REGIONAL SEDIMENT MANAGEMENT Program

ERDC
Engineer Research and Development Center

Linda Lillycrop
Program Manager

Jeff McKee
HQ, Proponent
Navigation Business Line Manager

Jeff Lillycrop
Technical Director, Navigation

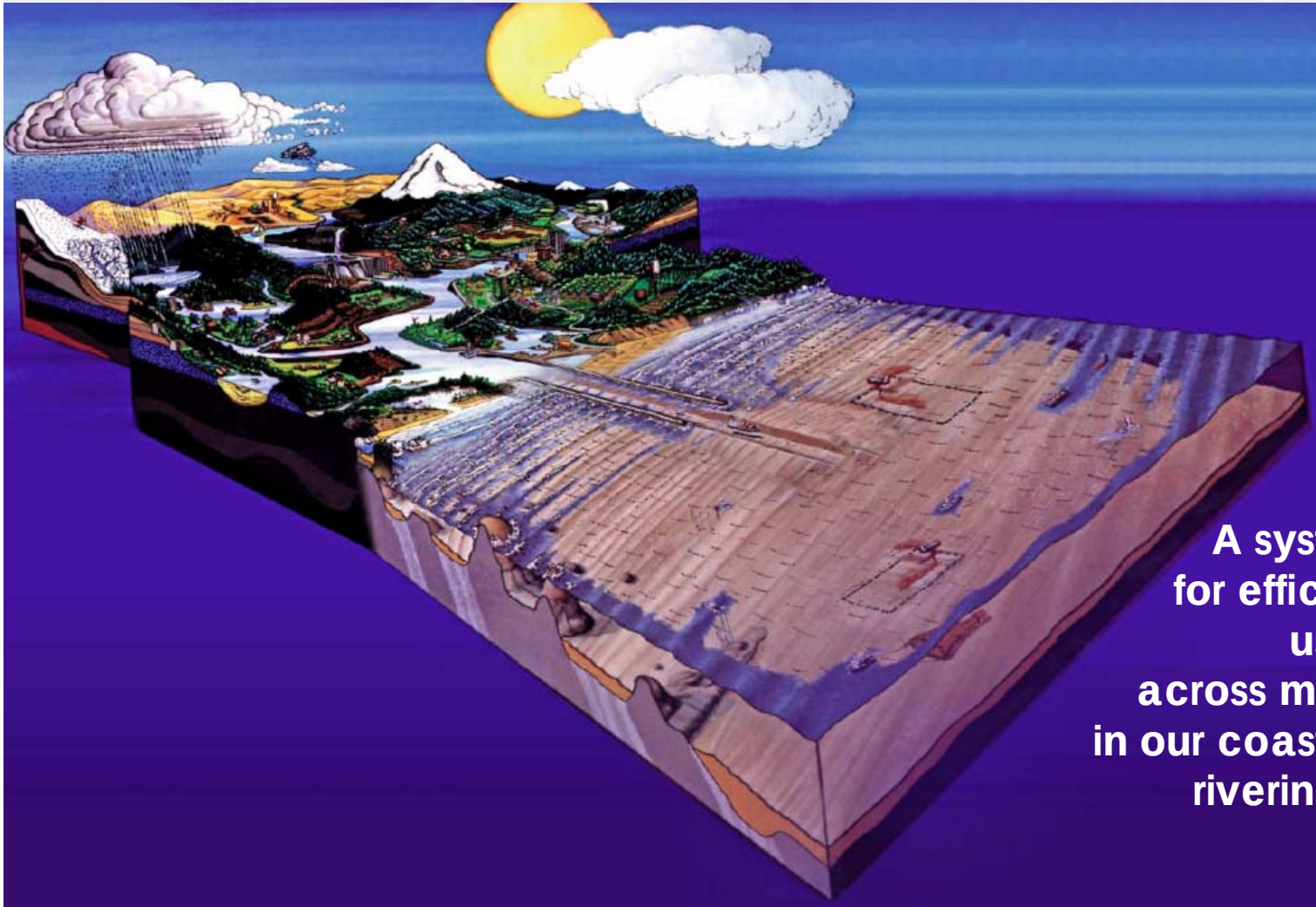
Eddie Wiggins
Associate Technical Director, Navigation

Navigation Research Area Review Group Meeting
7-9 April 2015

US Army Corps of Engineers
BUILDING STRONG®

USACE REGIONAL SEDIMENT MANAGEMENT (RSM)

ESTABLISHED OCTOBER 1999, CERB CHARGE



A systems approach for efficient & effective use of sediments across multiple projects in our coastal, estuarine, & riverine environments

RSM = Sustainable Solutions for…..

Navigation/Dredging	Flood Risk Management	Environmental Restoration
		

RSM Operating Principles:

- Recognize sediments as a regional resource; prioritize use
- Link and leverage across multiple projects, business lines, authorities
- Improve operational efficiencies & natural exchange of sediments
- Economically viable, environmentally sustainable solutions
- Local sediment actions which benefit the region, consider regional impacts
- Enhance technical knowledge/tools for regional approaches
- Share information and data
- Communicate and collaborate – USACE, Stakeholders, Partners
  ASBPA, WEDA

RSM Program

Districts

Regional Approaches

Coordination

Technology Transfer

Integrate RSM Across Projects and

Navigation O&M

Continuing Authorities Program

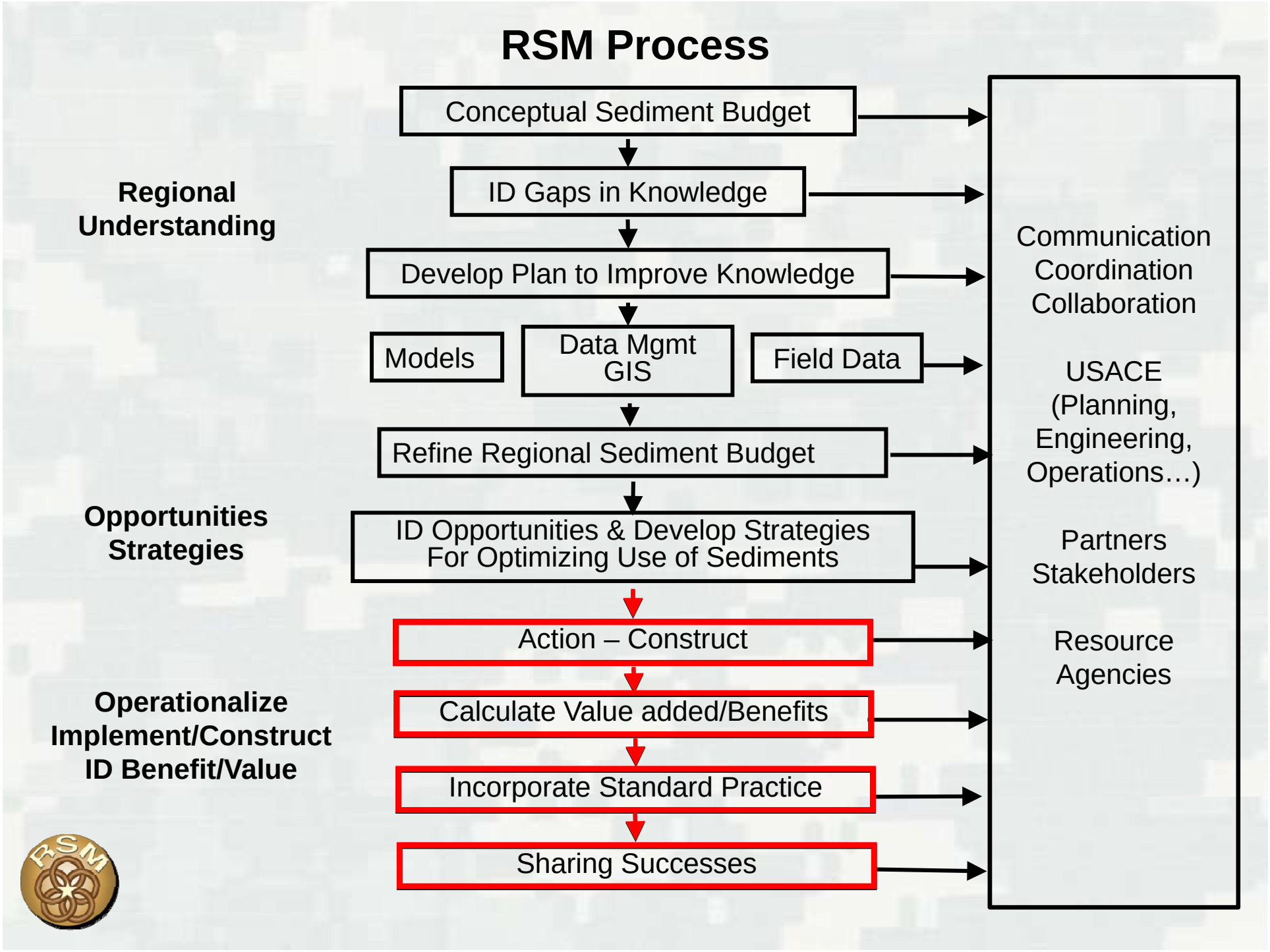
Dredge Material Mgmt Plans

Feasibility Studies

Other

Construction

RSM Process


Regional Understanding
Conceptual Sediment Budget
ID Gaps in Knowledge
Develop Plan to Improve Knowledge
Models
Data Mgmt GIS
Field Data
Refine Regional Sediment Budget
Opportunities Strategies
ID Opportunities & Develop Strategies For Optimizing Use of Sediments
Operationalize Implement/Construct ID Benefit/Value
Action – Construct
Calculate Value added/Benefits
Incorporate Standard Practice
Sharing Successes
Communication Coordination Collaboration
USACE (Planning, Engineering, Operations…)
Partners Stakeholders
Resource Agencies

HISTORICAL RSM PARTICIPATION (2000-2015)

◆ 27 Districts (20 Coastal, 7 Inland)

