TETRA TECH

Planning and Design for Resiliency, Reliability, Acceptability, and Sustainability

Nature-based Breakwater Islands for the Fort Pierce Marina

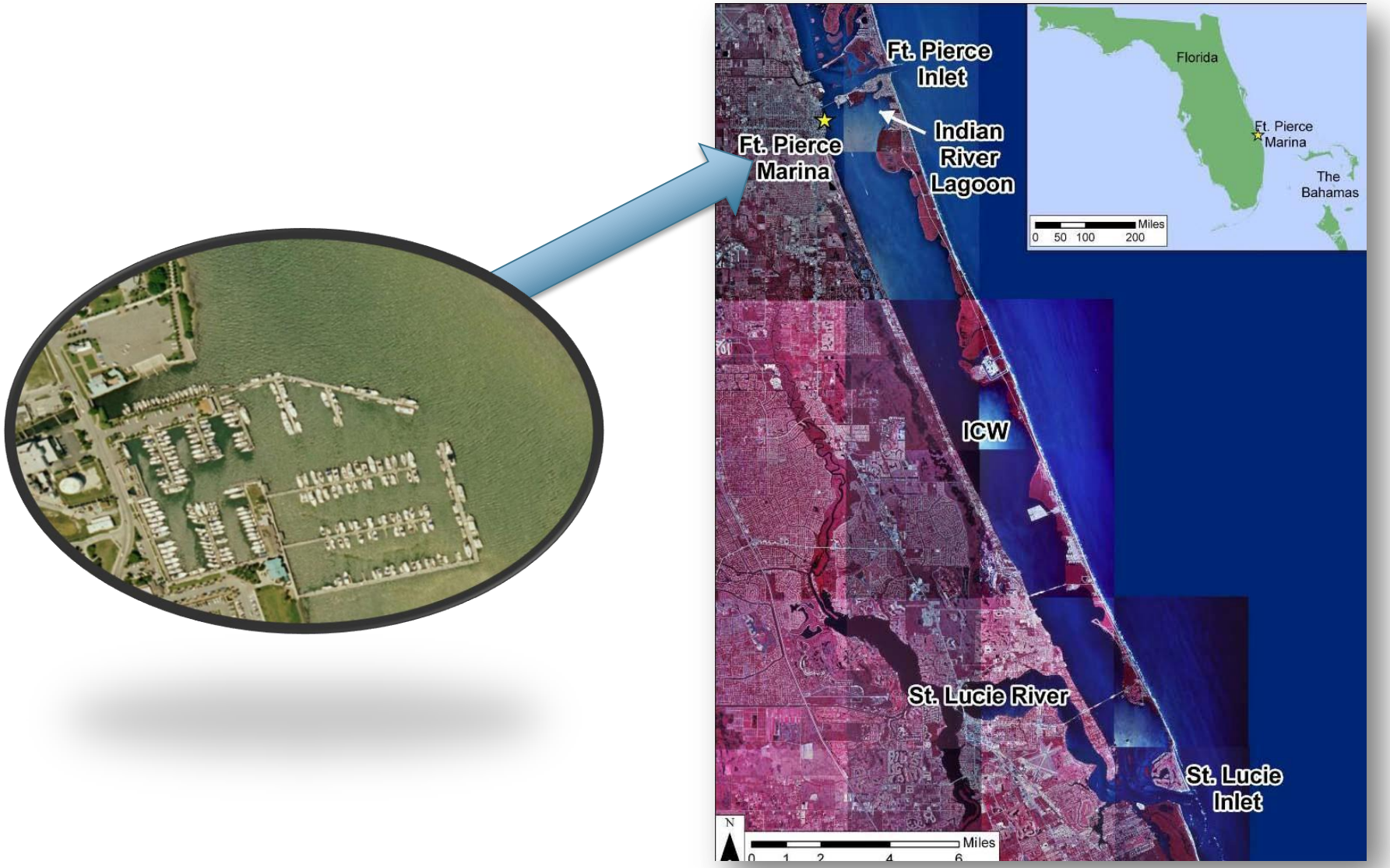
Richard Czlapinski, PE, D. CE




FORT PIERCE MARINA, FLORIDA

CHALLENGE: Planning, Permitting and Constructing Coastal Storm Damage Reduction with Sustainability under Difficult Site and Regulatory Conditions

Marina Location and Layout



2004 Hurricane Season

Project Challenges

Site Conditions

- Strong tidal currents
- Dynamic flood shoal
- Seagrass

Permit Constraints

- State policy barrier
- Project character and scale
- Essential fish habitat
- Aquatic Preserve

Project Planning

Rebuilding Options

- Rebuild like original
  - Risk of future damage
  - Future reconstruction funding issues
- Rebuild with storm protection
  - Explore FEMA Hazard Damage Mitigation funding
    - Improved project with reduced risks

Project Planning

FEMA Hazard Damage Mitigation Funding requires:

- Technical feasibility and effectiveness
- Cost effectiveness
- Hazard Mitigation Plan
- Environmental planning/historic preservation
- Statutory, regulatory and other requirements

Project Planning – Stakeholder Coordination

Regulatory

- USACE
  - USFWS
  - NOAA - NMF
  - NOAA – PRD
  - EPA
- FDEP
  - FWC
  - State Lands
  - ERP
  - SHPO
  - Governor and Cabinet

Other Stakeholders

- FEMA
- FIND
- FDOT
- St Lucie County
  - Harbor Advisory Committee
  - Port Authority
  - Artificial Reef Program
  - St Lucie Waterfront Council
- FDOT
- Audubon Society
- State and federal legislators

