USACE – Galveston District

Sustainable and Resilient Development of Nationally Significant Water Resources on the Texas Coast

Edmond J. Russo, Jr., PhD, PE, D.CE, D.NE, D.WRE
Deputy District Engineer
for Programs and Project Management
USACE, Galveston District

THU 21 APR 2016
3:40-4:00 pm
Session 45
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US Army Corps of Engineers
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Overview

- Galveston District (SWG) Value to the Nation
- Coastal Texas issues on sustainability and resilience
- Enabling program strategies, business practices, science, engineering, and technology
- Vignettes and vision toward sustainable and resilient regionally integrated infrastructure

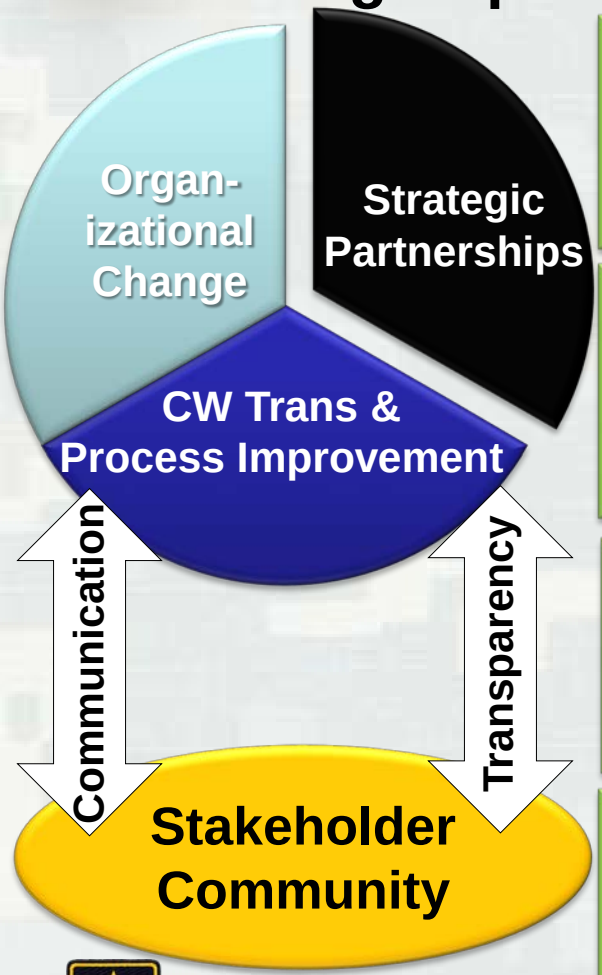
USACE – Galveston District

- Navigation
- Flood Risk Management
- Regulatory
- Ecosystem Restoration
- Emergency Management
- Interagency & International Support

- 50,000 square mile district boundary encompassing the Texas coast
- 28 ports handling 540 million tons of commerce annually
- 1,000+ miles of channels
  - 750 miles shallow draft
  - 270 miles of deep draft
- 367 miles of Gulf coastline
- 30 to 40 million cubic yards of material dredged annually
- 16 Congressional districts
- 48 Texas counties
- 18 Coastal counties - bays / estuaries
- 9 watersheds
- 2 Louisiana parishes

Texas Coast Strategy

Maximizing Capital



Lines of Effort

Improve Navigation
(Deepen / Widen / Safety / Capacity)

Sustain Federal Projects
(NAV / FRM / WQ Management O&M)

Support Non-Fed Investment
(Regulatory Permits, Real Estate Outgrants, Partnerships)

Reduce Coastal Risks
(Storm Damage, Ecosystem Restoration, Levee Certification)

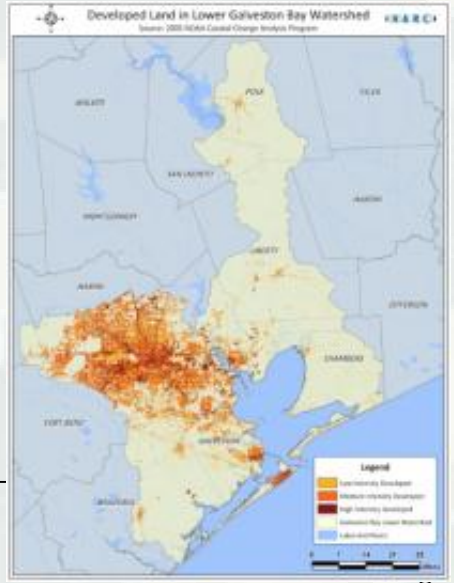
Future

Texas Coast is:

- A resilient community with healthy ecosystem
- Positioned for sustainable economic growth
- Supported by strategic partnerships that support Non-Federal investment

System Stressors and Future Scenario Drivers on Galveston District Missions

- Stressors
  - Extreme storm water levels (rivers, coast)
  - Dynamics of coastal shorelines, islands, wetlands, sediments, and debris
  - Drought effects on water availability and quality
  - Aging, outmoded, and/or exhausted infrastructure & equipment (e.g., locks, PAs, dredges)
  - Program funding levels
- Drivers
  - Relative sea level change
  - Changing legislation/policies
  - Resource availability (e.g., energy, land)
  - Development patterns/rates and modifications to natural systems

