ENVIRONMENTAL APPENDIX C

ATTACHMENT C-6

COOPERATING AGENCY MEETINGS

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 9 June 2016

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Meeting for Mobile Harbor General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) Agency Meeting

1. On March 31, 2016 the U.S. Army Corps of Engineers (USACE), Mobile District hosted an agency meeting for the Mobile Harbor GRR and associated SEIS. The meeting was a continuation of the previously initiated agency scoping meeting held on December 9, 2015 as part of the Mobile Bay interagency working group. The purpose of the meeting was to convene the team of cooperating federal and state agencies that require close involvement with this study and continue the process of soliciting agency participation and guidance. The primary goal of this meeting was to:

- Identify natural resources of concern
- Consideration of baseline assessments, identify existing information, and data gaps
- Identify desired inputs to tools/models necessary to evaluate effects on resources
- Discuss numerical modeling efforts

The meeting participants included representatives from the following agencies:

- Alabama State Port Authority (ASPA)
- U.S. Army Corps of Engineers, Mobile District (Corps)
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama Dept. of Environmental Management (ADEM), Mobile Field Office
- ADEM, Water Quality Branch
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- ADCNR, Marine Resources Division (MRD)
- Geological Survey of Alabama (GSA)
- Alabama Department of Transportation (ALDOT)
- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS), Habitat Conservation Division (HCD)

- Environmental Protection Agency (EPA)
- U.S. Geological Survey (USGS)
- Mobile Bay National Estuarine Preserve (MBNEP)

The meeting agenda and attendance list are attached. A sign-in sheet was circulated among the group in which the participants indicated their specific areas of interest and expertise. This information will used to establish sub-groups for future meetings dealing with specific issues that do not require assembling the entire agency team.

2. The meeting opened with a round of introductions followed by opening remarks by Curtis Flakes, Chief of Mobile District's Planning and Environmental Division. Mr. Flakes reminded the group that this meeting was the third opportunity for agency engagement. The first opportunity occurred with involvement in the Charette held January 2015 in which the agencies provided insight into the Smart Planning – 3x3x3 compliance decision. Many of the agencies also attended the Public Scoping Meeting held in January of 2016. Mr. Flakes emphasized the importance of this meeting for the agencies' help and guidance in identifying the environmental considerations that must be addressed in the integrated GRR and SEIS. Improving and maintaining the Mobile Harbor navigation project is important but must be accomplished in an environmentally sound manner.

3. The meeting continued with a brief presentation by Larry Parson of the Mobile District summarizing results of previous agency involvement. A copy of the presentation slides are attached. After reiterating the meeting purpose and goals, the group was reminded of projects constraints along with agency concerns as defined by the previous agency involvement. The environmental project constraints include:

- Avoid or minimize negative impacts on coastal and sediment transport processes
- Avoid or minimize shoreline erosion.
- Avoid or minimize negative impacts to:
    - Protected Species
    - Submerged Aquatic Vegetation
    - Essential Fish Habitat
    - Existing Natural Resources (marshes, wetlands, and bay bottoms)
    - Water Quality
    - Cultural resources
- Must have adequate Disposal Area Capacity
- Dredge material for ODMDS and open water placement must meet suitability criteria

As a result of the Charette and initial scoping meeting, a list of preliminary agency concerns were compiled which provided the Mobile District a good indication of the environmental issues that needed to be addressed in the early planning activities. The concerns previously identified by the agencies include but are not limited to the following:

- Effects on Physical Parameters
    - Water circulation
    - Salinity
    - Dissolved Oxygen
    - Sedimentation
    - Shoreline Erosion
    - Storm Surge
- Beneficial Use Opportunities
- Accurately Capturing Baseline Conditions
- Natural Resources
    - Fisheries
    - Essential Fish Habitat
    - Submerged Aquatic Vegetation
    - Oysters
    - Marshes and Wetlands
    - Protected Species
    - Shoreline Erosion
- Cultural Resources

One of the main purposes of this meeting was to revisit and expand on the above preliminary list to further capture more specific issues, how they should be addressed, and types of models and tools that can be used to evaluate them. This was done by utilizing “electronic flipcharts” to capture the information. These flip charts consist of a spreadsheet with multiple tabs for each discipline identified. This way, the information can be recorded and/or modified in real time in a way that is less cumbersome than using conventional paper flipcharts.

4. Next, David Newell from the Mobile District provided the group with an overview of the GRR process. His presentation focused on the project background describing the authorized project dimensions as well as other harbor improvements that have been implemented. Mr. Newell also spoke about the screening criteria in the planning process which considers cost, project benefits, and associated environmental effects to allow the selection of a plan that produces the greatest net benefits while minimizing environmental impacts at the least possible cost. As a result of the Alternative Milestone analysis, an array of focused alternatives have been identified to be evaluated during the course of this study which include:

- Deepening of the channel from 47’-53’
- Inclusion of an anchorage area up to 4,000’ length
- Existing Bar Channel width + 5 miles in Bay Channel @ 500’
- Existing Bar Channel width + 10 miles in Bay Channel @ 500’
- Existing Bar Channel width + 15 miles in Bay Channel @ 500’
- Existing Bar Channel width + 5 miles in Bay Channel @ 550’
- Existing Bar Channel width + 10 miles in Bay Channel @ 550’
- Existing Bar Channel width + 15 miles in Bay Channel @ 550’
- 700’ Bar Channel width + 5 miles in Bay Channel @ 500’
- 700’ Bar Channel width + 10 miles in Bay Channel @ 500’
- 700’ Bar Channel width + 15 miles in Bay Channel @ 500’
- 700’ Bar Channel width + 5 miles in Bay Channel @ 550’

- 700’ Bar Channel width + 10 miles in Bay Channel @ 550’
- 700’ Bar Channel width + 15 miles in Bay Channel @ 550’

The next critical milestones in the GRR include the determination of the Tentatively Selected Plan (spring of 2018) and the Agency Decision Milestone (fall of 2018) where the agencies provide an endorsement of the recommended plan based on the Draft SEIS scheduled to be released during the summer of 2018. A copy of Mr. Newell’s presentation slides are attached.

5. The meeting continued with group discussions on the various baseline and associated impacts assessments that should be considered during course of this study. It should be noted that the discussions were captured in the electronic flipchart which is included along with this MFR. The following is a summary of the considerations addressed during the group discussions.

Water Quality. Of the water quality concerns, saltwater intrusion was identified as the primary consideration consisting of changes within the Bay and underlying aquifers. The water quality parameters identified includes:

- dissolved oxygen
- nutrients
- sediment transport/turbidity
- water circulation
- temperature
- potential release of contaminants from dredged material
- potential contaminants release from Shipping industry
- total organic carbon
- algae and chlorophyll
- climate change/sea level rise
- changes in freshwater discharge
- increased ship waves
- effects on Dauphin Island drinking water

It was recommended that modeling efforts be conducted on a multiple year level for water quality impacts under various hydrological conditions and that the wet or dry hydrologic scenarios should also meet the needs for conducting habitat impact assessments. Baseline conditions have been conducted dating back to 1981. A more complete and detailed listing of the water quality considerations can be seen in the accompanying electronic flipchart.

Sedimentation. The primary concern with changes of sedimentation patterns within the bay is related to salinity regime changes associated with saltwater intrusion. As the sediments carried down the rivers meets and mixes with the higher saline waters of the bay, suspended sediment flocculate and begin dropping out of suspension. Depending on the degree of salinity change and water circulation patterns, this could result in changes to the sedimentation patterns within the Bay, navigation channel, and could also reach up into the river deltas. Based on these processes the group identified the following as concerns associated with changes in sedimentation that may result from expansion of the navigation channel:

- change in sediment transport patterns
- increased turbidity
- change in sedimentation rates in both bay and navigation channel
- change in sediment quality/characteristics
- ship wake turbidity concerns
- bank and bay bottom instability
- increase in head-cutting processes upriver

It should be noted that any beneficial use possibilities will be driven by the sediment quality. See the electronic flipchart for a more detailed listing of these concerns.

Water Circulation. The group felt that water circulation such as flushing, exchange rates, salinity, and dissolved oxygen are closely tied to water quality issues. The numerical modeling being conducted for this evaluation should consider seasonality changes of the existing and the future water circulation patterns. There should be a focus on critical times that may have an effect on the resources such as oyster and shrimp spawning that depend on water circulation and several water quality parameters. A complete list of the concerns relating to water circulation as identified by this group can be obtained in the electronic flipchart.

Shoreline Changes. Among the concerns on effects to shorelines, increased ship wakes were discussed as being the biggest contributor. Another potential issue that must be considered are the impacts to the littoral processes feeding the Alabama/Mississippi barrier island chain resulting from expansion of the bar channel. This could potentially have an effect on the Dauphin Island shorelines. It was discussed that the ongoing National Fish and Wildlife Foundation (NFWF) for the Alabama barrier island restoration will be useful in addressing impacts to Dauphin Island due to the widening and deepening. A more detailed list of concerns can found in the electronic flipchart.

Protected Species. There are several protected species that reside within and around Mobile Bay area that could potentially be effected from the widening and deepen action. Effects could be short-term from the actual construction of the project or more long-term from impacts to water quality, sedimentation, and hydrodynamic processes. A complete list of the species of concern can be found in the electronic flipchart.

Cultural Resources. Allen Wilson, Mobile District's Maritime Archeologist, summarized the nature of historically significant resources in the vicinity of the Mobile Harbor project. These resources are protected under the Section 106 of the National Historic Preservation Act and NEPA. In addition, when dealing with military ship wrecks, activities must also be in compliance with the Sunken Military Craft Act. This law states that any military ship wrecks discovered from another nation are considered property of that nation and requires international coordination. Cultural resources surveys were conducted in the 1980's as part of the Mobile Harbor re-authorization studies. The surveys conducted at that time utilized technologies that are now considered out of date and much less reliable than today's technology.   As a result, there is a need to reevaluate studies within the authorized channel and possibly conduct updated surveys to identify resources such as resources the older technology could not detect, unexploded ordinance, tribal resources, and submerged prehistoric artifacts and human remains. With possible shoreline changes at Fort Gaines due to increased ship wakes, surveys may also need to be conducted in that vicinity as well. A more comprehensive list of historic resources concerns are included in the electronic flipcharts.

Natural Resources. There is a variety of natural resources associated with Mobile Bay that are within the influence of the navigation project. As discussed earlier, modifications to the navigation channel may result in impacts to water quality, sedimentation, and hydrodynamic characteristics which in turn may have effects on the Bay's resources. The main resources identified during these discussions that must be addressed in this study include but not necessarily limited to:

- Fisheries
- Submerged aquatic vegetation
- Oysters
- Crabs
- Shrimp
- Finfish
- Managed species and essential
- Benthic communities

A more complete list of resources and other resources considerations are included in the accompanying electronic flip chart.

5. The next part of the meeting dealt with discussions regarding the use of models and tools for conducting resource impact assessments. The consensus of the group was that comprehensive modeling should be conducted in order to have a high degree of confidence in performing impact assessments and mitigation analysis. At this point in the study, the Corps is evaluating what type of models and/or tools are available that perform resource impact assessments. First, the pertinent background parameters representing baseline conditions must be identified, gathered, and used by numerical models such that the predicted changes in conditions can be made available to the models/tools used to evaluate resource impact. It would be most beneficial to select models that are already approved and certified. The desired parameters for such models are listed in electronic flipchart under the MODEL_TOOLS_PARAMETERS tab. Also included are some habitat models and tools appropriate for this study.

The group stressed that it's important to obtain baseline data as complete as possible. There are many existing sources such as studies completed by the Mobile Bay NEP that has already compiled high resolution resource mapping data that will continually be updated. The Mobile District requested that participants compile a list of data sources that their agencies can provide for use in the baseline determination. Establishing an accurate and comprehensive baseline will be important in evaluating resource impacts and conducting appropriate mitigation assessments.

6. The meeting continued with Elizabeth Godsey leading discussions on the numerical modeling that will be conducted. She provided an overview of proposed modeling tools that could be used to predict changes in the system due to modifications to the navigation channel and she discussed leveraging available modeling tools developed for other studies in the area (MsCIP, Regional Sediment Management, and Alabama Barrier Island Restoration). She then led a group discussion on the capabilities, limitations, and uncertainties in the various potential models and how those could be used to address specific areas of concern (e.g. changes in salinity, temperature, sediment transport pathways, etc.). For example, there are several water quality (WQ) models in existence. CEQUAL-ICM is an example of one existing model used in the Gulf that predicts 36 parameters and simulates the system to mimic Water Circulation to generate outputs that can be used by other tools in determining resource impacts. However, other models exist that have similar capabilities (LSPC-EFDC-WASP) and have been used in Mobile Bay for previous studies. Therefore, the group agreed it's necessary to organize a separate sub-workgroup specifically dealing with modeling to select the appropriate model for this study. A list of existing numerical models and their functions discussed by the group are included in the electronic flipchart is included under the NUMERICAL_MODELING tabs.

After compiling the list of models, the group revisited the previously discussed issues that were captured in the electronic flipchart. A column (titled "model") was added for those areas of concern that will rely on the numerical modeling to provide the appropriate information needed to conduct impact assessments. The added column indicates what model(s) would be appropriate to address that particular concern. See the electronic flipchart to review the listing of models that were identified for each area of concern indicating the appropriate model for each area of concern.

Since the agency meeting, a follow-on in-house meeting was held on May 10, 2016 at ERDC in Vicksburg, MS to discuss what is required for conducting habitat modeling.

7. Also include as part of the discussions was the need to prepare a monitoring and adaptive management plan that includes 5 – 10 years of monitoring. This is necessary to verify accuracy of the models and provide a means of ensuring project goals are met. This is something that EPA will be looking for in future draft documents. It was also mentioned that noise and air quality must be part considered in the study.

8. It is envisioned that agency meetings will be held on a regular basis to help guide and provide inputs to this study. In many cases, meetings do not have to involve the whole team, in which case sub-group meetings can be conducted via conference calls and webinars with only those who have indicated a specific area of interest.

9. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Draft copies furnished for comment to:

Allen Phelps – ADEM
Amanda Howell – EPA
Jacob Berkowitz – Corps ERDC
Bill Pearson – FWS
Bob Harris – ASPA
Barry Bunch – Corps ERDC
Carl Ferraro – ADCNR
Ray Chapman – Corps ERDC
Chris Johnson – ADEM
Glenn Fernandez – EPA
Earl Hayter – Corps ERDC
Jeff Powell – FWS
Joe Long – USGS
John Mareska – MRD
Josh Rowell – FWS
Judy Adams – ASPA
Lena Weiss – EPA
Ntale Kajumba – EPA
Patric Harper – FWS
Kevin Reine – Corps ERDC
Roberta Swann – MBNEP
Rusty Swafford – NMFS-HCD
Scott Brown – ADEM
Steve Jones – GSA
Dottie Tillman – Corps ERDC
Dan Holliman – EPA
Andrew Wood – ALDOT
James Moody – ADEM
Justin Rigdon – ADEM
Jenny Jacobson – Corps
Elizabeth Godsey – Corps
Justin McDonald – Corps
David Newell – Corps
Allen Wilson – Corps
Jackie Wittman - Corps

Agency Meeting
for the
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement
International Trade Center – Killian Room
Mobile, Alabama
March 31, 2016
9:00 – 3:30

MEETING AGENDA

Introductions

Mobile Harbor GRR Overview

Natural Resources of Concern and Associated Questions/Investigations
- Species (Threatened and Endangered, Fisheries, etc.)
- Habitats (Wetlands, Oyster Reefs, Submerged Aquatic Vegetation, Water Quality, etc.)

Resources Assessments (Species/Habitats)
- Baseline Assessments
- Existing Data/ Data Gaps
- Assessment Tools/Models Input

Numerical Modeling
- Hydrodynamics
- Water Quality
- Sediment Transport

Other Discussions

Mobile Harbor General Reevaluation Report - Agency Meeting
March 31, 2016

	NAME	AGENCY	PHONE	EMAIL	SUB-TEAM EXPERTISE	INTEREST/EXPERTISE CATEGORIES ←
1	Dan Holliman	USEPA	404-562-9531	Holliman.Daniel@epa.gov	2b,c/4/5	Please indicate your areas of interest and
2	Kevin Reine	USACE- ERDC	601-634-3436	Kevin.J.Reine@usace.army.mil	1, 2d 3a, 7	expertise for participation in future coordination
3	Elizabeth Godsey	USACE - Mobile District		elizabeth.s.godsey@usace.army.mil	5, 6, 7	and meetings. Choose from the following
4	JEFF POWELL	US Fish & WILDLIFE SERVICE	251-441-5858	JEFF_POWELL@FWS.GOV	1, 2,	(you can indicate multiple categories):
5	BILL PEARSON	US FISH & WILDLIFE SERVICE	251.441.5870	bill_pearson@fws.gov	1, 2	
6	Josh Rowell	US Fish & Wildlife Service	251-441-5836	josh_rowell@fws.gov	1, 2	1. Threatened &Endangered Species
7	Patric Harper	"	228-475-0765	patric_harper@fws.gov	1, 2, 7	2. Habitat Resources
8	Andrew Wood	Alabama DOT	251-470-8320	wooda@dot.state.al.us	~~2b/c, 7~~	a. oysters
9	CARL Ferraro	ADCNR - State Lands - Coastal	251-621-1216	Carl.ferraro@DCNR.ALABAMA.GOV	2B/C, 7	b. SAV's
10	Lena Weiss	USEPA	404-562-9228	weiss.lena@epa.gov	7	c. marshes/wetlands
11	Barry Bunch	ERDC	601 634 3617	barry.w.bunch@usace.army.mil	5, 6	d. benthic
12	Earl Hayter	ERDC	864 656 5947	earl.hayter@usace.army.mil	C	3. Resource Assessments
13	Dorothy (Dottie) Tillman	ERDC	601-634-2676	dorothy.h.tillman@usace.army.mil	6	a. data
14	RAY CHAPMAN	ERDC	601-634-3178	RAYMOND.S.CHAPMAN@USACE.ARMY.MIL	6	b. tools and models
15	ALLEN PHELPS	ADEM	251-304-1176	cap@adem.state.al.us	2c, 5	4. Cultural Resources
16	J. SCOTT BROWN	ADEM - MOBILE FIELD OFFICE	251 304 1176	jsb@adem.state.al.us	2, 7	5. Water Quality
17	Roberta Swann	MBNEP	251-380-7940	rswann@mobilebaynep.com	3, 5	6. Numerical Modeling
18	John Mareska	ADCNR / Marine Resources	251-861-2882	john.mareska@dcnr.alabama.gov	1, 2a, 2d, 3a 7	7. Beneficial Use of Dredged Material
19	Rusty Swafford	NOAA Fisheries	409-766-3699	Rusty.Swafford@noaa.gov	2, 3, 7	
20	Justin McDonald	USACE	251-690-3314	Justin.S.McDonald@usace.army.mil	5, 6, 7	
21	Joe Long	USGS	727-502-8024	jwlong@usgs.gov	3a, 3b, 6	
22	JENNY Jacobson	USACE	251-690-2724	jennifer.l.jacobson@usace.army.mil	1, 2, 5, 7	
23	Stephen C. Jones	Geological Survey of AL	205 247 3601	sjones@gsa.alabama.gov	2c, 3a, 5, 7	
24	Jacob Berkowitz	US ACE - ERDC	601 529 3115	Jacob.F.Berkowitz@usace.army.mil	2c, 3a, 3b, 7	
25	James Mooney	ADEM	334-394-4352	jjmooney@adem.state.al.us	5, 6	
26	Justin Rigdon	ADEM	334-271-4180	JbRigdon@adem.state.al.us	5, 6	wants real time riverdata
27	Chris Johnson	ADEM Water Quality Branch	334-271-7827	cljohnson@adem.state.al.us	5, 6	
28	Larry Parson	USACE	251-690-3139	larry.e.parson@usace.army.mil		
29	Jackie Wittmann	USACE	251-690-3559	jacqueline.j.wittmann@usace.army.mil		
30	Judith Adams	ASPA	251-441-7005	jadams@asdd.com		non-fed local sponsor
31	Allen Wilson	USACE	251-694-3867	allen.d.wilson@usace.army.mil	4	
32	Ron Harris	ASPA				
33	Glenn Fernandez	EPA (webinar/phone)		Fernandez.Glenn@epa.gov	5, 6	
34	Amanda Howell	EPA (webinar/phone)	404-562-9017	Howell.Amanda@epa.gov	5, 6	
35	Ntale Kajumba	EPA (webinar/phone)	251-690-2328	david.p.newell@usace.army.mil		
36	David Newell	USACE				
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DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 16 November 2016

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Meeting/Webinar for Mobile Harbor General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) regarding modeling and aquatic resources assessment scopes – 22 Sept 2016.

1. On September 22, 2016 the U.S. Army Corps of Engineers (USACE), Mobile District hosted an agency meeting in the form of a webinar as part of the ongoing agency scoping activities for the Mobile Harbor GRR and integrated SEIS. The purpose of the meeting was to reconvene the team of cooperating federal and state agencies to present an overview of the study approach being taken for modeling and aquatic resources assessments for the study. The primary goal was to provide an opportunity for agencies to ask questions and air concerns they may have for these efforts. Follow up coordinations as appropriate will be conducted to resolve questions and issues that were raised.

The meeting participants included representatives from the following agencies:

- Alabama State Port Authority (ASPA)
- U.S. Army Corps of Engineers, Mobile District (Corps)
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama Dept. of Environmental Management (ADEM), Mobile Field Office
- ADEM, Water Quality Branch
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- ADCNR, Marine Resources Division (MRD)
- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS), Habitat Conservation Division (HCD)
- Environmental Protection Agency (EPA)

The agenda, participation list, meeting slides are included below.

2. After a round of introductions and GRR status update presented by David Newell, the meeting proceeded with Elizabeth Godsey presenting on overview of the hydrodynamic, water quality, and sediment transport modeling that's being performed for the study (see meeting slides). The modeling will be conducted for a one year simulation period using representative conditions from January thru December for the year 2010. Modeling will also be done to assess changes in ship wakes associated with channel modifications.

Hydrodynamic Modeling: The **Coastal S**torm **M**odeling **S**ystem (CSTORM) and **AD**vanced **CIRC**ulation Model (ADCIRC) models are being used to provide offshore elevation boundary conditions for the nearshore hydrodynamic and sediment transport modules. The **ST**eady State Spectral **WAVE** **F**ull **P**lain (STWAVE-FP) model is being used to provide wave fields to the nearshore hydrodynamic and sediment transport modules. The Geophysical Scale Transport Modeling System (GSMB) - **M**ulti-**B**lock **C**urvilinear **H**ydrodynamics in **3-D**imensions-**W**aterways **E**xperiment **S**tation (MB-CH3D-WES) models provide water levels and current velocities to the water quality, estuarine sediment transport and habitat assessment modules.

Water Quality Modeling: GSMB-CE-QUAL-ICM model will be utilized for the water quality portion of the modeling effort. This model will assess potential changes in water quality including changes in flushing, salinity, dissolved oxygen, temperature, total suspended solids, nutrients and chlorophyll a as a result of channel improvements. Outputs from the model will provide water quality constituents (i.e. salinity, temperature, dissolved oxygen, total suspended solids etc.) for will be essential in the conducting habitat assessments.

Sediment Transport: GSMB–SEDZLJ is the model being used to assess relative changes in sedimentation rates as a result of channel improvements and will assess the change in the sedimentation rates and pathways within the bay resulting from the channel improvements. Delft3D (Flow, SWAN and Morph modules) modeling will be used to quantify relative changes in sediment pathways and morphological response of the adjacent nearshore environment as a result of proposed channel modifications.

Ship Wake Model Tool: The model will quantify relative changes in ship wake energy from associated with proposed channel improvement measures.

The question was raised if the ship wake modeling will be used to predict channel scouring? This will only be addressed if the analysis shows there's a potential for scouring to occur. At that point, the modeling may be extended to considering potential scouring.

Concerns with the simulation period were expressed by EPA as to why we are not using existing information to look at a 3-year simulation period. The Mobile District expressed that the project in on a strict schedule and budget and these restrictions prevent the study from conducting simulations beyond one year. A question was also asked if the District considered using a watershed study as part of the water quality assessment.

The study will be utilizing information from the watershed studies being prepared by the Mobile Bay NEP, but only for the 1-year 2010 simulation period.

It was expressed that using 10-layers in the 3-D simulation seems to be a very fine resolution. The District responded that the model is capable to perform to that resolution and feels that it is necessary given the size and depths in the study area.

Another concern raised by the agencies is that does that Mobile District have confidence the conditions represented in the 2010 simulation period adequately represent seasonal conditions. The 2010 simulation period is considered to be indicative of an average year with some high and low flow periods and considered to represent a typical year.

EPA raised the issue of information being made available for validation points. Is calibration being done for one or multiple locations and how long are the records? ADEM stated that they have a lot of information in the delta that can be provided to help with validation. The Mobile District will provide details of the calibration and validation process. A follow up meeting with the modeling sub-group can be organized if deemed necessary.

3. The next part of the meeting continued with presentations from ERDC on the approaches for conducting the baseline and impact assessments for the various aquatic resources that exist in the bay and extending up into the lower delta. The assumption has been made that biggest influence from parameters contributing to the aquatic impacts will be fluctuations in salinity resulting from saltwater intrusion. The attached slides provide a summary of the approaches that were developed towards evaluating impacts associated with salt water intrusion. The studies will be assessing the effects on wetlands, submerged aquatic vegetation (SAV), oysters, benthic communities, and fish.

<u>Potential Impacts to Wetlands</u>: A phased approach will be utilized as outlined in the attached slides. The general approach for wetland resource assessments will include assessment of existing resources and analysis of potential impacts based upon water quality and sediment modeling outputs under “without” project condition and proposed channel modification alternatives. The assessment will rely on the outputs from the water quality and hydrodynamics modeling results to evaluate potential future impacts to wetlands in the project area.

<u>Submerged Aquatic Vegetation</u>: A phased approach as, outlined in the attached slides, has been prepared to document the current distribution of SAV in the region, asses the spatial variability in SAV distributions in Mobile Bay, and identify potential changes in SAV resources associated with a future “without” project condition, and alternative project designs. The general approach will include an assessment of existing resources, an assessment of historic habitat variability, and an analysis of potential impacts based upon water quality and sediment modeling outputs under “without” project condition and proposed alternatives analysis. The assessment will rely on the outputs of water quality

and hydrodynamics modeling results to evaluate potential future impacts to SAV in the project area.

Follow on discussions revealed that additional SAV mapping is scheduled for 2017.

Oyster Reef Connectivity: An approach to determine how channel modifications will impact the current distribution of oysters in the region has been prepared to assess how the spatial variability in reef locations can best be used to maximize potential oyster recruitment, and identify potential changes in oyster resources associated with a future “without” project condition, and alternative project designs as summarized in the attached slides. The general approach will include an assessment of existing resources, an assessment of historic oyster resources, and an analysis of potential impacts based upon water quality and particle-tracking (for oyster larvae) under “without” project condition and proposed alternatives analysis. The assessment will rely on the outputs of water quality and hydrodynamics modeling results to evaluate potential future impacts to oysters in the project area. The modeling will include more than just particulate transport but will also include vertical migration. A habitat suitability model will also be incorporated.

A concern was raised if the oyster assessment will take into consideration the potential of increased dermo infection in oysters. Dermo infections have been linked to increases in salinity and temperatures and has been addressed in a feasibility study conducted by the Galveston District for Matagorda ship channel in Texas in which a methodology was developed to assess the potential of increased dermo infections. The existing model will take into account salinity variations but does not have the ability to consider the dermo infection potential. The Mobile District will contact the Galveston District to learn more about the methodology used in their study.

In addition to the modeling, it was noted that GIS shape files for mapping oyster reefs in the Bay are available through the MRD.

Potential Impacts to Benthic Invertebrates: Benthic invertebrates will be sampled, once in Fall 2016 and once in Spring 2017. A total of 180 benthic samples will be collected: 90 samples in September 2016 and 90 samples in February/March 2017. Samples will be collected at 30 stations in each zone (Freshwater, Transition and Estuarine (upper bay). Samples will be taken by ponar grab. Sampling the delta bays may require the use of a core sampler if water depths to too shallow to be access by boat. If a core sampler is used in the shallow, three (3) samples will the equivalent of one ponar grab sample. Successful samples require a minimum penetration depth of 10 cm into bottom sediments. Samples will be sieved in the field using a 0.5 mm mesh to remove excess sediment, placed in individual fabric bags, and preserved in 10% buffered formalin. All samples will be collected by ERDC personnel with the assistance of personnel from the USACE: Mobile District (boat and operator).

It was recommended to consider expanding the season for conducting benthic sampling. The concern is that early spring sampling may not be representative of typical spring conditions. It is possible that seasonal variations in DO would not be captured for the actual spring conditions. A recommendation would be to shift the Feb/March sampling to later in the spring. The Mobile District PDT will take a look at this to see if it can be accommodated in the schedule.

There was a concern that a more detailed work plan for benthic sampling was not provided to the agency team to review and comment. It was felt this should have been done for the habitat assess data collection efforts. A more detailed work plan for the benthic sampling effort is included below.

<u>Potential Impacts to Fish</u>: Fish will be collected seasonally with multiple gears in the three areas encompassing the Mobile Bay ecosystem: marine, brackish, and freshwater. Collections will occur late summer/early fall 2016 to evaluate recruitment and growth, and spring 2017 to evaluate the spawning period and young-of-year survival. Within each of the three study areas, a minimum of five sampling sites will be established representing the variability in physical habitat features. Final site selection will be coordinated with Mobile District and resource agencies. Number of individual sampling sites per season will be at least 15 (3 areas x5 sites).

- With the sampling being conducted in early spring, there is a concern that the sampling could occur under high freshwater flow conditions and the typical seasonal changes in salinities may not be captured. In order to capture and evaluate salinity fluctuations and tolerances, it was recommended that salinity profiles be collected. It was also recommended that the spring sampling times be shifted to later in the spring and possibly move sampling locations further south into the bay. The District PDT will take a look at this to see if it can be accommodated in the schedule.

As with the benthic sampling scope, there was a concern that a more detailed work plan for fish sampling was not provided to the agency team to review and comment.   A more detailed work plan for the fish sampling effort is included below.

4. The following actions will be taken in order to satisfy questions and concerns associated with the modeling and habitat resources assessments:

- The Mobile District will provide details of the calibration and validation process.
- ADEM to provide information from delta to help with validation.
- GIS shape files for mapping oyster reefs in the Bay to be provided by MRD.
- Work plans for the benthic and fish sampling to be provided by the Mobile District to the agencies.

5. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Draft copies were furnished for comment to all meeting participants.

Agency Meeting
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement (SEIS)
Conference Call/Webinar
Mobile, Alabama
September 22, 2016
1:00 – 3:00 Central

Agenda

Introductions

Mobile Harbor GRR/SEIS Update

Study Approach

- Numerical Modeling
  - Hydrodynamics
  - Water Quality
  - Sediment Transport

- Aquatic Resources Assessments
  - Wetlands
  - Submerged Aquatic Vegetation
  - Oysters
  - Benthic
  - Fish

Other Discussions

Next Steps

Mobile Harbor GRR Agency Webinar – List of Participants

Agencies
Bob Harris (ASPA)
Carl Ferraro (ADCNR)
John Mareska (ACDNR, MRD)
Scott Brown (ADEM)
Allen Phelps (ADEM)
Justin Rigdon (ADEM)
Chris Johnson (ADEM)
Dan Holliman (EPA)
Calista Mills (EPA)
Amanda Howell (EPA)
Josh Rowell (FWS)
Rusty Swafford (NMFS)
Brandon Howard (NMFS)

Corps of Engineers - ERDC
Kevin Reine
Barry Bunch
Earl Hayter
Ray Chapman
Christina Saltus
Todd Slack
Sung-Chan Kim
Matthew Balazik
Todd Swannack
Kevin Philley
Candice Piercy

Corps of Engineers – Mobile District
Elizabeth Godsey
Justin McDonald
David Newell
Richard Allen
Nate Lovelace
Angelia Lewis
Ashley Kleinschrodt
Rita Perkins
Larry Parson

Mobile Harbor General Reevaluation Report

Agency Webinar Meeting

Numerical Modeling and Resource Assessments

U.S Army Corps of Engineers

Mobile District

September 22, 2016
Mobile, Alabama

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US Army Corps of Engineers
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Agenda

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- Introductions
- Mobile Harbor GRR/SEIS Update
- Study Approach
  - Numerical Modeling
    - Hydrodynamics
    - Water Quality
    - Sediment Transport
  - Aquatic Resources Assessments
    - Wetlands
    - Submerged Aquatic Vegetation
    - Oysters
    - Benthic
    - Fish
- Other Discussions
- Next Steps

GENERAL REEVALUATION REPORT SCHEDULE (48 MONTHS)

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SCOPING | **ALTERNATIVE FORMULATION & ANALYSIS** | **FEASIBILITY-LEVEL ANALYSIS** | **REPORT APPROVAL**

1 ALTERNATIVES MILESTONE
Vertical Team concurrence on Array of Alternatives
2/17/16

2 TENTATIVELY SELECTED PLAN (TSP) MILESTONE
Vertical Team concurrence on TSP
Apr 2018

Public Review of Draft SEIS
Jul 2018

3 AGENCY DECISION MILESTONE
Agency Endorses Recommended Plan
Dec 2018

4 DIVISION ENGINEER TRANSMITTAL LETTER
Release for State & agency Review
Jun 2019

Public Review of Final SEIS
Aug 2019

5 GRR APPROVAL
Nov 2019

Current Activities

- Refining public involvement strategy
- Data collection to establish existing and baseline environmental conditions
- Developing commodity and fleet forecasts
- Determining beneficial use opportunities

Flow Diagram of Assessment Tools

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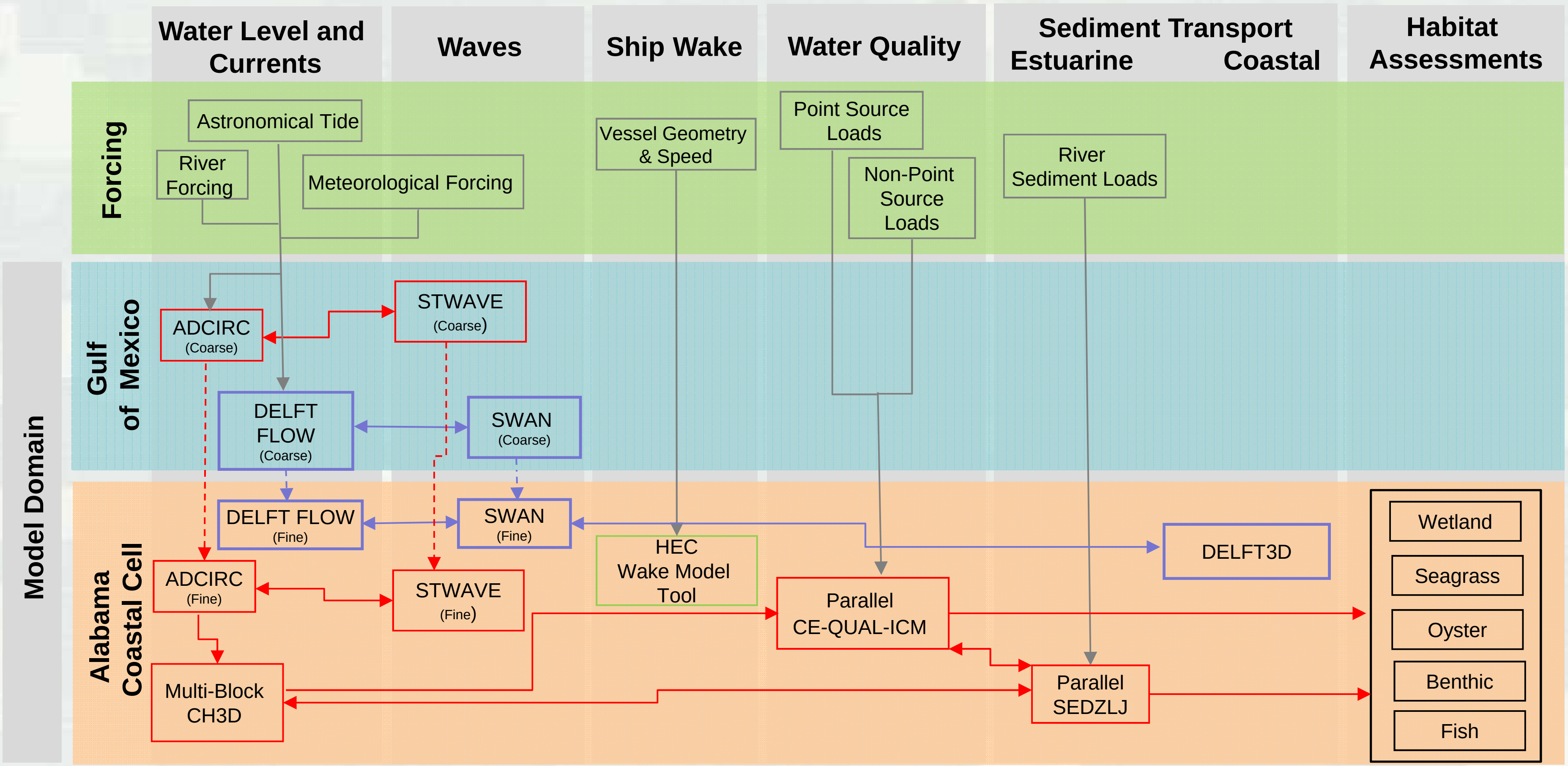


Hydrodynamic
(Water Levels and Current Velocities)

Coastal Storm **M**odeling **S**ystem (CSTORM) **–** **AD**vanced **CIRC**ulation Model (ADCIRC)

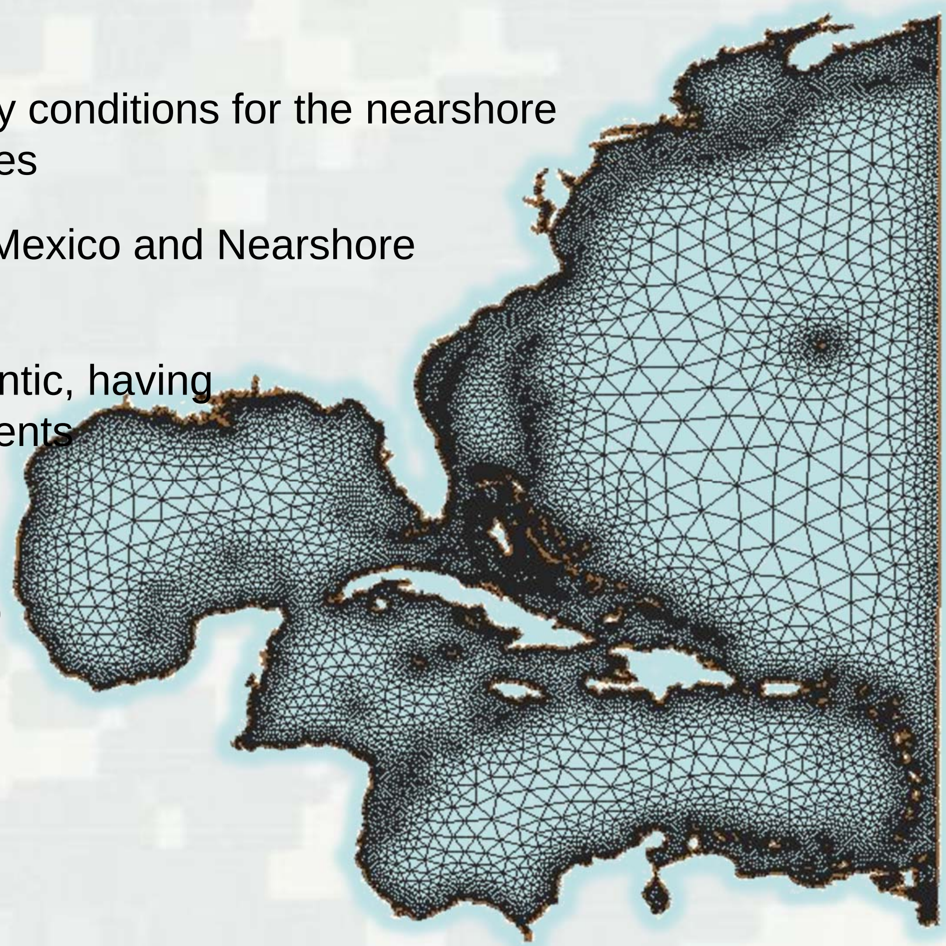
Purpose: Provide offshore elevation boundary conditions for the nearshore hydrodynamic and sediment transport modules

Spatial Domain: Atlantic, Caribbean Gulf of Mexico and Nearshore Coastal Alabama

Grid Resolution: Largest elements in the Atlantic, having nodal spacing of about 20 km, smallest elements resolve the Mobile Bay navigation channel, with nodal spacing ~ 60 m

Simulation Period: January - December 2010

Model Output: Water surface elevation and current velocity fields



Hydrodynamic (Waves)

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CSTORM – **<u>ST</u>**eady State Spectral **<u>WAVE</u>** **<u>F</u>**ull **<u>P</u>**lain (STWAVE-FP)

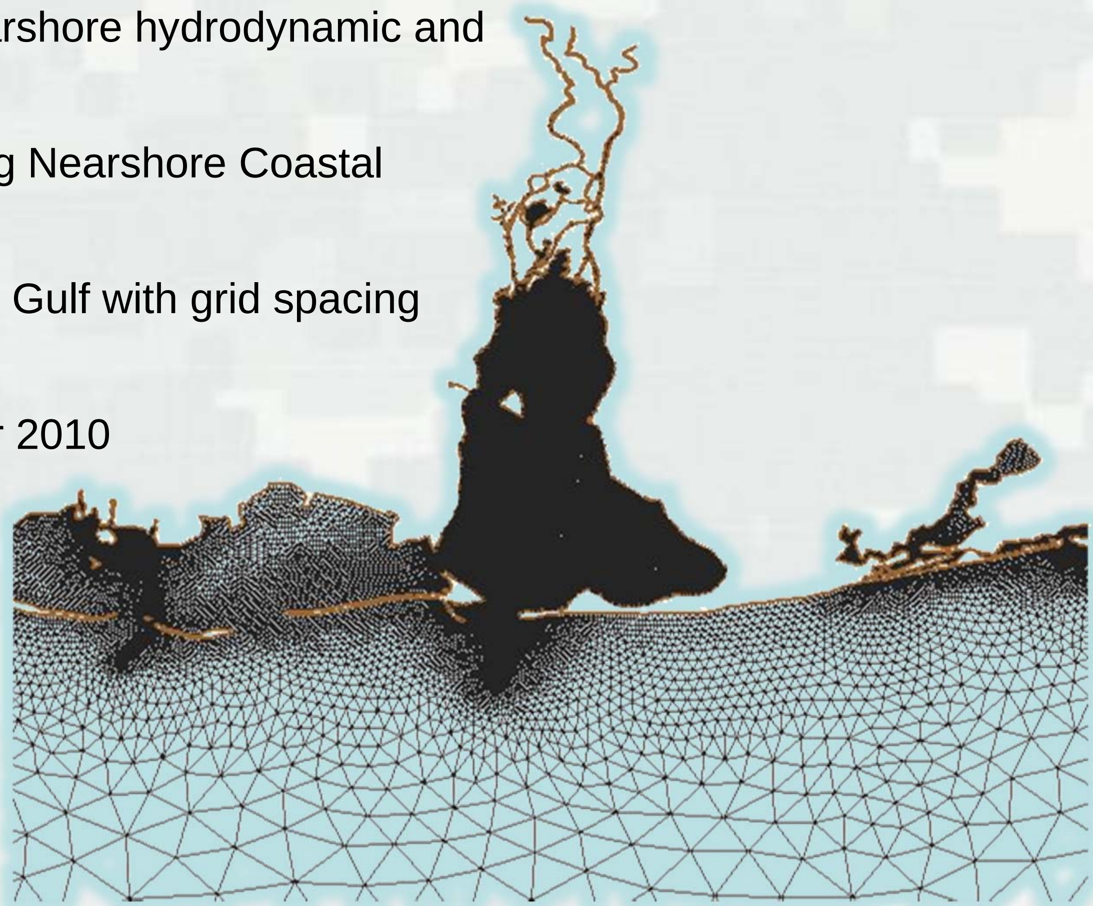
Purpose: Provide wave fields to the nearshore hydrodynamic and sediment transport modules

Spatial Domain: Gulf of Mexico including Nearshore Coastal Alabama and Mobile Bay

Grid Resolution: Largest elements in the Gulf with grid spacing of ~200 m.

Simulation Period: January – December 2010

Model Output: Significant wave height, peak period and mean direction. Radiation stress gradients.



Hydrodynamic
(Water Levels and Current Velocities)

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Geophysical Scale Transport Modeling System (GSMB) - **M**ulti-**B**lock **C**urvilinear **H**ydrodynamics in **3-D**imensions-**W**aterways **E**xperiment **S**tation (MB-CH3D-WES)

Purpose: Provide water levels and current velocities to the water quality, estuarine sediment transport and habitat assessment modules

Spatial Domain: East of Pensacola Bay, FL at the eastern boundary to Lake Ponchartrain, LA at the western boundary.

Grid Resolution: 10 layers in the vertical within every grid cell. Smallest elements resolve the Mobile Bay navigation channel, with nodal spacing of ~ 28 m with the maximum cell width elsewhere in the bay of ~350 m and maximum grid edge of the model domain is ~3000 m.

Simulation Time Period: January – December 2010

Model Output: Water levels, currents, salinity and temperature

Water Quality

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GSMB - CE-QUAL-ICM

Purpose: To assess potential changes in water quality including changes in flushing, salinity, dissolved oxygen, temperature, total suspended solids, nutrients and chlorophyll a as a result of channel improvements. Provide water quality constituents (i.e salinity, temperature, dissolved oxygen, total suspended solids ect.) for habitat assessments.

Spatial Domain: East of Pensacola Bay, FL at the eastern boundary to Lake Ponchartrain, LA at the western boundary.

Grid Resolution: 10 layers in the vertical within every grid cell. Smallest elements resolve the Mobile Bay navigation channel, with nodal spacing of ~ 28 m with the maximum cell width in the bay of ~ 350 m and maximum grid edge in model domain of ~3000 m.

Simulation Period: January – December 2010

Model Output:

Temperature	Dissolved Organic Nitrogen (DON)
Salinity	Particulate Organic Nitrogen (PON)
Suspended Solids	Dissolved Inorganic Phosphorus (DIP)
Coliforms	Dissolved Organic Phosphorus (DOP)
Dissolved Oxygen	Particulate Organic Phosphorus (POP)
Algae	Dissolved Organic Carbon (DOC)
Nitrate (NO_3-N)	Labile Particulate Organic Carbon (LPOC)
Ammonia (NH_4-N)	Refractory Particulate Organic Carbon (RPOC)

.

Estuarine Sediment Transport

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GSMB - SEDZLJ

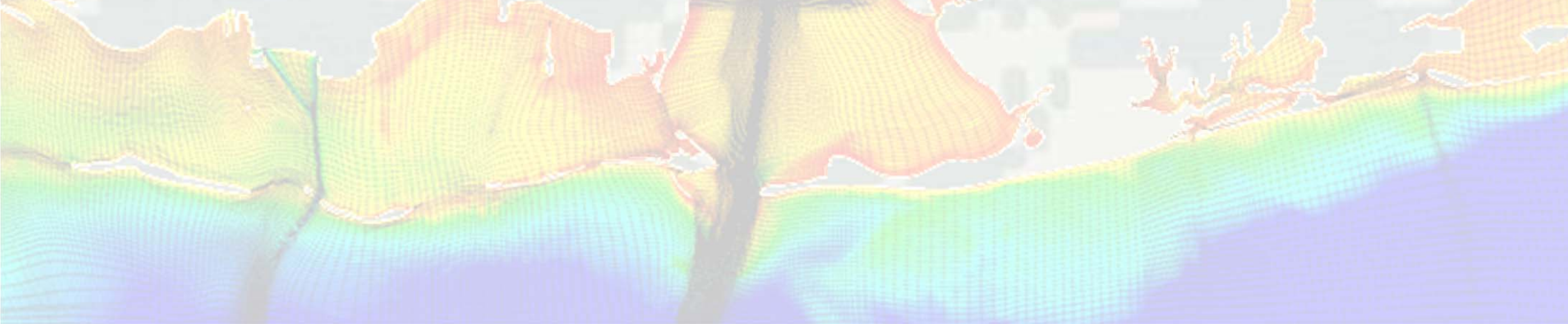
Purpose: To assess relative changes in sedimentation rates as a result of channel improvements

Spatial Domain: Nearshore Coastal Alabama, Mobile Bay and Delta.

Grid Resolution: 10 layers in the vertical within every grid cell. Smallest elements resolve the Mobile Bay navigation channel, with nodal spacing of ~ 28 m with the maximum cell width in the bay of ~ 350 m and maximum grid edge in model domain of ~3000 m.

Simulation Time Period: January – December 2010

Model Output: Sedimentation rates and pathways



Estuarine Sediment Transport

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GSMB - SEDZLJ

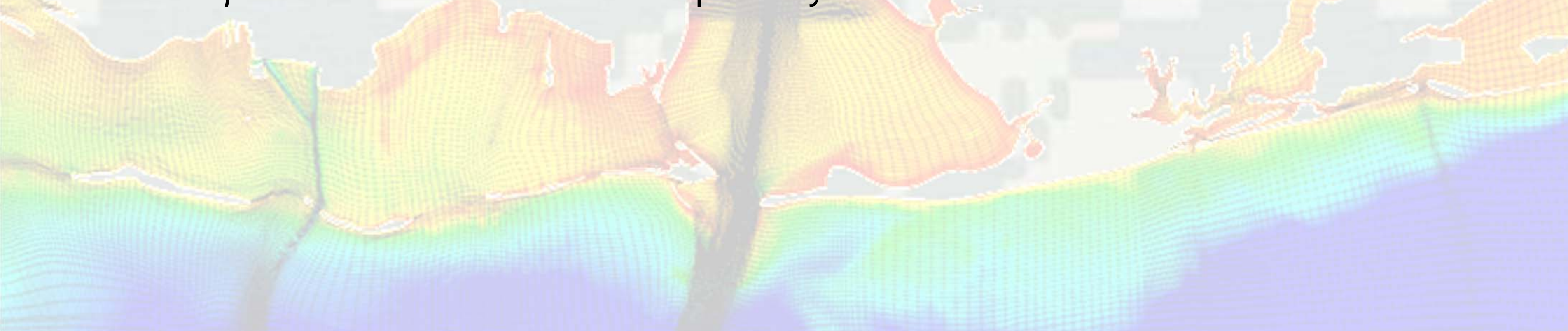
Purpose: To assess relative changes in sedimentation rates as a result of channel improvements

Spatial Domain: Nearshore Coastal Alabama, Mobile Bay and Delta.

Grid Resolution: 10 layers in the vertical within every grid cell. Smallest elements resolve the Mobile Bay navigation channel, with nodal spacing of ~ 28 m with the maximum cell width in the bay of ~ 350 m and maximum grid edge in model domain of ~3000 m.

Simulation Time Period: January – December 2010

Model Output: Sedimentation rates and pathways



Coastal Nearshore Sediment Transport

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Delft3D (Flow, SWAN and Morph modules)

Purpose: Quantify relative changes in sediment pathways and morphological response of the adjacent nearshore environment as a result of proposed channel modifications.

Spatial Domain: Northern Gulf of Mexico, Nearshore Coastal Alabama (Ebb Tidal Shoal and Dauphin Island)

Grid Resolution: Smallest elements resolve the nearshore, with grid spacing of approximately 20m in the longshore and 5 meters in the crosshore

Simulation Period: Reduced full wave climate of the coastal region to a set of representative wave wind conditions, which will be ran over a smaller time scales (ie tidal cycles) with its effect on the morphology multiplied by a Morpfac value.

*Model Output: S*ediment transport pathways and morphological response

Ship Wake

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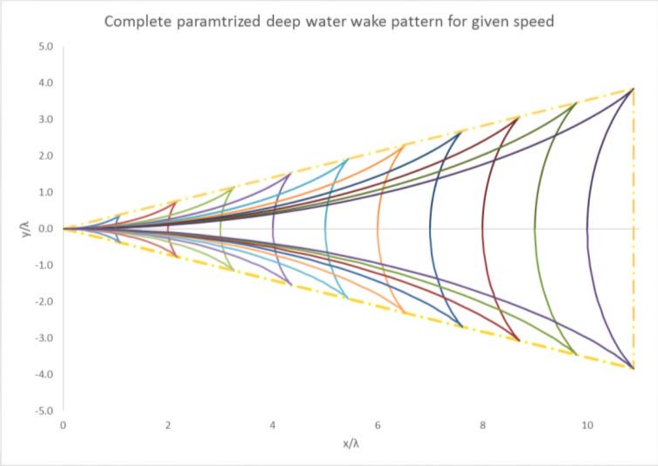
Wake Model Tool

Purpose: Quantify relative changes in ship wake energy from proposed channel improvement measures.



Spatial Domain: Navigation channel and distance off the sailing line of the navigation channel (i.e. points of Interest along the western shoreline)

Simulation Period: Simulated for a select number of representative vessels and vessel speeds.

Model Output: Diverging and transverse wave propagation and spatial determination of wave period, individual and group celerity, and individual and cumulative wave energy

Predictive Analysis of Potential GRR Impacts to Wetlands

- **Off site data collection - review existing mapping including current efforts**
- **Identify data gaps and finalize field study design**
- **Execute field study: 1) verify mapping and address data gaps, 2) describe wetland communities (soils, vegetation, hydrology), 3) link in-channel water quality (e.g., salinity) with wetland pore water data**
- **Develop plant community data/distribution tables**
- **Link wetland community type with salinity and water quality tolerance intervals**
- **Utilize water quality and sediment modeling results to predict potential impacts including spatial extant, degree, duration**
- **Develop draft report for review and comment from SAM and interagency team followed by comment response, final approval, and publication**

Predictive Analysis of Salt Water Intrusion to Submerged Aquatic Vegetation

- **Identification/Examination of Existing Data**:
  - Use historic, current and ongoing SAV maps, GIS layers, etc.
  - Establish the current state and extent of SAV resources within the project area
  - Initiated August 2016
- **Field Verification:**
  - Conduct field verification/ground-truth data to improve resolution in transition zones
  - Locations and spatial extent based on gaps in current SAV map and field efforts
  - SAVews (echo sounder) and/or visual transects focused on transition zones
  - October 2016 (initial site scoping, September 2016)
- **Evaluate habitat variability:**
  - Use historic SAV distribution data to determine habitat variation over time
  - Potential datasets include
    - 1957 (Baldwin)
    - 1963 (Lueth)
    - 1980 (Stout and Lelong)
    - 2002 (Vittor & Associates)
    - 2008 & 2009 (Vittor & Associates)
    - 2015 & 2016 (Vittor & Associates)
  - Focus on estuarine transition zones
  - Use spatial statistics to quantify historic variation in estuarine, brackish, freshwater zones

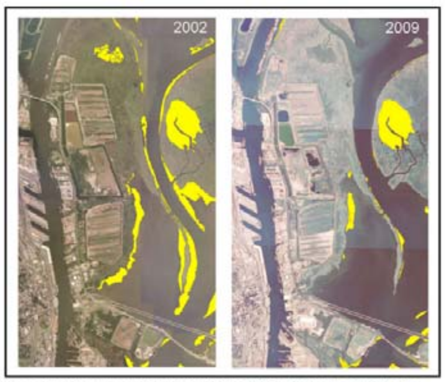


Figure 3-1. SAV coverage (shaded yellow) in the Mobile Quadrangle comparing the 2009 and 2002 surveys.

Vittor and Associates, 2009

Predictive Analysis of Salt Water Intrusion to Submerged Aquatic Vegetation


Mobile Bay National Estuary Program

- **Evaluate environmental tolerances:**
  - Review existing literature and current research efforts
  - Identify tolerance of SAV plant species to changes in water quality parameters
  - Establish ecological tolerance thresholds
- **Analysis of water quality model outputs and evaluation of alternatives:**
  - Use ecological tolerance thresholds to predict impacts on SAV from changes in hydrodynamics and water quality.
- **Reporting:**
  - Prepare data report on findings.

Predictive Analysis of Oyster Reef Connectivity

- Spatial data: Collect all relevant GIS files pertaining to oyster reefs within Mobile Harbor: October 2016 through January 2017 .
- Define hydrodynamic variables to be passed to a larval transport model such as velocities, temperature and salinity as well as water levels. October 2016 through June 2017
- Develop post-processing tools to generate required 3-D hydrodynamic information from MB model in the format required to interface with the larval transport model (e.g. PTM). Determine duration for simulation and time interval for hydrodynamic information update. January 2017 through March 2017
- Develop biological behavior library for larval tracking October 2016 through April 2017
- Evaluate larval tracking library and run baseline simulations
- Utilize water quality model and hydrodynamic model outputs to identify potential impacts based on tolerance levels and variability of oyster recruitment reef locations habitats
- Predictive Analysis (Saltwater Intrusion Impacts). Impacts to benthos from saltwater intrusion based on salinity values obtained through water quality modeling. 1) increases in salinity will increase species richness, 2) increased in salinity variability will reduce species diversity and 3) increases in salinity will result in higher benthic biomass and abundance.
- Reporting: Prepared data report on findings.

Predictive Analysis of Salt Water Intrusion to Benthic Invertebrates

- **Field Work: Collect 90 Samples by Ponar Grab per season: October 2016, Feb/March 2017 .**
- **Sampling Locations: samples will be collected in three zone: estuarine, brackish and freshwater**
- **Sediments and TOC: Sediment sample taken at each site to assess: Grain Size Distribution, Total Organic Content, % Moisture.**
- **Processing of benthos (stage 1): Wash samples in the field, preserve with 10% buffered formalin.**
- **Collect Physiochemical Data: Collect water quality data at each sampling station to include: salinity, DO, DO %sat, temperature, etc.**
- **Processing of benthos (stage 2). At the lab, transfer samples to 70% isopropyl alcohol, stain with Rose Bengal. Enumerate samples from debris.**
- **Taxomony: Taxonomic Identification to lowest practical identification level.**
- **Biomass: process biomass for major groups to include: Annelids, Arthropods, Mollusca, Echinoderms, Miscellaneous)**
- **Statistical Analysis: Compared abundance, taxa and diversity 1) between zones, 2)between areas with different substrates within zones, and 3) by water quality parameters.**
- **Fish Distribution/Food Resources: Correlate fish distribution to benthic invertebrates in all three zones.**
- **Predictive Analysis (Saltwater Intrusion Impacts). Impacts to benthos from saltwater intrusion based on salinity values obtained through water quality modeling. 1) increases in salinity will increase species richness, 2) increased in salinity variability will reduce species diversity and 3) increases in salinity will result in higher benthic biomass and abundance.**
- **Reporting: Prepare data report on findings.**

Predictive Analysis of Salt Water Intrusion to Fish

- **Objective: Evaluate relationships between salinity and fish assemblage structure to predict potential environmental impacts**
- **Field Work: Collect fish in late summer 2016 and spring 2017 using two gear types: seining and trawling**
- **Sampling Locations: Samples will be collected in three zones: estuarine, brackish and freshwater**
- **Habitat Data: Water quality collected including salinity**
- **Database: Data received from Alabama Marine Resource Division and includes the Fisheries Assessment and Monitoring Program (FAMP) data. Field data collected as part of the current study used to validate statistical models**
- **Categorize fish assemblage according to their salinity tolerance**
- **Develop statistical relationships between guild abundance (dependent variable) and salinity (independent variable)**
- **Physical models developed by Mobile District will be used to predict changes in salinity gradients for baseline and alternatives.**
- **Output will be provided as Habitat Units and will identify gains and losses in habitat for each functional guild**.