Planning – Technical Feasibility/Effectiveness

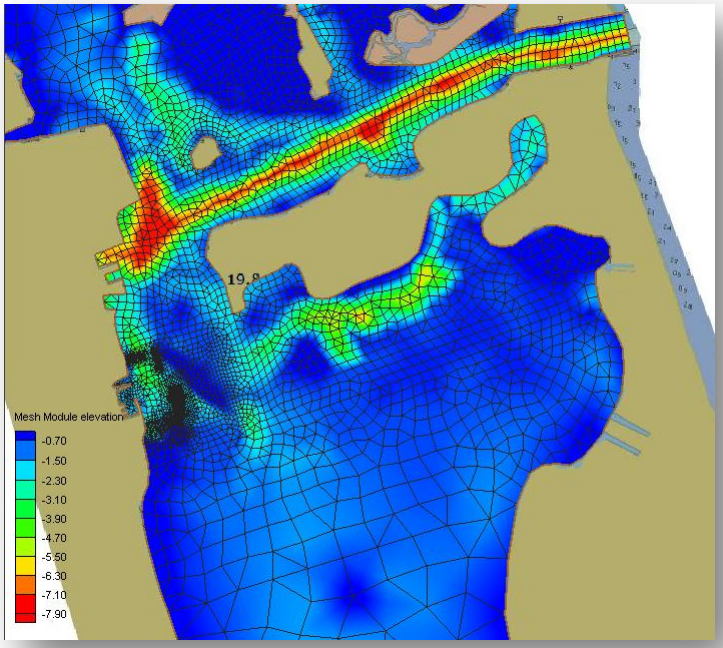
Project Design Objectives

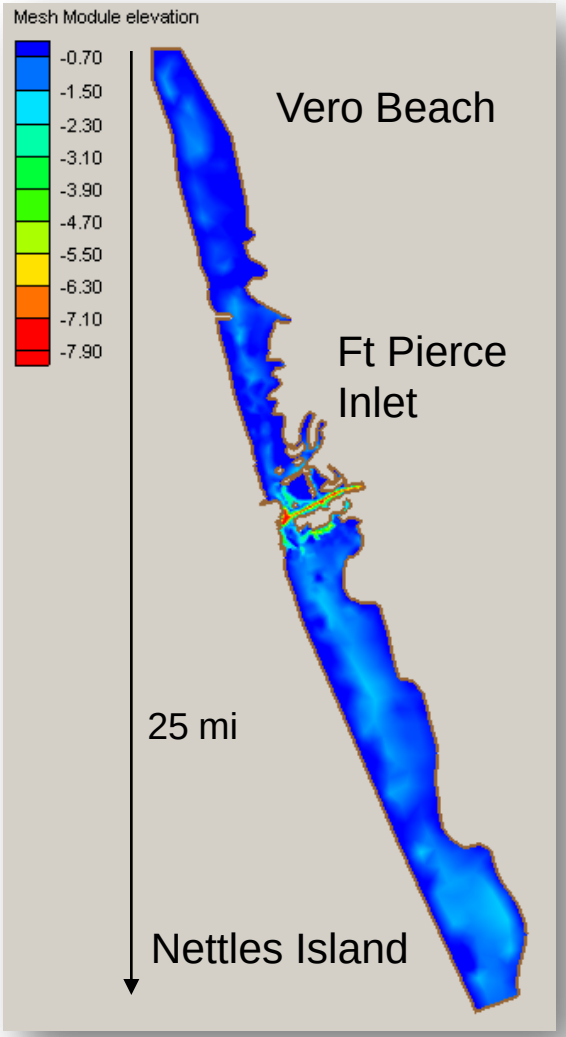
- Provide 100-yr wave/current protection
- Reduce basin currents
- Minimize changes in sedimentation patterns
- Improve access channel navigability
- Protect seagrass beds
- Provide for manatee transit
- Provide ecological enhancements with structural performance
- Protection of adjacent city waterfront

