GTM Research Reserve Technical Advisory Group (TAG)
May 17, 2023
Meeting Notes

Focus: Guana estuary
Objective: Share research and monitoring efforts and discuss and learn from stakeholders and subject matter experts about the Guana estuary.

Attendees:

Name	Affiliation
Abigail Kuhn	GTM Research Reserve
AJ Reisinger	University of Florida
Allix North	GTM Research Reserve
Ashley Reaume	University of Central Florida
Ashley Smyth	University of Florida
Avah Avonda	GTM Research Reserve Intern
Ben Williams	Wetland Preserve, LLC
Candace Killian	GTM Research Reserve
Chris Hughes	National Park Service
Chuck Jacoby	St. Johns River Water Management District
Courtney Hackney	University of North Florida, retired
Daniele Pinton	University of Florida
Diane Downing	GTM Research Reserve Volunteer
Eric Johnson	University of North Florida
Eric Smith	Dr. Eric J. Smith, LLC
Fara Ilami	Northeast Florida Regional Council
Garrett Miller	Anastasia Mosquito Control District
Geraldine Klarenberg	University of Florida
Gregory Dietl	Paleontological Research Institution/ Cornell University
Hans Prevost	GTM Research Reserve
Jacob Berna	GTM Research Reserve
Jaleigh Pier	Cornell University
Janet Koehler	GTM NERR Volunteer
JB Miller	City of St. Augustine
Jeff Finnan	GTM Research Reserve
Jen Lomberk	Matanzas Riverkeeper
Jenna Reimer	University of Florida
Jess Cantin	GTM Research Reserve
Jessica Beach	City of St. Augustine
Jessica Lee	GTM Research Reserve
Josephine Spearman	GTM Research Reserve
Justina Dacey	University of Florida
Kaitlyn Dietz	GTM Research Reserve
Katie Lebow	U.S. Army Corps of Engineers
Katie Petrinec	GTM Research Reserve

Kirstin Thompson	GTM Research Reserve
Kristie Perez	University of Florida
Kurt Foote	Fort Matanzas Nat. Monument, National Park Service
Marilyn Wiles	Enterprising Women's Leadership Institute
Michael Lagasse	Flagler County Board of County Commissioners
Michael Shirley	Florida Department of Environmental Protection
Neil Rashba	Private Citizen
Nicole de Venoge	Private Citizen
Nikki Dix	GTM Research Reserve
Noelle Beswick	Scientists in the Parks Conservation Legacy
Orlando Cordero	University of Florida, Center for Coastal Solutions
Patricia Ludwig	Private Citizen
Richard Thomas	Coastal Conservation Association
Rick Gleeson	University of Florida, retired
Ron Brockmeyer	St. Johns River Water Management District
Sam Baker	SOL Margin Fishing and Conservation Foundation
Savanna Mathis	GTM Research Reserve
Scott Jones	University of North Florida
Shannon Dunnigan	GTM Research Reserve
Shelley Beville	St. Johns River Water Management District
Shirley Baker	University of Florida
Silas Tanner	Matanzas Riverkeeper
Stephen Medeiros	Embry-Riddle Aeronautical University
Steven Kidd	Timucuan Ecological and Historic Preserve, National Park Service
Steven Smoleroff	Anastasia Mosquito Control District
Sydney Williams	University of Florida
Tessa Ricker	Florida Fish and Wildlife Conservation Commission
Tom Frick	St. Johns County Water Management District
Tricia Kyzar	University of Florida, Center for Coastal Solutions
Wade Brenner	Florida Fish and Wildlife Conservation Commission
Whitney Qualls	Anastasia Mosquito Control District
Zach Lepera	GTM Research Reserve

GUANA NUTRIENTS: BUDGETS AND BIVALVES, https://nerrssciencecollaborative.org/project/Smyth20

Assessing the Current and Potential Role of Shellfish in Improving Water Quality, *Ashley Smyth, Ph.D., University of Florida*

- Project overview:
    - The project team has completed year two and is starting the final year for the NERRS Science Collaborative project, Guana Nutrients: Budgets and Bivalves. The project was designed to meet two GTM Research Reserve management needs: 1) to understand the ecosystem benefits and tradeoffs (ecosystem services) of different management options and 2) to design a mesocosm approach to understanding the impact of watershed actions on water quality, harmful algal blooms, and biodiversity in the Guana estuary.