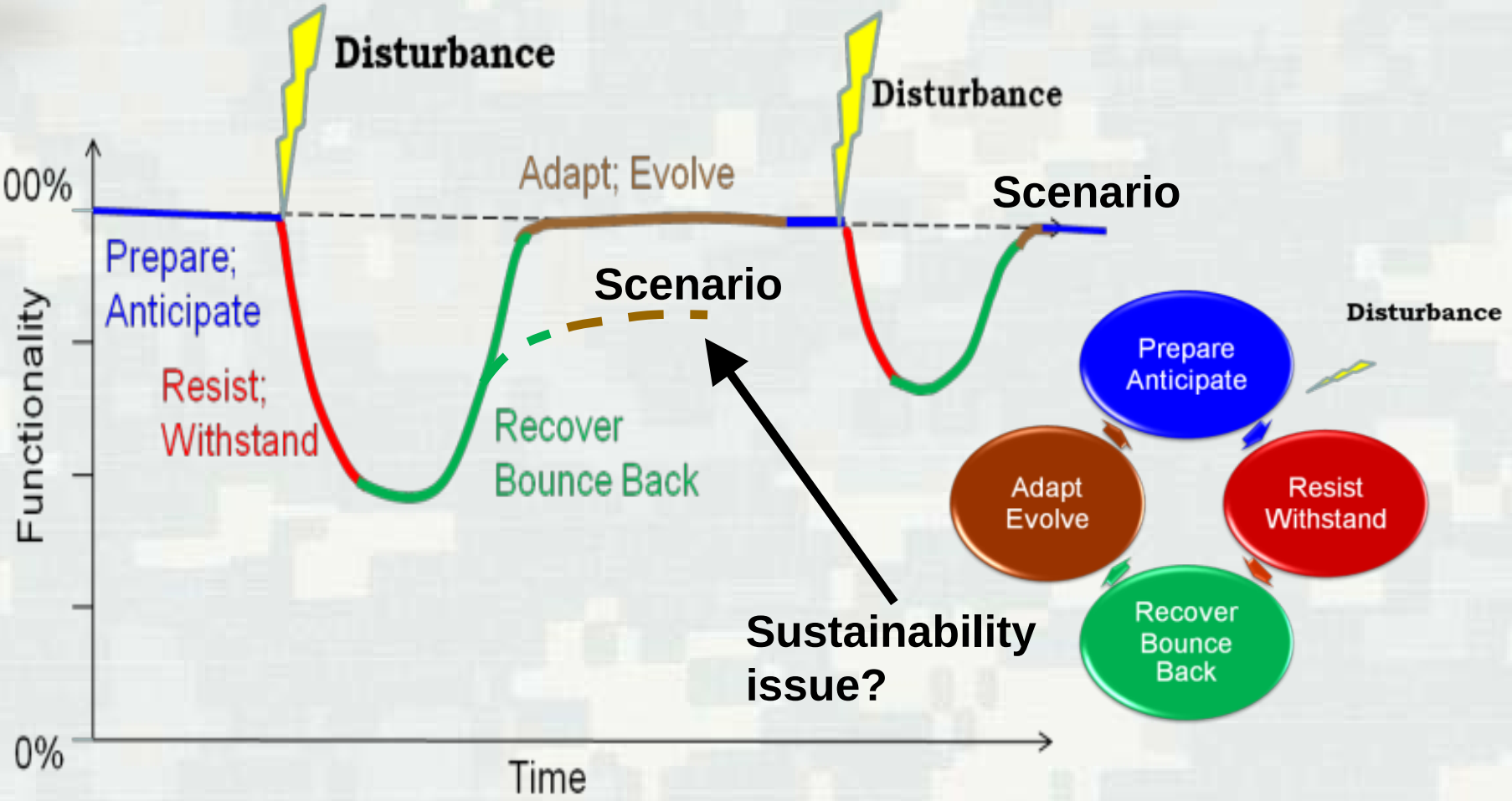


Working Definitions

- A **sustainable system**[a] is one whose functions are adaptively managed in a way that meets contemporary needs while ensuring those functions and needs are realized throughout the entire project lifecycle.
- An **integrated system** considers relevant interconnectivities of biophysical, engineered, economic, and anthropogenic systems and functions regionally across partnered business lines.
- The term "**resilience**[b]" may be considered as:
  - Ability of integrated infrastructure systems to resist and/or absorb disturbances, and
  - Retain their basic structure and function over time through advance preparations, impact recovery, and post-event adaptation

[a] Brundtland Commission (1987) [b] NAS (2012); E.O. 13653 (2013)

Concepts of Resilience against Disturbances and System Sustainability



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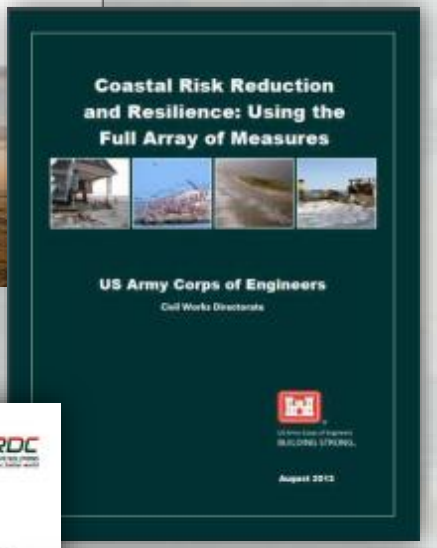
USACE Planning Systems Approach to Coastal Risk Reduction, Sustainability, and Resilience

- Supports integration of natural, nature-based, non-structural and structural measures for:
  - Reducing coastal risks
  - Increasing human and ecosystem community sustainability / resilience
- Considers engineering attributes of component features and life cycle dependencies and interactions among these features
- Considers full range of environmental and social benefits produced by component features