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BENTHIC INVERTEBRATE MONITORING PLAN

TO ASSESS THE POTENTIAL IMPACTS TO BENTHIC MACROINVERTEBRATES RESULTING FROM SALTWATER INTRUSION POST-DEEPENING OF THE FEDERAL NAVIGATION CHANNEL IN MOBILE BAY, ALABAMA

Submitted to the Mobile District
109 St. Joseph Street
Mobile, AL 36602

27 September 2016

Prepared by:

Kevin J. Reine
Research Marine Biologist
Environmental Laboratory
Engineer Research and Development Center

U. S. Army Corps of Engineers

INTRODUCTION

As part of an investigation of potential environmental effects of widening and deepening of the Federal navigation channel, the U.S. Army Corps of Engineers Mobile District requests the assistance of the Wetlands and Coastal Ecology Branch (W&CEB) of the U. S. Army Engineer Research and Development Center (ERDC) to assess potential impacts to benthic infauna and sediments in locations potentially impacted by saltwater intrusion. Characterizations of benthic assemblages (taxa, diversity and abundance) in estuarine, transitional (brackish), and freshwater environments are important to establish a baseline of the benthic community prior to channel deepening and potential impacts from saltwater intrusion. A key component of the current study is to document changes to benthic habitat along the salinity continuum moving upriver and estimate how far upriver changes may occur after the navigation channel is widened and depended to its new authorized depth. The current depth and width measures 45 foot deep by 400 foot wide channel in the bay and a 47-foot deep by 600-foot wide channel across the bar. Elevated salinities upriver and in adjacent marshes have raised concerns among resource managers because of potentially undesirable impacts to the marshes and their biological resources. Benthic invertebrates are a critical part of both estuarine and riverine food webs, providing forage for economically and ecologically important finfish and shellfish species, which are identified as an important indicator of potential effects, and are routinely monitored as part of environmental assessments. Annelids, polychaetes, nematodes, clams and crustaceans that inhabit the bottom substrate of estuarine and riverine systems are collectively called benthic macroinvertebrates. These organisms may be infauna, living within the bottom substrate or sediment or epifauna, living on or just above the bottom substrate. These organisms play a vital role in maintaining sediment and water quality and are an important food source for bottom feeding fish, shrimp, ducks, and marsh birds. Some examples of commercially or recreationally important fish species that feed on benthic invertebrates include: Atlantic Croaker, Southern Kingfish or Ground Mullet, Spot, and Flounder. Many other fish species located in the Mobile estuary feed primarily on epifauna, crustaceans and mollusks, include crabs, crayfish, snails, clams, etc. The Alabama Shad is a freshwater species that feeds almost exclusively on benthic invertebrates. Benthic communities are often used as indicators of perturbations in the environment because they are relatively immobile, and therefore cannot avoid environmental disturbances. The responses of benthic communities to habitat alterations (e.g. hypoxia) are often expressed as changes in community structure, density and diversity. Benthic populations and community characteristics are sensitive indicators of contaminants, dissolved oxygen stress, and salinity fluctuations.

1.0 PURPOSE: Sediment/benthic samples are collected for a variety of reasons including chemical, physical, toxicological and biological analysis. The current study plan is to assess and characterize the benthic assemblage (taxa, diversity and abundance), sediment characteristics and water quality in three primary zones: estuarine, brackish (transitional) and freshwater prior to deepening the Federal navigation channel in Mobile Bay. This assessment will establish a baseline dataset, especially in areas where little or no data is currently available. Although all three zones could experience changes in salinity resulting from salt water intrusion, the freshwater environment is an area where saltwater intrusion resulting from the widening and deepening of the Mobile Bay Federal Navigation Chanel may have the greatest impact. Saltwater intrusion is the influx of seawater into an area that is not normally exposed to high saline levels. Saltwater intrusion includes the inflow of seawater into a freshwater wetland or a freshwater riverine system. In addition to salinity, dissolved oxygen concentrations (mg/L), water depth, temperature (ºC) substrate type (e.g., sand, silt etc.) and organic content all affect benthic invertebrate communities.

2.0 STUDY SITE: Mobile Bay, Alabama is formed by the Fort Morgan Peninsula to the east and Dauphin Island, a barrier island on the west. Mobile Bay is 413 square miles (1,070 km^2) in area. It is 31 miles (50 km) long with a maximum width of 24 miles (39 km). The deepest (75 feet, 23 m) areas of the Bay are located within the federal navigation channel, which serves Alabama's only port for ocean-going vessels, but the average depth of the bay is around 10 feet (3 m). The Mobile Bay watershed is the sixth largest river basin in the United States and the fourth largest in terms of streamflow. It drains water from three-fourths of Alabama as well as portions of Georgia, Tennessee and Mississippi into Mobile Bay. Both the Mobile River and Tensaw River empty into the northern end of the Bay. Several smaller rivers: Dog River, Deer River, and Fowl River, on the western side of the Bay and the Fish River on the eastern side also empty into the Bay, making it an estuary. A feature of all estuaries is a transition zone, where the freshwater from the rivers mixes with the tidally-influenced salt water of the Gulf of Mexico.

3.0 Data Quality Objectives

- Establish baseline data for comparison to results/output from the modeling component of the study.
- Obtain pre-existing data for benthic stations in Mobile Bay, the delta and freshwater sites,
- Collected data will be used to determine changes in the benthic assemblage due to changes in salinities resulting from the widening and deepening of the Mobile Federal Navigation Channel.
- The Mobile District with input from various state and federal resources agencies will use this data to choose the most suitable option to achieve project goals while protecting valuable resources and habitat.
- All samples will be collected with the assistance of Mobile District personnel and vessels provided by the Mobile District.
- The Wetlands and Coastal Ecology Branch of the Environmental laboratory will be responsible for processing all samples collected.
- Number of samples to be collected is provided below.
- Schedule of sampling events and data processing is located in Tables 1-3.
- Statistical analysis, to include Univariate and Multivariate procedures, are provided in greater details in Section 6.
- Number of samples equals 30 per zone for a total of 90 samples taken during each sampling event. Sample locations are displayed on Figures 1 through 3.
- Water quality profiles (surface to bottom) will be taken at each site.
- A sediment sample will be taken at each site to obtained information on sediment grain size and total organic content.
- Quarterly progress reports will be provided to the Mobile District for review and comment.
- A data report will be presented to the Mobile District and Resource Agencies for Review and Comment.
- A final report will be submitted to the Mobile District after the incorporation of review comments.
- An ERDC Technical Report shall be submitted for publication through ERDC's Dredging Operation and Technical Support (DOTS) Program.
- All data will be entered into an electronic database (i.e. Excel). Output results from PRIMER-E as well as any maps plotting results will be put into PowerPoint for easy viewing. A hard copy of all the data records, including Chain of Custody forms shall be kept and archived at ERDC.
- All data, both hardcopies and electronic versions shall be sent to the District upon request.

4.0 Field Methods

Data collection: Benthic invertebrates will be sampled during the fall of 2016 and spring of 2017. A total of 90 benthic samples will be collected during each of the two sampling events (n = 180). Thirty samples will be collected in each of three zones: estuarine (Zone A), brackish (transitional, Zone B) and freshwater (Zone C) (Figure 1). A layout of sampling station by within each zones is located in Figures 2 through 4. Sampling stations are plotted in the Captain's Software v8 on NOAA Charts 11376 to 11380, and linked to a diff GPS Trimble Navigation System. GPS coordinates are provided in Appendix A.

- Spring sample measures recruitment of benthic invertebrates.
- Summer sampling can evaluate the response to presence/absence, taxa and abundance due to hypoxic periods. (Option)
- Fall Samples typically maximizes abundance, number of taxa, and biomass, most notably in areas that do not experience hypoxic conditions.

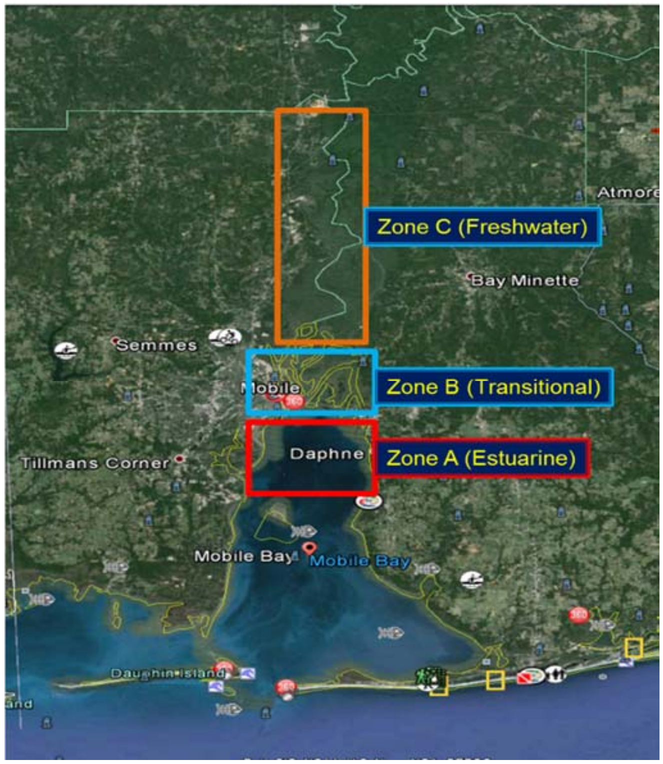

Figure 1. Sampling zones.

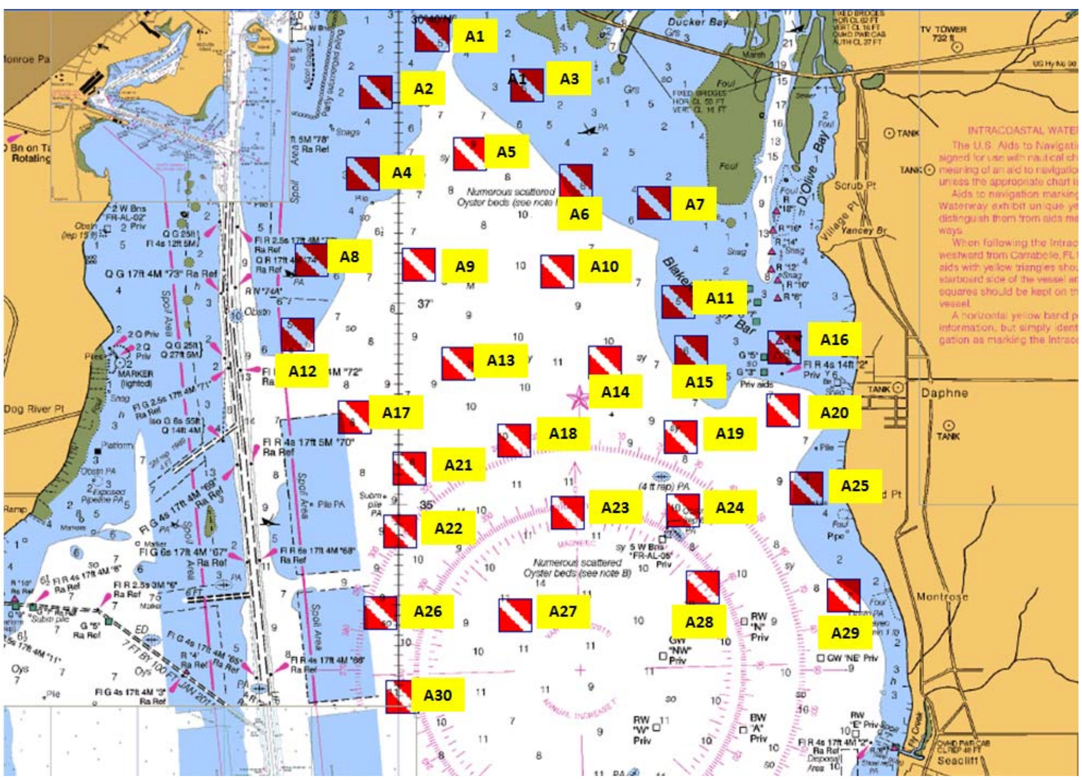

Figure 2. Benthic sampling stations in Zone A (estuarine zone).

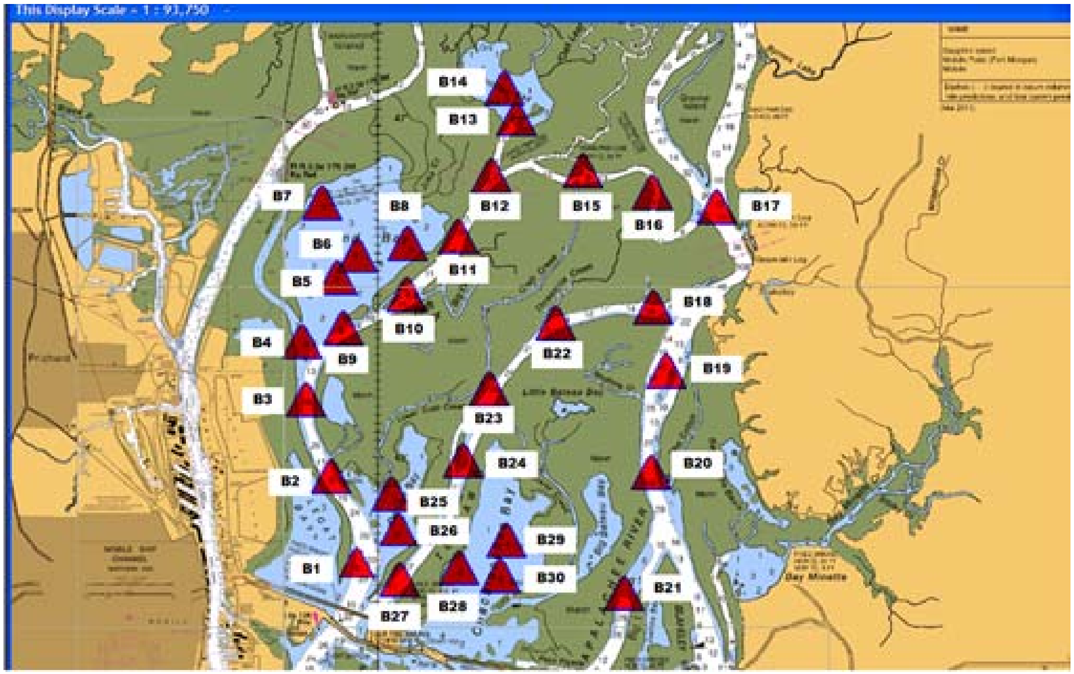

Figure 3. Benthic sampling stations in Zone B (brackish or transitional zone).

There is no NOAA Chart for this region of the Mobile River. These stations will have to navigated to using the boat's navigation system. The other stations can be navigated to using the Captain Software.

C1 thru C5 are located on NOAA Chart

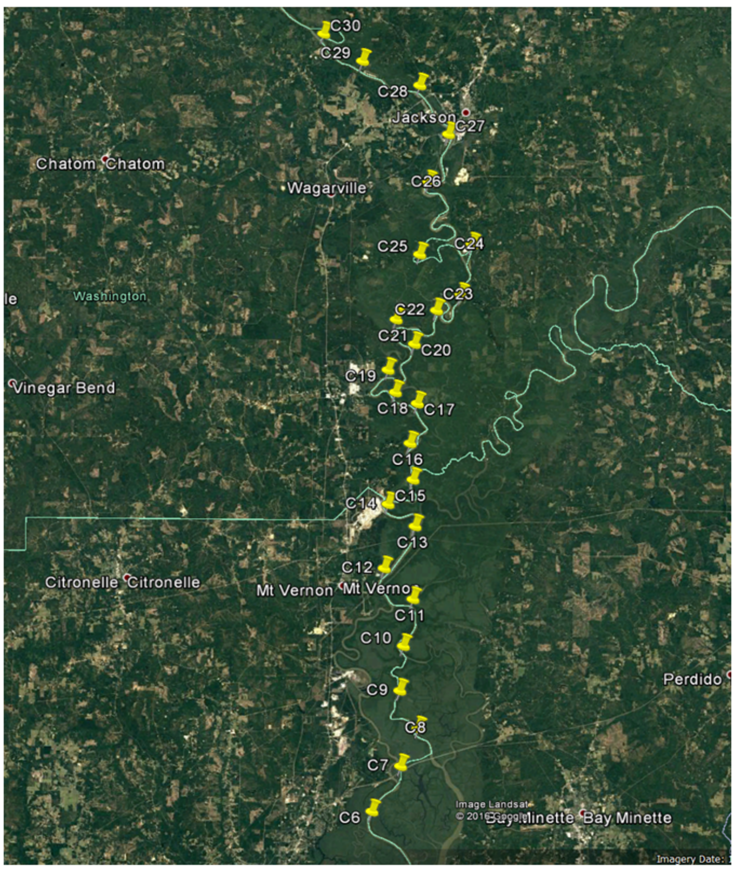

Figure 4. Sampling stations located in Zone C (freshwater zone).

4.1 Water Column: Water quality vertical profiles (surface to bottom) will be collected at each sampling station. Dissolved Oxygen (mg/l), Temperature (ºC), pH, Salinity (ppt), Specific Conductance (uS/Cm @ 25C), and Depth (m) will be measured with a Hydrolab M S5 Sonde manufactured by Hatch Corporation.

- Sampling at sites < 2 m, every 0.5 m interval
- Typical depths: sites > 2 m and less than 10 m, interval 1 m.
- Deep sites (> 10 m)-every 1 – m interval from surface to near bottom. Half m intervals in the lower 3 m of the bottom.
- Two profiles will be recorded, one while the instrument is being raised, the other during lowering.
- An example water quality data sheet is found in Appendix B.

Table 1. Data collection and processing activities for the fall sampling event. (See Note 1)

Dates	Vessel	Location	Samples Collected	Type Sample or Activity
June 2016	n/a	n/a	n/a	Literature review for salinity ranges of benthos found in Mobile Bay
October 11th	Wallace	Irvington Field Office	N/A	Mob Equip./ Travel to Mobile
Field Work, October 11th-14th	Wallace	Estuarine (Zone A)	30 each type	Benthic Substrate Water Quality
Field Work, October 15th – 17th	Wallace	Freshwater (Zone C)	30 each type	Benthic Substrate Water Quality
Field Work, October 18th – 21st	Carolina Skiff	Brackish Zone B)	30 each type	Benthic Substrate Water Quality
October 21st	Carolina Skiff	TBD	N/A	Demob Equipment/Travel back to ERDC
October 22nd – 25th		ERDC Lab	90 total	Wash Samples/Transfer to 70% Alcohol Stain with Rose Bengal
Oct 26th and 27th		ERDC Lab	90 total	Let samples stain for a minimum of 2 days
November 2016		ERDC Lab	90 total	Processing of fall samples; separating animals from sample debris
December 1st		ERDC	90 total	Ship samples to Dr. Gary Ray
December 2nd – 22nd		HX5	90 total	Taxonomic IDs
Dec 23rd – Jan 7th				Christmas Break
Jan 9th to Jan 17th		ERDC	450 max subsamples	Calculate biomass for Annelids Calculate biomass for Anthropods Calculate biomass for Echnoderms Calculate biomass for Mossusca Calculate biomass for Miscellanoeus

Note 1: Generally a spring sampling event (March 2017) would occur to assessment recruitment in the sampled area. The District and Resource Agencies have one of three options in addition to the fall sampling event: 1) conduct a spring sampling only as originally proposed in the SOW to assessment recruitment and salt water intrusion to recruitment, 2) conduct summer sampling to evaluate benthos under hypoxic conditions, or 3) conduct both a spring and summer sampling. The summer sampling event would be used to characterize benthos during low DO conditions as well as the added stress placed on the benthic community due to changes associated with salt water intrusion.

Table 2 Data collection and processing activities for benthic samples collected during the spring sampling event. *See Note 2*				
Dates*	**Vessel**	**Location**	**Samples Collected**	**Type Sample/ Activity**
March 6th		Irvington Field Office	n/a	Travel/Mob equipment
March 7th – 11th	Wallace	Estuarine (Zone A)	30 each type	Benthic Substrate Water Quality
March 11th – 14th	Wallace	Freshwater (Zone C)	30 each type	Benthic Substrate Water Quality
March 15th – 18th	Carolina Skiff	Brackish Zone B)	30 each type	Benthic Substrate Water Quality
March 18th	Carolina Skiff	TBD	N/A	Demob Equipment
March 18-22nd	N/A	ERDC's Coastal Lab	90 total	Wash Samples/Transfer to 70% Alcohol Stain with Rose Bengal
March 22nd and 23rd	B/A	ERDC's Coastal Lab	90 total	Let samples stain for a minimum of 2 days
March 23-April 24nd	N/A	ERDC's Coastal Lab	90 total	Processing of fall samples; separating animals from sample debris
April 24rd	N/A	ERDC's Coastal Lab	90 total	Ship samples to Dr. Gary Ray, Benthic Ecologist (retired ERDC employee)
April 24th – May 14th	N/A	HX5	90 total	Taxonomic IDs

Table 3. Processing activities after both the fall 2016 and spring 2017 sampling events are completed.				
May 14th – 26th	N/A	ERDC Coastal Lab	450 max subsamples	Calculate biomass for Annelids Calculate biomass for Anthropods Calculate biomass for Echnoderms Calculate biomass for Mossusca Calculate biomass for Miscellaneous
May 26th – Jun 9th	N/A	ERDC/HX5		Statistical Analysis of benthic and sediment results
June 10th – 23rd	N/A	ERDC/HX5		Correlation of fish distribution to benthic invertebrates
June 24th Jul 31st	N/A	ERDC/HX5		Predictive Analysis (Impacts from saltwater intrusion)
August 1st	N/A	ERDC/HX5		Deliver Draft Report to Mobile District and Resource Agencies
Aug 2nd-16th	N/A	ERDC/HX5		Incorporate comments from Mobile District and Resource Agencies
August 17th	N/A	ERDC/HX5		Final Report Delivered

Note 2: Currently fall of 2016 and spring of 2017 are reported in the Scope of Work for the collection of benthic invertebrate samples due to the extreme logistical constraints imposed by the 3x3x3 study. Given the deadline as to when a final report must be turned over to the District a late summer sampling event will not provide adequate time for processing and analyses of the data, unless there is a change in the stipulation that the final report is due by August 17th.

4.2 Sediment and Benthic Community Collection: The Ponar Sampler, or 'Grab Sampler', is widely used in fresh and estuarine environments for taking sediment samples from hard bottoms such as sand, gravel, consolidated marl or clay (Reine et al, 2014; 2013) . The Standard Ponar is deliberately heavy device for biting deep into the bottom and has proven success at invertebrate recovery. When the scoops strike the bottom, their tapered cutting edges penetrate well with very little sample disturbance. Removable screens on top of each scoop allow water to flow through as it descends. Constructed of 316 Stainless Steel and weighing 34kg when full, it is typically connected to a davit and lifted by winch to the surface. Some benefits include: center pivot for low bottom disturaance, tapered scoop edges for a clean cut, heavy duty hinges for high impact work, removable stainless steel top screens and a self-releasing pinch pin. It weighs 23 kg (50 lbs) empty and 34 kg (75 lbs) full. It has a sampling area of 229 by 229 mm. This grab type samples an area of 0.052 m^2 and has a maximum penetration depth of 15.2 cm. A successful grab has a relatively level, intact sediment over the entire area of the sampler to a minimum depth of 10 cm.

4.2.1 Processing of Benthic Samples

- Collect 30 benthic samples with each of the three zones (n = 90) using a 0.052-m^2 Ponar grab sampler. Benthic samples will be noted as quality, substrate type, and odor. Samples will then be sieved with a 0.5 mm mesh screen.
- Material retained on the screen will be placed in a HUBCO 485-5x7 Geological Sample Bay 5" x 7" and placed into a 5-gallong bucket for storage. Nalgene bottle may also be used for storage and transport.
- Sample will be preserved in 10% buffered formalin and stained with rose Bengal to facilitate sorting.
- Samples will be transported to ERDC's Coastal Ecology Lab for processing. Samples will be transferred from formalin to 70% alcohol.
- Samples are then processed based on currently accepted practices in benthic ecology (e.g. Holme and McIntyre, 1971) and on specific protocols described in the EMAP-E Lab Methods Manual (U. S. EPA 2001; 1995).
- Animals are then sorted from sample debris under a dissection microscope.

4.2.2 Quality Control

- A representative number of samples (10%) shall be selected at random and reprocessed too determine if all benthic organisms were separated from sediment and debris upon initial processing.
- If 10% of the total number of organisms were missed during the initial processing of the samples, all samples will be re-processed.

4.2.3 Total Organic Content (TOC).

- Stainless steel utensils will be used to remove a portion of the sediment sample for total organic content.
- The subsection of the substrate sample will be placed in a 24 oz. (710 ml) whirl-pac, sealed and placed in an ice cooler to remain cold.
- Analysis of TOC will be conducted at ERDC's sediment processing laboratory.
- A total of 90 substrate samples (30 from each zone) will be processed to determinant TOC.
- One substrate sample is collected at each benthic sampling station.
- Organic content will be measured as weight loss upon ignition following the procedures listed below.
- Measure duplicate aliquots (~ 2 gram we-weight).
- Dry aliquots at 100 ^{O}C for 12 hours.
- Re-weigh aliquots after cooling in a drying chamber.
- Place in muffle furnace at 500 ^{o}C for 12 hours.
- Allow sample to cool in drying chamber.
- Organic content will be calculated between aliquot ash-free and dry-weights.

4.2.4 Grain Size Distribution:

- GSD can have significant effects on the distribution on the distribution of benthic species. Higher percentages of sand, for example, may provider greater numbers of microhabitats for interstitial species to exist and could increase sediment permeability allowing greater exchange of oxygen and nutrients at depths in the sediment (Hyland et al. 1991), Weston 1988).
- All substrate samples will undergo processing for Grain Size Distribution at ERDC's sediment Processing Laboratory.
- GSD will be processed using a combination of wet-sieving, floatation procedures and coulter counter techniques.

4.2.4.1 Processing of sediment for Grain Size Distribution

- Soak samples in 20% sodium hexametaphophate solution to disaggregate silt and clay fractions.
- Agitate sample in sonic bath for several minutes.
- If sediment contains gravel it must be sieved in successively smaller sieves to determine size.
- The sand and silt/clay fraction are then run through the coulter counter.
- Grain size analysis will be performed using Gradistat v8.0 (Blott and Pye 2001), which takes the results obtained from the coulter counter and sieve data (gravel) to calculate a variety grain size parameters as well as the percentages of sediments in individual grain size categories.
- Grain size parameters and description will be based on the methods by Folk and Ward (1957) and Folk (1966).

4.2.5 Considerations for proper measurement and handling of sediment samples:

- Records on sampling, including field measurements will be taken and maintained (Appendix B).
- The appropriate field measurements and any information peculiar to the sample will be supplied to the laboratory along with the sample.
- The samples will be stored into Whirp-pac bags which resist puncturing.
- To obtain a representative sample for GSD, consideration of lateral and vertical variability in grab samples must be assessed in the field. Collect larger samples from poorly sorted sediment; smaller samples from well sorted sediment.
- To prevent the growth of organics within a sample, refrigeration in an ice cooler is necessary during the entire field data collection trip. Excessive evaporation must also be avoided, especially if the samples are marine and it is necessary to correct for salt content.
- All analyses will be performed within 1 month of arrival at ERDC Labs.

4.2.6 Sample Labeling - All sample containers will be labeled with:

- the site name as it appears on the laboratory submission form.
- the date and time of the sample collection
- the name of the sample collector or other information specified by the laboratory.

4.2.7 Sample Handling and Shipment

- Sample containers- Nalgene bottle can be placed in a standard ice cooler for shipment.
- Sediment cloth bags will be stored in a tightly sealed 5-gallon bucket with 10% buffered formalin.
- All sediment samples will be chilled and stored in coolers or similar containers at 4 ^{o}C..
- A description of how the samples were packed in the field, what preservatives were used and how they were shipped to the Lab will be recorded.
- A chain of custody form (Appendix B) will accompany each sample shipment.

4.2.8 Field observation recorded during benthic and sediment sampling.

- Weather conditions to include skies, seas, wind and direction and speed and air temperature, will be recorded at every sampling sites
- Habitat/water body type as well as submerged aquatic vegetation (SAV) and presence of marine debris will be documented.
- The benthic sediment will also be characterized for grab quality, substrate type, and odor.
- Water depth (m) will be recorded for each sample taken.

5.0 Taxonomic identification and biomass of benthic invertebrates.

- Species separated under the above tasks will be enumerated by LPIL (lowest practical identification level) taxa using a high-powered microscope.
- Wet-weight biomass will be determined after combining LPIL taxa into higher-order taxa (Annelids, Arthropods, Mollusca, Echinodermata, and Miscellaneous).
- Taxonomic ID will be performed by Dr. Gary Ray, Marine Benthic Ecologist, HX5 Corporation
- Wet-weight biomass will be performed at ERDC's Coastal Ecology Lab.
- Wet-weight biomass will be determined after combining LPIL taxa into higher-order taxa (Annelids, Arthropods, Mollusca, Echinodermata, and Miscellaneous).
- Given that each sample (n = 90 per sampling event) can be subdivided into 5 categories for a maximum total of 450 possible benthic subsamples.
- Wet-weight biomass will be calculated for each subsample. Note: Not all samples will have representative in each of the five major taxa categories.

6.0 Procedures for determining wet-weight biomass.

- Place filter on manifold apparatus and attach glassware.
- Rinse filter with distilled water.
- Using a vacuum pump remove excess water.
- Place wet filer in number glass container
- Weight filter and container on mass balance scale.
- Remove filter and replace back on manifold.
- Reattach glassware.
- Empty sample into glassware and wash with distilled water.
- Remove excess water with a vacuum pump.
- Remove filter with benthic invertebrates and place into glass container for weighing.
- Weight sample on mass balance scale.
- Record measurement.
- Substrate weight of wet filter and container from container with benthic invertebrates.
- Remove animals from filter and stored in vial with 70% alcohol as reference.

7.0 Statistical Analysis: Trends in benthic assemblages are generally evaluated by some combination of three analytical methods: univariate statistics, multivariate statistics and benthic indices. Less common approaches include examination of functional groups (Wilber and Stern, 1992). Species within families share functional roles; therefore aggregation of abundance data at the family level is useful when conducting impacts analyses (Somerfield and Clarke, 1995). Benthic macrofaunal abundance data will be aggregated at the family level and transformed, as needed, to increase the contribution of the less abundance species to the analysis.

7.1 Univariate Analyses: Univariate measures include commonly reported parameters such as, total abundance, taxa richness, and total biomass. Analysis of Variance (ANOVA) tests will be used to compare these parameters among:

- Within Zones
- Between sampling periods.

7.1.1 Purpose: This univariate technique will provide an overview of spatial and temporal trends within the system.

7.2 Multivariate Statistics: Multivariate analyses will be conducted on the benthic infaunal abundance data to determine differences between

- Zones, (e.g. brackish vs. estuarine)
- Within Zones (e.g. freshwater sites on the upper (north) end of the sampling stations to freshwater sites located downriver (south).
- Time periods.

- Community species composition will be analyzed by non-metric multi-dimensional scaling (nMDS) ordinations.
- After completion of nMDS data will be analyzed using Analysis of Similarity (ANOSIM) using PRIMER-E software (Clarke and Gorley, Clarke et al., 2014).
- Non-metric multi-dimensional scaling ordinations (nMDS0 will be generated using ranked similarity matrices based on Bray-Curtis similarity measures of data that most likely will be log(x=1) transformed to reduce the importance of abundant taxa and permit taxa with ow or rate occurrences to contribute to similarity groupings of the samples.
- ANOSIM test will test for difference among zones/time periods.
- SIMPER will be used to identify taxa that contributed the most to distinctions among groups.

7.2.1 Purpose: Necessary to determine what key factors are having the greatest impact to abundance, taxa richness, etc., within and between zones.

8.0 Correlation of Fish Distribution/Food Resources to the benthic community

- The aforementioned statistical techniques that we be applied to the benthic data will be used to examine associations between fish distributions and the salinity/sediment gradient within the system.
- In addition, analyses will be conducted to determine whether fish distributions are correlated with benthic prey resources.
- The benthic team will work closely with the fish team to obtain the necessary baseline data to complete the correlation of fish distribution and the benthic community.

8.1 Purpose: To determine impacts to the fish community structure due to changes in benthic diversity, taxa richness and abundance. Reduce costs by not having to collect fisheries data twice, one for the fish team analysis and the other for this task of the benthic study.

9.0 Predictive Analysis

- Upon completion of the above tasks, comparisons among zones will be completed assessing the presence/absence, abundance, taxa, and diversity of benthic invertebrates related to the physical conditions (i.e. salinity, substrate, organic content, depth and dissolved oxygen, within each zone.
- Results of the water quality model will generate predicted changes in salinity concentrations.
- Model results will include not only mean salinity values, but the expected variance in salinity, which is an important factor affecting the benthic community stability.
- Changes to the taxonomic composition of benthic communities in the different salinity zones will be predicted based on the empirical results of the aforementioned tasks.
- Taxonomic composition of benthic assemblages can be predicted from other studies (See Table 4 from Pollock et al., 2009), however, the baseline *in situ* will provide the most relevant data.
- In addition to the data that will be collected in fall 2016 and spring 2017, the overall predictive assessment will include other relevant studies to include (Junot et al., 1983; Lercari and Defeo, 2006; Pollack et al., 2009; Van Diggelen and Montagna, 2016).

9.1 Potential effects of salt water intrusion on the benthic community.

- Will increases in salinity increase species richness?
- Will increases in salinity variability reduced species diversity?
- Will increases in salinity results in higher benthic biomass and abundance?

9.2 Potential effects on the fish community due to changes in the benthic community?

- How will changes in species composition affect the benthic fish community?
- Will the lower abundance of certain species of invertebrates, for example, affect commercially and recreationally important species due to a reduction in available food resources?

9.3 Purpose:

To determine changes in the benthic assemblage due to changes in salinity zones due to salt water intrusions from the deepening project. The locations where salinity zones change and the resultant changes to benthic community composition will be determined when baseline benthic sampling results can be applied to the water quality model.

Table 4. Some examples of benthic taxa in Mobile and their salinity ranges.			
Taxa	**Range**	**Average**	
Streblospio benedicti	15-35	27	Mesohaline
Paraprionospio pinnata	16-35	27	Meso-Polyhaline
Maranzellaria viridis	ND		Oligo-Mesohaline
Axiothella mucosa	19-35	30	Polyhaline
Hobsonia florida	ND		Oligo-Mesohaline
Melinnia maculata	1-34	27	Meso-Polyhaline
Pectinaria gouldii	1-35	27	Meso-Polyhaline
Mediomastus sp.	ND		Meso-Polyhaline
Heteromastus filiformis	18-35	29	Mesohaline
Capitella capitata	15-35	28	Mesohaline
Leitoscoplos fragilis	ND		Mesohaline
Aricidea spp	18-35	31	Polyhaline
Allita succinea	3-35	26	Meso-Polyhaline
Laeoneris culveri	1-35	24	Meso-Polyhaline
Gyptis vittata	18-34	27	Meso-Polyhaline
Diopatra cuprea	9-35	27	Meso-Polyhaline
Hypereteone fauchaldi	51-34	26	Meso-Polyhaline
Sigambra spp	11-35	27	Meso-Polyhaline
Glycera spp	16-35	27	Meso-Polyhaline

10.0 Data Management.

- The Wetland and Coastal ecology Branch (W&CEB) will serve as the central repository for all data collected during the baseline assessment.
- W&CEB will ensure that the status of all study components are updated regularly, providing quality control assessment and identification of problem or logistical constraints in any individual component.
- Data management will include coordination of standardized data entry and storage requirements, spreadsheets formats, and data archival and statistical analysis functions.
- W&CEB will be responsible for periodically tracking disposition of samples through the collection, processing and analysis states.
- After biomass is calculated for each major taxonomic group by sample, the species identified will be preserved in 70% alcohol and stored in archive as a future reference collection or in the event results (i.e. taxonomic species identification) are questioned.
- All data shall be turned over to the Mobile District upon request.

11.0 Report findings of the assessment

- W&CEB will verbally report progress through frequent contact with the Mobile District's technical representatives.

- W&CEB will prepare a written draft report entitles: *"Predictive analysis of potential impacts to benthic invertebrate and fish assemblages result from salt water intrusion".*
- The Mobile District and resource agencies will have 30 days to review the draft report and to responds with questions or concerns.
- W&CEB will then have 10 days in which to submit the revised final report.
- Although the data report is the only requirement for reporting findings, the W&CEB will publish the data report in as an ERDC Technical Report.
- The ERDC Technical Report will be submitted to the district (after the initial year of the 3x3x3 study) for approval of publication and release.
- W&CEB will assist with interagency coordination where requested by the Mobile District.

12.0 References

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APPENDIX A

Lat	Lon	Name	Area	Real Lat	Real Lon
30º 39.677' N	087º 59.608' W	Mobile	A1	30.6612818	-87.9934675
30º 39.109' N	088º 00.265' W	Mobile	A2	30.6518148	-88.004409
30º 39.178' N	087º 58.523' W	Mobile	A3	30.652972	-87.9753755
30º 38.495' N	087º 59.179' W	Mobile	A4	30.6415779	-87.986317
30º 38.228' N	087º 57.960' W	Mobile	A5	30.6371271	-87.966006
30º 38.008' N	087º 57.061' W	Mobile	A6	30.6334684	-87.9510221
30º 37.324' N	087º 58.174' W	Mobile	A7	30.622072	-87.9695634
30º 38.298' N	088º 00.412' W	Mobile	A8	30.6382923	-88.0068704
30º 37.440' N	088º 01.002' W	Mobile	A9	30.6239987	-88.016698
30º 36.698' N	088º 01.162' W	Mobile	A10	30.6116333	-88.0193667
30º 37.394' N	087º 59.769' W	Mobile	A11	30.6232333	-87.99615
30º 36.408' N	087º 59.313' W	Mobile	A12	30.6068	-87.98855
30º 37.023' N	087º 56.781' W	Mobile	A13	30.61705	-87.94635
30º 36.525' N	087º 56.633' W	Mobile	A14	30.60875	-87.9438833
30º 35.643' N	087º 58.670' W	Mobile	A15	30.59405	-87.9778333
30º 35.875' N	088º 00.506' W	Mobile	A16	30.5979167	-88.0084333
30º 35.365' N	087º 59.876' W	Mobile	A17	30.5894167	-87.9979333
30º 36.420' N	087º 57.624' W	Mobile	A18	30.607	-87.9604
30º 35.678' N	087º 56.754' W	Mobile	A19	30.5946333	-87.9459
30º 36.570' N	087º 55.561' W	Mobile	A20	30.6095	-87.9260167
30º 35.944' N	087º 55.574' W	Mobile	A21	30.5990667	-87.9262333
30º 34.948' N	087º 56.727' W	Mobile	A22	30.5824667	-87.94545
30º 34.925' N	087º 58.054' W	Mobile	A23	30.5820833	-87.9675667
30º 34.739' N	087º 59.984' W	Mobile	A24	30.5789833	-87.9997333
30º 33.927' N	088º 00.212' W	Mobile	A25	30.56545	-88.0035333
30º 34.100' N	087º 54.877' W	Mobile	A26	30.5683333	-87.9146167
30º 34.183' N	087º 56.499' W	Mobile	A27	30.5697167	-87.94165
30º 35.167' N	087º 55.306' W	Mobile	A28	30.5861167	-87.9217667
30º 33.092' N	087º 59.957' W	Mobile	A29	30.5515333	-87.9992833
30º 33.903' N	087º 58.657' W	Mobile	A30	30.56505	-87.9776167
30º 42.116' N	087º 59.716' W	Mobile	B2	30.7019333	-87.9952667
30º 42.539' N	087º 59.810' W	Mobile	B3	30.7089833	-87.9968333
30º 41.994' N	087º 58.282' W	Mobile	B4	30.6999	-87.9713667
30º 41.675' N	087º 58.912' W	Mobile	B5	30.6945833	-87.9818667
30º 41.363' N	087º 56.721' W	Mobile	B6	30.6893833	-87.94535
30º 42.058' N	087º 56.278' W	Mobile	B7	30.7009667	-87.9379667

Appendix A (continued).

30º 41.531' N	087º 59.709' W	Mobile	B8	30.6921833	-87.99515
30º 42.932' N	087º 58.853' W	Mobile	B9	30.7155333	-87.9808833
30º 42.747' N	088º 00.620' W	Mobile	B10	30.71245	-88.0103333
30º 44.333' N	088º 01.009' W	Mobile	B12	30.7388833	-88.0168167
30º 45.086' N	088º 00.540' W	Mobile	B11	30.7514333	-88.009
30º 45.357' N	088º 00.267' W	Mobile	B13	30.75595	-88.00445
30º 44.495' N	088º 00.453' W	Mobile	B14	30.7415833	-88.00755
30º 44.889' N	087º 59.615' W	Mobile	B15	30.74815	-87.9935833
30º 45.566' N	087º 58.925' W	Mobile	B16	30.7594333	-87.9820833
30º 43.772' N	087º 58.510' W	Mobile	B17	30.7295333	-87.9751667
30º 44.623' N	087º 57.457' W	Mobile	B18	30.7437167	-87.9576167
30º 47.314' N	087º 58.310' W	Mobile	B19	30.7885667	-87.9718333
30º 46.956' N	087º 58.148' W	Mobile	B20	30.7826	-87.9691333
30º 46.354' N	087º 57.760' W	Mobile	B21	30.7725667	-87.9626667
30º 45.704' N	087º 55.877' W	Mobile	B22	30.7617333	-87.9312833
30º 44.743' N	087º 56.320' W	Mobile	B23	30.7457167	-87.9386667
30º 44.268' N	087º 57.988' W	Mobile	B24	30.7378	-87.9664667
30º 41.571' N	087º 58.363' W	Mobile	B25	30.69285	-87.9727167
30º 45.966' N	088º 00.736' W	Mobile	B26	30.7661	-88.0122667
30º 45.496' N	087º 59.596' W	Mobile	B27	30.7582667	-87.9932667
30º 46.330' N	087º 56.373' W	Mobile	B28	30.7721667	-87.93955
30º 43.644' N	088º 00.944' W	Mobile	B29	30.7274	-88.0157333
30º 46.289' N	087º 58.484' W	Mobile	B30	30.7714833	-87.9747333
30º 48.673' N	087º 59.288' W	Mobile	C1	30.8112167	-87.9881333
30º 49.159' N	087º 58.055' W	Mobile	C2	30.8193174	-87.9675871
30º 50.096' N	087º 56.661' W	Mobile	C3	30.8349306	-87.9443566
30º 51.091' N	087º 57.479' W	Mobile	C4	30.85151	-87.9579751
30º 51.830' N	087º 58.953' W	Mobile	C5	30.8638333	-87.98255

APPENDIX C

Water Profile Data Sheet

Recorder	
Field Crew	
Date	
Time	
Vessel	
Latitude	
Longitude	
Water Depth (Feet/ Meters)	
Location	
Instrument	**HyroLab YSI OBS Other**

Station #	Depth (f / m)	Temp (ºC)	Salinity (ppt)	Turbidity/OBS (NTU / mg/l)	Cond. (mS/cm)

BENTHIC SAMPLING DATA SHEET

LOCATION: _____Mobile Bay_________ **Sheet # _1_of _1_**

Recorder:	**Kevin Reine**	**Vessel Name**	
Date:		**Vessel Operator**	

Zone	SAMPLE ID	Time	Latitude	Longitude	Grab Penetration	Sediment Type	Sediment Description	Water Depth (m / f)	Other Sampling (SED or WQ)

Chain of Custody Form	
Engineer Research & Development Center **USACE Waterways Experiment Station** **3909 Halls Ferry Road**	EL Project # ___________ State Where Samples Collected:
REPORTS RESULTS TO:	**TURNAROUND TIME**
Name:	Date Results Needed By:
Company	Standard (2 weeks) □
Address	1 Week □ 72 Hrs □
City	48 Hrs □ 24 Hrs □
State Zip	Approved By:
TEL	
FAX	
Sampled By: (Signature)	Date of Shipment:

Identification		**Matrix**							**Sample Preservation**			**Analysis Needed**						
Sample #	Sample ID	Comp	Grab	Water	Soil	Air	Sludge	Other	Formalin	ICE	Other	DATE	TIME	NTU	TSS	TOC	SGS	% Moisture

Released By:	Date & Time Released:	Delivery Method	Received By:
Agency	Condition Noted:	Date & Time Received :	Comments:

Reporting Format:	Standard □	Results and QC □	Reduced Deliverables □	Disk □

Mobile Bay Deepwater Navigation - Fishery Assessment
Field Protocol and Statistical Analysis

Background and Objectives

A deep water navigation channel is proposed for Mobile Bay harbor. Changes in depth may alter salinity patterns in the surrounding estuarine ecosystem and impact fish and other faunal groups. The objectives of the fishery assessment is to establish baseline conditions in the project area including species distribution and abundance, and evaluate relationships between salinity and fish assemblage structure to predict potential environmental impacts.

Field Sampling

Fish will be collected during fall 2016 and spring 2017 using trawls and seines in the three areas encompassing the Mobile Bay ecosystem: marine, brackish, and freshwater. In order to utilize existing data collected in Mobile Bay, we will adopt the same collecting techniques used by the Alabama Marine Resource Division for the Fisheries Assessment and Monitoring Program (FAMP) database. The FAMP is a fishery-independent database for shrimp, crab, and finfish started in 1980 and continues to the present. Sample sites for this study will correspond to FAMP locations in Mobile Bay, and will be expanded to include the transitional and freshwater zones.

A two-seam, 16-ft otter trawl will be used to sample benthic fish over a range of water depths. A minimum of two trawl samples will be taken at each site. The body of the trawl is made of 1⅜-inch webbing and the cod end liner is 3/16-inch mesh to retain smaller bodied individuals. Trawling will occur in water depths ranging from 5 to over 30 ft. The length of the tow lines will be about three-times the water depth to ensure that the footrope of the trawl remains along the bottom. A tickler chain will be attached to the footrope to disrupt the substrate and increase catch efficiency of benthic organisms. The net will be deployed from the bow followed by the otter boards as the boat slowly backs up. Any twists or crossing of the ropes will be corrected during deployment. A float line is tied to the cod end in case the trawl becomes entangled on underwater obstructions. If entangled, a trailer boat will grab the float line and slowly back up lifting the trawl from the obstruction; the sample is usually discarded. A GPS will record average speed and distance travelled during a 10-minute trawl sample, which is the duration used for the FAMP data. The trawl will be retrieved after completion of the sample and contents of the cod end will be emptied into a sorting container.

A 50 x 4 ft., 3/16-inch mesh knotless bag seine will be used to sample shoreline fish and shellfish. One seine haul will be taken per site. Two people will carry the seine out from the shoreline 60-ft, then move parallel to the shore a short distance to avoid disrupting the sample area. The 60-ft distance will be confirmed by a person with a range finder standing along the shoreline. The seine will be unfurled and hauled towards the shoreline ensuring that the lead line is in full contact with the substrate. In structurally-complex areas (e.g., vegetation), a third person will be located behind the mid-section of the seine in case the lead line becomes entangled on a snag. If entangled, the third person will reach down and pull back the lead line usually freeing the net from the snag. If the seine cannot be readily freed, the sample will be discarded and an adjacent site will be sampled. Once the shoreline has been reached by the seiners, the wings of the seine will be shaken down until all organisms are in the bag area where they can be removed.

All organisms collected by trawl and seine will be identified to species or the lowest practical taxon, enumerated, and measured. Large-bodied fish and shellfish will be released at the point of capture after processing. Smaller bodied fish, shellfish, and other invertebrates will be preserved in 10% formaldehyde and processed in the laboratory. A label will be placed in each sample container including location, date, and sample number. Total length will be measured for all fish. Weights for adults will be calculated from length-weight relationships calculated from the FAMP data. Carapace or disc width will be measured for crabs, anemone, and other shellfish. Mantle length will be measured for squids.

Water quality, depth, substrate type, surface velocity, and relative abundance of aquatic vegetation will be measured at each sampling site to characterize habitat conditions. Surface and bottom water quality will be measured using a calibrated YSI multi-parameter meter and includes temperature, pH, conductivity, salinity, and dissolved oxygen. Depth and surface velocity will be measured along a representative transect and will include a minimum of five vertical locations to obtain mean, maximum, and coefficient of variation values. Depth will be recorded from boat-mounted transducers in deeper waters or using a stadia rod in shallower waters. Substrate type (i.e., sand or mud/silt) will be visually assessed from otter boards or using the stadia rod to probe the bottom. Surface velocity will be measured using a Marsh-McBirney or SonTek flow meter. The relative percentage and species of aquatic vegetation encompassing the sampling site will also be recorded. GPS locations will be recorded to develop maps of sampling effort and allow us to utilize extant data on vegetation coverage, bathymetry, shoreline configurations, and other factors that may account for variability in fish distribution and abundance.

Statistical Analysis

Data collection will be consistent with the FAMP protocols and comparable to the Louisiana Dept. of Wildlife and Fisheries, Marine Fisheries Division database collected over a 30-year period. Both of these databases include species abundance based on trawls and seines, and in most cases, a select set of habitat variables (i.e., depth and salinity) measured concurrently with fish collections. Therefore, we will merge these databases with the baseline assessment being conducted for this study to conduct the analysis. Tables will be prepared summarizing seasonal species abundance at each area. Statistical analysis, including ordination, will be performed to evaluate correlations between fish assemblage, sampling areas, and environmental variables using Statistical Analysis System 9.4 and Primer 7.0. All analysis will be coordinated with state fishery personnel and other disciplines including benthic and wetland assessments.

The seasonal and spatial variation of the fish assemblage in the Mobile Bay study area, with emphasis on salinity, will be described, classified, and analyzed for alternative analysis using a four step process:

1. Develop guilds separating species into the three major study reaches: marine/estuarine, transitional, and freshwater. Following the conceptual model by Elliott et.al (2007)[1], functional categories of feeding areas, nursery areas, refugia, and migration routes will be assigned to each species within each of the three major habitat types. This results in 12 guild cells, although some may not contain any species while others will overlap with the same species. However, the guild cells characterize the entire fish community and will be used as dependent metrics in the correlation analysis.
2. Statistical relationships between guild abundance (dependent variable) and salinity (independent variable) will be evaluated using various curve-fitting techniques in SAS 9.4 and the output standardized as suitability index curves ranging from 0 to 1.
3. Physical models developed by Mobile District will be used to predict changes in salinity gradients for baseline and alternatives. These data will be included in a GIS framework to calculate acres of habitat by salinity classification (e.g., 0 to 5 ppt – freshwater; 5 to 10 ppt – transitional, 10-20 ppt – estuarine, and >20 ppt marine).
4. Habitat Units will be calculated for the study area by species guild using the following equation: $\text{Suitability Index}_{\text{salinity}} * \text{Acres}_{\text{salinity classification}}$ = Habitat Units. Habitat Units will be determined for baseline and each alternative. Changes in Habitat Units will indicate impacts or benefits of the project alternatives to the fish community.

---

1 Elliott, M., A. K. Whitfield, I. C. Potter, S. J. M. Blaber, D. P. Cyrus, F. G. Nordlie, and T. D. Harrison. The guild approach to categorizing estuarine fish assemblages: a global review. Fish and Fisheries 8: 241-268.

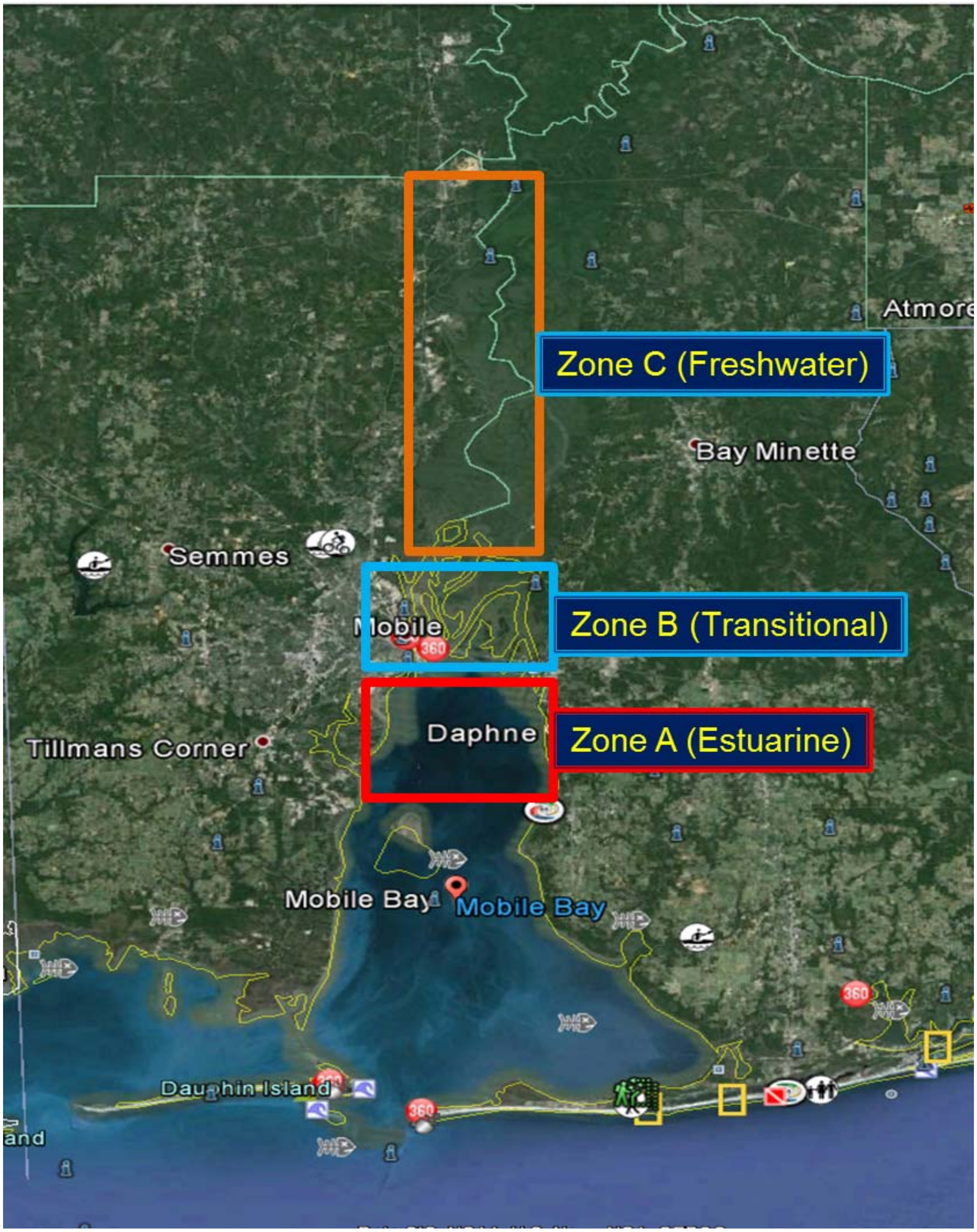


Figure 1. Study site depicting estuarine, transitional and freshwater zones.

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC March 2, 2017

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Meeting/Webinar for Mobile Harbor General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) regarding aquatic resources assessment preliminary results – 2 February 2017.

1. On February 2, 2017 the U.S. Army Corps of Engineers (Corps), Mobile District hosted a teleconference/webinar with the cooperating agencies as part of the ongoing agency scoping activities for the Mobile Harbor GRR and integrated SEIS. The purpose of the meeting was to reconvene the team of cooperating federal and state agencies to present preliminary results of aquatic resources assessments being conducted by the Engineering Research and Development Center (ERDC) for the study. This meeting was a follow up to the September 22 webinar in which the Corps and ERDC team presented an overview of the study approach that was developed for the aquatic resources assessments.

The meeting participants included representatives from the following agencies:

- Alabama State Port Authority (ASPA)
- U.S. Army Corps of Engineers, Mobile District (Corps)
- U.S. Army Corps of Engineers, Charleston District
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama Dept. of Environmental Management (ADEM), Mobile Field Office
- ADEM, Water Quality Branch (WQB)
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS), Habitat Conservation Division (HCD)
- Environmental Protection Agency (EPA)
- U.S. Geological Survey (USGS)

The agenda, participation list, meeting slides are included below.

2. After a round of introductions, representatives from the ERDC team involved in the study efforts gave presentations on the status and preliminary results from the ongoing aquatic resource assessments. A copy of the presentation slides are included at the end of this MFR.

3. Following the presentations, the meeting was opened to questions and discussion. The ADCNR, State Lands Division had provided some of the data sets for the SAV mapping efforts and recommended discarding the SAV data for fall of 2015. There is speculation that weather conditions prior to conducting the surveys acted to detach the tops of the seagrasses, resulting in the appearance that no seagrasses were present. However, it is believed that rhizomes were still present in the sediment, but not detectable. ADCNR also expressed concerns that the 1994 data appears to be distorted in the middle part of the bay. It was recommended overlaying the 2000 or 2015 shape files over the 1994 data in an attempt to quantify the amount of distortion. It is likely at this point that there may not be any SAV surveys conducted for 2016. The State is waiting on RESTORE funds which is not expected to be received in time for 2016 surveys.

4. A question was asked by EPA on why there are no surveys and data collection being conducted for wetlands and SAVs in the lower bay. Representatives from ERDC explained that resources in the lower bay are already salt tolerant and would not be significantly affected by changes resulting from the channel modifications. Also, the southern region of the bay is routinely covered by various studies and therefore much data already exists. The GRR studies are being focused on transition areas that would be more sensitive to variations in the water quality regimes.