    - Project team: Dr. Ashley Smyth, Dr. AJ Reisinger, Dr. Christine Angelini, Dr. Shirley Baker, Dr. Peter Ifju, Dr. Nikki Dix, and Kaitlyn Dietz
    - Current students: Hallie Fischman, Andrew Ortega, Jenna Reimer, Justina Dacey, Kristie Perez
- Project approach:
    - Identify nitrogen sources in Guana Lake
    - Understand how nitrogen moves and changes throughout Guana Lake and into Guana River
    - Evaluate how water quality impacts oysters and how oysters impact water quality
    - Develop water quality targets and restoration goals for a water quality restoration plan
- The project area is focused on three zones:
    - Guana Headwaters- The project team collects monthly water quality data, currently has a real-time nitrate sensor at the weir, and performs seasonal sampling of isotopes to track nitrogen. The output of this data is to understand the timing and amount of nitrogen entering Guana Lake.
    - Guana Lake- The project team works to identify how the balance of nitrogen sources and sinks affects export of nitrogen into Guana River. Monthly water quality data is collected. The output of this data is the total lake nitrogen budget. Benthic fluxes and the type of nutrients leading to algal blooms are also topics of study.
    - Guana River- The project team collects data on shellfish growth rates, filtration rates, shellfish nitrogen content, and shellfish denitrification. The output of this data is the amount of nitrogen removed by shellfish from filtration, denitrification, and storage in the shells and tissue. The goal is to assess how water quality affects shellfish and how shellfish affect water quality.
- Project Timeline
    - Year 1 (April 2021- March 2022)- The focus was on nitrogen sources and sinks and the nitrogen budget. The project team studied sediment fluxes and performed bioassays.
    - Year 2 (April 2022- March 2023)- The project team did surveys of oyster reefs using lasers and drones to figure out the location and quantity of oysters and mussels in the Guana estuary. They also performed a manipulation experiment to understand the effect of water quality on shellfish and shellfish filtration rates.
    - Year 3 (April 2023- March 2024)- The focus is on shellfish denitrification and the creation of biogeochemical models using coupling to understand water quality dynamics and nitrogen removal. In this stage the project team will provide recommendations on how to improve and protect water quality in the Guana estuary.
- Project Goals
    - The main goal of the project is to develop a framework for water quality management in the Guana estuary. The project will determine where reductions in pollution is needed, develop water quality restoration plans, and develop best management practices (BMPs).

Review an Informational Handout: Guana Estuary Water Quality Impairment and Restoration Options, *Jen Lomberk, Matanzas Riverkeeper*

Jen Lomberk and the Guana Nutrients: Budgets and Bivalves project team have been working to produce a handout that describes the water quality impairment problem in the Guana estuary and provides a concise reference of restoration plan options. This document can be provided to local elected officials as a talking point and serve as a guide for decision-making. The handout will be finalized soon and shared with project stakeholders. For more information, contact Kaitlyn.Dietz@FloridaDEP.gov.

Best Management Options: Protecting Water Quality in the Guana Estuary, *AJ Reisinger, Ph.D., University of Florida*

