

Title: Locating Organic-Rich Sediments (Muck) in Indian River County

Indian River County Muck Survey – Phased sampling to locate muck deposits

INTRODUCTION/BACKGROUND

Anthropogenic changes to lagoon hydrology and nutrient loading over the past century have created conditions leading to the accumulation of muddy deposits throughout the Indian River Lagoon. Indian River Lagoon (IRL) mud, locally known as “muck,” is anoxic and uninhabitable to seagrasses and benthic fauna (Fuller et al., 2021). Decomposition of organic matter contained in muck leads to releases (fluxes) of dissolved nitrogen (N) and phosphorus (P) to the overlying water that can contribute to the onset and proliferation of algal blooms and trigger positive feedback loops that can sustain or worsen eutrophication (Fox and Trefry, 2018; Kemp et al., 2005). In some sub-basins of the IRL, muck contributes up to 40-50% of the total N and P loading from all sources including runoff, direct discharges and atmospheric deposition (Tetra Tech, 2021; Fox and Trefry, 2018). Muck management has thus become an important part of restoration plans for the lagoon system and selection of optimal sites for mitigation can help select where treatment would be most cost effective with respect to decreasing internal nutrient loading thereby improving outcomes of restoration efforts.

The purpose of this project is to locate muck throughout Indian River County and obtain preliminary data showing differences in composition and fluxes among major deposits. In Brevard County, benthic fluxes of nitrogen and phosphorus among deposits ranged by 20-fold (Trefry and Johnson, 2019). By strategically selecting the highest fluxing deposits for restoration, it is thereby possible to maximize benefits towards nutrient removal while obtaining the largest possible TMDL credits (based on current draft credit guidance). Prior to conducting physical surveys, historical datasets and remote sensing techniques will be used to locate probable muck deposits for further investigation. A grand survey will focus on these areas while also investigating the entire lagoon within Indian River County at lower resolution. Up to 5 discrete muck deposits located during the grand survey will be evaluated in more detail better defining boundaries of the deposits and estimating annualized inputs of nitrogen and phosphorus from each deposit. Detailed surveys will be designed to capture the extent and composition of surface sediments in each deposit and determine the number of samples required based on pre-dredging TMDL credit guidance (based on draft guidance from FDEP). Currently, few data regarding the distribution of muck in Indian River County are available and it is difficult to predict the extent of muck and the need for further detailed investigations. Therefore, this initial phase (Phase I) of study may identify a need for further investigation of additional discrete deposits within Indian River County.

LOCATION OF PROJECT (Narrative and Project Location Map)

This project will be carried out in the Indian River Lagoon throughout Indian River County, centered at 27°42'00"N 80°23'30"W (Figure 1).

