,700,000	1,426	$1,192
Sykes Creek - Zone B	207	$4,140,000	3,038	$1,363
Port St. John - Zone B	197	$3,940,000	2,849	$1,383
South Central - Zone B	190	$3,800,000	2,486	$1,528
Sykes Creek - Zone H	77	$1,540,000	992	$1,552
Sykes Creek - Zone I	31	$620,000	386	$1,605
Sykes Creek - Zone G	53	$1,060,000	632	$1,679
Sykes Creek - Zone J	55	$1,100,000	503	$2,186
Sykes Creek - Zone K	170	$3,400,000	1,539	$2,210
Sykes Creek - Zone O	161	$3,220,000	1,158	$2,782
Sykes Creek - Zone A	247	$4,940,000	1,767	$2,796
Sykes Creek - Zone Y	168	$3,360,000	1,083	$3,102
Sykes Creek - Zone F	24	$480,000	95	$5,051
Sykes Creek - Zone L	175	$3,500,000	687	$5,098
Sykes Creek - Zone P	342	$6,840,000	1,074	$6,372
Sykes Creek - Zone E	86	$1,720,000	217	$7,934
Sykes Creek - Zone D	85	$1,700,000	183	$9,279
Port St. John - Zone C	82	$1,640,000	96	$17,058
South Beaches - Zone B	170	$3,400,000	123	$27,742
Port St. John - Zone A	55	$1,100,000	7	$159,571

Note: The projects highlighted in green are the most cost-effective and are recommended as part of this plan.

Table D-7: Short-Term Opportunities for Septic System Removal in Central IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of Palm Bay – near sewer lines	647	$7,764,000	17,530	$443
City of Palm Bay – Zone B	235	$4,700,000	6,347	$741
City of West Melbourne	112	$2,240,000	2,974	$753
City of Palm Bay – Zone A	99	$1,980,000	1,893	$1,046
South Beaches - Zone D	62	$1,240,000	558	$2,221
South Beaches - Zone C	124	$2,480,000	579	$4,282

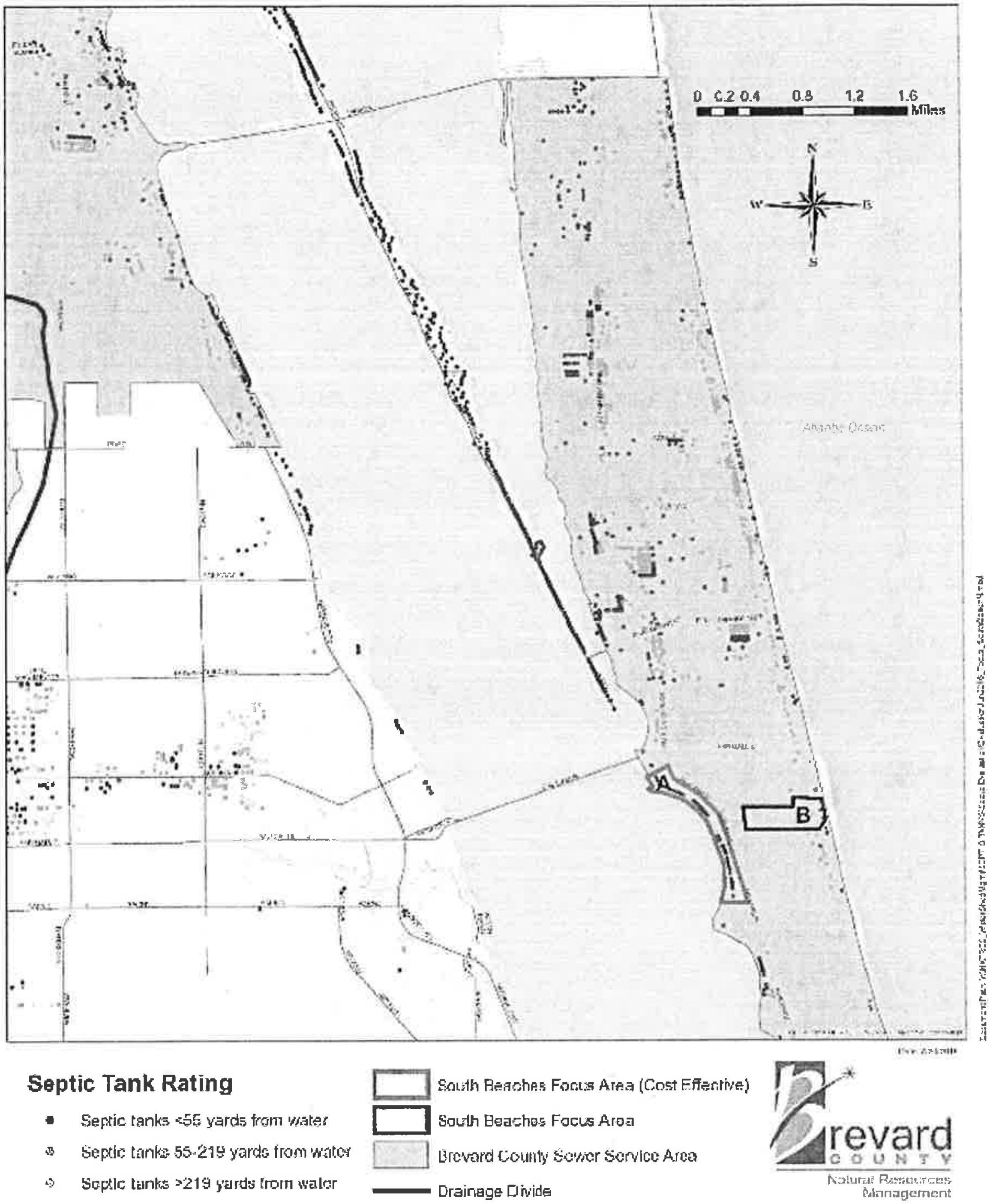
Table D-8: Summary of Septic System Removal Projects by Sub-Lagoon

Sub-lagoon	Number of Lots	Cost	TN Reductions (lbs/yr)	Average Cost per Pound per Year of TN
Banana River Lagoon	613	$12,260,000	13,736	$898
North IRL	641	$12,820,000	14,029	$875
Central IRL	446	$8,920,000	11,214	$795
Total	***1,700***	***$34,000,000***	***38,979***	***$872***

Note: This summary does not include the connection of septic systems near existing sewer lines in Palm Bay.

In **Figure D-1** through **Figure D-10**, the septic systems located within 55 yards of a surface waterbody are shown in the darkest blue and those systems that are further than 219 yards from a surface waterbody are shown in the lightest blue. On each map, the neighborhood focus areas that were evaluated for potential septic system removal are outlined in black. Those focus areas that were determined to be the most cost-effective for connection, and are therefore recommended for funding in this plan, are outlined in green.

SOUTH BEACHES (NORTH) - SHORT TERM OPPORTUNITIES



Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-1: Map of South Beaches Priority Septic System Areas

Figure D-1 Long Description

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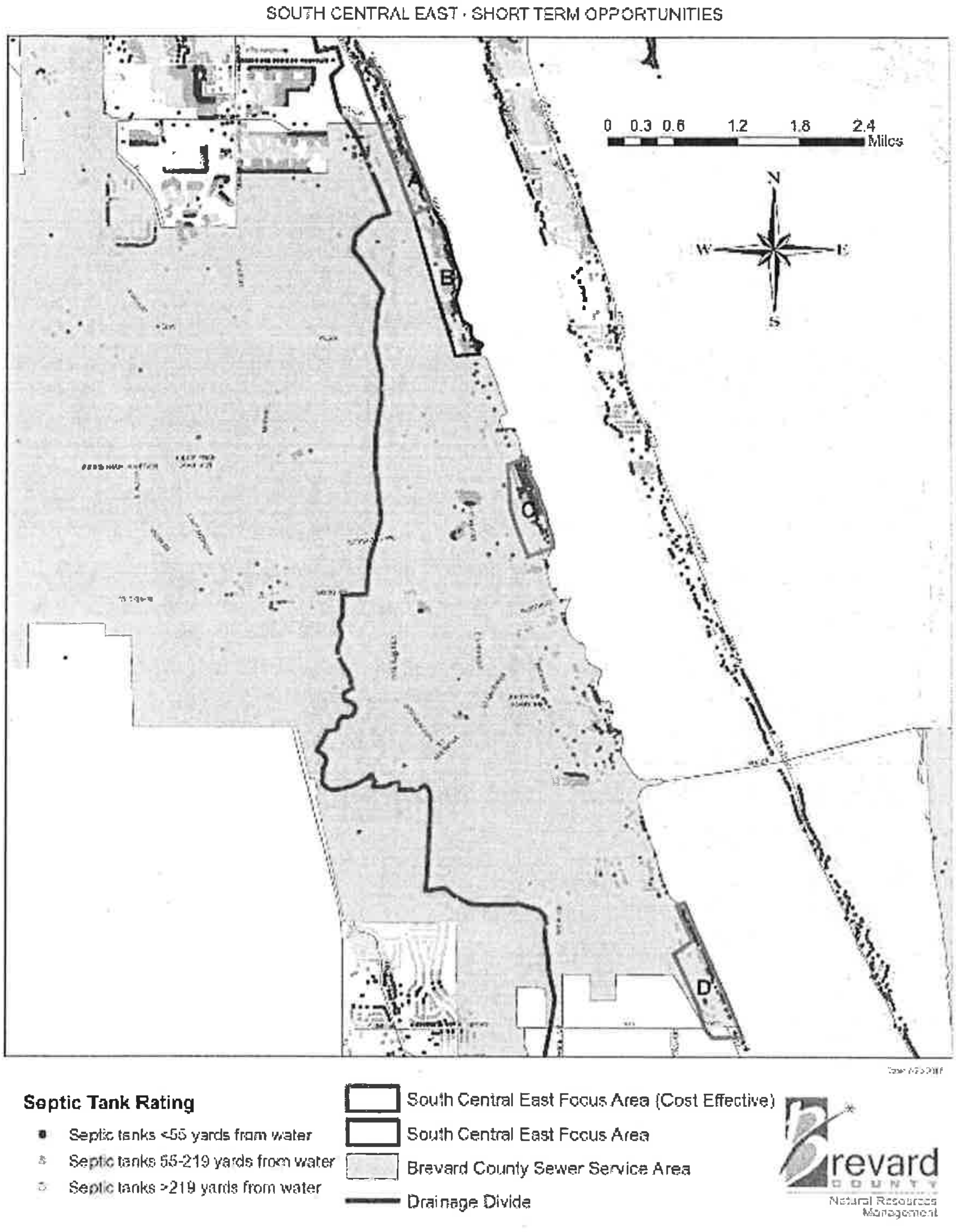

Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-2: Map of South Central Priority Septic System Areas

Figure D-2 Long Description

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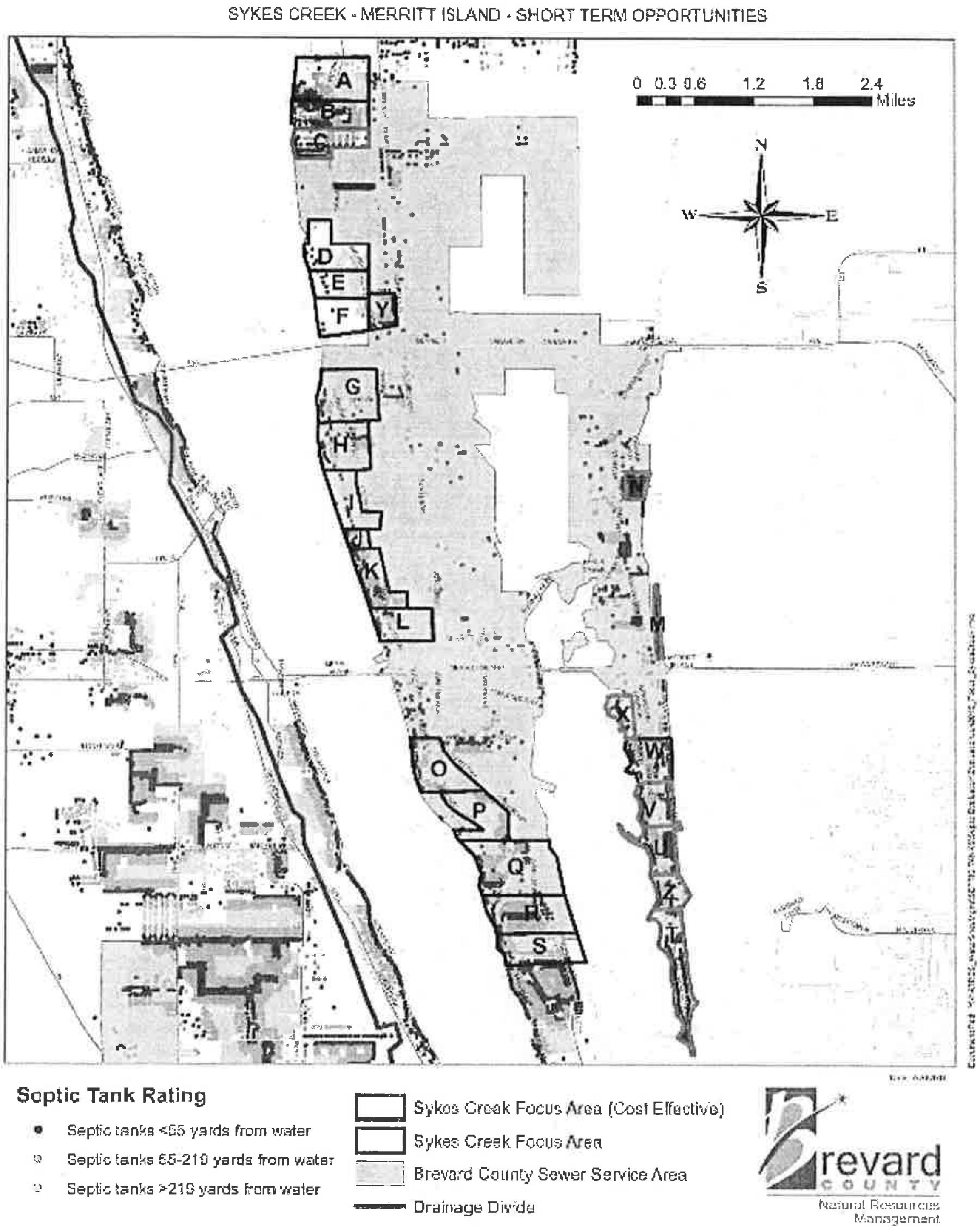

Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-3: Map of Sykes Creek Priority Septic System Areas

Figure D-3 Long Description

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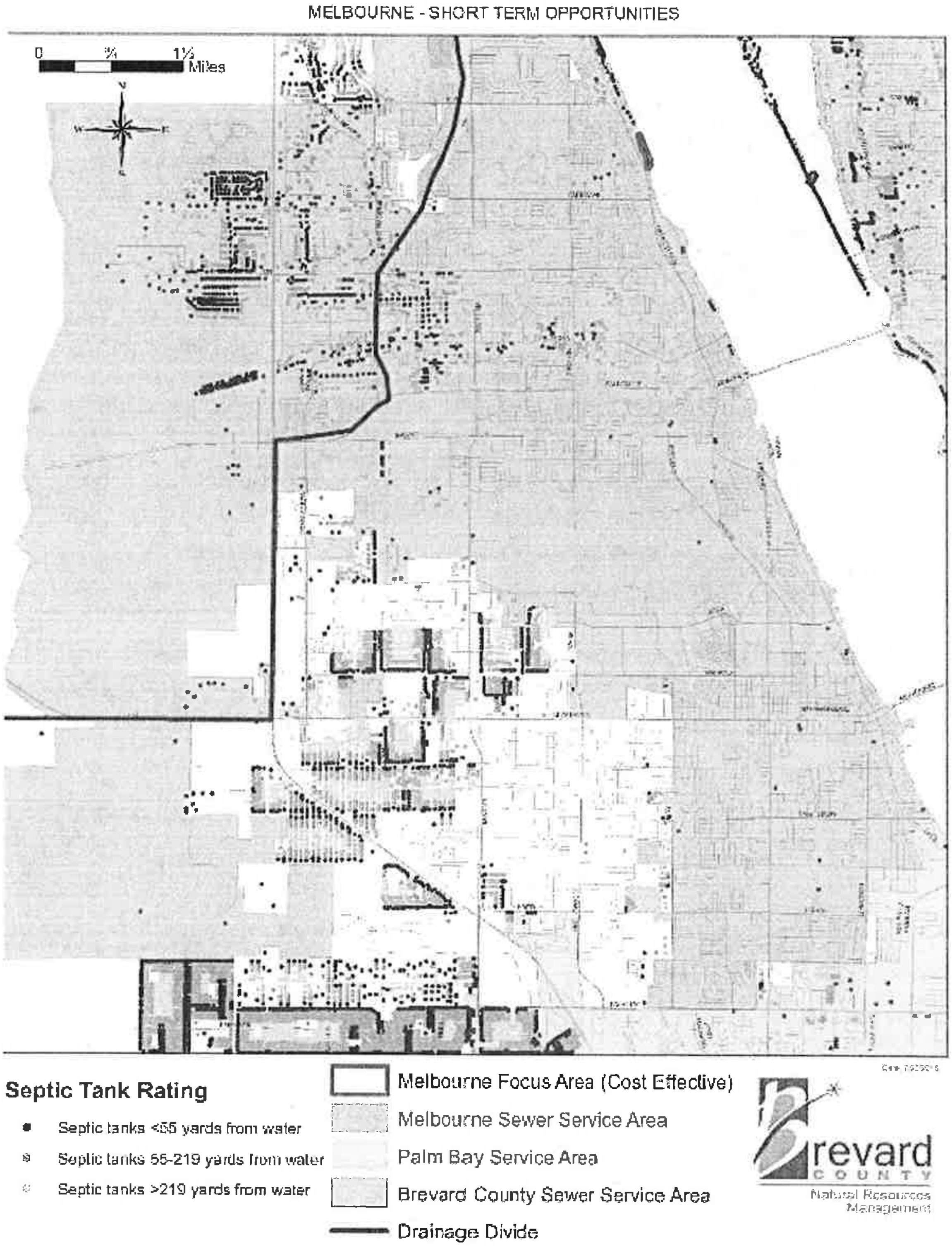

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-4: Map of City of Melbourne Priority Septic System Areas