Planning – Technical Feasibility/Effectiveness

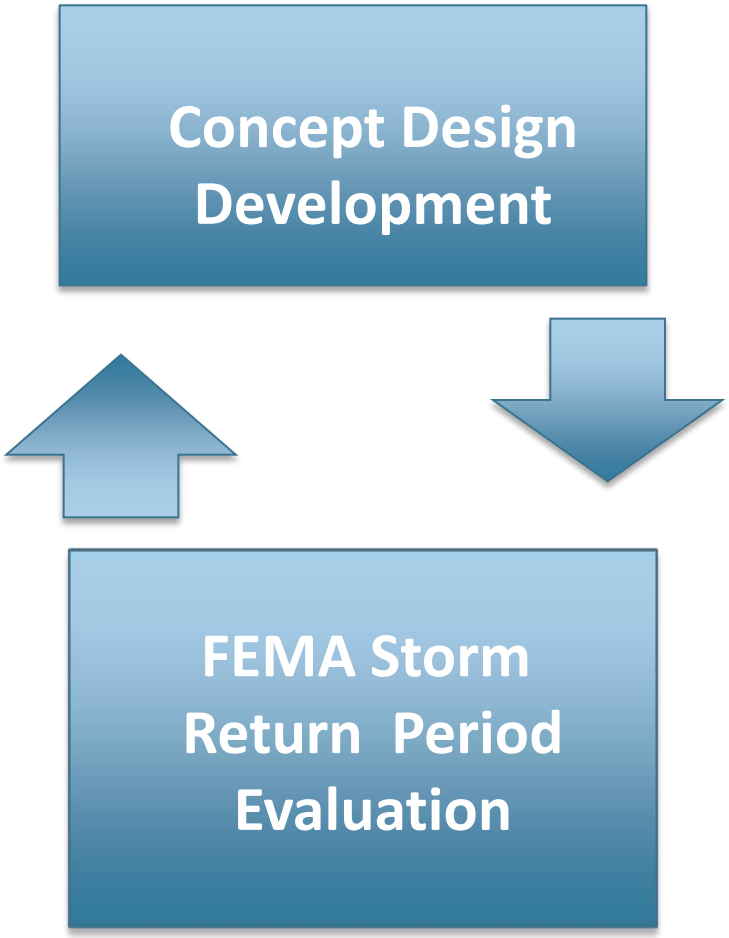
Hydrodynamic Modeling

- Finite element
- Model domain of 3 by 25 mi





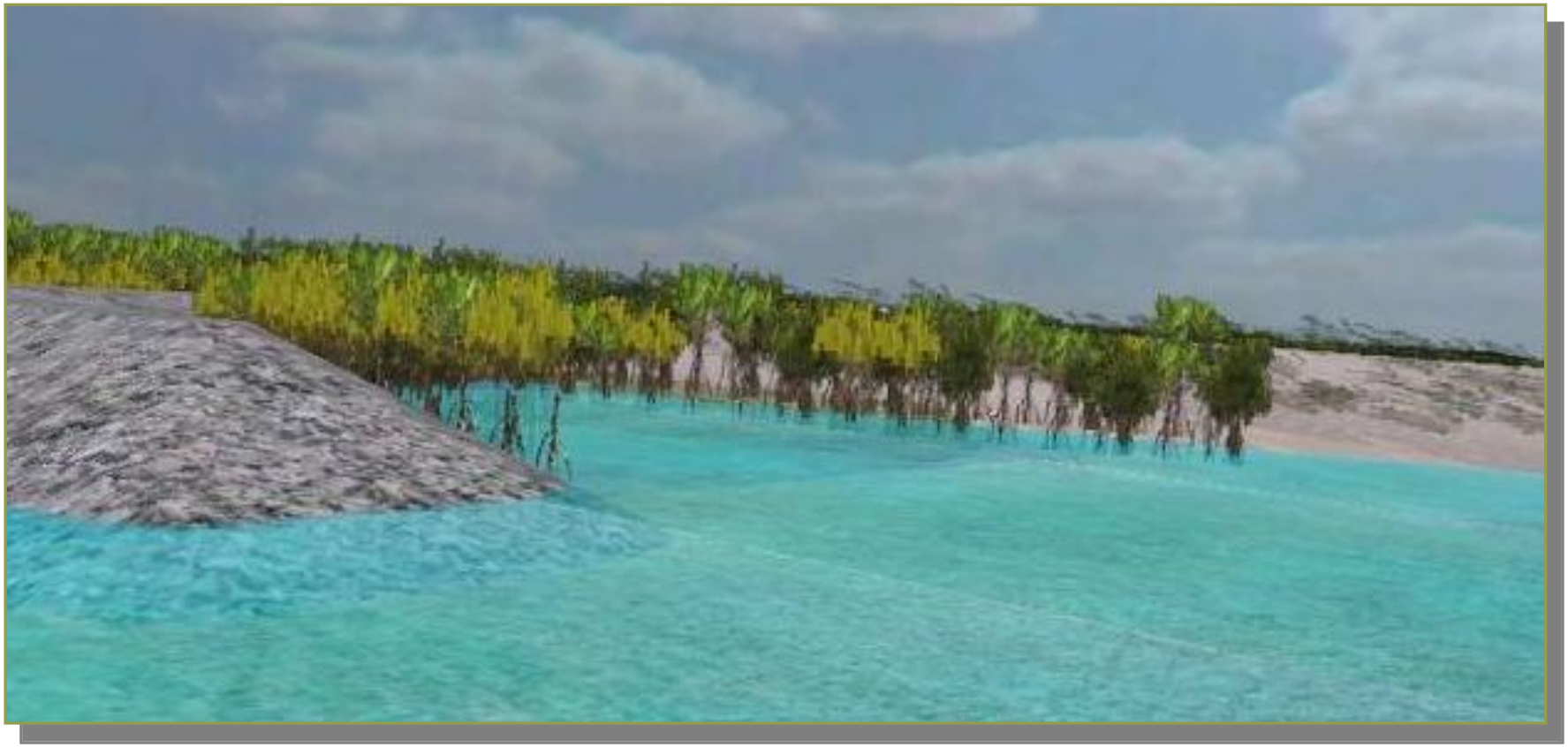
Planning – Cost Effectiveness



Planning – Technical Feasibility/Effectiveness

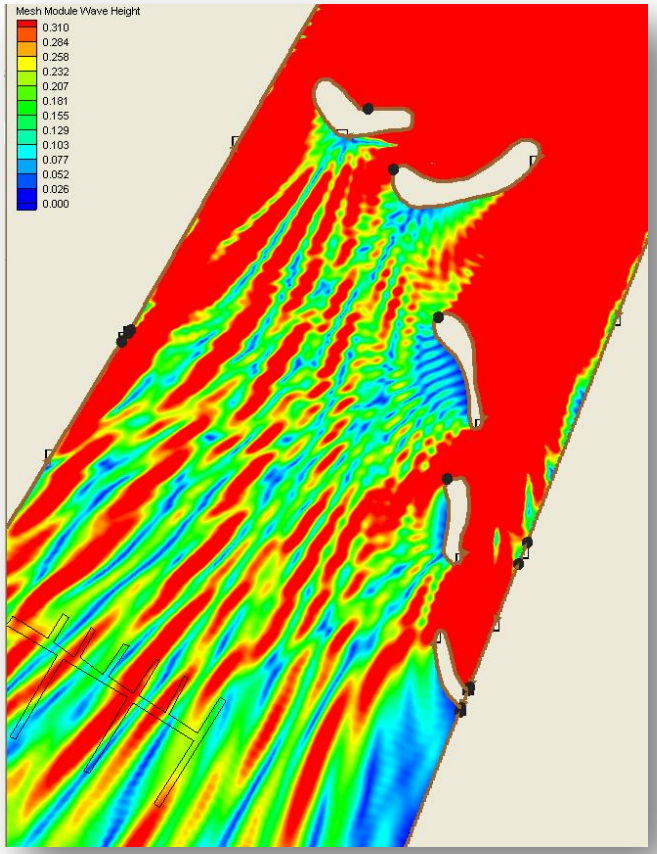
Conceptual Design Development

Mature Project



Planning – Technical Feasibility/Effectiveness

Physical/Numerical Modeling



Planning – Technical Feasibility/Effectiveness