5. Pertaining to the studies underway in the oyster shell mining areas, ADCNR inquired if there are any apparent differences in the benthic communities between the mining areas compared to other areas included in the study? Such information will be useful in determining if the benthic communities in the oyster mining areas continue to be depressed. ERDC indicated that the samples collected in these areas have not yet been completely processed to a point to make a determination at this time. The sampling plan in the oyster mining areas was set up to differentiate between areas of known disturbance and undisturbed (control) areas.

6. Corps representatives expressed the concern that the species of phragmites observed during the wetland field verification work is not the common species addressed widely in the local literature. In many cases, the common species is considered invasive. This differentiation between the species will need to be addressed in the study. ERDC pointed out that there are genetic and morphological differences between the tropical and common species. What was predominantly observed during the field verification work was the tropical species which is considered to be native species. Will need to confirm if there are native versus non-native species. The tropical species is considered to be native, while the common species is invasive. It was recommended that the study examine areas where there are large stands of phragmites to see if there are morphological differences to be able to differentiate which species is

predominant. The ASPA acknowledged that this is an important issue and we need to do what it takes to resolve.

7. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/s/ Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Agency Meeting
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement (SEIS)
Conference Call/Webinar
February 2, 2017
1:00 – 3:00 Central

Aquatic Resources Assessment - Preliminary Results
Agenda

Introductions

Aquatic Resources Assessments Updates

- Wetlands
- Submerged Aquatic Vegetation
- Oysters
- Benthic
- Fish

Questions and Discussion

Next Steps

Mobile Harbor GRR Agency Webinar – List of Participants

Agencies
Bob Harris (ASPA)
Judy Adams (ASPA)
Carl Ferraro (ADCNR)
Scott Brown (ADEM)
Allen Phelps (ADEM)
Justin Rigdon (ADEM-WQB)
Chris Johnson (ADEM-WQB)
James Mooney (ADEM-WQB)
Dan Holliman (EPA)
Calista Mills (EPA)
Ntale Kajumba (EPA)
Patric Harper (FWS)
Josh Rowell (FWS)
Rusty Swafford (NMFS)
Brandon Howard (NMFS)
Michelle Myers (USGS)

Corps of Engineers - ERDC
Jacob Berkowitz
Safra Altman
Todd Slack
Todd Swannack
Kevin Philley
Jack Killgore
Candice Piercy
Carra Carrillo
Dara Wilber

Corps of Engineers – Mobile District
Elizabeth Godsey
Justin McDonald
David Newell
Richard Allen
Nate Lovelace
Rita Perkins
Joe Paine
Larry Parson
LeKesha Reynolds
Jennifer Jacobson
Susan Rees
Joe Givhan

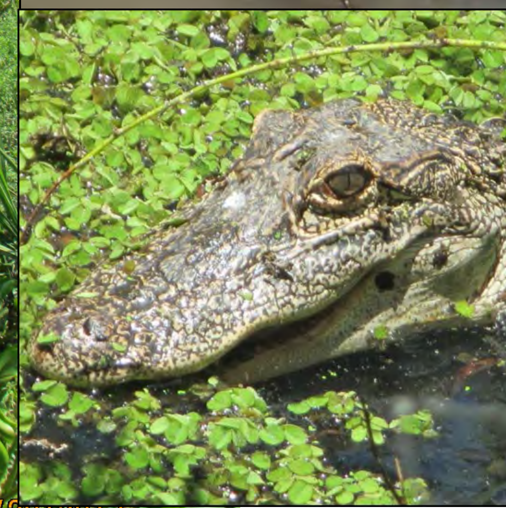
Corps of Engineers – Charleston District
Mark Messersmith

Update: Aquatic Resources Assessment of Mobile Bay

Interagency team webinar - February 02, 2017

Jacob F. Berkowitz - wetlands
Kevin Reine - benthics
Safra Altman - SAV
Todd Swannack - oysters
Jack Killgore - fish

US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS



ERDC
Engineer Research and Development Center

Objectives

1. Evaluate aquatic resources within Mobile Bay
    1. Wetlands, benthics, SAV, oysters, fish

2. Incorporate findings of water quality models

3. Determine potential aquatic resource impacts from Navigation projects conducted by SAM.

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Mobile Bay Wetland Community Classification

Jacob Berkowitz, Kevin Philley USACE – ERDC
Environmental Laboratory

Wetlands and Coastal Ecology Branch

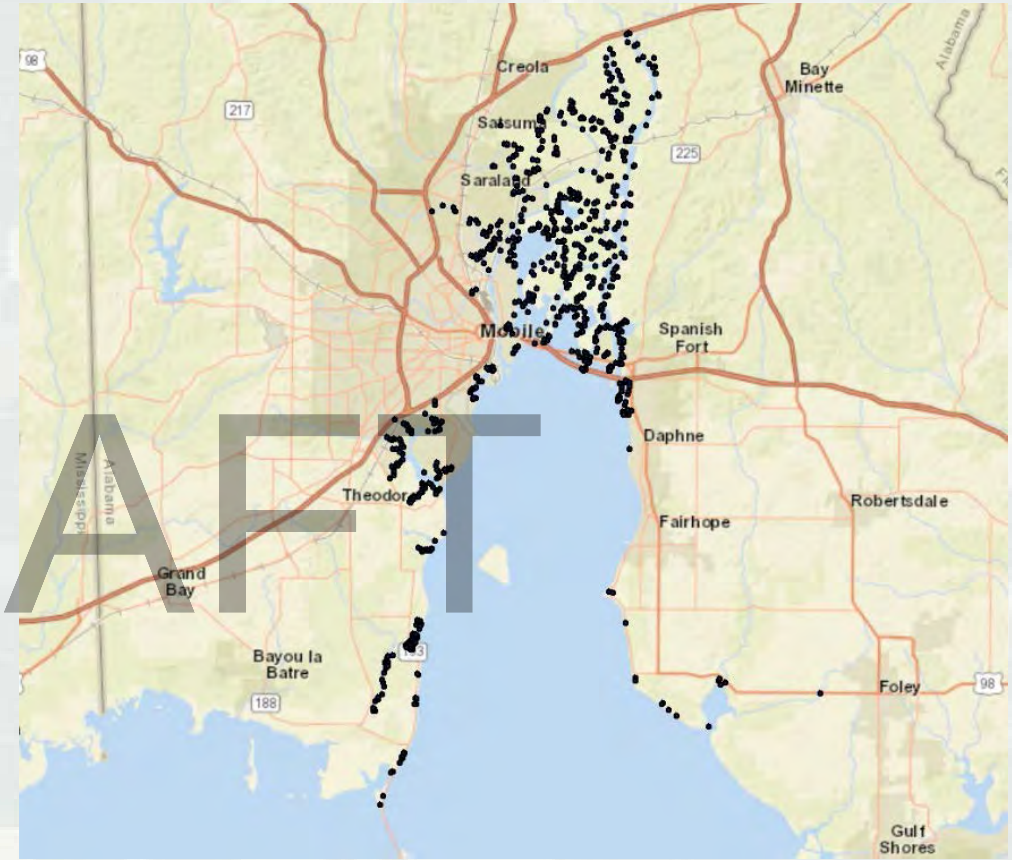
Photos: Nathan Beane

ERDC
Engineer Research & Development Center

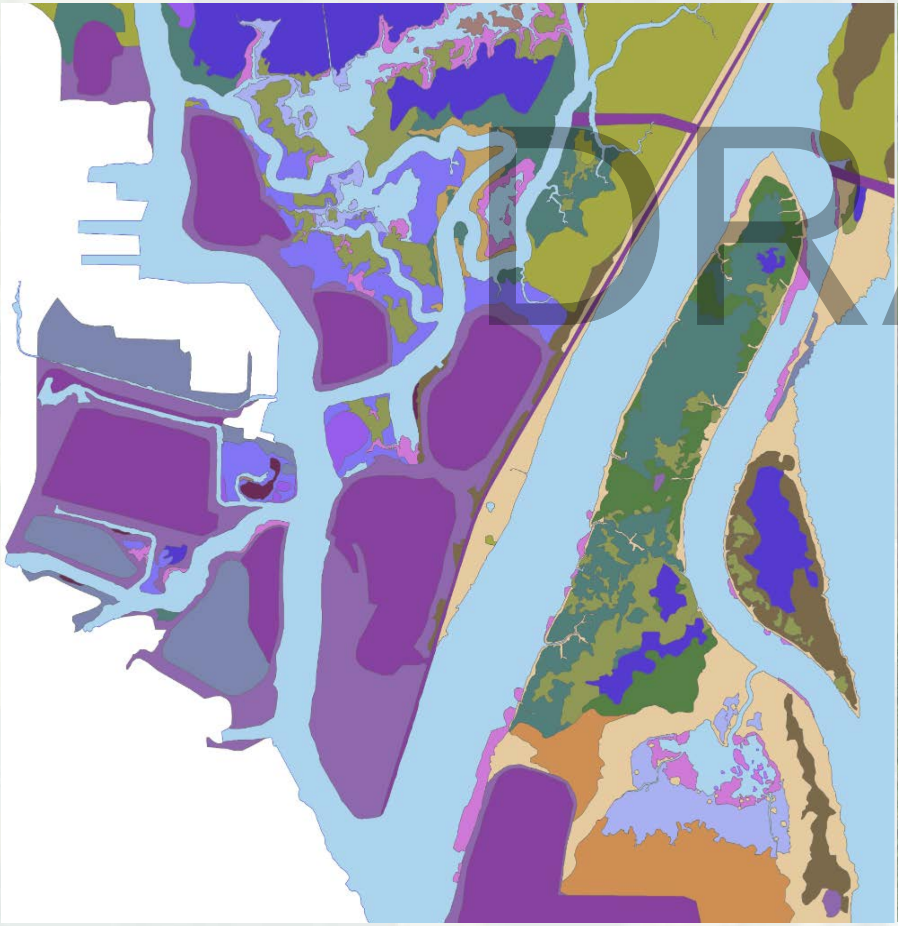
Project Objectives

- Map the distribution of wetland communities within the Mobile Bay survey area
- Establish tolerances to salinity and other parameters based upon published literature
- Determine potential impacts to wetland resources based upon water quality modeling outputs

- Methods
  - ► Sampled ~800 unique locations
  - ► Descriptive data points
    - Dominant species composition recorded based on visual estimate
      - ▷ Ex. “Big cordgrass/Switchgrass”
  - ► Established vegetation plots
    - Representative locations within wetland communities
    - Recorded species richness, abundance, and structure



- Mapping utilized remote sensing tools images (growing season and late season) to capture multi-seasonal changes in vegetation color and texture
  - USDA – National Agriculture Inventory Program (NAIP) 2015
  - 2014 High resolution orthoimagery
  - Google Earth imagery
- 40 preliminary classes
  - Some will be merged based on extent, shared water quality tolerance

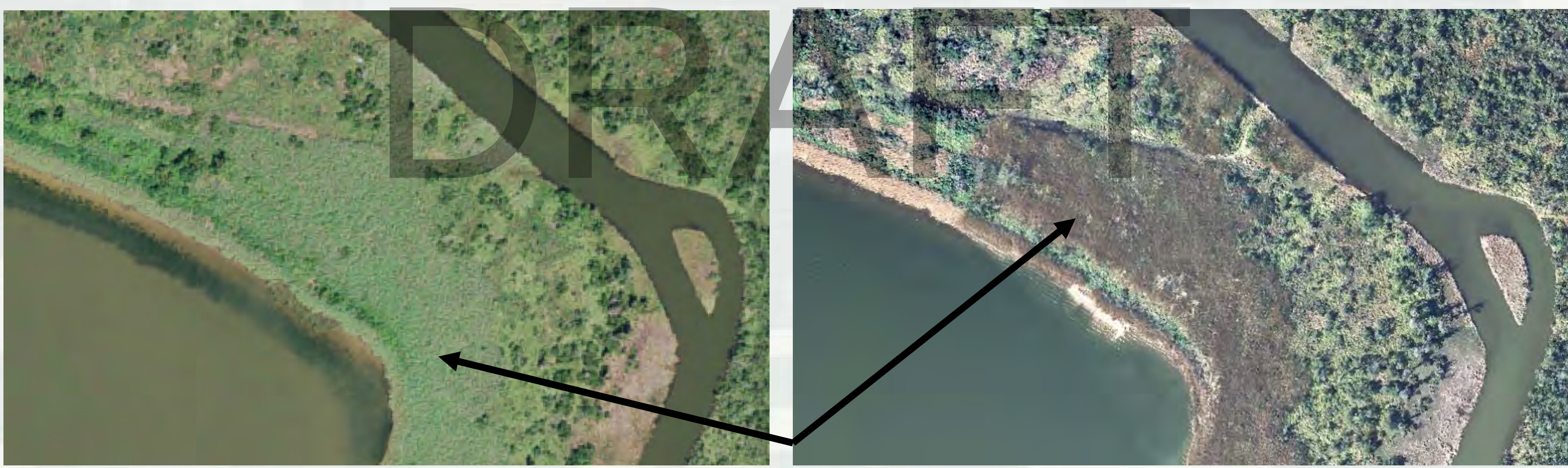


Common communities

- *Phragmites karka* (Tropical reed)
  - Considered native to the Gulf Coast
  - Frequently forms large monotypic stands
  - Distinctive signature in both winter and growing season photos

Common communities

Phragmites **often appears globular or linear in shape and parallel to water features. Light green, coarse texture during growing season, and darkened during late season.**

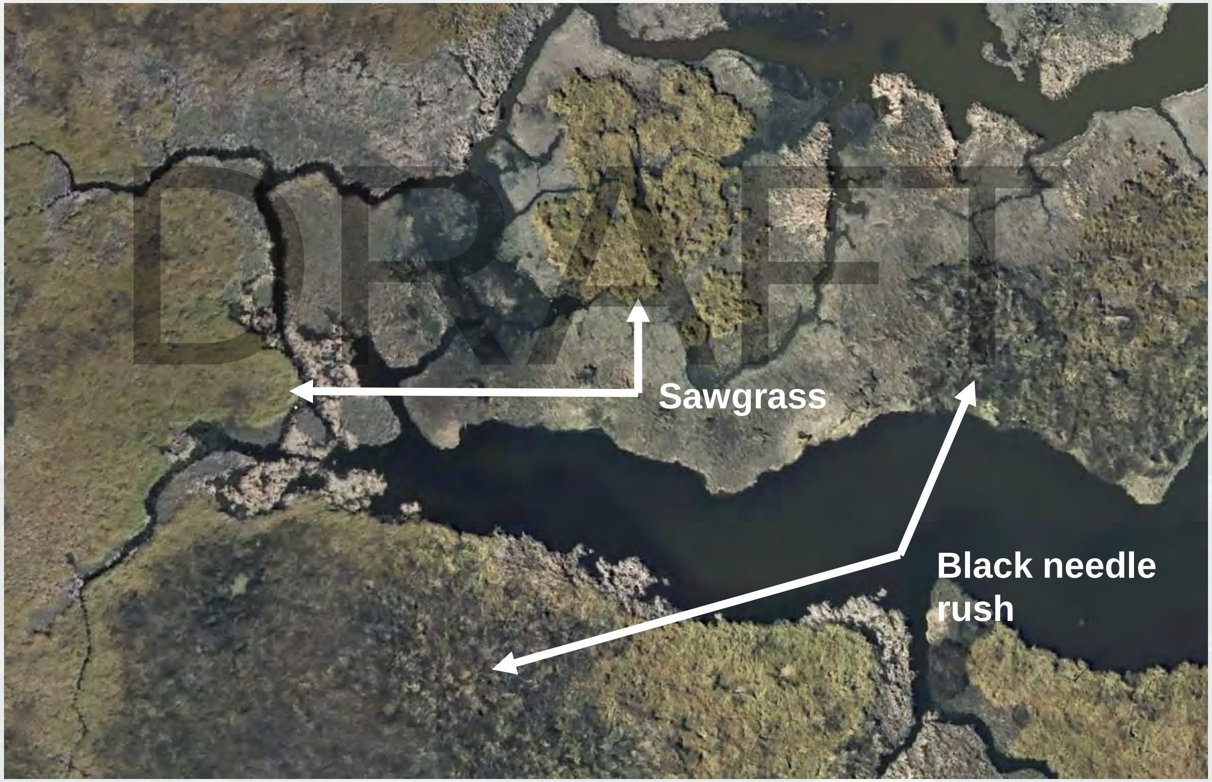


Phragmites

Common communities

- Sawgrass - (*Cladium jamaicense*)
  - Typically forming near monotypic stands
  - Often adjacent to black needlerush (*Juncus roemerianus*)
  - Distinctive texture and yellow-green color in late season aerial photographs

Common communities

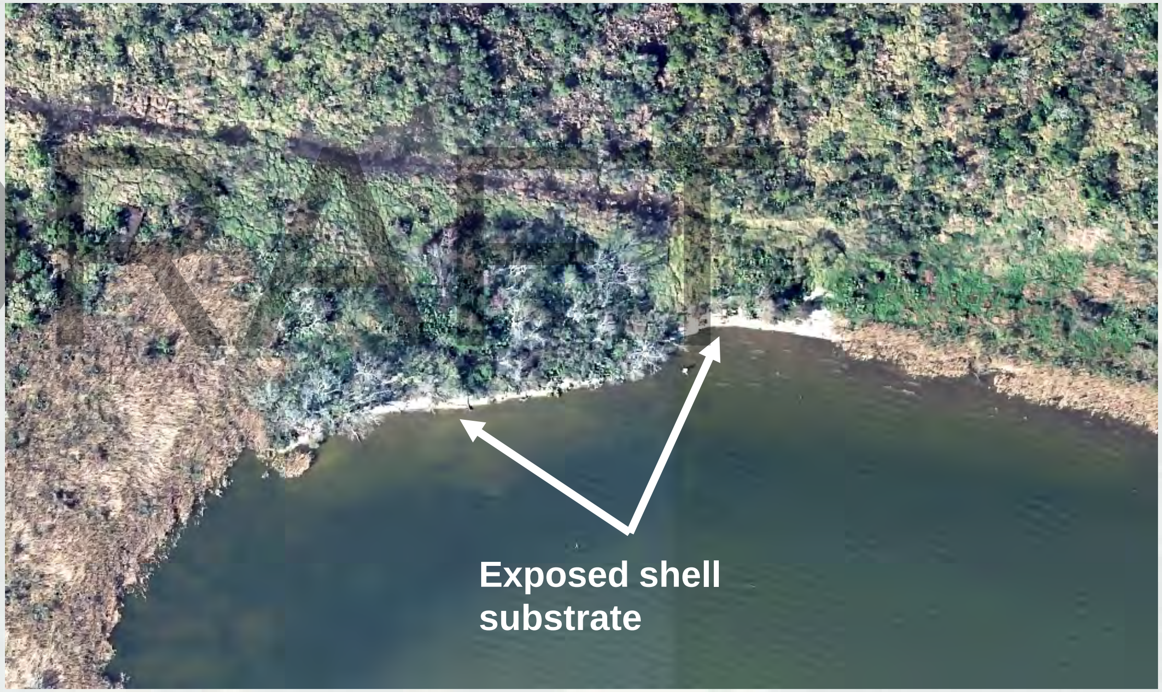


Unique communities

- Shell middens
  - Floristically unique communities on substrate of discarded shells
  - Often small (<1 ha), with portions not likely meeting wetland criteria
  - Habitat for rare plants
    - Small flower mock buckthorn (*Sageretia minutiflora*); Christmas berry (*Lycium carolinianum*); both state listed species in AL)
  - Archaeological significance

Unique communities

Shell midden located along the northern shore of Grand Bay.



Unique communities

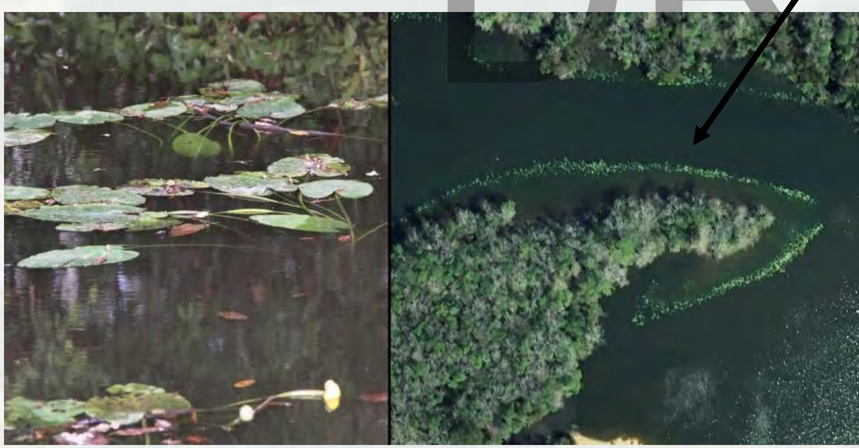
Florida Soapberry (*Sapindus marginatus*) – tree restricted to coastal hammocks and shell middens of AL, FL, GA, and MS (Weakley, 2015).

Southern sedge (*Cyperus thyrsiflorus*) collected from a midden on the Tensaw River. This was only the fourth collection of this species from AL.

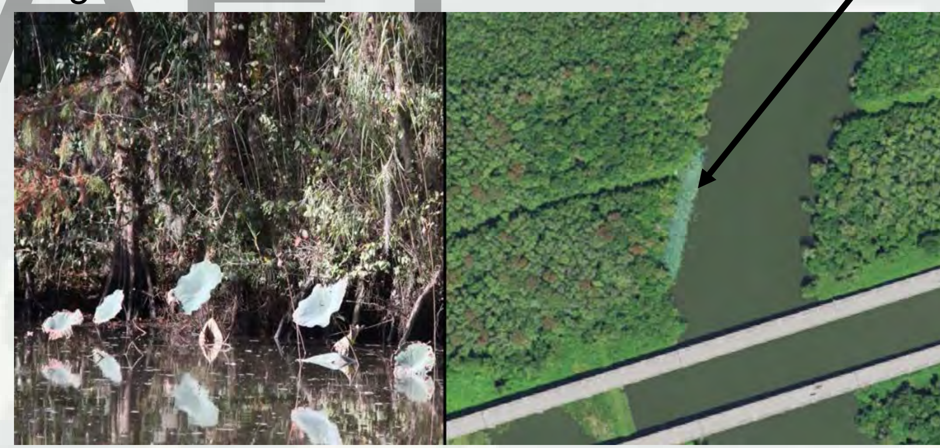
Aquatic bed communities

- Formed large stands or narrow bands in shallow channel margins and bays.

Yellow pond-lily (*Nuphar sp.*) – bright green “halo”



Water lotus (*Nelumbo lutea*) - distinct blue-green color



Preliminary Wetland Community Map completed

Continuing tasks

- Refine map
- Determine if additional data needed
- Compile additional supporting literature

Future tasks

- Obtain water quality model outputs
- Determine potential impacts to wetlands

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Mobile Bay wetland assessment

The USACE Mobile District provided funding for the efforts. Special thanks to Richard Allen and Nathan Beane for assistance with field data collection.

Questions or comments should be submitted to Dr. Jacob Berkowitz - Jacob.F.Berkowitz@usace.army.mil

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Benthic Invertebrate Update Summary

Overview

- 180 samples were collected by Ponar Grab in October 2016.
- Samples were collected in four zones (A-D).
- Water quality data was collected at each sampling station.
- One sediment sample was collected at each sampling station to assess: 1) Grain Size Distribution (GSD), % Percent Moisture and Total Organic Content (TOC).
- Positioning data was collected for mapping purposes

Zones A-C (Estuarine, Transition and Freshwater Zones)

- Thirty benthic, water quality and substrate samples were collected in each of the three zones.
- Status: Benthic samples transferred from 10% buffered formalin to 70% alcohol and stained with Rose Bengal (awaiting processing).
- Water quality data entered into Excel database ready for analysis. (Data entry 100% completed).
- Substrate samples processed for GSD and TOC. (100% completed).
- Data being prepared for statistical analysis.

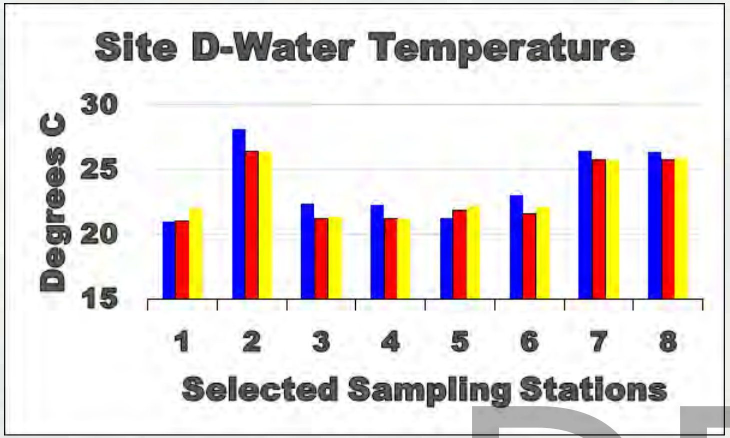
Benthic Invertebrate Update Summary

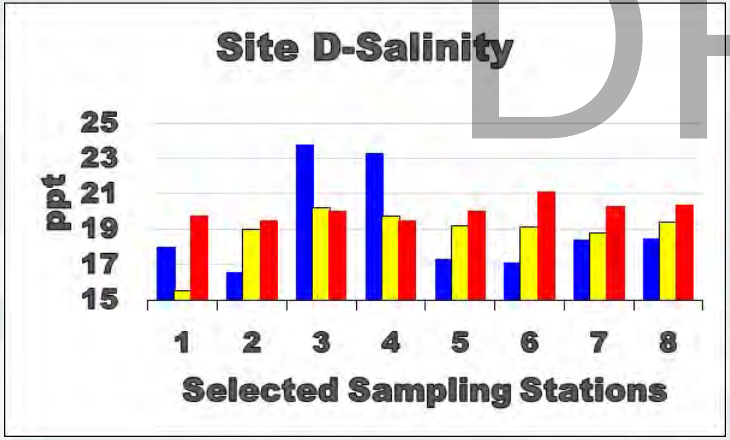
Zone D (Beneficial Uses Site-Oyster Holes)

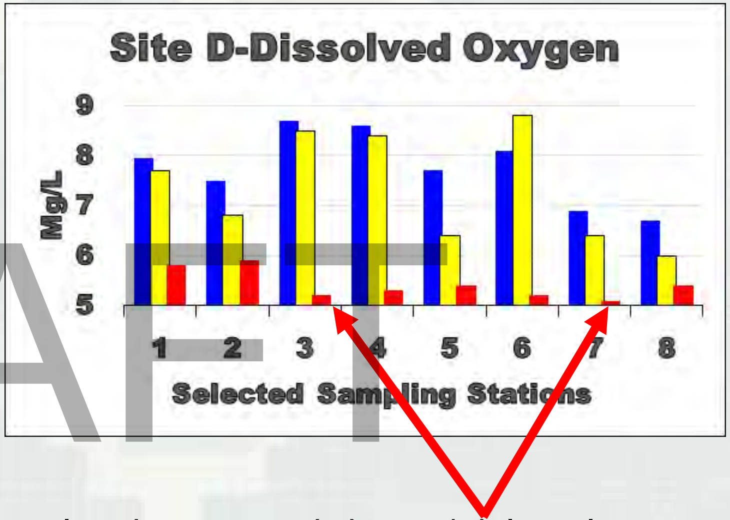
- Ninety (90) samples were collected from Zone D.
- Zone D was divided into four primary areas to include 1) Baseline, 2) Control, 3) Impact and 4) Placement area.
- Note: that Placement Area samples were collected at a site where thin-layer placement had previously occurred
- The impact area includes the oyster holes and immediate area surrounding the holes.
- All water quality data and substrate data has been processed.
- 100% of all Zone D benthic samples have been processed.

- **Preliminary Results and Observations**
  - Substrate Data
- The majority of samples were comprised of silt to sandy silt.
- Less than 10% of all samples were pure sand.
- A significant number of the beneficial uses site (Zone D) samples characterized by the presence of shell hash.
- Most samples had large amounts of organic debris (exception: samples with mostly sand or large amount of shell hash.

Benthic Invertebrate Update
Summary
Water Quality







Dissolved oxygen (D), Mg/L) levels at some sampling sites were at 5 Mg/L.

DO (Mg/L) would most likely go hypoxic during summer months.

Note: Measurements taken at surface (blue column); mid-water (yellow column) and bottom water depths (red columns)

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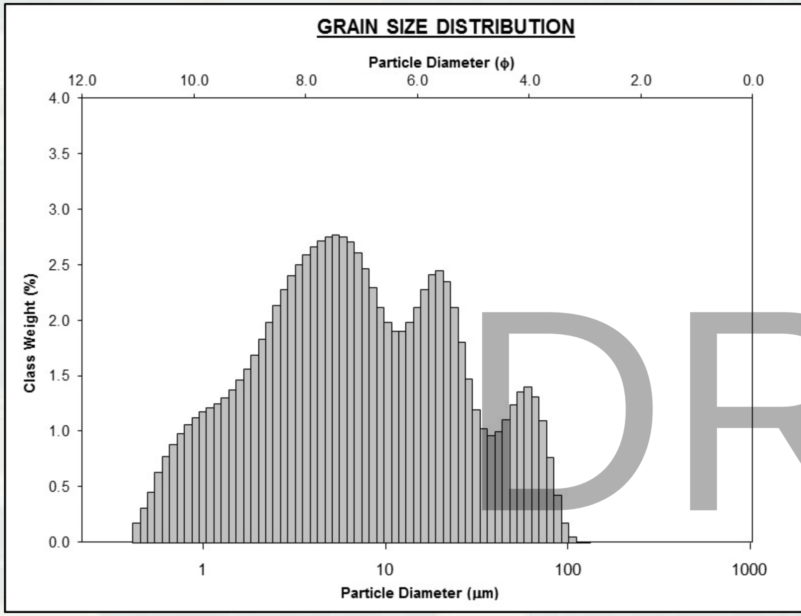
Site D--Clay-Silt Substrate Example



SAMPLE STATISTICS

SAMPLE IDENTITY: ANALYST & DATE: KJR

SAMPLE TYPE: Trimodal, Poorly Sorted TEXTURAL GROUP: Mud

SEDIMENT NAME: Fine Silt

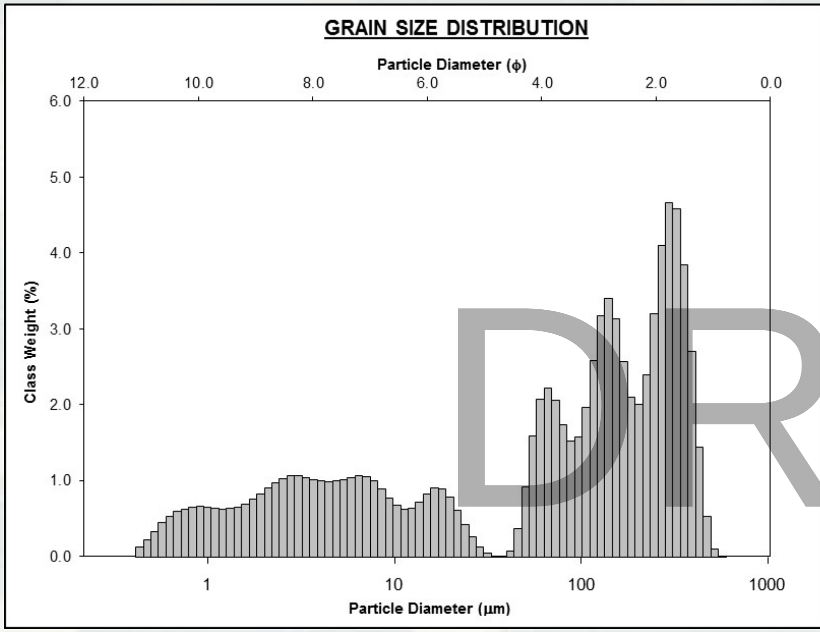
	μm	ϕ
MODE 1:	5.361	7.545
MODE 2:	19.79	5.661
MODE 3:	60.60	4.046
D_{10}:	1.229	4.617
MEDIAN or D_{50}:	6.516	7.262
D_{90}:	40.75	9.668
(D_{90} / D_{10}):	33.16	2.094
$(D_{90} - D_{10})$:	39.52	5.051
(D_{75} / D_{25}):	6.613	1.472
$(D_{75} - D_{25})$:	15.45	2.725

GRAIN SIZE DISTRIBUTION	
GRAVEL: 0.0%	COARSE SAND: 0.0%
SAND: 4.2%	MEDI[illegible] 0.0%
MUD: 95.8%	FINE SAND: 0.0%
	V FINE SAND: 4.2%
V COARSE GRAVEL: 0.0%	V COARSE SILT: 8.8%
COARSE GRAVEL: 0.0%	COARSE SILT: 15.9%
MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 15.9%
FINE GRAVEL: 0.0%	FINE SILT: 20.6%
V FINE GRAVEL: 0.0%	V FINE SILT: 17.1%
V COARSE SAND: 0.0%	CLAY: 17.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	14.32	6.869	7.186	6.750	7.211	Fine Silt
SORTING (σ):	18.35	3.534	1.821	3.720	1.895	Poorly Sorted
SKEWNESS (Sk):	2.088	0.022	-0.022	0.038	-0.038	Symmetrical
KURTOSIS (K):	7.101	2.240	2.240	0.925	0.925	Mesokurtic

- 90% of all samples collected at Site D had GSD comprised mostly of silt-clay
- Approximately 5% of the sample was Very Fine Sand
- Less than 10% of all sample had small amounts of shell hash.
- 75% of samples had organic debris

Site D—Example of a Sandy Substrate



SAMPLE STATISTICS

SAMPLE IDENTITY: **D58** ANALYST & DATE: KJR

SAMPLE TYPE: Polymodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Fine Silty Medium Sand

	μm	ϕ
MODE 1:	140.3	2.835
MODE 2:	66.52	3.912
MODE 3:	6.460	7.276
D_{10}:	2.008	1.588
MEDIAN or D_{50}:	101.6	3.300
D_{90}:	332.7	8.960
(D_{90} / D_{10}):	165.7	5.644
$(D_{90} - D_{10})$:	330.7	7.373
(D_{75} / D_{25}):	31.69	3.427
$(D_{75} - D_{25})$:	233.2	4.986

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	59.8%	MEDIUM SAND:	23.6%
MUD:	40.2%	FINE SAND:	20.8%
		V FINE SAND:	15.3%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	4.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	4.2%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.8%
FINE GRAVEL:	0.0%	FINE SILT:	7.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	7.7%
V COARSE SAND:	0.0%	CLAY:	9.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	134.1	44.97	4.475	46.88	4.415	Very Coarse Silt
SORTING (σ):	130.0	7.234	2.855	7.425	2.892	Very Poorly Sorted
SKEWNESS (Sk):	0.686	-0.728	0.728	-0.539	0.539	Very Fine Skewed
KURTOSIS (K):	2.264	2.141	2.141	0.697	0.697	Platykurtic

- Approximately 60% of the sample is sand.
- 40% of the sample ranged from clay to very coarse silt.
- A few samples collected closer to the shore had a higher sand fraction.

Benthic Invertebrate Update Summary

- **Benthic Taxa - Taxonomic IDs have not been completed. Data below represents preliminary observations.**

- **Dominate taxa (thus far) are Polycheates Annelids. Of the 8000 species the majority are found in marine water. A few species occur in brackish and freshwater.**

- **Dominate Bivalve, *Macoma Mitchelli*, a species of salt water clam.**

- **Two species of Nematodes (roundworms) were present in most all samples.**

Predictive Analysis of Salt Water Intrusion to Submerged Aquatic Vegetation

- **Identification/Examination of Existing Data**:
  - Use historic, current and ongoing SAV maps, GIS layers, etc.
  - Establish the current state and extent of SAV resources within the project area
  - Initiated August 2016

- **Field Verification:**
  - Conduct field verification/ground-truth data to improve resolution in transition zones
  - Locations and spatial extent based on gaps in current SAV map and field efforts
  - Submersed Aquatic Vegetation Early Warning System (SAVews, downward aimed echo sounder) and/or visual identification focused on transition zones

Field Verification

- SAVews data collection occurred October 25-27, 2016

- Total of 31864 points
  - Display Points about 1 m apart
  - 1788 of points determined to be SAV

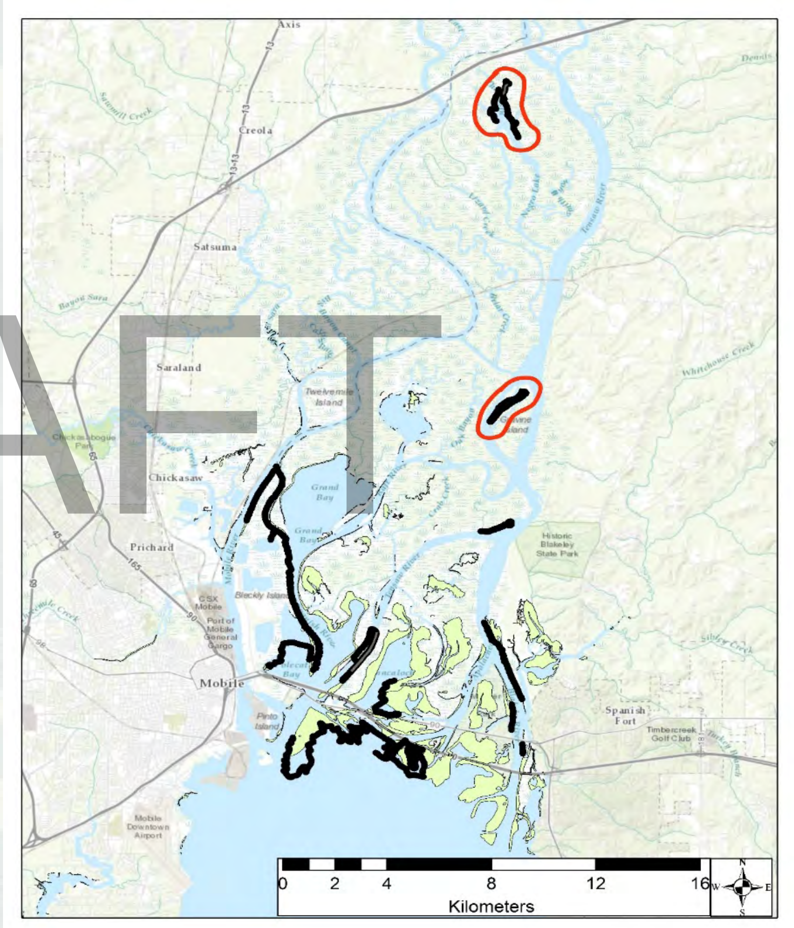
- Technical Issues

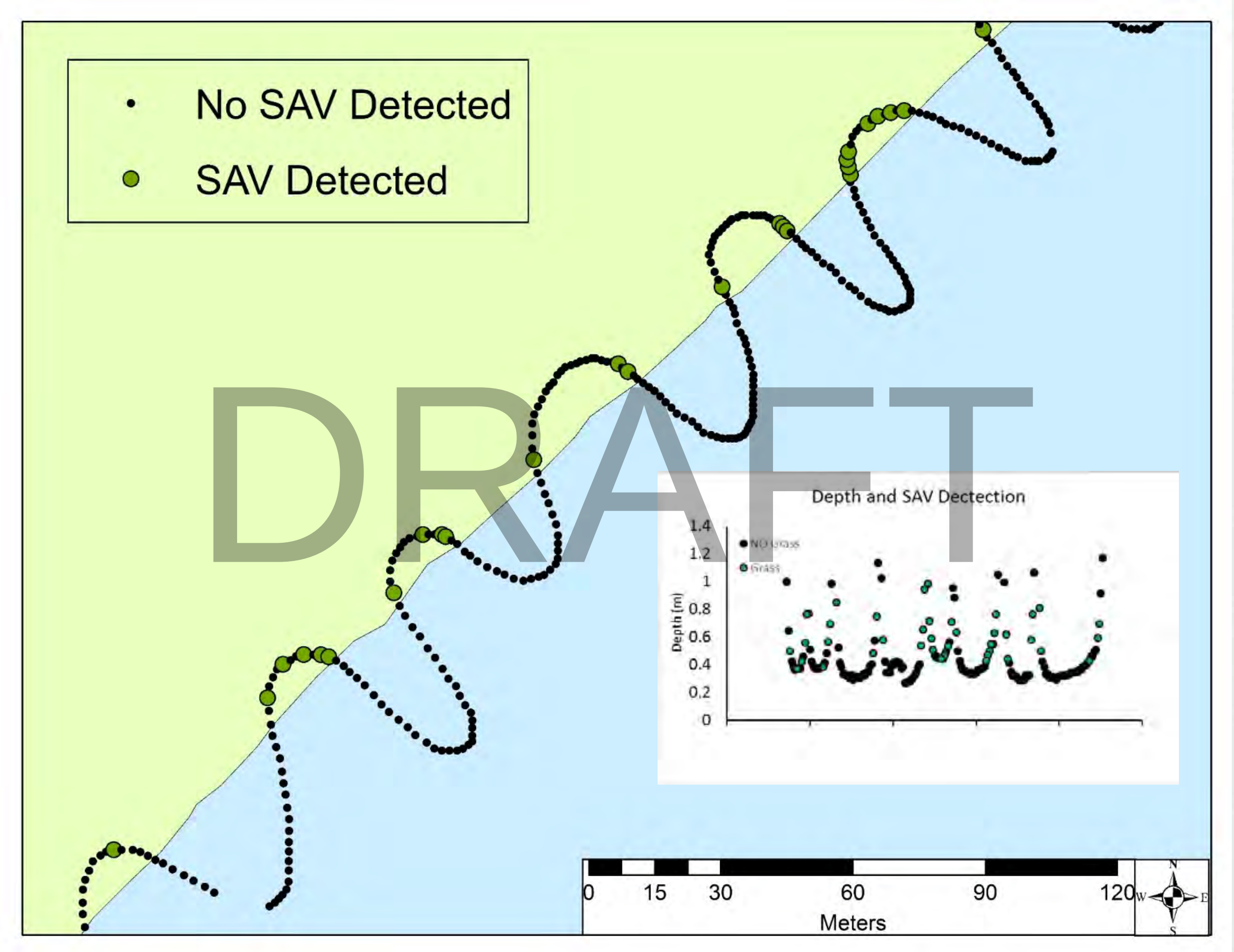
  - Depth
    - In shallow water with tall SAV, “clogged” the transducer

    - Creates problems with some species(Vallisneria and Myriophyllum)

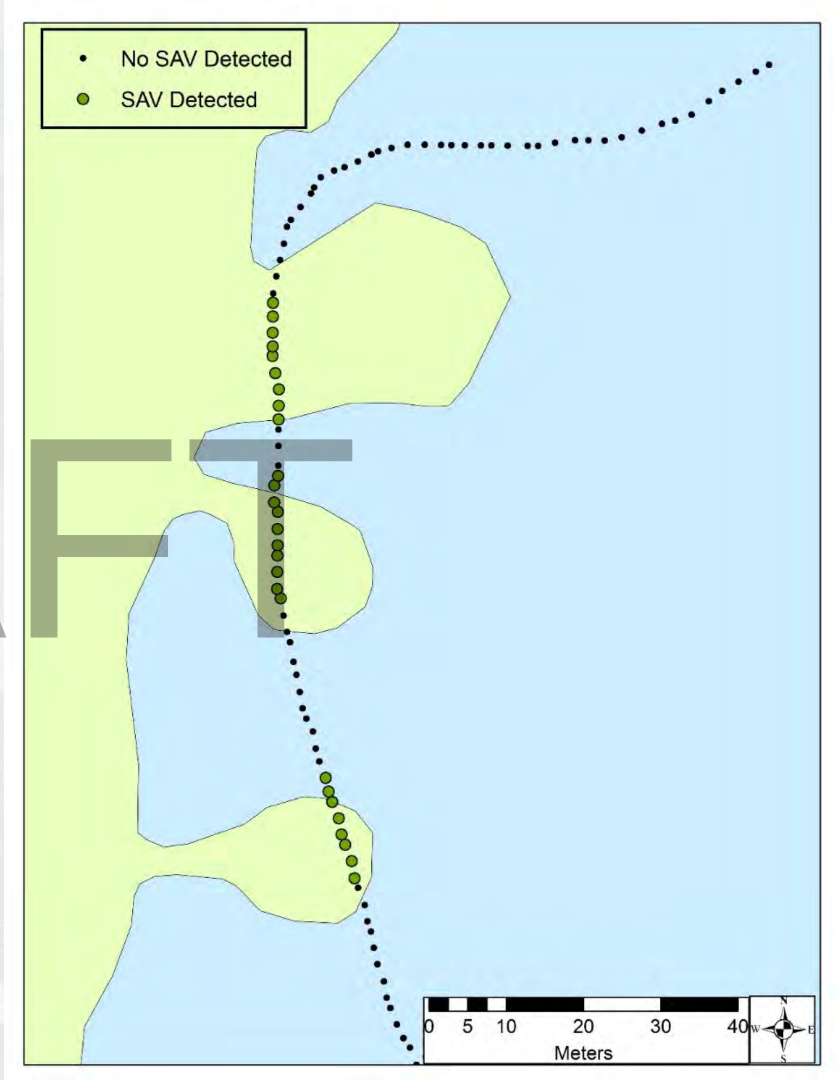
  - Scan fall of 2016, compared to fall of 2015 polygon data

  - Plan to update with 2016 polygon data when available




No SAV Detected
SAV Detected
DRAFT
Depth and SAV Dectection
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Depth (m)
0
15
30
60
90
120
Meters
N
W
E
S

- Percent agreement between Scan and Fall 2015 Polygons
  - ▸ Fall 2015: 85% agreement
  - ▸ 8% of points showed SAV present in areas that did not have mapped SAV patches
    - Median distance from known patches was ~8m
    - May be due to annual variation
  - ▸ Remaining 7% of points
    - in areas possibly outside extent of fall 2015 data
    - along river channel detected in summer 2015 but not fall 2015 data.



Predictive Analysis of Salt Water Intrusion to Submerged Aquatic Vegetation

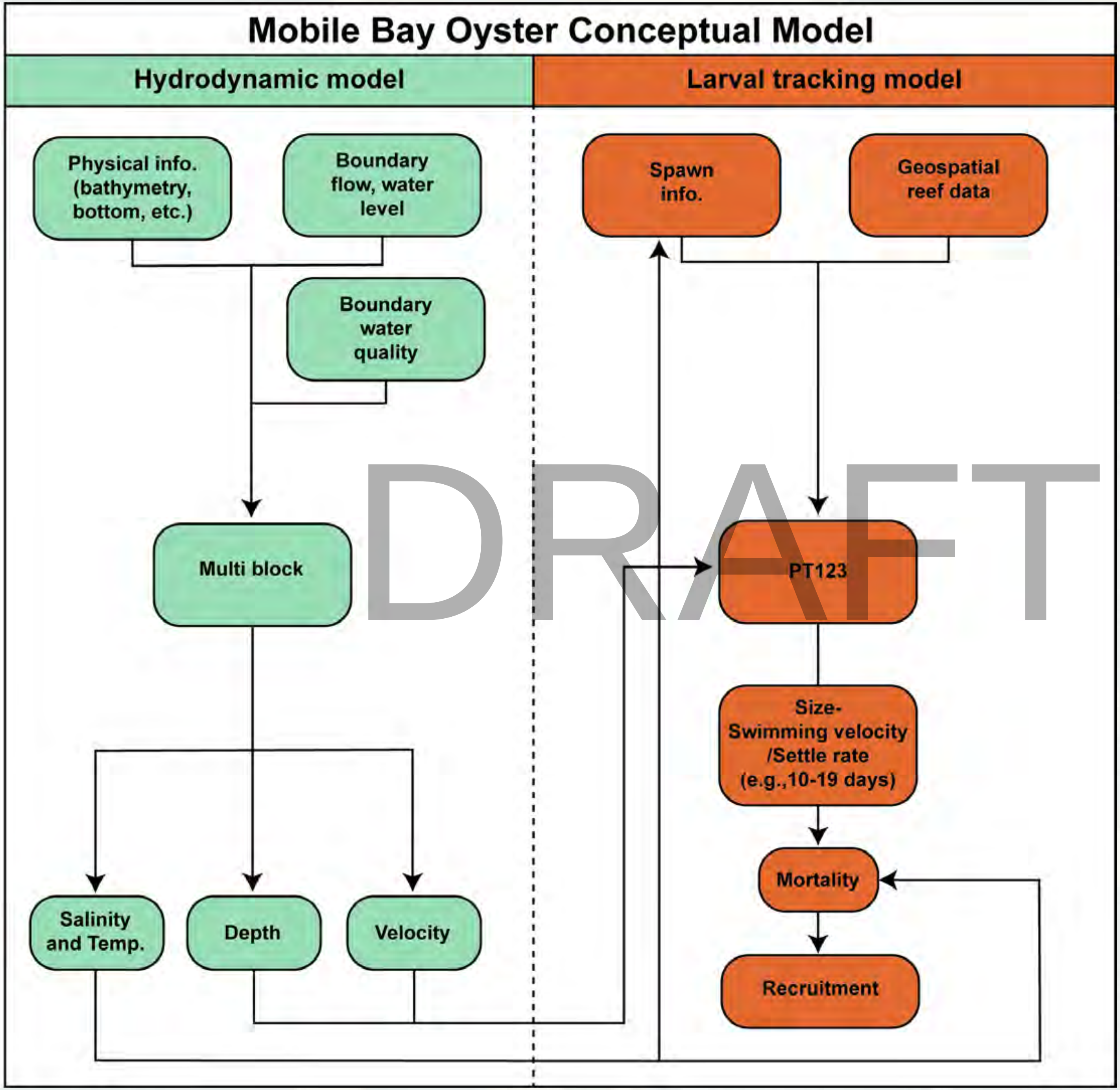
- **Evaluate habitat variability:**
  - Use historic SAV distribution data to determine habitat variation over time
  - Use spatial statistics to quantify historic variation in estuarine, brackish, freshwater zones
  - Determined positive agreement between Field verification points and SAV polygons

    1994: 34% agreement
    2002: 66% agreement
    2009: 33% agreement
    Summer 2015: 89% agreement
    Fall 2015: 85% agreement

- **Evaluate environmental tolerances:**
  - Review existing literature and current research efforts
  - Identify tolerance of SAV plant species to changes in water quality parameters
  - Establish ecological tolerance thresholds

- **Analysis of water quality model outputs and evaluation of alternatives:**
  - Use ecological tolerance thresholds to predict impacts on SAV from changes in hydrodynamics and water quality.

- **Reporting:**
  - Prepare data report on findings.



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Mobile Bay Deepwater Navigation - Fishery Assessment

Todd Slack and Jack Killgore

ERDC-EL

Vicksburg, MS

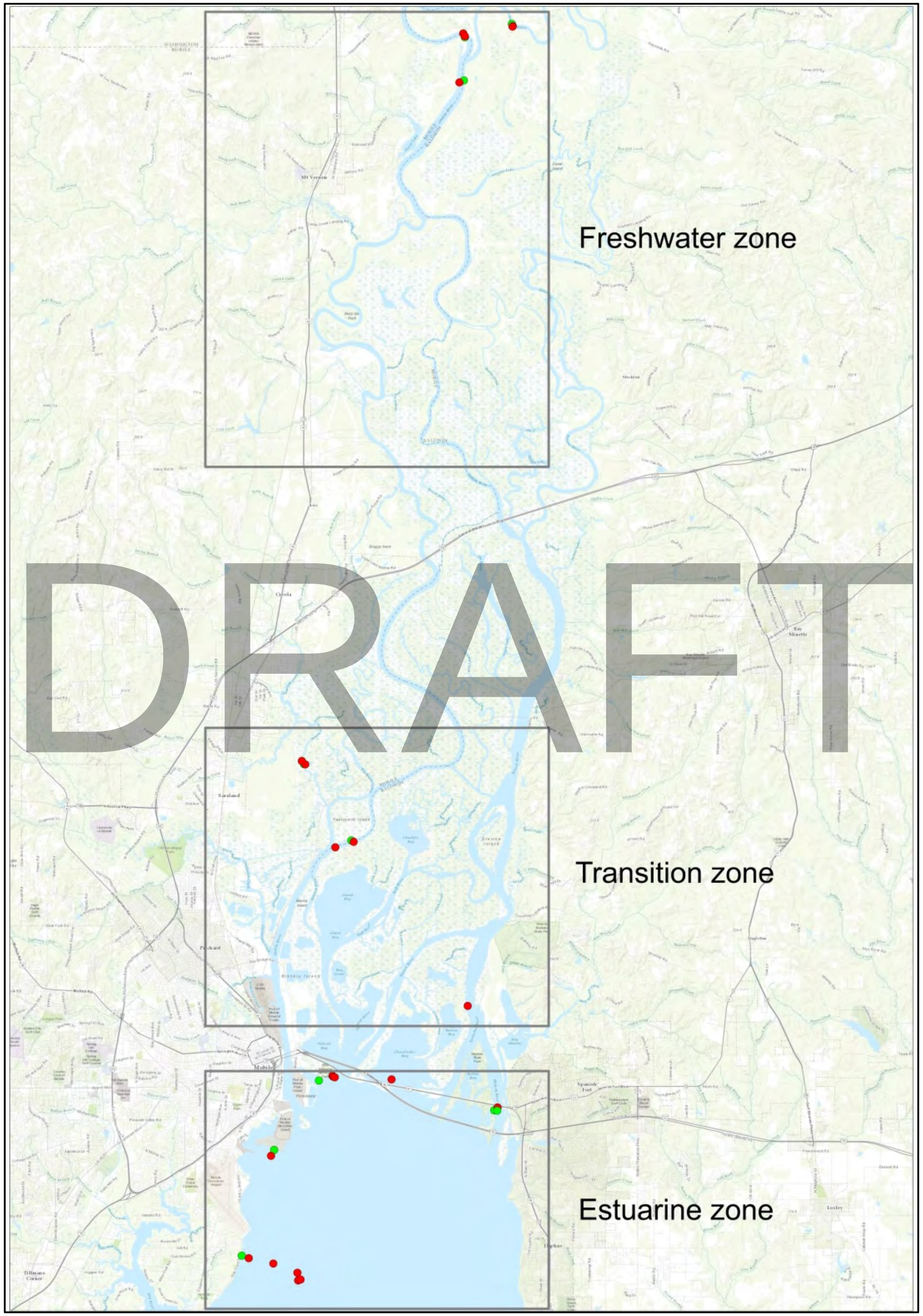
<u>**Objectives**</u>

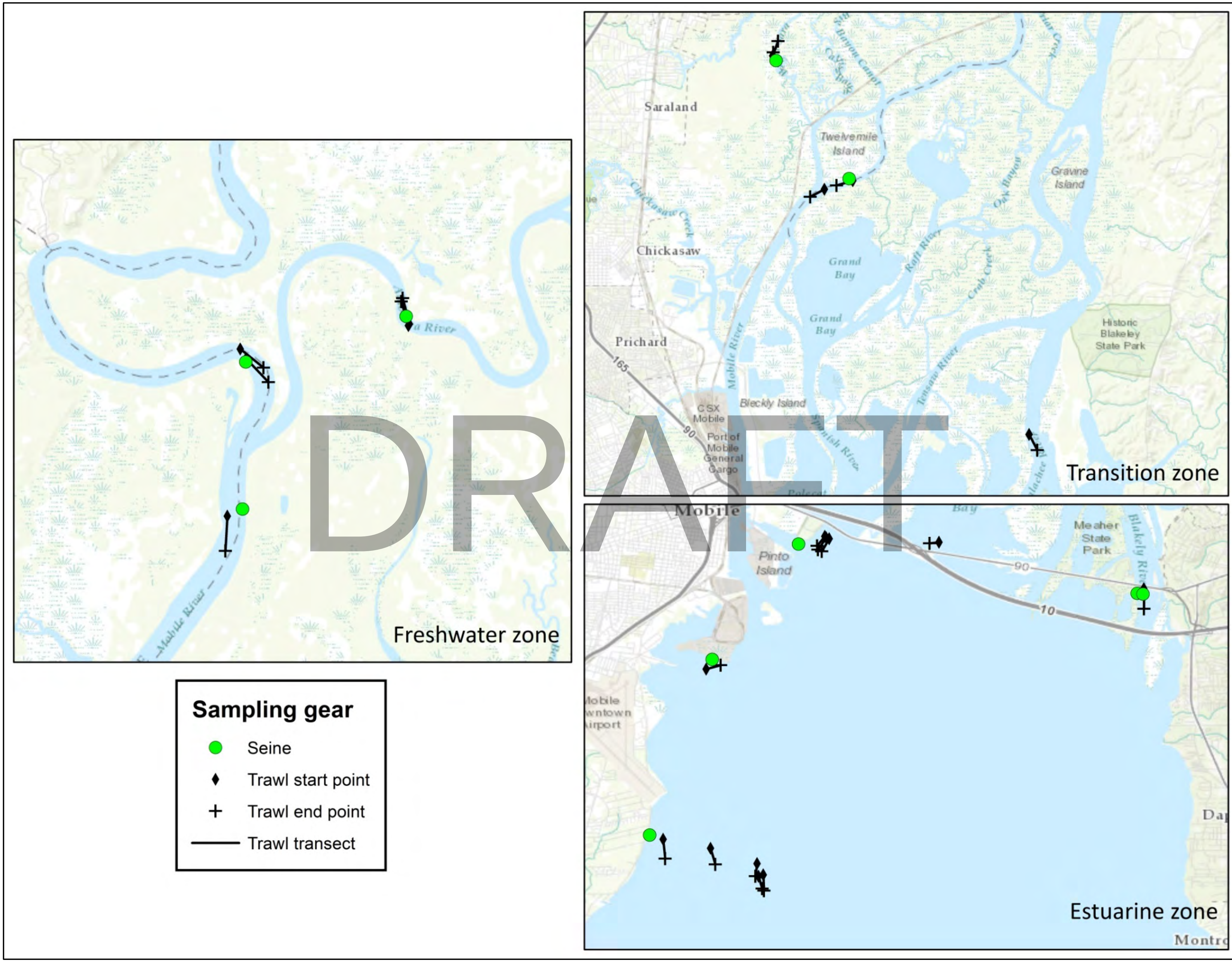
- Establish baseline conditions in the project area
- Quantify relationships between salinity and fish assemblage structure to predict potential environmental impacts.
- Compare alternatives

US Army Corps of Engineers®

Methods

- Fish collected seasonally with two gears in the three areas encompassing the Mobile Bay ecosystem: marine, brackish, and freshwater.
- Collections will occur late summer/early fall 2016 to evaluate recruitment and growth, and spring 2017 to evaluate the spawning period and young-of-year survival.