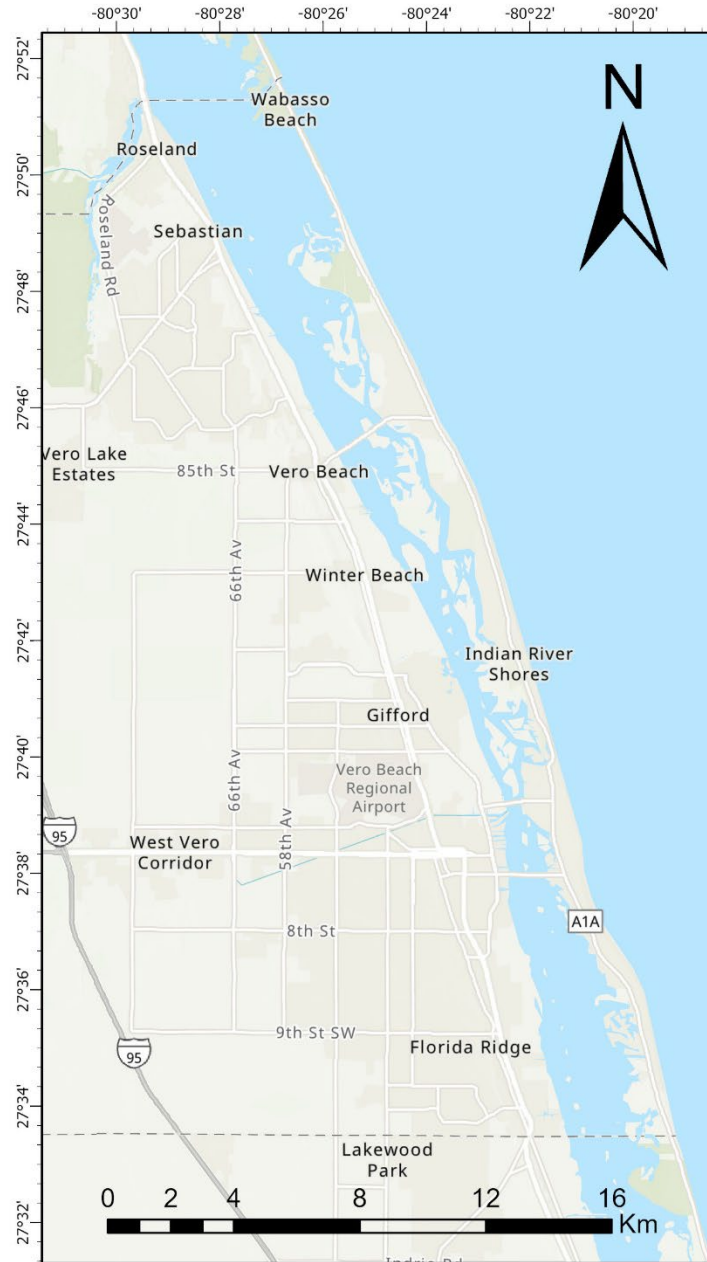


Figure 1. Map showing the Indian River Lagoon in Indian River County

SCOPE OF WORK (Outputs/Deliverables)

Florida Tech will use a phased approach to locate and identify potential muck deposits within Indian River County. The phased approach will utilize a combination of existing knowledge and remote sensing techniques to identify probable muck deposits. These efforts will be combined with gridded

Indian river County Muck Survey

in-situ probing throughout Indian River County using a tessellated grid system with cells sized between 1 and 5 km based on morphological and hydrologic features of the lagoon (e.g., Figure 2)

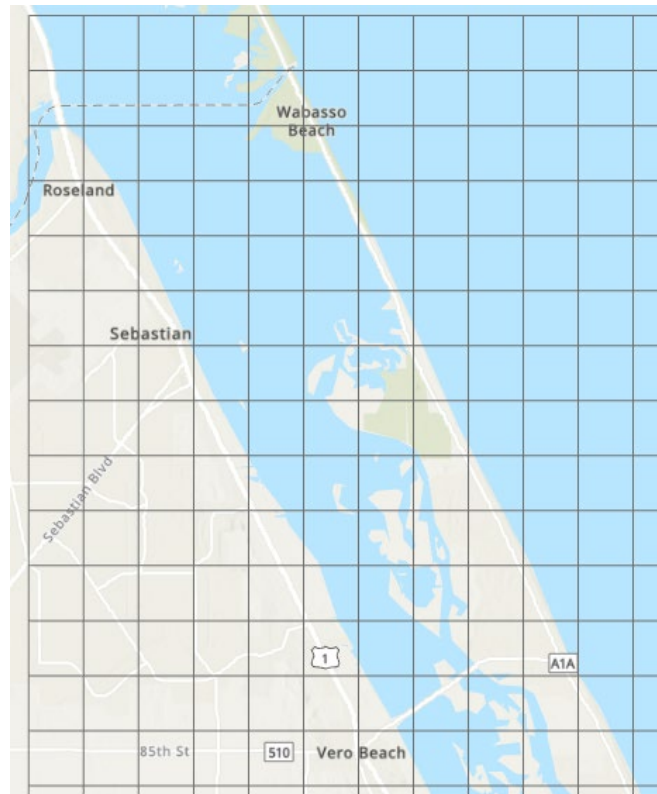


Figure 2. Example grid showing 1 km grid cells. Broad survey will include randomly selected sites within each tessellated grid cell to ensure even coverage yet random site selection.

TASK IDENTIFICATION:

Task 1. Conduct a literature review and compile existing data for the location / thickness of muck in Indian River County.

Task 2. Using remote sensing techniques (e.g., Lidar) and existing knowledge of the lagoon system, locate target areas for further investigation using in-situ probing. Create sample grid and complete study design based on historical data and remote sensing (example Lidar targets shown in Figure 3).