◆ ERDC, IWR-HEC

NDIF

CODS

RSM FY14 Participation

RSM FY14: 22 Districts, ERDC, IWR/HEC

RSM FY15 Participation

RSM FY15: 20 Districts, ERDC, IWR/HEC

RSM Program Funding Process

- Request for Proposals (FY16 Proposals due 17 July 2015)
- Submittals THRU:
  - District RSM POC
  - District Chief, Operations
  - MSC RSM POC and MSC Chief, Operations
- Submittals TO:
  - HQ, Navigation Business Line Manager, Jeff McKee
  - ERDC RSM Program Manager, Linda Lillycrop

- Review Team: Districts (Coastal/Inland); CWG Lead; Inland POC, R&D PMs
- RSM PM formulates program
- Recommend Program/Budget ERDC TD Navigation
- Recommend/Approval to HQ Navigation Business Line manager
- Notify Districts of selections

Required from all initiatives:

Quarterly Progress Reports, Fact Sheets, Present RSM-EWN IPR/Workshop

Lessons Learned: RSM Technical Notes

RSM FY16 Proposal Criteria

- **Supports RSM and EWN Principles and Practices**
- **Takes action to optimize and move sediment**
- **Reduces lifecycle costs/Increases benefits or value added**
- **Innovative solutions**:
  - Links multiple projects, business lines, programs, projects
  - Develops new capabilities or techniques.
- **Utilizes existing/enhances Corps tools & builds Corps expertise**
- **National significance & product transferability**
- **Technical Transfer**:
  - Communicate lessons learned / Publish results
  - Calculate benefits/value-added
  - Participation in Annual RSM-EWN IPR & Workshop
- **Past Performance: Completed Products, Milestones, Participation**

FY16

- **Establish Interagency/Stakeholder Working Group**
- **Hold IWG meeting**
- **Calculate benefits/value-added**

FY15: 38 proposals submitted, 20 selected

*FY16 Proposals due 17 July 2015

FY14 RSM

Districts

LRC IL North Shore Sediment Budget, RSM Strategy
NAB Atlantic Coast of MD Sediment Budget, RSM Strategy
POH West Maui Sediment Budget, RSM Strategy
SAJ N Coast Puerto Rico Sediment Budget, RSM Strategy
SAW Masonboro Inlet Sediment Budget, RSM Strategy
NAE Saco Bay-Scarborough Inlet RSM Strategy
NAN Sandy Hook Channel Sediment Management
SWG Galveston Entrance Channel RSM
MVR Sangamon/Illinois River System Analysis
MVS Kaskaskia River Sedimentation Reduction
SAC Charleston Harbor Modeling, RSM Strategy
NAO James River Navigation Channel, RSM Strategy
SAJ Nassau & Duval Co RSM Strategies
NWP Yaquina Jetty Sediment Stabilization-Sand Fencing
SAJ/ERDC Fate of Fines/Ship to Shore
SPD/Corpswide Nearshore Placement
LRE/LRB RSM PDT, Nearshore Placement, CE-Dredge Data
NAP Document Post Sandy/Irene RSM-EWN Strategies/Actions
NWO Inland RSM-EWN Workshop, RSM PDT/Coordination
NWK Inland RSM-EWN Workshop, Reservoir Sustainability

R&D/Tech Transfer

Nav Data Integration Framework
CE-Dredge Dredging Histories DB
Sediment Analysis & GeoApp
RSM Projects Database
Nearshore Placement Guidance/Tools
Sediment Budget Analysis System
Defining Coastal Regions – Lidar
CIRP/DOER Model/Tool Applications
NCMP Data and Tools
Engineering With Nature

FY15 RSM

Districts

LRB Sediment Budgets Lake Erie/Ontario
LRC IL North Shore Sediment Budget & RSM Strategy
POH Sunset Beach Oahu Sediment Budget & RSM Strategy
NAE Saco Bay Sediment Budget & RSM Strategy
NAP Barnegat Inlet & Bay System RSM & EWN strategy
NWP Lower Columbia River RSM Strategy
NAO James River Navigation Channel, RSM Strategy
SAJ Puerto Rico Sediment Budget & RSM Strategy
SPL CA RSM Plans – Implementation
SPN CA RSM Plans – Implementation
SAC Stakeholder Coordination
NAP Data Management Major NAP Navigation Projects
SWG Lower Matagorda Ship Channel Shoaling Reduction/Tools
SAM/SAJ Eval FL Turbidity Compliance Issues w/Nav Projects
SAM BU Dredged Material: Fill Oyster Dredge Holes Mobile Bay
NWS Ediz Hook post-dam removal shoreline change
MVR Sangamon/Illinois River Sedimentation Reduction
NWO Monitor Spencer Dam Flushing: enhance HEC-RAS Reservoir Flushing Modeling
NWK Environmental Benefits of Turbidity in the Kansas River
SPA Post-Wildfire Sedimentation Impacts to Cochiti Lake FRM
POH Fate of Inland Sediment in Nearshore Environment
SAJ RSM-Center of Expertise

R&D/Tech Transfer

Nav Data Integration Framework
RSM Projects Database
RSM Portal
DOER CE-Dredge Dredging Manager
Sediment Budget Analysis System
Sediment Analysis & GeoApp
CIRP/DOER Model/Tool Applications
NCMP Data and Tools
Benthic Mapping Demonstration
Engineering With Nature

FY14 Program Publications – 15 Technical Notes, 5 Technical Reports

CHETN-XIV-36	Regional Sediment Management (RSM) Modeling Tools: Integration of Advanced Sediment Transport Tools into HEC-RAS	NWO/IWR
CHETN-XIV-37	Potential Regional Sediment Management (RSM) Projects in the Haleiwa Region, Oahu, Hawaii	POH
CHETN-XIV-38	Sediment Budgets for the Haleiwa Region, Oahu, Hawaii	POH
CHETN-XIV-39	The Atlantic Coast of Maryland, Sediment Budget Update	NAB/ERDC
CHETN-XIV-43	Reservoir Sediment Management Workshop for Tuttle Creek Lake and Perry Lake Reservoirs in the Kansas River Basin	NWK
In-publication Reviw		
CHETN-XIV-40	Alternatives to Reduce Shoaling in the Gulf Intracoastal Waterway and Prevent Erosion of Barrier Islands along the North Shoreline of West Galveston Bay	SWG/ERDC
CHETN-XIV-41	Regional Sediment Management (RSM) Strategy for Mobile Bay, Alabama	SAM/ERDC
CHETN-XIV-42	Benefits and Lessons Learned from Maintenance Dredging Projects using Government Shallow-Draft Dredges within the USACE Jacksonville District	SAJ/ERDC
CHETN-XIV-44	Reservoir SEDiment MANagement (SEDMAN) Technologies Interactive Web Interface: An Overview	ERDC
CHETN-XIV-45	Saco Bay, Maine: Sediment Budget for Late-20th Century to Present	NAE/ERDC
CHETN-XIV-46	Identification of Alternatives to Reduce Shoaling in the Galveston Entrance Channel, Texas	SWG/ERDC
CHETN-XIV-47	Beach and Morphology Change Using Lidar	SAJ
CHETN-XIV-48	Regional CMS Modeling; Southwest Florida Gulf Coast	SAJ
CHETN-XIV-49	Regional Sediment Management (RSM) Assessment of Longboat Pass, Manatee County, FL	SAJ
CHETN-XIV-50	Passage Key Inlet, Florida; CMS Modeling and Borrow Area Impact Analysis	SAJ
	Northeast Florida Regional Sediment Management: Implementation Strategies and Recommendations for Nassau County and Duval County, Florida	SAJ
	Hawaii RSM: Regional Sediment Budget for the West Maui Region	POH
	RSM Strategies for the Vicinity of St. Augustine Inlet, St. Johns County, Florida	SAJ
	Sediment Transport Analysis; Port Orford, Oregon	NWP
	Sediment Budget Analysis; Masonboro Inlet, North Carolina	SAW

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RSM Technical Notes, Reports, Manuals, Conference Papers

Bi-Monthly RSM Conference Calls Webinars

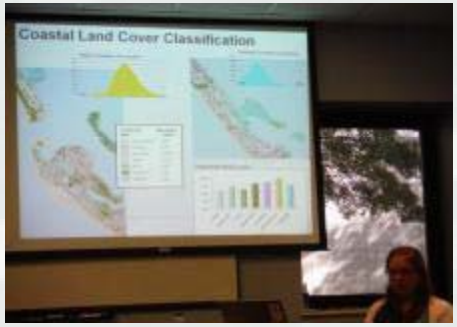
Technical Webinars with Districts

CE-Dredge Dredging Manager
Sediment Sampling Database
Sediment Analysis and GeoApp
Sediment Budget Analysis System

15th Annual
RSM and EWN
In-Progress-Review and Workshop

18-20 August 2015
Vicksburg, MS

Please Join Us!!



2014 RSM and EWN IPR and Workshop
Coastal and Hydraulics Laboratory, Vicksburg

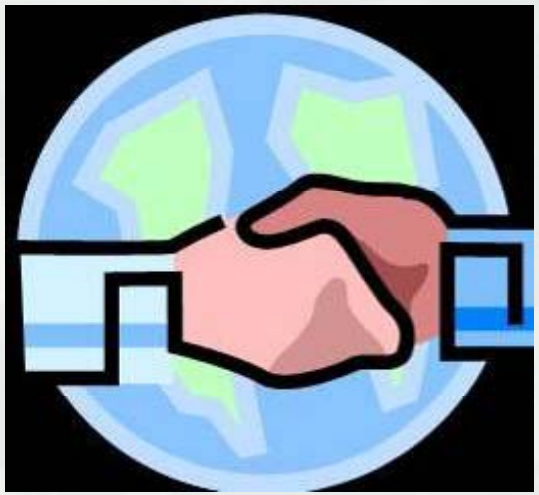
*PDH available

Linda.S.Lillycrop@usace.army.mil

FY14 RSM District RSM Efforts

**Just a Sampling*

SAD-RSM-CX
Estab Dec 2014



RSM Program + **RSM Regional Center of Expertise**

ERDC Lead ***District Lead***

WHY CX?