- Steps to determine how to protect and restore the water quality of a watershed
    - Identify whether the water body is impaired. An impaired water body does not meet certain water quality thresholds and could be impaired for specific pollutants of concern like nutrients, heavy metals, fecal coliform, e-coli, or low dissolved oxygen.
    - Set a Total Maximum Daily Load (TMDL). Researchers identify a pollutant of concern and choose a threshold for that pollutant. There are different limits/thresholds for different pollutants. Pollutant loads can be allocated to different users throughout the watershed (i.e., agriculture, urban stormwater, or wastewater treatment can only contribute x amount of pollutant)
    - Create a Basin Management Action Plan (BMAP) or a Reasonable Assurance Plan (RAP).
        - BMAP is a process driven by Florida Department of Environmental Protection (DEP) that is enforceable and requires parties who have contributed to the pollutant load to agree to take various actions to meet the TMDL.
        - RAP is stakeholder-driven plan that can be developed before a TMDL is established. If the RAP is deemed sufficient by the DEP, a TMDL is not developed.
- Best Management Practices (BMPs) can be used in a wide array of scenarios. In the context of this project, BMPs are behaviors or technologies that serve to protect, improve, and conserve water quality with the target of reducing pollutant export. They can be structural, such as engineering solutions, or non-structural, such as education or behavioral changes.
- Guana estuary land use nutrient sources and BMPs
    - The Guana estuary watershed land use includes two golf courses and three wastewater treatment facilities, with 29% of the land developed (26% highly developed) and 71% natural.
        - Golf courses
            - Potential nutrient sources include fertilizer, grass clippings, irrigation, parking lots, and other impervious surfaces
            - Opportunities/solutions for BMPs can be gleaned from the UF/IFAS golf course BMP manual, which has an entire chapter focused on protecting the water quality and ecology of the watershed. Other opportunities include education and enhancing the natural ecosystem functioning by having more wetlands and vegetation in non-play areas.
        - Wastewater treatment facilities
            - Wastewater treatment facilities directly contribute nutrients to the system via effluent. Infrastructure failures and septic tank discharge can result in contamination of waterways. Every facility in Florida is required to do a secondary treatment that disinfects the effluent, but this does not remove the bulk of the nutrients.
            - Opportunities/solutions for BMPs include upgrading wastewater treatment facilities to tertiary treatment, creating treatment wetlands, converting septic systems to sewer, and sustaining regular maintenance.
    - 90% of the nitrogen input is from urban land use and 6% is from forests
    - 78% of the phosphorus input is from urban land use (septic tanks), while 18% is from forests
        - Urban stormwater

        - Urban stormwater contributes nutrients to the system when residential neighborhood water runoff enters the stormwater system through pipes into stormwater ponds. Storm water ponds slow down flooding and add water quality benefits, but they are not as efficient at removing nutrients as originally thought. An alternate approach to stormwater ponds is green stormwater infrastructure, which discharges the stormwater into smaller pocket treatment areas
    - Examples of nonstructural BMPs
        - Reducing urban area by increasing soil and vegetation and decreasing impervious areas, which reduces how rapidly pollutants move across the landscape
        - Disconnecting impervious areas by building vertically instead of horizontally, allowing for more space for a yard
        - Creating curb cuts or removing curbs, which allows water to enter vegetation first, where water is absorbed
        - Fertilizer reductions and using Florida Friendly Landscaping can decrease nutrient inputs via ordinances
        - Street sweeping that picks up dust with particles of nutrients
    - Examples of structural BMPs
        - Bioretention via rain gardens
        - Stormwater planters
        - Permeable pavements
        - Infiltration trenches and drywells
        - Subsurface exfiltration
        - Vegetated swales
        - Baffle boxes (nutrient separating)
        - Cisterns
        - Green roofs
- Guana Nutrients: Budgets and Bivalves breakout session: In small groups, attendees made a prioritized list of potential BMPs for nutrient reduction in the Guana estuary that identified strengths, weaknesses, opportunities, and concerns. See the prioritized list and discussion table at the end of this document.

HIGH RESOLUTION SURVEYS AND NUMERICAL MODELING TO OPTIMIZE GUANA LAKE LEVELS, *Daniele Pinton, Ph.D., University of Florida*

Project 1: Guana Lake

- Project overview
    - The project involves identification of sources of fecal pollution in the Guana estuary by using a combination of monitoring and numerical modeling. The objective is to promote a sustainable estuarine ecosystem that can withstand urban inputs while supporting biodiversity, recreation, education, and a growing shellfish industry. A better understanding of the quantity, sources, and fates of nutrients throughout the watershed and along a nutrient and salinity gradient in the Guana Lake was needed to develop remediation strategies for the impaired water body.
    - Project team: Dr. Daniele Pinton, Dr. Alberto Canestrelli, and Stefano Biondi