Freshwater zone
Transition zone
Estuarine zone


Freshwater zone
Mobile River
Transition zone
Saraland
Twelvemile Island
Gravine Island
Chickasaw
Chickasaw Creek
Grand Bay
Raft River
Crab Creek
Oak Bayou
Historic Blakeley State Park
Prichard
Mobile River
Tensaw River
Blecky Island
CSX Mobile
Port of Mobile General Cargo
Spanish River
Estuarine zone
Mobile
Pinto Island
Meaher State Park
Blakely River
90
10
Sampling gear
Seine
Trawl start point
Trawl end point
Trawl transect

COMMON NAME	HABITAT	COMMON NAME	HABITAT
Euryhaline			
Gizzard shad	Freshwater entering estuary	Sand seatrout	Marine entering estuary
Threadfin shad	Freshwater entering estuary	Spot	Marine entering estuary
Atlantic stingray	Marine entering estuary	Atlantic croaker	Marine entering estuary
Gulf menhaden	Marine entering estuary	Bay whiff	Marine entering estuary
Hardhead catfish	Marine entering estuary	Bay anchovy	Resident estuarine
Gafftopsail catfish	Marine entering estuary	Inland silverside	Resident estuarine
Inshore lizardfish	Marine entering estuary	Gulf killifish	Resident estuarine
Striped mullet	Marine entering estuary	Rainwater killifish	Resident estuarine
Atlantic needlefish	Marine entering estuary	Spotted seatrout	Resident estuarine
Gulf pipefish	Marine entering estuary	Highfin goby	Resident estuarine
Leatherjacket	Marine entering estuary	Freshwater goby	Resident estuarine
Pinfish	Marine entering estuary	Hogchoker	Resident estuarine

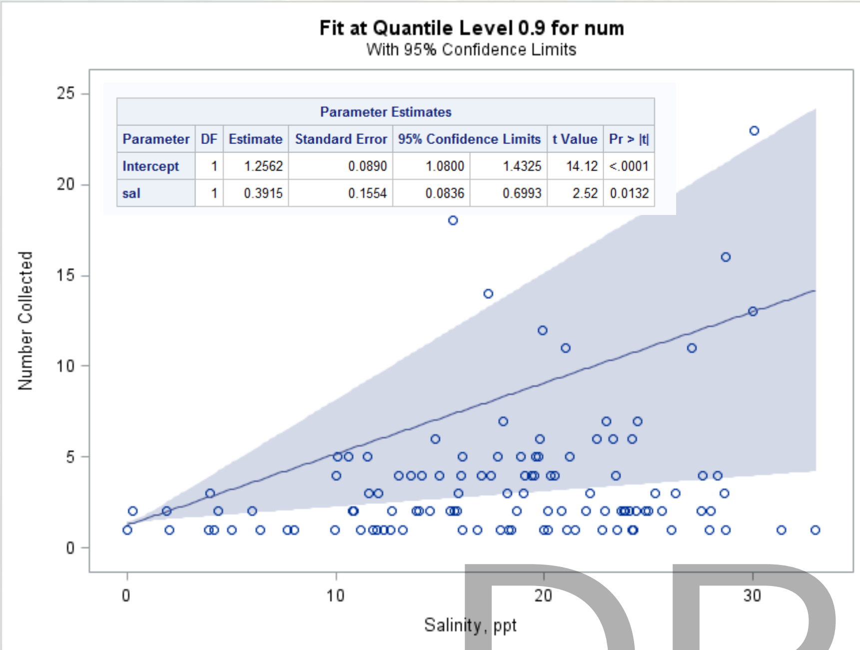
DRAFT

Freshwater Entering Estuary
Smallmouth buffalo
Blue catfish
Channel catfish
Bluegill
Longear sunfish
Redear sunfish
Redspotted sunfish
Largemouth bass
Black crappie

Freshwater Only
Slender blacktail shiner
Mississippi silvery minnow
Mobile chub
Silver chub
Emerald shiner
Silverside shiner
Fluvial shiner
Crystal darter
Freshwater drum

Marine Entering Estuary
Bighead searobin
Atlantic bumper
Bluntnose jack
Atlantic moonfish
Silver perch
Banded drum
Harvestfish
Blackcheek tonguefish

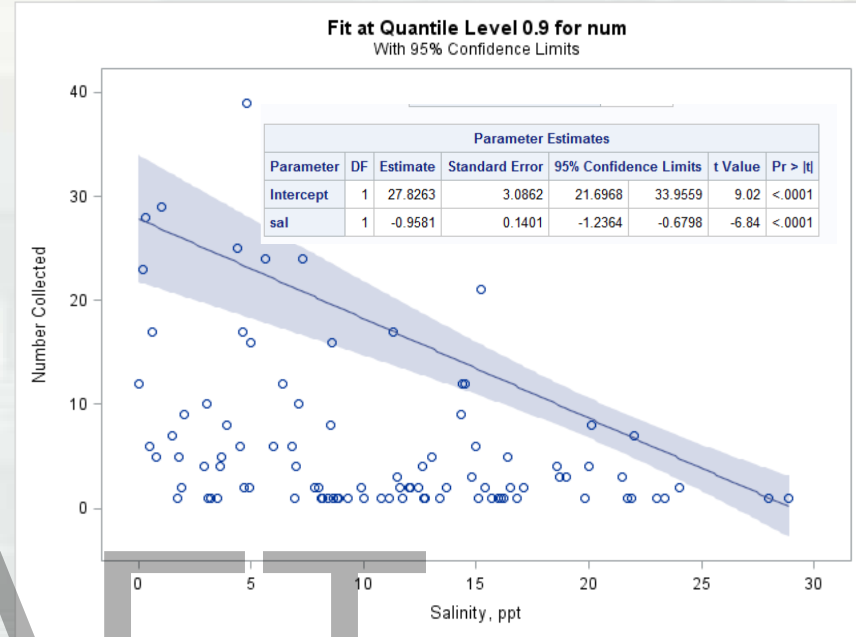
Ladyfish season=fall



Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		t Value	Pr > |t|
Intercept	1	1.2562	0.0890	1.0800	1.4325	14.12	<.0001
sal	1	0.3915	0.1554	0.0836	0.6993	2.52	0.0132

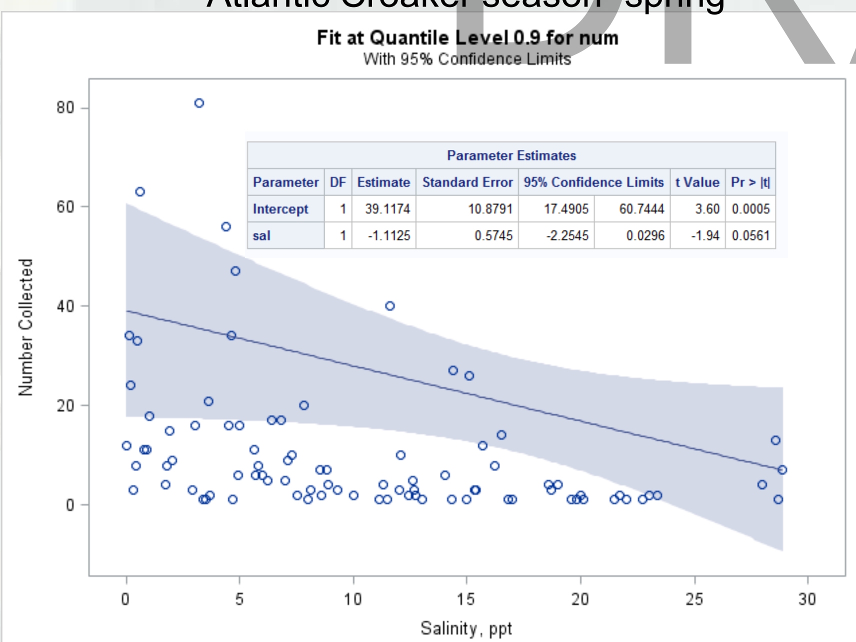
Spotted Seatrout season=spring



Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		t Value	Pr > |t|
Intercept	1	27.8263	3.0862	21.6968	33.9559	9.02	<.0001
sal	1	-0.9581	0.1401	-1.2364	-0.6798	-6.84	<.0001

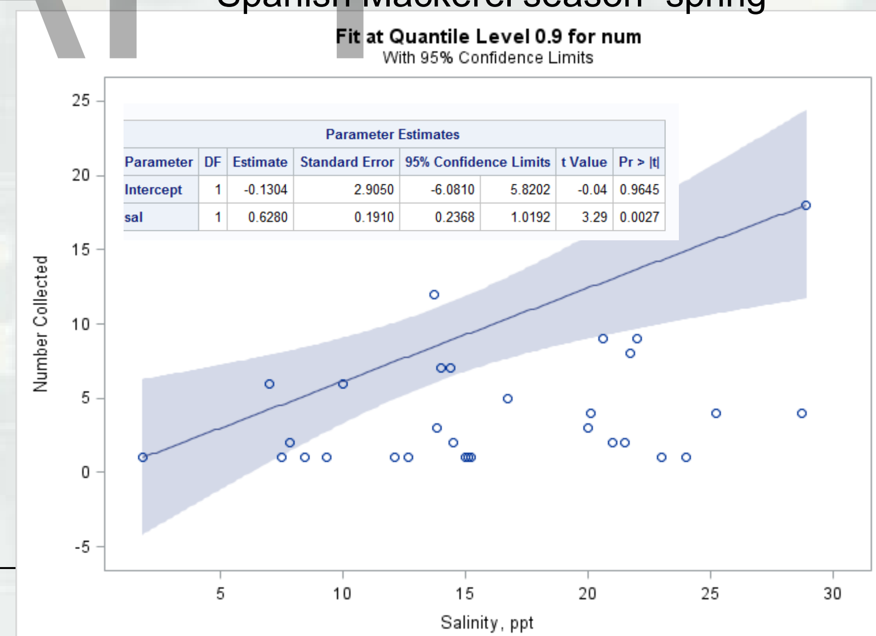
Atlantic Croaker season=spring



Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		t Value	Pr > |t|
Intercept	1	39.1174	10.8791	17.4905	60.7444	3.60	0.0005
sal	1	-1.1125	0.5745	-2.2545	0.0296	-1.94	0.0561

Spanish Mackerel season=spring



Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		t Value	Pr > |t|
Intercept	1	-0.1304	2.9050	-6.0810	5.8202	-0.04	0.9645
sal	1	0.6280	0.1910	0.2368	1.0192	3.29	0.0027

Questions and comments

Jacob.F.Berkowitz@usace.army.mil

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 3 October 2017

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Meeting/Webinar for Mobile Harbor General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) regarding channel dimensions selected for initial modeling.

1. On September 13, 2017 the U.S. Army Corps of Engineers (USACE), Mobile District hosted an agency webinar meeting as part of the ongoing agency scoping activities for the Mobile Harbor GRR and integrated SEIS. The purpose of the meeting was to reconvene the team of cooperating federal and state agencies to present the deepening and widening alternative selected in which the initial modeling will be conducted. Updates on the progress of the modeling and aquatic resources assessments were also presented.

The meeting participants included representatives from the following agencies:

- Alabama State Port Authority (ASPA)
- U.S. Army Corps of Engineers, Mobile District (Corps)
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama Dept. of Environmental Management (ADEM), Mobile Field Office
- ADEM, Water Quality Branch
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- ADCNR, Marine Resources Division (MRD)
- Geological Survey of Alabama (GSA)
- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS), Habitat Conservation Division (HCD)
- Environmental Protection Agency (EPA)
- Mobile Bay National Estuary Program (MBNEP)

The agenda, participation list, meeting slides, and draft preliminary resources maps are included below.

2. The meeting opened with a round of introductions after which Julie McGuire presented a summary of the economic analysis conducted to determine the feasibility of channel improvements. Two main problems were identified in this study. The first being is that vessels are light loading, meaning vessels carry less cargo tons than maximum capacity because of sailing draft constraints (channel depth). The second was vessels delays due to one way traffic for vessels over a certain size. Alternative plans were developed in response to these problems which were channel deepening of 47'-55' and widening for up to 550' for 15 miles.

The purpose of the economic analysis is to determine the most efficient plan. Channel deepening alternatives allow for increased cargo loads for vessels using the channel. Channel widening would allow larger vessels to meet and reduce delay times for vessels waiting offshore or at the dock. The project benefits are reduction in transportation costs for goods shipped through Mobile Harbor with deepening and or widening. The economic analysis considers many components including types, volumes, origins and destinations of commodities coming into and being exported through Mobile Harbor. The composition of the historic, existing and future fleet expected to call the harbor was determined. It is the maximum net National Economic Development (NED) benefits that are used as the primary determinant of the most efficient plan, and would likely be recommended from an economic standpoint. The NED for the deepening analysis was a channel depth of 51 feet. However, ASPA considers a channel depth of 50 feet as the most reasonable from a cost sharing standpoint.

As illustrated in the attached slides, the channel dimensions selected from the economic analysis consists of deepening of the navigation channel from about a mile south of the tunnels, including the turning basin, extending south to the mouth of the bay to a depth of 50 feet. The turning basin will also be widened 250 feet to the south. Widening of 100 feet to a width of 500 feet is being considered from the mouth of the bay northward for 5 miles. The entrance channel extending from the mouth of the bay southward into the Gulf will be deepened to 52 feet including a bend easing in the mouth of the bay. Additional deepening (up to 4 feet) beyond the economically justified channel depths of 50 and 52 feet will occur to account for advanced maintenance (2 feet) and allowable overdepth (2 feet).

3. The meeting continued with a summary of the modeling approach presented by Justin McDonald which is included in the attached slides. In support of the modeling effort, significant field data collection has been conducted at various locations in the upper bay and delta. The data collected for the study includes water levels, salinity, temperature, turbidity, suspended sediments, and ship wake measurements to help characterize existing conditions. The data collected is valuable to increase the confidence levels of model outputs.

Hydrodynamic modeling is being conducted using Coastal Storm Modeling System (CSTORM) and ADvanced CIRCulation Model (ADCIRC) to provide offshore elevation boundary conditions for the nearshore hydrodynamic and sediment transport modules. The STeady State Spectral WAVE Full Plain (STWAVE-FP) model is being used to provide wave fields to the nearshore hydrodynamic and sediment transport modules. The Geophysical Scale Transport Modeling System (GSMB) - Multi-Block Curvilinear Hydrodynamics in 3-Dimensions-Waterways Experiment Station (MB-CH3D-WES) model provides water levels and current velocities to the water quality, estuarine sediment transport, and habitat assessment modules.

Water quality modeling is utilizing the GSMB-CE-QUAL-ICM model which will assess potential changes in water quality including changes in flushing, salinity, dissolved oxygen, temperature, total suspended solids, nutrients and chlorophyll a as a result of channel modifications. Outputs from the model will provide water quality constituents (i.e. salinity, temperature, dissolved oxygen, total suspended solids etc.) that will be used in the conducting the aquatic habitat impact assessments.

The sediment transport modeling is using the GSMB–SEDZLJ model to assess relative changes in sedimentation rates and pathways within the bay as a result of channel modifications. Delft3D (Flow, SWAN and Morph modules) modeling will be used to quantify relative changes in sediment pathways and morphological response along the barrier islands and ebb tidal shoal as a result of the increased channel dimensions. Ship wake analysis is also being done to assess changes in ship wakes from the vessels utilizing the larger channel dimensions.

A concern was raised by ADEM that the modeling capture maximum conditions by including advanced maintenance and overdepth dimensions. The Corps confirmed that those additional depths will be included in the model grids. ADEM requested copies of the channel dimensions and grid files to add to their model grids. Elizabeth Godsey will be coordinating this effort with ADEM. It is anticipated that the modeling of this initial alternative will be completed in approximately one month. At that time, results from the modeling will be turned over to the habitat evaluation team to begin the impact assessments.

4. A status of the aquatic resource assessments being conducted by the ERDC team for the baseline and impact assessments for the various aquatic resources was presented. The assumption has been made that biggest influence from parameters contributing to the aquatic impacts will be fluctuations in salinity resulting from saltwater intrusion.

Wetlands. Field verifications were completed for remote sensing and field data sets being used to map the distribution of wetlands. The wetland vegetation distribution maps are being finalized. Preliminary maps of the wetland vegetation were presented to the group and included with this MFR. Salinity tolerances have been determined for each of the observed species. This information will be compared to outputs from the water quality model to conduct potential impact assessments.

The question was asked concerning how the salinity tolerances were being determined and if the ranges are for preferred or maximum? In response, it was indicated that the tolerance levels are being compiled using existing studies and literature. The tolerances are being considered for average salinity conditions.

Submerged Aquatic Vegetation (SAV). Field verifications of existing data sets have been completed and SAV and maps are being finalizing showing species distributions in the study area. Salinity tolerances for observed species have been compiled which will be compared to water quality and hydrodynamic model outputs for the potential impact assessment of existing resources. This effort is also examining historic habitat variability.

Oysters. The team has requested and received oyster reef distribution information from the MRD and are preparing maps of oyster reef distributions throughout the bay. The study will use numerical modeling to determine the potential effects of larvae distribution associated with changes in the channel dimensions. Outputs from the water quality and hydrodynamic modeling will examine changes to dissolved oxygen and other water quality parameters to determine potential impacts to existing reefs.

A concern was raised if the oyster assessment will take into consideration the potential of increased dermo infection in oysters. Dermo infections have been linked to increases in salinity and temperatures. The MRD indicated that they have had discussions with the Corps regarding salinity and the effects from dermo and oyster drills. Will need to wait on results from modeling to determine these effects.

Benthic Invertebrate Communities. Summer and spring benthic sampling has been completed within the zones identified as areas that would likely be impacted by increased channel dimensions. These zones consist of areas exhibiting estuarine, transitional, and freshwater conditions. Sediment grain size and TOC analysis has also been completed for each sample location. All taxonomic identification has been completed and statistical analyses and data interpretation is in progress. The data from the benthic analysis will be compared to results of the water quality model to determine effects on benthic communities.

Fish. Summer and spring field data collection has been completed and has been coordinated with MRD on the approach used for data collection and analysis. Based on the information from the field analysis the team is determining relationships between salinity and fish populations to evaluate recruitment and growth and evaluate the spawning period and young-of-year survival. Results from the water quality and hydrodynamic models will be used to determine effects to fish populations.

5. Discussion

ADEM expressed the concern of using the year 2010 conditions and how valid interpretations of drought and wet years will be accomplished. The Corps has determined that conditions represented by year 2010 is representative of a typical average year. However, 2010 also has periods of both high and low flow conditions that will be used to extract non-average conditions. These periods representing non-average conditions (high and low flow) will be used to indicate and evaluate critical stress conditions for the habitats of concern, i.e. wetland vegetation, SAVs, oysters, fish, and benthic invertebrate communities.

Another concern was raised by EPA pertaining model calibration using the 2010 data. The Corps is evaluating 2016 data that was collected to get an indication of representative conditions such as salinities during that time to be able to validate model outputs.

It was pointed out that any impacts resulting from the 2010 oil spill be considered in the study. The Corps conducted sediment analysis shortly after the spill within the navigation channel to assess the presence of oil in the sediments. The results of this testing will be considered in the study.

It was requested that presentation slides and read ahead material be provided to the agencies prior to future meetings. It was also suggested that a Doodle Poll be conducted for more efficient planning of the next meeting.

6. Next Steps. Once the results of the modeling are available, outputs will be provided to the aquatic resources assessment team. The information will be compared against the without project conditions to determine impact assessments for the aquatic resources being considered. When the impacts assessments are completed, a follow up meeting with the cooperating agencies will be scheduled to present the preliminary results. This meeting will likely be a face-to-face workshop format in Mobile. At that time, the significance of impacts will be evaluated to determine if other alternative modeling runs will be necessary in efforts to avoid or minimize impacts. The meeting will also be a forum to begin considering appropriate mitigation requirements, if needed. It is anticipated that this meeting will be scheduled for late October or early November of this year.

7. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/s/ Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Draft copies were furnished for comment to all meeting participants.

Agency Meeting
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement (SEIS)
Conference Call/Webinar
September 13, 2017
9:00 – 10:30 Central

Initial Modeling Dimensions and Study Updates
Agenda

Introductions

Selection of Initial Modeling Dimensions

Modeling Approach

Update of Aquatic Resources Assessments
- Wetlands
- Submerged Aquatic Vegetation
- Oysters
- Benthic
- Fish

Questions and Discussion

Next Steps

Mobile Harbor GRR Agency Webinar – List of Participants

Agencies
Bob Harris (ASPA)
Carl Ferraro (ADCNR)
John Mareska (ACDNR, MRD)
Stephen Jones (GSA)
Allen Phelps (ADEM)
Justin Rigdon (ADEM)
Chris Johnson (ADEM)
James Mooney (ADEM)
Lena Weiss (EPA)
Dan Holliman (EPA)
Calista Mills (EPA)
Amanda Howell (EPA)
Ntale Kajumba (EPA)
Josh Rowell (FWS)
Patric Harper (FWS)
Rusty Swafford (NMFS)
Tom Herder (MBNEP)

Corps of Engineers - ERDC
Kevin Reine
Barry Bunch
Ray Chapman
Todd Swannack
Safra Altman

Corps of Engineers – Mobile District
Colonel James DeLapp
Julie McGuire
Justin McDonald
David Newell
Joe Paine
Richard Allen
Ashley Kleinschrodt
Susan Rees
Joe Givhan
Larry Parson

MOBILE HARBOR GRR

With Integrated Supplemental Environmental Impact Statement

Cooperating Agency Update

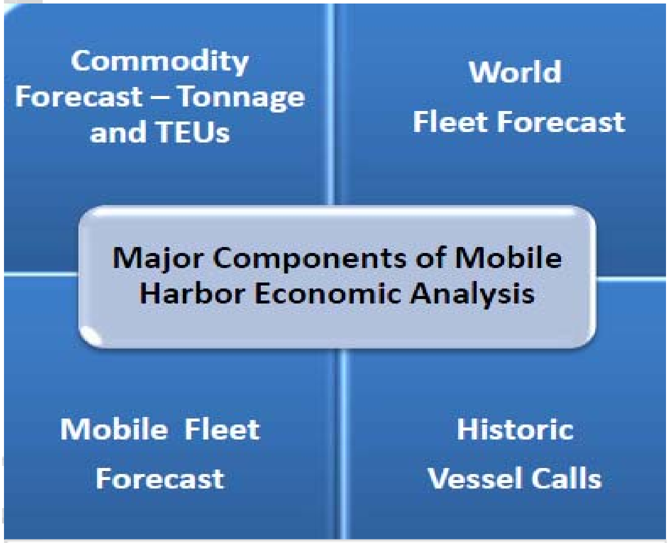
September 13, 2017

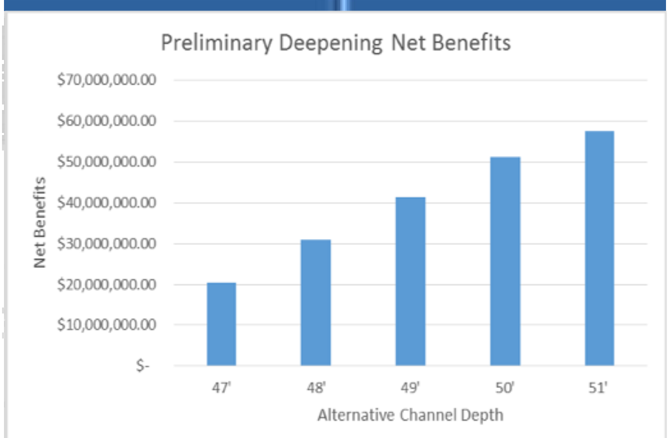
Cooperating Agency Meeting
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement (SEIS)

Initial Modeling Dimensions and Study Updates
Agenda

- Introductions
- Selection of Initial Modeling Dimensions
- Modeling Approach
- Update of Aquatic Resources Assessments
  - Wetlands
  - Submerged Aquatic Vegetation
  - Oysters
  - Benthic
  - Fish
- Discussion
- Next Steps

Corps Economic Analysis for Mobile Harbor

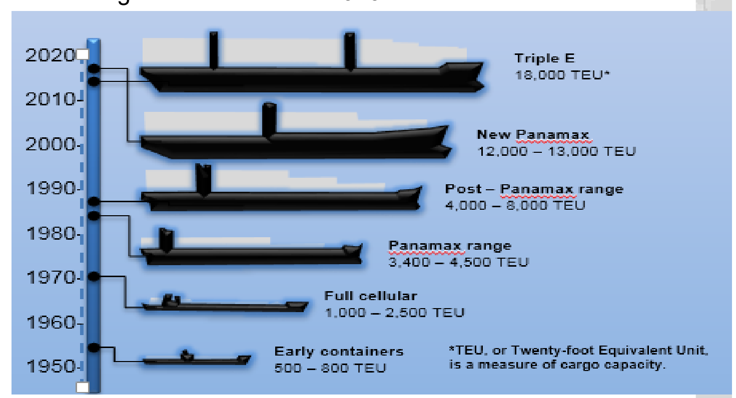




Concepts behind Mobile Harbor Economic Analysis:

- Deeper channels allow for greater vessel loading resulting in trade route efficiency
- Total voyage distance and amount of cargo are main determinants of vessel operating costs
- The project benefits are reduction in transportation costs for goods (imports/exports) shipped through the Mobile Harbor with deepening/widening

Evolution of container ships
Post-Panamax ships make up 16 percent of the world's container fleet today, but carry 45 percent of the cargo. New Panamax ships will be the largest that can pass through the new locks in 2016.



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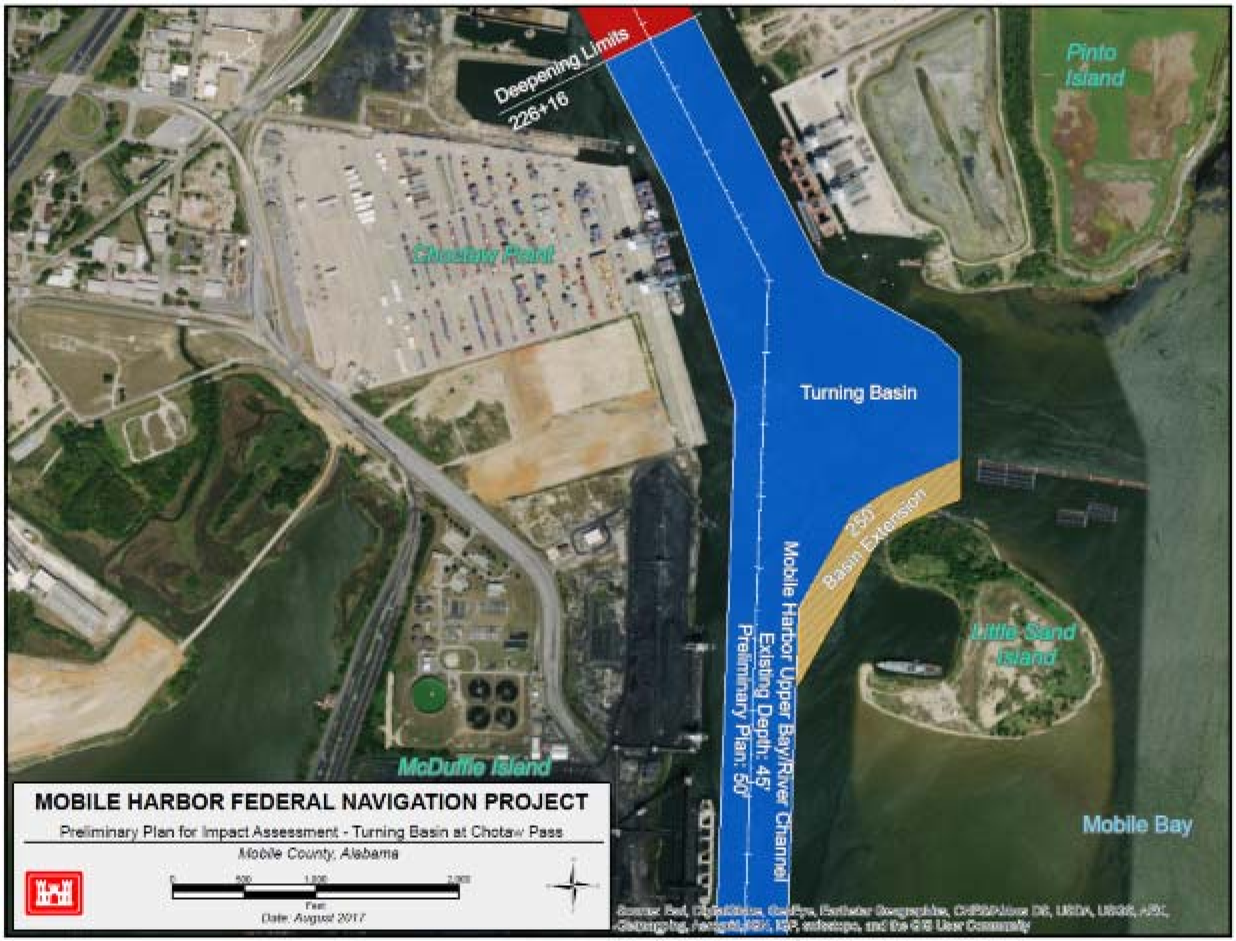
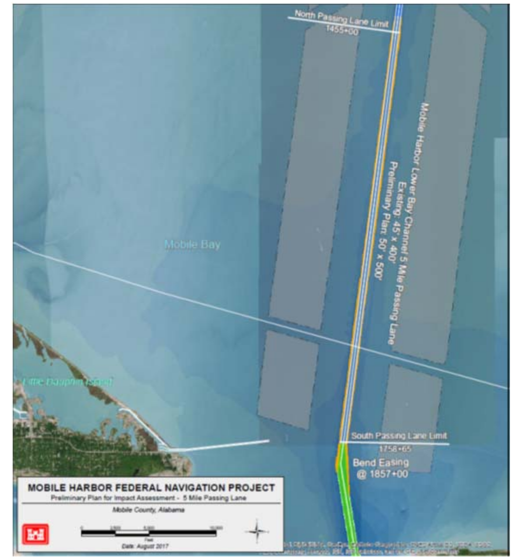
MOBILE HARBOR GRR
ALTERNATIVES

Initial	➢ **Deepening: 47 to 55 feet Including Turning Basin** ➢ **Bend Easing** ➢ **Widener: 100 and 150 feet 5, 10,15 miles in length**

Proposed for Impact Assessment	➢ **Deepening: 50 feet Including Turning Basin** ➢ **Bend Easing** ➢ **Widener: 100 feet 5 miles in length**

MOBILE HARBOR PROJECT





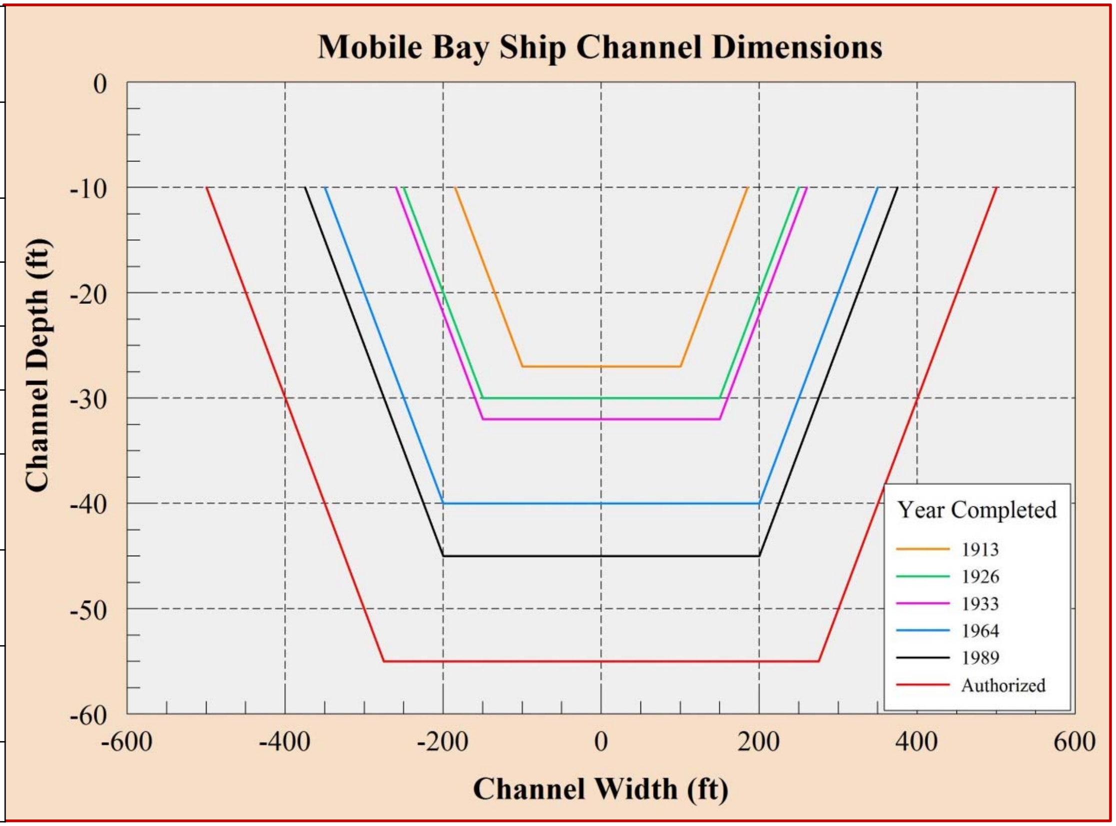
MOBILE HARBOR GRR
BACKGROUND

Mobile Entrance Channel:

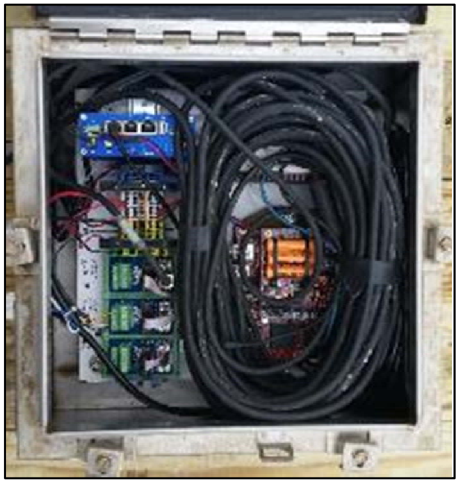
Channel Dimension (ft)	New Work Dredging Dates
30 x 300	May 1904 to October 1913
33 x 300	October 1913 to June 1924
36 x 450	June 1924 to August 1934
36 x 450	August 1934 to July 1965
42 x 450	July 1965 to April 1990
42 x 600	April 1990 to September 1999
47 x 600	September 1999 to June 2006

Mobile Bay Channel:

Channel Dimensions (ft)	New Work Dredging Dates
13 x 200	September 20, 1870 to September 1876
17 x 200	February 19, 1881 to June 30, 1885
23 x 280	October 1888 to October 3, 1895
23 x 100	June 26, 1899 to July 12, 1909
27 x 200	January 6, 1911 to August 15, 1913
30 x 300	September 10, 1918 to July 25, 1926
32 x 300	FY 1932 to July 19, 1933
40 x 400	January 27, 1956 to November 10, 1964
45 x 400	**October 24, 1987 to July 3, 1989**



Continuously Operating Data Collection Platforms



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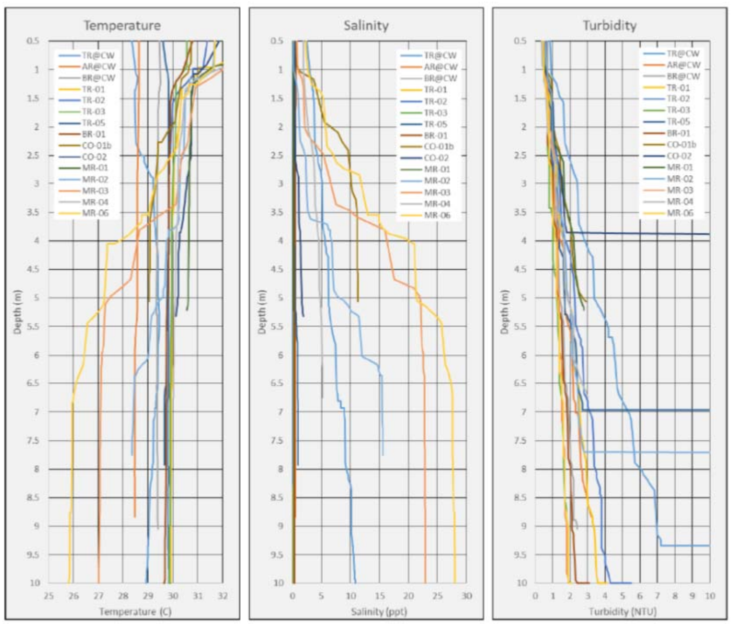
Mobile-Tensaw Delta Discrete Sampling Locations

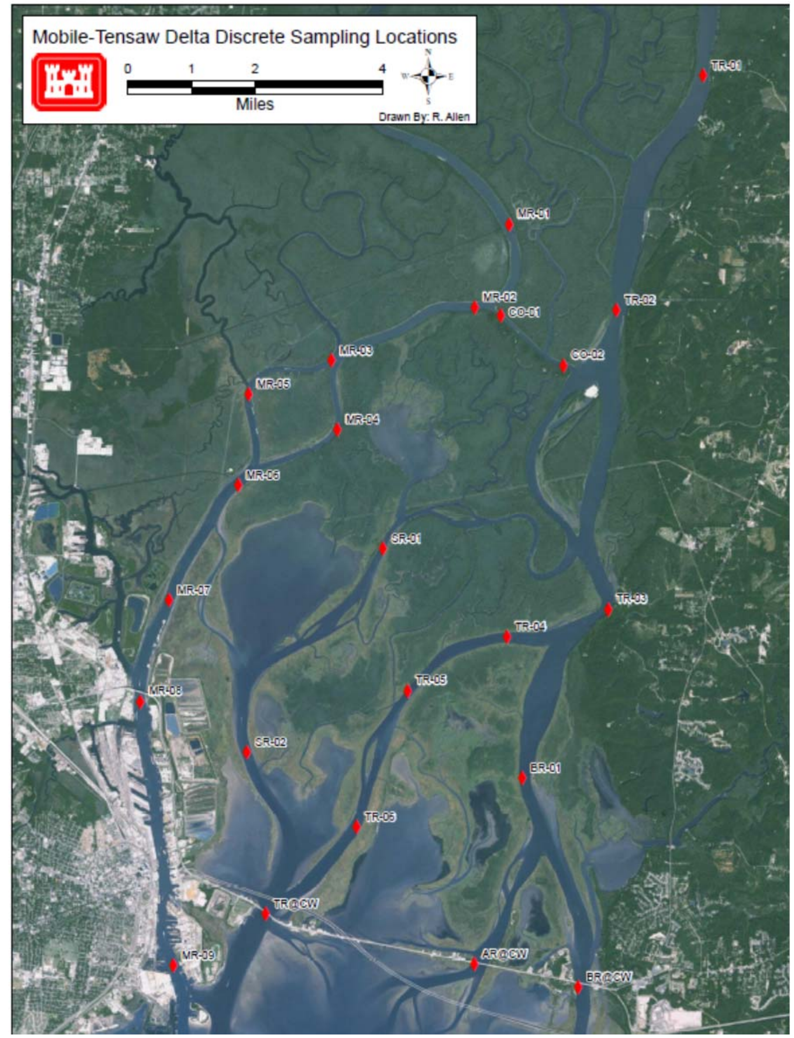
Discrete Sampling – June and September 2016

Acoustic Doppler Current Profile (ADCP) measurements and depth measurements at discrete locations along the rivers

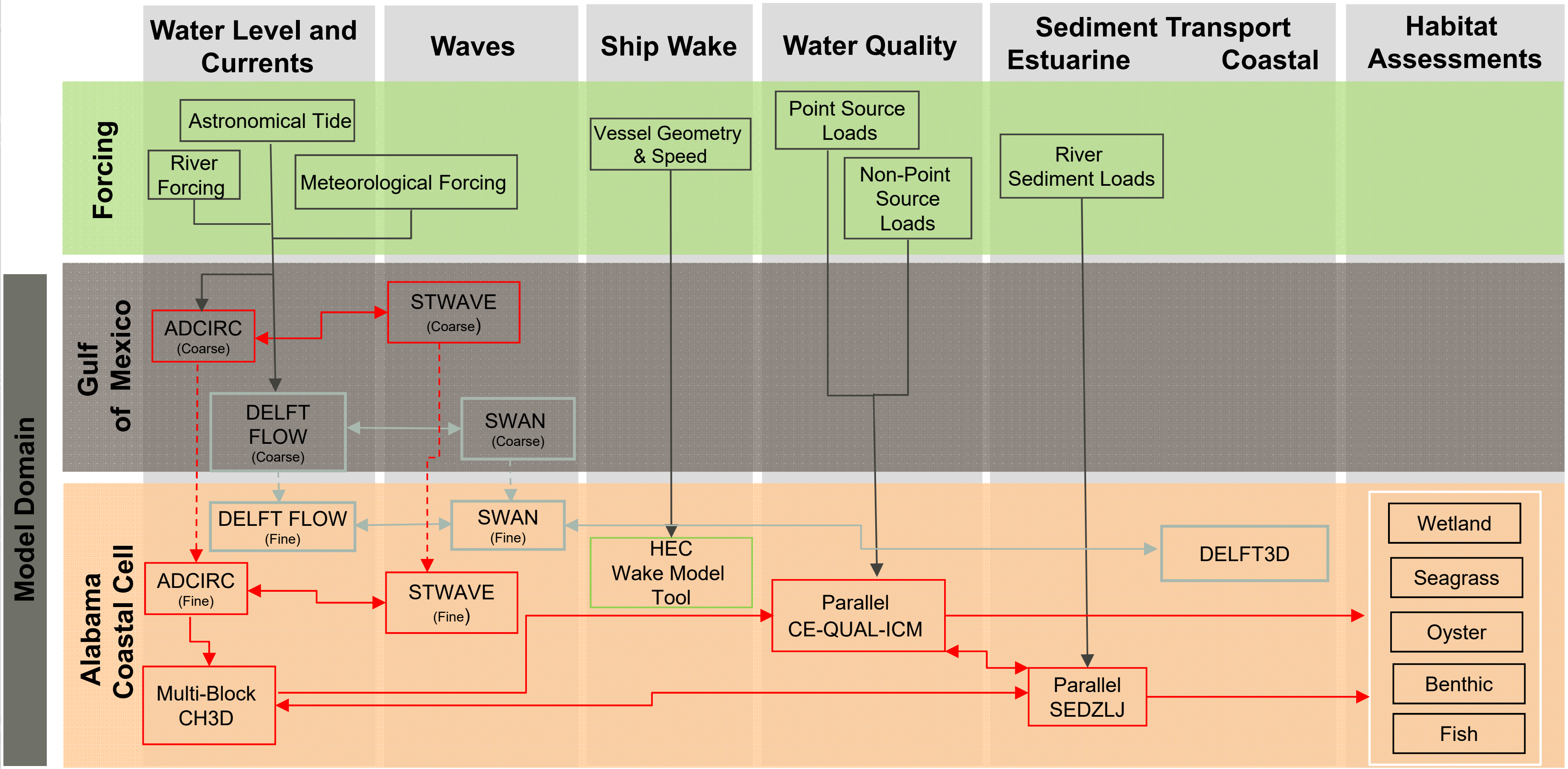
Vertical profiles of temperature, turbidity, & conductivity at discrete locations

Suspended Sediment Samples at discrete locations





Flow Diagram of Assessment Tools



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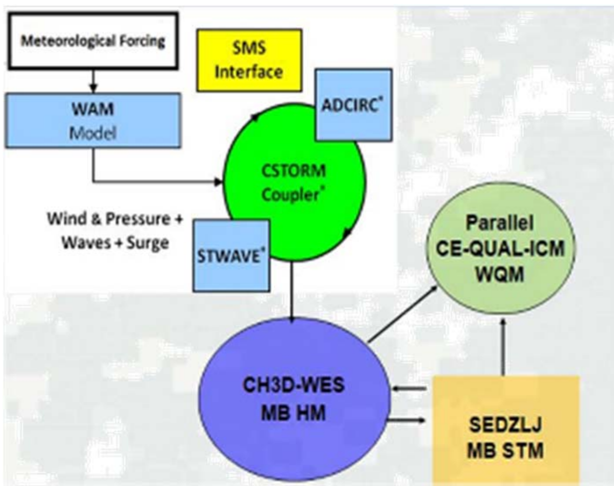
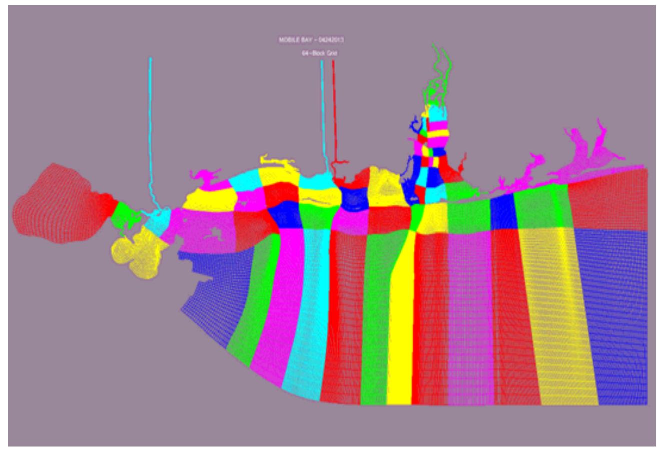
GSMB Hydrodynamic Modeling and WQM Linkage

Geophysical Modeling System Multi-Block



Model Domain



Forcing

Wind and Atmospheric Pressure
River Flow
ADCIRC Tidal Elevation Boundary
STWAVE Wave Input

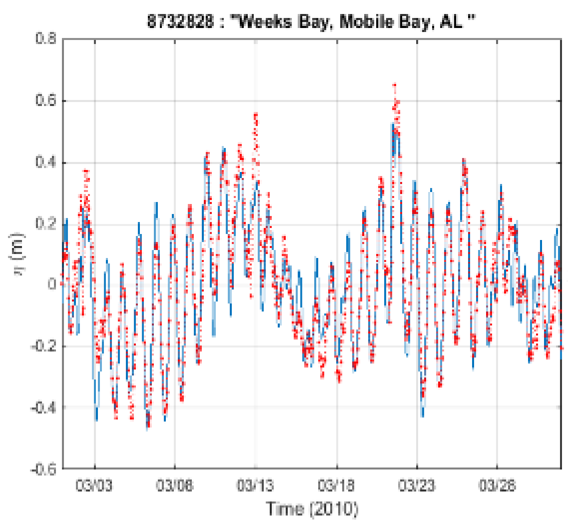
WQM Linkage Support

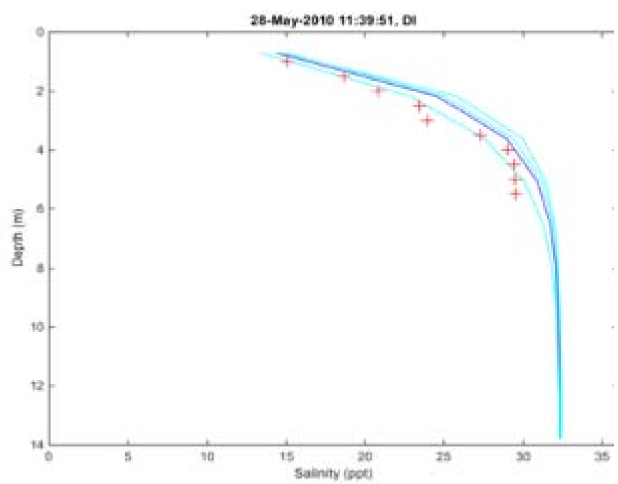
MB Hydro To WQM Mapping
Grid Geometry
Flow
Vertical Mixing Coefficient

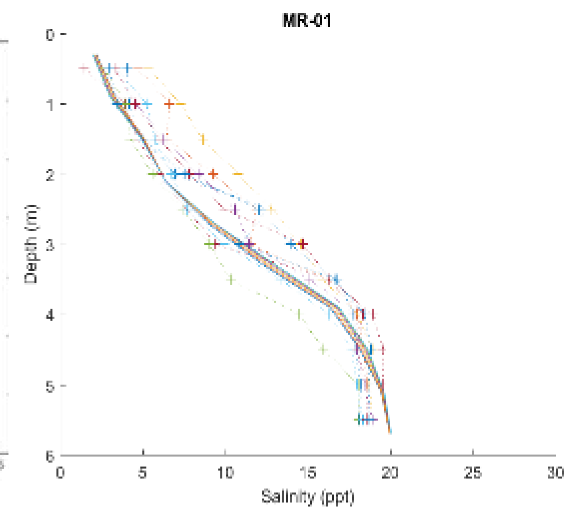
Model Evaluation

NOAA Tide Gages
2010 & 2016 Salinity
Measurements in Bay and Delta

Model Evaluation







GSMB CE-QUAL-ICM Water Quality Modeling

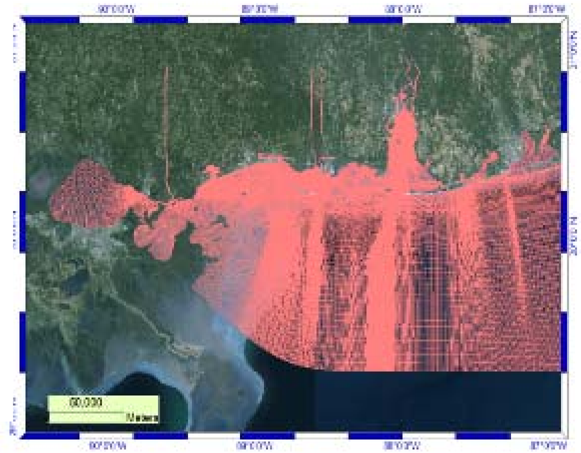
CE-QUAL-ICM

PARALLEL VERSION ICM
RUNS & POST-PROCESSESS ON HPC
FULL SUITE OR WQ STATE VARIABLES & PROCESSES

ICM STATE VARIABLES

TEMPERATURE	DO	TOTAL PHOSPHATE
AMMONIUM	SALINITY	POP
NITRATE	ALGAE	DISSOLVED SILICA
DON	DOC	SUSPENDED SOLIDS
PON	POC	

Model Domain



Hydro and Linkage

Utilizes GSMB Concatenated Multi Block Grid Hydrodynamics

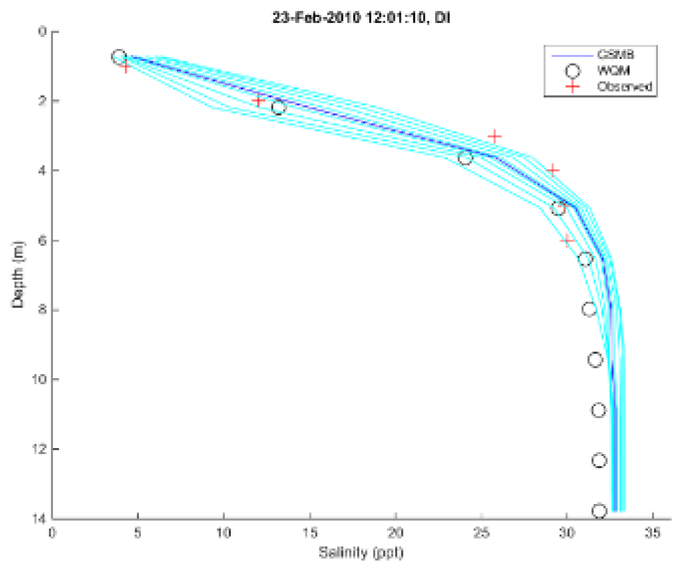
Proper Linkage to GSMB Investigated and Demonstrated Using:

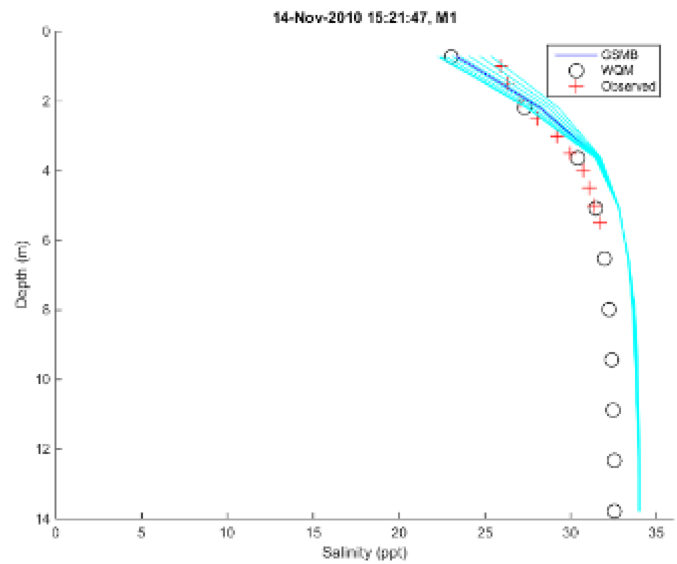
A. Volume Conservation Test
B. Mass Conservation Test
C. Transport Comparisons

Boundary Conditions

Using 2010 Observed Data and Mobile Airport Met Data

Model Evaluation





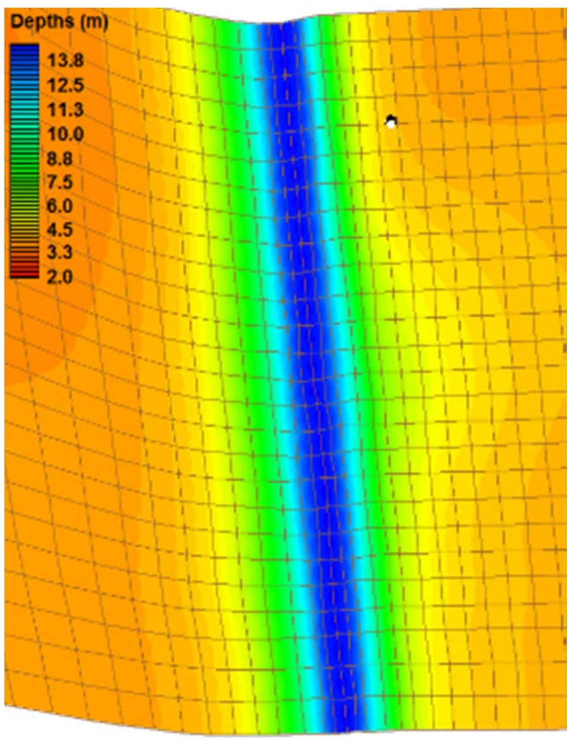
GSMB Sediment Transport Modeling

Simulates 3-dimensional transport of multiple cohesive and noncohesive sediment size classes. Suspended load and bedload transport, deposition, erosion and bed armoring are simulated.

Grid:
Fine resolution in the navigation channel (channel and side slopes are 12 cells wide – 30 m in width in the channel) being used to simulate intra-channel longitudinal and lateral transport.

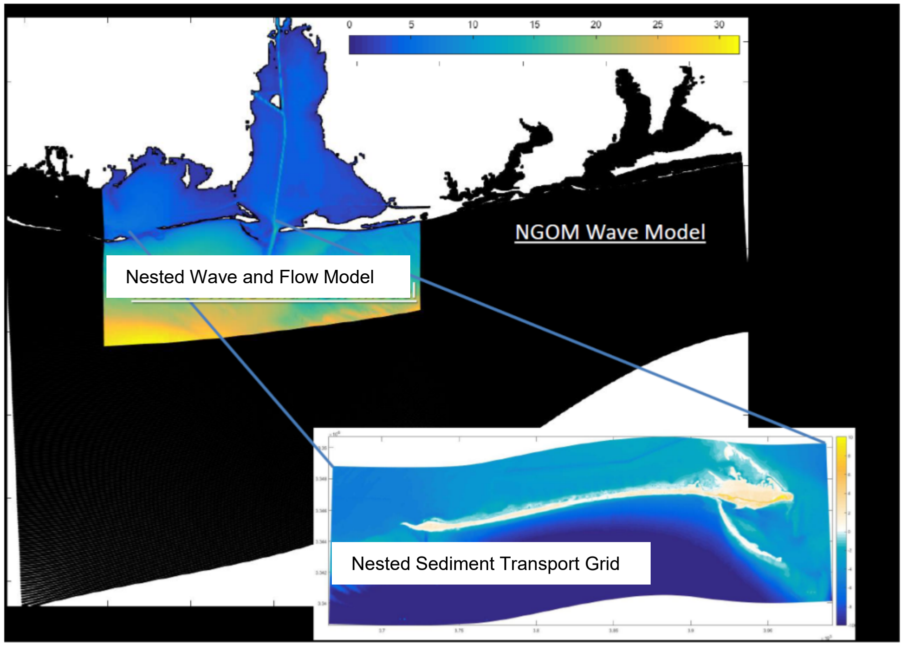
Boundary Conditions (BCs):
Suspended Sediment Concentrations (SSC) measured during field study in the upper bay were used to adjust discharge – SSC rating curve that is used for the Mobile and Tensaw Rivers BCs.

Model Evaluation:
Dredged volumes from different sections of the navigation channel (see figure below) were used to calibrate and validate the STM.