Figure D-4 Long Description

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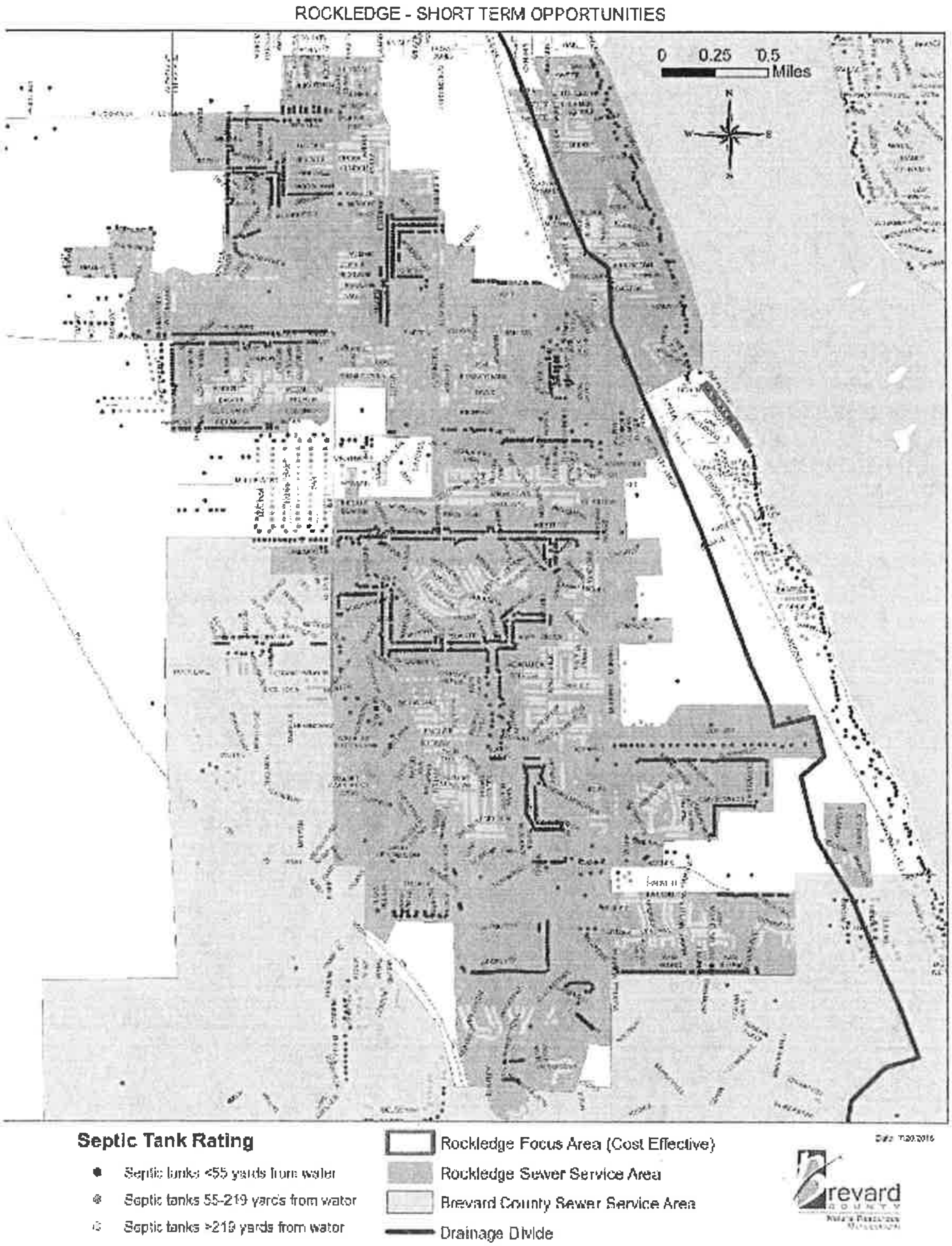
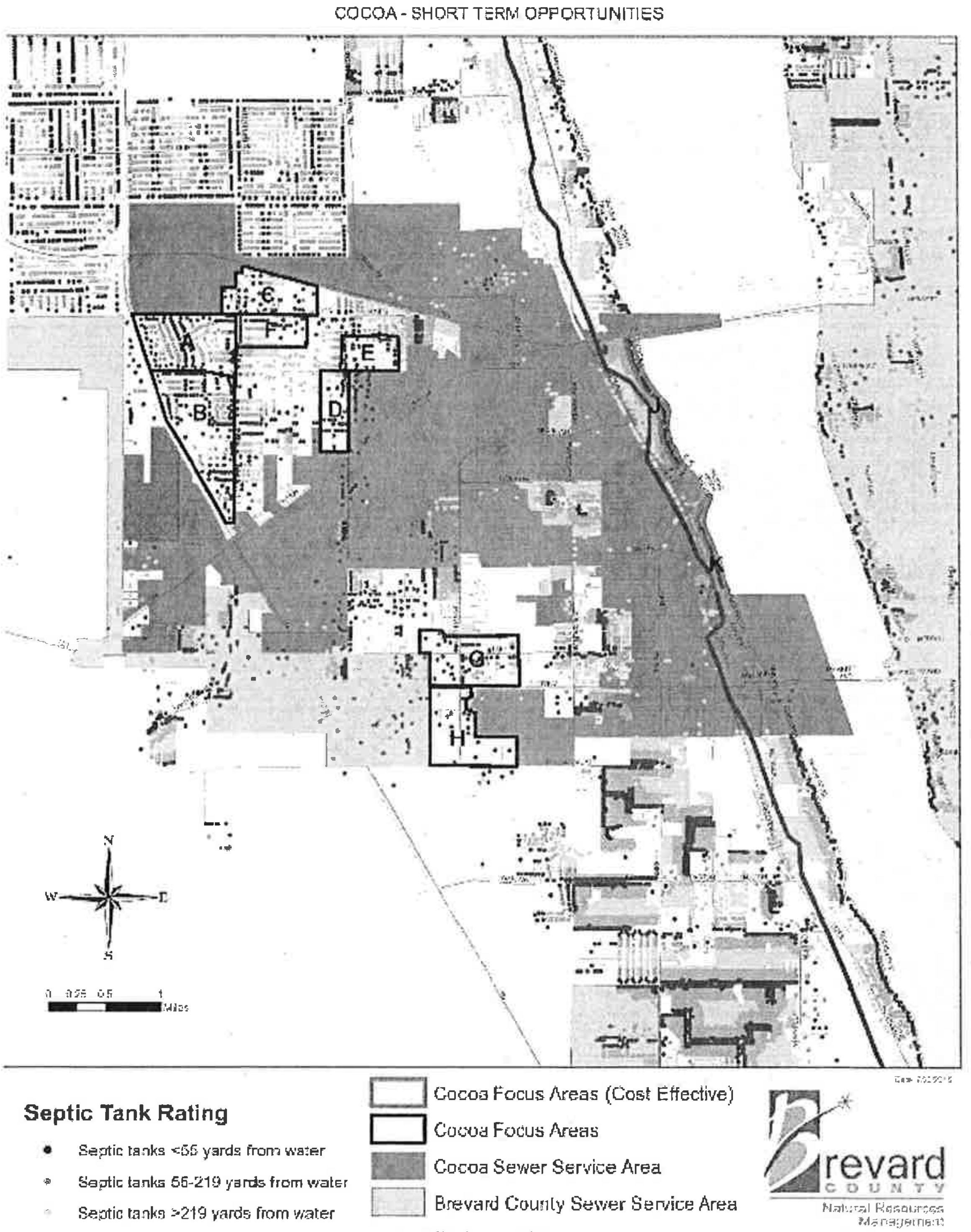


Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-5: Map of City of Rockledge Priority Septic System Areas

Figure D-5 Long Description

331



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-6: Map of City of Cocoa Priority Septic System Areas

Figure D-6 Long Description

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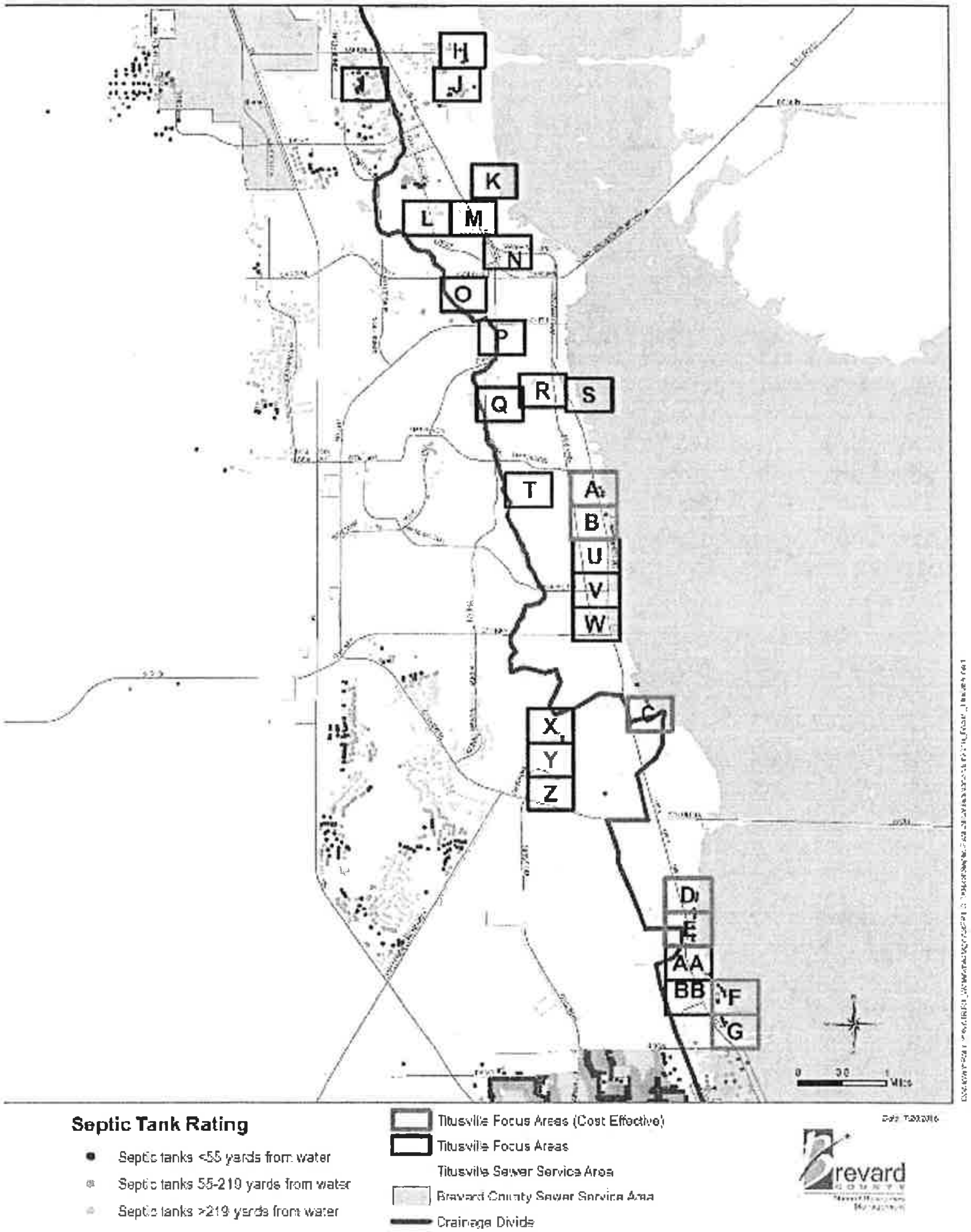
TITUSVILLE - SHORT TERM OPPORTUNITIES

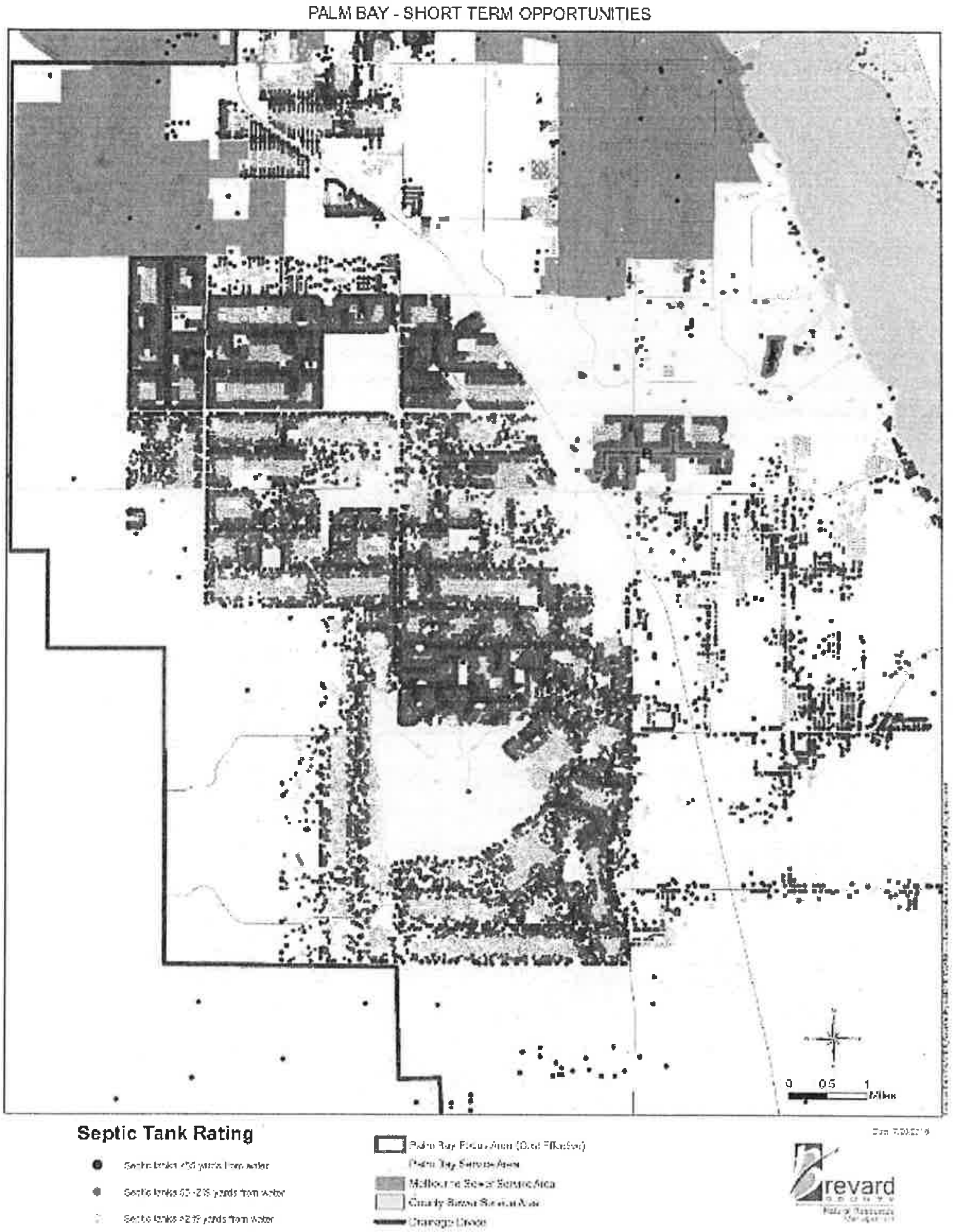


Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-7: Map of City of Titusville Priority Septic System Areas

Figure D-7 Long Description

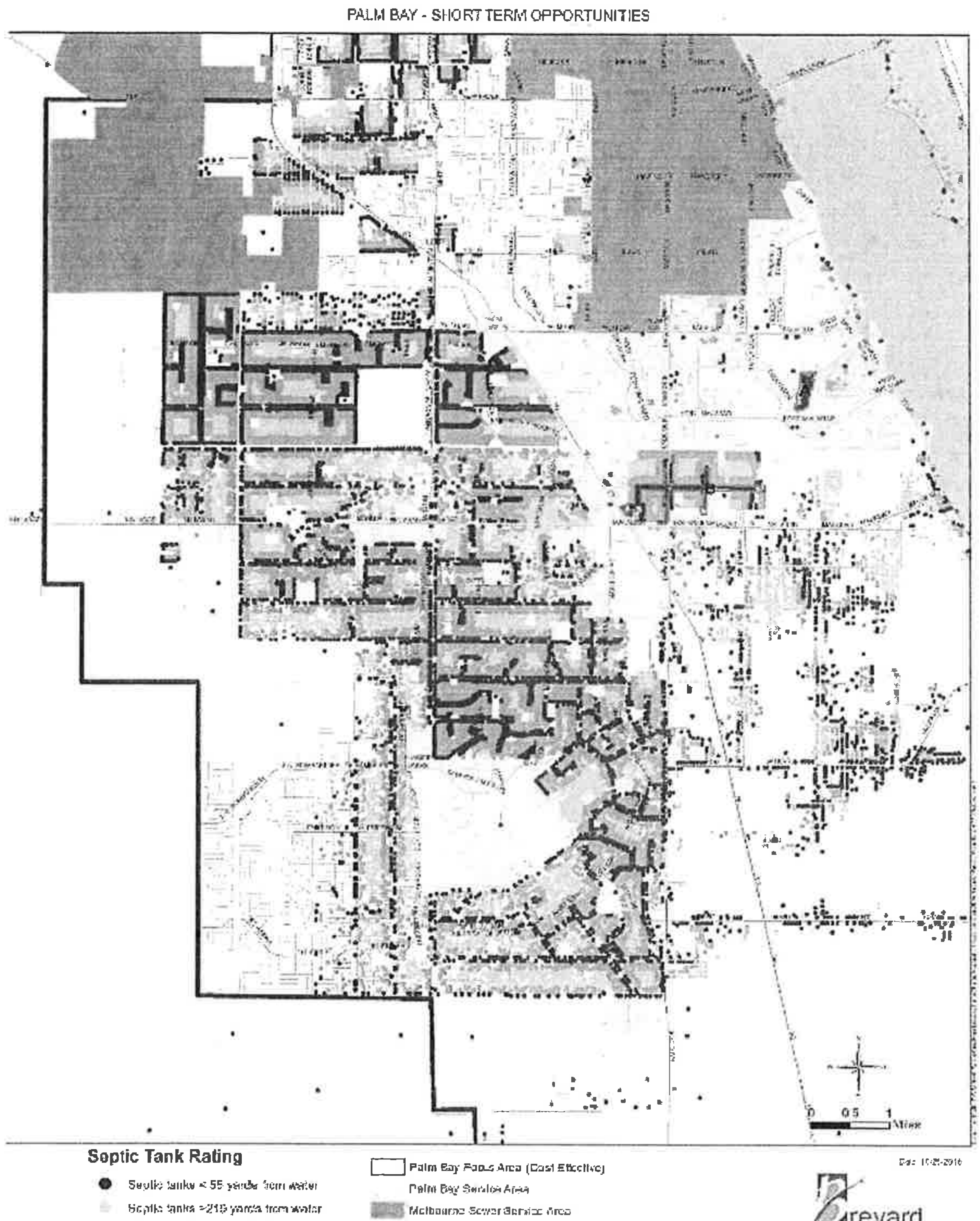
333



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-8: Map of City of Palm Bay Priority Septic System Areas