- Bathymetry
    - Water depth decreases from south to north, although there are some areas in the southern part of the lake with lower depth. Bed elevation is variable, especially in the central part of the lake, which is occupied by channels with different cross-sections.
- Temperature/Conductivity/Salinity
    - Temperature increases throughout the day. The distribution is unusual because the lake was surveyed in 4 days.
    - Salinity decreases from south (Guana Dam) to north (Mickler's Dam). Salinity gradients are lower close to the two dams. This depends on the higher depth and the lower water fluxes of these areas.
- Water quality
    - Oxygen is high in the northern part of the lake, which has more vegetation, fluxes and turbulence, and less depth. The center of the lake has low oxygen, with smaller channels. The Southern portion of the lake has average oxygen levels.
    - pH is low in the northern part of the lake, which is due to nitrogen fluxes from Mickler's weir. The center part of the lake is high in pH due to the presence of vegetation, and the southern portion has average values of pH.
    - Turbidity is high at landing sites and in small channels.
    - Chlorophyll-a is high in the northern/center part of the lake due to the presence of vegetation. The southern area has a low Chl-a concentration because vegetation is nearly absent.
    - Nitrogen data was collected along the whole lake (~1 minute sampling frequency) by using a SUNA V2 Nitrogen Sensor, attached to the side of the boat. Data analysis is ongoing.
- Project difficulties
    - The project team faced challenges such as with the GPS connection, battery life, and HYCAT velocity, which may cause overheating of the airboat. Environmental related difficulties include seagrass clogging propellers, narrow channels cannot be surveyed, and elevation of the vegetated areas in the lake cannot be obtained using the HYCAT.

Project 2: Crescent Beach

- Overview and main goals
    - Provide managers of the Guana estuary with information on the relative contribution of human fecal pollution related to septic systems under various development, water level, and precipitation scenarios.
    - Project team: Dr. Daniele Pinton, Dr. Alberto Canestrelli, Dr. Todd Osborne, and Dr. Elise Morrison
- Approach
    - Quantify, using an ArcGIS-based numerical model (ArcNLET), the flux of fecal indicator bacteria (FIB) and human-fecal indicators from septic tanks into groundwater and adjacent surface water
    - Investigate the dispersal of FIB in the estuary and nearshore region using a three-dimensional numerical model (Delft3D) and determine spatiotemporally varying FIB concentrations and residence times
    - Work with local stakeholders to create maps with impact indices
- Surveys and models

- Water level, water salinity, and water temperature are currently being collected in three separate properties, 1 pristine and 2 developed, with a sampling frequency of 10-15 minutes.
- A Delft3D numerical model describing the hydrodynamic in the GTM estuary has already been implemented. Also, the horizontal transport model ArcNLET has already been used to describe the pollutants load from a group of residential units to the GTM estuary.
- FIB data have been collected, but data are not available yet. Data analysis is ongoing.

USING COLLABORATIVE OPEN SCIENCE TOOLS TO IMPROVE ENGAGEMENT WITH THE ECOLOGY OF THE GUANA RIVER ESTUARY, *Kristie Perez and Geraldine Klarenberg, Ph.D., University of Florida*