Delft 3D Sediment Transport Modeling

Modeling Domain

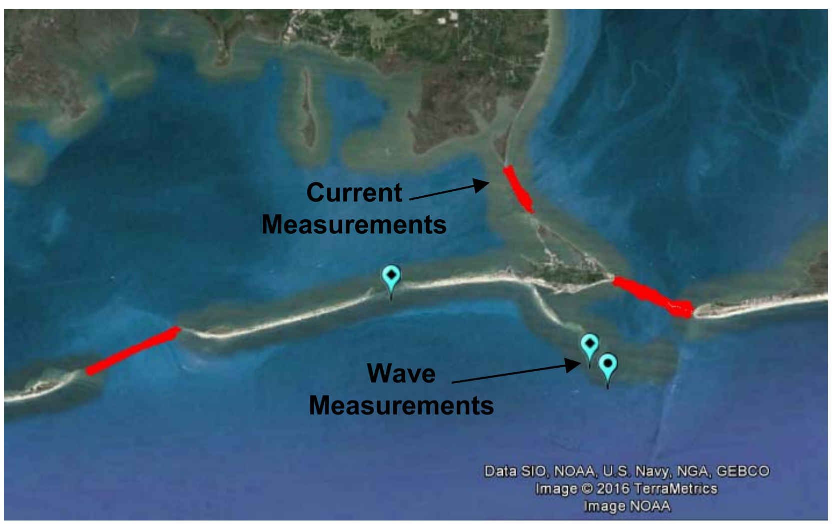


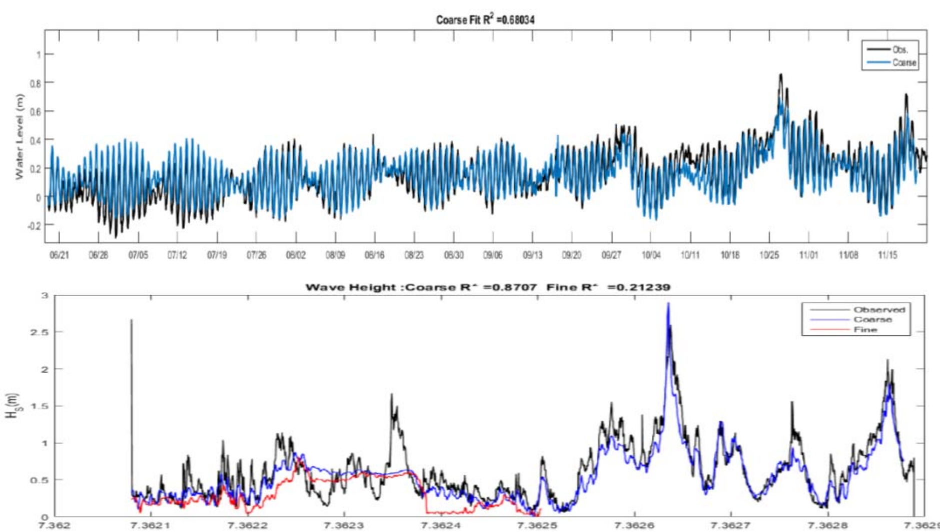
Forcing

Wind and Atmospheric Pressure
River flow
10 year Wave Climatology

Model Evaluation

NOAA Tide Gages
2015 Waves and Current Measurements
Historic Topographic and Bathymetric change Measurements





AQUATIC RESOURCES ASSESSMENTS ERDC

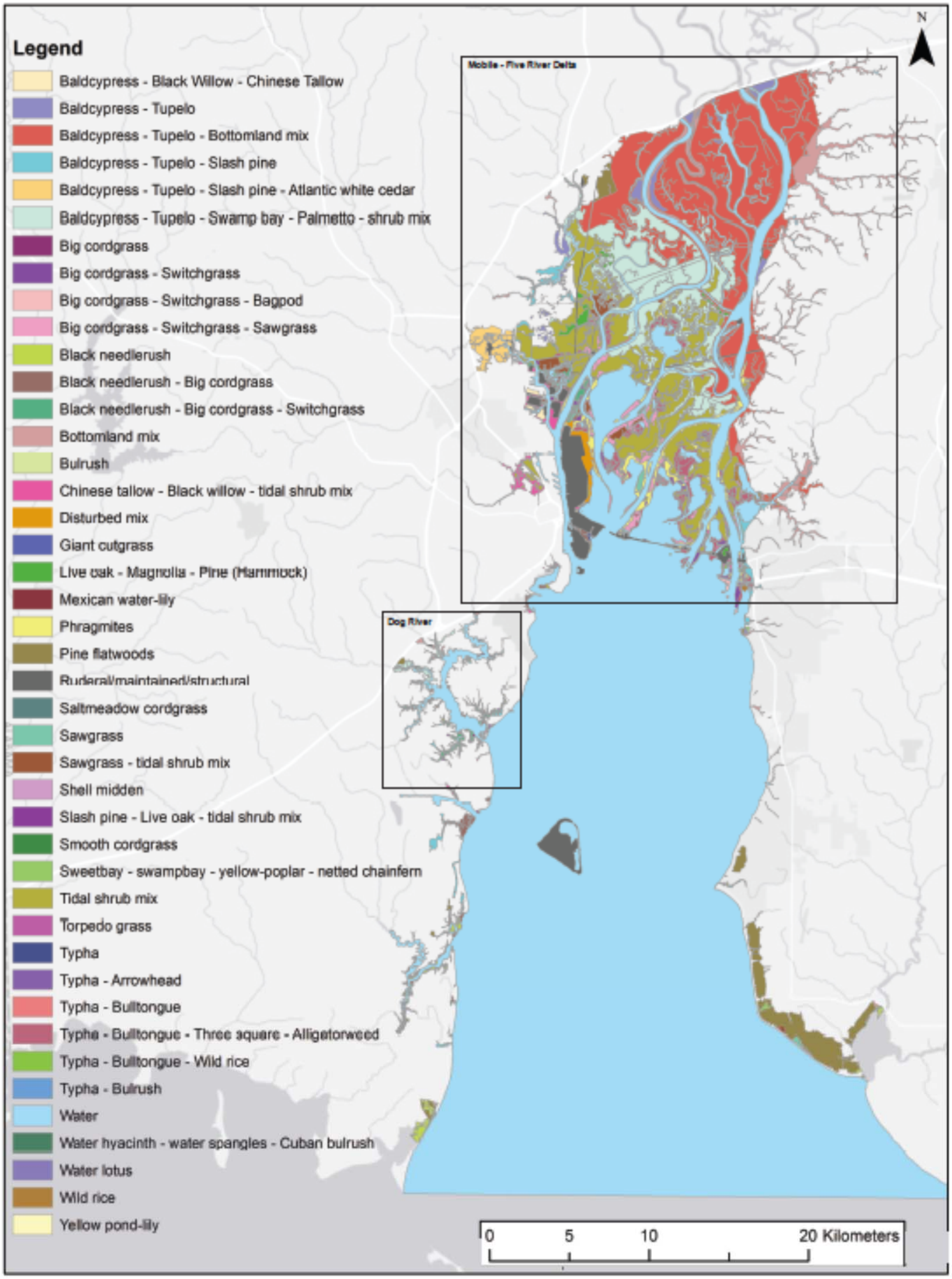
- **Wetlands**
  - ✓ Completed field verification of existing data
  - ✓ Finalizing mapping for vegetation distributions
  - ✓ Determining salinity tolerances for observed species
  - ✓ Compare tolerances with WQ model outputs
- **Submerged Aquatic Vegetation (SAV)**
  - ✓ Completed field verifications of existing data sets
  - ✓ Finalizing mapping showing species distributions
  - ✓ Determining salinity tolerances for observed species
  - ✓ Compare tolerances with WQ model outputs
- **Oysters**
  - ✓ Received oyster reef distributions information from MRD
  - ✓ Preparing maps of oyster reef distributions
  - ✓ Numerical modeling to determine oyster larvae distribution
  - ✓ Use WQ model results to determine potential impacts to existing reefs – dissolved oxygen
- **Benthic Communities**
  - ✓ Completed spring & summer sampling
  - ✓ Sediment grain size and TOC complete
  - ✓ Statistical analysis and interpretation in progress
  - ✓ Use WQ model results to determine effects on benthic communities
- **Fish**
  - ✓ Completed data collection for spring & summer sampling
  - ✓ Coordinated with MRD on approach used for data collection and analysis
  - ✓ Determining relationships between salinity and fish populations
  - ✓ Use WQ model results to determine effects to fish populations


MOBILE HARBOR GRR
With Integrated Supplemental Environmental Impact Statement
DISCUSSION
US Army Corps of Engineers
U.S.ARMY

Classifications and Mapping of Mobile Bay Wetland Communities

Kevin Philley and Jacob F. Berkowitz
US Army Corps of Engineers, Engineer Research and Development Center

DRAFT – CONTAINS UN-REVIEWED DRAFT INFORMATION
NOT FOR PUBLIC RELEASE



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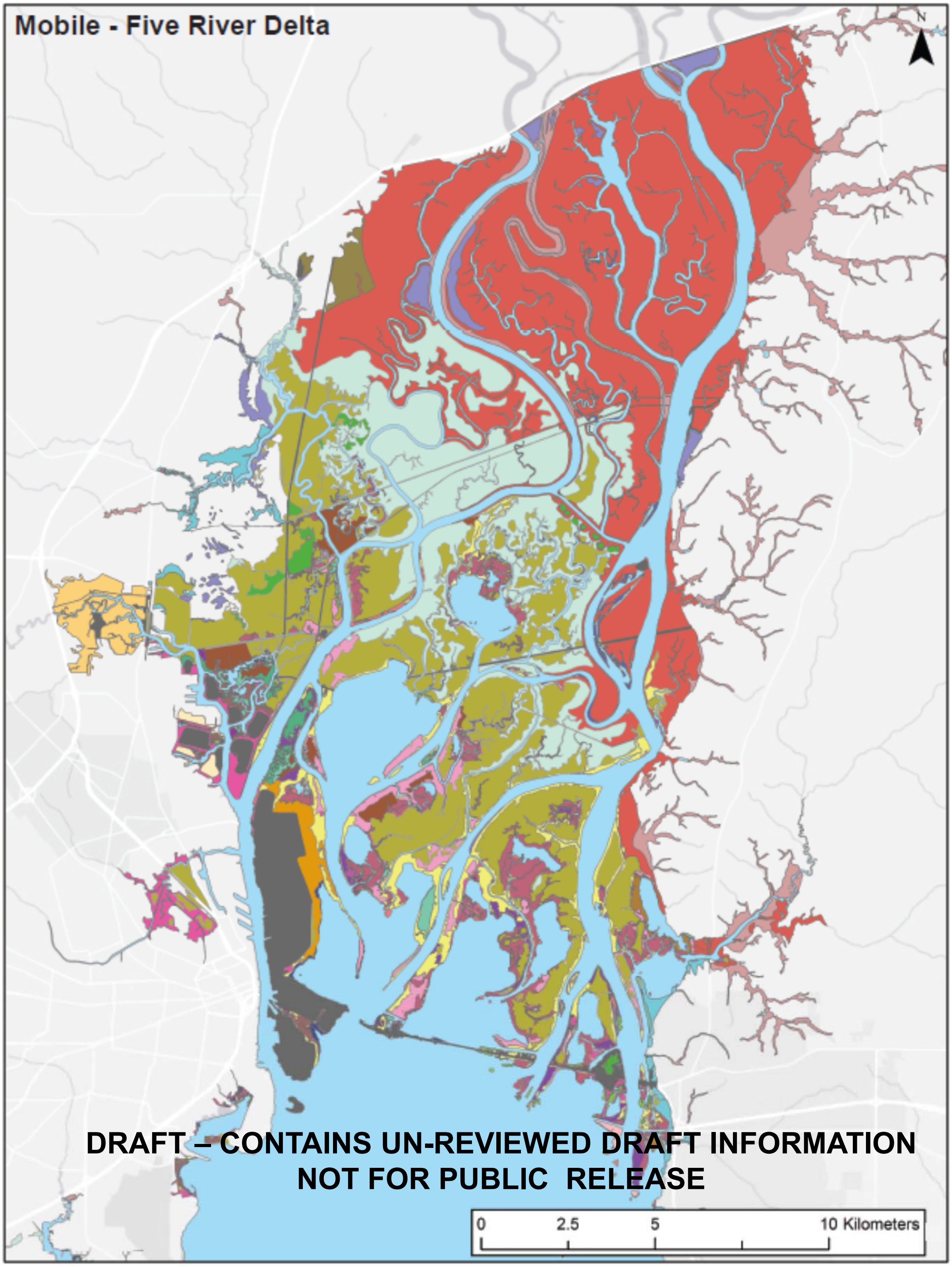
Acknowledgements: The US Army Corps of Engineers Mobile District provided funding for this project. Nathan Beane, Steven Currie, and Richard Allen provided assistance with field data collection and preliminary mapping.

Contact Information: Jacob.F.Berkowitz@usace.army.mil 601-634-5218 or Kevin.D.Philley@usace.army.mil 601-634-5411

Classifications and Mapping of Mobile Bay Wetland Communities

Kevin Philley and Jacob F. Berkowitz
US Army Corps of Engineers, Engineer Research and Development Center



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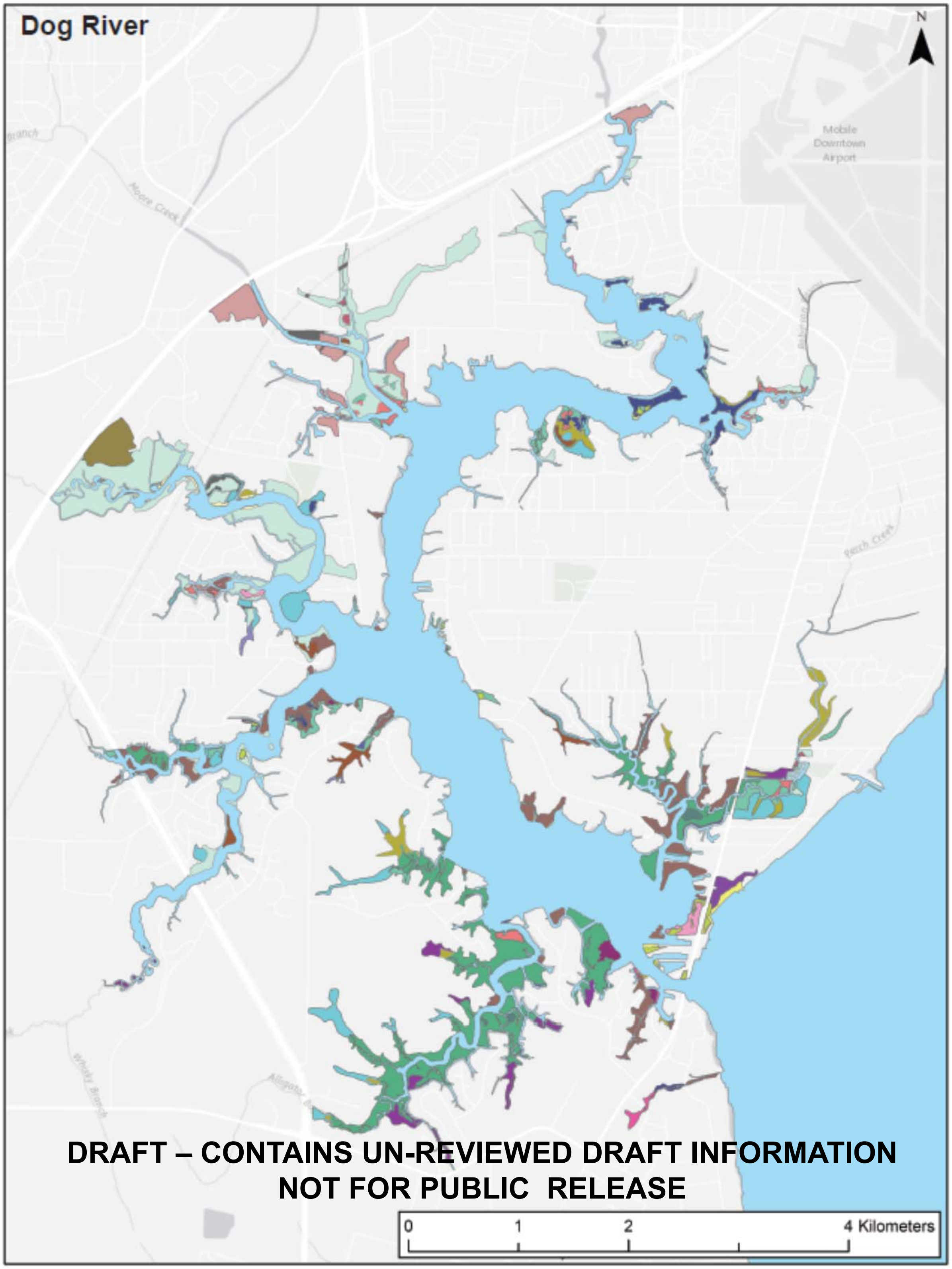

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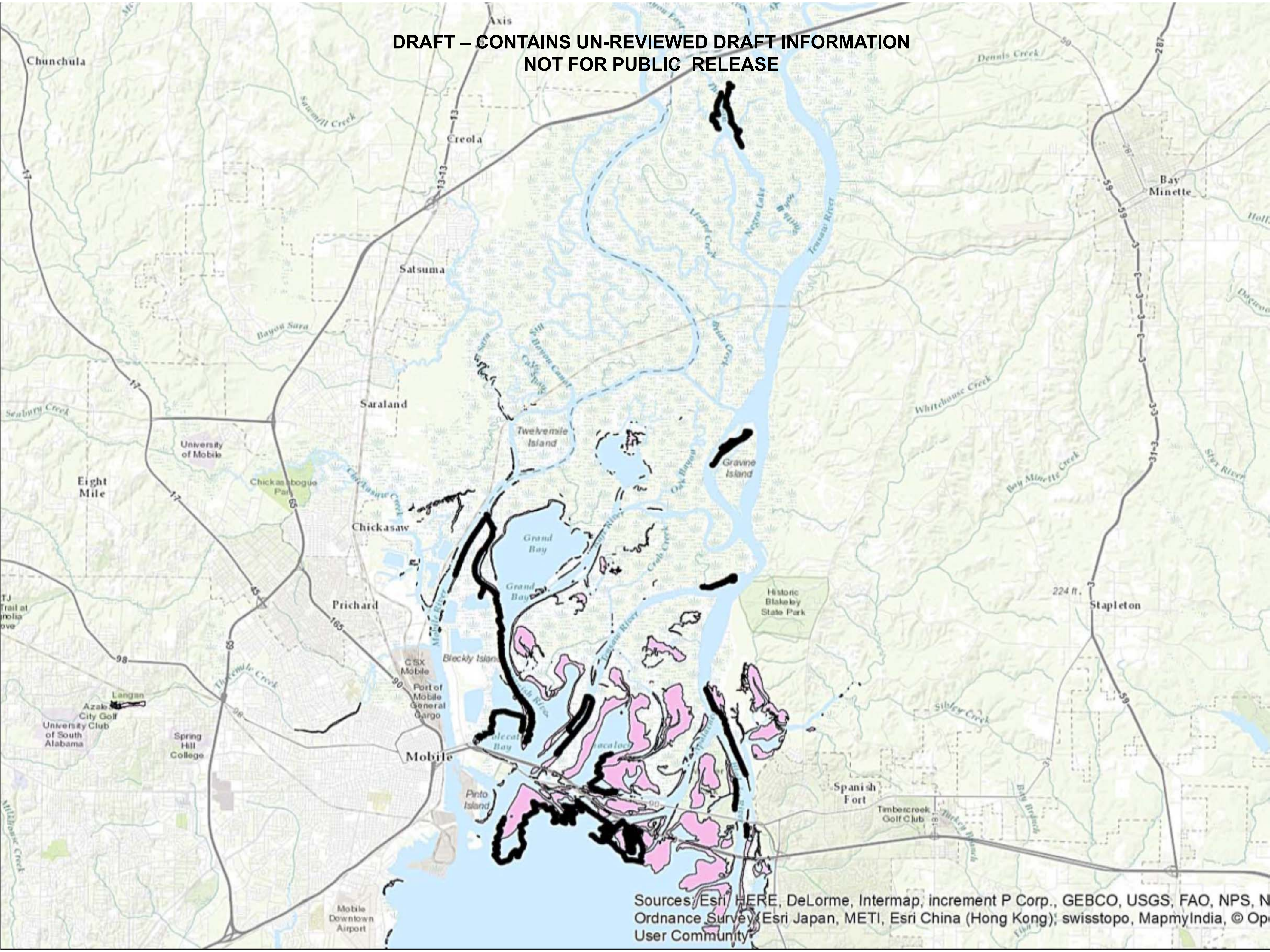

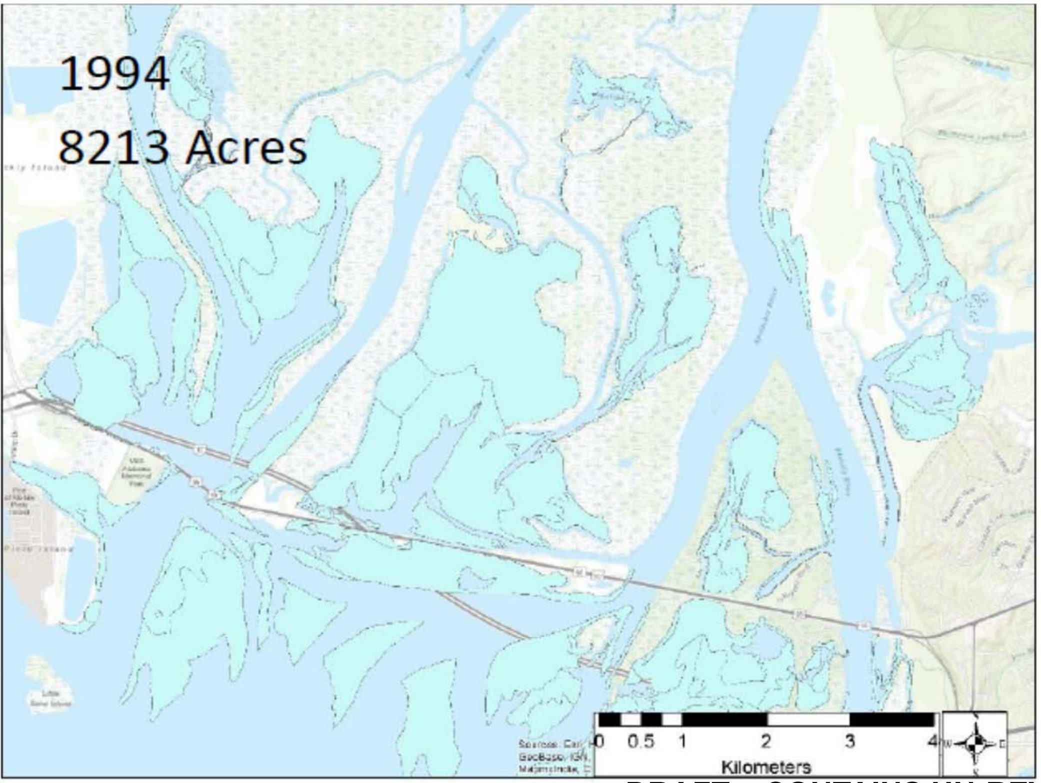

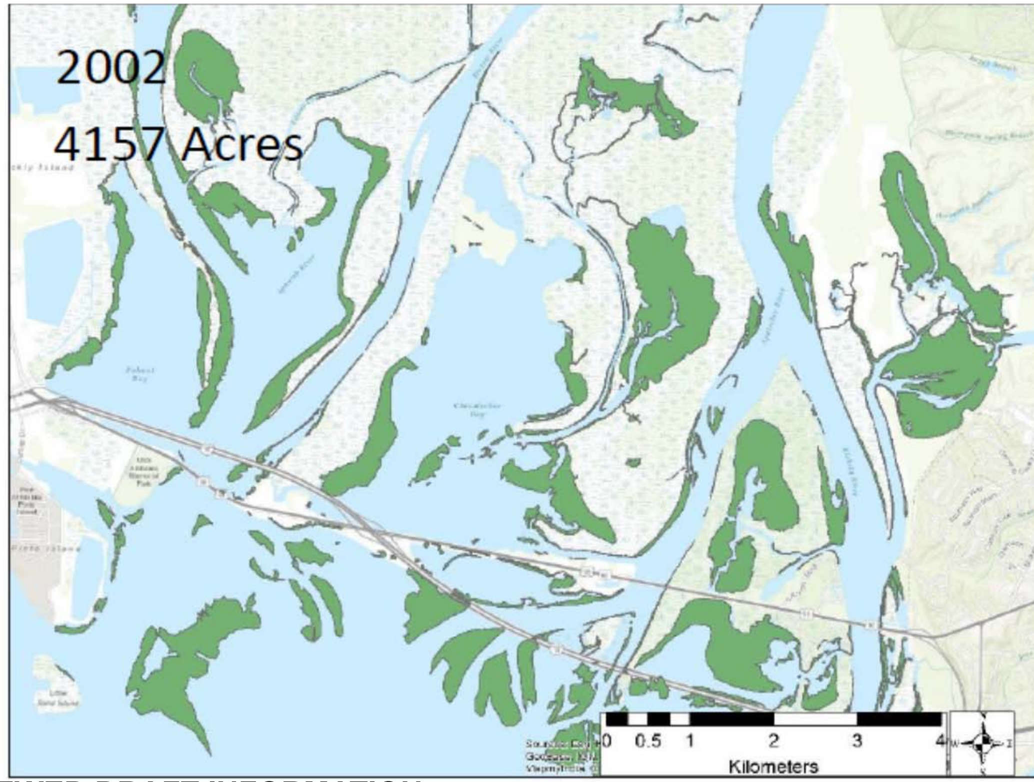

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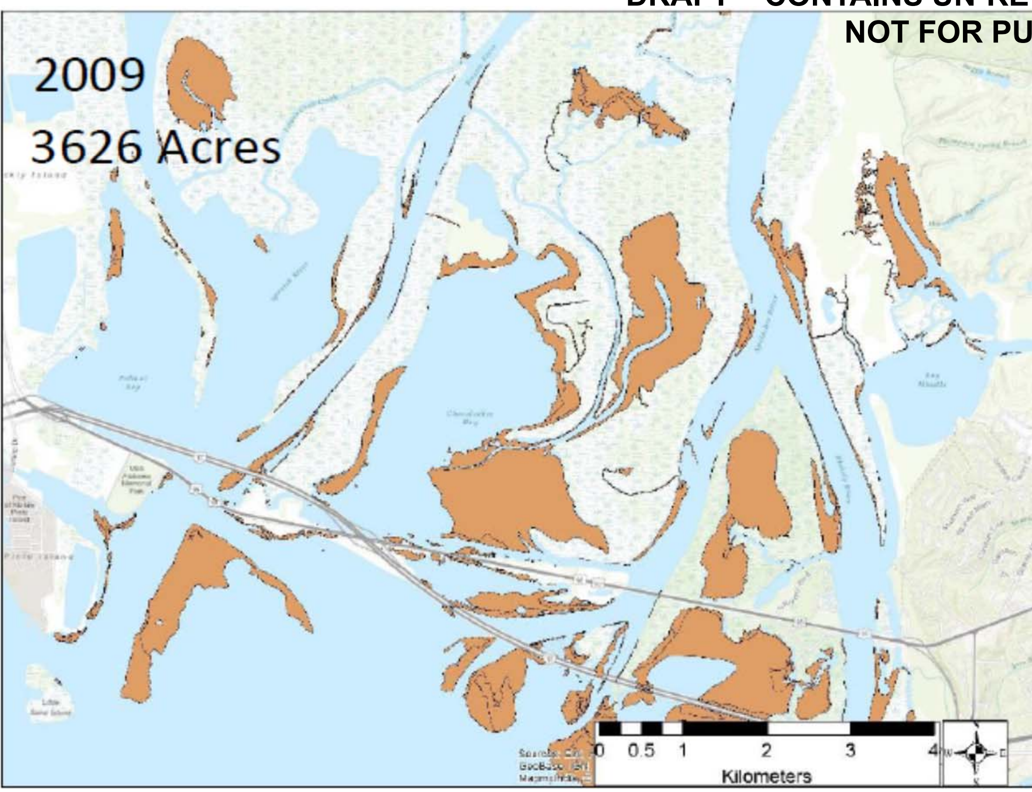

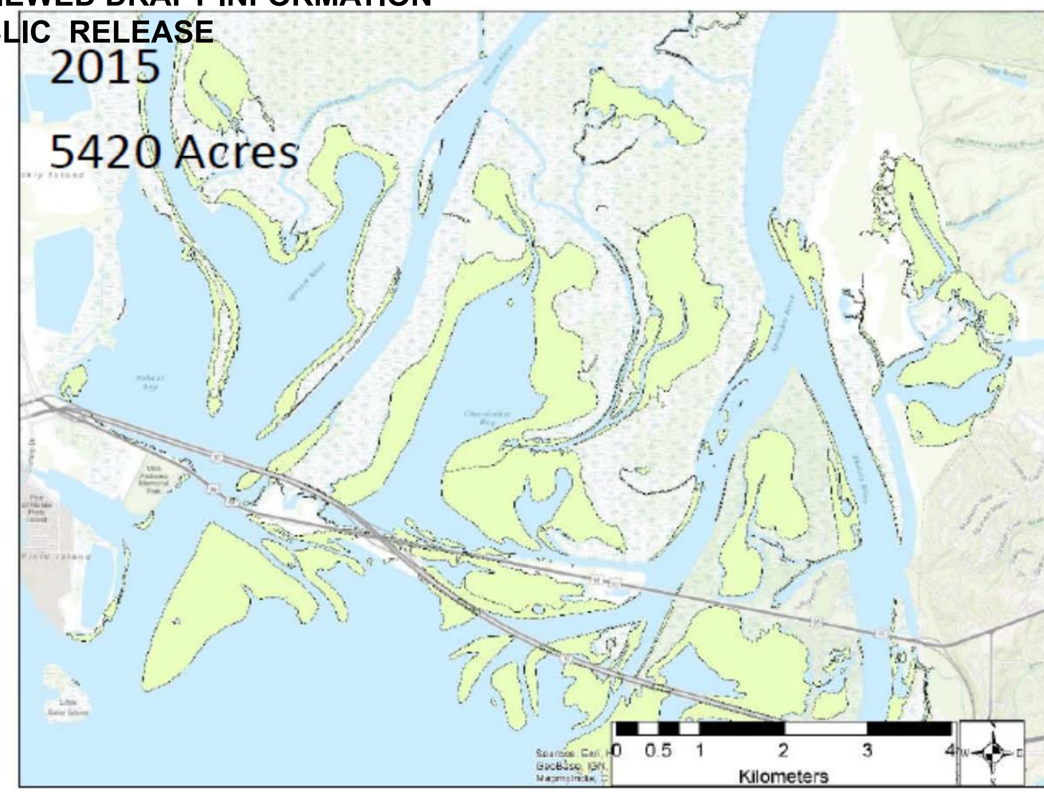

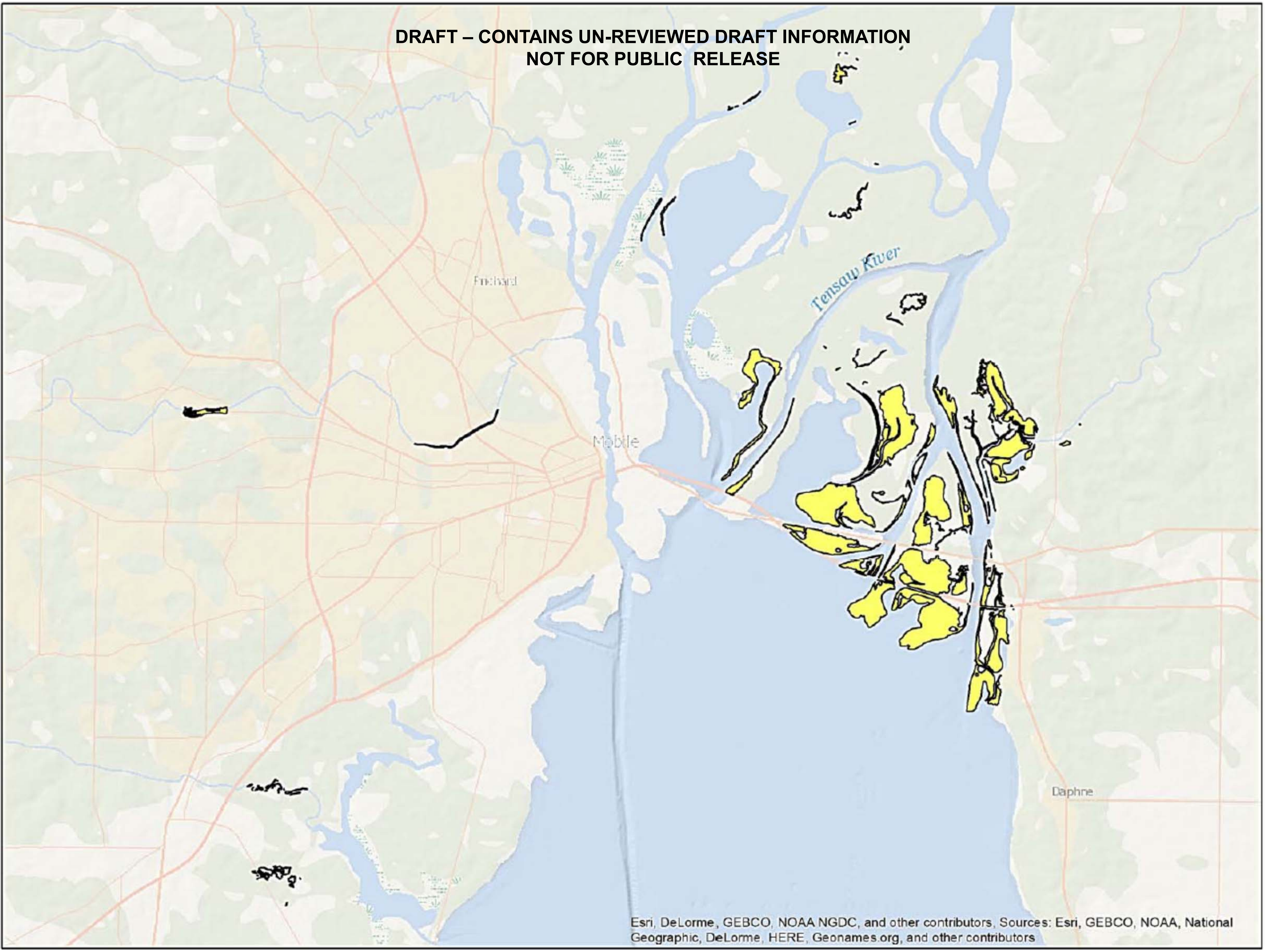

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Tensaw River
Prichard
Mobile
Daphne
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors, Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

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Legend

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- Brookley_Reef
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- oyster_reef_2001
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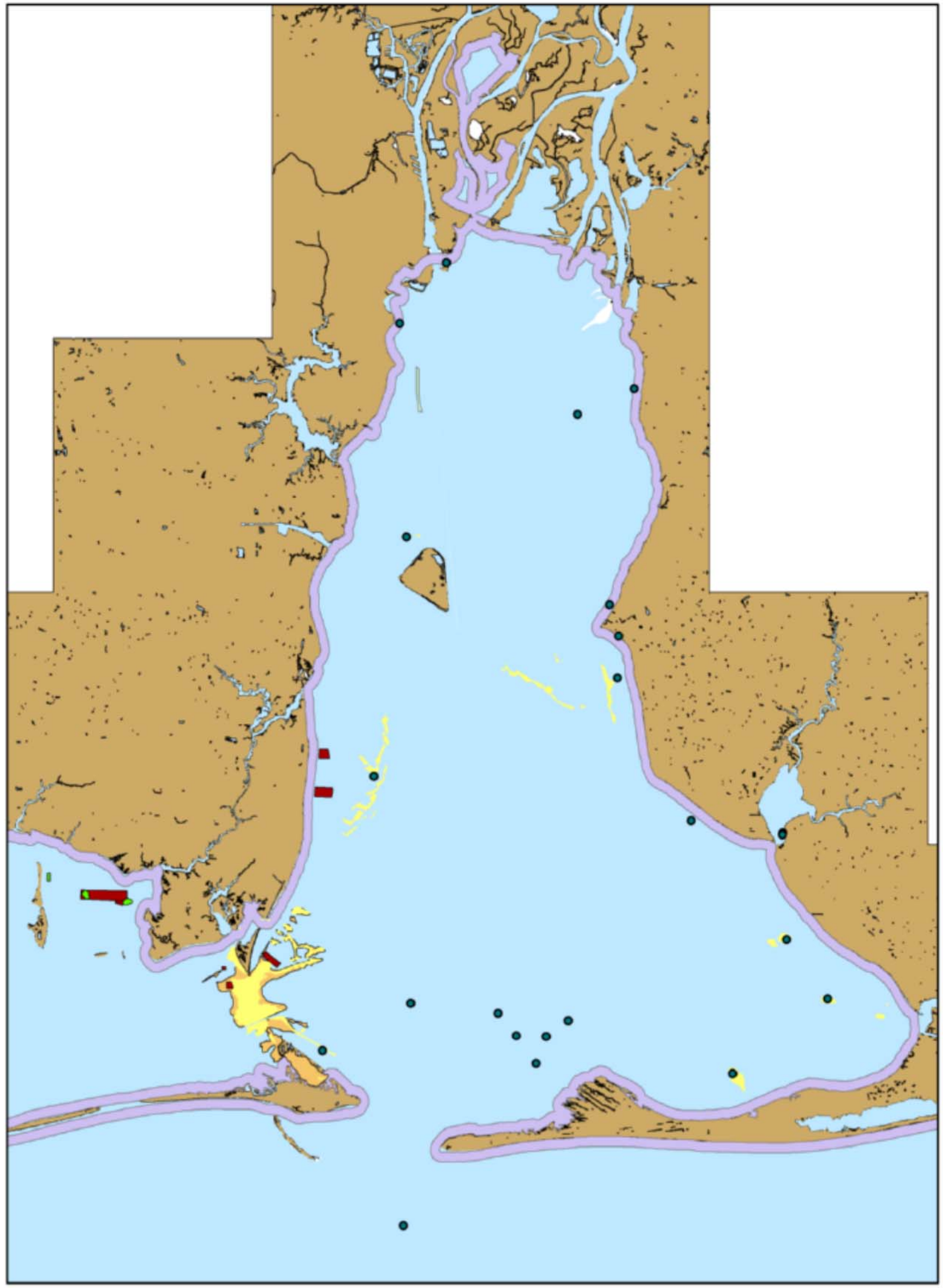
- oyster_zones
- Oyster_1995_survey
- al_rght_Ind_pub_wat_gat_oystr
- AL_oyster_classification_GA14

Land or Water

- Land
- Water



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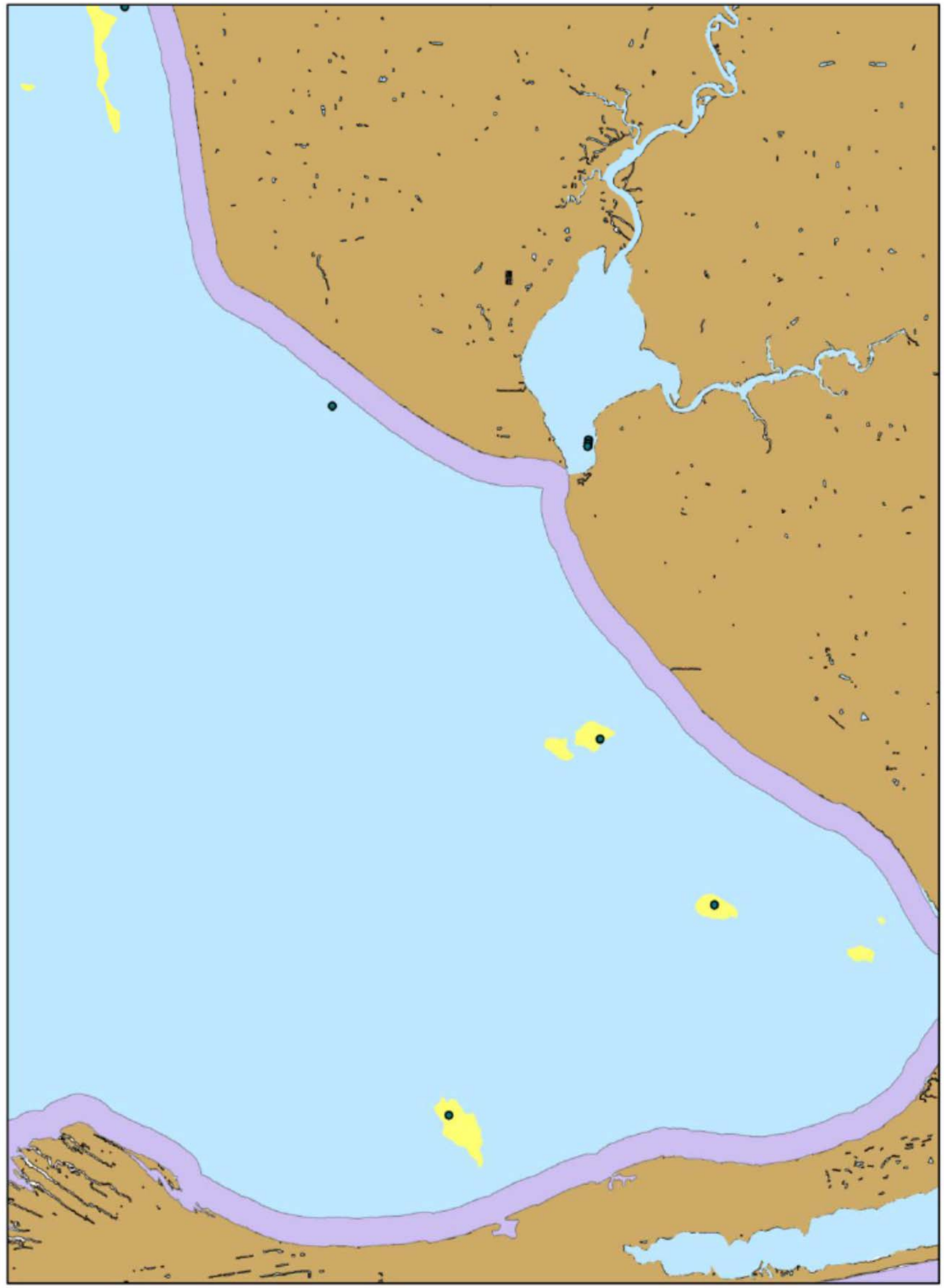

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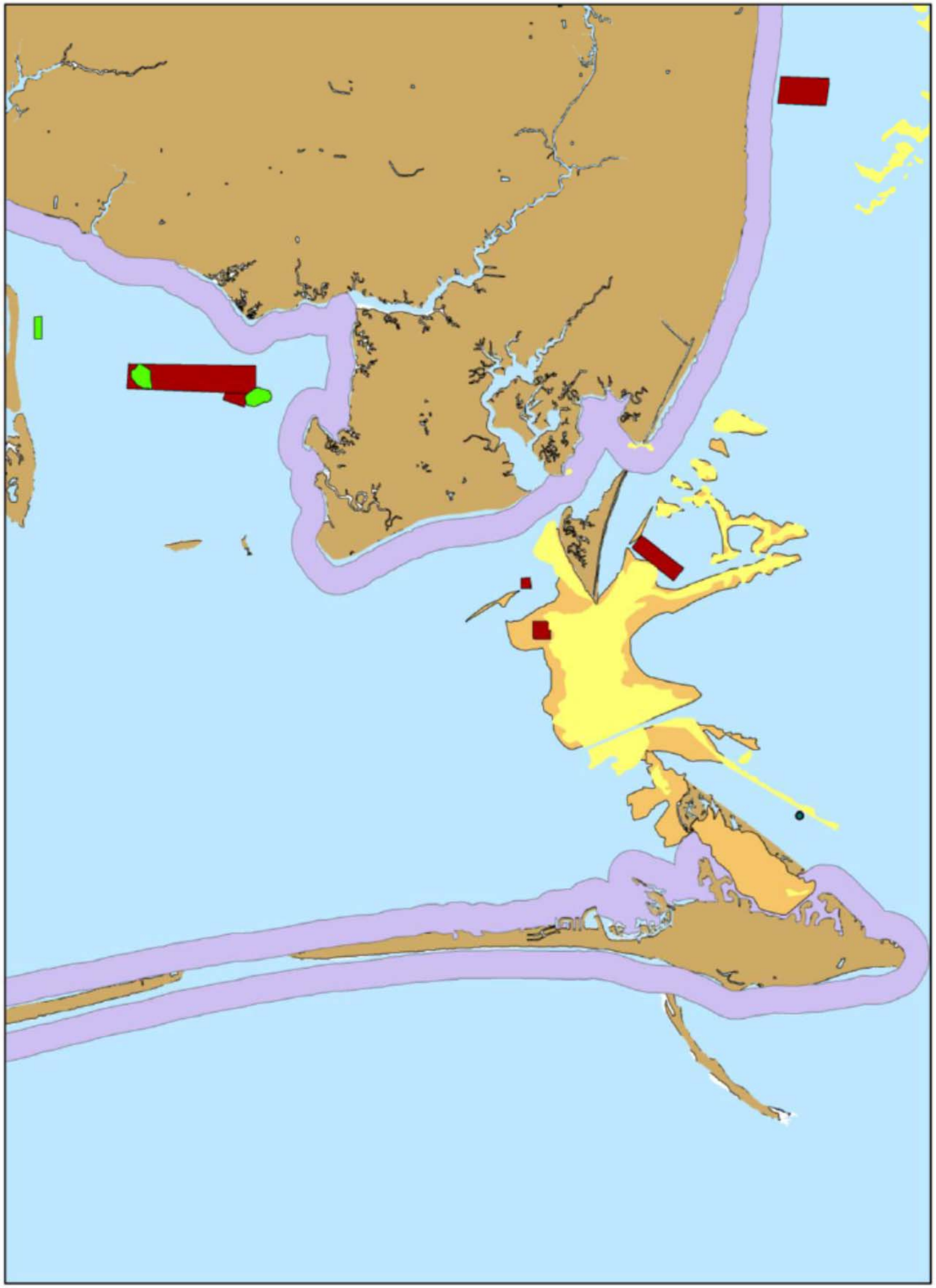

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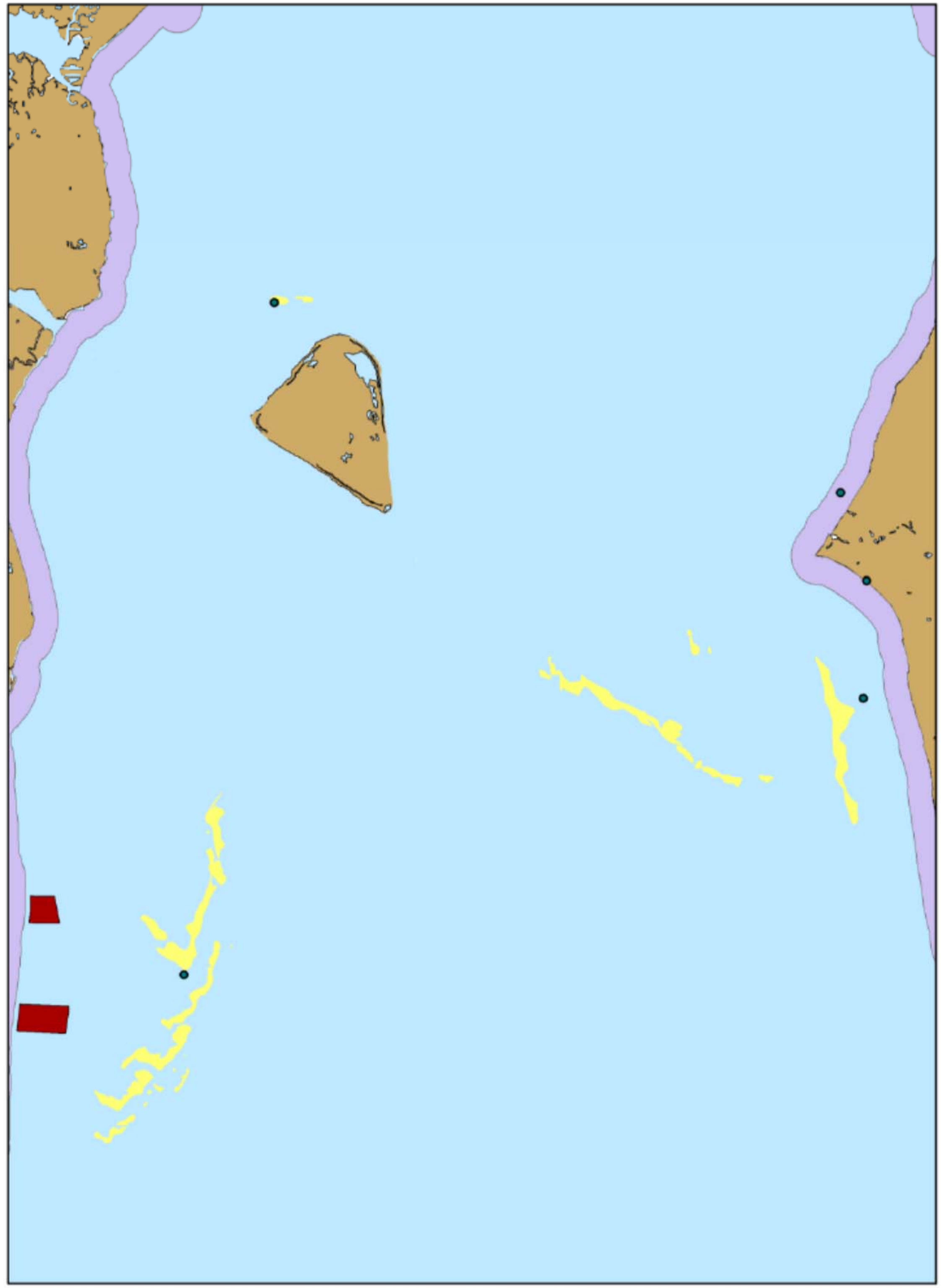

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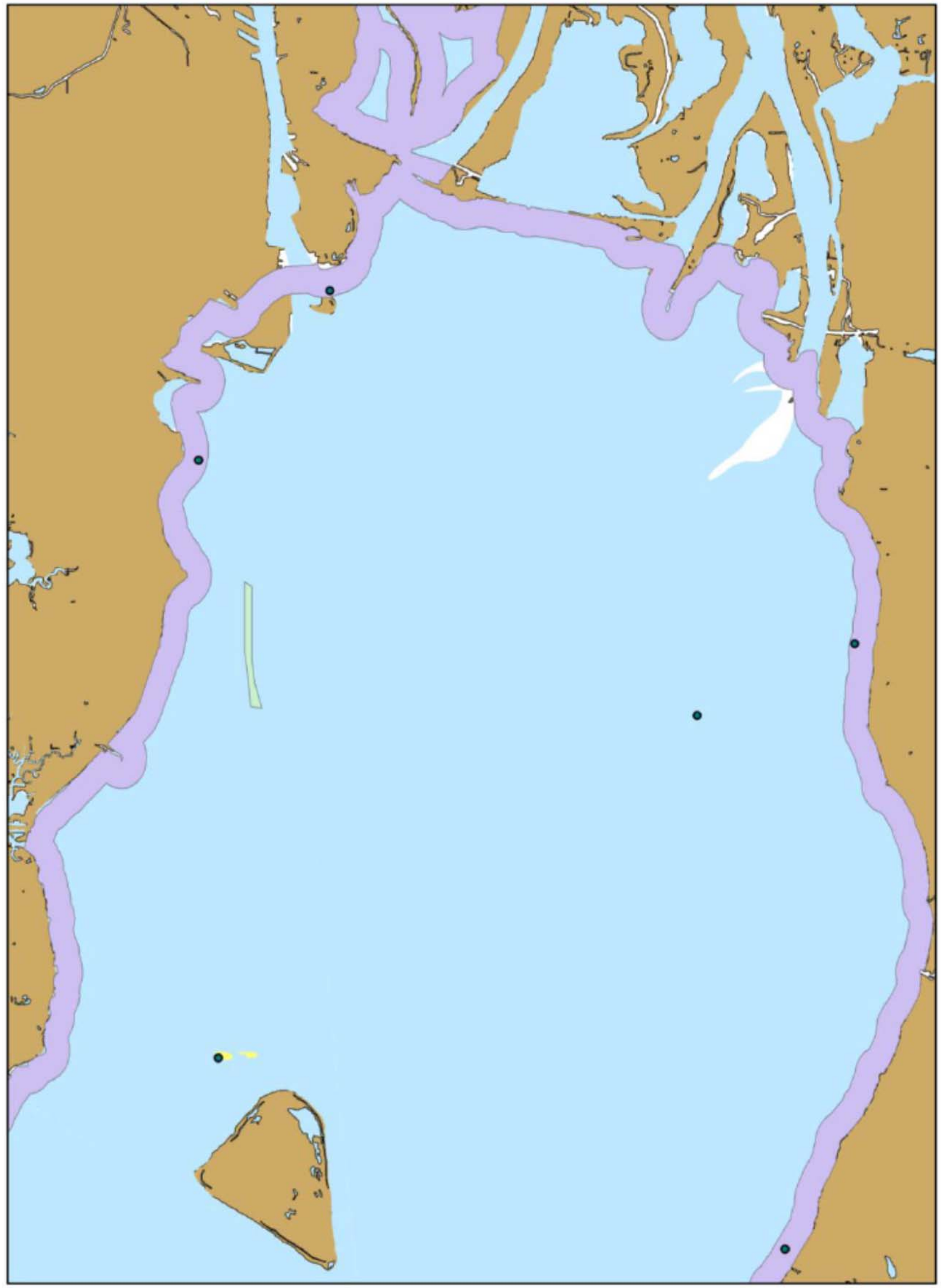

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 29 March 2018

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Meeting for Mobile Harbor General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) regarding preliminary impact assessments

1. On February 15, 2018 the U.S. Army Corps of Engineers (USACE), Mobile District hosted an agency webinar meeting as part of the ongoing agency scoping activities for the Mobile Harbor GRR and integrated SEIS. The purpose of the meeting was to reconvene the team of cooperating federal and state agencies to present and discuss preliminary results for the modeling efforts and aquatic resources impact assessments.

The meeting participants included representatives from the following agencies:

- Alabama State Port Authority (ASPA)
- U.S. Army Corps of Engineers, Mobile District (USACE)
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- U.S. Army Corps of Engineers Corps, ECO-PCX
- Alabama Dept. of Environmental Management (ADEM), Mobile Field Office
- ADEM, Water Quality Branch
- Alabama Dept. of Conservation and Natural Resources (ADCNR), Marine Resources Division (MRD)
- Geological Survey of Alabama (GSA)
- U.S. Fish and Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS), Habitat Conservation Division (HCD)
- Environmental Protection Agency (EPA Region 4)
- Mobile Bay National Estuary Program (MBNEP)
- U.S. Geological Survey (USGS)

The agenda, participation list, and meeting slides are included below.

2. Larry Parson opened the meeting with statements identifying the intent to present and discuss the preliminary results from the modeling efforts and impacts assessments to aquatic resources. After a round of introductions, a project overview was presented

to the group by David Newell which is included in the slides attached below and states that approximately two thirds of the vessels calling on the Port are restricted in some manner and is one of the primary issues for the need of the channel expansion. The study budget and schedule is defined by the USACE's Smart Planning process in which the Mobile District was able to implement an exemption process to increase the time and funds necessary to conduct the necessary modeling and environmental assessments. The GRR/SEIS is a 4 year study with the Draft SEIS to be released for public review in June 2018.

The economic analyses included dimensional ranges from 48 to 50 feet in the main bay channel and 50 to 52 feet at entrance. The study also proposes bend easing with a 3-mile widener of 100 feet in the lower channel and expansion of the turning basin in the upper bay channel just south of the mouth of the Mobile River. The modeling to evaluate potential impacts from proposed channel modifications are based on deepening the channel to 50 feet, plus 2 feet of advanced maintenance and 2 feet of allowable overdepth with a 5-mile widener in the lower bay. Since the actual plan will likely be something less than those dimensions, the USACE feels the habitat assessments represents a worst-case scenario.

Steve Jones from GSA asked why a change in the proposed dimensions? It was stated that modeling was begun prior to completion of the economic analysis. Modifications used in the modeling were considered the most reasonable and likely maximum dimensions. The economic assessment showed the costs to construct a 5-mile widener would exceed the required benefits, however, the project with a 3-mile widener showed economic benefits would be justified. The widener must also be safe and supported by the pilots. Currently, economics justify a NED plan of 51 feet, however, based on a variety of considerations, the maximum depth is not anticipated to exceed 50 feet.

3. Mr. Newell presented three placement sites being proposed for the new work material. A significant volume (5 – 7 million cubic yards) of material from the upper reaches of the channel is being proposed for placement in an area in the northeastern part of the bay where past relic oyster shell mining operations were conducted, resulting in a deepening and degradation of the bay bottom in that area. Larry Parson clarified that the relic mined areas was also one of those previous sites identified in the past during beneficial use discussions with the agencies. The site is considered a beneficial use site but is also the least cost option for the Upper Mobile Bay Material. Placement would be accomplished with a maximum thickness of approximately 3 feet due to the characteristics of the new work material. Volume estimates are based on an average thickness of approximately 1 foot.

Any significant amount of sandy material from the entrance channel would be placed in the Sand Island Beneficial Use Areas (SIBUA) or the Sand Island/Pelican Island complex site. Justin McDonald noted that in the current geotechnical borings there is very little suitable sand in this area. It is intended that the vast majority of the new work material would be placed within the Ocean Dredged Material Disposal Site (ODMDS)

However, to accommodate the new work material, the ODMDS site must be expanded from its current 4.7-nmi^2 area to the proposed 24-nmi^2 area. The USACE is in the process of coordinating the expansion with EPA.

From a geotechnical aspect, we have a considerable about of existing data down to -50 feet with some gaps in the southern part of the bay. The USACE will likely have to collect about 15 additional borings during the study phase but will conduct more borings during the Pre-construction Engineering Design (PED) phase of the project.

Rusty Swafford raised the concern if the USACE has considered how to place various material types in order to address fishermen's concerns regarding mobilization of the finer material compared to clays. Dredging of the material to be placed in the relic oyster mined areas would start at the northern limits and then placed closest to the dredging site. If the USACE sees a need to modify the placement strategy during construction, it will be considered further as appropriate.

Molly Martin from EPA asked if the material being beneficially used in the relic oyster mining area will be tested. The Corps responded that all of the new work material will be test according to the ocean testing manual to assure that it meets ocean disposal criteria.

4. The meeting proceeded to the Modeling portion of the agenda. Justin McDonald gave an overview of the modeling efforts and presented the approach for developing the modeling tools and assessments that was then provided to the environmental group for conducting aquatic resource impact assessments. The modeling conducted includes hydrodynamic, water quality, and estuarine and coastal sediment transport as well as ship wake analysis; some of which is still ongoing.

Hydrodynamic Modeling. Ray Chapman and Sung-Chan Kim of ERDC presented the hydrodynamic modeling and preliminary results. The modeling slides are included below. The purpose of conducting hydrodynamic modeling is to generate water levels, current velocities, and salinities to provide to the water quality and estuarine sediment transport modules. The model also provides a time-averaged salinity to support habitat assessments. The modeling was conducted using a group of models including the Coastal Storm Modeling System (CSTORM) and ADvanced CIRCulation Model (ADCIRC) for regional model forcing to the nearshore modules. The STeady State Spectral WAVE Full Plain (STWAVE-FP) model was used to provide wave fields to the nearshore hydrodynamic and sediment transport modules. The Geophysical Scale Transport Modeling System (GSMB) - Multi-Block Curvilinear Hydrodynamics in 3-Dimensions-Waterways Experiment Station (MB-CH3D-WES) model provided water levels and current velocities.

The model was calibrated for a one-year period of 2010. Additional data from September 2016 from field data collected by USACE, Mobile District within the delta was used to demonstrate the validity of the vertical profiles established to support the environmental assessments.

The information generated and output from the hydrodynamic model required a significant post-processing effort to translate and provide information being used by the environmental team in conducting the aquatic resources impact assessments.

Information generated from the hydrodynamic model was also linked to the oyster larvae transport modeling.