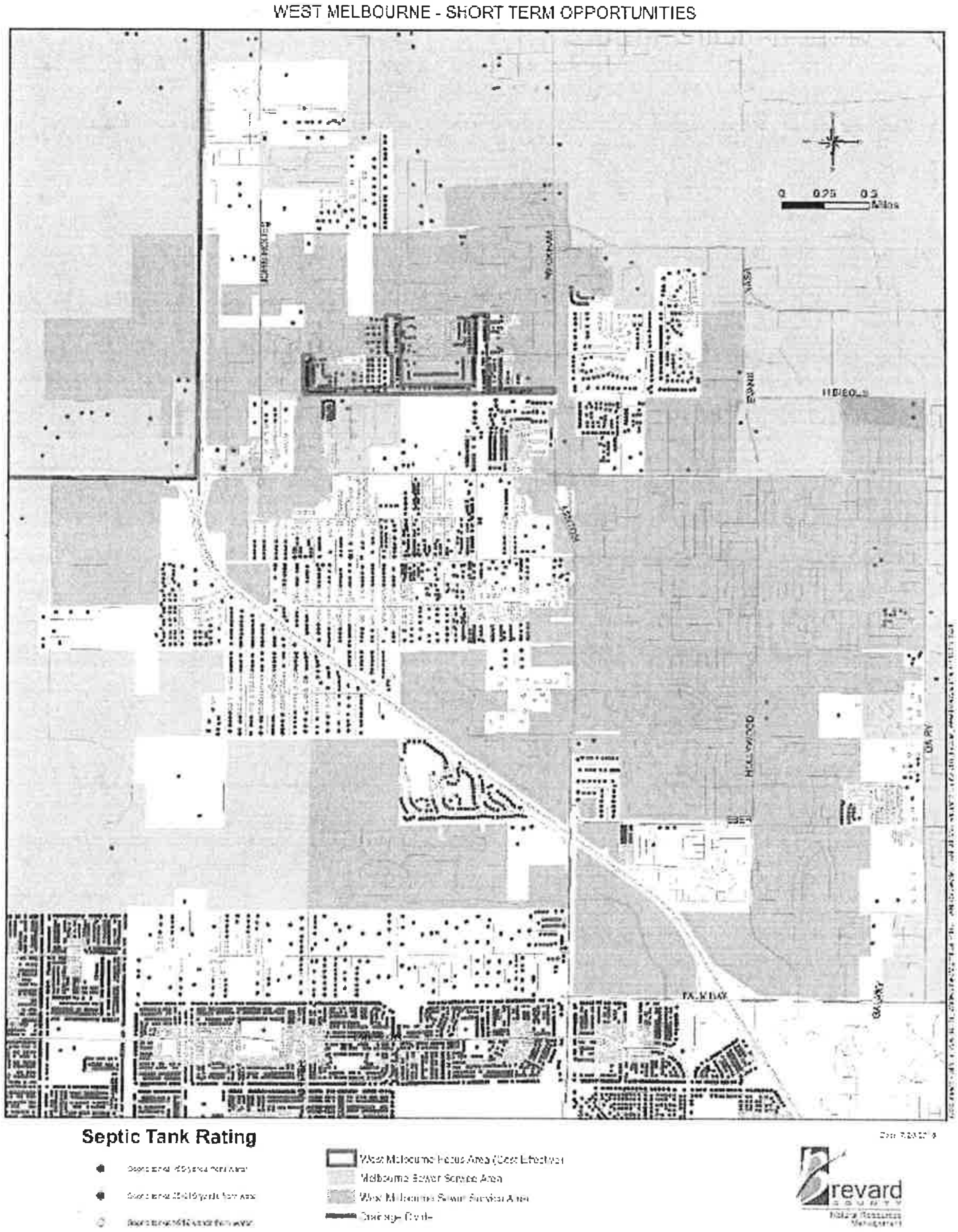
Figure D-8 Long Description



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-9: Map of City of Palm Bay Septic System Areas Near Sewer Lines

Figure D-9 Long Description



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-10: Map of City of West Melbourne Priority Septic System Areas

Figure D-10 Long Description

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Septic System Upgrades

One option for a septic system upgrade is to add a biosorption activated media to enhance nutrient and bacterial removal before the effluent reaches the drainfield or groundwater. Examples of biosorption activated media include mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols (Wanielista et. al. 2011). A test of the biosorption activated media removal capacity was conducted at Florida's Showcase Green Envirohome in Indialantic, Florida. This test location is a residential site built with stormwater, graywater, and wastewater treatment in a compact footprint onsite (Wanielista et. al. 2011). The media used in this study was Bold & Gold, which is a patented blend of mineral materials, sand, and clay. In this study, the effluent to the septic tank was evenly divided between a sorption filter media bed/conventional drainfield in series (innovative system) and to a conventional drainfield. The study found that the TN and TP removal efficiencies were 76.9% and 73.6%, respectively, for the Bold & Gold plus drainfield system, which was significantly higher than the 45.5% TN removal and 32.1% TP removal from a conventional drainfield alone.

Another pilot study was conducted at the University of Central Florida using wastewater from the 15-person BPW Scholarship House, which contains a kitchen and living quarters. The wastewater is pumped to septic tanks from where the effluents are divided into the test Bold & Gold drainfield and the standard drainfields. The Bold & Gold system was designed to provide aerobic and anoxic environments, which allowed for nitrification and denitrification to occur. In this study, the media used was a sand layer on top of a mixture of approximately 68% fine sand, 25% tire crumbs, and 7% sawdust by volume. Overall, TN was reduced by 70.2% and TP was reduced by 81.8%. In addition, the removal efficiency of *Escherichia coli* was 99.93% (Chang et al. 2010).

Another option for a septic system upgrade is the use of passive nitrogen removing systems, and the Florida Department of Health recently completed a study on the efficiency and costs of these systems. The Florida Department of Health defines a passive system as, "A type of enhanced conventional onsite sewage treatment and disposal system that excludes the use of aerator pumps, includes no more than one effluent dosing pump with mechanical and moving parts, and uses a reactive media to assist in nitrogen removal." This definition of passive includes the use of up to one pump because of Florida's flat topography and the need to move water to allow for treatment (Florida Department of Health 2015).

To determine the feasibility of using passive nitrogen removing system, Florida Department of Health contracted with Hazen and Sawyer. The types of passive systems that were tested fell into two general categories: (a) in-tank system and (b) in-ground system. In the in-tank system concept, wastewater flows through the septic tank (STE) to a tank filled with an unsaturated layer of expanded clay (lignocellulosic material) (Stage 1). The wastewater is then sent to a pump tank (NO_3 Recycle), which recycles a portion back to the top of Stage 1. The rest of the wastewater is pumped into a tank with two sections: a saturated layer of wood-chip material (Stage 2A), and a saturated mixture of sulfur and oyster shells (Stage 2B). The wastewater then flows by gravity to the existing drainfield or soil treatment unit (STU) (Dispersal). This concept is shown in **Figure D-11.**

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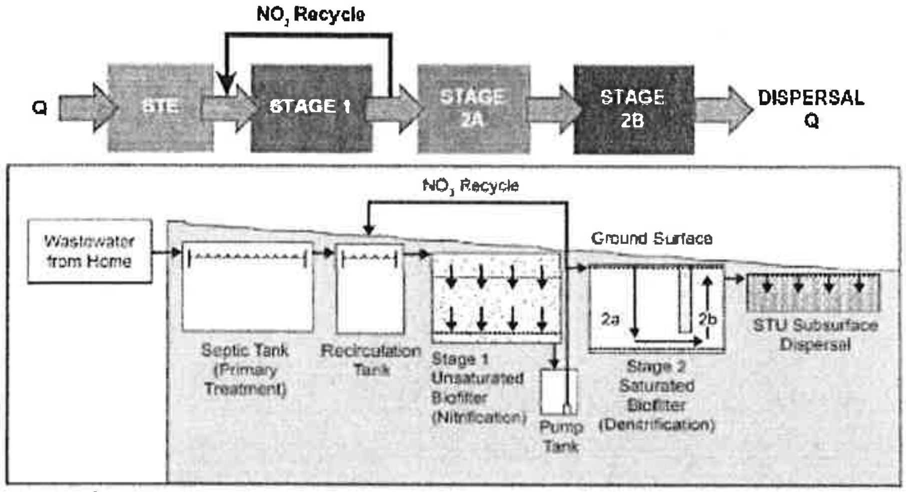
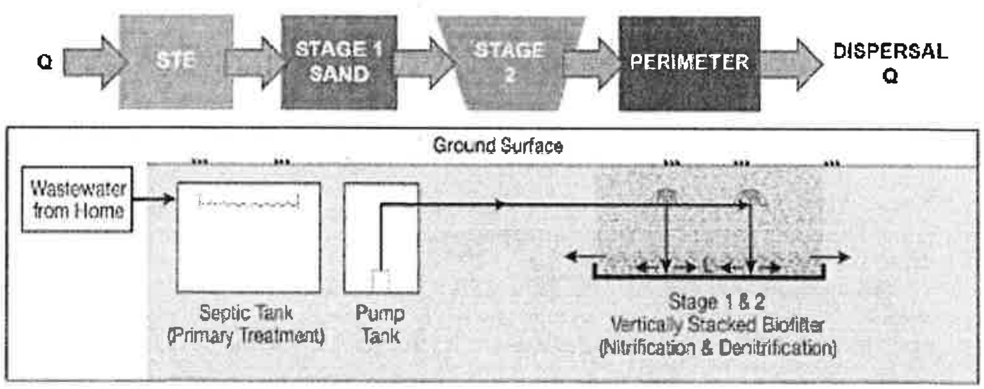


Note: from Hazen and Sawyer 2015

Figure D-11: Example Diagram of an In-Tank Two Stage Biofilter

In the in-ground system concept, wastewater flows through the septic tank (STE) to a pump tank which pressure doses a lined drainfield to spread the sewage throughout the drainfield. Under the drainfield, within the liner, are two layers: an unsaturated layer of regular drainfield sand (Stage 1) above a saturated layer of wood-chip material (Stage 2). The treated wastewater flows over the rim of the liner (Perimeter) into the soil (Dispersal). This concept is shown in **D-12**.



Note: from Hazen and Sawyer 2015

Figure D-12: Example Diagram of an In-Ground Stacked Biofilter

In the test systems, the media depth ranged from 10 inches to 30 inches. The tanks used in the systems at the test sites ranged from 1,050 gallons to 2,800 gallons (Hazen and Sawyer 2015). System longevity could not be directly determined in these systems due to the very low use of media over the two-year study period. Theoretical calculations and literature review suggest that these systems could have a media life of 25 years or longer. For the in-tank Stage 2 biofilters, it would be relatively easy to replace reactive media, helping to extend the life of the system. The study systems were all retrofits of existing septic systems, which have a higher cost than new construction. In addition, these were prototype systems that were being constructed for the first time in Florida. The costs of these systems are expected to decrease with more widespread implementation. The estimated cost to retrofit a septic system to an in-tank passive system is $15,500 and the cost to retrofit to an in-ground system is $12,000. The results of the study found that the TN removal efficiency ranged from 65% to 98%, with an average removal of 90%. 338

The TP removal efficiency ranged from 12% to 96%, with an average removal of 64% (Florida Department of Health 2015).

The cost to upgrade all 15,090 septic systems within 55 yards of an open water connection to the lagoon, which were not recommended for connection to sewer, would be $241,440,000. Therefore, these systems were further evaluated to prioritize those posing the greatest risk to IRL water quality. The criteria used in the original Plan were the distance from the groundwater table, soil types, year the property was developed, population density, and proximity to surface waters. These scoring criteria were a variation on the method used by Martin County to evaluate their septic systems. Brevard County Natural Resources Management, Utilities, and Department of Health staff met and agreed on how to modify the Martin County criteria to best fit Brevard County. Additional details about the scoring criteria are shown in **Table D-9**. The results of this scoring provided information used to prioritize septic systems for upgrades.

Table D-9: Summary of Septic System Scoring Criteria

Evaluation Factors	Scores	Explanation
A - Groundwater Table	0 points: less than 48 inches 8 points: 48 inches 12 points: greater than 48 inches	These data were pulled from the U.S. Geological Survey Soil Survey for Brevard County using Table 9 - Estimates of Soil Properties, Column titled "Depth to - Seasonal High-Water Table."
B - Soil Types	0 points: Most ideal soils for drainfield performance 8 points: Moderate drainfield performance 12 points: Excessively or poorly drained soils	These data were scored by using the 2013 U.S. Geological Survey Soil Survey for Brevard County using an average of scores from a table created by County staff. The scoring was based on an average of permeability following the Martin County example.
C - Surface Water Management Systems	4 points: Property developed after 1986 8 points: Property developed between 1980 and 1986 12 points: Property developed before 1980	These scores were derived by joining the property appraiser data to the scoring table and scoring based on the year built field.
D - Population Density	4 points: Low Density less than 2 units per acre 8 points: Medium Density great than 2 to 5 units per acre 12 points: High Density greater than 5 units per acre	The population density is the zoning of the parcel collected from Municode using "minimum expected density" for unincorporated county areas. Low Density is less than 2 units per acre, Medium Density is 2 to 5 units per acre, High Density is greater than 5 units per acre. Areas outside of unincorporated Brevard were scored using the size of the parcel (less than 0.2 acres is High Density, 0.2 to 0.5 is Medium Density and Greater than 0.5 acres is Low Density).
E - Proximity to Surface Waters	4 points: Properties greater than 219 yards from an open channel 8 points: Properties within 55 yards of any open channel 12 points: Properties with boundary along the Lagoon or within 20 feet of IRL shoreline	Identified parcels within 20 feet of the IRL; parcels between 55 yards and 219 yards of an open channel polyline; parcels greater than 219 yards from an open channel polyline.

The septic systems with the highest (worst) scores and within 55 yards of a surface waterbody are recommended for retrofit upgrades to reduce the impacts of these septic systems on the waterbodies. The number of these lots and the costs by sub-lagoon are shown in **Table D-10**. The locations of these septic system upgrades are shown in **Figure D-13** through **Figure D-15**. It is important to note that the septic system locations shown in the figures were based on the best available data from the Florida Department of Health and the cities, and additional systems may be field verified and eligible for upgrade funding. This upgrade opportunity addresses 2.3% of the septic systems in the IRL drainage basin.

Table D-10: Septic Tank Upgrades and Costs for Highest Priority Septic Systems within 55 Yards of a Surface Waterbody

Sub-lagoon	Number of Lots	Cost	TN Load (lbs/yr)	TN Removal Efficiency	TN Reductions (lbs/yr)	TN Cost per Pound per Year
Banana River*	258	$4,128,000	6,991	73.6%	5,145	$802
North IRL*	515	$8,240,000	13,954	73.6%	10,270	$802
Central IRL*^	614	$9,824,000	16,636	73.6%	12,244	$802
Total	***1,387***	***$22,192,000***	***37,581***	***73.6%***	***27,659***	***$802***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ The projects in the Central IRL sub-lagoon are located both in Zone A and Zone SEB (refer to **Section 2.1**).