https://nerrssciencecollaborative.org/project/Klarenberg22

- Project overview:
  - The project uses open data science principles and participatory practices to create a web-based interactive data dashboard that can be easily updated by GTM researchers to provide access to Guana estuary datasets, give users the ability to visualize data, and engage the community with the reserve and its ecology.
  - Project team: Dr. Geraldine Klarenberg, Dr. Shirley Baker, Dr. Nia Morales, Dr. Nikki Dix, and Kristie Perez
  - Stakeholder workshops in December 2022 revealed that stakeholder groups had differing foci related to the dashboard. Scientists were primarily focused on the data itself, whereas non-science professionals and community members had overlapping interests. Further, stakeholders requested that the project team not "reinvent the wheel" as they preferred to focus on what was missing from other resources and link to or otherwise incorporate existing credible sources.
  - As the project is strongly end user focused, the team endeavors to solicit stakeholder feedback on an ongoing basis to ensure the usefulness of the final dashboard. This session was part of the larger stakeholder-driven approach to create a continuous two-way dialogue, allowing stakeholders to refine their input and feedback, and allowing the project team to update deliverables through the implementation process.
  - Science collaborative breakout sessions: The attendees split into two groups 1) scientists and 2) professionals other than scientists (or people who identify with the community). The attendees discussed aspects of their overlapping priorities identified during the December workshops, which included:
    - Streamlined, engaging data (i.e., summarized data, appropriate to target audience with visuals)
    - Data interpretation (i.e., including layman's explanation, with practical significance, and context information)
    - Well maintained, current data (i.e., reference to when data is collected vs. uploaded, includes citations)
    - **Group 1** had the opportunity to engage in discussions about SEACAR (Statewide Ecosystem Assessment of Coastal and Aquatic Resources) and using the tool to shape the functionality of the data dashboard for this project. Cheryl Clark, DEP Office of Resilience and Coastal Protection, who manages SEACAR, led a tutorial via Zoom. SEACAR is a repository for data across the state, including the GTMNERR. In the spirit of

"not reinventing the wheel", in this session participants explored the use of SEACAR to meet some of the scientists' needs outlined in the December 2022 workshop.

- SEACAR "show and tell": Cheryl showed the list of monitoring programs and the program information/metadata that is available when you click on a program. She explained the file download option and the data submission procedure, as well as the QA/QC processes. When you click on "Map of Sample Locations" in program info, or on "Maps" in the top menu bar, you get an ARCGIS application. This includes layers, and additional information when you click on polygons or points.
- SEACAR Q & A:
    - Which GTM data is on the dashboard right now? Select "Guana Tolomato Matanzas NERR" from the dropdown menu "Managed Area"
    - Can researchers contribute shapefiles/spatial data? Yes, but right now there is limited capacity to make this publicly available.
- Participants separated into subgroups to discuss the strengths and weaknesses of making use of SEACAR in dashboard development, see chart below (grouping created by Dr. Geraldine Klarenberg).

Strengths

(Internal, characteristics that we can control and/or change, and that give a (relative) advantage and that we can leverage)

Technical	*Data Availability*	*Efficiency considerations*	*General (these are probably more external "opportunities" than strengths)*
- Could possibly link to data dashboard from SEACAR - GTM-specific tool can allow for more detailed data availability	- Keeps unique datasets + collection strategies separate - Historic data - All different types of data - Data comparability/compatibility for syntheses	- Sharing data - It is available - There are QA/QC standards - One database/repository	- More visibility for Guana - More use (potential funding) for SEACAR

Weaknesses

(Internal, characteristics that we can control and/or change, and that give a (relative) disadvantage and that we can improve):

Technical	*Data Availability*	*Desired use of data by stakeholders (and dashboard design)*	*General (these are possibly more external "threats" than weaknesses)*
- Individual portal needed for GTM - Updating contact info	- Data limitations – not all types of data included - Limited indicators - Selective dataset sharing	- No data visualization - Not developed for GTM needs - Different levels of specificity of metadata - Consolidation across projects and sites - Cross-data comparisons - Not standardized (across projects: e.g., different resolutions, spatial and temporal)	- User-dependent data - Latency - Capacity

Additional Feedback: If participants have feedback for the project team about using SEACAR (in relation to building the dashboard), they can use this Google form.

- **Group 2:** Based on the December 2022 workshop, the project team has placed additional focus around science communications and the human dimensions of natural resources. Group 2 discussed potential uses of information/data from the dashboard and ideal presentation of the overlapping prioritized data elements noted above. This information will aid the project team in defining/prioritizing target audiences and identifying non-technical project goals.

Uses of water quality data/information from the dashboard		
Education	*Research*	*Decision-making*
- Teaching residents how to be better stewards of our environment - Informing the public/outreach - Informing about safety, environmental health, and public health	- Analysis of pollutants (Ecoli & beyond) - Pollution outputs (daily, weekly) - Identifying sources of pollution - Identifying areas where more testing is needed - To inform surveys or research/monitoring	- Educating decision makers to influence change - Inform Regional Resiliency Action Plan (includes recommendations on water levels, water quality, flooding, etc.)