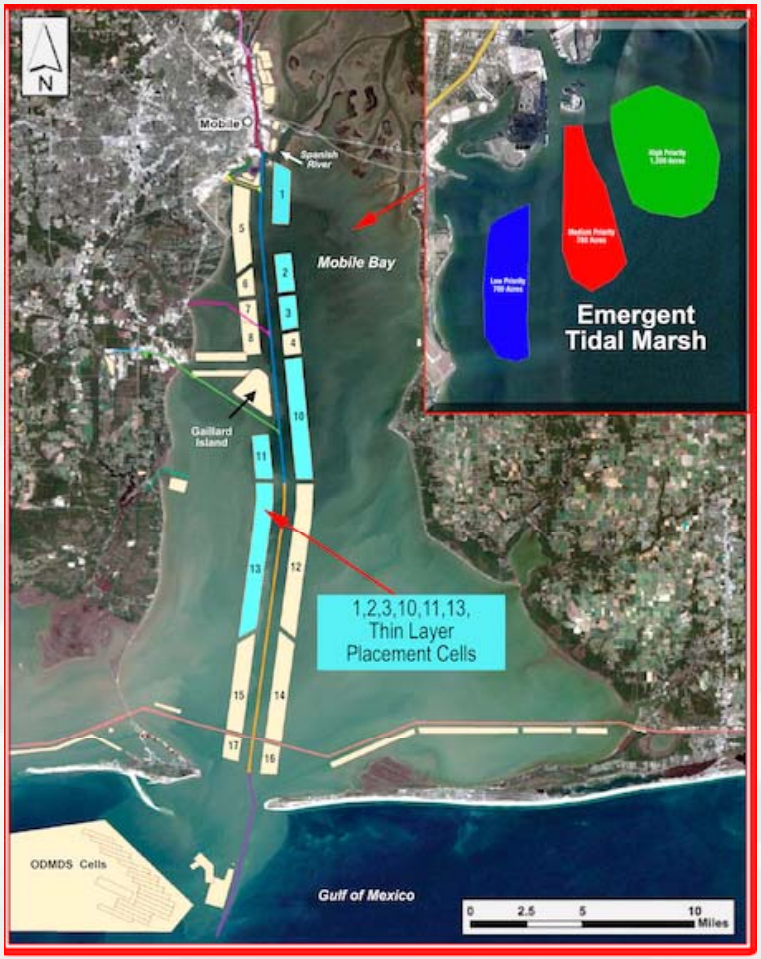
- Implementation branch of RSM
- Measure & communicate value
- Capture/share successes
- One door to consistent guidance
- Leverage tools and initiatives
- Requests for help
- National SMEs

WHY SAJ/SAD?

- Passion, experience, motivation
- Humble – We don't know it all
- Subject Matter Experts Nationwide

Mobile District: Mobile Bay RSM Strategy and Thin-Layer Placement

Larry Parson, Nate Lovelace, Elizabeth Godsey



- WRDA86: Place all dredged sediments in ODMDS
- Tripled maintenance costs
- 2007 RSM Watershed – Mobile Bay Basin Interagency Working Group
- 2012 Emergency conditions – Upper Bay
- Thin-layer placement demo SAM-ERDC
- 2014 Approval Long-Term in-bay placement
- Placed $1M cy cost savings $4M
- 1000-acre emergent marsh/filling dredge holes

Interagency RSM Team

- Alabama Department of Conservation and Natural (ADCNR), State Lands Division
- ADCNR, Marine Resources Division
- Alabama Department of Environmental Management (ADEM)
- Alabama State Port Authority
- U.S. Fish and Wildlife Service
- NOAA, National Marine Fisheries Service
- Alabama/Mississippi Sea Grant
- Mobile Bay National Estuarine Program
- Others….

NAP Post-Sandy RSM & EWN Actions, Monica Chasten

Description

- Hurricane Irene (Sept'11)/Superstorm Sandy (Oct'12) impacted NJ coastline moving sand/debris into NJIWW and other Federal coastal channels.

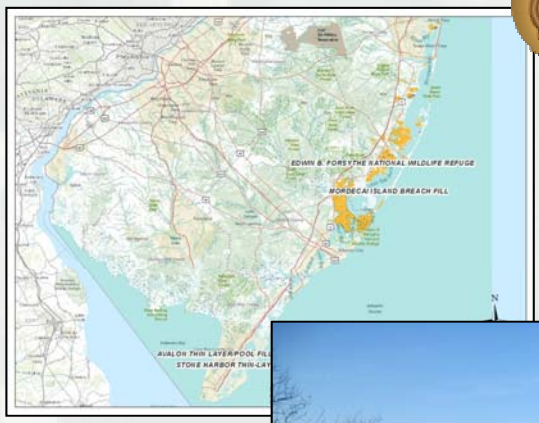
Objectives

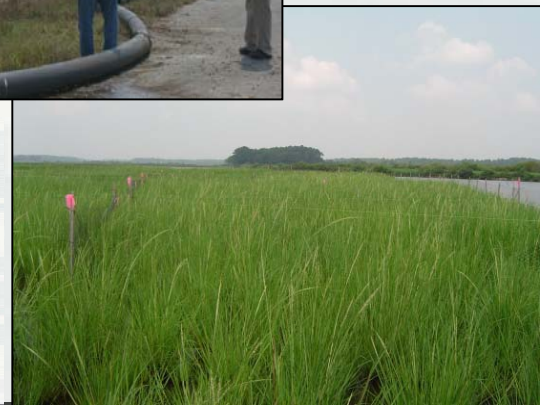
- Restore navigation mission AND seek opportunities to assist shoreline & ecosystem recovery
- Use EWN & RSM concepts to develop short-term (post-Sandy) & long-term dredging strategies
- A Sediment Progression:

  From Confinement to In-Water Creation

Accomplishments/Lessons Learned

- Completed "easy ones" first (NJIWW Mantoloking, Tow Island, Absecon Inlet, Barnegat Inlet, Cold Spring Inlet, Manasquan Inlet); new and improved
- Recovery/resiliency work continues w/more challenging dredge and placement areas of NJIWW
- Collaboration and learning on thin layering & marsh restoration techniques
- **Small actions hopefully lead to large shift within NJ and future O&M funding**





NAP Oregon Shoreface Sediment Stabilization
Rod Moritz, Kate Groth, Jarod Norton

Description

- Increased shoaling at Yaquina Entrance due to aeolian transport
- Sediment transports to S jetty, then migrates to channel
- Limited federal/state resources for dredging

Objectives

- Reduce aeolian transport from the dunes and beaches south of the Yaquina South Jetty
- Reduce dredging need in the Navigation Channel
- Reduce funding and equipment constraints
- Leverage construction funds from Port of Newport

Accomplishments/Lessons Learned

- Up to 40,000 CY may be captured in sand fencing saving roughly $300,000
- $.03/CY sand fencing VS $7.50/CY hopper dredging
- Allows dredge YAQUINA to focus on other priorities
- Add'l sand fencing may further reduce dredging need, and continue to reduce aeolian transport in the FNC
- Sand fencing will build the foredune

SWG, Galveston Entrance Channel RSM
Tricia Campbell

Description

- Funding challenge to maintain Galveston Entrance Channel Galveston Harbor, upland PAs
- Dredge approx 2MCY every 18-24 months

Objectives

- Find solutions (structural/non-structural) to reduce channel sedimentation & increase dredging cycle
- Develop BU solutions to keep sediment in suspension
- Allow more flexibility to manage overall project

<u>Maximum</u> Sediment Saved by Implementing Each Alternative Individually

- Sand-tighten jetties: 113,000 CY/YR
- Prevention of wind-blown sand: 21,000 CY/YR
- Back-passing plant with spur dikes 150,000 CY/YR
- Close boat cut in North Jetty: 160,000 CY/YR
- Place PA A material on beach: 300,000 CY/YR

MAXIMUM POSSIBLE SAVINGS OF <u>ALL</u> ALTERNATIVES:
707,000 CY/YR* ~ $2.8M/YR (based on $4/CY)

Proposed fencing/vegetation for reducing wind-blown sand

MVR Sedimentation Impacts at the Confluence of the Sangamon and Illinois Rivers, Heather Bishop & Nicole Manasco

Description

- Chronic Dredging Location
- Backwater areas of Illinois have filled in with sediment
- Lack of data
- Lack of awareness/interest

Objectives

- Greater understanding of consequences due to channelization & land use activities
- Explore opportunities to address sediment delivery to IL River
- Continue sediment data acquisition and analyses
- Expand collaboration efforts
- Develop beneficial use strategies for sediment management

Accomplishments/Lessons Learned

- Collaboration with Stakeholders
  Illinois River Coordinating Council – Aug 2014; Scoping Workshop – September 2014
- Erosion Analysis
  Discussions with experts; XS Survey Planned for August 2014
- Developing the USACE Team
- Developing Beneficial Use strategy that considers real estate constraints and environmental restoration needs while reducing required dredging for navigation
- Collaboration with the Levee Safety program – leveraging opportunities to acquire Lidar

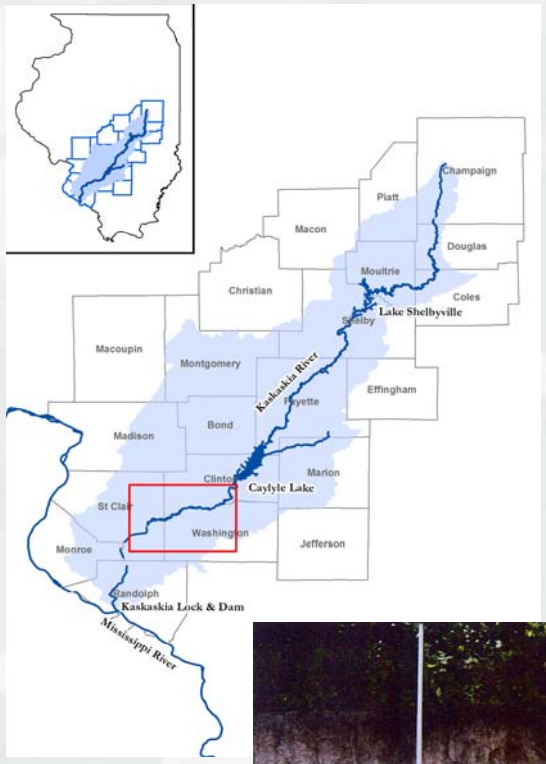
MVS Kaskaskia River
David Gordon, P.E., Timothy Lauth, P.E.