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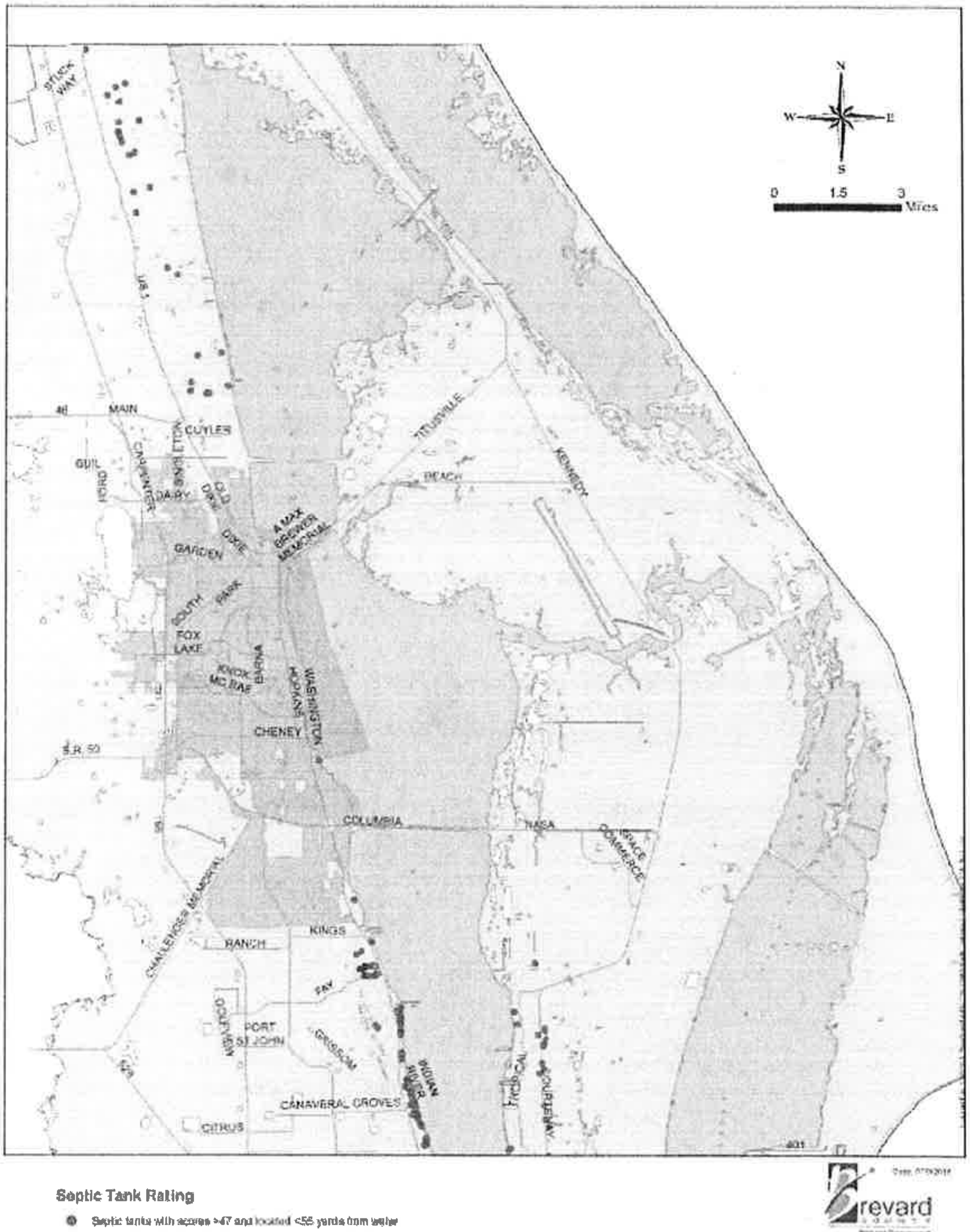

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-13: Map of Locations for Septic System Upgrades in North IRL

Figure D-13 Long Description

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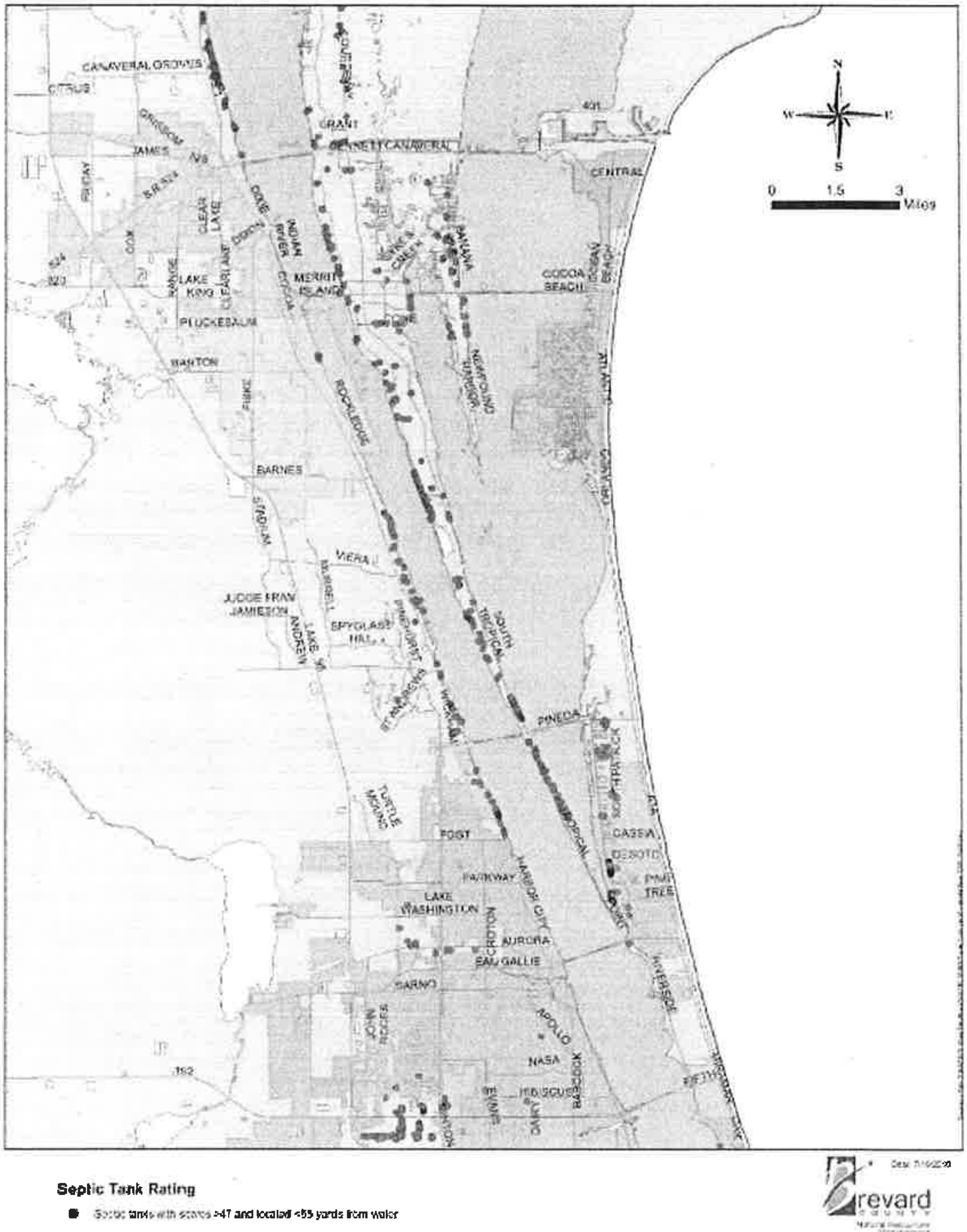

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-14: Map of Locations for Septic System Upgrades in Banana River Lagoon and North IRL

Figure D-14 Long Description

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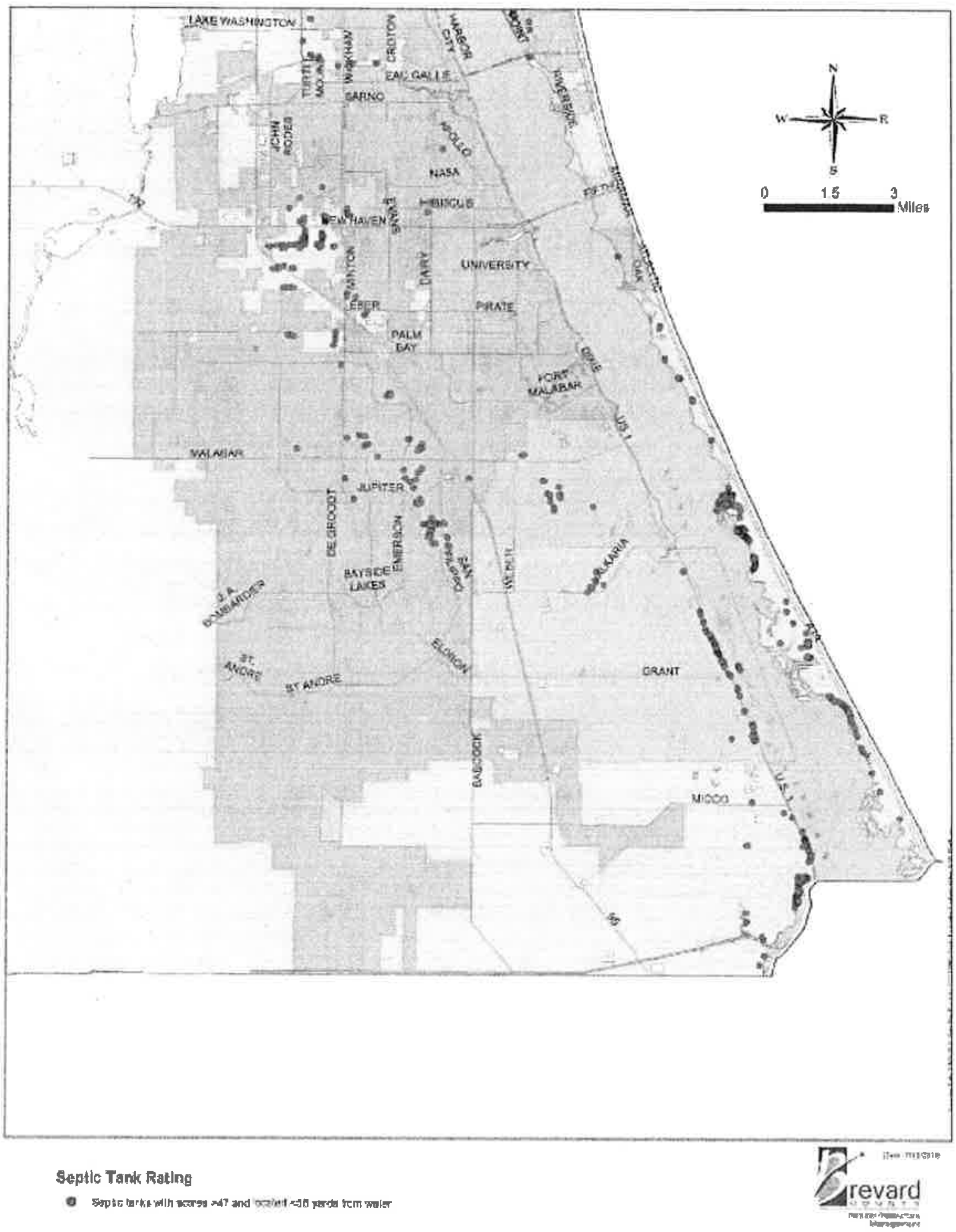

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-15: Map of Locations for Septic System Upgrades in Central IRL

Figure D-15 Long Description

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Appendix E: Summary of Stormwater Project Basins

Table E-1: Summary of Potential TN Reductions for Stormwater Project Basins in Banana River Lagoon

Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
611	$176,300	144	79	3,009	1,354	$130	Merritt Island
828	$215,900	252	138	3,104	1,397	$155	Merritt Island
951	$258,900	408	225	3,472	1,562	$166	Merritt Island
691	$300,600	489	269	3,887	1,749	$172	Merritt Island
984	$251,100	430	237	3,139	1,412	$178	Merritt Island
CCB-E	$243,400	445	245	2,966	1,335	$182	Barrier Island
873	$141,500	112	61	1,723	775	$182	Merritt Island
CCB-F	$203,100	339	187	2,318	1,043	$195	Barrier Island
497	$186,700	287	158	2,115	952	$196	Merritt Island
925	$176,000	143	78	1,989	895	$197	Merritt Island
1066	$232,200	419	230	2,554	1,150	$202	Merritt Island
602	$230,000	376	207	2,521	1,135	$203	Merritt Island
998	$194,400	316	174	2,118	953	$204	Merritt Island
1002	$185,300	278	153	2,007	903	$205	Merritt Island
CCAFS-4A	$435,000	850	468	4,646	2,091	$208	Barrier Island
979A	$242,300	446	245	2,582	1,162	$209	Merritt Island
781	$170,900	184	101	1,816	817	$209	Merritt Island
CCB-G	$201,300	340	187	2,124	956	$211	Barrier Island
539	$198,200	328	181	2,079	935	$212	Merritt Island
CCAFS-6B	$829,500	2,228	1,225	8,683	3,907	$212	Barrier Island
1037	$150,400	186	102	1,574	708	$212	Merritt Island
CCAFS-3A	$640,700	1,447	796	6,435	2,896	$221	Barrier Island
CCAFS-5A	$442,300	939	516	4,370	1,967	$225	Barrier Island
CCB-B	$172,100	264	145	1,689	760	$226	Barrier Island
CC-B2A	$176,700	283	156	1,721	774	$228	Barrier Island
CCAFS-1A	$580,100	1,312	722	5,624	2,531	$229	Barrier Island
674	$277,900	542	298	2,679	1,206	$230	Merritt Island
650	$289,900	571	314	2,781	1,251	$232	Merritt Island
1222	$218,800	389	214	2,068	931	$235	Merritt Island
CCAFS-6D	$213,200	402	221	2,011	905	$236	Barrier Island
1024	$158,700	222	122	1,485	668	$237	Merritt Island
CCAFS-6A	$178,300	300	165	1,632	734	$243	Barrier Island
CCAFS-2A	$434,200	839	461	3,952	1,778	$244	Barrier Island
1304	$180,200	291	160	1,636	736	$245	Barrier Island
CCB-C	$130,700	151	83	1,167	525	$249	Barrier Island
1172	$228,800	414	228	2,042	919	$249	Merritt Island
CCB-D	$156,700	225	124	1,396	628	$250	Barrier Island
1067	$202,600	346	191	1,802	811	$250	Merritt Island
484	$111,800	74	40	989	445	$251	Merritt Island
CCB-I	$338,000	722	397	2,972	1,337	$253	Barrier Island
730	$146,900	145	80	1,279	576	$255	Merritt Island
483	$184,400	306	168	1,573	708	$261	Merritt Island

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Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
CCB-H	$163,900	247	136	1,397	629	$261	Barrier Island
601	$132,100	133	73	1,124	506	$261	Merritt Island
1309	$155,500	225	124	1,317	593	$262	Barrier Island
1280B	$145,100	194	107	1,224	551	$263	Barrier Island
350	$184,500	329	181	1,543	695	$266	Merritt Island
997	$144,900	193	106	1,211	545	$266	Merritt Island
476	$181,100	305	168	1,510	680	$266	Barrier Island
479	$119,300	115	64	989	445	$268	Merritt Island
520	$107,600	69	38	888	400	$269	Merritt Island
1037A	$145,700	195	107	1,199	540	$270	Merritt Island
537	$161,100	224	123	1,314	591	$272	Merritt Island
543	$139,300	170	93	1,136	511	$272	Merritt Island
1187	$177,400	278	153	1,432	645	$275	Merritt Island
CCAFS-9A	$170,100	246	135	1,363	614	$277	Barrier Island
1124	$148,100	203	111	1,184	533	$278	Merritt Island
585	$132,000	138	76	1,053	474	$279	Merritt Island
591	$111,200	76	42	886	399	$279	Merritt Island
508	$153,600	207	114	1,213	546	$281	Merritt Island
673	$167,900	251	138	1,322	595	$282	Merritt Island
CCAFS-4C	$230,900	414	228	1,781	801	$288	Barrier Island
638	$130,200	142	78	990	445	$292	Merritt Island
940B	$153,200	209	115	1,162	523	$293	Merritt Island
CC-B2C	$128,000	149	82	954	430	$298	Barrier Island
CC-B4B	$125,100	145	80	914	411	$304	Barrier Island
592	$109,500	78	43	798	359	$305	Merritt Island
Total	***$14,403,300***	***24,119***	***13,266***	***141,633***	***63,738***	***$226***	-

Table E-2: Summary of Potential TP Reductions for Stormwater Project Basins in Banana River Lagoon

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
611	$176,300	20	13	255	115	$873	Merritt Island
828	$215,900	35	23	283	127	$785	Merritt Island
951	$258,900	56	37	342	154	$812	Merritt Island
691	$300,600	67	44	407	183	$682	Merritt Island
984	$251,100	59	39	318	143	$873	Merritt Island
CCB-E	$243,400	61	40	466	210	$596	Barrier Island
873	$141,500	15	10	154	69	$1,439	Merritt Island
CCB-F	$203,100	47	30	352	158	$632	Barrier Island
497	$186,700	39	26	211	95	$1,051	Merritt Island
925	$176,000	20	13	199	90	$1,115	Merritt Island
1066	$232,200	58	37	384	173	$579	Merritt Island
602	$230,000	52	34	272	122	$817	Merritt Island
998	$194,400	44	28	319	144	$696	Merritt Island
1002	$185,300	38	25	280	126	$792	Merritt Island
CCAFS-4A	$435,000	117	76	659	296	$675	Barrier Island
979A	$242,300	61	40	385	173	$721	Merritt Island
781	$170,900	25	16	182	82	$1,224	Merritt Island
CCB-G	$201,300	47	30	327	147	$680	Barrier Island
539	$198,200	45	29	217	98	$1,023	Merritt Island
CCAFS-6B	$829,500	307	199	1,211	545	$505	Barrier Island
1037	$150,400	26	17	216	97	$1,029	Merritt Island
CCAFS-3A	$640,700	199	130	1,000	450	$611	Barrier Island
CCAFS-5A	$442,300	129	84	624	281	$713	Barrier Island
CCB-B	$172,100	36	24	246	110	$905	Barrier Island
CC-B2A	$176,700	39	25	277	125	$803	Barrier Island
CCAFS-1A	$580,100	181	117	867	390	$705	Barrier Island
674	$277,900	75	48	323	145	$859	Merritt Island
650	$289,900	79	51	356	160	$937	Merritt Island
1222	$218,800	54	35	301	135	$739	Merritt Island
CCAFS-6D	$213,200	55	36	239	107	$931	Barrier Island
1024	$158,700	31	20	231	104	$960	Merritt Island
CCAFS-6A	$178,300	41	27	180	81	$1,231	Barrier Island
CCAFS-2A	$434,200	116	75	686	309	$648	Barrier Island
1304	$180,200	40	26	246	110	$905	Barrier Island
CCB-C	$130,700	21	14	184	83	$1,209	Barrier Island
1172	$228,800	57	37	295	133	$754	Merritt Island
CCB-D	$156,700	31	20	229	103	$972	Barrier Island
1067	$202,600	48	31	254	114	$876	Merritt Island
484	$111,800	10	7	89	40	$2,495	Merritt Island
CCB-I	$338,000	99	65	417	187	$934	Barrier Island
730	$146,900	20	13	137	61	$1,628	Merritt Island
483	$184,400	42	27	187	84	$1,189	Merritt Island
CCB-H	$163,900	34	22	228	102	$977	Barrier Island
601	$132,100	18	12	116	52	$1,912	Merritt Island
1309	$155,500	31	20	199	89	$1,118	Barrier Island
1280B	$145,100	27	17	181	81	$1,228	Barrier Island
350	$184,500	45	29	189	85	$1,174	Merritt Island

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
997	$144,900	27	17	184	83	$1,206	Merritt Island
476	$181,100	42	27	174	78	$1,274	Barrier Island
479	$119,300	16	10	93	42	$2,379	Merritt Island
520	$107,600	9	6	78	35	$2,843	Merritt Island
1037A	$145,700	27	17	177	79	$1,258	Merritt Island
537	$161,100	31	20	152	68	$1,464	Merritt Island
543	$139,300	23	15	120	54	$1,853	Merritt Island
1187	$177,400	38	25	188	85	$1,182	Merritt Island
CCAFS-9A	$170,100	34	22	287	129	$774	Barrier Island
1124	$148,100	28	18	173	78	$1,287	Merritt Island
585	$132,000	19	12	107	48	$2,083	Merritt Island
591	$111,200	10	7	82	37	$2,698	Merritt Island
508	$153,600	29	19	132	59	$1,683	Merritt Island
673	$167,900	34	22	156	70	$1,421	Merritt Island
CCAFS-4C	$230,900	57	37	256	115	$1,085	Barrier Island
638	$130,200	20	13	105	47	$2,112	Merritt Island
940B	$153,200	29	19	167	75	$1,329	Merritt Island
CC-B2C	$128,000	21	13	141	63	$1,579	Barrier Island
CC-B4B	$125,100	20	13	148	66	$1,506	Barrier Island
592	$109,500	11	7	77	34	$2,903	Merritt Island
Total	***$14,403,300***	***3,322***	***2,157***	***18,717***	***8,413***	***$1,712***	-