Presentation of water quality data/information within dashboard				
Community concerns	*Communication*	*Graphics/Figures*	*Organization*	*Data*
- Safety of swimming & recreation/alerts to the community - Include economic return on investment information where/if available - Ways for community control (pollutants) - Nutrient loads targeted at anglers in the reserve	- Instagram alerts of daily outputs (pollutants) - Alert system sign-up (pollutants)	- Graphs representing change over time - Horizontal line to represent state water quality standards - Colored geographic charts (of pollutants) - Maps with colors showing levels of various nutrients - Salinity mapped by position on the river/lake	- Separate data by interest groups (i.e., climate/weather, water level/nutrients, current/ongoing research) - Show breakdown for each collection event - Daily live ticker across top of environmental readings (pollutants)	- Live water quality data including turbidity and DO level (basic screen for school students) - Nutrient outflow dairy enterococcus

General and other uses of dashboard data/information				
Education	*Research*	*Management*	*Recreation*	*Economy*
- Education of students- teachers and students can access data before and after field trips onsite - Helps with classroom activities - Goes beyond data collection - Provide background & answer questions as a volunteer interpretive guide	- Species monitoring data used for biodiversity index/ecological value of land - Biodiversity data- what wildlife you might see on the trails, trail maps including Wildlife Management Area - Weather, tides, and plankton species - Data comparison with National Park Service, Timucuan Preserve, and other preserves further south - Presence/absence data – informing about climate change progression - Federal projects, project scoping, creating presentations, writing reports - Oyster cover data, map showing cover change over time to inform management decisions - Sea Level Rise data - Elevation shift in salt marshes	- Fish species/regulations- fishers can see what they might catch, which trails have the most of what species, etc. - Inform current and future water level, vegetation treatment, and other management practices in Guana Lake - When tide in Guana River is equal in elevation to Guana Lake, necessary to adjust water control structure gates - Invasive plant maps to analyze populations & treatment recommendations	- Inform recreational use (kayak, hike, fish), i.e., to decide if you want to hike a trail or not, hunting days/times - Rainfall, air temp, water temp, wind, tides & water levels (at boat launches) – useful to decide on recreation opportunities, i.e., wind speed and direction for fishing at the dam	- Benefit ecotourism

	- Sea turtle data (including Adopt-a-nest) to engage the public			

Presentation of general and other dashboard data/information				
Graphics/Figures	Links	Explanations	Accessibility	Quantification
- Map- click on locations (numbered), then photos available - Map would be superimposed on aerial plot for trails so you could see the type of terrain on trail traverses - Table with daily, weekly, and monthly data - Graphical format where possible (Richard Thomas), maybe tabular too (Jeff Finnan) - Pair explanations with figures, include a damage threshold in figures	- Link to more in-depth readings for those interested - "Hot Links"	- "General background" section - Concise summary (Layman's terms, ~2 paragraphs) - A tab answers "why does this matter"? Use bullets - "General findings" section including a "what does this mean?" section - Key findings that are most significant, clearly explained with the simplest figures possible	- Touchscreen or computer in the exhibit hall in visitor center - Have a QR code to dashboard available at the dam - Searchable (direct you to appropriate content) - Exportable, able to download raw data - Live feeds	- Number of sea turtle nests, locations, number hatched, nest success, and compare current season

- Additional comments provided:
    - Mercury monitoring stations academic website
    - Weather storm data stations
    - Department of Health information
    - Healthy Beaches & Safe Waterway Acts
        - Blue water task force provides alerts
        - People want to know the health dangers and what caused it
        - Potential to scan a QR code to be added to a list & receive emails
- Other thoughts shared:
    - Crossover with social media
    - Actively push out info (i.e., notifications)