Description/Challenges

- Upper reaches require significant maintenance dredging to maintain authorized channel depths.
- Headcutting/bank erosion from channel straightening contribute excess sediment into project and degrade riparian and aquatic habitat upstream

Objectives

- Seek solution to channel degradation due to headcutting
- Lower maintenance costs & improve habitats
- Determine dredging quantities, sediment transport rates, bank erosion rates, headcutting locations, and beneficial uses of dredge material.
- Model potential solutions & develop plan
- Engage community on ongoing activity



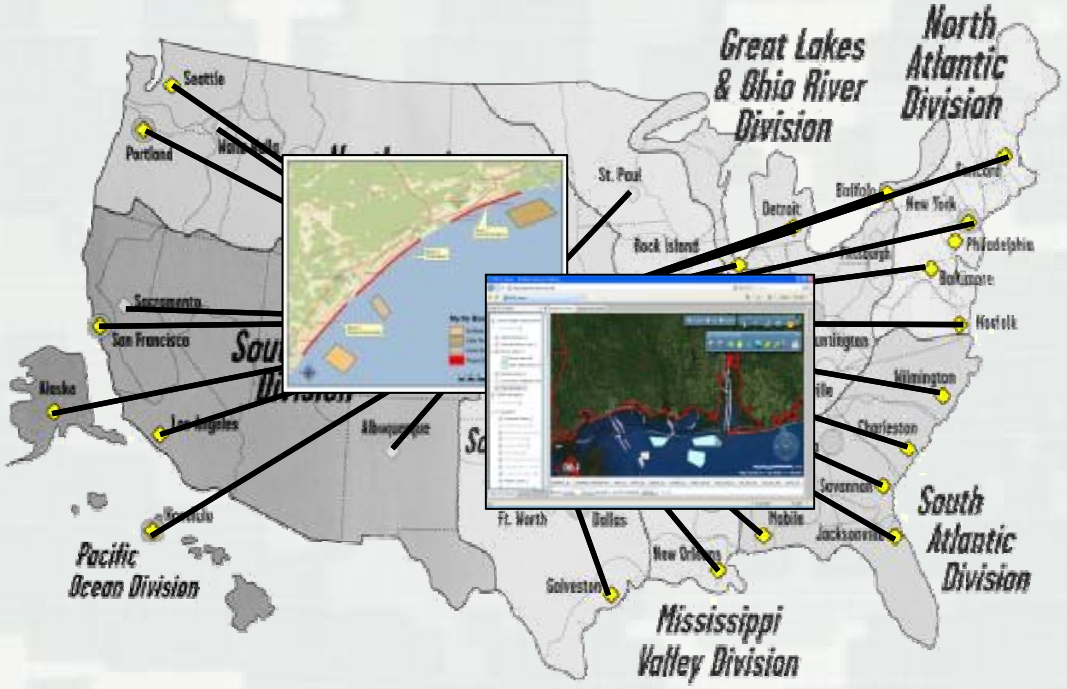
Next Steps

- Communicate plan with partners & explore funding options

RSM R&D and Tech-transfer

**A Sampling*

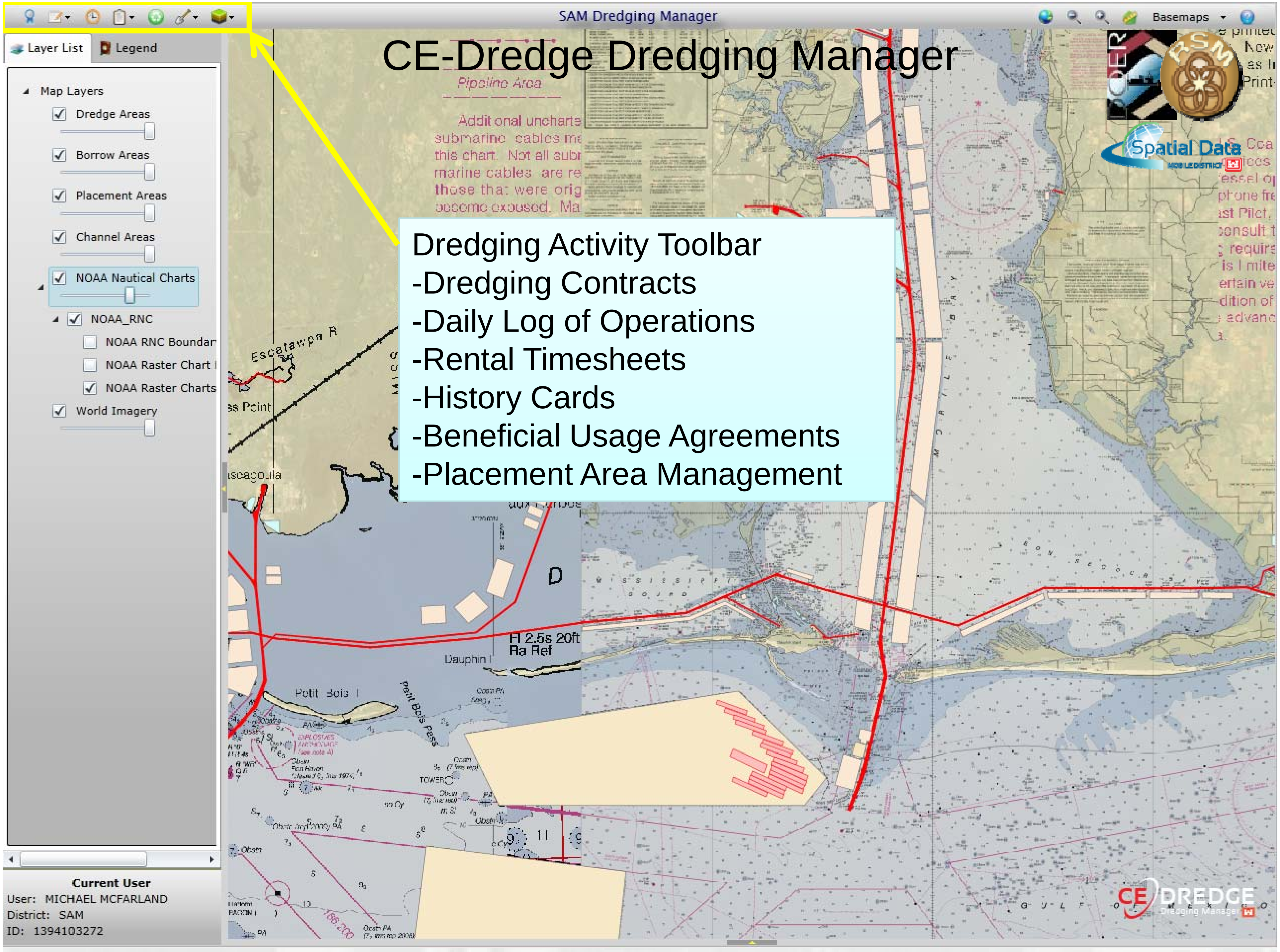
CE-Dredge/RSM Tools
Web-based GIS



- Data management, visualization & analysis
- Access to Corps dredging & RSM data
- Improve decision making
- Facilitate sharing data & tools
- Protect our investments
- Retain Institutional knowledge