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Table E-3: Summary of Potential TN Reductions for Stormwater Project Basins in North IRL

Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
716	$124,800	38	21	2,570	1,157	$108	Mainland
622	$152,100	100	55	2,603	1,172	$130	Mainland
608	$102,800	9	5	1,654	744	$138	Mainland
286	$129,500	73	40	1,863	839	$154	Mainland
668	$235,400	328	180	3,352	1,508	$156	Mainland
659	$122,700	40	22	1,742	784	$157	Mainland
384	$158,700	164	90	2,191	986	$161	Mainland
TV-St. Johns Basin	$419,300	863	475	5,751	2,588	$162	Mainland
253	$207,100	257	142	2,760	1,242	$167	Mainland
911	$168,500	168	92	2,231	1,004	$168	Mainland
560	$96,800	11	6	1,272	572	$169	Mainland
TV-ST Teresa Basin	$492,400	1,070	589	6,381	2,872	$171	Mainland
16	$188,800	298	164	2,433	1,095	$172	Mainland
338	$340,900	598	329	4,307	1,938	$176	Beaches
1419	$313,800	622	342	3,855	1,735	$181	Mainland
TV-Addison Canal Basin	$1,280,300	3,024	1,663	15,710	7,070	$181	Mainland
199	$204,100	303	166	2,499	1,125	$181	Mainland
973	$387,600	808	444	4,742	2,134	$182	Mainland
TV-Chain of Lakes Basin	$857,100	2,072	1,139	10,461	4,707	$182	Merritt Island
498	$227,900	354	194	2,762	1,243	$183	Mainland
662	$180,000	232	128	2,172	977	$184	Mainland
1399	$276,500	532	293	3,330	1,498	$185	Mainland
CO-2K	$269,500	485	267	3,218	1,448	$186	Mainland
1430	$439,700	976	537	5,247	2,361	$186	Mainland
TV-La Paloma Basin	$399,600	846	465	4,769	2,146	$186	Beaches
CO-2QA	$253,200	458	252	3,009	1,354	$187	Mainland
895	$213,100	308	170	2,511	1,130	$189	Mainland
TV-South Marine Basin	$237,200	408	224	2,782	1,252	$189	Mainland
176	$152,400	149	82	1,770	797	$191	Mainland
1396	$193,900	308	170	2,247	1,011	$192	Mainland
RL-2A	$329,500	645	355	3,811	1,715	$192	Mainland
62	$138,500	162	89	1,601	721	$192	Mainland
141	$202,100	325	179	2,332	1,049	$193	Mainland
19	$157,600	217	119	1,818	818	$193	Merritt Island

Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
TV-Main Street Basin	$250,200	463	255	2,884	1,298	$193	Mainland
94	$221,500	394	216	2,535	1,141	$194	Mainland
115	$266,900	516	284	3,049	1,372	$194	Mainland
478	$174,400	221	121	1,990	896	$195	Mainland
RL-3B	$422,400	907	499	4,795	2,158	$196	Mainland
992	$244,000	447	246	2,758	1,241	$197	Mainland
865	$174,300	227	125	1,953	879	$198	Merritt Island
388	$238,700	444	244	2,673	1,203	$198	Mainland
116	$185,700	281	155	2,079	936	$199	Mainland
193	$257,700	472	260	2,883	1,297	$199	Mainland
1377	$263,400	504	277	2,943	1,324	$199	Mainland
TV-Parrish Basin	$213,200	352	193	2,378	1,070	$199	Mainland
26	$179,500	280	154	1,999	900	$200	Merritt Island
RL-3I	$600,700	1,369	753	6,686	3,009	$200	Mainland
1392	$210,600	360	198	2,334	1,050	$200	Mainland
204	$125,000	84	46	1,383	622	$201	Mainland
451	$216,100	340	187	2,390	1,075	$201	Mainland
1335	$292,400	579	319	3,226	1,452	$201	Mainland
72	$209,300	363	200	2,308	1,038	$202	Merritt Island
TV-Sycamore Basin	$251,900	468	257	2,769	1,246	$202	Mainland
1387	$180,400	275	151	1,977	890	$203	Mainland
1349	$354,400	750	412	3,882	1,747	$203	Mainland
474	$163,100	205	113	1,780	801	$204	Mainland
157	$183,500	279	153	1,996	898	$204	Mainland
816	$138,800	122	67	1,507	678	$205	Mainland
TV-Marina Basin	$239,500	441	242	2,597	1,169	$205	Mainland
410	$271,300	512	282	2,939	1,322	$205	Mainland
1456	$195,400	316	174	2,116	952	$205	Mainland
824	$148,500	167	92	1,603	721	$206	Mainland
833	$224,300	393	216	2,407	1,083	$207	Mainland
254	$120,200	55	30	1,290	581	$207	Mainland
575	$137,600	105	58	1,470	662	$208	Merritt Island
218	$102,100	23	13	1,090	491	$208	Mainland
CO-2I	$204,500	332	183	2,176	979	$209	Mainland
155	$191,100	309	170	2,030	913	$209	Mainland

Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
1464	$202,800	335	184	2,150	968	$210	Mainland
1368	$237,200	439	241	2,499	1,125	$211	Mainland
738	$104,900	53	29	1,104	497	$211	Merritt Island
832	$203,400	336	185	2,139	962	$211	Mainland
314	$175,100	245	135	1,838	827	$212	Merritt Island
1458	$200,500	328	181	2,104	947	$212	Mainland
901	$401,100	816	449	4,210	1,895	$212	Merritt Island
1256	$337,000	673	370	3,511	1,580	$213	Mainland
1409	$293,800	597	328	3,055	1,375	$214	Merritt Island
TV-South Street Basin	$193,300	316	174	2,000	900	$215	Mainland
829	$175,200	242	133	1,805	812	$216	Mainland
6	$154,900	195	107	1,592	716	$216	Merritt Island
22	$134,800	134	73	1,381	622	$217	Mainland
439	$127,100	111	61	1,299	585	$217	Beaches
10	$207,400	347	191	2,118	953	$218	Mainland
413	$199,200	340	187	2,034	915	$218	Merritt Island
1263	$199,500	323	178	2,031	914	$218	Merritt Island
758	$116,900	68	38	1,185	533	$219	Mainland
835	$249,000	455	250	2,519	1,134	$220	Mainland
1078	$224,800	402	221	2,259	1,017	$221	Mainland
831	$162,200	208	114	1,629	733	$221	Merritt Island
TV-Royal Palm Basin	$195,500	316	174	1,952	878	$223	Mainland
499	$169,800	251	138	1,691	761	$223	Mainland
1381	$216,500	384	211	2,152	968	$224	Mainland
1342	$231,700	425	234	2,297	1,034	$224	Beaches
1298	$374,200	801	440	3,704	1,667	$224	Mainland
112	$165,700	246	135	1,631	734	$226	Merritt Island
RL-3A	$179,800	276	152	1,768	796	$226	Mainland
89	$245,100	467	257	2,409	1,084	$226	Mainland
Total	***$23,584,400***	***40,735***	***22,403***	***270,697***	***121,818***	***$194***	-

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Table E-4: Summary of Potential TP Reductions for Stormwater Project Basins in North IRL

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
716	$124,800	5	3	187	84	$1,188	Mainland
622	$152,100	14	9	191	86	$1,162	Mainland
608	$102,800	1	1	153	69	$1,455	Mainland
286	$129,500	10	7	141	63	$1,578	Mainland
668	$235,400	45	29	309	139	$720	Mainland
659	$122,700	5	4	124	56	$1,797	Mainland
384	$158,700	23	15	186	84	$1,193	Mainland
TV-St. Johns Basin	$419,300	119	77	781	351	$569	Mainland
253	$207,100	35	23	292	132	$760	Mainland
911	$168,500	23	15	201	90	$1,108	Mainland
560	$96,800	2	1	91	41	$2,447	Mainland
TV-ST Teresa Basin	$492,400	147	96	946	426	$528	Mainland
16	$188,800	41	27	392	176	$567	Mainland
338	$340,900	82	54	468	210	$713	Beaches
1419	$313,800	86	56	553	249	$603	Mainland
TV-Addison Canal Basin	$1,280,300	416	271	2,031	914	$301	Mainland
199	$204,100	42	27	239	108	$929	Mainland
973	$387,600	111	72	682	307	$570	Mainland
TV-Chain of Lakes Basin	$857,100	285	185	1,518	683	$403	Merritt Island
498	$227,900	49	32	263	118	$847	Mainland
662	$180,000	32	21	223	101	$995	Mainland
1399	$276,500	73	48	515	232	$539	Mainland
CO-2K	$269,500	67	43	454	204	$612	Mainland
1430	$439,700	134	87	771	347	$576	Mainland
TV-La Paloma Basin	$399,600	116	76	699	314	$557	Beaches
CO-2QA	$253,200	63	41	443	199	$627	Mainland
895	$213,100	42	28	300	135	$740	Mainland
TV-South Marine Basin	$237,200	56	36	392	176	$567	Mainland
176	$152,400	21	13	164	74	$1,357	Mainland
1396	$193,900	42	28	327	147	$680	Mainland
RL-2A	$329,500	89	58	547	246	$610	Mainland
62	$138,500	22	14	262	118	$847	Mainland
141	$202,100	45	29	362	163	$614	Mainland
19	$157,600	30	19	285	128	$779	Merritt Island

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
TV-Main Street Basin	$250,200	64	41	419	189	$662	Mainland
94	$221,500	54	35	395	178	$562	Mainland
115	$266,900	71	46	443	199	$627	Mainland
478	$174,400	30	20	177	80	$1,254	Mainland
RL-3B	$422,400	125	81	681	307	$652	Mainland
992	$244,000	62	40	414	186	$671	Mainland
865	$174,300	31	20	242	109	$918	Merritt Island
388	$238,700	61	40	289	130	$768	Mainland
116	$185,700	39	25	316	142	$703	Mainland
193	$257,700	65	42	430	193	$646	Mainland
1377	$263,400	69	45	445	200	$625	Mainland
TV-Parrish Basin	$213,200	48	31	363	163	$612	Mainland
26	$179,500	39	25	306	138	$726	Merritt Island
RL-3I	$600,700	189	123	940	423	$650	Mainland
1392	$210,600	50	32	353	159	$629	Mainland
204	$125,000	12	8	123	55	$1,810	Mainland
451	$216,100	47	30	274	123	$811	Mainland
1335	$292,400	80	52	464	209	$598	Mainland
72	$209,300	50	32	333	150	$668	Merritt Island
TV-Sycamore Basin	$251,900	64	42	409	184	$680	Mainland
1387	$180,400	38	25	278	125	$799	Mainland
1349	$354,400	103	67	596	268	$653	Mainland
474	$163,100	28	18	170	76	$1,309	Mainland
157	$183,500	38	25	200	90	$1,110	Mainland
816	$138,800	17	11	289	130	$770	Mainland
TV-Marina Basin	$239,500	61	39	378	170	$587	Mainland
410	$271,300	70	46	351	158	$791	Mainland
1456	$195,400	44	28	306	138	$727	Mainland
824	$148,500	23	15	230	103	$967	Mainland
833	$224,300	54	35	407	183	$545	Mainland
254	$120,200	8	5	100	45	$2,229	Mainland
575	$137,600	15	9	120	54	$1,859	Merritt Island
218	$102,100	3	2	87	39	$2,562	Mainland
CO-2I	$204,500	46	30	323	146	$687	Mainland
155	$191,100	42	28	208	94	$1,068	Mainland
1464	$202,800	46	30	298	134	$746	Mainland

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
1368	$237,200	60	39	361	162	$616	Mainland
738	$104,900	7	5	112	51	$1,980	Merritt Island
832	$203,400	46	30	353	159	$629	Mainland
314	$175,100	34	22	191	86	$1,166	Merritt Island
1458	$200,500	45	29	285	128	$780	Mainland
901	$401,100	112	73	517	232	$860	Merritt Island
1256	$337,000	93	60	525	236	$635	Mainland
1409	$293,800	82	53	464	209	$718	Merritt Island
TV-South Street Basin	$193,300	44	28	292	131	$762	Mainland
829	$175,200	33	22	358	161	$621	Mainland
6	$154,900	27	17	187	84	$1,191	Merritt Island
22	$134,800	18	12	152	69	$1,458	Mainland
439	$127,100	15	10	117	53	$1,898	Beaches
10	$207,400	48	31	319	144	$696	Mainland
413	$199,200	47	30	228	103	$975	Merritt Island
1263	$199,500	45	29	293	132	$759	Merritt Island
758	$116,900	9	6	110	49	$2,023	Mainland
835	$249,000	63	41	354	159	$785	Mainland
1078	$224,800	55	36	334	150	$666	Mainland
831	$162,200	29	19	234	105	$950	Merritt Island
TV-Royal Palm Basin	$195,500	44	28	283	127	$786	Mainland
499	$169,800	35	22	172	78	$1,289	Mainland
1381	$216,500	53	34	324	146	$686	Mainland
1342	$231,700	59	38	349	157	$637	Beaches
1298	$374,200	110	72	508	229	$765	Mainland
112	$165,700	34	22	239	107	$931	Merritt Island
RL-3A	$179,800	38	25	252	113	$881	Mainland
89	$245,100	64	42	333	150	$835	Mainland
Total	***$23,584,400***	***5608***	***3643***	***35895***	***16150***	***$1,460***	-

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Table E-5: Summary of Potential TN Reductions for Stormwater Project Basins in Central IRL

Basin	Estimated Cost	Five-Month Baseflow TN Load (lbs/yr)	Five-Month TN Reductions (55% Efficiency) (lbs/yr)	Annual TN Loads (lbs/yr)	Annual TN Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TN Removed	Area
2159	$407,500	749	412	6,120	2,754	$148	Mainland
2185	$196,200	183	101	2,685	1,208	$162	Mainland
2163	$205,500	189	104	2,808	1,264	$163	Mainland
1736	$710,600	1,552	854	9,473	4,263	$167	Mainland
1604	$486,400	1,041	573	6,481	2,916	$167	Mainland
2239	$276,900	492	271	3,651	1,643	$169	Mainland
1762	$716,700	1,668	917	9,445	4,250	$169	Mainland
2222	$258,700	432	238	3,408	1,534	$169	Mainland
2191	$326,500	528	290	4,277	1,925	$170	Mainland
1511	$410,300	865	476	5,354	2,409	$170	Mainland
Total	***$3,995,300***	***7,699***	***4,236***	***53,702***	***24,166***	***$165***	-

Table E-6: Summary of Potential TP Reductions for Stormwater Project Basins in Central IRL

Basin	Estimated Cost	Five-Month Baseflow TP Load (lbs/yr)	Five-Month TP Reductions (65% Efficiency) (lbs/yr)	Annual TP Loads (lbs/yr)	Annual TP Reductions (45% Efficiency) (lbs/yr)	Annual Cost per Pound of TP Removed	Area
2159	$407,500	103	67	778	350	$500	Mainland
2185	$196,200	25	16	209	94	$1,064	Mainland
2163	$205,500	26	17	199	89	$1,118	Mainland
1736	$710,600	214	139	1,226	551	$499	Mainland
1604	$486,400	143	93	945	425	$529	Mainland
2239	$276,900	68	44	580	261	$479	Mainland
1762	$716,700	230	149	1,381	621	$443	Mainland
2222	$258,700	59	39	503	226	$552	Mainland
2191	$326,500	73	47	410	185	$813	Mainland
1511	$410,300	119	77	841	378	$462	Mainland
Total	***$3,995,300***	***1,060***	***688***	***7,072***	***3,180***	***$1,256***	-

Appendix F: Seagrasses

Loss of Seagrass

In partnership, the St. Johns River Water Management District, South Florida Water Management District, and Florida Department of Environmental Protection mapped seagrass from aerial imagery taken in 1943 and every two to three years since 1986 (**Figure F-1**). Through 2009, the areal footprint of seagrass generally expanded, with some areas nearing their targets, which are benchmarks used to evaluate the success of reducing loads of nutrients to the IRL system. Unfortunately, the areal extent of seagrass in the lagoon began to decline in 2011. In 2011, mapping documented a loss of almost 43% of the acreage present in 2009. Most of this loss occurred in the reaches adjacent to Brevard County, with extensive losses in Banana River Lagoon (24,000 to 3,000 acres or an 88% reduction) and the IRL down to Sebastian Inlet (50,000 to 20,000 acres or a 60% reduction). The losses occurred during a bloom of phytoplankton (single-celled algae) that reached unprecedented concentrations for a record duration as indicated by concentrations of chlorophyll-*a* (**Figure F-2**). Beyond the shallowest water, the bloom effectively reduced the amount of light reaching seagrasses below what they required for survival. Additional intense blooms exacerbated the situation.