Technical Reviews

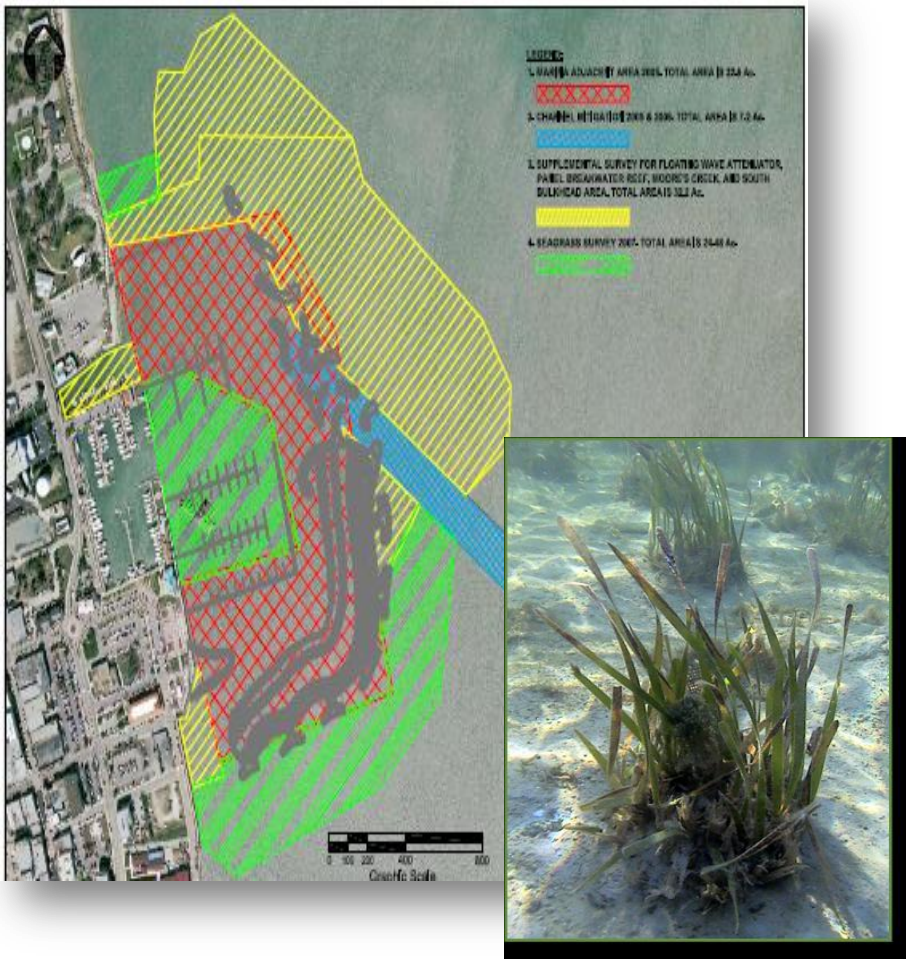
- FEMA independent technical reviewer
- USACE
  - Local office
  - District office
  - Engineer Research and Development Center
- FL DEP
  - District office
  - HQ
  - Florida Governor and Cabinet
- FDOT
- Final Construction Plan Reviews

Planning - Environmental

Planning – Environmental

Field Investigations

- Marine resource surveys
- Bathymetric, sidescan and magnetometer surveys
- Sediment and water sampling and testing