SoN 2013-N-22 Data Integration Framework – Navigation Portal

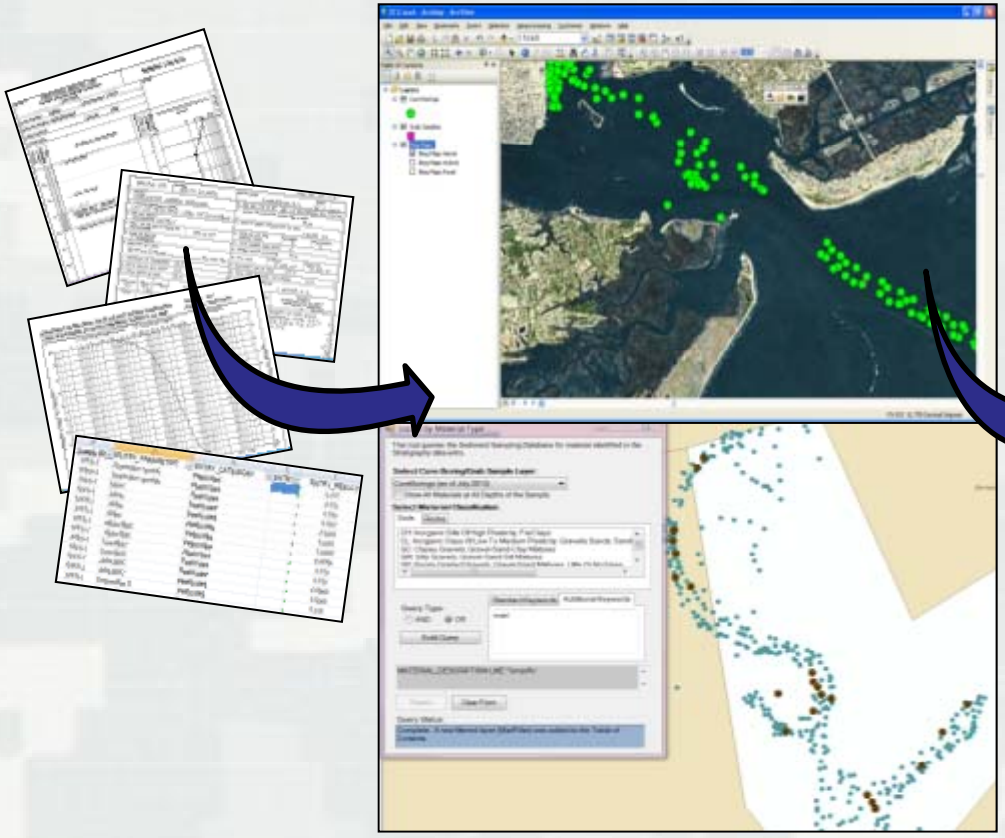
CE-Dredge Dredging Manager



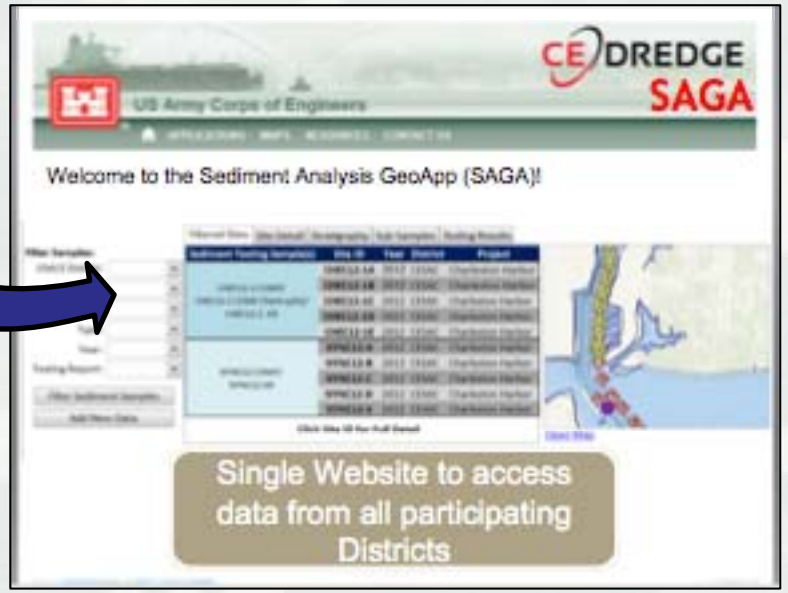
Dredging Activity Toolbar
- Dredging Contracts
- Daily Log of Operations
- Rental Timesheets
- History Cards
- Beneficial Usage Agreements
- Placement Area Management

Sediment Analysis Geo-App (SAGA)

SAC, SPN, MVD



Sediment Database & Desktop

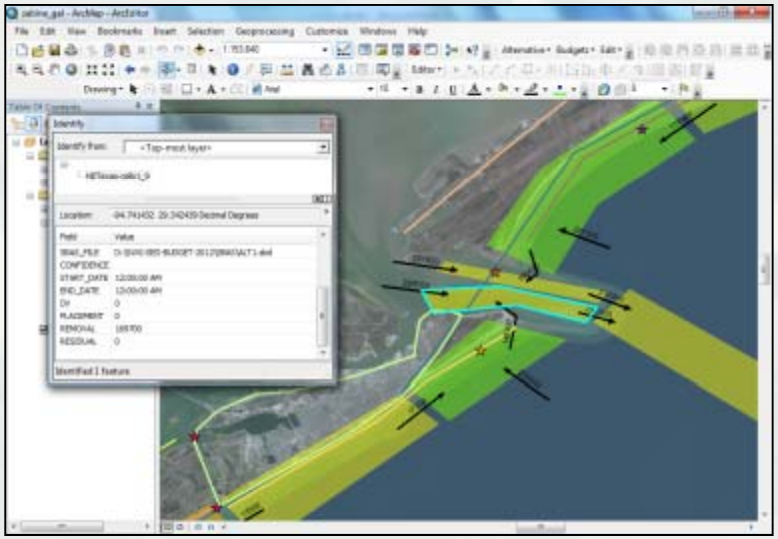


SAGA Web application

SoN 2013-N-25 Sediment Source Priority Tool

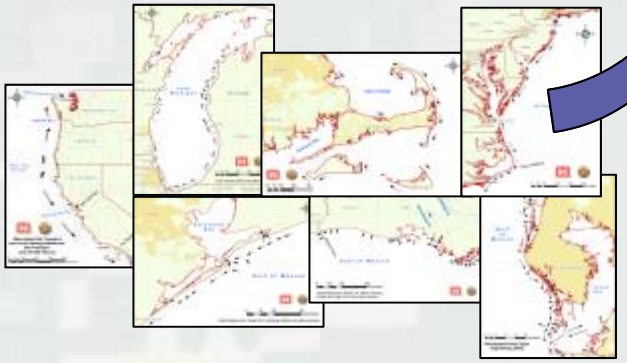
SoN 2013-N-22 Data Integration Framework

Sediment Budget Analysis System (SBAS)



SBAS ArcMap

Web-based SBAS Viewer



Sediment Budget Repository

SoN 2013-N-22 Data Integration Framework – Navigation Portal

SoN 2012-N-15 Automated Feature Extraction for Sediment Budgets

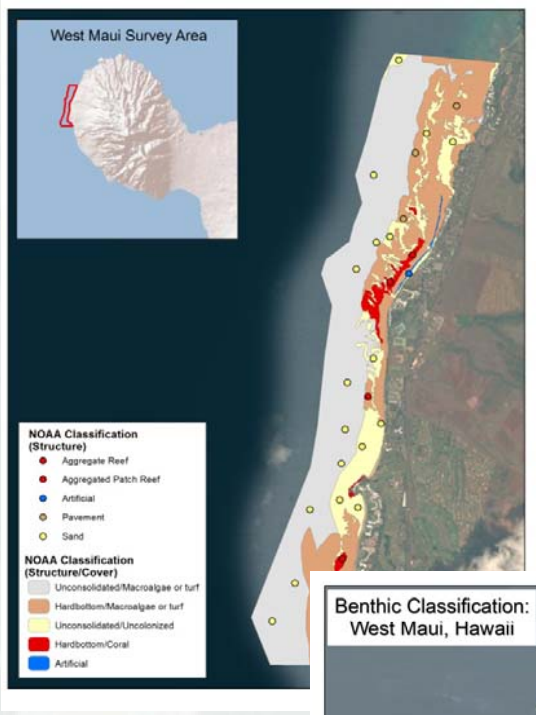
FY14 Reservoir Technologies In SEDMAN

Benthic Mapping Demonstration for West Maui, Hawaii

Tom Smith, Lauren Dunkin

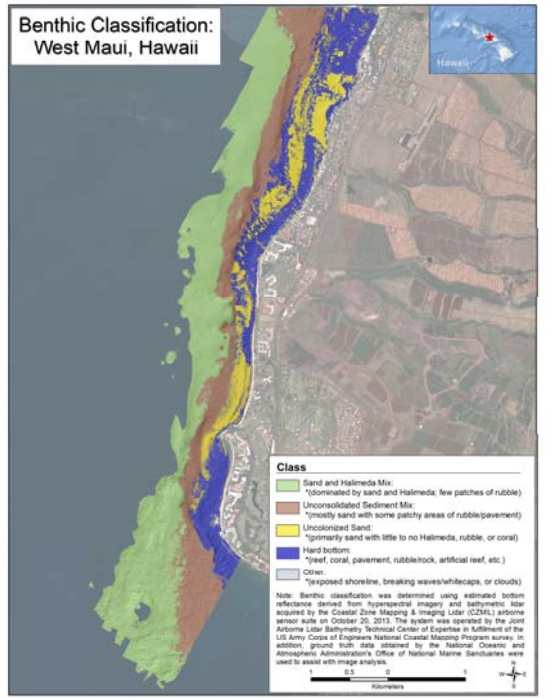
Objective

Use NCMP 2013 lidar bathymetry and hyperspectral imagery to enhance seafloor data products to identify hard bottoms (e.g. corals) and sand fields