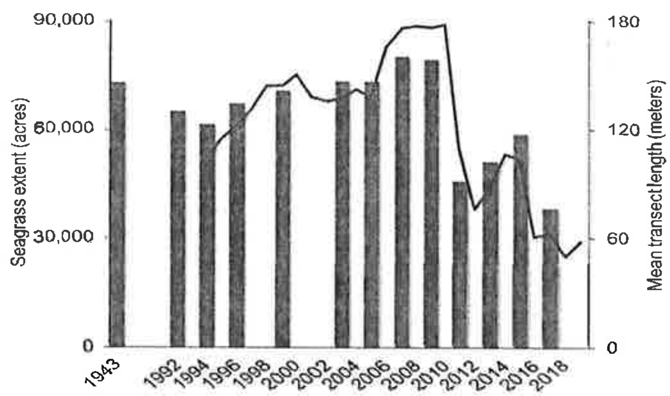


Figure F-1: Mean Areal Extent of Seagrass and Mean Length of Transects

Figure F-1 Long Description

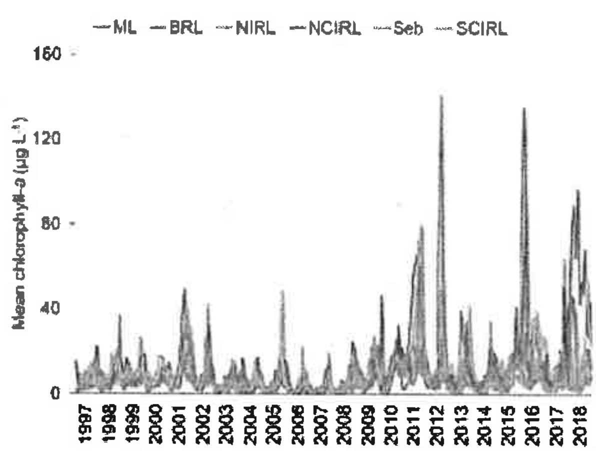
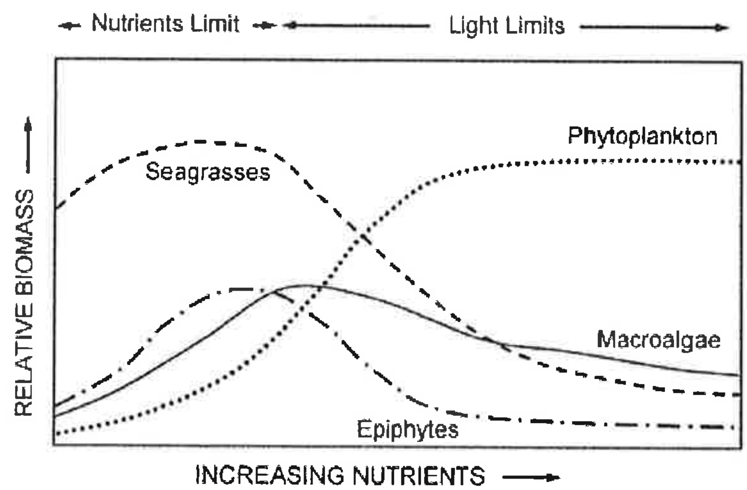


Figure F-2: Mean Chlorophyll-*a* Concentrations

Figure F-2 Long Description

Since 2011, some seagrass acreage has returned. In the IRL along Brevard County, about 9,000 acres have returned or about 30% of the 30,000 acres that were lost. In addition, there has been a similar amount of recovery in Banana River Lagoon (6,000 acres returned out of 21,000 lost or about 30% recovery). Recovery has been hampered by further blooms that include a brown tide (*Aureoumbra lagunensis*) bloom in 2016, whose effects will be apparent in maps produced from digital photography acquired in 2017. The prognosis is not good because the percentage cover of seagrass reached 5%, which is a record drop from 30–50% (**Figure F-1**).

Unfortunately, the IRL appears to be following a pattern described for systems that receive increased loads of nutrients (Duarte 1995; Burkholder et al. 2007). The pattern involves a shift in the composition of the primary producer assemblage, with higher nutrient loads differentially promoting faster growing macroalgae and ultimately phytoplankton (**Figure F-3**). The macroalgae and phytoplankton can exacerbate loss of seagrasses, especially by shading them. Loss of seagrass and macroalgae makes more nutrients available to phytoplankton through decreased competition (Schmidt et al. 2012), and loss of seagrass means that the sediments can be resuspended, which also reduces light penetration. Overall, the change in the system becomes self-perpetuating. Reducing nutrient loads represents a critical first step in efforts to reverse the shift in primary producers. However, a return to the previous areal coverage of seagrass may take some time, especially if too few recruits are available and sediments are too destabilized for colonization.



Note: Adapted from Burkholder et al. 2007

Figure F-3: Conceptual Model Illustrating a Shift in Biomass Among Major Primary Producers with Increasing Nutrient Enrichment

Nutrient Content of Seagrass

Halodule wrightii stores nutrients in its aboveground and belowground biological material or biomass. The biomass of this and other seagrasses changes seasonally, with peak growth of aboveground shoots occurring in April and May and the greatest aboveground biomass recorded during summer. These seasonal changes introduce uncertainty into estimates of nutrient storage, but mean values will suffice for estimating return on investment in the long-term (**Table F-1**). For example, a single shoot of *Halodule wrightii* may contain up to five or more leaves in the summer, whereas in the winter this same shoot may contain only one leaf (Dunton 1996). For this estimate of nutrient content, we will assume that spring-summer growth and fall-winter senescence are equal. Thus, we will focus on our recent estimates of an average amount of aboveground and belowground biomass or standing stock of *Halodule wrightii* (**Table F-1** and **Table F-2**).

Table F-1: Estimates of Biomass for *Halodule* Species

Location	Total Biomass (grams dry weight per square meter)	Reference
Texas (Laguna Madre)	10–400	Zieman and Zieman 1989
North Carolina (multiple locations)	22–208	Zieman and Zieman 1989
South Florida and Tampa Bay	10–300	Zieman and Zieman 1989
IRL (Fort Pierce Inlet)	124–198	Hefferman and Gibson 1983
IRL (Grand Harbor/Vero)	45	Hefferman and Gibson 1983
IRL (Link Port)	20–140	Virnstein unpublished
IRL (Brevard County)	53*	Morris, Chamberlain, and Jacoby unpublished
Texas (Laguna Madre)	10–400	Zieman and Zieman 1989

* Mean aboveground biomass = 23 grams dry weight $meters^{-2}$ = [(mean percent cover × 30.533) × 0.019]; mean belowground biomass = 30 grams dry weight $meters^{-2}$ = 1.3 × aboveground biomass

Table F-2: Total Biomass in Seagrasses Along Brevard County

Sub-lagoon	Description	Total Biomass (grams dry weight per square meter)
Mosquito Lagoon	Brevard County line to southern end of sub-lagoon	74
Banana River Lagoon	National Aeronautics and Space Administration restricted area	64
Banana River Lagoon	Remainder of Banana River Lagoon	44
IRL	North of State Road 405	51
IRL	State Road 405 to Pineda Causeway	35
IRL	Pineda Causeway to Hog Point	28
IRL	Hog Point to Brevard County line	51
Mean	***Not applicable***	***50***

Duarte (1990) compared nutrient contents of 27 species of seagrass, including *Halodule wrightii*. He determined that nitrogen and phosphorus represent about 2.2% and 0.2% of the dry weight of aboveground and belowground tissue of *Halodule wrightii*, respectively. These values are similar to those calculated during a recent study in the IRL (**Table F-3**). The values can be combined with estimates of biomass to calculate how much nitrogen and phosphorus are sequestered by 100 acres of *Halodule wrightii* on average (**Table F-4**).

Table F-3: Estimates of Nutrient Content for *Halodule wrightii* (percentage of dry weight)

Location	Carbon Above Ground	Nitrogen Above Ground	Phosphorus Above Ground	Carbon Below Ground	Nitrogen Below Ground	Phosphorus Below Ground
BRL-1	29.60	2.02	0.17	30.60	1.24	0.14
BRL-2	30.60	2.36	0.24	29.08	1.47	0.27
BRL-3	29.60	2.66	0.26	28.09	1.48	0.25
IRL-1	31.74	2.39	0.18	31.69	1.42	0.15
IRL-2	30.08	2.56	0.26	30.48	1.74	0.27
IRL-3	28.26	2.08	0.25	23.86	1.36	0.20
Mean	***29.98***	***2.35***	***0.23***	***28.97***	***1.45***	***0.21***

BRL = Banana River Lagoon, IRL = Indian River Lagoon

Table F-4: Average Amount of Nutrients Contained in Seagrass from 1996–2009

Sub-lagoon	Acres	Seagrass (pounds per 100 acres)	Nitrogen (pounds per 100 acres)	Phosphorus (pounds per 100 acres)
Southern Mosquito Lagoon	14,000	45,000	1,000	100
Banana River Lagoon	21,000	45,000	1,000	100
North IRL	19,000	37,000	900	90
Central IRL	7,000	36,000	900	90

Draft Evaluation Criteria for Planting Seagrass

Part of the wisdom accumulated from past seagrass restoration projects is the importance of selecting sites that will support seagrass growth. Key information has been synthesized into an initial guide, with higher scores and more certainty indicating better sites for planting seagrass (**Table F-5**). Please note that the presence of seagrass leads to a lower score based on the premise that natural recruitment represents the most cost-effective option for restoring seagrass. In addition, a high level of uncertainty can suggest targets for further study. This guide can be refined following pilot studies to determine optimal methods for planting seagrass (e.g., type of planting units, use of chemicals to enhance growth, and density of initial planting) and protecting it from disturbance (e.g., grazing, waves, exposure, and low salinity) until it is established.

References

Burkholder, J.M., D.A. Tomasko, and B.W. Touchette. 2007. Seagrasses and eutrophication. Journal of Experimental Marine Biology and Ecology 350: 46–72.

Duarte, C.M. 1990. Seagrass nutrient content. Marine Ecology Progress Series 6: 201–207.

Duarte, C.M. 1995. Submerged aquatic vegetation in relation to different nutrient regimes. Ophelia 41: 87–112.

Dunton, K.H. 1990. Production ecology of Ruppia maritima and Halodule wrightii Aschers in two subtropical estuaries. Journal of Experimental Marine Biology and Ecology 143: 147–164.

Hefferman J.J., and R.A. Gibson. 1983. A comparison of primary production rates in Indian River, Florida seagrass systems. Florida Scientist 46: 295–306.

Schmidt, A.L, Wysmyk, J.K.C., Craig, S.E., Lotze, H.K. 2012. Regional-scale effects of eutrophication on ecosystem structure and services of seagrass beds. Limnology and Oceanography 57(5): 1389-1402.

Zieman, J.C., and R.T. Zieman. 1989. The ecology of seagrass meadows of the west coast of Florida: a community profile. U.S. Fish and Wildlife Service, Biological Report 85(7.25), September 1989.

Table F-5: Guide for Ranking Potential Seagrass Restoration Sites

Category	Metric	Timeframe	Attributes for Score = 0	Attributes for Score = 2	Attributes for Score = 4	Attributes for Score = 6	Score	Uncertainty (1 = low, 3 = high)
Critical Depth Zone 0.5-0.8 meters below mean sea level	**Width of Critical Depth Zone** (distance perpendicular to shore)	Recent	**Very narrow:** < 25 meters wide (< 82 feet)	**Narrow:** 25-50 meters (82-164 feet)	**Moderately wide:** 50-100 meters (164-328 feet)	**Broad:** > 100 meters (> 328 feet)		
Critical Depth Zone 0.5-0.8 meters below mean sea level	**Distance to seagrass** (identified via the most recent map or targeted reconnaissance)	Recent	**Continuous seagrass at site and within 1 kilometer (land use code = 9116):** seagrass is a dominant feature (restoration not needed)	**Isolated:** no seagrass within 1 kilometers (0.6 miles) so conditions may be unfavorable	**Discontinuous seagrass at site and within 1 kilometers (land use code = 9113):** seagrass is patchy, so restoration may connect patches	**Seagrass nearby:** seagrass within 0.5-1.0 kilometers (0.3-0.6 miles)		
Critical Depth Zone 0.5-0.8 meters below mean sea level	**Percent cover in Critical Depth** Zone (derived from the closest transect, paired considerations)	Past (2000-2009)	**High:** > 30%	**Low:** 10-20%	**Moderate:** 20-30%	**High:** > 30%		
Critical Depth Zone 0.5-0.8 meters below mean sea level	**Percent cover in Critical Depth** Zone (derived from the closest transect, paired considerations)	Last 3 Years	**High:** > 10% (restoration not needed)	**Low:** < 10% (restoration may not help)	**Low:** < 10% (restoration may help but ultimate gain is likely limited)	**Low:** < 10% (potentially optimum site for restoration)		
Potential stressors	**Water quality** (salinity and light availability derived from the closest station)	Last 3 Years	**Bad:** salinity < 10 anytime and < 18 for ³ 3 consecutive months or annual mean salinity - 1 standard deviation < 17 Secchi depth £ 0.50 meters (1.6 feet) anytime and £ 0.65 meters (2.1 feet) for ³ 3 consecutive months or annual mean Secchi depth - 1 standard deviation £ 0.65 meters	**Poor:** salinity < 18 for 3 consecutive months but never < 12 or annual mean salinity - 1 standard deviation³ 17 Secchi depth £ 0.65 meters for < 3 consecutive months but never £ 0.50 meters or annual mean Secchi depth - 1 standard deviation ³ 0.65 meters	**Supportive:** salinity always ³ 18 Secchi depth always > 0.65 meters and may be 0.65-1.0 meters (2.1-3.3 feet) for 3 consecutive months	**Good:** salinity consistently ³ 23 Secchi depth consistently > 1.0 meters		
Potential stressors	**Sediment** (assessed via visits to the site or other current information)	Present	**Not supportive:** anoxic and sulfidic near the surface or easily resuspended or moved	**Minimally supportive:** hard bottom (e.g., compact sand or shells), not conducive for growth of rhizomes and roots, porewater may lack nutrients	**Generally supportive:** unconsolidated sediment that holds plants with relatively little resuspension and movement observed, porewater nutrients not limiting	**Fully supportive:** loosely consolidated sediment with firmly anchored plants if present, anoxic and sulfidic layers located below the zone occupied by roots and rhizomes, porewater rich in nutrients		
Potential stressors	**Water movement** (assessed via visits to the site or other current information)	Present	**High currents - possible scouring:** frequent and strong currents or waves that may cause ripples in the sediment and uproot new plants	**Moderate to high currents:** currents and waves bend plants, sweep fragments of seagrass away before they can gain a foothold, and cause some resuspension of sediment	**Moderate currents:** plants often stand upright, fragments of seagrass may be trapped, sediment typically not resuspended	**Low currents:** mild currents or waves, sediment not disturbed, no apparent negative effects on any seagrass that is present		
Potential stressors	**Shoreline characteristics** (assessed via visits the site or other current information)	Present	**Unnatural shoreline:** Critical Depth Zone in close proximity to urban development, including canals, and a hardened shoreline (e.g., riprap or bulkhead)	**Semi-natural shoreline:** Critical Depth Zone near moderate development and some shoreline is vegetated	**Mostly natural shoreline:** Critical Depth Zone near low to moderate development, most of the shoreline is vegetated shoreline or the site is associated with living shoreline project	**All natural shoreline:** vegetated shoreline with very limited development		
Potential stressors	**Public use** (assessed via visits to the site visits or other current information, including recent aerial photographs)	Present	**High use:** Critical Depth Zone adjacent to or within an area with frequent boating, swimming or fishing (e.g., aerial photographs show prop scars)	**Near high use:** Critical Depth Zone within 0.5 kilometers (0.3 miles) of a highly used area	**Not near high use:** Critical Depth Zone more than 0.5 kilometers from a highly used area	**Low use:** no public facilities nearby and limited signs of use		
Potential stressors	**Biota** (assessed via visits to the site or other current information on grazing or physical disturbance)	Present	**Heavy use:** site adjacent to deep water or manatee zone, power plant within 10 kilometers (6.2 miles), freshwater nearby, manatees and rays observed frequently, disturbance or grazing evident in > 50% of the area on a weekly-monthly basis	**Moderate use:** power plant > 10 kilometers away, deep water and manatee zones > 0.5 kilometers away, no freshwater nearby, disturbance or grazing evident in < 50% of the area on a monthly basis	**Intermittent use:** disturbance or grazing evident in < 25% of the area on a quarterly basis	**Rare use:** disturbance or grazing hardly evident		
Logistics	**Enhancement or protection** (assessed via visits to the site)	Present	**Extensive need:** dense planting required due to absence of seagrass, fencing or caging required due to grazing, other enhancement or protection required, including living shorelines, sediment barriers, wave baffles	**Substantial need:** moderately dense planting required because only 1-2% cover present, fencing or caging required, few additional enhancements or protections required	**Moderate need:** low density planting sufficient because at least 2% cover present, fencing or caging required for a limited time, other enhancements or protections beneficial but not critical	**Limited need:** minimal density planting or no planting required because > 2% cover present and protection from grazing may result in spread of seagrass, no other enhancements or protections required		
Logistics	**Maintenance** (assessed via visits to the site)	Anticipated	**High maintenance:** weekly cleaning	**Moderate maintenance:** monthly cleaning	**Low maintenance:** quarterly cleaning	**Minimum maintenance:** maintain as needed		
Logistics	**Staging and accessibility** (assessed via visits to the site)	Present	**Very difficult:** substantial impediments that may include boat ramps > 10 kilometer away, soft sediment that is easily disturbed, permitting and access issues	**Moderately difficult:** boat ramp within 10 kilometers, somewhat firm sediment, tractable permitting and access issues	**Relatively simple:** boat ramp nearby and few other issues	**No issues**		
Logistics	**Monitoring** (relevant past, current and future information on water quality and seagrasses available)	Present	**No external support:** no sampling of seagrass within 5 kilometers (3.1 miles), nearest water quality station not representative of conditions at the site	**Minimal external support:** seagrass surveyed within 3-5 kilometers (1.9-3.1 miles), water quality station is representative of conditions at the site	**Moderate external support:** seagrass and water quality sampled within 3 kilometers, so both are representative of conditions at the site	**Considerable external support:** seagrasses and water quality sampled at or adjacent to the site		
Total								

Notes:
Optimize potential for success by planting: a) within the Critical Depth Zone (e.g., at 0.6-0.8 meters below mean sea level) with due recognition of tides and annual changes in water levels; or b) during the spring (e.g., late March to May) when water clarity is best, water temperatures are warming, and grazing by fish is relatively low
Scoring: If conditions do not match the attributes provided, then assign a score between the two that are most applicable

Section 10. Appendix G: Long Descriptions of Tables

Figure 1 1: Decline of Commercial Fishing and Increasing Fish Kill Severity

The graph compares the value of commercial fishery to the fish kill counts in Brevard County for FWC reporting years of 1995 to June 2016. The commercial fishery values drop over time while fish kill counts increase with the largest peaks in 2007 and 2016. The following table is an estimate of the values represented in the graph and are not the exact values.