Planning - Environmental

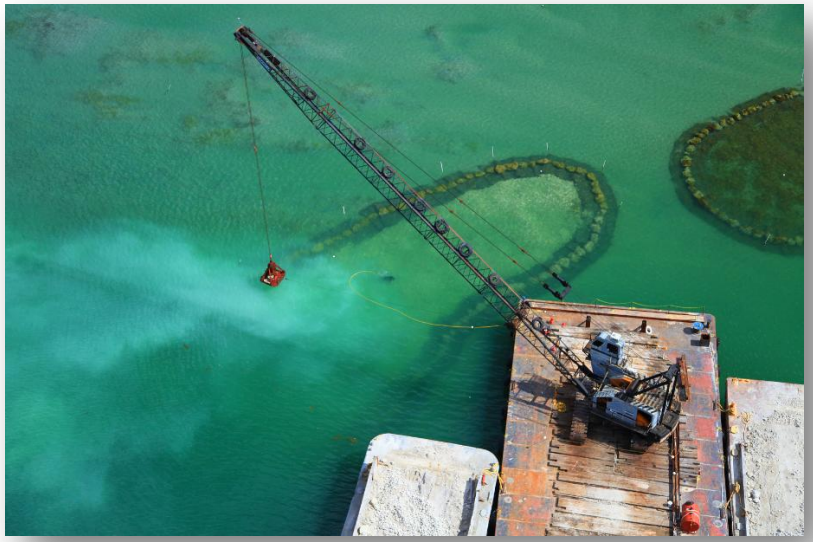
Permitting Issues

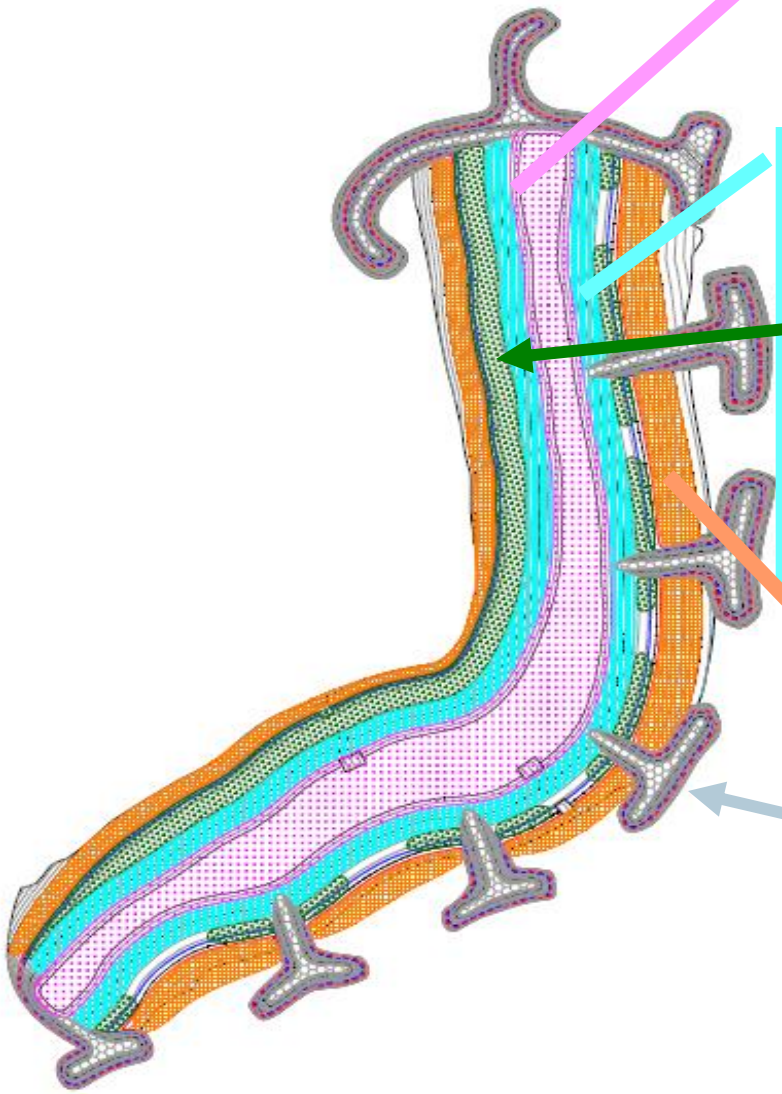
- Initial agency reaction
- State sovereign submerged land policy
- Precedence issue
- Technical concerns
  - Active flood shoal
  - Marine resources
  - Essential fish habitat
  - Aquatic preserve
  - Marine resource valuations
- EA/FONSI

Environmental Planning

Mitigation

- Most of environmental enhancements don't count
- Extensive off-site mitigation
- Extensive monitoring
  - Turbidity Control / Monitoring Plan
  - Island Performance Plan
  - Habitat Creation Plans
  - Habitat Monitoring Plan
  - Island Maintenance Plan
  - Four Mitigation Project Plans