Guana Nutrients: Budgets and Bivalves Breakout Sessions

BMPs: retrofitting existing infrastructure, *Lead Kaitlyn Dietz*

BMP	Strengths	Weaknesses	Opportunities	Concerns
Development of green homeowner, green community, or green resident program	• Enhance water quality • Reduce cost of home ownership • Increase biodiversity • Decrease flooding • Increase stewardship	• Don't care who is going to manage the program? • Lack of implementation • No buy-in from some homeowners	• Recruit volunteers • Levels of contributions • Volunteer hours • UF/IFAS backed • GTM supported • Checklist criteria to be a green homeowner	• HOA obstacles • Implementation of green infrastructure projects •
Assessment of current water quality and nutrient load projects by St. Johns County	• Large potential nutrient load reductions • Knowledge • Already identified	• Money • Slow process • Weak regulations/enforcement	• Federal money • New technologies	• County buy-in • NIMBY (not in my backyard)
Septic to sewer conversion	• Reduce nutrient load		• Grant money	• Cost to build • Utility cost
Retrofit golf course discharge	• Big impact on pollutant loading	• Space/land • Cooperation required	• Dual benefit elements • Grant funding • Golf Course Best Management Practices manual usage	• Aesthetics • Cost • Golf ops disrupted

BMPs: in-water, *Lead Dr. Ashley Smyth*

BMP	Strengths	Weaknesses	Opportunities	Concerns
Vegetation harvesting	• Direct removal of nitrogen and phosphorus • Replaces herbicide • Invasive plant management	• Time intensive • Costly • Needs to be maintained	• Dune restoration • Other fertilizer uses • Mulching • compost	• Disruption/resuspension • Where does it go?
Filter feeders	• Already historically present	• Growing time • Many variables to account for (conditions)	• Nutrient credits • relaying	• Relaying • Disruption of natural community genetics

	• Promotes recreational harvest			• Net nitrogen removal is not always guaranteed (context dependent)
Dam management	• Cheap- its already there	• Currently managed for waterfowl		• How would that work? • Stakeholder disagreement
Floating wetlands	• Locate near point sources			• Cost associated with harvesting • Scale

BMPs: recreation, *Lead Dr. Nikki Dix*

BMP	Strengths	Weaknesses	Opportunities	Concerns
Education	• Public awareness and individual impacts • Understanding • action	• Tendency to reach people already familiar • Lack of baseline knowledge about Florida environment	• New resident newcomer groups • Golf course and other maintenance people • Rotary clubs • Fishery clubs • HOAs • IFAS extension • Larger neighborhood associations • Sawgrass	• Perception that problems are too big to fix • Large increase in development makes it challenging to reach everyone
Florida-Friendly Landscaping	• Native species support • Biodiversity • Habitat/food • Less water needed • Pollinators • Revert to original landscape • Fight invasives • Less allergens • No fertilizer	• Difficult to access	• Educate landscapers • Boost engagement • Propagation program • Native plant sale- promote local nursery	• Illegal harvest • Pushback from HOA/board
Treatment Wetlands	• Improve biodiversity		• Mitigation	• Cost

	• Shown to decrease nutrients effectively		• 70% natural land in watershed • Schools- education opportunity	• Increases mosquito breeding habitat unless deep enough with predatory fish •
Increasing pervious surface and decreasing impervious surface	• Less runoff • Decrease flooding, • Opportunity for Enhancing greenways • Promoting Florida friendly landscaping • More native plants increase pollinators • Accessibility • Less runoff/flooding	• Upkeep • Costs • Maintenance • durability	• Local contractors/ businesses • Greenways • Potentially less upkeep/maintenance • New technologies	• Might be pushbacks from HOAs- getting away from lawn and be more env friendly • Mosquitos • Cost • High traffic areas • ADA

BMPs: new development*, Lead Dr. AJ Reisinger*

BMP	Strengths	Weaknesses	Opportunities	Concerns
Reduction of impervious areas (building vertical)	• Shade • Keep water on site	• People/homeowners do not like it • Height limits • Negative perception of density • Buy-in from developers	• Marketing • New urbanism • Flood mitigation	• Actual engineering process/funding • What to do with our cars?
Education	• Can reach broad audience • Relatively cheap • Lasting behavior change- cascading effects	• Effects aren't tangible/timely • Hard to convince people • Where? Who? • Disconnect	• Regulatory licensing change • NERRS-led	• Lasting effectiveness • Level of education/detail • Will people attend