FWC Reporting Year	Value of Commercial Fishery	Fish Kill Count
1995	$22,000,000	2,000
1996	$24,500,000	12,000
1997	$15,000,000	4,000
1998	$11,000,000	44,000
1999	$15,000,000	6,000
2000	$15,500,000	4,000
2001	$13,000,000	55,000
2002	$6,000,000	40,000
2003	$7,000,000	15,000
2004	$8,000,000	35,000
2005	$6,000,000	35,000
2006	$6,000,000	7,500
2007	$5,000,000	209,000
2008	$8,000,000	16,000
2009	$6,000,000	28,500
2010	$6,500,000	43,000
2011	$8,500,000	61,500
2012	$8,000,000	12,000
2013	$7,500,000	84,000
2014	$6,500,000	49,000
2015	$7,000,000	37,000
2016 January-June	$2,000,000	127,000

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Figure 4-1: Map of Locations for Septic System Removal Projects in Northern Banana River Lagoon

Map showing the locations of the 11 highest priority and high priority sewer locations within the northern portion of the Banana River Lagoon. These include North Merritt – Zone B, North Merritt Zone A, North Merritt Zone D, Sykes Creek Zone C, North Merritt Zone E, North Merritt Zone F, Sykes Creek Zone IJ, Sykes Creek Zone N, Merritt Island Zone C, Merritt Island Zone F, and Skyes Creek Zone M. The 4 areas with the highest loading, which include Sykes Creek Zone N, Merritt Island Zone C, Merritt Island Zone F, and Skyes Creek Zone M, are funded for septic removal. The map also shows the locations of all individual septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. Most of them are concentrated along the water in the west and south east portions of Merritt Island with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. There are some of those scattered across the north center portion of Merritt Island as well. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-2: Map of Locations for Septic System Removal Projects in Central Banana River Lagoon

Map showing the locations of the 9 highest priority and high priority sewer locations within the southern portion of the Banana River Lagoon. These locations include MIRA Phase 1 MIRA Phase 2 Cone Road, Sykes Creek Zone R, Sykes Creek Zone S, Sykes Creek Zone G, Sykes Creek Zone T, South Banana Zone B, South Banana Zone A, and Merritt Island Zone H. The 7 areas with the highest loading, which include 1 MIRA Phase 2 Cone Road, Sykes Creek Zone R, Sykes Creek Zone S, Sykes Creek Zone G, Sykes Creek Zone T, and South Banana Zone B, are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water including the center of Merritt Island are 0-10 pounds. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-3: Map of Locations for Septic System Removal Projects in Southern Banana River Lagoon

Map showing the locations of the highest priority and high priority sewer locations within the central portion of the Banana River Lagoon. These locations include Merritt Island Zone G, Merritt Island Zone H, and Merritt Island Zone A. None of those areas are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. Most of Merritt Island is 10-30 pounds with a scattering of 30-50 pounds in the north portion. There are also a few spots of 0-10 pounds in the center north part of the island. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4 4: Map of Locations for Septic System Removal Projects in Northern North IRL

Map showing the locations of the 4 highest priority and high priority sewer locations within the northern portion of the North Indian River Lagoon. These areas include Titusville Zone A, Titusville Zone B, Titusville Zone C, and Titusville Zone H. All are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. The zones previously mentioned have loading in the 10-30 and 30- 50 range. There is a sparse scatter of 0-10 zones over the rest of the map with two dense concentrations in the northern half of the map. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-5: Map of Locations for Septic System Removal Projects in North-Central North IRL

Map showing the locations of the 7 highest priority and high priority sewer locations within the north-central portion of the North Indian River Lagoon. These areas include Titusville Zone D, Titusville Zone E, Titusville Zone F, Titusville Zone G, Sharpes Zone A, Sharpes Zone B and Cocoa Zone C. All areas are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-6: Map of Locations for Septic System Removal Projects in Central North IRL

Map showing the locations of the 5 highest priority and high priority sewer locations within the central portion of the Central North Indian River Lagoon. These areas include Cocoa Zone C, Cocoa Zone J, Cocoa Zone K, City of Rockledge, and Rockledge Zone B. All are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-7: Map of Locations for Septic System Removal Projects in South-Central North IRL

Map showing the locations of the 6 highest priority and high priority sewer locations within the south-central portion of the North Indian River Lagoon. These areas include City of Rockledge, Rockledge Zone B, Rockledge Zone C, South Central Zone A, South Central Zone B, and South Central Zone BC. The area of City of Rockledge, Rockledge Zone B, and South Central Zone A were funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. Rockledge Zone C is not along the water and has areas near the center that are 10-30 or 30-50 pounds and the areas near the East and West sides are 0-10 pounds. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-8: Map of Locations for Septic System Removal Projects in Southern North IRL

Map showing the locations of the 8 highest priority and high priority sewer locations within the southern portion of the North Indian River Lagoon. These include South Central Zone B, South Central Zone BC, South Central Zone C, South Central Zone Pineda, South Central Zone I, South Central Zone D (Brevard), South Central Zone D (Melbourne), and City of Melbourne Riverside. The areas of South Central Zone C, South Central Zone D (Brevard), South Central Zone D (Melbourne), and City of Melbourne Riverside are funded. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-9: Map of Locations for Septic System Removal Projects in South North IRL

Map showing the locations of the 8 highest priority and high priority sewer locations within the southern portion of the North Indian River Lagoon. These areas include City of Melbourne Riverside, City of Melbourne Zone A, South Central Zone E, South Central Zone G, South Central Zone F, South Beaches Zone A, South Beaches Zone P, and South Beaches Zone O. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds. There are clusters of all three types of loading away from the water in the west-central and south west part of the map. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4 10: Map of Locations for Septic System Removal Projects in Northern Central IRL

Map showing the locations of the 7 highest priority and high priority sewer locations within the northern portion of the Central Indian River Lagoon. The funded areas include City of Melbourne Roxy, City of Melbourne Pennwood, City of Melbourne Hoag. The unfunded areas include Melbourne Village Zone B, Melbourne Village Zone Z, City of West Melbourne Sylvan Estates, and City of West Melbourne Zone A. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering some of the areas near the water with the areas closest to the water being 30-50 pounds. The areas further away from the water are 0-10 pounds and 10-30 pounds mostly clustered in the center of the map just west of the Melbourne Causeway along U S 192 and approximately 4 miles west of U S 192 in West Melbourne.

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Figure 4 11: Map of Locations for Septic System Removal Projects in North-Central Central IRL

Map showing the locations of the 8 highest priority and high priority sewer locations within the southern portion of the North Indian River Lagoon. The funded areas include City of Palm Bay Zone A and B. The unfunded areas include Malabar Zones F D C A B as well as South Zone A, South Zone B, and Grant Valkaria Zone H. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering about thirty percent of the map with a few areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water are 0-10 pounds and tightly clustered in the western part of the map west of Babcock Street in the Malabar area. There are clusters of all three types of loading away from the water in the central and south central part of the map.

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Figure 4 12: Map of Locations for Septic System Removal Projects in South-Central Central IRL

Map showing the locations of the 15 highest priority and high priority sewer locations within the south central portion of the Central Indian River Lagoon. The unfunded areas on this map include South Beaches Zones C D F N L K and M. Other unfunded areas are Malabar Zones F D C A B, South Zone B, and Grant Valkaria Zones H and G. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering half of the areas near the water on the barrier island on the eastern portion of the map. There are isolated clusters of high loading areas along the waterfront on the mainland or western side of the map. There are clusters of all three types of loading away from the water in the west-central and south west part of the map.

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Figure 4-13: Map of Locations for Septic System Removal Projects in South Central IRL

Map showing the locations of the 12 highest priority and high priority sewer locations within the southern portion of the Central Indian River Lagoon. The unfunded areas include Grant Valkaria Zones G, D, F, C, B, E, A and South Beaches Zones E and G. The funded areas include Micco Zones A and B. The map also shows the locations of all septic systems with loading estimates of 0-10 pounds, 10-30 pounds, and 30-50 pounds. They are covering most of the areas near the water and along the Saint Sebastian River with the areas closest to the water being either 10-30 pounds or 30-50 pounds. The areas further away from the water in the northwestern portion of the map are 30-50 pounds. There are clusters of all three types of loading away from the water in the north western and and southern part of the map.

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Figure 4-14: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in North Brevard County

Map showing the locations of properties eligible to receive reimbursement to connect to a sewer system in the northern portion of the north Indian River Lagoon. Dots scattered along the map indicate whether the owner can connect to a force main or gravity type sewer. On this map the dots are mostly near the water. Approximately half are for force main connections and half are for gravity sewer connections. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 10-1: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in Central Brevard County

Map showing the locations of properties eligible to receive reimbursement to connect to a sewer system in the central Indian River Lagoon. Dots scattered along the map indicate whether the owner can connect to a force main or gravity type sewer. On this map the dots are mostly near the water and tightly clustered in the northern portion of the map on Merritt Island. There are a few scattered near the water in the southern portion of the map south of the Pineda Causeway. Approximately half are for force main connections and half are for gravity sewer connections. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 10-2: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in South Brevard County

Map showing the locations of properties eligible to receive reimbursement to connect to a sewer system in the southern portion of the Indian River Lagoon in Brevard County. Dots scattered along the map indicate whether the owner can connect to a force main or gravity type sewer. On this map the dots are mostly near the water and tightly clustered in the northern portion of the map near Melbourne and Eau Gallie. There are a few scattered near the water in the central portion of the map near Malabar. Approximately 20 percent are for force main connections and approximately 80 percent are for gravity sewer connections. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 10-3: Example In-Ground Nitrogen-Reducing Biofilters Septic System

This a diagram showing how an in ground nitrogen reducing biofilter is constructed. It shows a septic tank to the left with a pipe leading out of it with an arrow showing the direction of water flow to the drainfield. The drainfield area is depicted as an eighteen inch layer of soil above a twelve inch layer of woodchips or other denitrification media. There is a layer below these that shows an empty space which indicates native soil that should be at least six inches above the seasonal high water table.

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Figure 10-4: Map of Locations for Septic System Upgrades in North Brevard County

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the northern portion of Brevard County along the Indian River Lagoon. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are mostly near the water and scattered from north to south. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 10-5: Map of Locations for Septic System Upgrades in Central Brevard County

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the central portion of Brevard County along the Indian River Lagoon. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are mostly near the water and scattered from north to south on Merritt Island, along Tropical Trail and along U S one. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 10-6: Map of Locations for Septic System Upgrades in South Brevard County

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the southern portion of Brevard County along the Indian River Lagoon. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are mostly near the water and scattered from north to south on along U S one and about one to three miles inland. There is a line running north to south in the west that shows where the drainage divide is.

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Figure 4-21: Map of Selected Stormwater Projects in North Brevard County

Map showing the selected basins for stormwater treatment in the northern portion of the Banana River Lagoon and North Indian River Lagoon in Brevard County. Project areas cover roughly 60% of the shoreline on the mainland and are all part of the North Indian River Lagoon Section. Project areas cover roughly 75% of North Merritt Island and half are part of the North Indian River Lagoon Section while the other half are part of the Banana River Lagoon Section, Project areas cover roughly 85% of the Barrier Island and all are part of the Banana River Lagoon Section.

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Figure 4-22: Map of Selected Stormwater Projects in Central Brevard County

Map showing the selected basins for stormwater treatment in the southern portion of the Banana River Lagoon and North Indian River Lagoon in Brevard County. Project areas cover roughly 50% of the shoreline on the mainland and are all part of the North Indian River Lagoon Section. Project areas cover roughly 70% of South Merritt Island and half are part of the North Indian River Lagoon Section while the other half are part of the Banana River Lagoon Section, Project areas cover roughly 80% of the Barrier Island and all are part of the Banana River Lagoon Section.

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Figure 4-23: Map of Selected Stormwater Projects in South Brevard County

Map showing the selected basins for stormwater treatment in the Central Indian River Lagoon for Brevard County. There is one project area on the Barrier Island on the north end of the map that is part of the Banana River Lagoon Section. Project areas for the North Indian River Lagoon Section cover roughly 30% of the shoreline and are concentrated in the north half of the mainland with two sections also on the Barrier Island. Ten project areas are scattered inland from the shoreline in the southern half of the map.

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Figure 4-24: Location of Muck Removal Projects in Banana River Lagoon

Map of the Banana River Lagoon in Brevard County showing the location of four muck removal projects. Port Canaveral S is at the top of the map along the Barrier Island shoreline. Cocoa Beach Golf is halfway down the Banana River Lagoon along the Barrier Island shoreline. Patrick Airforce Base is near the bottom of the Banana River Lagoon along the Barrier Island shoreline. Pineda Banana River Lagoon is just west of that project near the Merritt Island Shoreline.

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Figure 4-25: Location of Muck Removal Projects in North Indian River Lagoon

Map of the North River Lagoon in Brevard County showing the location of five muck removal projects. Titusville Railroad West is at the top of the map along the mainland shoreline. Just east of that on the Merritt Island Shoreline is the Titusville Railroad East project. NASA Causeway East is one third of the way down from the top of the North Indian River Lagoon along the Merritt Island shoreline. Rockledge A is one third of the way up from bottom of the North Indian River Lagoon along the Merritt Island shoreline. Eau Gallie NE is at the bottom of the map near the Merritt Island Shoreline.

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Figure 4-26: Phase I Potential Enhanced Circulation Project Locations

Map of Brevard County showing a 40 square mile area where Potential Enhanced Circulation Projects could be located. St Johns River Water Management District identified eternal projects the following areas, one in the south part of the Mosquito Lagoon, one in the north part of the Banana River, two in Cape Canaveral, one at Patrick Airforce Base, and one at Malabar. They identified 4 internal projects with one at the north end of Merritt Island, two around Haulover Canal and one in central Merritt Island. CDM Smith identified 23 additional potential project locations both internal and external spread throughout Brevard County with a heavy concentration around central Merritt Island.

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Figure 4-27: Shoreline Survey to Identify Locations Appropriate for Oyster Bars and Planted Shorelines

Map of Brevard County showing the shoreline survey edge types including bulkhead and seawall, hardened slope and riprap, and no structures. No structures were found mainly in the north portion of the county on the mainland and also around the central part of Merritt Island near the Space Center. There were also small concentrations on the south part of Merritt Island in the Banana River Lagoon and on the southern portion of the Barrier Islands. The rest of the shoreline was interspersed with both bulkhead and seawall types and hardened slope and riprap types. A large concentration of bulkhead and seawall was found on the west shore of Merritt Island, along Sykes Creek, in Cocoa Beach, and much of the west coast of the central Barrier Island.

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Figure 4-28: Estimated Economic Value of Some Seagrass Services

Graphic showing the economic value provided by seagrass adapted from Dewsbury et. al. 2016. Seagrass provide direct grazing by turtles, manatees, fish, and snails has an unknown economic value. It is also nursery grounds for fish and crabs benefit coral reefs commercial fisheries and recreation for a $4,600 per acre per year economic value. Additionally, it sequesters carbon which reduces carbon dioxide for a $162 per acre per year economic value. It also reduces wave energy which leads to sediment stability and improved water quality for an unknown economic benefit. Finally, it cycles and sequesters nutrients for an economic value of $7,695 per acre per year. Seagrass provides a total economic benefit of $12,457 per acre per year. In 2007 there were 72,400 acres providing a total benefit of more than $902,000,000.

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Figure 4-30: Completed Projects in North Brevard County

Map of North Brevard County showing locations of eight completed projects. Mims Muck Removal and Coleman Pond Maps were in the north part of the North Brevard on the mainland. Church Street Baffle Box and Breeze Swept Septic to sewer were in the south part of North Brevard on the mainland. MIRA Septic Removal Phase 1 was in the south part of the map on Merritt Island. Central Brevard Baffle Box Bettinger Oyster Reef and Cocoa Beach Country Club were in the south part of the map on the Barrier Island. There is a line running north to south just in from the coast of the mainland indicating the drainage divide.

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Figure 4-31: Completed Projects in South Brevard County

Map of south Brevard County showing locations of nine completed projects. Gitlin Oyster Bar, Marina Isles Oyster Bar, and Gleason Park Upgrade were located in the north part of North Brevard on the Barrier Island. Bomalaski Oyster Reef was located in the north part of South Brevard on Merritt Island. Lagoon House Living Shoreline, Bayfront Stormwater Project, Turkey Creek Muck Removal, and Review Senor Resort Oyster Reef are located in the center of South Brevard on the mainland. Long Point Package Plant Upgrade was located in the south part of South Brevard on the Barrier Island. There is a line running north to south just in from the coast of the mainland indicating the drainage divide.

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Figure 9-2. Summary of the Save Our Indian River Lagoon Outputs and Outcomes

Graphic showing output of Public Education will result in years 0-5 Early Adopters Lead, Years 6-10 Supporters Join, and Years 10+ Lagoon Friendly Lifestyles are normal. Output of Reclaimed Water Upgrades, Sewer Later Rehabilitation, Septic System Removal and Upgrades, Stormwater Treatment will result in years 0-5 cleaner ground and surface water, years 6-10 cleaner lagoon water, and years 10+ lush seagrass beds. Outputs of Muck Removal and Treatment of Muck Interstitial Water will result in years 0-5 exposed sandy sediments and tons of pollution removed, years 5-10 plentiful bottom dwelling marine life, and years 10+ abundant fishes. Output of Oyster Reefs and Living Shorelines will result in years 0-5 increased filtration, years 5-10 faster storm recovery, years 10+ healthy stability. Outputs of Project Performance Monitoring and Plan Updates will result in years 0-5 increased efficiency and cost effectiveness, years 5-10 lagoon report card shows improvement, and years 10+ IRL economy grows.

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Figure D-1: Map of South Beaches Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the South Beaches portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There is a funded project on the southeastern portion of the map and an unfunded project area to the east and father inland.

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Figure D-2: Map of South Central Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the south central portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There is a funded project along the water in the northern portion of the map. There is a funded project in the center of the map and another at the southern end of the map.

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Figure D-3: Map of Sykes Creek Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Sykes Creek portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There are many unfunded project areas running down the western shoreline of Merritt Island in the center of the map. There are seven funded project areas on the eastern shore of Merritt Island and one on the northern end of the map on the western shore of Merritt Island. There is a line running north to south that shows where the drainage divide is.

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Figure D-4: Map of City of Melbourne Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Melbourne portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There is a funded project area in the northern portion of the map along the water north of the Eau Gallie Causeway. There is a line running north to south that shows where the drainage divide is.

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Figure D-5: Map of City of Rockledge Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Rockledge portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There is a funded project on the eastern portion of the map along the water in Rockledge. There is a line running north to south that shows where the drainage divide is.

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Figure D-6: Map of City of Cocoa Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Coty of Cocoa portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There are two funded projects on the eastern portion of the map and eight unfunded project areas to the west and father inland. There is a line running north to south near the water that shows where the drainage divide is.