Coastal Program Building for Sustainability and Resilience

- Greatest opportunities for efficient and effective application during surges of economic development and inhabitation, rather than as afterthought
- Requires broad understanding and buy-in of concepts by agency leaders and stakeholders to be supported
- Potential for increased success via synergies across business lines supporting coalition building that resonates with decision makers for action
- Requires formation and use of a National team of experts under high level governance for realizing results
- Involves use of cutting edge S&T and incorporating innovations in practice for meeting expectations

Enabler: Enhancing Strategic Partnerships

- Texas coast shared visioning for alignment of agency values toward mutually desired outcomes
  - Vibrant regional and national economy
  - Resilient and sustainable communities
  - Healthy, diverse, and functional ecosystems
- Driving progress through regularly-engaged partnering and governance
  - Multi-agency participation (Local, State, Federal)
  - Shared vision steering
  - Identifying / resolving barriers to progress
- Team building, collaboration, and unified communications
  - Articulating challenges and successes
  - Building stakeholder awareness and support for action
  - Supporting elected officials with information they need

Collaboration with Partners/Clients/Stakeholders

Maximizing Capital

CBP & ICE

Port of Corpus Christi

Port of Texas City

Port of Harlingen

USDOT MARAD

Communication

Transparency

Stakeholder Community

Enabler:
Regional Sediment Management (RSM)

…Managing sediment regionally has potential to save money, allow use of natural processes to solve engineering problems, and improve the environment.

Key Elements:

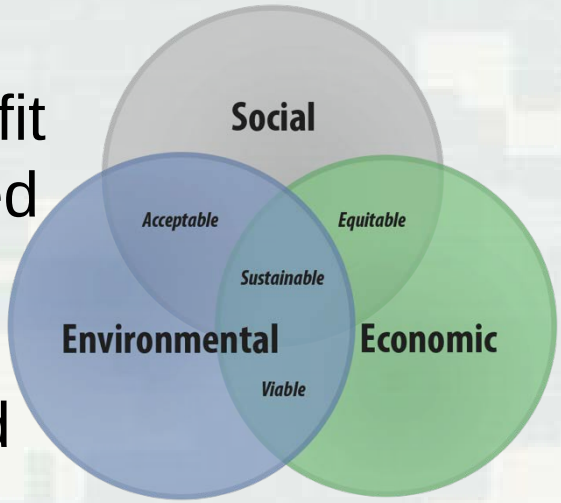
- Uses a river watershed and coastal basin systems approach
- Incorporates physical processes and effects of anthropogenic influences
- Supports stewardship of natural resources in balance with economic development and national security needs

Enabler:
Engineering with Nature (EWN)

…the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

Key Elements:

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes across agency programs to organize and focus interests, stakeholders, and partners



"Manage"

- Plan
- Execute
- Adapt

"Intersect"

- Infuse new knowledge
- Tech transfer enterprise tools
- Pilot-demo & prove innovations
- Improve on-the-job workforce skills

"Shape"

- Enhance strategic partnerships
- Address policy and authority "conundrums"
- Revolutionize business practices
- Evolve science to close priority knowledge gaps
- Co-develop / apply enabling technologies

"Analyze"

- Objectively monitor performance
- Identify key uncertainties, inefficiencies, and barriers to decision making

Enabler: High Performing Culture for Continuous Process Improvement

Vignette: Placement Area (PA) Capacity – Houston Galveston Navigation Channel (HGNC) Complex

Sustainability / resilience issues:

- Capacity for FED channel O&M (routine/extreme shoaling events)
- Capacity for non-FED users
- Real estate availability
- Future environmental impacts
- Beneficial use opportunities

- **Phase 1: RSM Placement Area Optimization, Houston Ship Channel (HSC) in Galveston Bay** Optimization of navigation channel network, historical sedimentation and dredging, and system of placement areas, informing DMMP update
- **Phase 2: Dredged Materials Management (DMM) Modernization, GIWW, High Island to Brazos River Reach** Streamline Preliminary Assessments / DMMP technical analyses and communication

Dredged Materials Management Requirements / Tools

Timing, location and volume of prioritized dredging needs

eHydro-CSAT-CPT

- Timing, location, volume of FED / Non-FED materials dredged / placed
- PA remaining capacities
- PA management quality

CE-Dredge Dredging Manager

Navigation channel and Placement Area (PA) locations

Nat'l Channel Framework and PA Databases

SAGA

Sediment characteristics in channels and PAs

- Sediment sources
- Sediment location needs
- Natural transport pathways

SBAS

EcoSyn

Ecological habitat impacts in dredging / PAs

BU-ADMM

ID of potential new BU opportunities

CE-Dredge Dredging Manager

Closeout: Final volumes, payment, reports, etc.