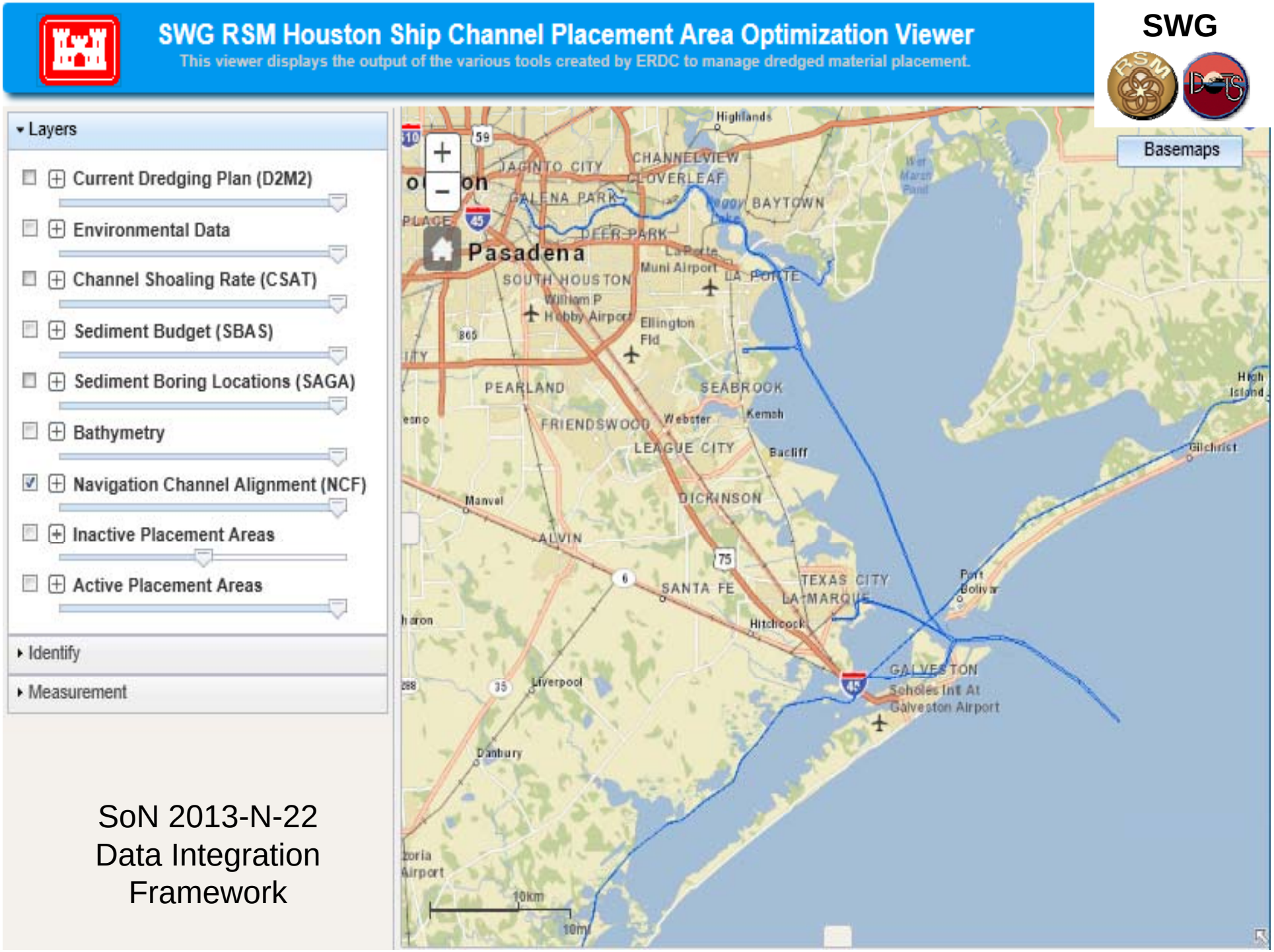


Products

- Benthic habitat maps for West Maui, HI
- Enhanced seafloor data products facilitate RSM objectives:
  - distinguish sand fields from hard bottoms to aid in managing dredged sediments
  - locate potential sites for sediment sources and placement areas



SoN 2014-N-08 Benthic Mapping demonstration through a Multi-Agency Partnership

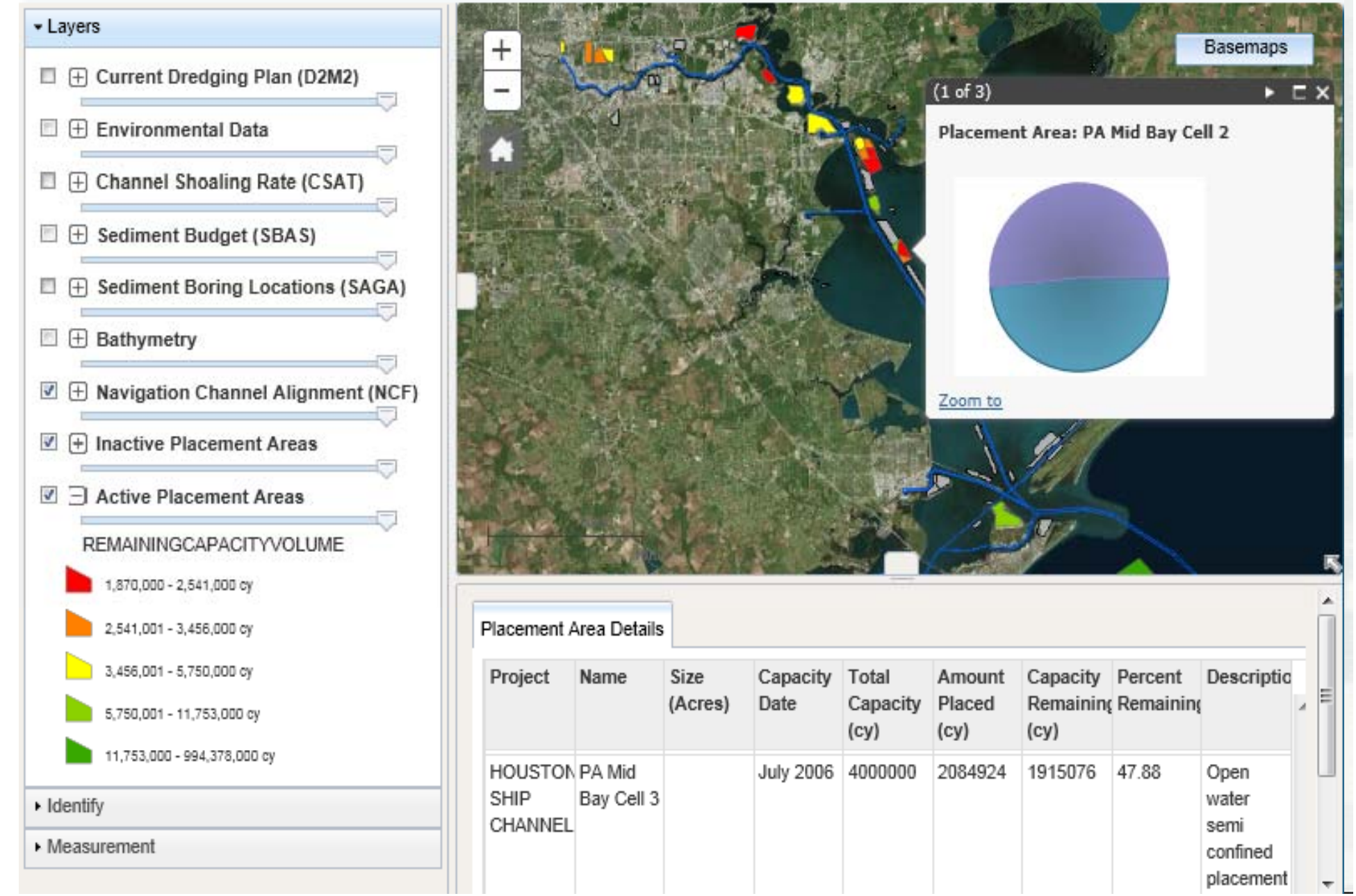


SoN 2013-N-22
Data Integration
Framework

SWG RSM Houston Ship Channel Placement Area Optimization Viewer

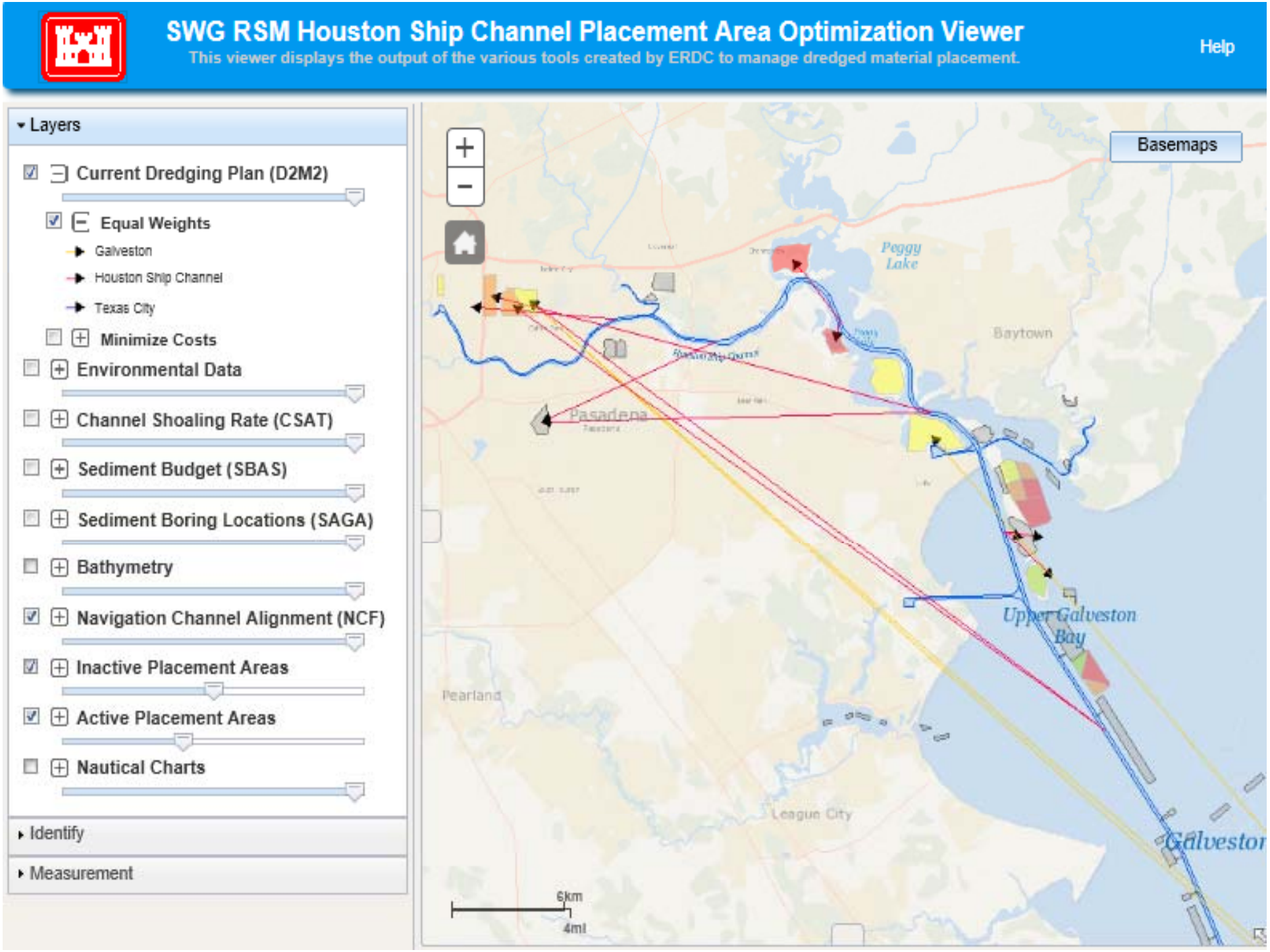
This viewer displays the output of the various tools created by ERDC to manage dredged material placement.