Water Quality. Barry Bunch from ERDC presented the preliminary results of the water quality modeling effort. The purpose is to assess potential changes in water quality including changes in flushing, salinity, dissolved oxygen, temperature, total suspended solids, nutrients and chlorophyll a as a result of the proposed channel improvements. The information generated from this effort was provided to the habitat team for the aquatic resources assessments. This modeling effort utilized the GSMB-CE-QUAL-ICM model which assessed potential changes in water quality parameters listed above.

The model utilized a years-worth of hydrological data from the year 2010 which represents a typical year including periods of both high and low flow conditions used to extract non-average conditions. The results and figures are included in the slides below.

Differences predicted between existing and project water quality conditions are the result of changes in hydrodynamic conditions between the two cases. When there are no quantifiable differences indicated between existing and project conditions, it is reasonable to make the determination that there is no project impact on water quality. Existing and Project simulations were also conducted considering a 0.5 meter sea level rise (SLR) scenario which indicated little to no difference in salinity and water quality conditions when comparing project and existing conditions. This agreement in existing and project conditions occur through the duration of the year-long simulation and is, therefore, reasonable to expect that the project water quality will be similar to the existing conditions.

Several questions were raised concerning the water quality modeling:

- The first question was concerning the depth of the grid in the Bay. The grid has 10 vertical layers so the depth of each layer 1/10 of the total depth in a particular location.

- Is this 2010 data representing a calendar year or water year? The modeling was conducted using data from the 2010 calendar year.

- Does the density flow capture the salt wedge salinity wedge in the bay? Yes the model is set up to capture the salt wedge.

- With the project being modeled at a 54 foot depth (including the 2+2) with the 5 mile widener at 100 foot wide, are there any concerns with a reduced project dimension that will likely be selected as the TSP? The USACE would rather consider the worse-case scenario in determining potential impacts.

- Amanda Howell with EPA asked if they could be provided additional information on the calibration of the Water Quality Model? The USACE will coordinate a separate meeting to more specifically discuss the model calibration.

Barry Bunch informed the group that water quality modeling is slower to evolve compared to hydrodynamic modeling which can be done on an hourly basis if needed. Water quality modeling is looking at many more parameters (6 x more) compared to hydrodynamics.

Sediment Transport. Earl Hayter from ERDC presented the preliminary finding from the sediment transport modeling effort within the bay. The sediment transport slides are included below. The purpose of this effort is to assess relative changes in sedimentation rates within the channel, dredged material placement and surrounding areas as a result of channel improvements within the bay representing a simulation period of 2010. The sediment transport modeling utilizes the GSMB–SEDZLJ model to assess relative changes in sedimentation rates and pathways within the bay as a result of channel modifications.

The modeling also incorporated field data collected in 2016 and 2017 by Richard Allen which included suspended sediment concentrations. The data were used to refine and improve on sediment discharge relationships. The dredging records from 2009-2011 were used to determine the sedimentation rates for that time period. These rates were used to calibrate the model. The calibrated model simulated a shoaling volume of 2.5% less than the historic dredged volume. Increases in average annual shoaling vary from 5 to 15% along the navigation channel with project channel depths.

Joe Long and Davina Passeri from the USGS presented preliminary findings from the coastal sediment transport modeling (Delft 3D modeling) being used to evaluate the potential effects of widening and/or depending of the navigation channel on the ebb tidal shoal and adjacent nearshore coastal areas considering with and without project conditions. The model used a wave climatology derived from hindcast wave model output covering the time period of 1998 to 2016 that consists of representative bins based upon wave height and direction.

There was a good agreement made between observed and modeled wave and water levels near the island and ebb/flood velocities through the passes adjacent to Dauphin Island. The model captured patterns of erosion and accretion along the edge of the channel, near Dixie Bar, and by Pelican Island. Additional sensitivity tests (Hurricane Ivan) were conducted to evaluate tropical storm influence on widespread erosion between the 5 and 10 m contours. The simulations indicated that the difference in bed level changes between project and existing conditions was minimal in the bay and ebb-tidal shoal.

Ship Wake. The ship wave analysis modeling effort was presented by Richard Allen from the Mobile District. The purpose of the ship wake study is to determine vessel generated wave energy propagation from the Federal Navigation Channel for vessel classes having an overall length greater than 400 feet to assess potential impacts to shorelines within Mobile Bay as a result of proposed channel improvements using statistical comparisons of the current and forecasted fleets and channel geometries. Doing this type of study is challenging because there is no existing literature specific to Mobile Bay considering the complex bathymetry and distance from the channel. Vessel generated waves do not follow common wave theories.

Wave gages were installed at 5 sites and were able to collect information for a period of 62 days (11/18/2017 to 01/19/2018) as shown in the slides below. Information was also collected from the Coast Guard for specific vessel input/output.

After processing the existing data, the next steps will look at statistical differences and anticipated changes in vessel fleet calling upon the port. The analysis will compute the correlation between dimensionless vessel parameters and vessel generated wave energy, spatial orientation, vessel direction, speed, and climatology. This will then be used to develop a "predictive" method to forecast future vessel generated wave energy and determine the statistical difference in vessel generated wave energy and background wave energy. Statistical comparisons of current and forecasted vessel wave energy will then be developed.

Other general discussions related to the analysis included how the ships in general are using the channel. Mobile Harbor channel is basically restricted to one-way traffic. Passing is allowed in some incidents, however, engineering evaluations become challenging when three or more vessels are being brought in a rapid succession. The pilots currently have rules that 2 panamax are not permitted to pass. Under the specific circumstances, some ships do pass but the rules become more restrictive with increase ship sizes. Patric Harper of the FWS expressed concerns about possible erosion along the mid-bay shoreline and possible impacts to property owners and living shorelines due increases in ship sizes. John Mareska from the ADCNR, MRD expressed concerns of erosion on the shoreline of Little Dauphin Island.

Economic analyses has shown that the future fleet will continue to come without the project but will access the Port by light-loading. Demand stays the same with the project but ships will be able to access the Port without having to light-load, which may result in less ships calling on the Port. Rusty Swafford from NMFS pointed out that a deeper channel in theory will also cause displacement of more water.

5. Habitat Impact Assessments. The next portion of the meeting pertained to discussions on preliminary results of impact assessments conducted for the aquatic resources of concern associated with the proposed channel modifications. The slides presented during the meeting are included below. Jacob Berkowitz from EDRC oversaw this effort and presented the results of this effort and led subsequent discussions. Outputs from the models described above were used by the ERDC team to assess impacts to resources which included wetlands, submerged aquatic vegetation

(SAV), oysters, benthic invertebrates, and fisheries. This is an extensive collaborative effort to compile existing data and field data observations and ground truthing information. Significant assistance from the State of Alabama providing vital communications, information on state-listed species encountered in field mapping efforts, GIS data files on wetland and SAV mapping efforts, water quality data, and information from their fish assessment and monitoring program (FAMP). As a result of guidance received from past agency meetings, it was determined that the study should focus on the five resources listed above. The assessments of these resources utilized the outputs from all the previously described modeling and also considered the effects of SLR.

Considering the results of the models, a grid of the study area was established consisting of 30 blocks. The blocks were further divided into cells totaling 48,000 cells over the entire study area. The resource assessments also considered a SLR scenario of 0.5 meters over a 50-year period. Each resource was approached differently, for instance, the SAV considered bottom salinities and while wetlands considered upper water column conditions. The study considered the average salinities using data for the year 2010. Conditions over the 75th percentile were also considered in order to capture the more extreme conditions over the course of the year.

Wetlands. The wetland assessments compared existing and project conditions with and without SLR. The effort mapped 43 wetland community types utilizing existing data and 800 on-site samples to generate high resolution mapping of 77,000 acres of wetland within the project area. All products produced from this study will be available to the agencies as well as other organizations. Once the mapping was completed, each species was evaluated for water quality tolerances (particularly salinity) to identify their environmental thresholds. This was accomplished through a literature review. A tiered approached first considered long term studies conducted within the local area then followed by long term studies anywhere outside the study area. Salinity tolerances were assessed to determine if mortality of plants or reduced productivity would occur as a result of the proposed channel modifications. When considering the delta areas as shown in the slides, there are no significant salinity changes predicted in the upper reaches and a potential increase of 1 part per thousand (ppt) in the lower reaches, which is well within tolerance for those species. This block was selected because it is considered to be the most sensitive to these types of changes.

The wetland assessments looked at the upper 1/3 of the water column and upper foot. Based upon anticipated depth, wetland losses are not anticipated based on average conditions. Looking at the 75th percentile approach for the extreme conditions, which is considered a conservative approach, there is a potential for a minor and temporary vegetation shift within some wetlands of approximately 600 acres based on a short term productivity reduction. It must be considered that these wetlands are not monotypic but rather have multiple species. Thus, there would be no losses in wetland or wetland functions anticipated resulting from project conditions. There does exist a potential over time to see a 10% reduction of productivity of some species within a wetland type. This reduction would likely be filled by another species within that wetland vegetation type. Therefore, there would be no shift in wetland types (freshwater to estuarine, etc.) but there may be some vegetation changes overtime within a wetland type. When applying the 0.5m SLR scenario, it becomes apparent that there will be inundation of wetlands, however, when adding the project on top of the projected SLR the differences are negligible.

Rusty Swafford from NMFS stated that the results seen from this study are consistent with that seen from the Houston Ship Channel expansion. There have not been any observed losses of wetlands due to salinity and no mitigation was recommended based on predicted salinity changes.

Submerged Aquatic Vegetation. The approach used for evaluating the SAVs was similar to that used for the wetlands. Historic mapping efforts and field ground truthing was used to create an updated map of the SAVs for Mobile Bay. The SAV salinity tolerances were established based upon literature review. When examining tolerances from different areas, if the data showed that salinity in the Mobile Bay was different from other areas, the values for Mobile Bay were used. The maps generated identify where the various specifies of SAVs are located but are not able to specify the mixture of species. Subsequently, where there are beds of mixed SAV species, the most sensitive species are identified and used to evaluate potential impacts of salinity changes. The study assessed the impacts using a georeferenced database by identifying areas where the “with project” increased salinity above baseline adjusted tolerances. Preliminary results indicate that SAV tolerances were not exceeded when considering project conditions. There were some impacts predicted for the Eurasian watermilfoil which is considered an invasive species and not of particular concern. Potential minor effects were predicted for approximately 13 acres of wild celery and coon’s tail over short time periods. Other sources have documented that the wild celery can tolerate salinities up to 25 ppt and the coon’s tail can tolerate salinities of up to 12 ppt in pulses of less than 7 days in duration. The monthly salinity data is being evaluated to see if these conditions were exceeded.

Although the study looked at the whole year, the information presented at this meeting represents the month of October because this month exhibits the most extreme salinity ranges for that year, and would have the largest impact on species distribution. The figures show mapped SAV beds from fall 2015.

Dissolved oxygen (DO) would only have an impact if there were areas with very low, persistent DO that caused stress to the SAVs. Preliminary results indicate that DO with the project does not get low enough to have an impact.

There were subsequent discussions on evaluating SLR as compared to the baseline and project conditions. Evaluations were conducted considering the effects of SLR on the SAVs. No differences were predicted between the existing and project conditions on top of SLR. SLR alone would likely cause a shift in SAVs, however, the project on top of the SLR did not indicate any differences. Patric Harper raised a concern that the impacts of the project on top of SLR could cause a tipping point. The preliminary results has not predicted any tipping point thresholds.

Justin McDonald clarified that the USACE is considering the relative SLR of 0.5 meters based off USACE intermediate curve projections over a 50-year horizon. If something greater than that were used, then SLR would drown out any impacts that the project could ever cause.

John Mareska of DMR expressed that SLR would anticipate a large increase in the influx of freshwater rivers from melting of polar cap. A discussion followed that if there could actually be an increase or decrease in salinity due to SLR. At this point in the study, the USACE does not see any difference between the existing and project conditions with SLR. Justin Rigdon from the ADEM Water Quality branch stated that it's not surprising that we are not seeing much changes in salinity because the channel depth increase being modeled is not that great. We're not starting with a bay without a channel and building a brand new channel, we already have a bay with a channel and modifying it a little.

<u>Oysters</u>. The meeting continued with presenting the preliminary results of the oyster impact assessment. This assessment used an integrated models that included hydrodynamics, water quality, and oyster behavior models to conduct oyster larvae particle release and fate simulations for determining potential oyster mortality and flushing of larvae from Mobile Bay. The analysis includes both the Brookley Reef and Cedar Point Reef which are considered to be the most vulnerable and sensitive reefs in the bay.

The study also considered minimum existing levels of DO and if there were any circumstances where DO levels where outside the oyster tolerances. The oyster larvae particle tracking model predicted zero mortality under all salinity scenarios and DO levels stayed well above minimum oyster tolerances as a result of post-project conditions. SLR scenarios also predicted no oyster mortality with no increases in larvae flushing between project and existing conditions.

The models are currently running with a release of 42 particles (oyster larvae) to determine the particle settlement and mortality. The models predict that 41 of the particles are able to settle and not be lost from the bay. The agencies expressed the concern that it doesn't make sense that there was a release of 42 particles and 41 of those particles settle and attach. It was explained that attachment does not necessarily mean settling to the bottom and becoming an adult oyster. It simply means that those particles were not flushed and were retained in the bay. The agencies also requested that the number of days that the oysters are transferring/not attached needs to be included in the results.

Kevin Anson from MRD expressed that the SLR scenario also predicts no oyster mortality. There is a concern that higher salinity conditions favor the oyster drill and drought conditions, salinities may be more favorable to the oyster drills which prey on oysters. Could SLR provide conditions that are more favorable to the oyster drill that could change mortality rates for adult oysters? Overall oyster model includes behavior such as how many oysters will die and it is recognized that there are other factors.

Benthic Invertebrates. The macro-benthic invertebrate sampling and analyses took advantage of the various works that already existed for Mobile Bay. 240 benthic samples were collected in three different habitat zones representing freshwater, transitional, and upper bay habitats in the fall of 2016 and spring of 2017. Sampling within these habitat zones ensured that information was collected for the most sensitive habitats that could potentially be effected by the proposed channel modifications. The statistical analyses examined whether benthic macrofauna differed among habitat types and determined how the macrofauna were related to salinity in these zones. Locations of changes in macrofauna communities were identified in correlation to the habitat types. Salinity changes associated with the channel deepening and widening were modeled for each sampling station and predicted changes were evaluated for the fall and spring conditions. At the most basic level, habitats with a saltwater influence are dominated by polychaete worms and freshwater habitats are dominated by oligochaete worms and insects.

The modeling shows that the degree of freshwater inputs from the rivers rather than saltwater influx from the bay dictates the species transition locations for the habitat types and that the location of transition to a freshwater benthic community (orange ovals shown on slide) will remain similar to baseline conditions. The modeling did not identify any benthic impacts due to changes in DO. Subsequently, there will not be a significant shift in the benthic communities associated with the project. Additionally, impacts to higher trophic levels (e.g., fish) associated with prey availability appear negligible because prey distributions are unlikely to be affected.

A question was raised concerning the effects of the benthic communities in open water placement areas such the relic oyster shell mining area. A similar situation was encountered associated with the Houston Ship Channel. Studies were conducted by ERDC and Galveston Lab and determined that the benthic communities typically recover within 18 to 24 months. Similar results were seen from thin-layer studies conducted in Mobile Bay and Mississippi Sound.

Fish. The fisheries evaluations are built upon data provided by the MRD over a 10-year period from the FAMP. ERDC used the FAMP data supplemented with additional targeted sampling in the bay, delta, and river habitats. A 500 meter buffer was established at each sample station from existing sites with a model grid for evaluating bottom and mean salinity values. Using this approach, the sampling included approximately 98,000 individual fish comprised of 140 species.

The habitat types and salinity tolerances were considered for each species which linked salinity and abundance of species to baseline conditions. The preliminary results of the modeling and analysis predicts that there would be no impacts expected from the project due to salinity increases of less than 5 ppt and that no impacts would be expected due to freshwater or euryhaline species habitat availability upstream. For resident estuarine or euryhaline species, no impacts would be expected due to the high range of species utilization across salinity gradients. Considering marine species entering the bay and resident marine species, no impact are expected due to available bay and marine environments.

The MRD identified a potential issue concerning some of the samples they provided were only taken in one period of time, specifically during summer season. ERDC will be coordinating this with the MRD

Summary of Aquatic Resources Assessments. In summary, the baseline resources were identified across the five aquatic resources including wetlands, SAVs, oysters, benthic invertebrates, and fish. Water quality thresholds were established for each resource within the different habitat zones (freshwater, transitional, and estuarine). The modeling and impact assessments have predicted no major impacts (i.e., loss of resources) anticipated under the post-project conditions. Additionally, post-project impacts remain negligible under 0.5 meter SLR scenario.

6. The meeting proceeded by querying the participating cooperating agencies if they feel the USACE is going in the right direction with the study and if they perceive that there is anything we need to address prior to the release of the draft report. Generally, the agencies concur with the approach taken on the modeling and resource assessments. However, some concerns were raised that should be addressed prior to finalizing certain aspects of the study.

The MRD expressed concerns regarding the presentation of the DO data coming out of the water quality modeling. The MRD has data from 2015 and 2016 that indicates DO levels associated with existing oyster reefs at 5 sites in Mobile Bay. These data are not consistent with the DO outputs from the water quality model. MRD will be providing the data to the USACE. The USACE will look into this issue and coordinate with the MRD.

The MRD also expressed that the public would want to see impacts on the lower bay and that they would be interested in salinity and effects on shoreline. The USACE explained that they did not sample in the lower portion of the bay because the lower bay already exhibits full salinity rages and the resources are already subject to high salinity conditions.

There are concerns about the shoreline effects on properties resulting from the potential of increased ship wakes. The USACE should at least convey that they are evaluating such impacts to shorelines. When USACE has completed the ship wake analysis, the energy tolerances for resources such as wetlands and SAVs should be addressed. USACE is still in the process of conducting the ship wake study and will consider impacts to wetlands and SAVs in the final analysis.

Kevin Anson from MRD expressed concerns of the 0.5 meter SLR defined over a 50-year period. He would like to see if there is a way to shorten this timeframe because some of the population is not concerned with looking that far in advance. The USACE responded that the study goal is to look at impacts from the proposed deepening and widening of the channel and are required to include impacts from SLR since it is accepted that it will occur regardless.

7. Larry Parson concluded the meeting with final discussions on potential mitigation requirements base on the results presented at this meeting. Based on the minor predicted impacts relating to changes in the hydrodynamics, water quality, and sediment transport, the cooperation agencies in attendance felt that mitigation measures would not be necessary. Similar impacts were observed for other studies where there was the potential for a minor shift of vegetation within a specific wetland type but no real loss to the wetland. It would not be reasonable to pull out the specific impacts within that specific wetland type and mitigation was not required. The group recommended that the results of the ship wake analysis be fully considered for potential effects on shorelines and resources before a final determination on mitigation requirements can be made.

8. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/s/ Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Draft copies were furnished for comment to all meeting participants.

Cooperating Agency Meeting
Mobile Bay General Reevaluation Report (GRR)
Supplemental Environment Impact Statement (SEIS)

February 15, 2018
9:30 – 3:00 Central
International Trade Center
Mobile, Alabama

Preliminary Results for the Modeling and Impact Assessments Agenda

Introductions

Project Overview

Preliminary Modeling Results and Discussions
- Hydrodynamics
- Water Quality
- Sediment Transport
- Ship Wake

Habitat Impact Assessment Preliminary Results and Discussions
- Wetlands
- Submerged Aquatic Vegetation
- Oysters
- Benthic
- Fish

Mitigation Concepts

Next Steps

Mobile Harbor GRR Agency Webinar – List of Participants

Cooperating Agencies
Bob Harris (ASPA)
Judy Adams (ASPA)
John Mareska (ACDNR, MRD)
Scott Bannon (ACDNR, MRD)
Kevin Anson (ACDNR, MRD)
Stephen Jones (GSA)
Allen Phelps (ADEM)
Justin Rigdon (ADEM)
James Mooney (ADEM)
Glen Higdon (ADEM)
Molly Martin (EPA)
Amanda Howell (EPA)
Ntale Kajumba (EPA)
Josh Rowell (FWS)
Patric Harper (FWS)
Rusty Swafford (NMFS)
Tom Herder (MBNEP)
Joe Long (USGS)
Michelle Myers (USGS)
Davina Passeri (USGS)

Corps of Engineers - ERDC
Jacob Berkowitz
Dara Wilbur
Barry Bunch
Ray Chapman
Earl Hayter
Todd Swannack
Safra Altman
Sung-Chan Kim

Corps of Engineers – Mobile District
Curtis Flakes
Lekesha Reynolds
Jennifer Jacobson
Justin McDonald
David Newell
Elizabeth Godsey
Richard Allen
Joe Givhan
Larry Parson

Corps of Engineers ECO-PCX
Nate Richards
Greg Miller

Harbor General Reevaluation Report Overview

15 February 2018

US Army Corps of Engineers

U.S.ARMY

MOBILE HARBOR DEEPENING AND WIDENING

"Modernizing the Port of Mobile is necessary because 2/3rds of the Port of Mobile's vessel traffic today is restricted or delayed directly impacting shipper costs and competitiveness."

- James K. Lyons, ASPA Director

Full Service Seaport
- ✓ 10th Largest in the U.S.
- ✓ 58M+ Tons of Cargo Handled Port-wide

Growth Steadily Climbs
- ✓ Record 2017 20% Container Growth
- ✓ Ranked #2 Steel Port in U.S.
- ✓ Ocean Carriers continue to add service

Strong Exporter of U.S Materials and Goods

Contributes Significantly to the Economy
- ✓ 153,000+ Jobs
- ✓ $25.1B in economic value

GENERAL REEVALUATION REPORT SCHEDULE

US Army Corps of Engineers

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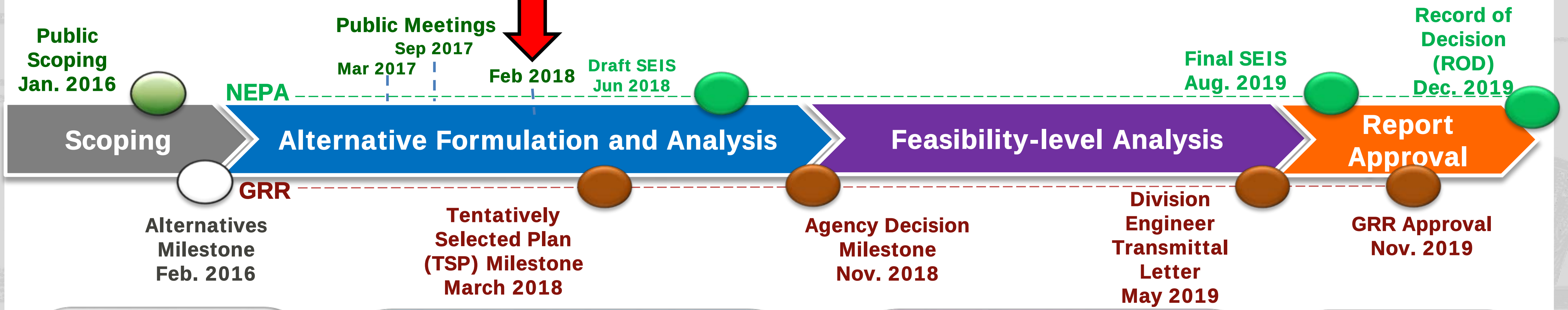


- Identify study objectives
- Define problems & opportunities
- NEPA scoping
- Inventory & forecast
- Formulate alternative plans
- Evaluate alternatives & identify reasonable array

- Develop the “Future without Project Condition”
- Analyze, evaluate and compare alternatives to identify TSP
- Prepare the Draft Integrated GRR and SEIS
- Vertical team concurrence on tentatively selected plan
- Release Draft Integrated GRR/SEIS report review (Public, Agency, HQ)

- Respond to comments in the SEIS
- Agency consultation activities
- Agency endorsement of recommended plan
- Prepare the Final Integrated GRR and SEIS
- Final integrated report package transmitted to Corps Headquarters

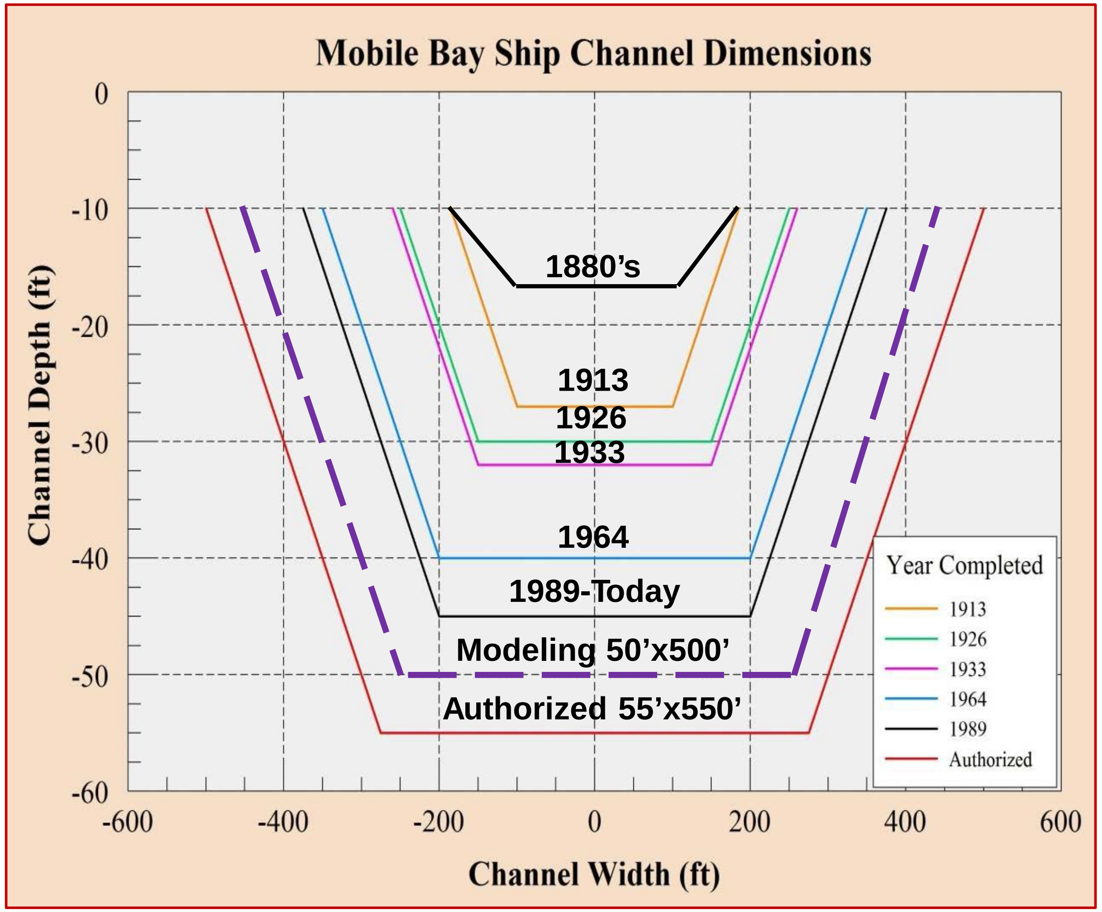
- Headquarters’ review of final report
- Final SEIS; Alabama state and Federal agency review
- GRR approval
- Record of Decision signed

MOBILE HARBOR GENERAL REEVALUATION REPORT

US Army Corps of Engineers

U.S. ARMY

4-year $7.8M STUDY
Began Nov 2015 Complete Nov 2019



Current Measures Under Consideration

- Deepening: 48' to 50'
  (50' to 52' at entrance)
- Widener: 100' (3 miles)
- Bend Easing
- Turning Basin Modification

Tentatively Proposed Placement Locations

- Formerly mined relic shell area
- Sand Island Beneficial Use Area (SIBUA)
- Pelican/San Island Complex
- Ocean Dredged Material Disposal Area Site (ODMDS)

Release of Draft Supplemental Environmental Impact Statement scheduled for June 2018

US Army Corps of Engineers

MOBILE HARBOR PROJECT

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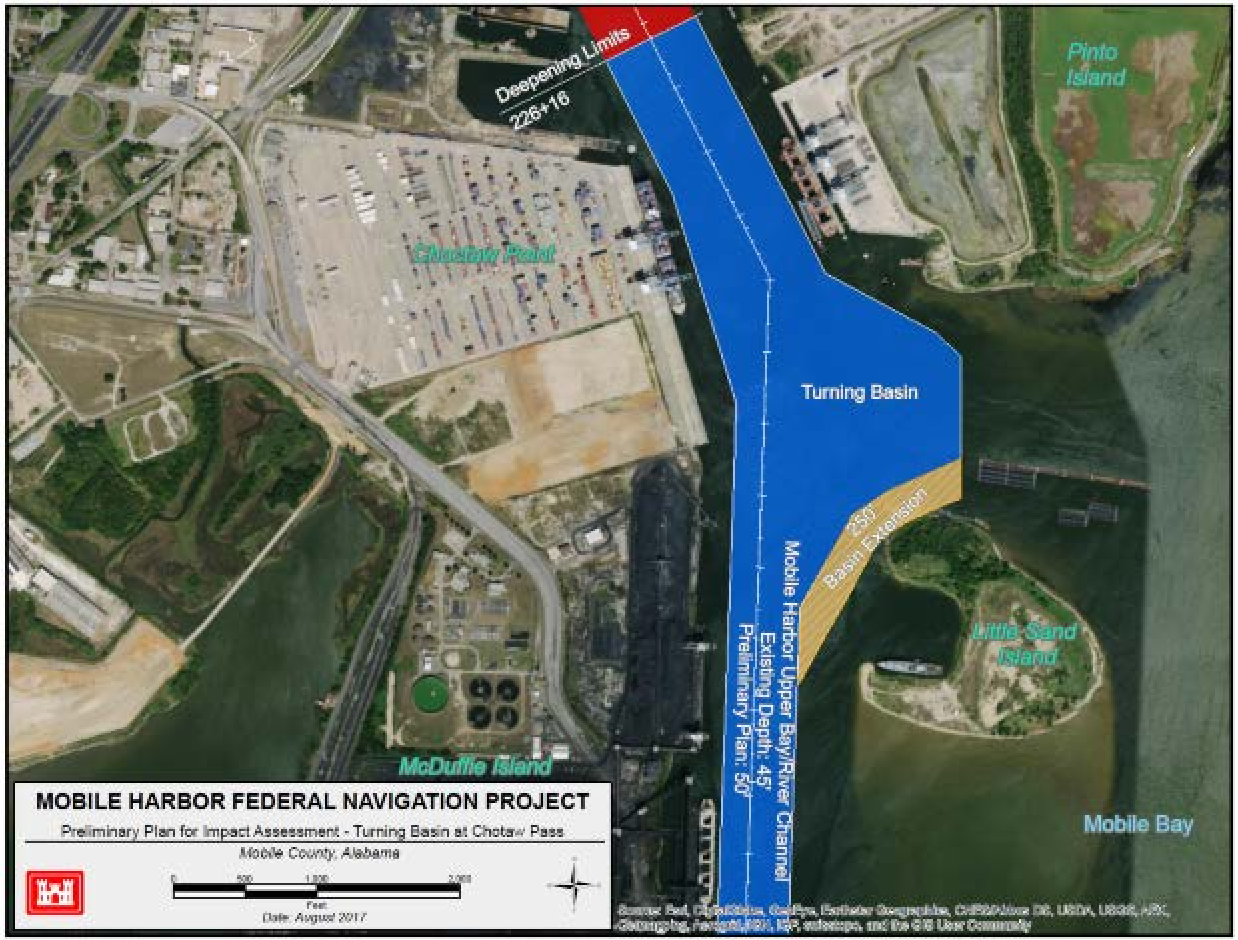
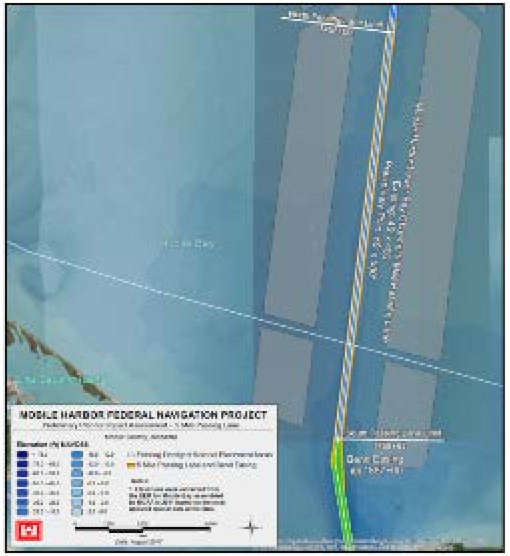
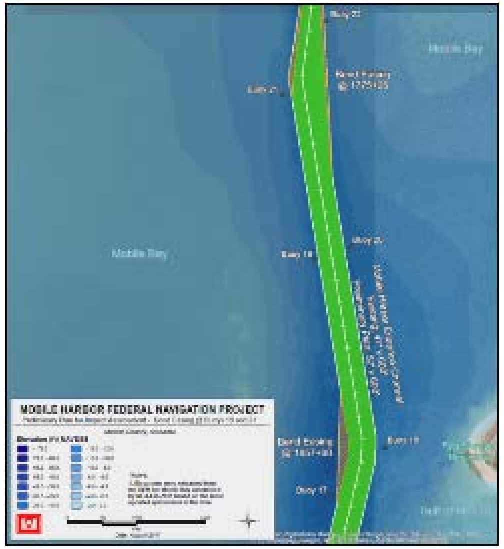
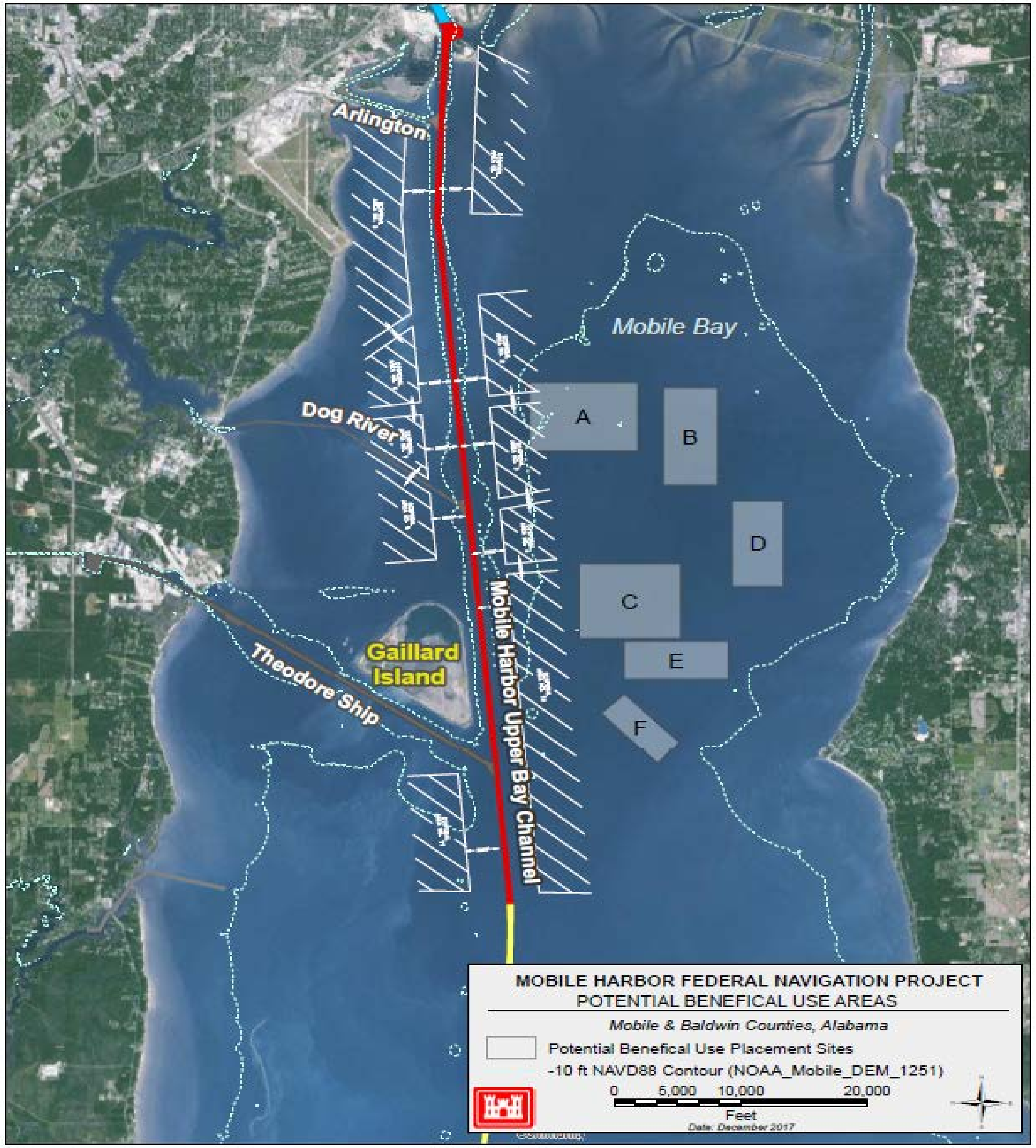






MOBILE HARBOR PROJECT



ECONOMIC CONSIDERATIONS

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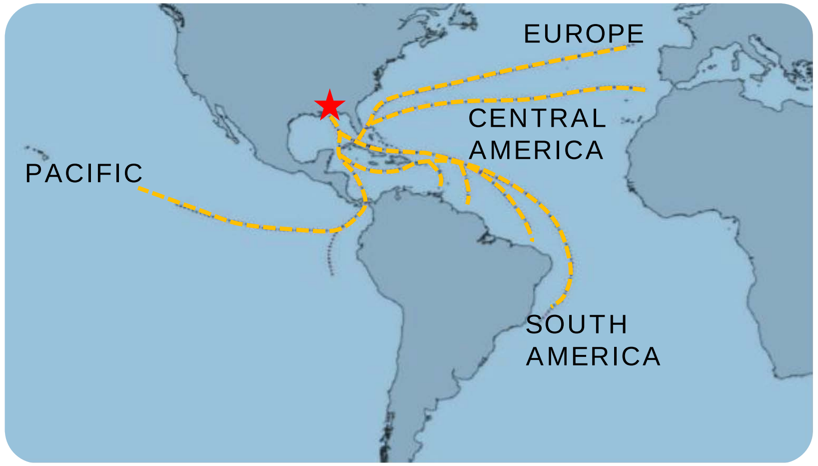
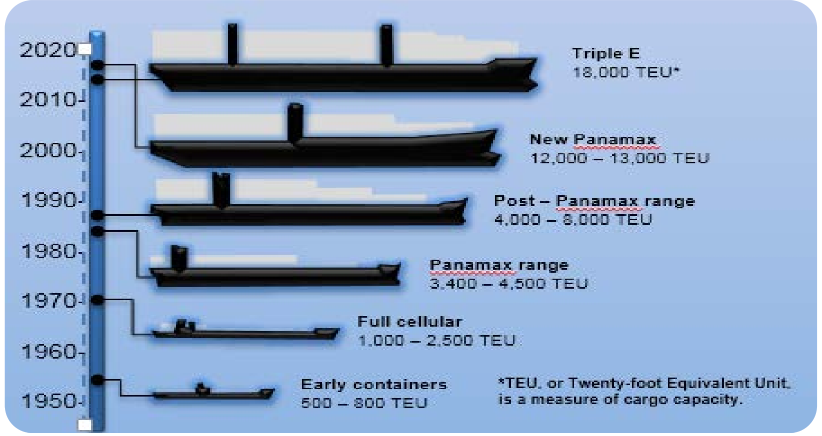


Mobile Harbor Trade Routes



Evolution of container ships

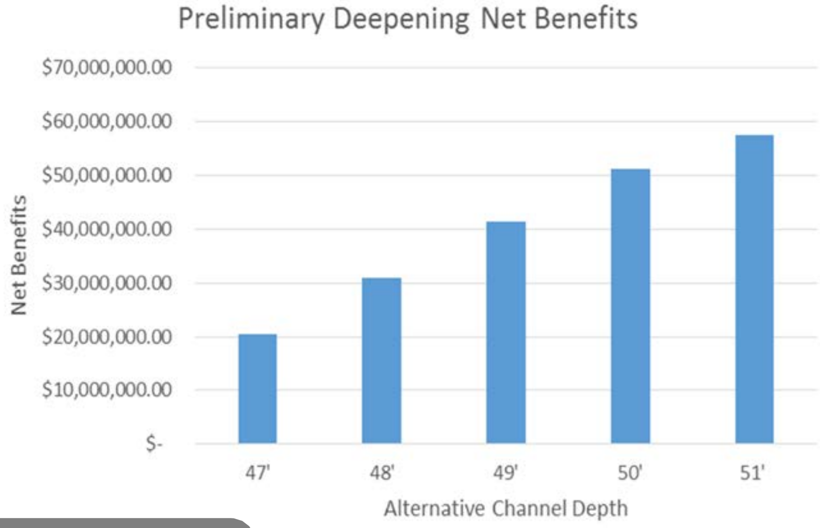
Post-Panamax ships make up 16% of the world's container fleet today, but carry 45% of the cargo. New Panamax ships are the largest that can pass through the new locks in 2016.

Concepts Behind Mobile Harbor Economic Analysis

- With and without the project, the same volume of cargo is assumed to move through the Port of Mobile
- Growth is assumed only to the capacity of the facilities
- Deeper channels allow vessels to load more efficiently
- Channel widening reduces transit delays/wait times to gain efficiencies
- The project benefits are reduction in transportation costs

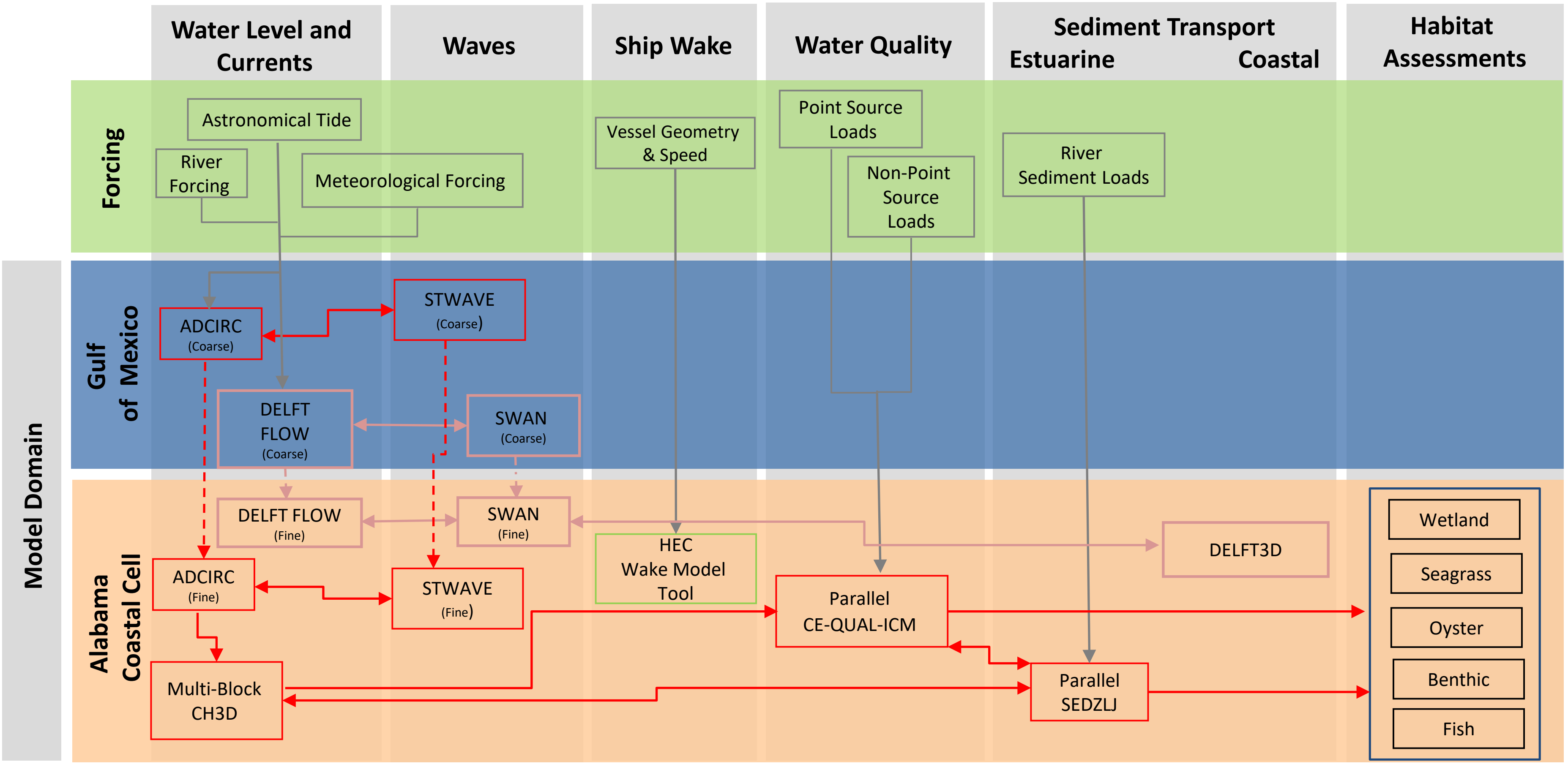
Major Components of Mobile Harbor Economic Analysis

- Commodity Forecast
- World Fleet Forecast
- Mobile Fleet Forecast
- Historic Vessel Calls



National Economic Development (NED) Plan reasonably maximizes net benefits at 51 foot depth

FLOW DIAGRAM OF ASSESSMENT TOOLS



HYDRODYNAMIC MODELING

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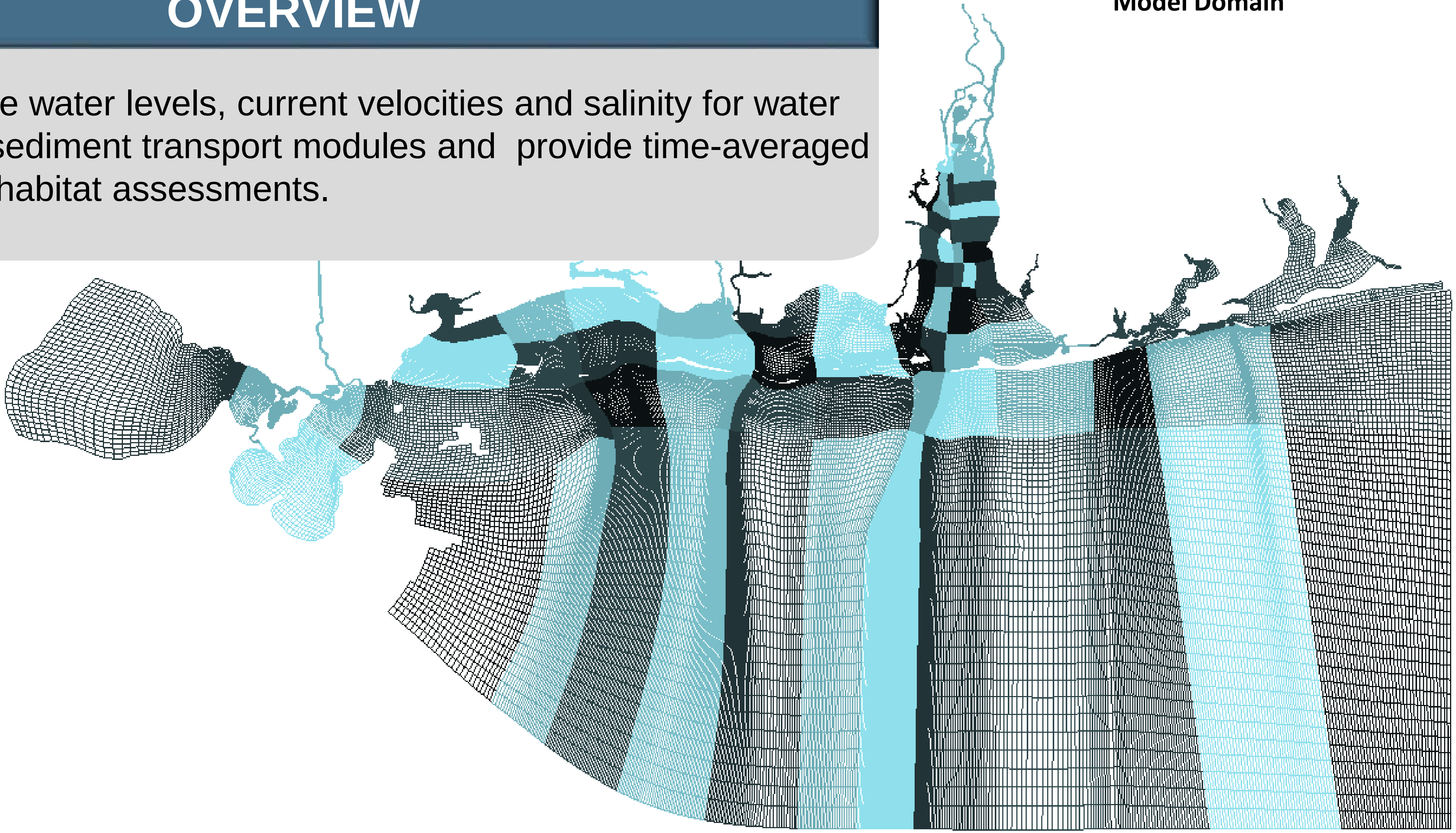
OVERVIEW

Purpose: Generate water levels, current velocities and salinity for water quality, estuarine sediment transport modules and provide time-averaged salinity to support habitat assessments.

Model Domain



HYDRODYNAMIC MODELING

APPROACH

Model(s): Simulations made using Geophysical Scale Transport Modeling System (GSMB). Components of GSMB include: two-dimensional (2D) deep water wave model WAM, STWAVE nearshore wave model, large scale 2D ADCIRC and regional scale CH3D-MB hydrodynamic modules.

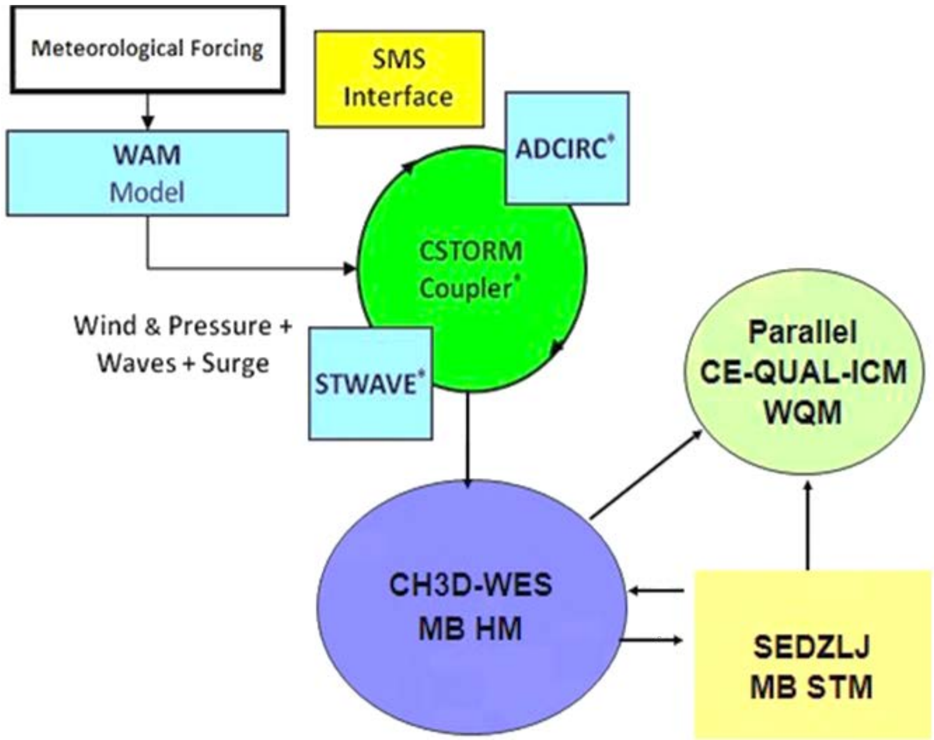
Simulation Time Period: January – December 2010

Simulated Conditions: Existing, with project and 0.5 meter relative rise in sea level.

Forcings: Wind and Atmospheric Pressure, River Flow, ADCIRC Tidal Elevation Boundary, and STWAVE Wave Input

Model Evaluation: Made using 2010 water surface elevations and 2010 and 2016 water quality data.