SedMan & Dredging Technologies

- ID dredging and placement options
- ID tools / models to evaluate options

D2M2

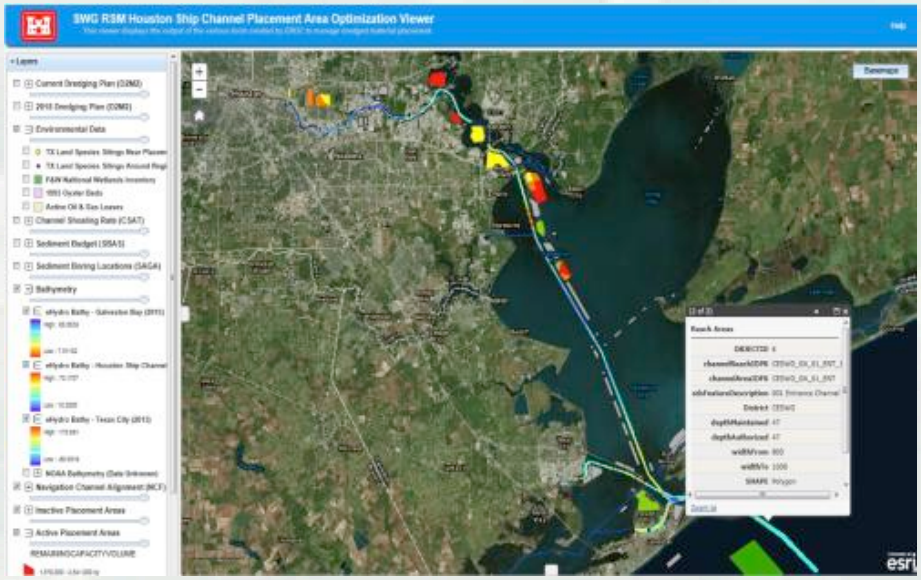
Construction compliance

DQM

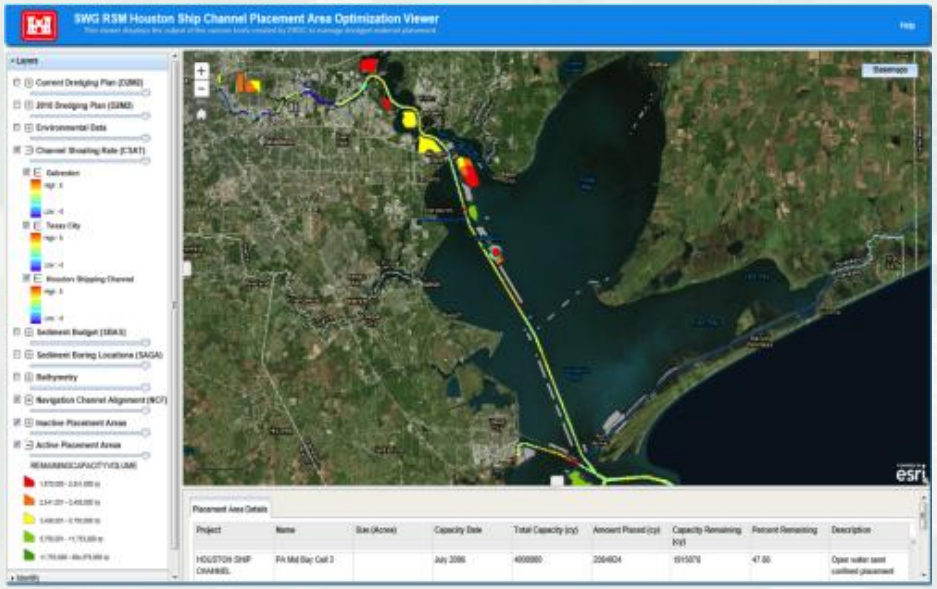
Stakeholder priorities

Optimal dredging and placement options for goals

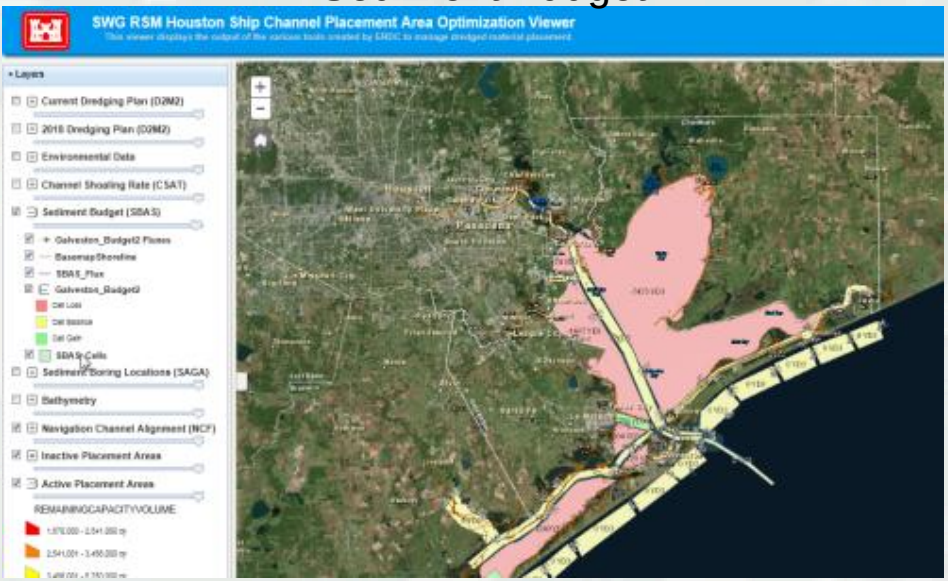
Placement Areas: Color Coded By Capacity Channel Surveys and Dimensions