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Figure D-7: Map of City of Titusville Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Titusville portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There are seven funded projects running down the center of the map from north to south and twenty-one unfunded project areas interspersed among these. There is a line running north to south that shows where the drainage divide is.

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Figure D-8: Map of City of Palm Bay Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the City of Palm Bay portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There are many hundreds of septic tanks mapped in the center of this map but most are a good distance west of the Indian River Lagoon. There are two funded projects on the central portion of the map. There is a line running north to south that shows where the drainage divide is.

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Figure D-9: Map of City of Palm Bay Septic System Areas Near Sewer Lines

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the Palm Bay portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions and also any parcels that can hook up to a nearby sewer line. There are two funded projects on the eastern portion of the map and a cluster of properties that can connect to a sewer line in the center of the map. There is a line running north to south that shows where the drainage divide is.

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Figure D-10: Map of City of West Melbourne Priority Septic System Areas

This map shows the septic systems in Brevard County and their ranking based on distance from a surface water body in the City of West Melbourne portion of the Indian River Lagoon. This map also shows the locations of the most cost-effective focus areas for septic to sewer conversions. There are many hundreds of septic tanks mapped in the center of this map but most are a good distance west of the Indian River Lagoon. There is one funded project on the north central portion of the map. There is a line running north to south that shows where the drainage divide is.

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Figure D-13: Map of Locations for Septic System Upgrades in North IRL

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the northern portion of Brevard County along the Indian River Lagoon. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are mostly near the water. They are scattered to the north of Titusville and clustered tightly along U S 1 in the Canaveral Groves area.

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Figure D-14: Map of Locations for Septic System Upgrades in Banana River Lagoon and North IRL

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the Banana River and North IRL portions of Brevard County. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are mostly near the water in the Merritt Island area and in Rockledge along U S 1. There are some scattered in the southern portion of the map in West Melbourne.

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Figure D-15: Map of Locations for Septic System Upgrades in Central IRL

Map showing the locations of properties eligible to receive reimbursement to install an upgraded septic system in the Central IRL portion of Brevard County. Dots scattered along the map indicate whether the owner is eligible to receive reimbursement. On this map the dots are scattered in the northwestern portion of the map and located a few miles inland. In the south eastern portion of the map the dots are located along the water on the barrier island and in the towns of Grant and Micco.

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Figure F-1: Mean Areal Extent of Seagrass and Mean Length of Transects

A line and bar graph comparing seagrass extent in acres versus the mean transect length in meters. The date range is 1943 and then every other year from 1992 to 2018. In 1942 the seagrass extent was about 75000 acres. In 1992 the extent was about 65000 acres. The acreage gradually climbed to a peak of around 80000 and 79000 in 2008 and 2010 respectively. The acreage then drastically dropped in 2012 to about 42000. It slowly increased to about 58000 in 2016 and then dropped to about 34000 acres in 2018. The mean transect length followed a similar trend in years starting at about 100 meters in 194 with a peak around 180 meters in 2016 and 2018. It dropped to around 70 meters in 2012 and increased to 100 in 2016. It then dropped to about 60 in 2018. The follow table is an estimate of the numbers shown in the graph and does not represent the actual data.

Year	Seagrass extent (acres)	Mean transect length (meters)
1943	75000	no data
1992	65000	no data
1994	60000	100
1996	67000	120
2000	70000	140
2004	75000	130
2006	75000	130
2008	80000	180
2010	79000	180
2012	42000	70
2014	52000	80
2016	58000	100
2018	34000	60

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Figure F-2: Mean Chlorophyll-a Concentrations

Line Graph of mean chrolorphyll a in micrograms per liter showing lines for the Mosquito Lagoon (ML), Banana River Lagoon (BRL), North Indian River Lagoon (NIRL), North Central Indian River Lagoon (NCIRL), Sebastian (Seb), and South Central Indian River Lagoon (SCIRL). The time span is yearly from 1007 to 2018. The values for each area overlap greatly making it difficult to discern individual values, only a range of values. There are some years where one area has a discernable peak. 1997 had values ranging from 0 to 10 with no discernable peak. 1998 ranged from 0 to 20 with the highest being NCIRL. 1999 ranged mainly from 0-15 with one peak in Seb around 40. 2000 ranged from 0 to 30 with the highest in SCIRL. 2001 ranged from 0-55 with the highest in NCIRL. 2002 ranged from 0 to 50 with the highest in NIRL. 2003 and 2004 ranged from 0 to 25 with no discernable peak areas. 2005 ranged from 0 to 50 with the highest in NIRL. 2006 ranged from 0 to 20 with the highest in NIRL. 2007 ranged from 0 to 20 with the highest in Seb. 2008 ranged from 0 to 25 with the highest in NCIRL. 2009 ranged from 0 to 30 with no discernable peak. 2010 ranged from 0 to 50 with the highest in NCIRL. 2011 ranged from 0 to 80 with the highest in NIRL. 2012 ranged from 0 to 140 with the highest in ML. 2013 ranged from 0 to 45 with the highest in NIRL and ML. 2014 ranged from 0 to 40 with the highest in NIRL 2015 ranged from 0 to 30 with no discernable peak. 2016 ranged from 0 to 130 with the highest in BRL. 2017 ranged from 0 to 40 with no discernable peak. 2018 ranged from 0 to 100 with the highest in BRL.

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Project Order	Project Number	ProjectName	Jurisdiction	ProjectType	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cummulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approval Amount	Difference from Previous Approved Amount	Recommendation
27	135	Rotary Park	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	20	$250	$5,000	$4,800	$240	$5,049,096	$ -	$200		7	$714				
~~28~~	~~137~~	~~Port St John Lateral Smoke Testing~~	~~Brevard County Utility Services Department~~	~~Sewer Lateral Rehab~~	~~North Indian River Lagoon~~	~~194~~	~~$284~~	~~$55,000~~	~~$55,000~~	~~$284~~	~~$5,104,096~~	~~$ -~~			—	$0				
29	138	Ray Bullard WRF Biological Nutrient Removal Upgrades	City of West Melbourne	WWTF Upgrades for Reclaimed Water	Central Indian River Lagoon	11,360	$572	$6,500,000	$4,260,000	$375	$9,364,096	$ -	$2,240,000		3,302	$1,514				
30	139	Brevard Zoo North IRL Oyster Project 2	Brevard Zoo	Oyster Reef	North Indian River Lagoon	841	$400	$336,400	$336,400	$400	$9,700,496	$ -			21	$16,019				
31	140	Brevard Zoo Central IRL Oyster Project 2	Brevard Zoo	Oyster Reef	Central Indian River Lagoon	677	$400	$270,800	$270,800	$400	$9,971,296	$ -			17	$15,929				
32	141	Brevard Zoo Banana River Oyster Project 2	Brevard Zoo	Oyster Reef	Banana River Lagoon	662	$400	$264,800	$264,800	$400	$10,236,096	$ -			17	$15,576				
33	142	Brevard Zoo Oyster Reef Adjustments North IRL	Brevard Zoo	Oyster Reef	North Indian River Lagoon	68	$400	$27,200	$27,200	$400	$10,263,296	$ -			2	$13,600				
34	143	Brevard Zoo Oyster Reef Adjustments Banana River	Brevard Zoo	Oyster Reef	Banana River Lagoon	32	$400	$12,800	$12,800	$400	$10,276,096	$ -			1	$12,800				
35	144	Satellite Beach Muck Dredging	City of Satellite Beach	MuckRemoval	Banana River Lagoon	3,885	$1,087	$4,222,500	$1,884,225	$485	$12,160,321	$ -	$2,338,275		518	$8,152				
36	145	Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,292	$851	$1,100,000	$1,100,000	$851	$13,260,321	$ -			-	$0				
37	50b	South Central C	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,146	$952	$4,900,000	$4,900,000	$952	$18,160,321	$ -			-	$0	Y	$ 4,672,080	$227,920	
38	136	Micco B	Brevard County Utility Services Department	Septic System Removal Extend	Central Indian River Lagoon	8,687	$1,036	$9,000,000	$9,000,000	$1,036	$27,160,321	$ -			-	$0				
39	146	Merritt Island C	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,419	$1,113	$1,580,000	$1,580,000	$1,113	$28,740,321	$ -			-	$0	Y	$ 2,836,620	-$1,256,620	
40	3b	Micco Sewer Line Extension - Phase II	Brevard County	Septic System Removal Extend	Central Indian River Lagoon	618	$1,148	$709,745	$709,745	$1,148	$29,450,066	$ -			-	$0				
41	147	Sykes Creek R	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,925	$1,197	$3,500,000	$3,500,000	$1,197	$32,950,066	$ -			-	$0				
42	150	South Central D	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	3,387	$1,410	$4,774,500	$4,774,500	$1,410	$37,724,566	$ -			-	$0	Y	$ 2,703,132	$2,071,368	
43	148	North Merritt Island E	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	2,541	$1,431	$3,635,000	$3,635,000	$1,431	$41,359,566	$ -			-	$0				
44	151	Merritt Island G	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	11,078	$1,625	$18,000,000	$16,617,000	$1,500	$57,976,566	$ -	$1,383,000		-	$0				
45	152	Sharpes B	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	2,692	$1,634	$4,400,000	$4,038,000	$1,500	$62,014,566	$ -	$362,000		-	$0				
46	153	Cocoa C	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	3,499	$1,715	$6,000,000	$5,248,500	$1,500	$67,263,066	$ -	$751,500		-	$0				
47	154	Sykes Creek U	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	1,028	$1,848	$1,900,000	$1,542,000	$1,500	$68,805,066	$ -	$358,000		-	$0				
48	155	North Merritt Island F	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	830	$1,867	$1,550,000	$1,245,000	$1,500	$70,050,066	$ -	$305,000		-	$0				
49	156	North Merritt Island D	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	685	$1,888	$1,293,000	$1,027,500	$1,500	$71,077,566	$ -	$265,500		-	$0				
50	157	South Central AB	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	7,308	$1,906	$13,932,000	$10,962,000	$1,500	$82,039,566	$ -	$2,970,000		-	$0	Y	$ 3,370,572	$7,591,428	
51	158	Pineda	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	644	$1,952	$1,257,000	$966,000	$1,500	$83,005,566	$ -	$291,000		-	$0				
52	159	South Central BC	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	582	$2,100	$1,222,000	$873,000	$1,500	$83,878,566	$ -	$349,000		-	$0				

* Accept and modify by adding following next in line projects where the $/lb TN levels have already been reviewed by the COC - funding out of unallocated portion of SOIRL funds

Project Order	Project Number	ProjectName	Jurisdiction	ProjectType	Sub Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cummulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approval Amount	Difference from Previous Approved Amount	Recommendation
1	2b	Osprey Nutrient Removal Upgrade Phase 2	City of Titusville	WWTF Upgrades for Reclaimed Water	North Indian River Lagoon	3,626	$83	$300,000	$300,000	$83	$300,000	$ -	$1,919,750		-	$0				
2	111	Draa Field Vegetation Harvesting	City of Titusville	Vegetation Harvesting	North Indian River Lagoon	574	$87	$50,000	$50,000	$87	$350,000	$ -			-	$0				
3	110	Osprey Plant Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	606	$99	$60,000	$60,000	$99	$410,000	$ -			88	$679				
4	112	County Wide Stormwater Pond Harvesting	Brevard County Stormwater	Vegetation Harvesting	North Indian River Lagoon	140	$893	$125,000	$14,000	$100	$424,000	$ 37,500	$73,500	FDEP	28	$3,125				
5	113	Satellite Beach Interstitial Water Treatment	City of Satellite Beach	Treatment Interstitial Water	Banana River Lagoon	29,978	$136	$4,076,940	$3,057,756	$102	$3,481,756	$ -	$1,019,184		3,059	$1,333				
6	114	Barefoot Bay Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	864	$104	$90,000	$90,000	$104	$3,571,756	$ -			-	$0				
7	115	South Beaches Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	Central Indian River Lagoon	1,662	$120	$200,000	$200,000	$120	$3,771,756	$ -			-	$0				
8	116	Merritt Island Lateral Smoke Testing	Brevard County Utility Services Department	Sewer Lateral Rehab	North Indian River Lagoon	2,042	$122	$250,000	$250,000	$122	$4,021,756	$ -			-	$0				
9	117	Basin 10 County Line Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	597	$215	$128,225	$72,773	$122	$4,094,529	$ 35,000	$20,452	Florida Legislative Funding	90	$1,034				
10	118	Basin 26 Sunset Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	605	$215	$130,062	$73,810	$122	$4,168,339	$ 35,000	$21,252	Florida Legislative Funding	92	$1,035				
11	119	Basin 141 Irwin Avenue Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	567	$220	$124,626	$69,174	$122	$4,237,513	$ 35,000	$20,452	Florida Legislative Funding	86	$1,045				
12	120	Draa Field Pond MAPS	City of Titusville	Stormwater Projects	North Indian River Lagoon	256	$234	$60,000	$31,281	$122	$4,268,794	$ -	$28,719		38	$1,563				
13	121	Basin 2258 Babcock Road Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	Central Indian River Lagoon	412	$243	$99,980	$50,203	$122	$4,318,997	$ 35,000	$14,777	Florida Legislative Funding	62	$1,046				
14	122	Basin 22 Hunting Road Serenity Park Woodchip Bioreactor	Brevard County Stormwater	Stormwater Projects	North Indian River Lagoon	329	$316	$103,852	$40,077	$122	$4,359,074	$ 35,000	$28,775	Florida Legislative Funding	50	$1,391				
15	123	Ray Bullard WRF Stormwater Management Area	City of West Melbourne	Stormwater Projects	Central Indian River Lagoon	800	$2,130	$1,704,160	$97,600	$122	$4,456,674	$ -	$1,606,560		366	$4,656				
16	124	Floating Wetlands to Existing Stromwater Ponds	City of Cocoa	Stormwater Projects	North Indian River Lagoon	12	$4,075	$50,000	$1,497	$122	$4,458,171	$ -	$48,503		3	$16,453				
17	125	Diamond Square Stormwater Pond	City of Cocoa	Stormwater Projects	North Indian River Lagoon	85	$6,458	$549,643	$10,383	$122	$4,468,554	$ -	$539,260		23	$24,224				
~~18~~	~~126~~	~~South Central Lateral Smoke Testing~~	~~Brevard County Utility Services Department~~	~~Sewer Lateral Rehab~~	~~North Indian River Lagoon~~	~~4,108~~	~~$126~~	~~$516,000~~	~~$516,000~~	~~$125~~	~~$4,983,554~~	~~$ -~~			—	$0				
19	127	Basin 5 Dry Retention	Town of Indialantic	Stormwater Projects	North Indian River Lagoon	113	$601	$67,700	$16,680	$148	$5,000,234	$ -	$51,020		18	$3,782				
20	128	Jackson Ct. Stormwater Treatment Facility	City of Satellite Beach	Stormwater Projects	Banana River Lagoon	56	$7,057	$394,133	$8,266	$148	$5,008,500	$ -	$385,867		8	$46,809				
21	129	Forrest Ave. 72-inch Outfall Baseflow Capture / Treatment	City of Cocoa	Stormwater Projects	North Indian River Lagoon	94	$12,902	$1,216,663	$13,956	$148	$5,022,456	$ -	$1,202,707		12	$98,993				
22	130	Brevard Zoo North IRL Plant Project 2	Brevard Zoo	Living Shorelines	North Indian River Lagoon	41	$240	$9,840	$9,840	$240	$5,032,296	$ -			14	$703				
23	131	Brevard Zoo Central IRL Plant Project	Brevard Zoo	Living Shorelines	Central Indian River Lagoon	8	$240	$1,920	$1,920	$240	$5,034,216	$ -			3	$640				
24	132	Brevard Zoo Banana River Plant Project 2	Brevard Zoo	Living Shorelines	Banana River Lagoon	2	$240	$480	$480	$240	$5,034,696	$ -			1	$480				
25	133	Fisherman's Landing	Marine Resources Council	Living Shorelines	Central Indian River Lagoon	20	$250	$5,000	$4,800	$240	$5,039,496	$ -	$200		7	$714				
~~26~~	~~134~~	~~Riverside Landing~~	~~Marine Resources Council~~	~~Living Shorelines~~	~~Central Indian River Lagoon~~	~~20~~	~~$250~~	~~$5,000~~	~~$4,800~~	~~$240~~	~~$5,044,296~~	~~$ -~~	~~$200~~		~~7~~	~~$714~~				

Project Order	Project Number	ProjectName	Jurisdiction	ProjectType	Sub-Lagoon	TN Reduction (lbs/year)	Total Cost TN $/lb	Total Cost	Eligible Tax Funding Adjusted	Eligible Tax Funding $/lb TN	Cummulative Eligible Tax Funding	Dollar Amount Secured Grants	Dollar Amount Local Cost Share	Sources Secured Grants	TP Reduction (lbs/year)	TP $/lb	Previously Recommended	Previous Approval Amount	Difference from Previous Approved Amount	Recommendation
53	160	South Banana A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,418	$7,133	$3,025,000	$2,127,000	$1,500	$86,005,566	$ -	$898,000		-	$0				
54	161	North Merritt Island A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,821	$2,331	$4,245,000	$2,731,500	$1,500	$88,737,066	$ -	$1,513,500		-	$0				
55	162	South Central I	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	772	$2,811	$2,170,000	$1,158,000	$1,500	$89,895,066	$ -	$1,012,000		-	$0				
56	163	Sharpes A	Brevard County Utility Services Department	Septic System Removal Extend	North Indian River Lagoon	5,248	$2,839	$14,900,000	$7,872,000	$1,500	$97,767,066	$ -	$7,100,000		-	$0	Y	$ 6,207,192	$1,664,808	
57	164	Merritt Island H	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	5,464	$4,118	$22,500,000	$8,196,000	$1,500	$105,963,066	$ -	$14,304,000		-	$0				
58	165	Sykes Creek S	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,584	$4,167	$6,600,000	$2,376,000	$1,500	$108,339,066	$ -	$4,224,000		-	$0				
59	166	North Merritt Island B	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	1,066	$4,400	$4,690,000	$1,599,000	$1,500	$109,938,066	$ -	$3,091,000		-	$0				
60	167	Merritt Island A	Brevard County Utility Services Department	Septic System Removal Extend	Banana River Lagoon	3,440	$4,855	$16,700,000	$5,160,000	$1,500	$115,098,066	$ -	$11,540,000		-	$0				
		Totals				140,529		$ 175,595,967	$115,098,066						7,941					