Planning - Environmental

Mosaic Habitat Creation

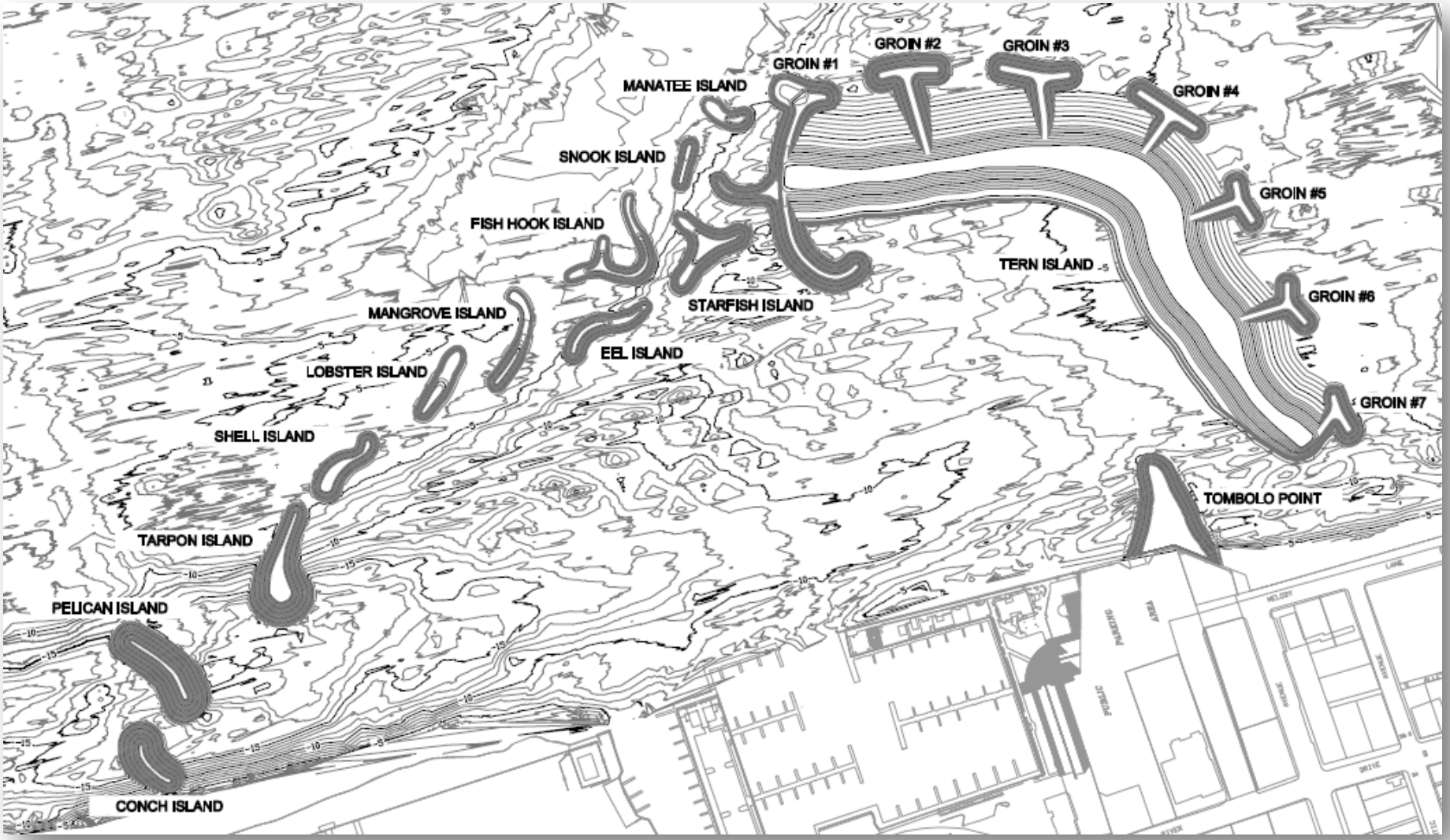
- Total island area = 15 acres
- Total habitat created = 21.7 acres
  - Oyster habitat = 1.3 acres
  - Artificial reef /riprap substrate = 6.3 acres
  - Mangrove communities = 1.5 acres
  - Coastal dune habitat = 2.2 acres
  - Seagrass recruitment = 8.1 acres
  - Shorebird habitat = 2.3 acres




Habitat Developing

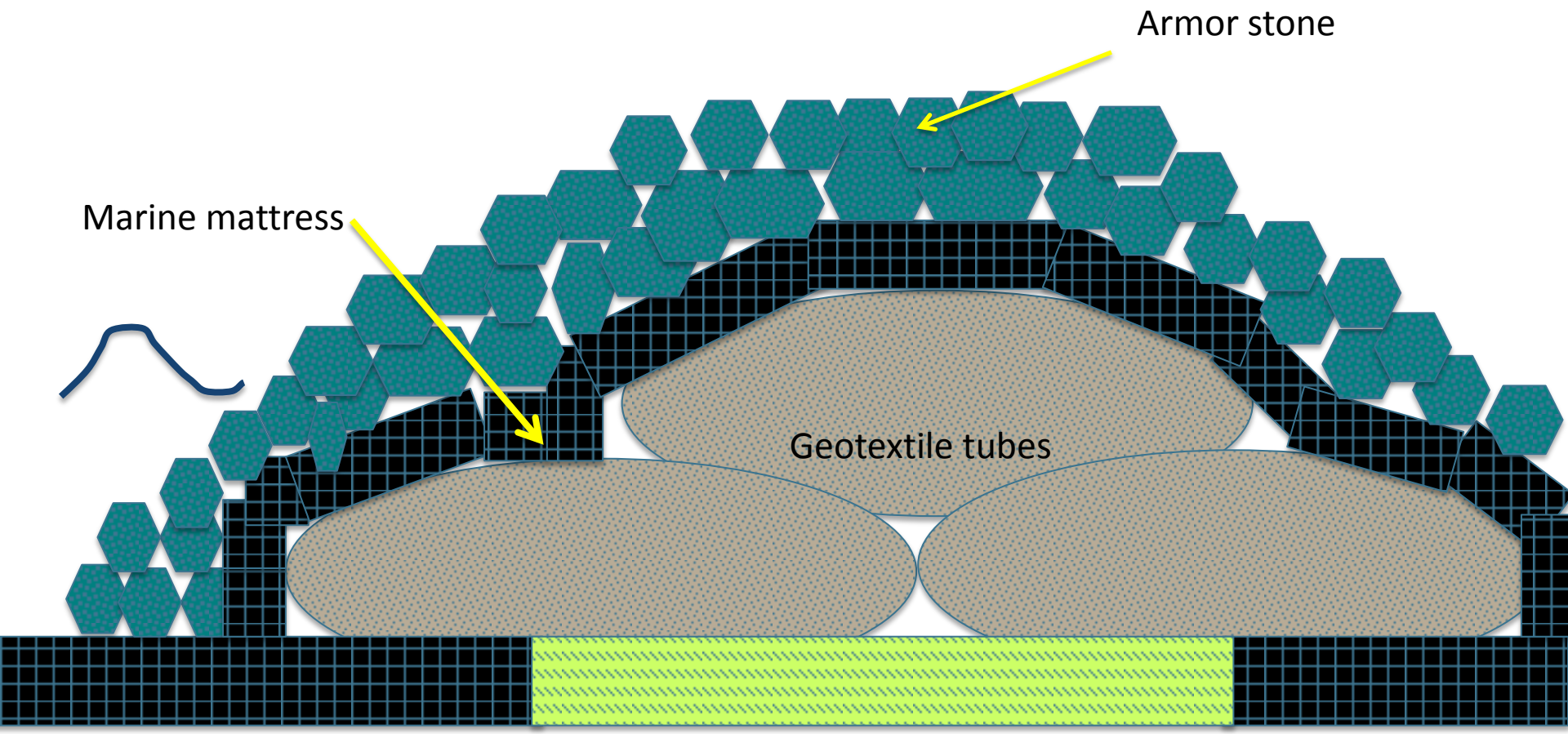
"I was very impressed by the breakwater habitat islands - I've never seen a proposal with such a well-designed net environmental benefit before; you really did a great job." **– Alexis Meyer, NOAA – NMFS Protected Resources Division**