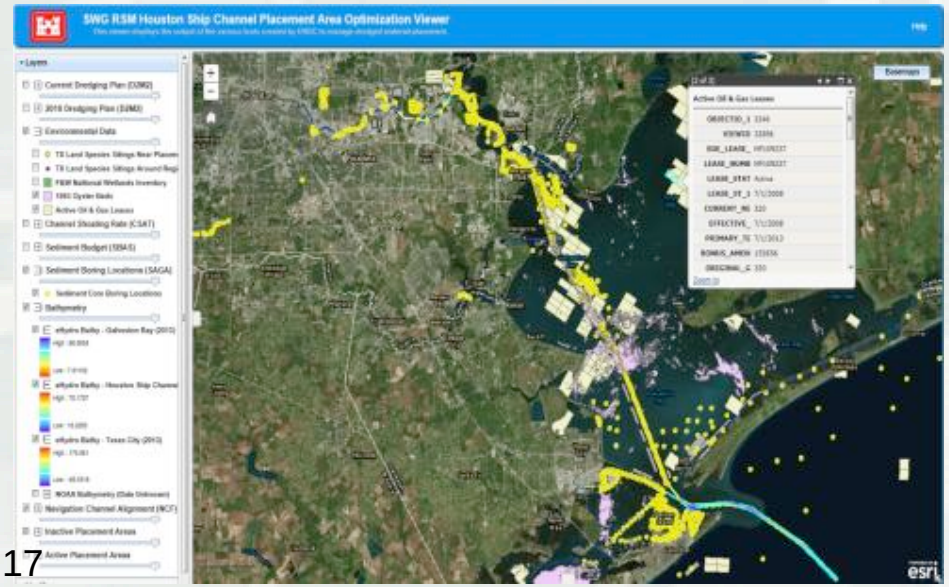
Placement Areas with Capacity Table Channel Shoaling Areas



Sediment Budget



Oyster Beds, Active Oil & Gas Leases, Core Borings



PA Management Way Forward

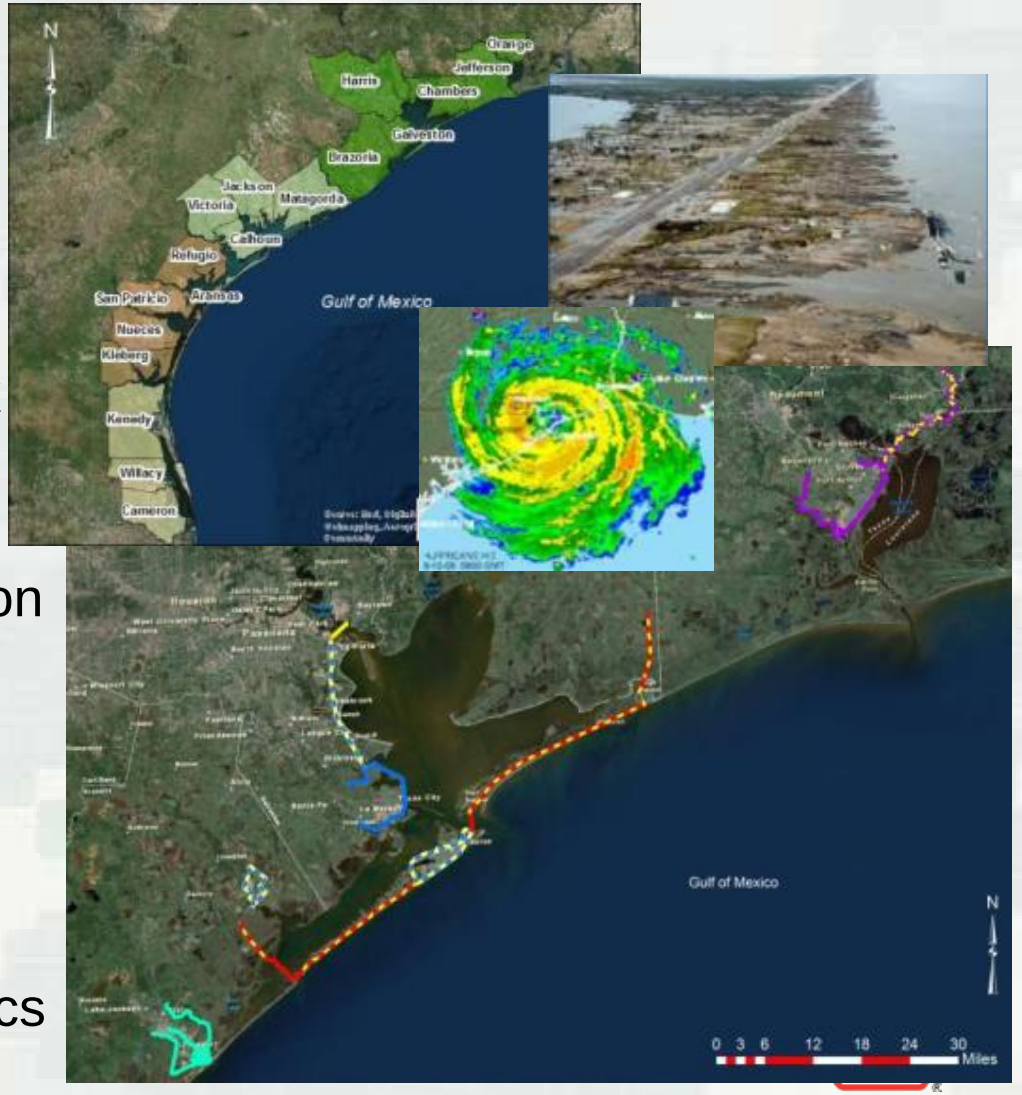
Completion of Phase 2: GIWW, High Island to Brazos River Reach – Modernize and streamline Preliminary Assessments / DMMP technical analyses and communication, which will involve:

- Populating enterprise databases
- Integrating tools – streamline access to data (input / output)
- Incorporate data and results into Navigation / Dredging Portal
- Technical Transfer and Training with SWG
- Stakeholder engagement

Future: Scheduling / budgeting parametric tool for 5-yr plan annual updates and repository for all historical project records, **"living" DMMPs** for HGNC and GIWW