Help



Placement Area Details

Project	Name	Size (Acres)	Capacity Date	Total Capacity (cy)	Amount Placed (cy)	Capacity Remaining (cy)	Percent Remaining	Descriptio
HOUSTON SHIP CHANNEL	PA Mid Bay Cell 3		July 2006	4000000	2084924	1915076	47.88	Open water semi confined placement

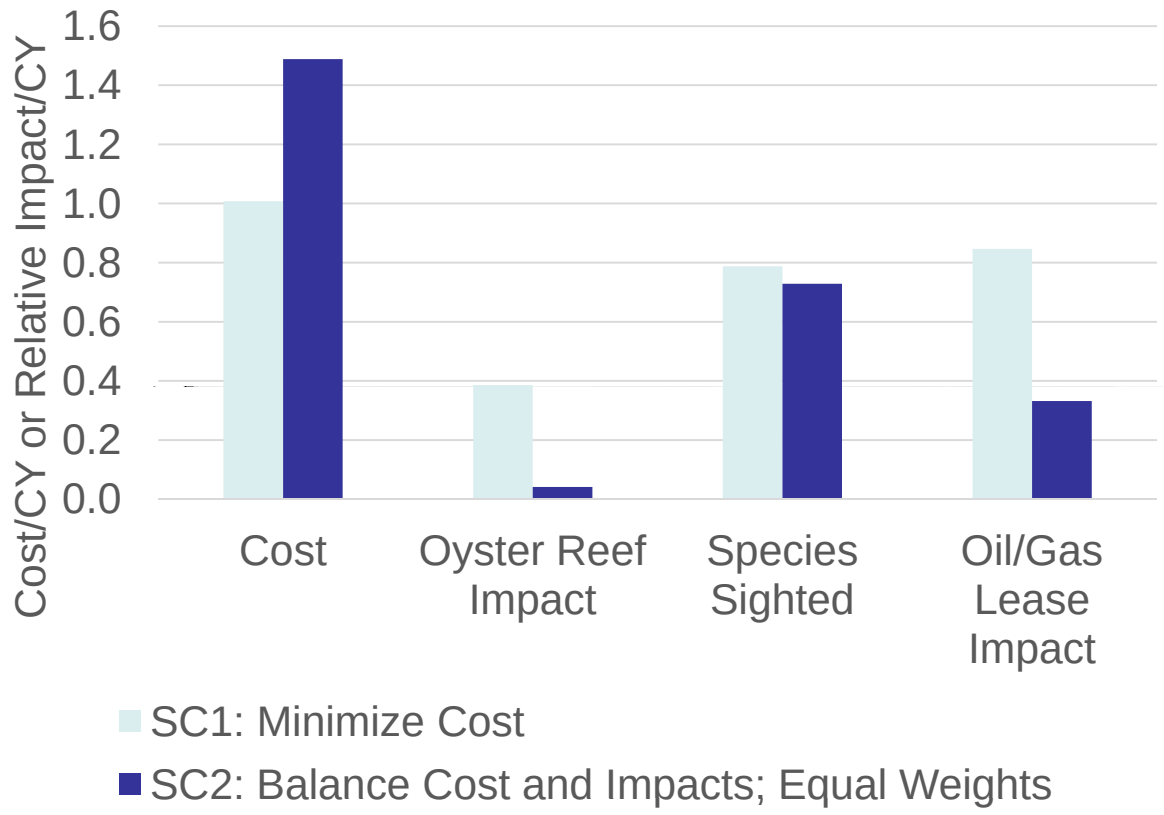

SWG RSM Houston Ship Channel Placement Area Optimization Viewer
This viewer displays the output of the various tools created by ERDC to manage dredged material placement.
Help
Layers
Current Dredging Plan (D2M2)
Equal Weights
Galveston
Houston Ship Channel
Texas City
Minimize Costs
Environmental Data
Channel Shoaling Rate (CSAT)
Sediment Budget (SBAS)
Sediment Boring Locations (SAGA)
Bathymetry
Navigation Channel Alignment (NCF)
Inactive Placement Areas
Active Placement Areas
Nautical Charts
Identify
Measurement
Basemaps
Peggy Lake
Baytown
Pasadena
Upper Galveston Bay
Pearland
League City
Galveston
6km
4mi

e View Navigate

178

	HS_03_BMP_3	HS_04_MPE_4	HS_05_ECB_5	HS_06_CB	
ALEXANDER ISLAND PLACEMENT AREA	0	0	1336836 2030 / 2033	0	
ATKINSON IS MARSH CELL M10	0	0	0	0	
ATKINSON IS MARSH CELL M7/M8/M9	0	0	0	0	
CLINTON EAST PLACEMENT AREA	0	0	0	0	
CLINTON WEST PLACEMENT AREA	0	0	0	0	
FILTERBED PLACEMENT AREA	0	0	0	0	
GLENDALE PLACEMENT AREA	0	0	0	0	
HOUSE TRACT PLACEMENT AREA	0	0	0	0	
LOST LAKE PLACEMENT AREA	0	0	0	82220 2014 / 20	
MID BAY PLACEMENT AREA	0	0	0	0	
PA 14	0	0	0	0	
PA 15	9573400 2014 / 2033	0	0	0	0
PA 15 - PA 14 CONNECTION PLACEMENT AREA	0	0	0	0	0
PEGGY LAKE PLACEMENT AREA	0	0	6149044 2014 / 2030	0	0
PELICAN ISLAND BENEFICIAL USE SITE	0	0	0	0	0

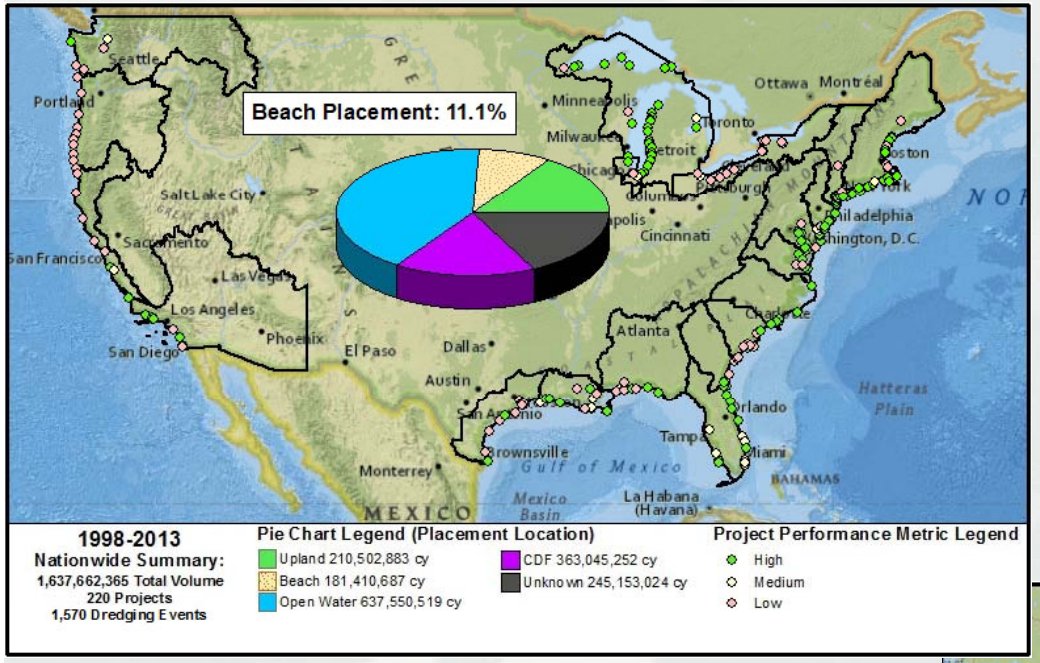
Comparing cost and impact results from two D2M2 scenarios



If costs and impacts are considered equally important, the optimal routing costs 60% more than the minimize cost scenario, and has a significant relative impact savings for oysters and oil/gas leases

RSM Database – Coastal Navigation Sediment Utilization

Navigation sediments to beach placement

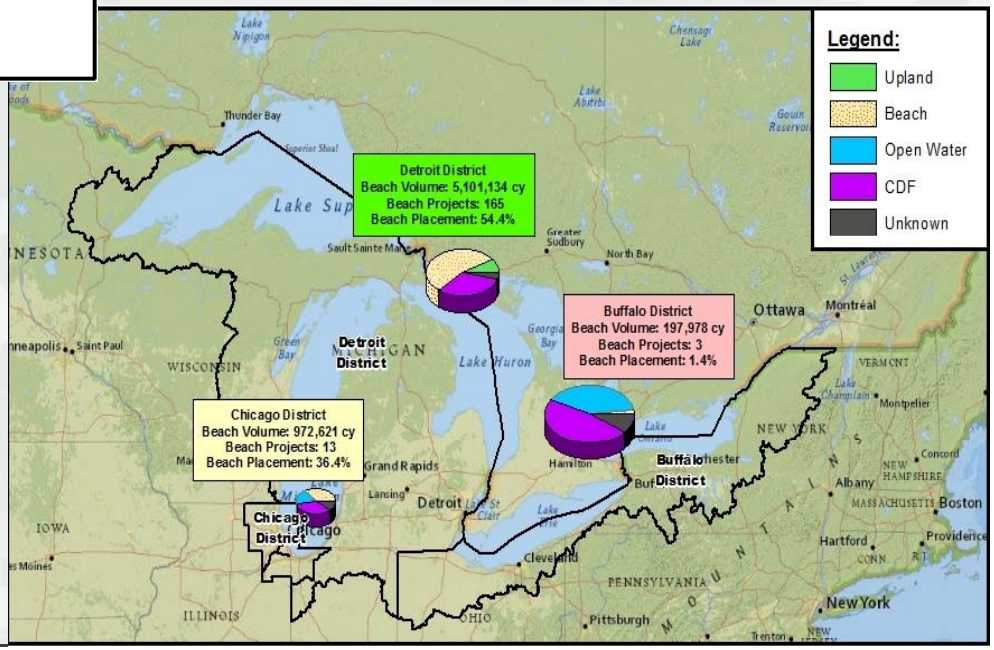


*DIS database, 1998-2013
220 USACE O&M projects
20 coastal Districts analyzed
65% projects placed on beaches
11% coastal navigation vol on beaches
= 12 Mcy annually on beaches
89%=1.5 Bcy, non-beach placement