Design

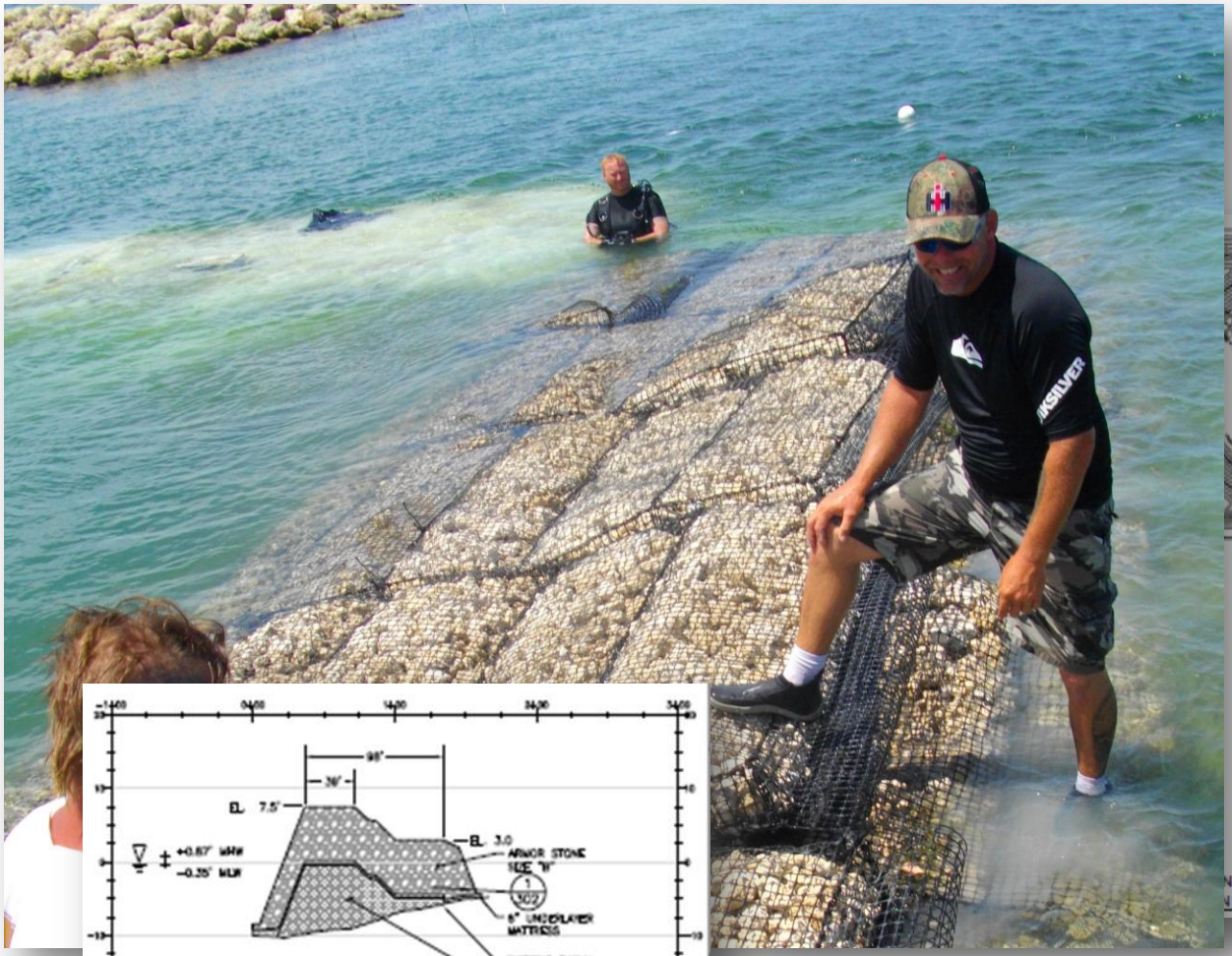

GROIN #1
GROIN #2
GROIN #3
GROIN #4
GROIN #5
GROIN #6
GROIN #7
MANATEE ISLAND
SNOOK ISLAND
FISH HOOK ISLAND
TERN ISLAND
STARFISH ISLAND
MANGROVE ISLAND
EEL ISLAND
LOBSTER ISLAND
SHELL ISLAND
TARPON ISLAND
PELICAN ISLAND
CONCH ISLAND
TOMBOLO POINT