Vignette: USACE Storm Risk Management and Ecosystem Restoration Projects

- Sabine Pass to Galveston Bay Feasibility Study and Coastal Texas Mega Study
  - Develop comprehensive plan with detailed regional focus
  - Determine Coastal Storm Risk Management (CSRM) risk reduction solutions
  - Develop Ecosystem Restoration (ER) projects to restore degraded ecosystems
  - Incorporate relative sea level change into analyses
  - Does not address potential changes in storm characteristics



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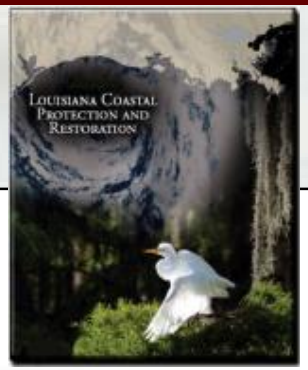
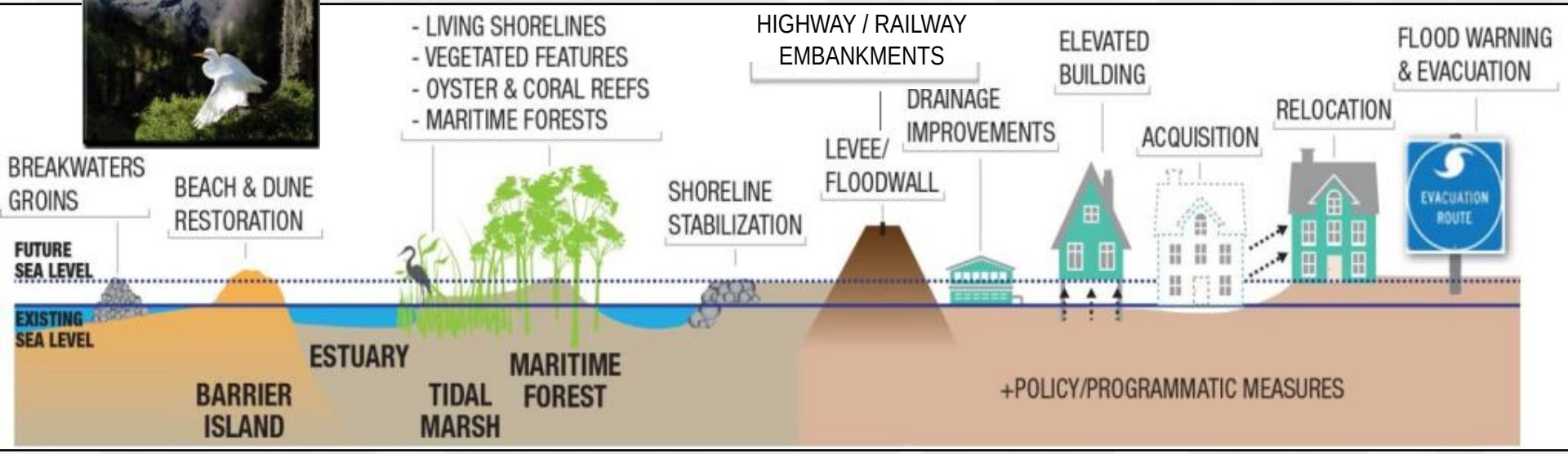
Strategy for Sustainability and Resiliency: Multiple Lines of Defense (MLD)





- Combination of structural, non-structural, and NNBF:
  - Coastal storm damage risk reduction
  - Coastal ecosystem restoration
- Uses an integrated natural/engineered systems approach
- Supports coastal sustainability and resilience

Coastal Storm Risk Management Measures

Storm surge barriers, spillways, levees, floodwalls, and gates

Asset relocation, elevation, and strengthening

Shoreline management

Coastal restoration

Sustainability / Resiliency Issues: Barrier Plan Alternative

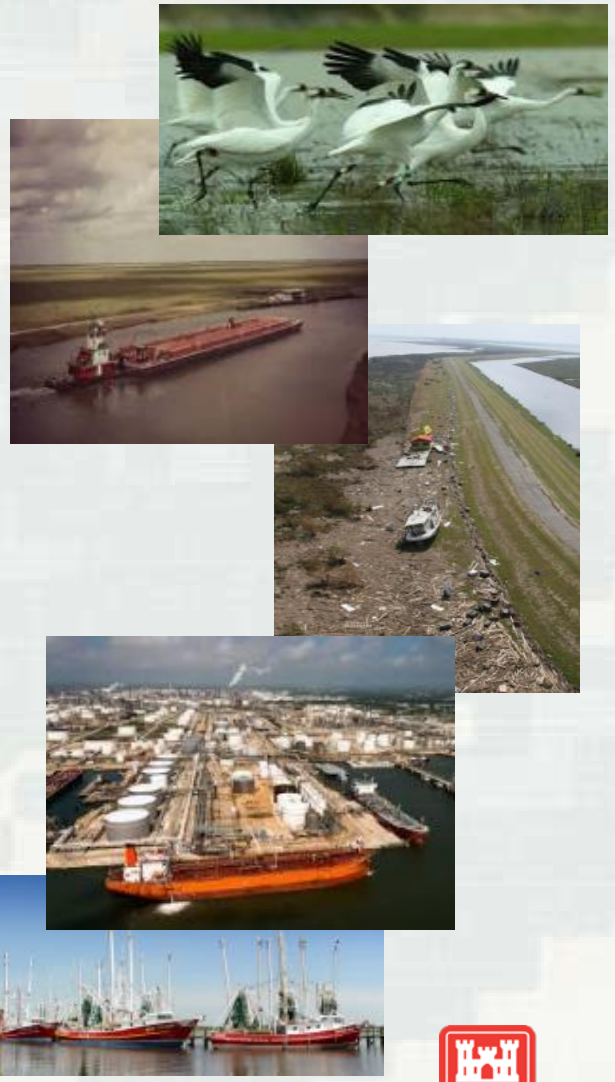
- Managing life cycle requirements of both HGNC and CSDRM system at surge barrier “mega structure”
- Limits on structural system adaptability from engineering, environmental, social, and real estate perspectives
- Unknowns of long term O&MRR for mega structures
- Potential for induced low-lying development within enclosed barrier system subject to flood damages with system changes over time
- Direct/indirect, cumulative, long term environmental impacts to bay system
- Federal budget affordability
- Financial demands on non-Federal sponsor(s) in construction and O&MRR phases