Geophysical Modeling System Multi-Block

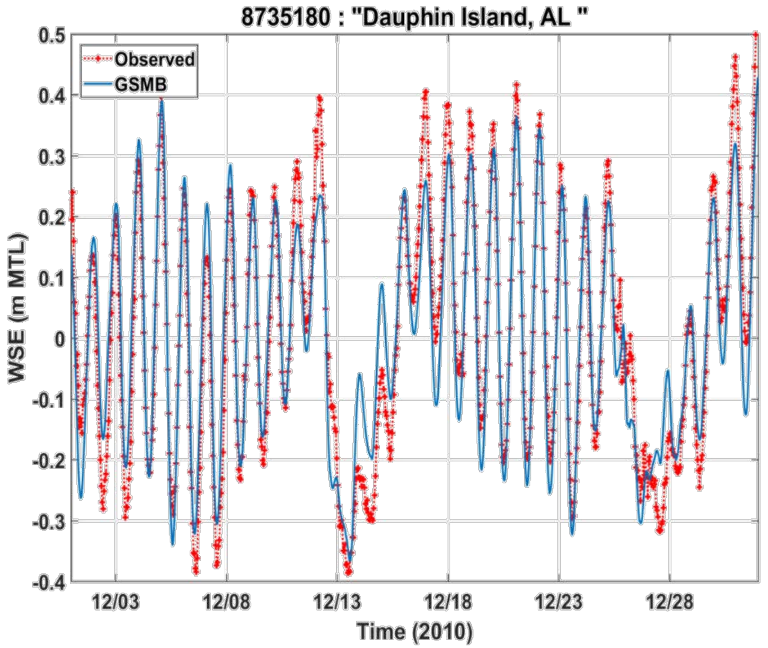


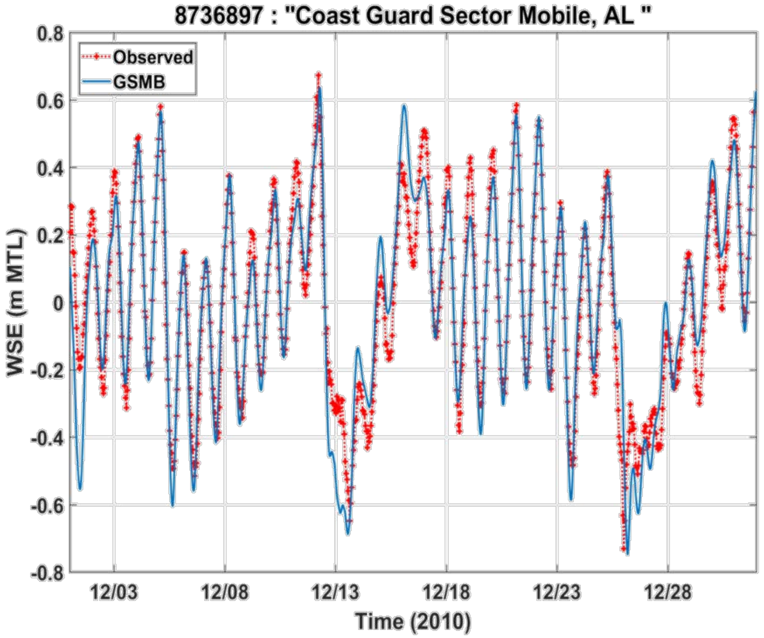
HYDRODYNAMIC MODELING

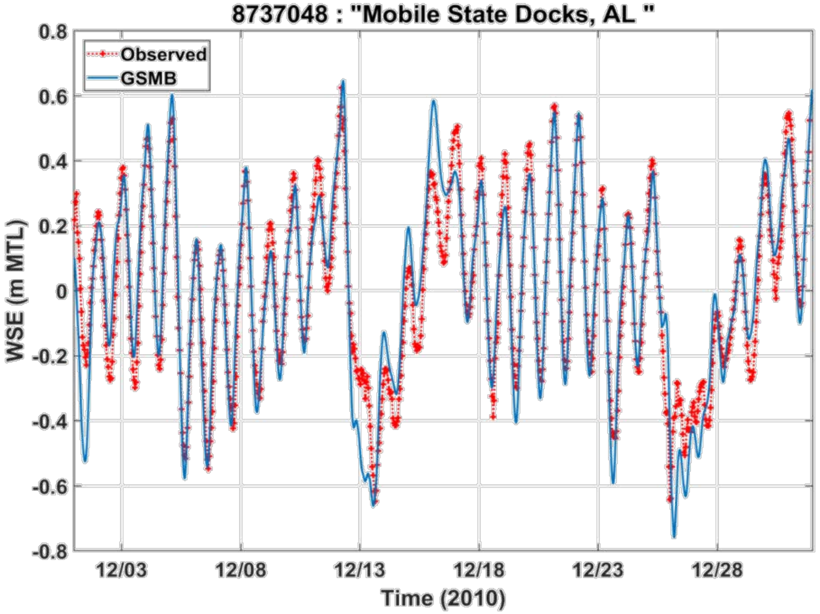
MODEL PERFORMACE

Comparison of Water Surface Elevations at NOAA Tide Gages

Water Surface Elevations Observed Versus Modeled







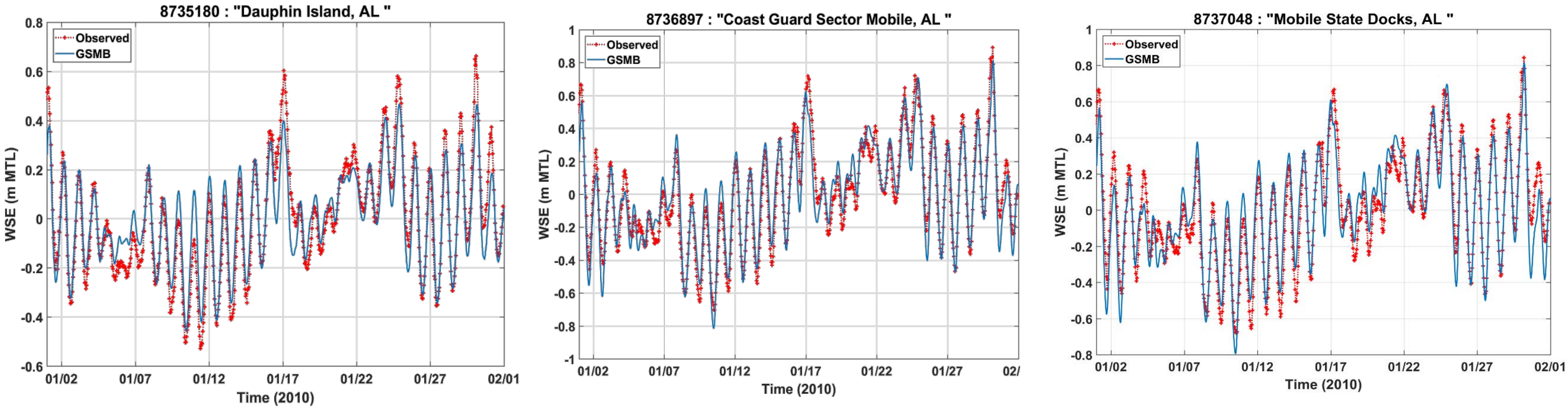
Daily Average Flows Ranged at and Below Normal (less than 25 percentile)

HYDRODYNAMIC MODELING

MODEL PERFORMACE

Comparison of Water Surface Elevations at NOAA Tide Gages

Water Surface Elevations Observed Versus Modeled



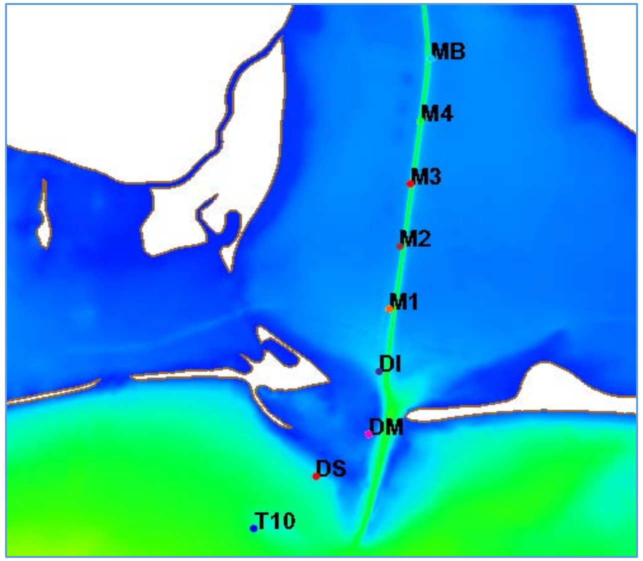
Daily Average Flows Above Normal (greater than 75 percentile)

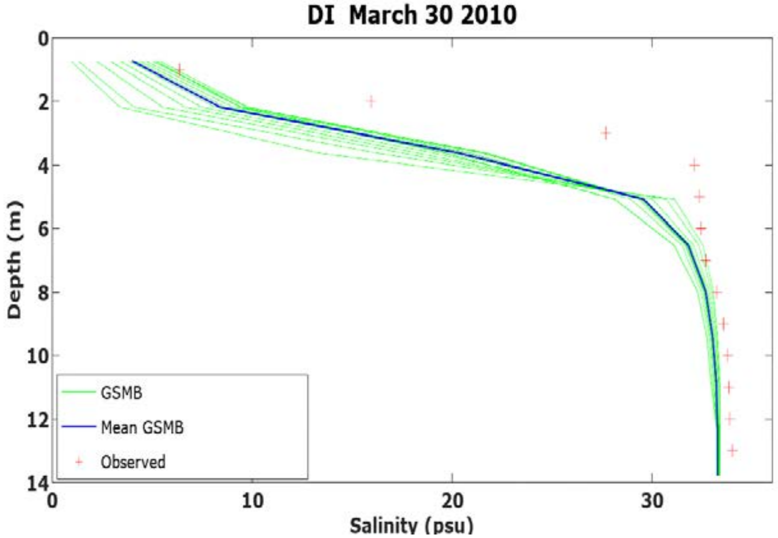
HYDRODYNAMIC MODELING

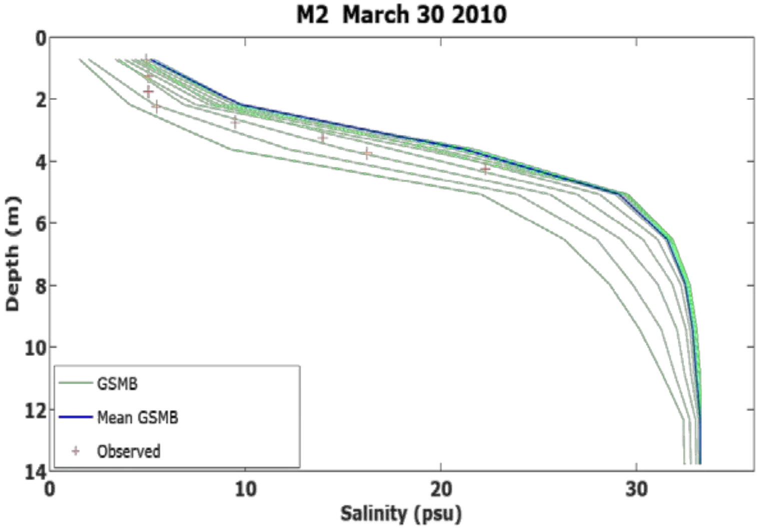
MODEL PERFORMACE

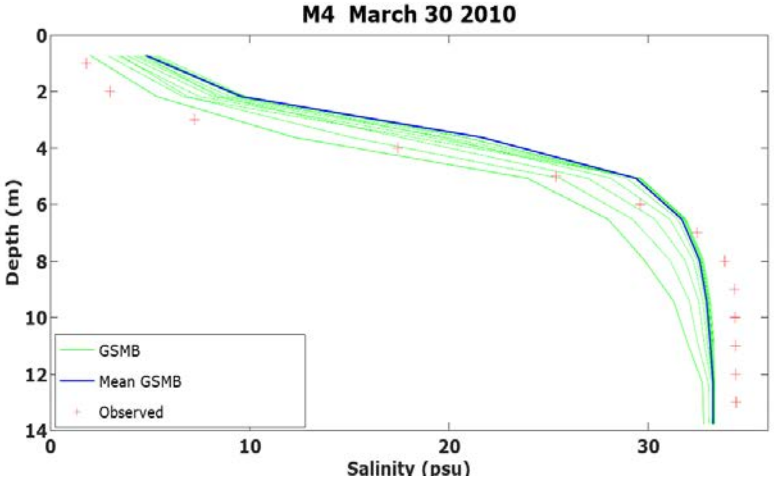
Comparisons of 2010 NOAA Salinity Measurements in the Bay

Observed Versus Modeled Salinity









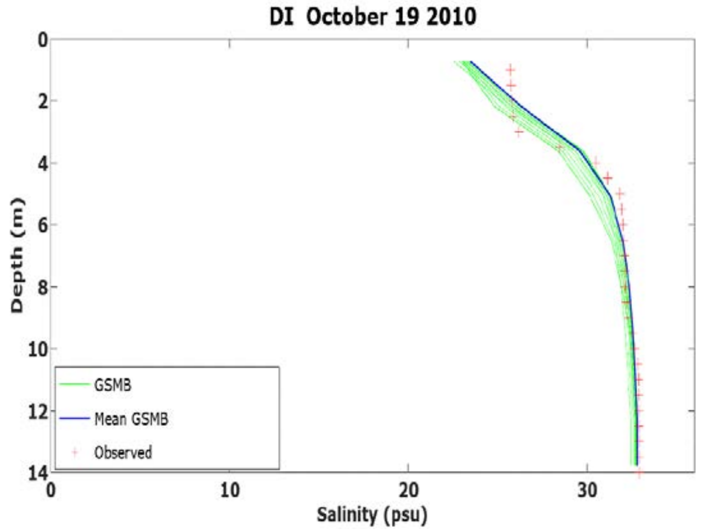
Daily Average Flows Above Normal (Exceeded 75 percentile)

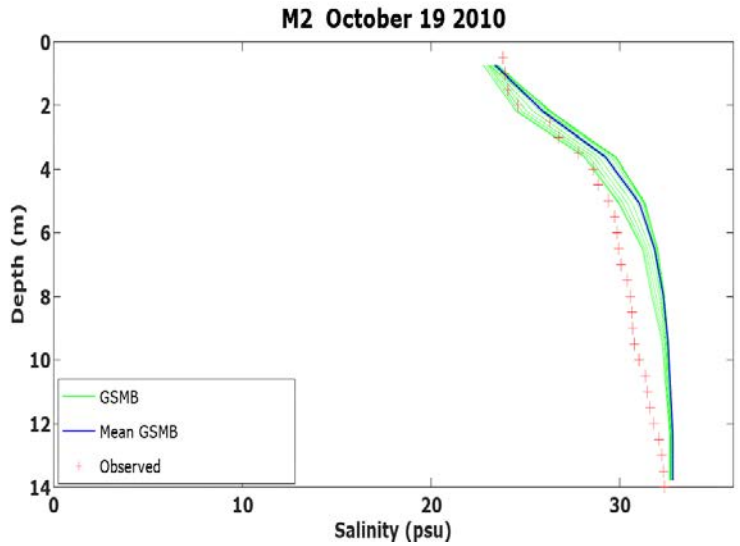
HYDRODYNAMIC MODELING

US Army Corps of Engineers. U.S.ARMY

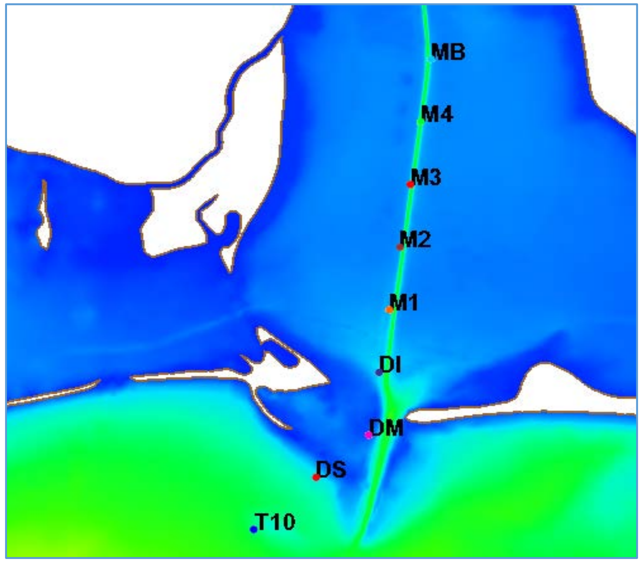
MODEL PERFORMACE

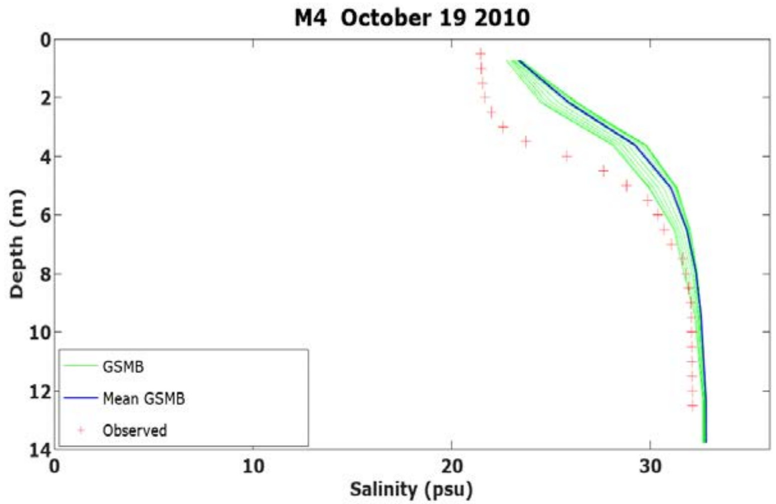
Comparisons of 2010 NOAA Salinity Measurements in the Bay





Observed Versus Modeled Salinity





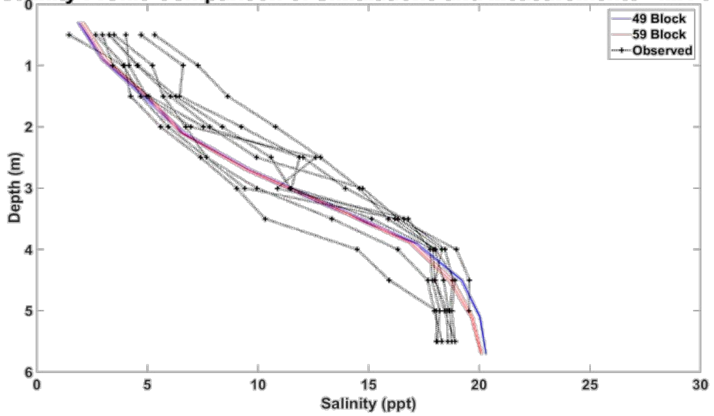
Daily Average Flows Below Normal (less than 25 percentile)

HYDRODYNAMIC MODELING

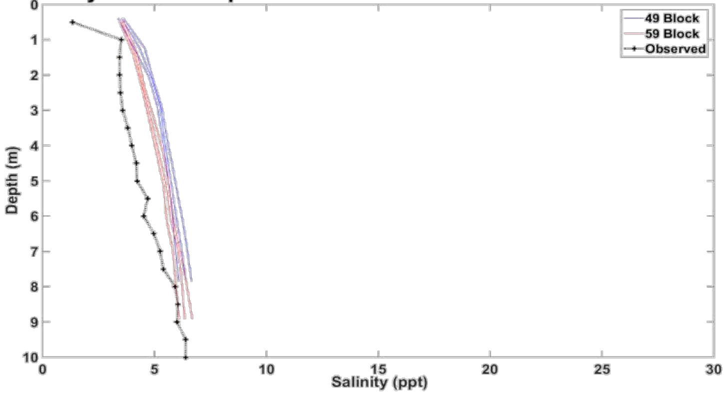
MODEL PERFORMACE

Comparisons 2016 USACE Salinity Measurements the Delta

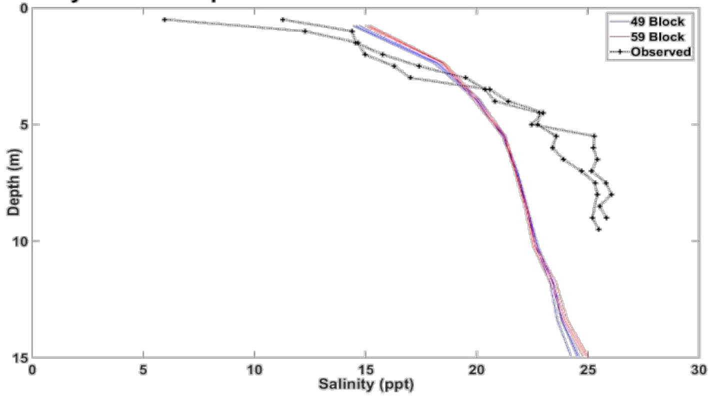
Salinity Profile Comparison of Simulations and Measurements - MR-01



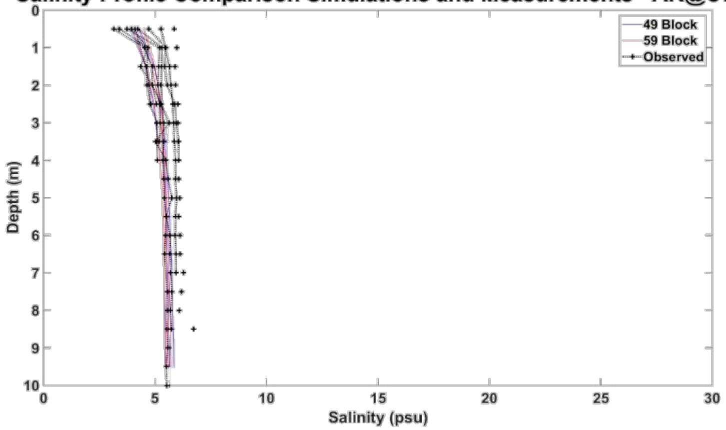
Salinitiy Profile Comparison of Simulations and Measurements -TR-03



Salinity Profile Comparison of Simulations and Measurements -MR-09

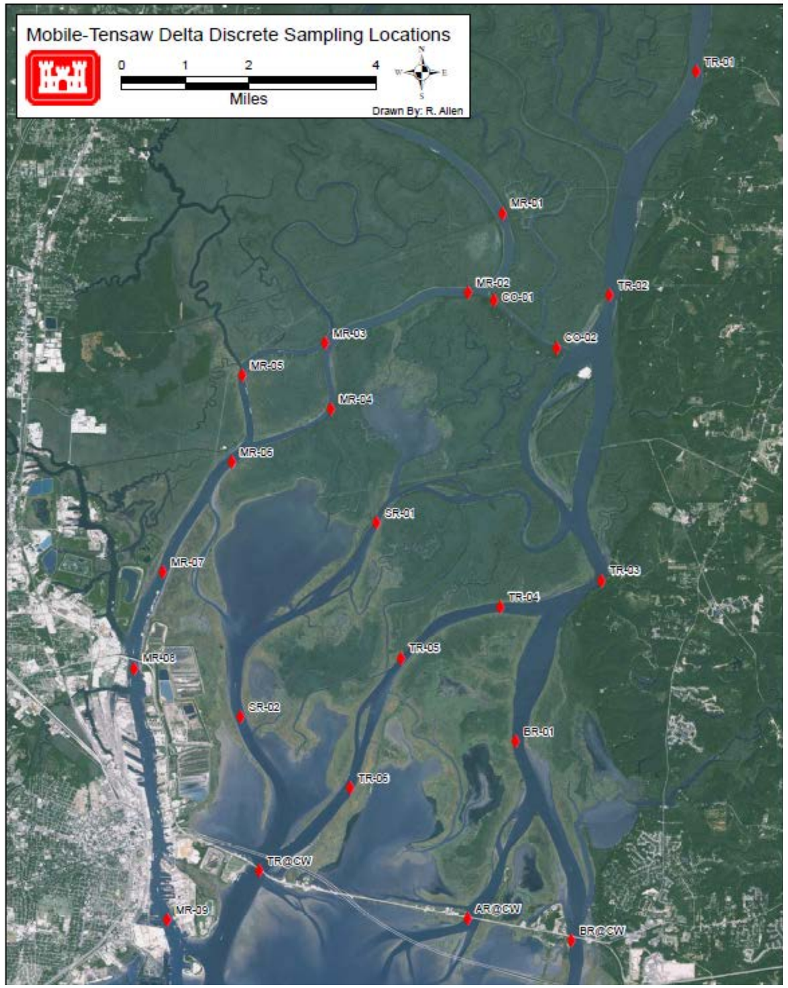


Salinity Profile Comparison Simulations and Measurements - AR@CW



Daily Average Flows Below Normal (less than 25 percentile)

September 2016 Observed Versus Modeled Salinity



HYDRODYNAMIC MODEL POSTPROCESSING

POSTPROCESSING FOR OYSTER MODELING

At 42868 nodes

Hourly surface elevation

At 42868 nodes × 3 levels (surface, mid depth, and bottom)

3-D currents (East-West, North-South, and vertical velocities)

POSTPROCESSING FOR HABITAT ASSESSMENTS

Using 30 blocks out of 59 blocks

For layers

- Depth-average
- Surface
- Top 3-layers
- Bottom 3-layers
- Bottom

Monthly statistics for salinity

- Mean
- Standard deviation
- Maximum
- Minimum
- Percentiles – 1, 5, 10, 25, 50 (median), 75, 90, 95, and 99

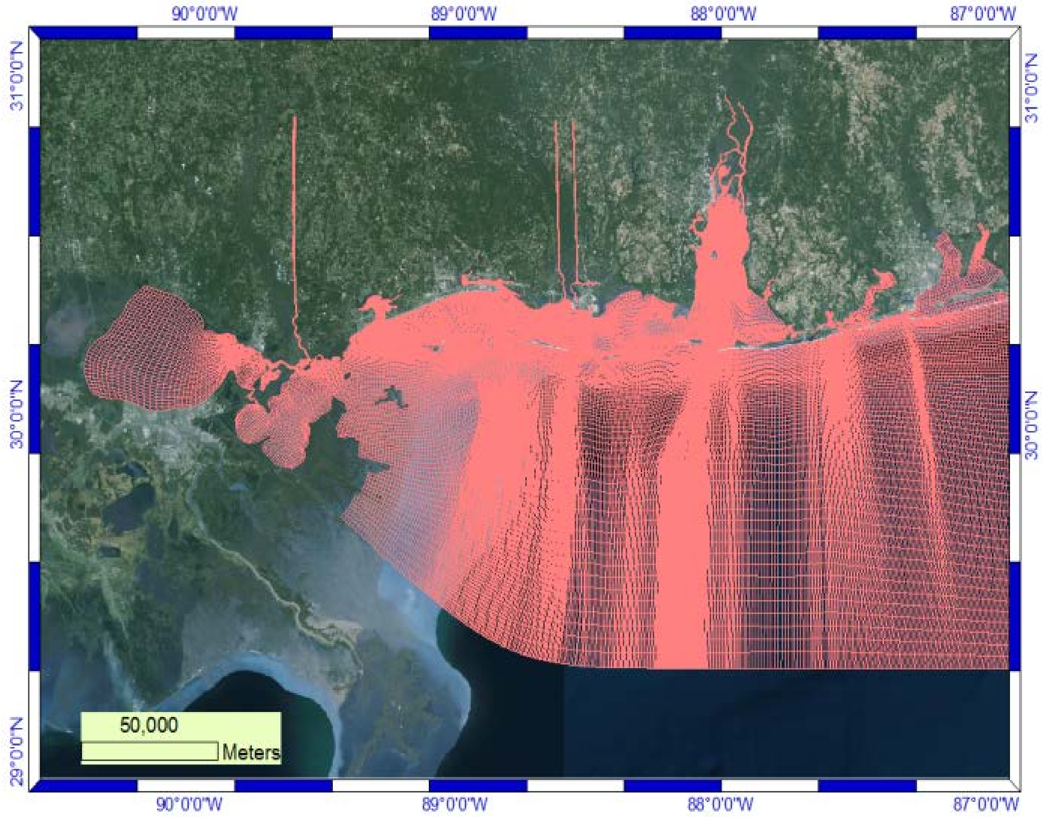
WATER QUALITY MODELING

US Army Corps of Engineers
U.S. ARMY

OVERVIEW

Purpose: To assess potential changes in water quality including changes in flushing, salinity, dissolved oxygen, temperature, total suspended solids, nutrients and chlorophyll a as a result of channel improvements. Provide water quality constituents (i.e salinity, temperature, dissolved oxygen, total suspended solids ect.) for habitat assessments.

Model Domain



WATER QUALITY MODELING

US Army Corps of Engineers

U.S. ARMY

APPROACH

Model: Simulation made using GMSM CE-QUAL-ICM module.

Simulation Period: January – December 2010

Simulated Conditions: Existing, with project and 0.5 meter relative rise in sea level.

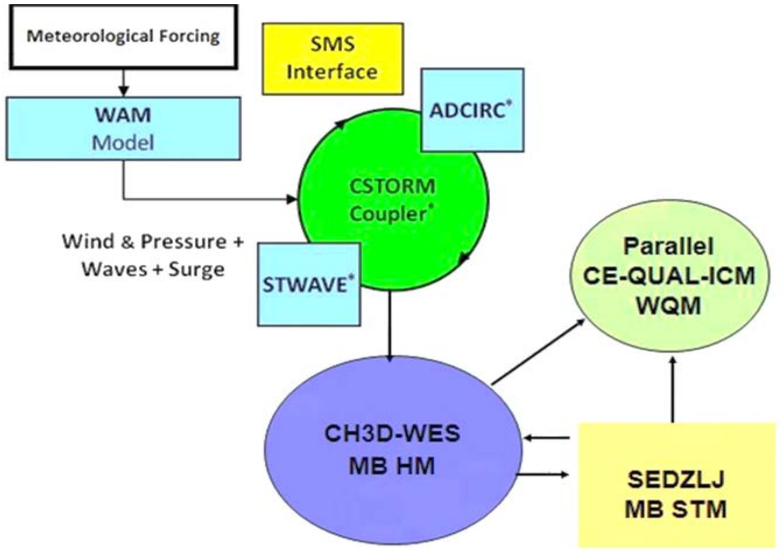
Model Forcing and Boundary Conditions: Meteorological data from Mobile Airport, Point Source loads from State records, and boundary conditions from observation and published information

Model Evaluation: Made using 2010 and 2016 water quality data.

Output: Results output as daily averages for all constituents for locations of interest.

- Time series plot:
  - Surface, mid-depth, and bottom concentrations differences
  - Differences in Existing and Project or Existing with SLR and Project with SLR
- Profile plots of whole water column

Geophysical Modeling System Multi-Block



PARALLEL VERSION ICM
RUNS & POST-PROCESSES ON HPC
FULL SUITE OR WQ STATE VARIABLES & PROCESSES

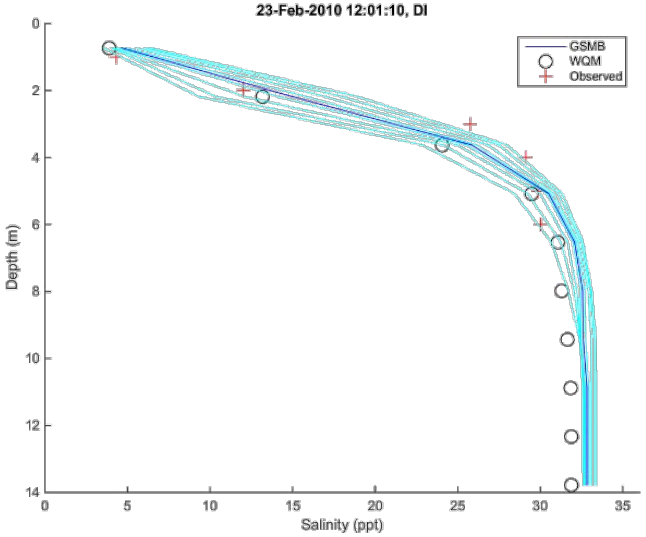
ICM STATE VARIABLES

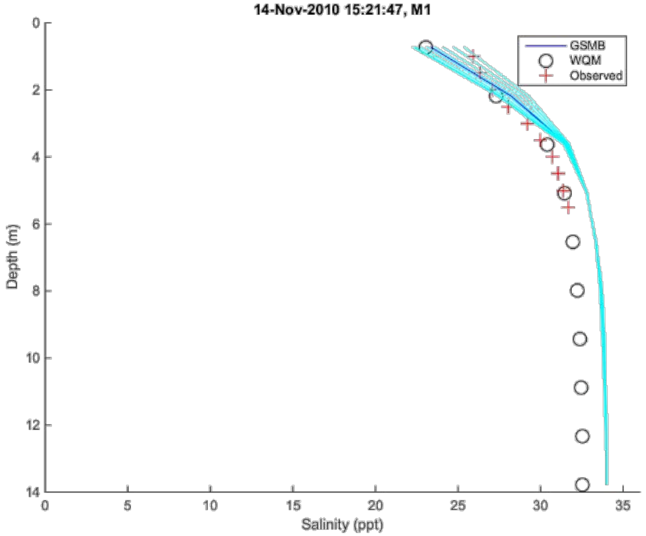
TEMPERATURE	DO	TOTAL PHOSPHATE
AMMONIUM	SALINITY	POP
NITRATE	ALGAE	DISSOLVED SILICA
DON	DOC	SUSPENDED SOLIDS
PON	POC	

WATER QUALITY MODELING

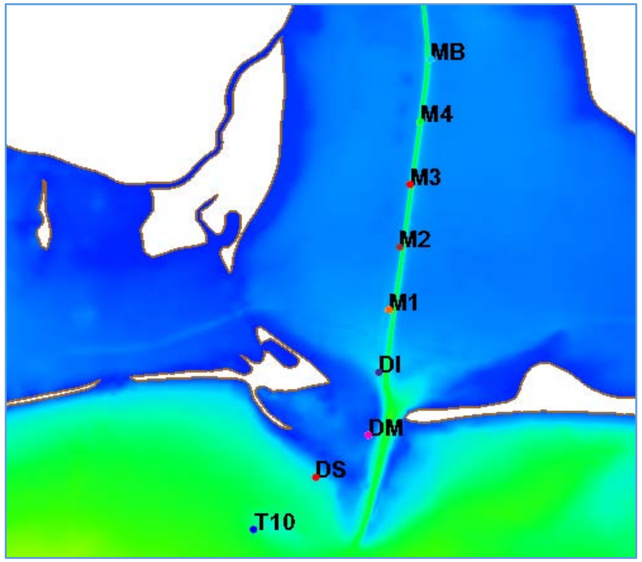
MODEL PERFORMACE

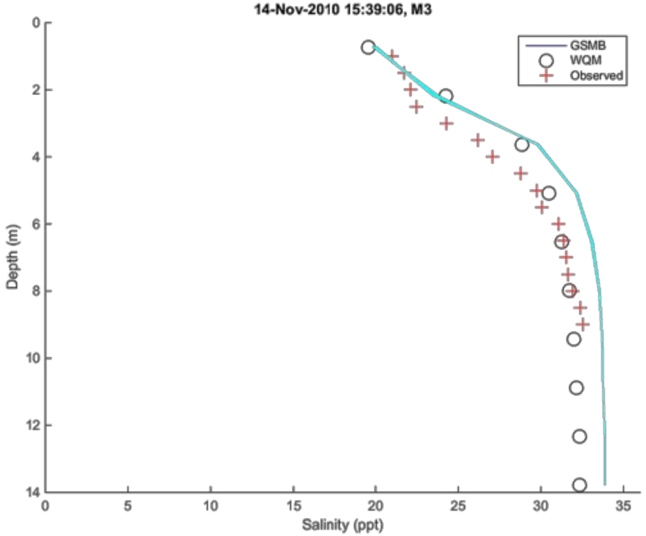
Comparisons of 2010 NOAA salinity measurements in the bay and USACE 2016 salinity measurements in the delta