Design - Marine Mattresses

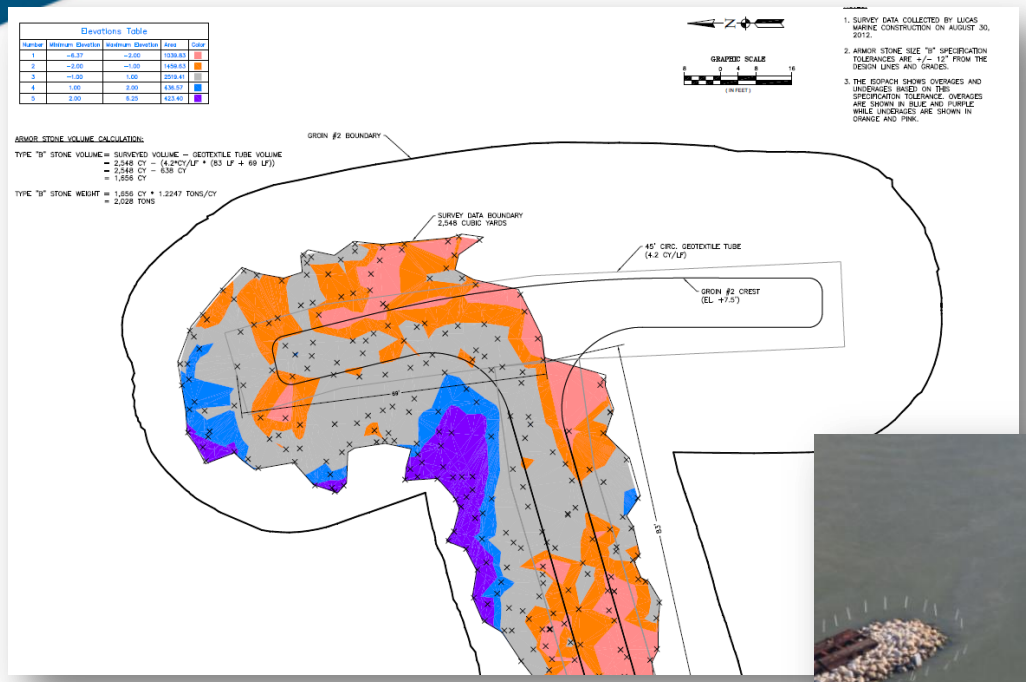
Design – Structure Section



Design – Tee Groins



Design - Armor Rock



Construction Monitoring

Special Construction Issues

- Construction sequence
- Proximity to marine resources
- Cost control
  - City purchased materials
  - FEMA budget limits

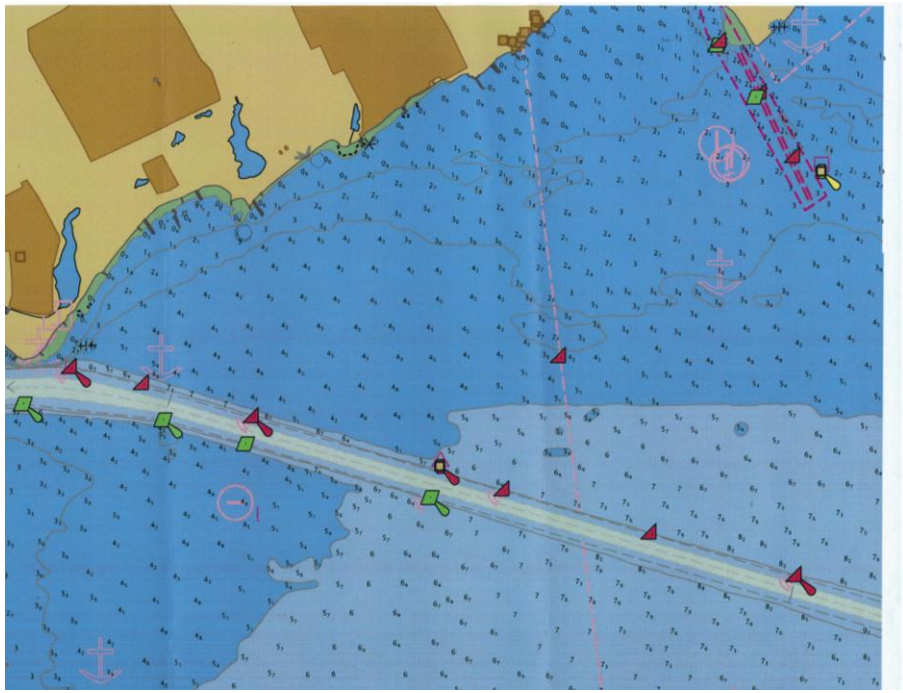
Construction Progress

Construction Progress

Construction Progress

Breakwater Island Applications

Shallow Water



Wave-affected Areas


QUESTIONS ?