Sustainability / Resiliency Issues: Perimeter Plan Alternative

- Managing life cycle requirements of both HGNC and CSDRM system components
- Potential for increasing/changing demands on forced interior drainage systems in future
- Limits on structural system adaptability from engineering, environmental, social, and real estate perspectives
- Potential future increased vulnerability of non-structural measures outside of discrete structural CSDRM systems in future with system changes over time
- Federal budget affordability
- Financial demands on non-Federal sponsor(s) in construction and O&MRR phases

Science, Engineering, and Technical (SET) Challenges for Sustainability / Resilience

- Organize and expand science and engineering related to natural processes and features
  - Reduce uncertainties of NNBF design and construction
  - Understand dynamic performance of NNBF
  - Learn how to effectively integrate NNBF with other measures on a regional scale
- Integrating expertise across disciplines and organizations
  - Research, development, pilot-demo, and scaling up new knowledge
  - Planning, designing, constructing, operating, monitoring, and maintaining integrated built infrastructure-NNBF systems



Addressing SET Challenges: Establishment of SWG EWN Proving Ground

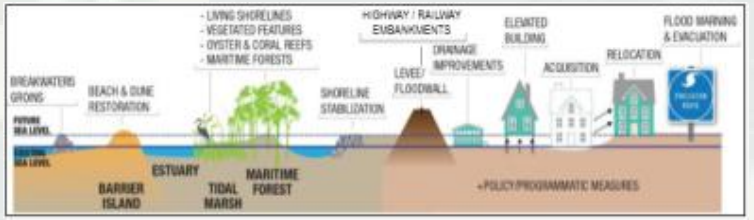
- Collaborate across USACE:
  - Galveston* (SWG), Buffalo* (LRB), and Philidelphia* (NAP) Districts
  - US Army Engineer Research and Development Center (ERDC) and Mobile District (SAM)

* Proving Grounds

- Engage stakeholders to understand interests and inform life cycle project decision making
- Manage TX coast as systems portfolio
- Derive synergies across business lines for enhanced efficiency / effectiveness
- Incorporate coastal storm and RSLC resilience and sustainability via integration of built and natural features
- Exploit EWN and RSM concepts, methods, tools, and resources as enablers

Vision for Sustainable and Resilient Regionally Integrated Infrastructure

- Interconnected portfolio of partnered projects across business lines.
- Incorporates RSM, EWN, NNBF, and MLD principles.
- Nested/networked infrastructure interoperating regionally to deliver broad spectrum of enduring economic, environmental, and social values.
- Value proposition for pursuit via inter-operational synergies:
  - Transformed organizational technical, business, and management processes,
  - High performing workforce culture, and
  - Parties who understand, contribute to, and value the concepts and support infusion into practice.



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Assessing Long Term Vulnerability and Resilience using Performance Metrics

Dunes and Beaches

Benefits/Processes

Break offshore waves

Attenuate wave energy

Slow inland water transfer

Performance Factors

Berm height and width

Beach Slope

Sediment grain size and supply

Dune height, crest, width

Presence of vegetation

Vegetated Features:

Salt Marshes, Wetlands, Submerged Aquatic Vegetation (SAV)