Next Steps
Need to understand sediment characteristics and placement of 89%

*DIS database limitations, 89% includes:

- nearshore placement
- island or marsh (upland) creation
- overboard
- hole filling in shallow bays
- contaminated sediments



Framework to Expand RSM Inland

RSM-EWN Workshop, 29 April - 1 May, 2014 Omaha

Challenges

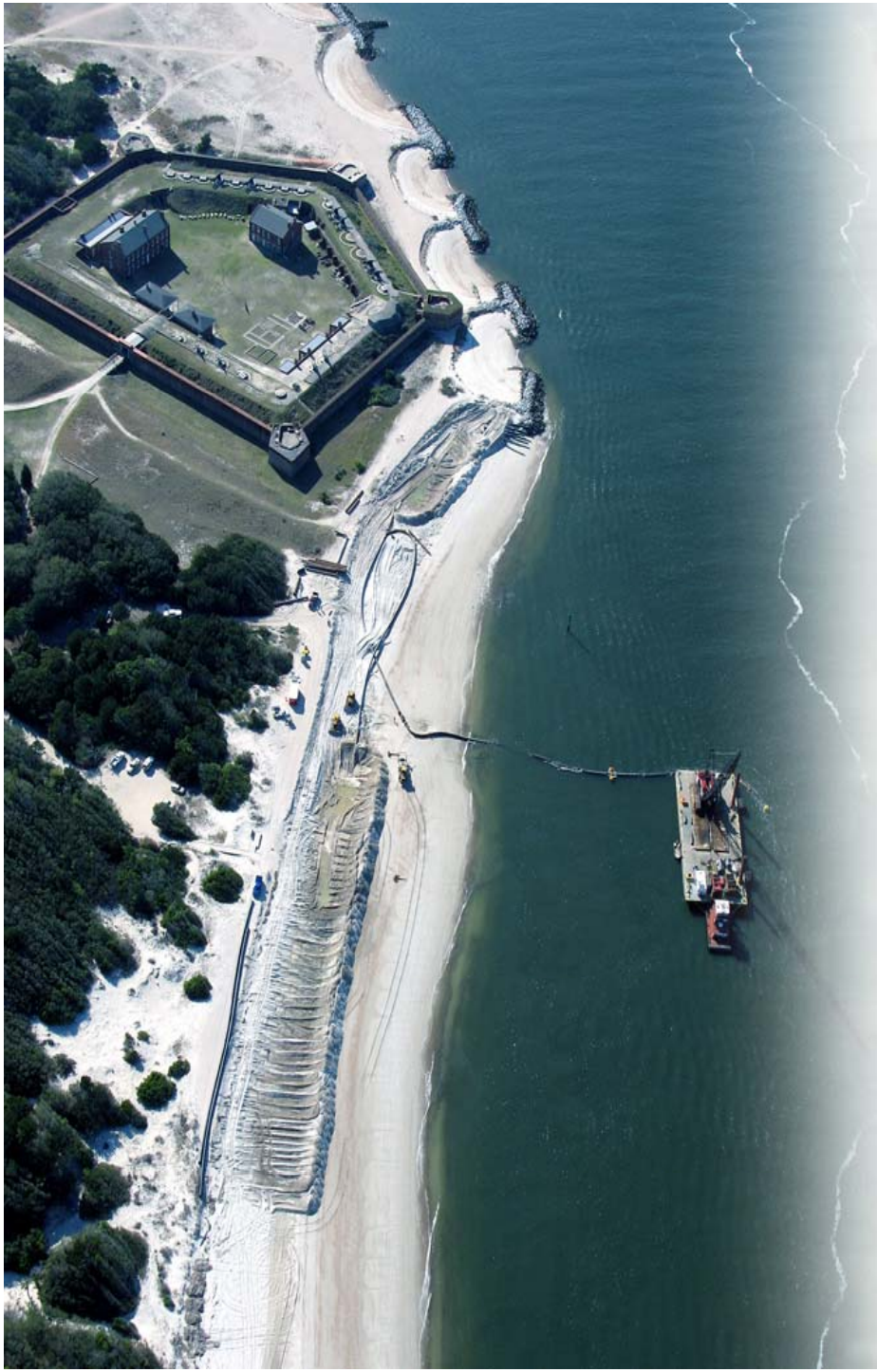
- Misconception that sediment is a pollutant
- Regulatory hurdles which drive up costs
- Lack of inland river systems data
- Spatial extent of Watershed-level systems
- Opposing sediment mgmt objectives/issues on river system
- Different environmental agency goals
- Quantifying benefits (economic, environmental)
- Limited State budgets for infrastructure development
- RSM = reduce sedimentation/need to dredge
- Many ongoing projects not identified as RSM/EWN

- Prospect courses on river engineering not available
- No overall inland group communication (i.e. CWG)
-

RSM Implementation Meeting:
Challenges, Successes, and Lessons Learned 24-27 March 2015

Challenges

- Operationalize, construct RSM opportunities
- Funding for construction – leverage multiple projects, cross business lines
- Stakeholder/Resource Agency road blocks
- Fear of fines
- Incorporate RSM principles into SMART planning
- Quantify value added/cost savings across BLs
- Capture environmental/ecosystem value/benefits
- Lack of information: District successes, activities
- Communicate value, successes, lessons learned Corpswide
- …….



WHY RSM?

- Dredging contract savings
- Cross Business Line value
- Programmatic savings
- USACE as valuable partner
- Resilient, sustainable systems approach

WHY CX?

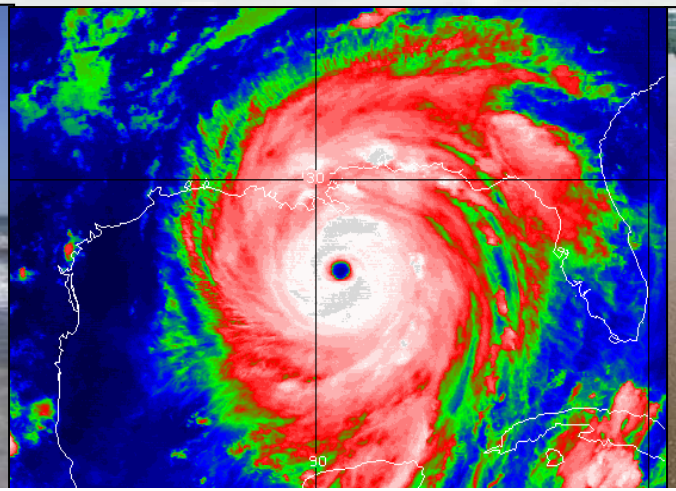
- Implementation branch of RSM
- Measure & communicate value
- One door to consistent guidance
- Leverage tools and initiatives
- Requests for help
- National SMEs

WHY SAJ/SAD?

- Passion, experience, motivation
- Humble – We don't know it all
- Subject Matter Experts Nationwide

Why RSM is Important to Navigation

- Improve channel availability
- Optimize placement options
- Reduce dredging expenses: frequency/quantity
- Increase value of sediment use
- Link projects, leverage funding, reduce timelines
- Environmental stewardship
- Improve partnerships and collaboration



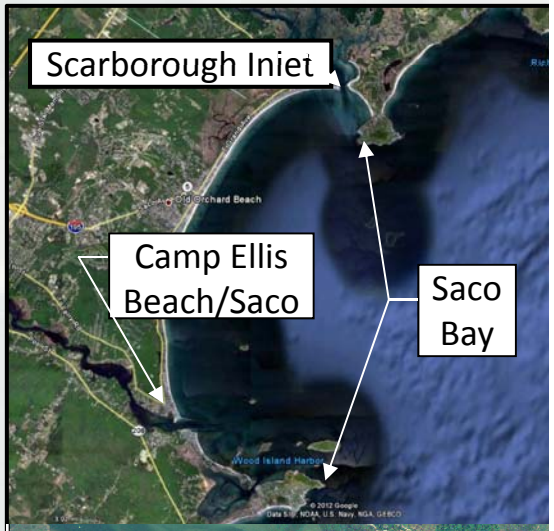

RSM

New E, Saco Bay Maine RSM
John Winkelman and Andrew Morang

Description

- Need to manage sediment holistically/cost efficiently in Saco Bay
- Two Federal Navigation Channels

  Saco River/Camp Ellis, Scarborough River Inlet
- Towns/Cities all want sand
- Sediment sources for Section 111 study



Objectives

- Develop strategy to better manage dredged sand to minimize cost & down drift impacts, maximize env benefits
- Optimize use of maintenance dredge sand from the Saco River & Scarborough Inlets for the Camp Ellis Beach Section 111 project and to reduce operational costs.

Benefits to O&M, FRM, Environmental

- Cost savings to O&M will be sought through:
  - lower placement costs
  - more efficient operations
  - perhaps lessening dredge requirements
- Provide a plan to O&M for dredge material placement
- Provide greater certainty of down drift impacts of placing sand east of Scarborough Inlet (environmental and recreational navigation)
- Provide a more cost effective source of sand for the Camp Ellis Beach Section 111 Project