Indian river County Muck Survey

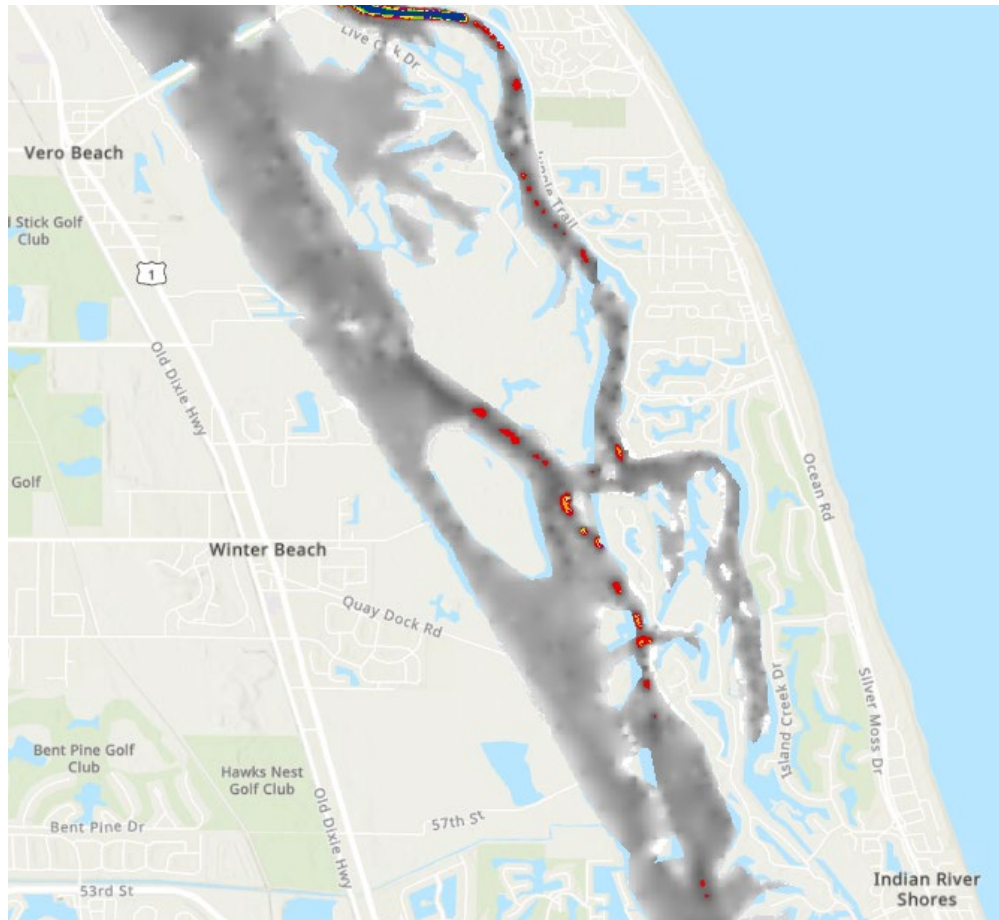


Figure 3. Remote sensing used to identify locations for physical surveys.

Task 3. Conduct a grid-based, grand muck survey using an in-situ probing technique (Trefry et al., 1989). This survey will follow the tessellated grid system with probe locations within each approximately 1 km² grid cell. Using data from the broad survey, target areas for more detailed surveys will be located and discussed with Indian River County Staff.

Task 4. Collect sediment samples from sites containing at least 10 cm of soft (probe-penetrable) sediments in the gridded grand survey. Sediments will be analyzed for sediment water, organic matter and carbonate contents with a selected subset of samples analyzed for grain size, carbonate plus Fe, Al and Si contents.

Task 5. Based on results from the grand survey, up to 5 muck deposits will be surveyed in detail (grid cells 0.1 to 0.5 km on a side). Within each detailed survey, muck thickness will be recorded at each site and 5-10 sediment samples collected for determination of sediment composition and benthic fluxes using our quick flux technique. Additional detailed surveys may be carried out as part of future phases of this project. Focused areas – resolution based on DEP dredging credit guidance and the number of sites based on the total sample size.

Task 6. Reporting. Progress and updates will be reported in 3 approximately quarterly reports (brief one-page project updates) and a detailed final report.

Indian river County Muck Survey

DELIVERABLES AND TIME FRAMES

- Task 1. Map showing areas likely to contain muck based on existing data, observations and literature review.
- Task 2. Map based on Lidar, showing the grid that will be used for the initial, in-situ grand survey.
- Task 3. Datasets and maps showing water depths and muck presence / thicknesses at sites in the grand survey.
- Task 4. Datasets for muck composition at sites containing at least 10 cm of probe-penetrable sediments. A map showing targeted areas for further investigation with up to 5 areas selected for investigation during this phase of muck mapping/locating.
- Task 5. Maps of muck thickness at each of the sites selected for detailed surveys. Data for muck surface areas and volumes (extrapolated from probe surveys using geospatial analysis), sediment composition and benthic nitrogen and phosphorus fluxes (as ammonia and phosphate) and estimated annual releases of N and P from each deposit.
- Task 6. Compile data into approximately quarterly data updates and a final project report. The final report will provide quantitative and descriptive analyses of findings from all phases of this project.

Budget Table

Task Line Item	Deliverables	IRC Funding Amount (\$)
1	Literature review and preliminary mapping	3,125
2	Remote sensing and site selection/design for grand survey	4,250
3	Grand survey and Field effort	42,850
4	Sediment composition	14,500
5	Detailed surveys for discrete deposits	32,550
6	Report	5,000
	Summary Cost	
	Project Total Cost	\$102,275

Indian river County Muck Survey

Timeline

Timeline showing major milestones including start and completion dates (mobilization and demobilization)

Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12+
(1) Lit. Review	x	x	x									
(2) Remote Sensing	x	x	x									
(3) Grand Survey			x	x	x	x	x					
(4) Laboratory Analysis					x	x	x	x	x	x	x	
(5) Detailed surveys							x	x	x	x	x	x
(6) Report				Q1			Q2			Q3		Final

Q = Quarterly Report. Timeline is tentative and subject to change based on coordination with IRC staff and findings throughout the investigation.