Benefits/Processes

Break offshore waves

Attenuate wave energy

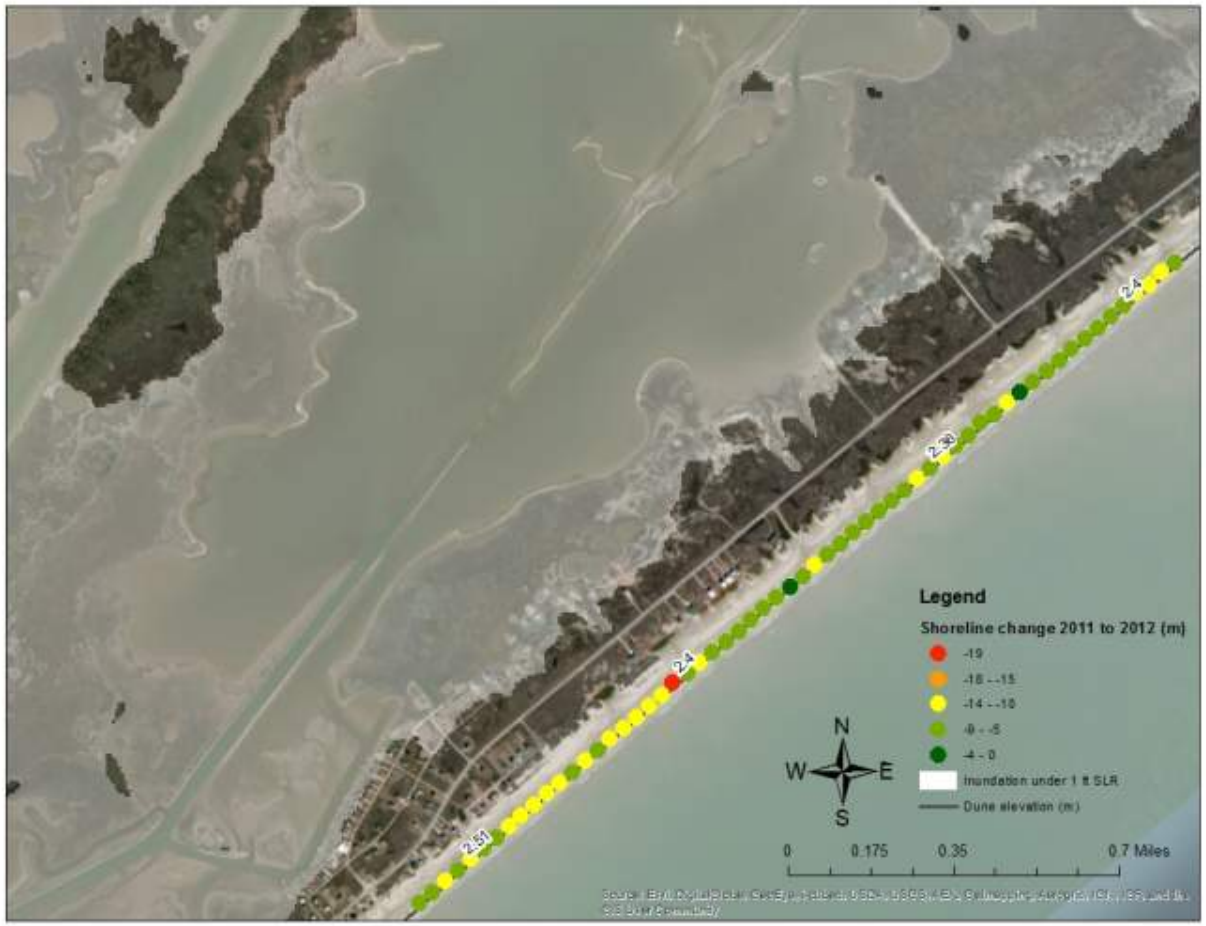
Slow inland water transfer

Increase infiltration

Performance Factors

Marsh, wetland, or SAV elevation and continuity

Vegetation type and density



Inundated under +1 ft of RSLC

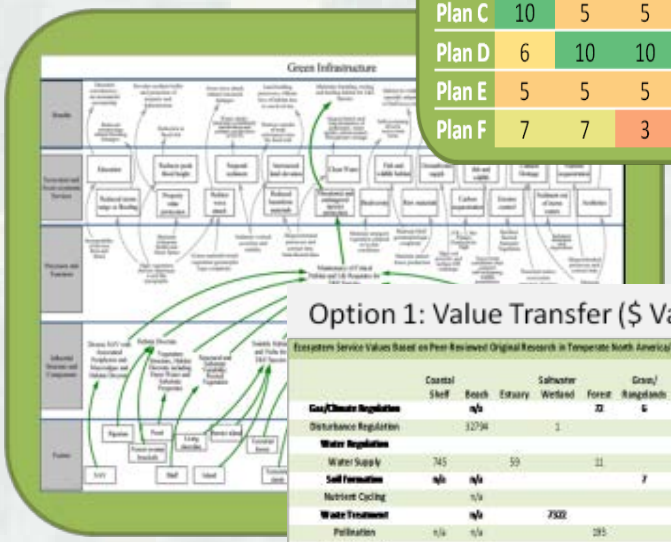
Drum Bay, Follets Island

System Performance Evaluation

Wt	1	2	4	3	5		
	B1	B2	B3	B4	B5	Mean	Wtd
Plan A	10	8	5	1	0	4.8	49
Plan B	10	10	0	0	0	4	30
Plan C	10	5	5	9	7	7.2	102
Plan D	6	10	10	8	5	7.8	115
Plan E	5	5	5	10	10	7	115
Plan F	7	7	3	4	7	5.6	80

- **Level 1** – Qualitative characterization of performance
- **Level 2** – Semi-quantitative characterization of performance
- **Level 3** – Quantitative characterization of performance

72 individual performance metrics identified for NNBF



Option 1: Value Transfer ($ Value per acre)

Option 2: Ecosystem Production Functions

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Future Potential Opportunities: Increase Scientific Understanding

- Performance of BUDM placement configurations
  - Mounds with edges
  - Marsh with edges
  - Contribution to coastal resilience (wider island)
  - Value of upland habitat and perched wetlands (storm forces dampening)
- Communication of scientific findings to interested and affected parties for understanding and buy-in

Future Potential Opportunities: Broaden the Regional Benefits

- Harvest and reuse materials from upland confined PAs to create natural and nature based elements via BUDM:
  - Emergent wetland restoration
  - Sub-aquatic habitat restoration
  - Coastal sustainability and resilience
  - Recreation
  - Commercial fisheries
- Reuse suitable new work dredged materials for CSDRM structural measures, integrated with NNBFs

Goods
Water, food, energy, materials

Services
Natural systems functions, wildlife and human inhabitation

Human Needs
Sustenance, shelter, regulation, education, inspiration, spiritual, symbolic, aesthetic, recreation