Observed Versus Modeled Salinity



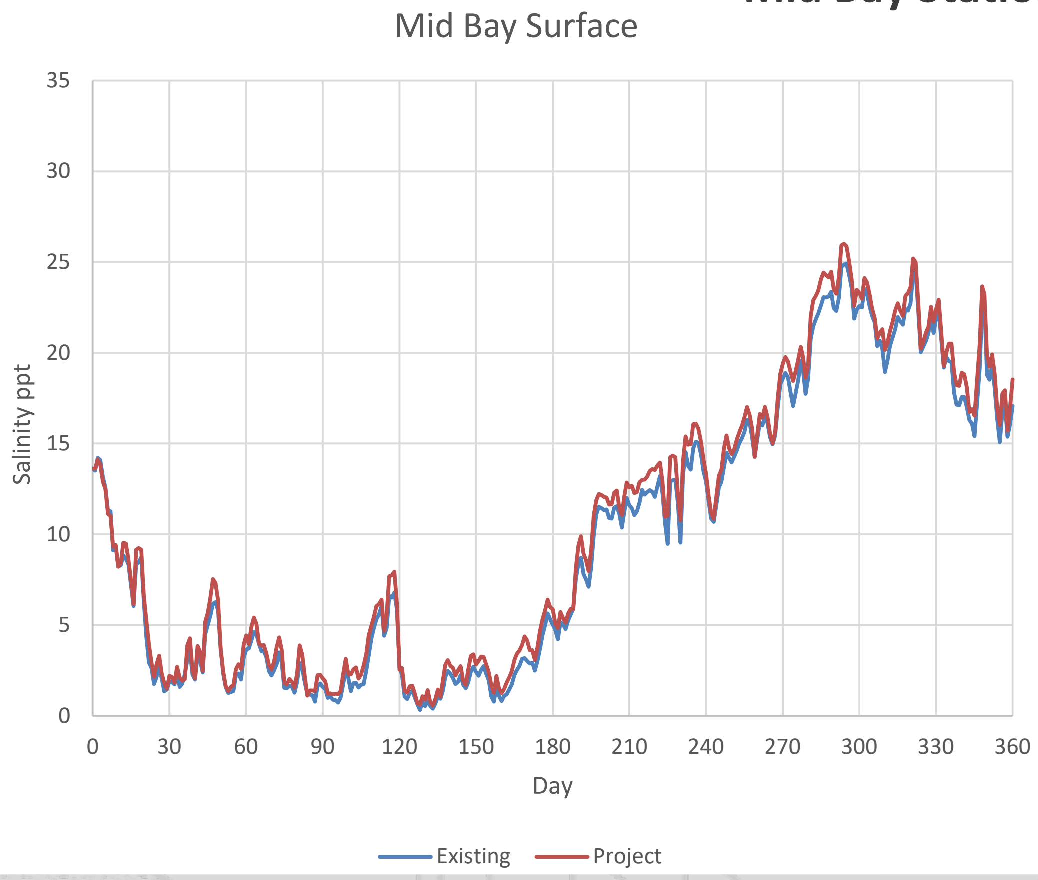


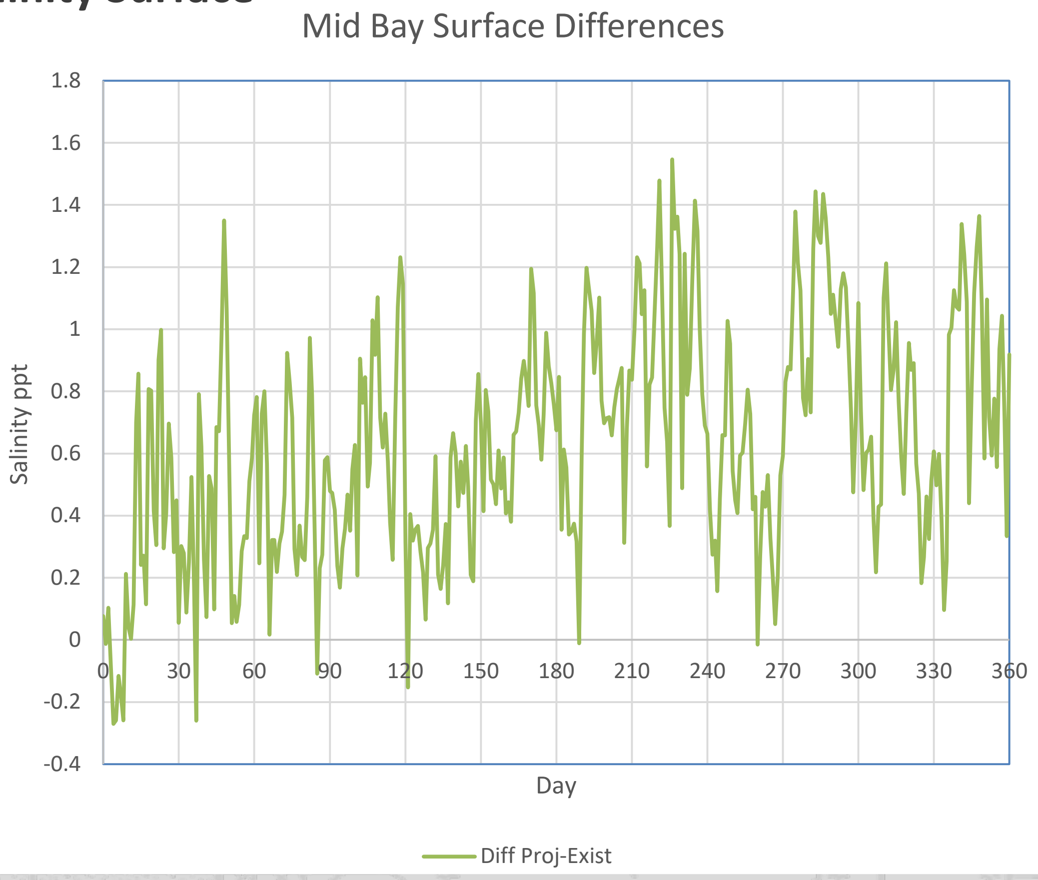
WATER QUALITY MODELING

TYPICAL RESULTS

Salinity Time Series and Difference Plots

Mid Bay Station Salinity Surface



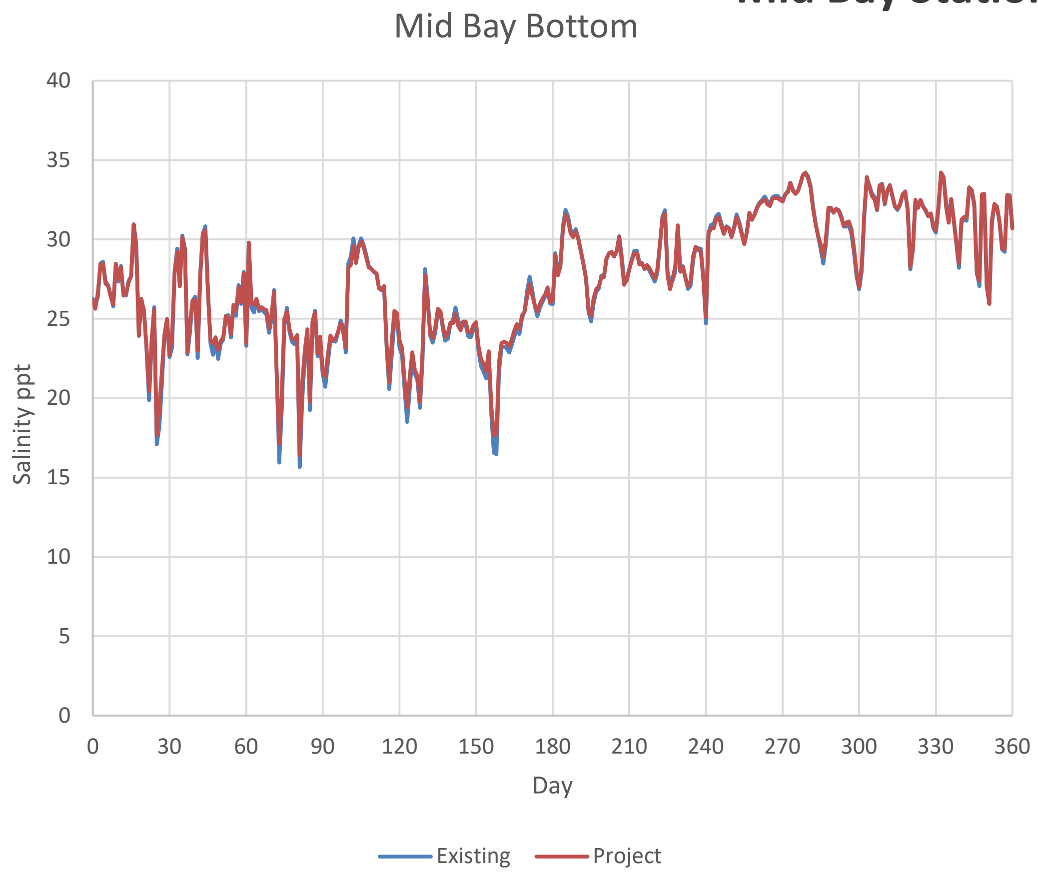


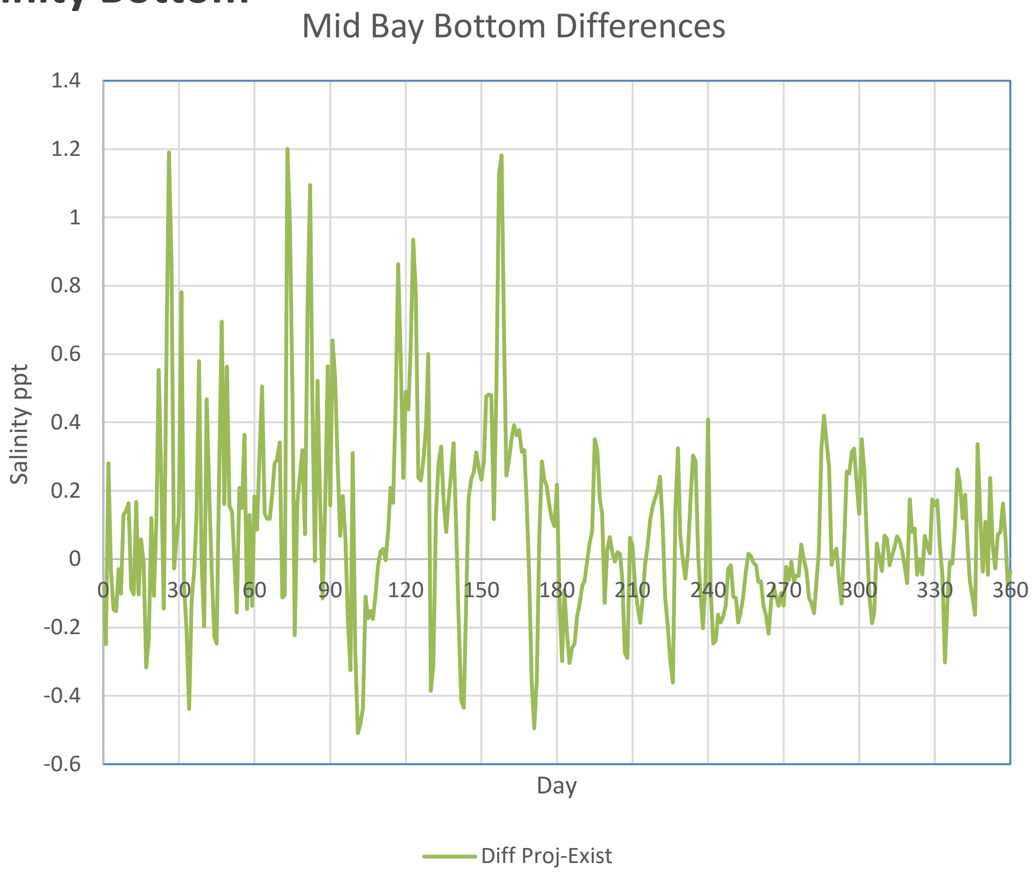
WATER QUALITY MODELING

TYPICAL RESULTS

Salinity Time Series and Difference Plots

Mid Bay Station Salinity Bottom



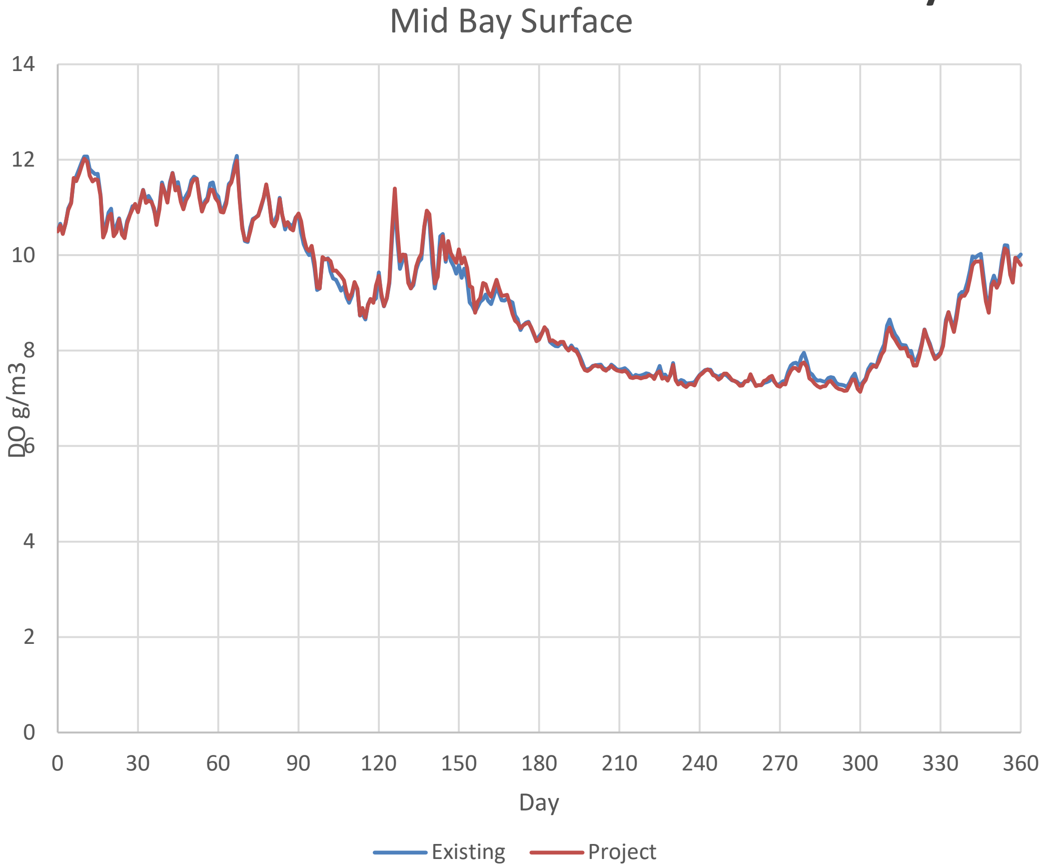


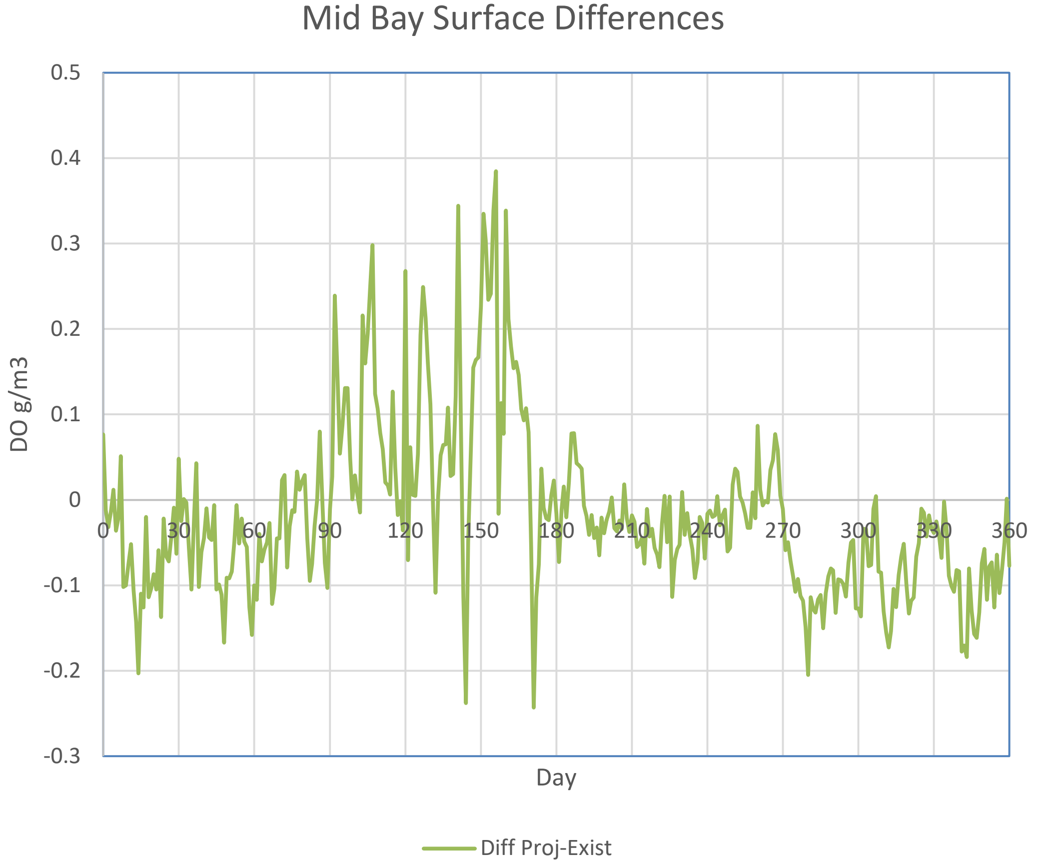
WATER QUALITY MODELING

TYPICAL RESULTS

Dissolved Oxygen Time Series and Difference Plots

Mid Bay Station DO Surface





WATER QUALITY MODELING

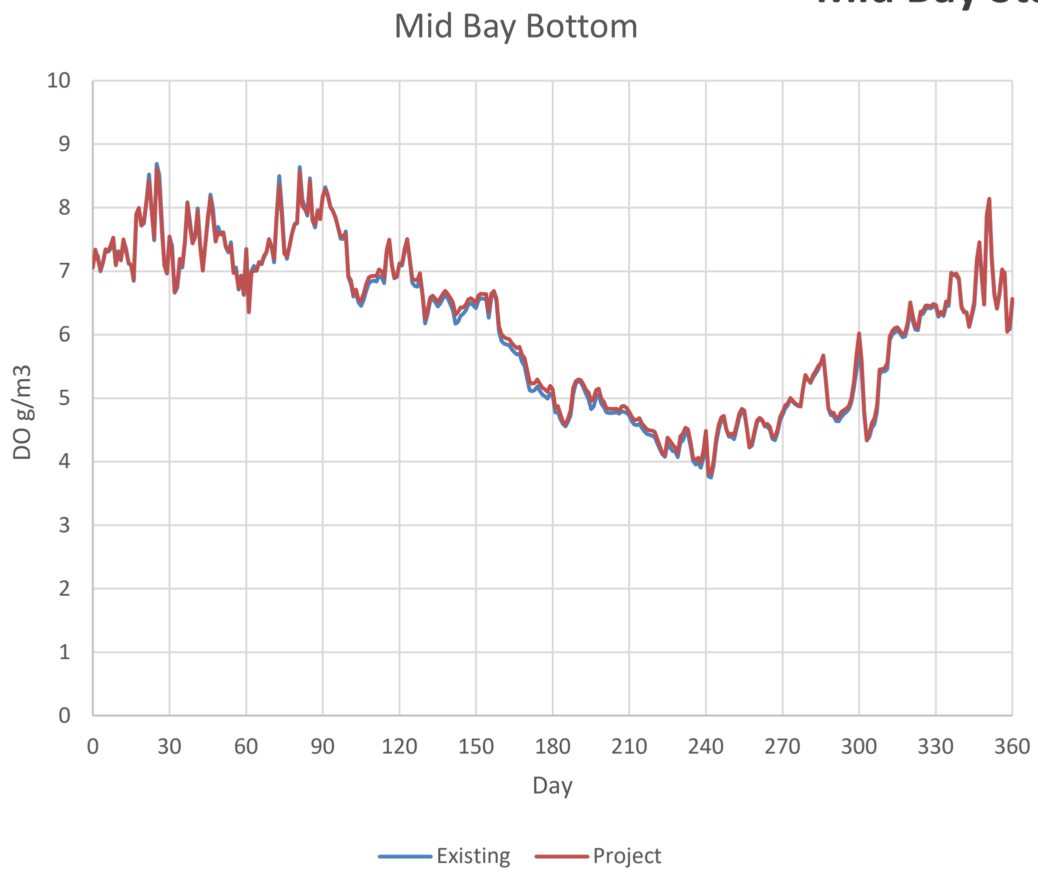
US Army Corps of Engineers

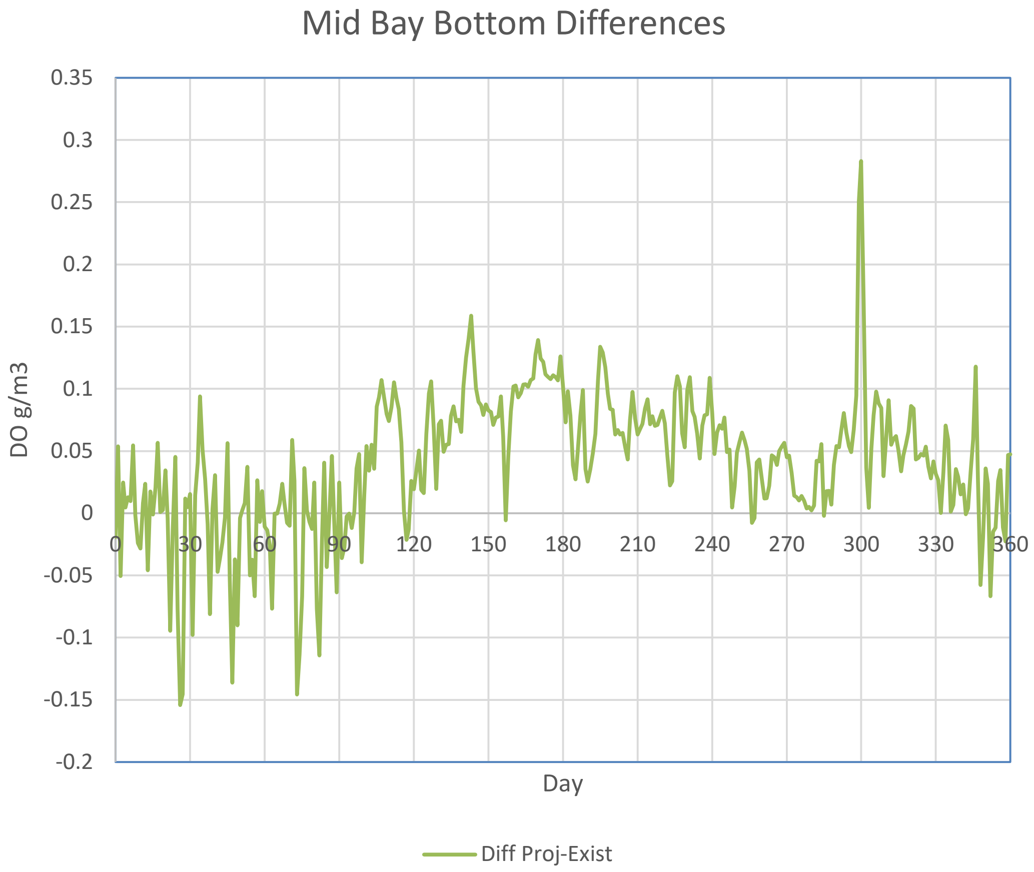
U.S. ARMY

TYPICAL RESULTS

Dissolved Oxygen Time Series and Difference Plots

Mid Bay Station DO Bottom



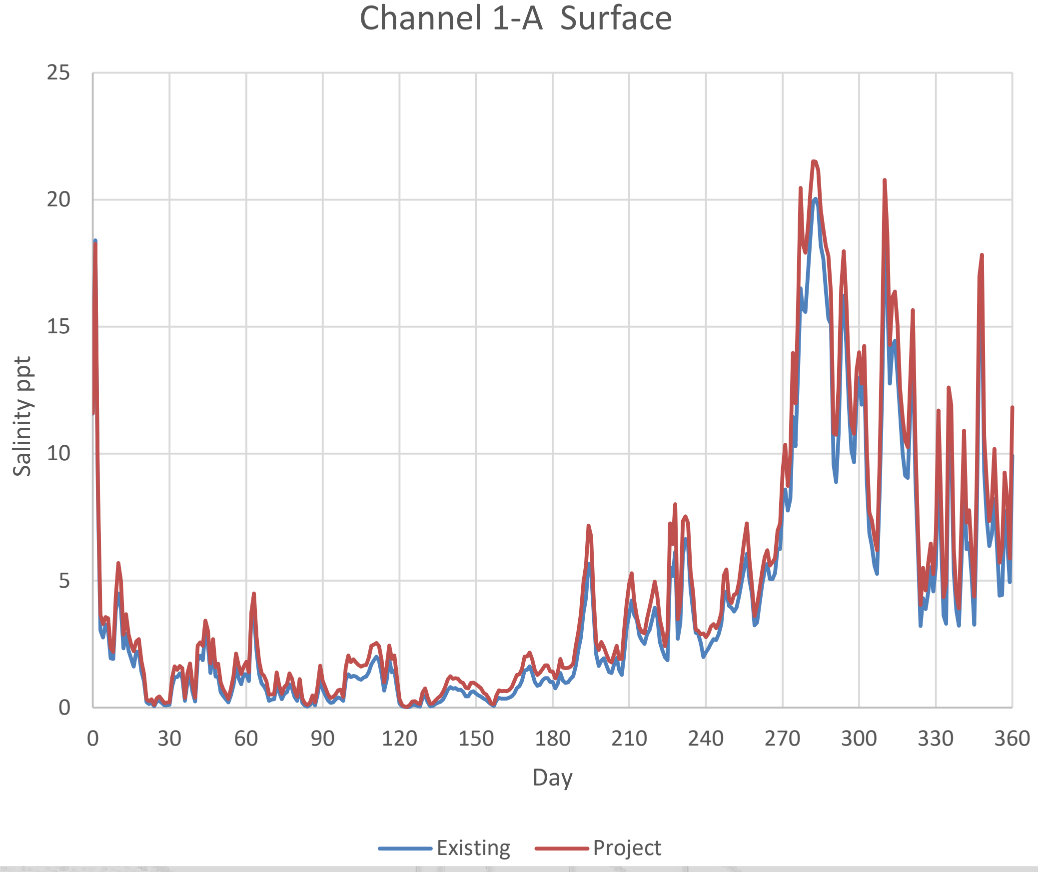


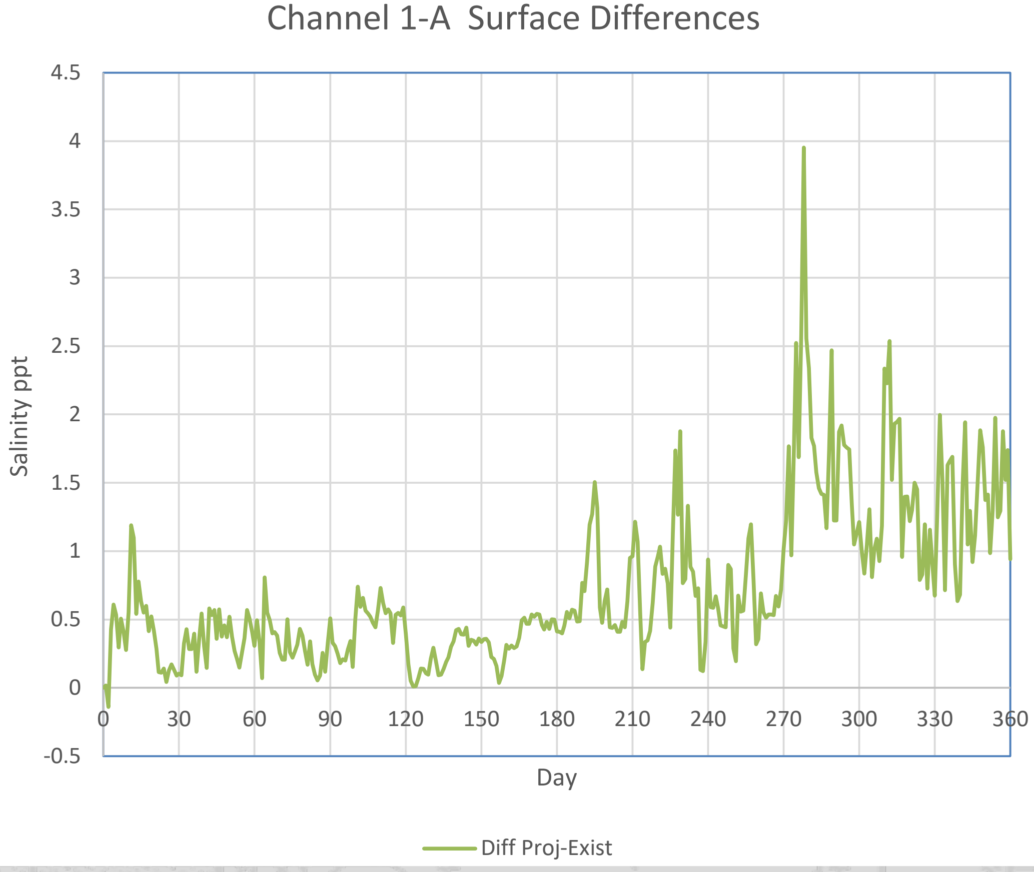
WATER QUALITY MODELING

TYPICAL RESULTS

Salinity Time Series and Difference Plots

Channel – 1A Salinity Surface



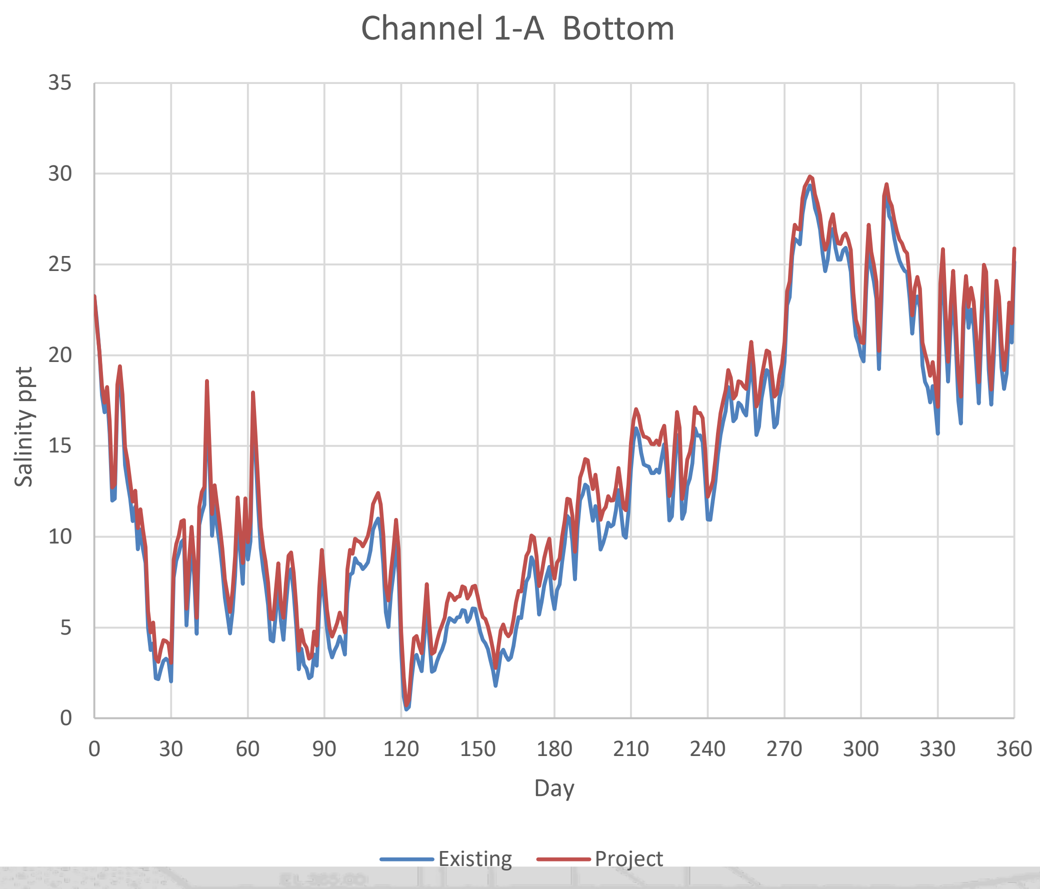


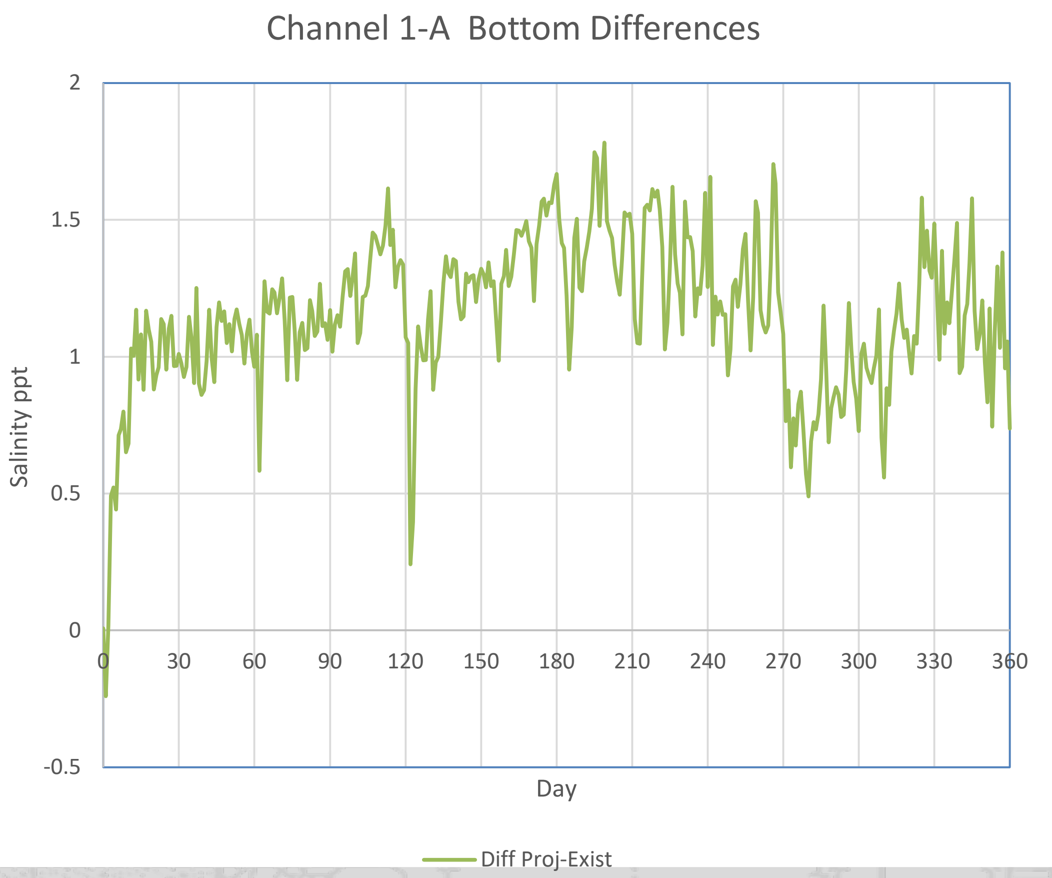
WATER QUALITY MODELING

TYPICAL RESULTS

Salinity Time Series and Difference Plots

Channel – 1A Salinity Bottom



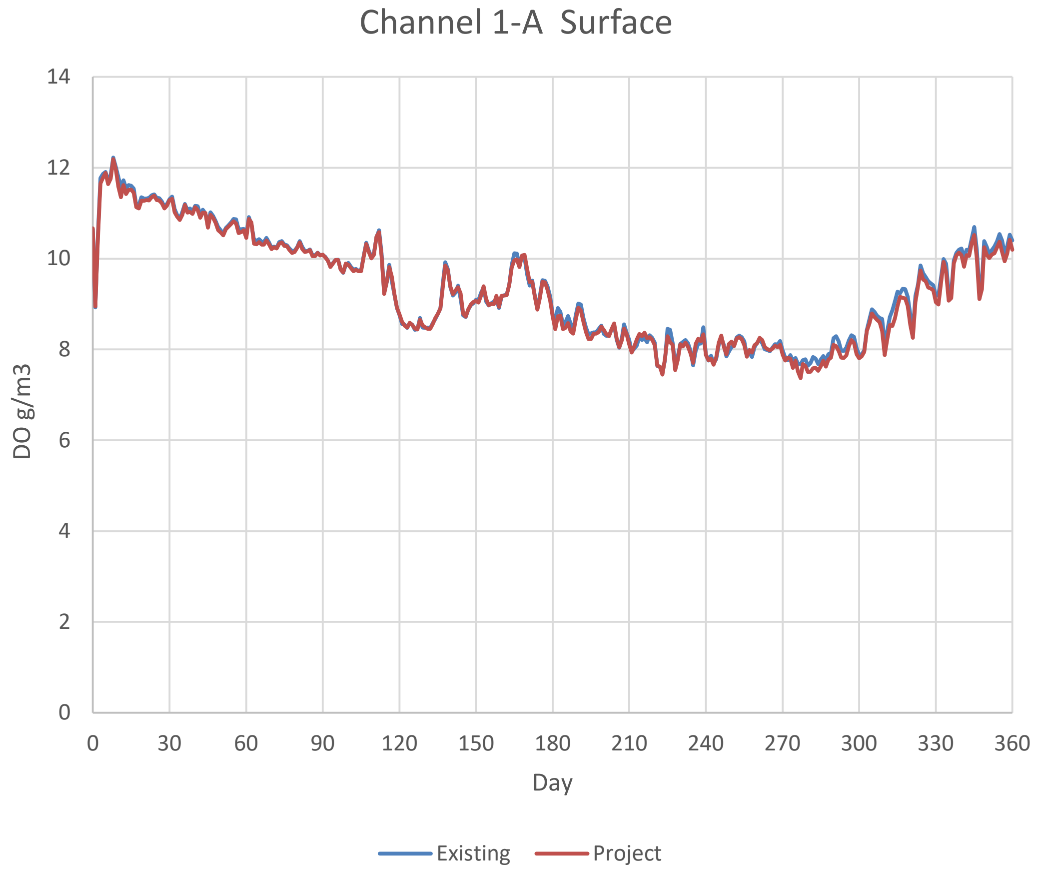


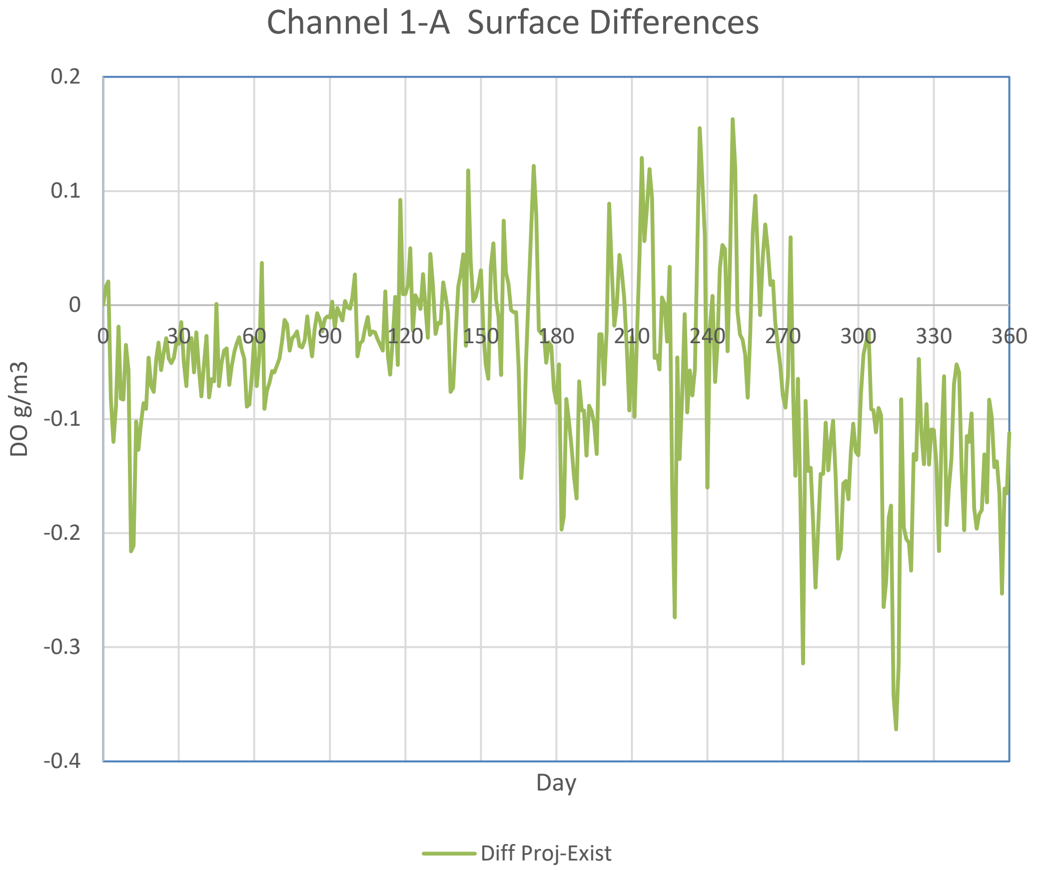
WATER QUALITY MODELING

TYPICAL RESULTS

Dissolved Oxygen Time Series and Difference Plots

Channel – 1A Surface DO



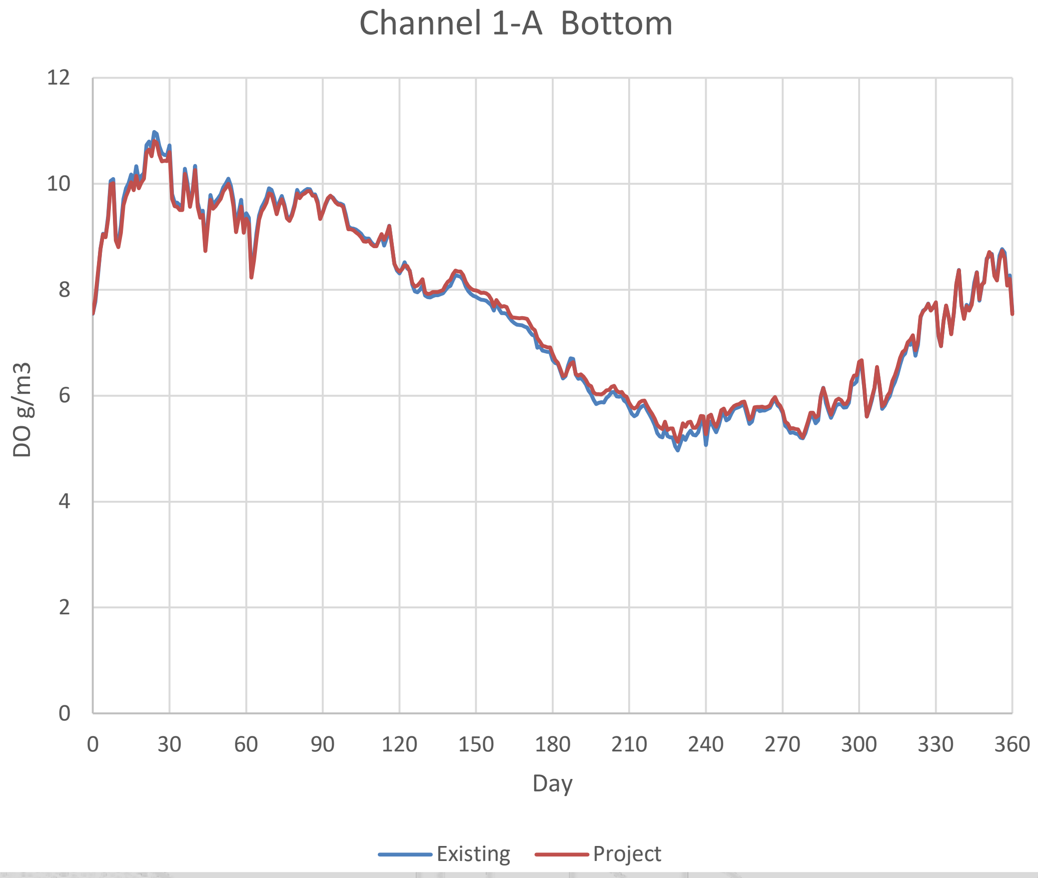


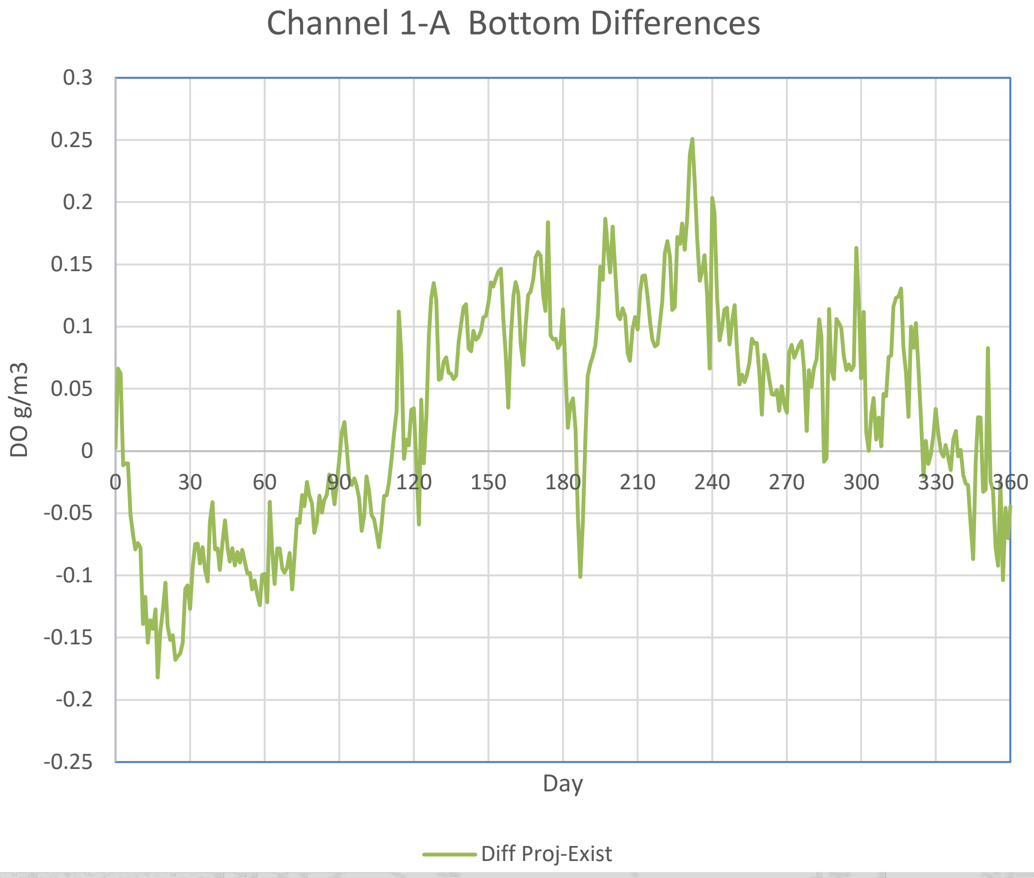
WATER QUALITY MODELING

TYPICAL RESULTS

Dissolved Oxygen Time Series and Difference Plots

Channel -1A Bottom DO





WATER QUALITY MODELING

US Army Corps of Engineers

U.S. ARMY

RESULTS SUMMARY

Existing and project conditions are set up identically EXCEPT for hydrodynamic information. Any differences predicted between **Existing** and **Project** water quality conditions are the result of ***changes*** in **hydrodynamic conditions** in the two cases.

When **no differences** are indicated between existing and project conditions then it is reasonable to believe that there is **no project impact** upon water quality.

Existing and Project simulations with Sea Level Rise show similar behavior: Little to no difference in salinity and water quality conditions.

This agreement in existing and project conditions occur during the duration of the year long simulation.

Therefore it is reasonable to expect that the project water quality will be similar to the existing conditions.

HYDRODYNAMIC MODEL POSTPROCESSING

US Army Corps of Engineers

U.S. ARMY

POSTPROCESSING FOR OYSTER MODELING

At 42868 nodes × 3 levels (surface, mid depth, and bottom)

Daily Salinity, temperature, and dissolved oxygen

POSTPROCESSING FOR HABITAT ASSESSMENTS

Using 413020 cells out of 826830 cells

For layers

- Depth-average
- Surface
- Top 3-layers
- Bottom 3-layers
- Bottom

Monthly statistics for dissolved oxygen

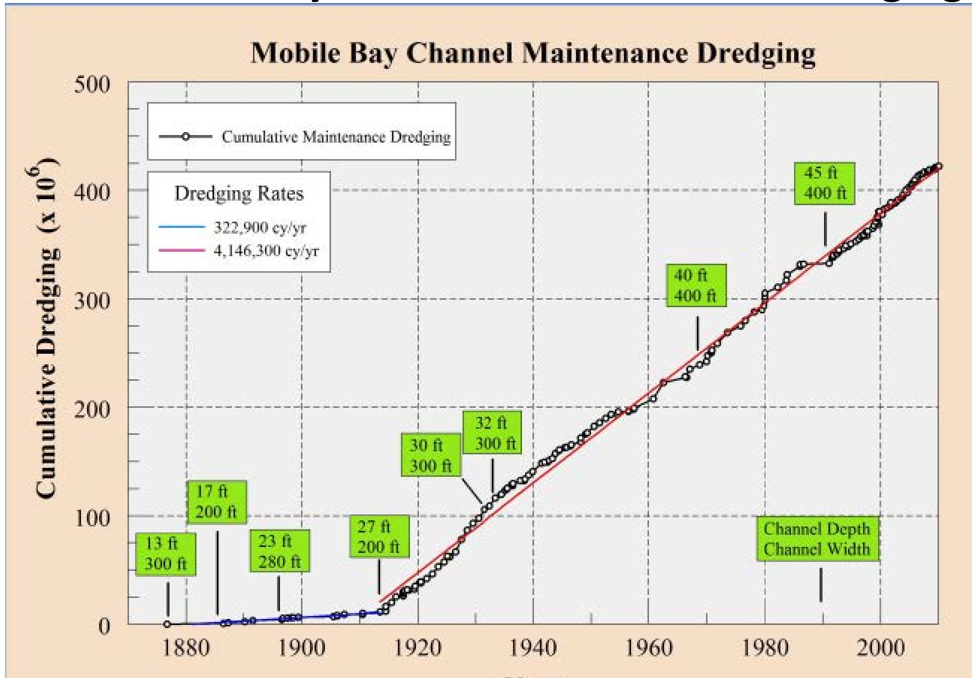
- Mean
- Standard deviation
- Minimum
- Maximum
- Percentiles – 1, 5, 10, 25, 50 (median), 75, 90, 95, and 99

ESTUARINE SEDIMENT TRANSPORT MODELING

OVERVIEW

Purpose: To assess relative changes in sedimentation rates within the channel, dredged material placement and surrounding areas as a result of channel improvements within the bay.

Cumulative Bay Channel Maintenance Dredging



Source: Byrnes, et. al, 2013

Source: NASA

ESTUARINE SEDIMENT TRANSPORT MODELING

US Army Corps of Engineers. U.S. ARMY

APPROACH

Model: Simulations made using GMSM SEDZLJ MB STM module.

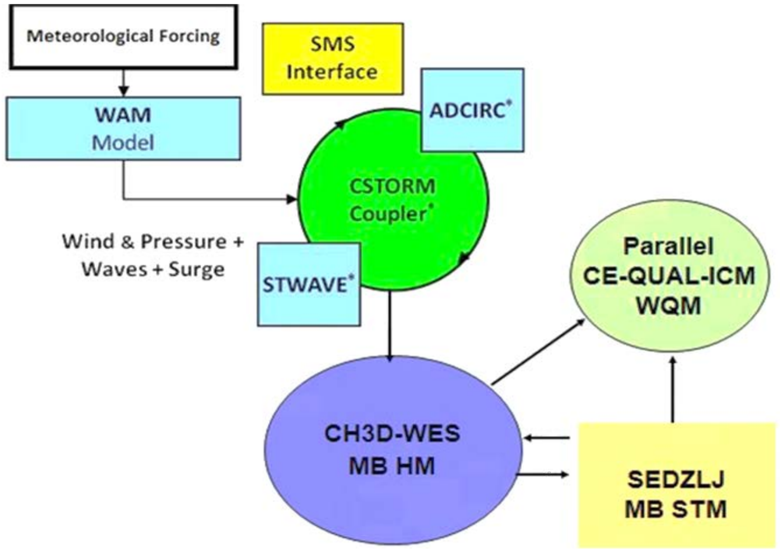
Simulation Period: January – December 2010

Simulated Conditions: Existing, with project and 0.5 meter relative rise in sea level.

Forcing: Wind and Atmospheric Pressure, River Flow, ADCIRC Tidal Elevation Boundary, and STWAVE Wave Input

Model Evaluation: Made using 2009-2011 Dredging Records and TSS measurements collected in 2016-2017.

Geophysical Modeling System Multi-Block



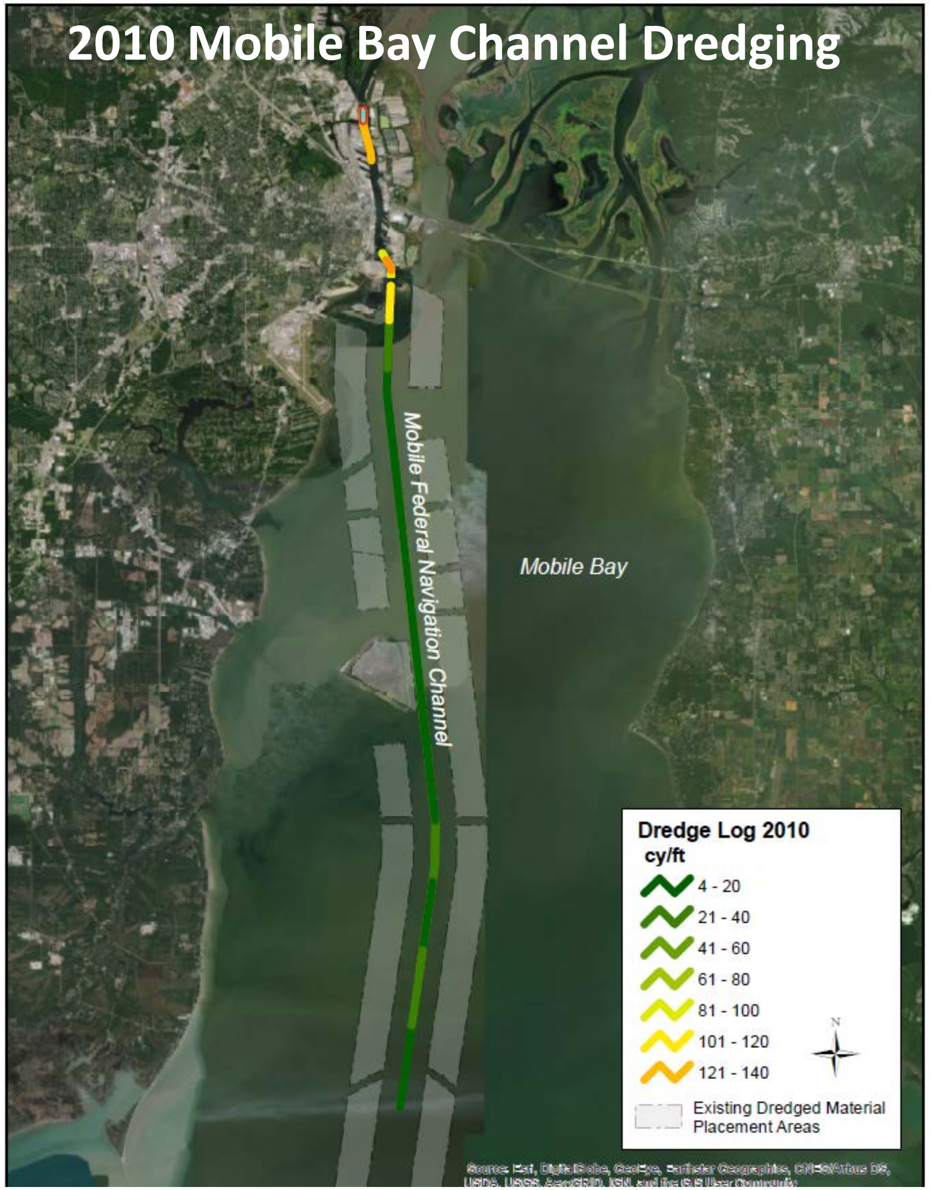
ESTUARINE SEDIMENT TRANSPORT MODELING

US Army Corps of Engineers

U.S.ARMY

Locations of Suspended Sediment Concentrations in 2016-2017

ESTUARINE SEDIMENT TRANSPORT MODELING



ESTUARINE SEDIMENT TRANSPORT MODELING

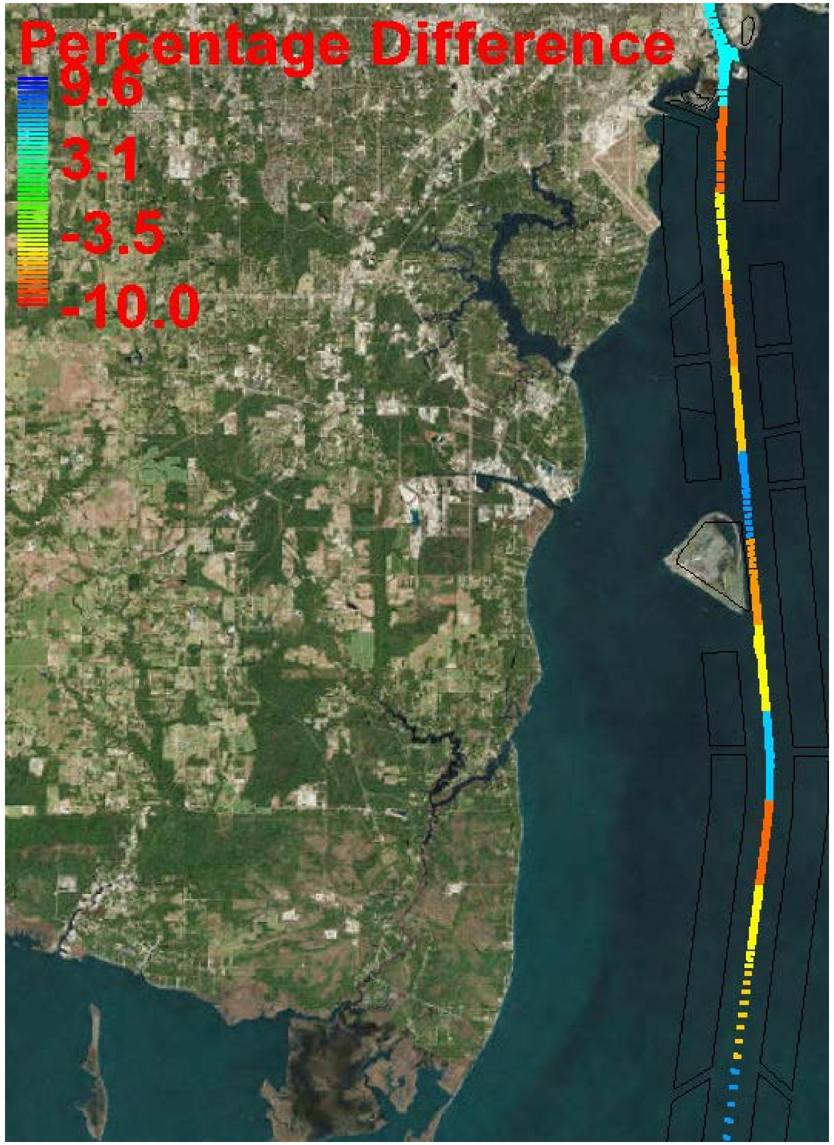
US Army Corps of Engineers

U.S. ARMY

MODEL PERFORMACE

Percentage difference between measured and simulated shoaling rate in the navigation channel with existing channel depths.

Channel simulated shoaling volume 2.5% less than historic dredged volume.



ESTUARINE SEDIMENT TRANSPORT MODELING

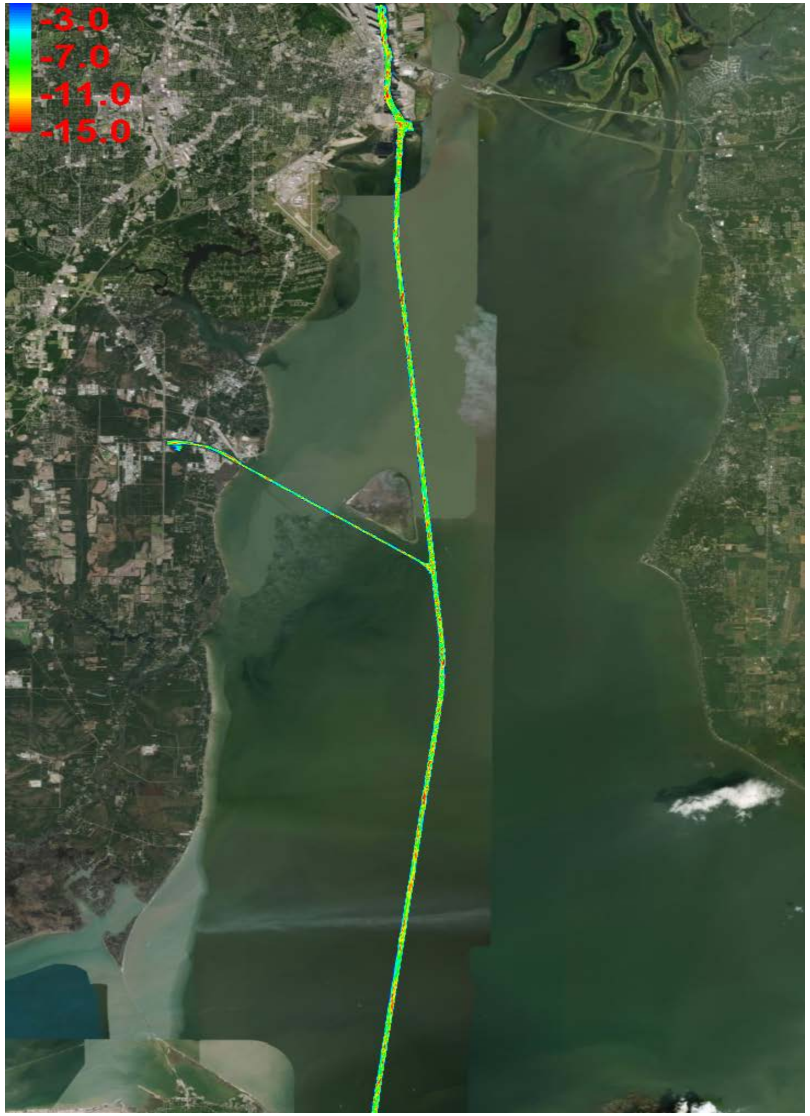
US Army Corps of Engineers

U.S. ARMY

RESULTS SUMMARY

Increases in average annual shoaling vary from 5 to 15% along the navigation channel with Project channel depths.

Percent Increase in Channel Shoaling

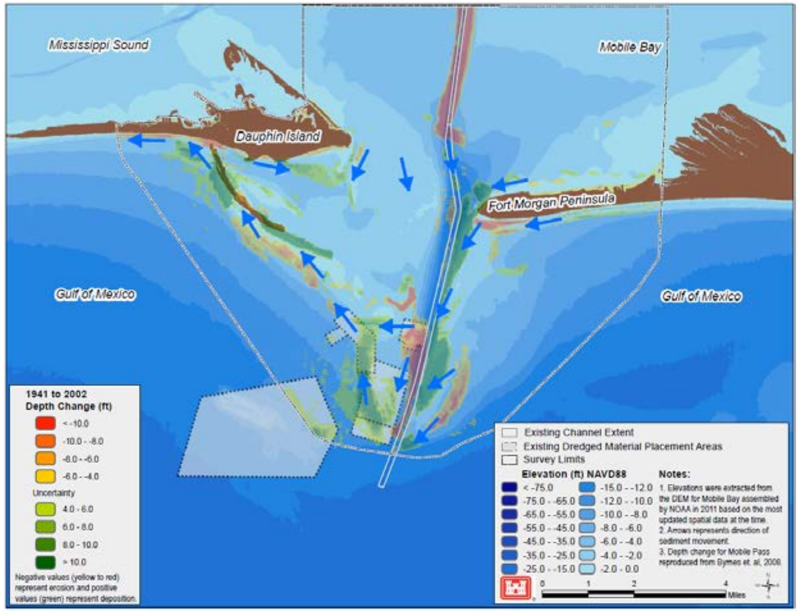


COASTAL SEDIMENT TRANSPORT MODELING

OVERVIEW

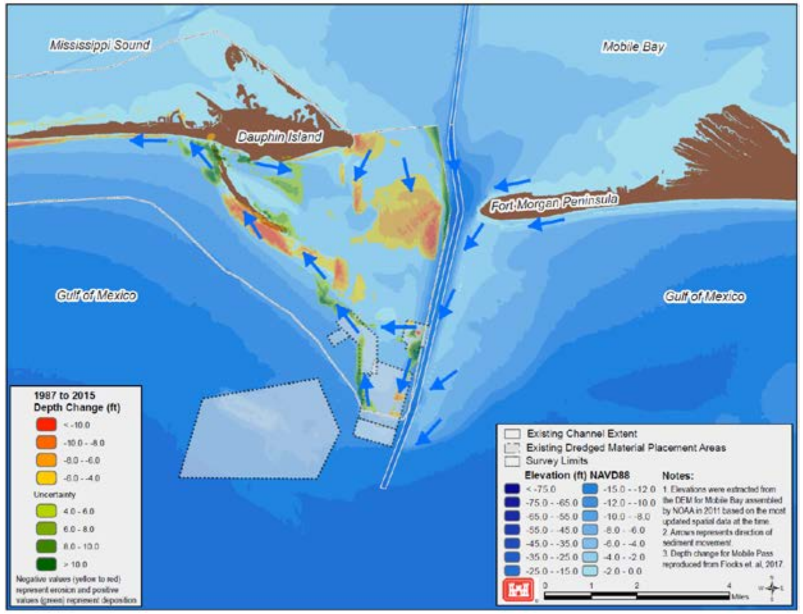
*Purpose: T*o evaluate possible effects of widening and/or depending the Mobile Harbor Navigation Channel on the ebb tidal shoal and adjacent nearshore coastal areas.

Mobile Pass Bed Level Change 1941 to 2002 (+/- Erosion/Deposition, ft)



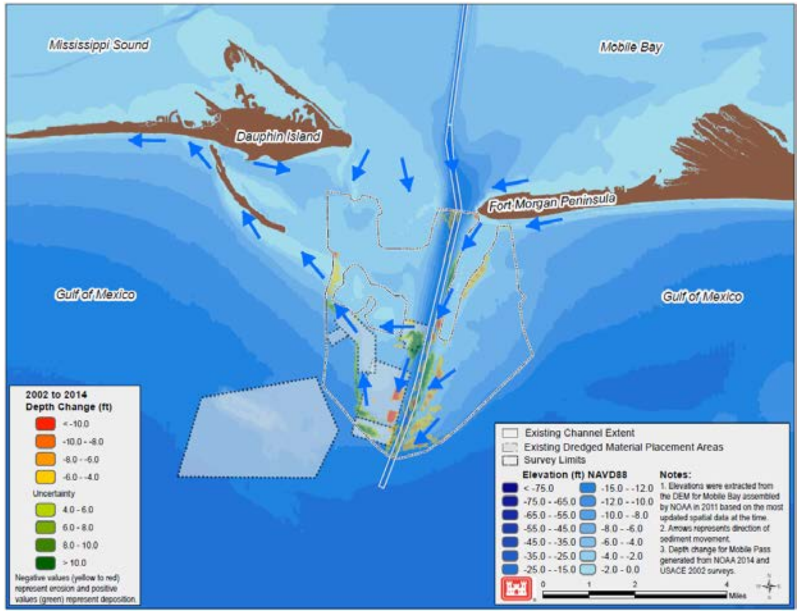
Depth change reproduced from Byrnes et. al, 2008 "Evaluation of Channel Dredging on Shoreline Response at and Adjacent to Mobile Pass, Alabama"

Mobile Pass Bed Level Change 1987 to 2015 (+/- Erosion/Deposition, ft)



Depth change reproduced from Flocks, et. al, 2017 "Analysis of Seafloor Change around Dauphin Island, Alabama, 1987–2015" Open-File Report 2017–1112.

Mobile Pass Bed Level Change 2002 to 2014 (+/- Erosion/Deposition, ft)



Depth change generated from USACE 2002 and NOAA 2014 surveys.

COASTAL SEDIMENT TRANSPORT MODELING

US Army Corps of Engineers

U.S. ARMY

APPROACH

Model: Simulations made using Delft3D.

Simulation Period: 10 years

Simulated Conditions: Existing, with project and 0.5 meter relative rise in sea level.

Forcing: 10 year wave climatology derived from data spanning from 1998-2016

Model Evaluation: Made using NOAA tide gages, 2015 waves and current measurements and historic topographic and bathymetric change measurements

COASTAL SEDIMENT TRANSPORT

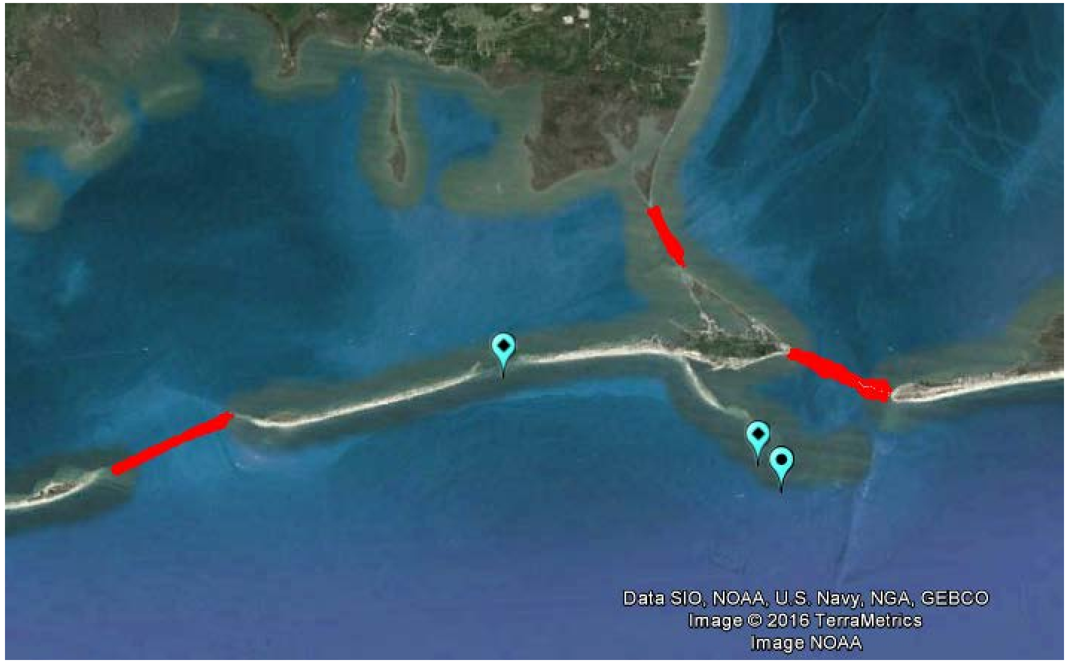
US Army Corps of Engineers

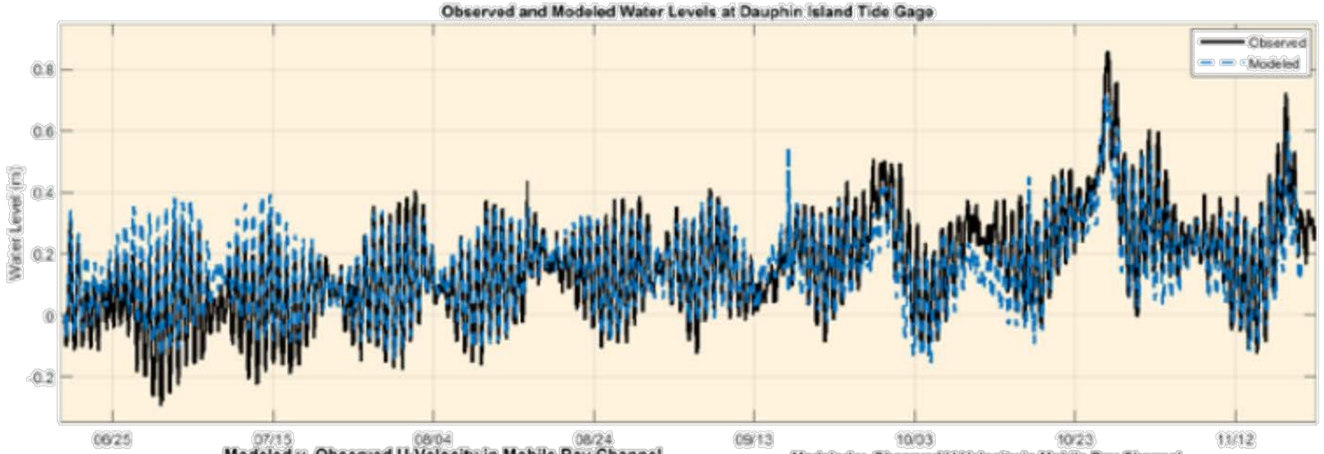
U.S.ARMY

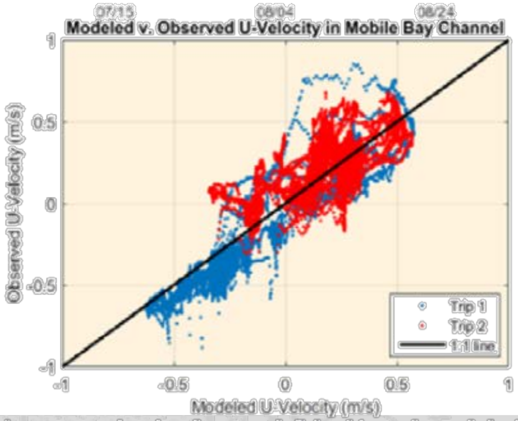
MODEL PERFORMACE

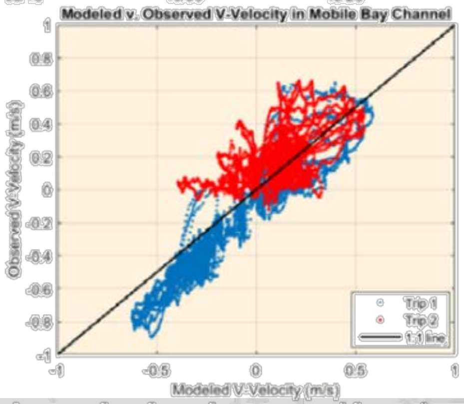
Good agreement made between observed and modeled wave and water levels near the island and ebb/flood velocities through the passes adjacent to Dauphin Island.

Comparison: Observed Water Level and Currents Versus 2015 Observed









USGS
science for a changing world

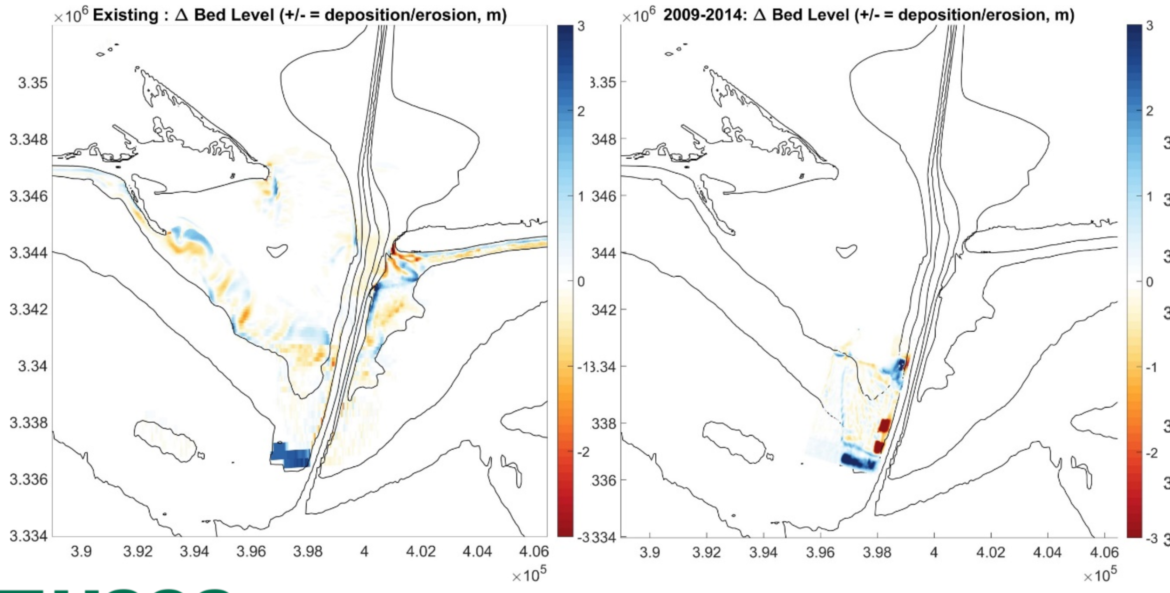
COASTAL SEDIMENT TRANSPORT

MODEL PERFORMACE

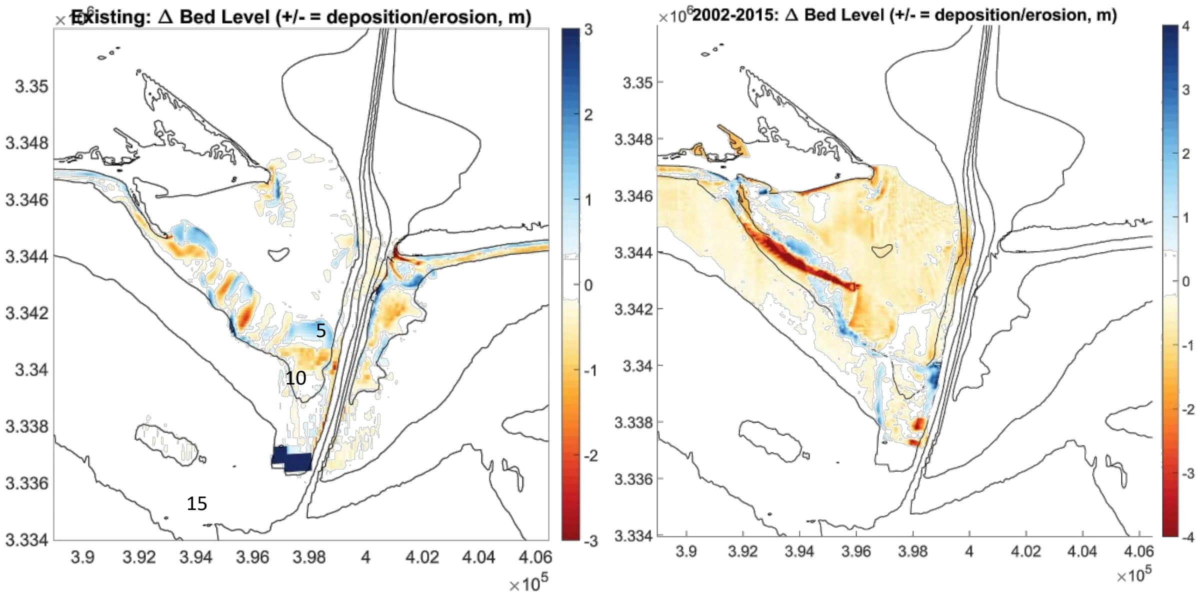
Model captured patterns of erosion and accretion along the edge of the channel, near Dixie Bar and by Pelican Island.

Additional sensitivity tests (Hurricane Ivan) ran to evaluate tropical storm influence on widespread erosion between the 5 and 10 m contours.

Comparison: 5-year Modeled vs. 2009 to 2014 Observed



Comparison: 10-year Modeled vs. 2002 to 2015 Observed



US Army Corps of Engineers

U.S. ARMY

USGS
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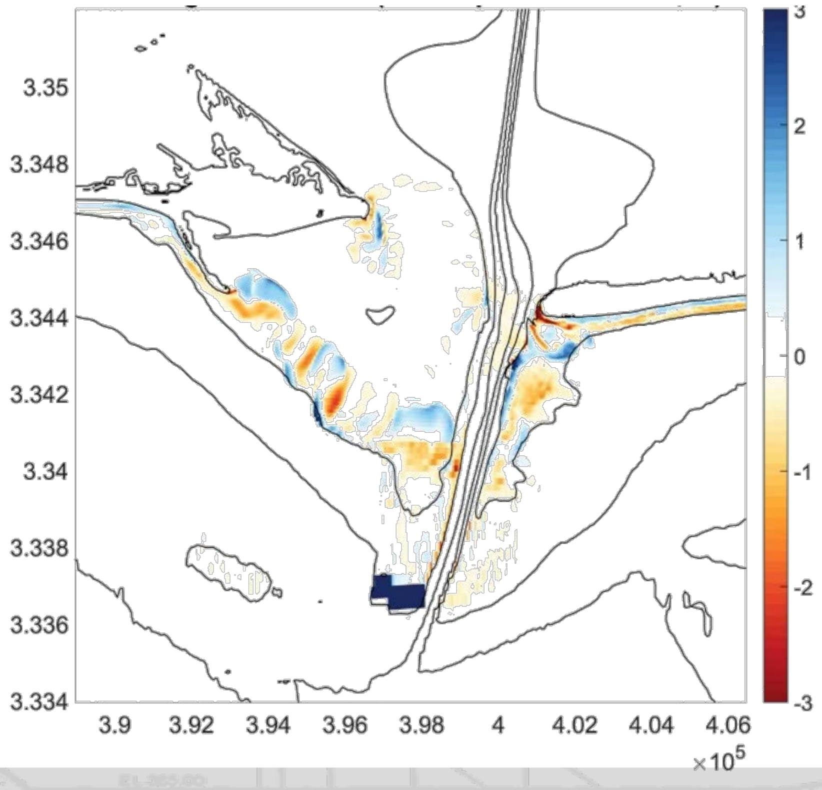
COASTAL SEDIMENT TRANSPORT

RESULTS SUMMARY

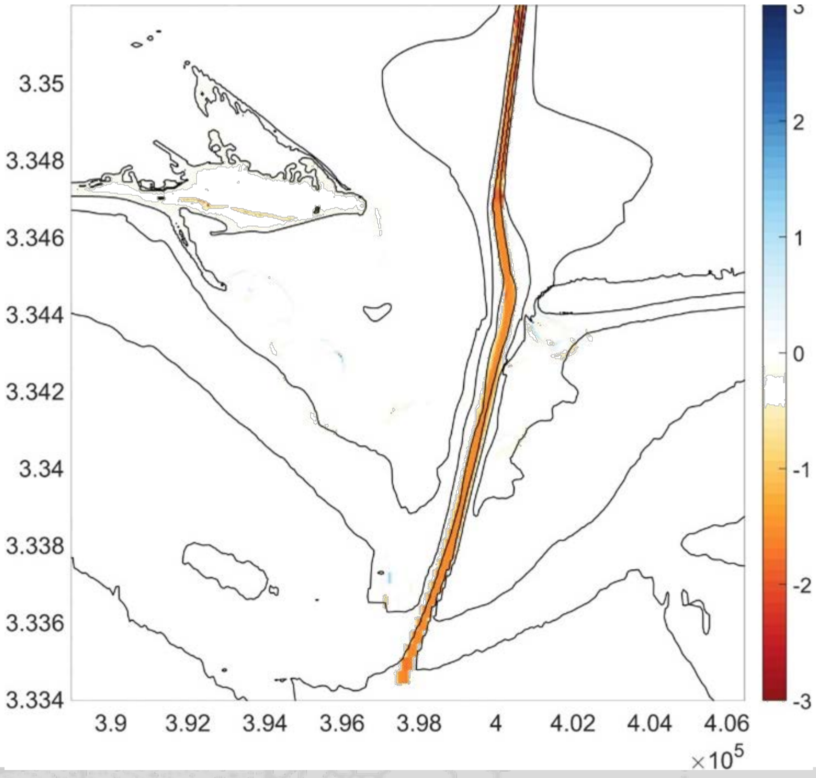
Minimum bed level changes between with project and existing conditions estimated in the bay and ebb-tidal shoal.

Mobile Pass Sediment Transport Modeling (Delft 3D)

With Project Condition 10 Year Simulation
Bed Level Change (+/- Erosion/Deposition, m)



With Project – Existing Condition
Bed Level Change (+/- Erosion/Deposition, m)



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VESSEL GENERATED WAVE ENERGY

US Army Corps of Engineers

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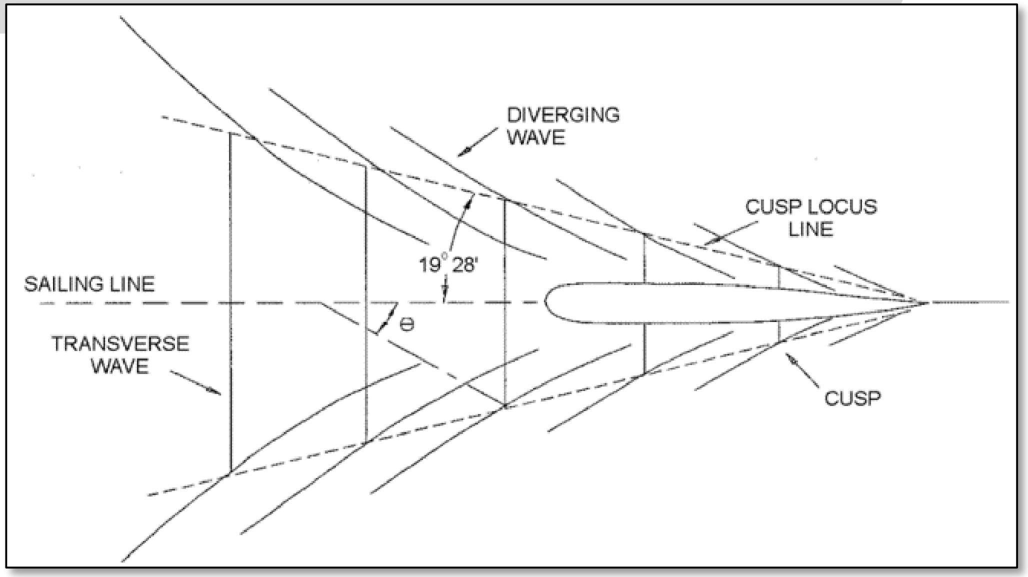
OBJECTIVE

Determine vessel generate wave energy propagation from the Federal Navigation Channel for vessel classes having an overall length greater than 400 feet to assess potential impacts to shorelines within Mobile Bay as a result of proposed channel improvements using statistical comparisons of the current and forecasted fleets and channel geometries.

$$SW = f(V_L, V_B, V_D, V_S, V_{Dir}, d_C, D_S)$$



CHALLENGE

1. No literature specific to Mobile Bay available.
2. Complex bathymetry and distance from channel unaccounted for in literature.
3. Methods to quantify vessel generated waves as wave height not useful for analysis.
4. Vessel generated waves do not follow common wave theories.

VESSEL GENERATED WAVE ENERGY

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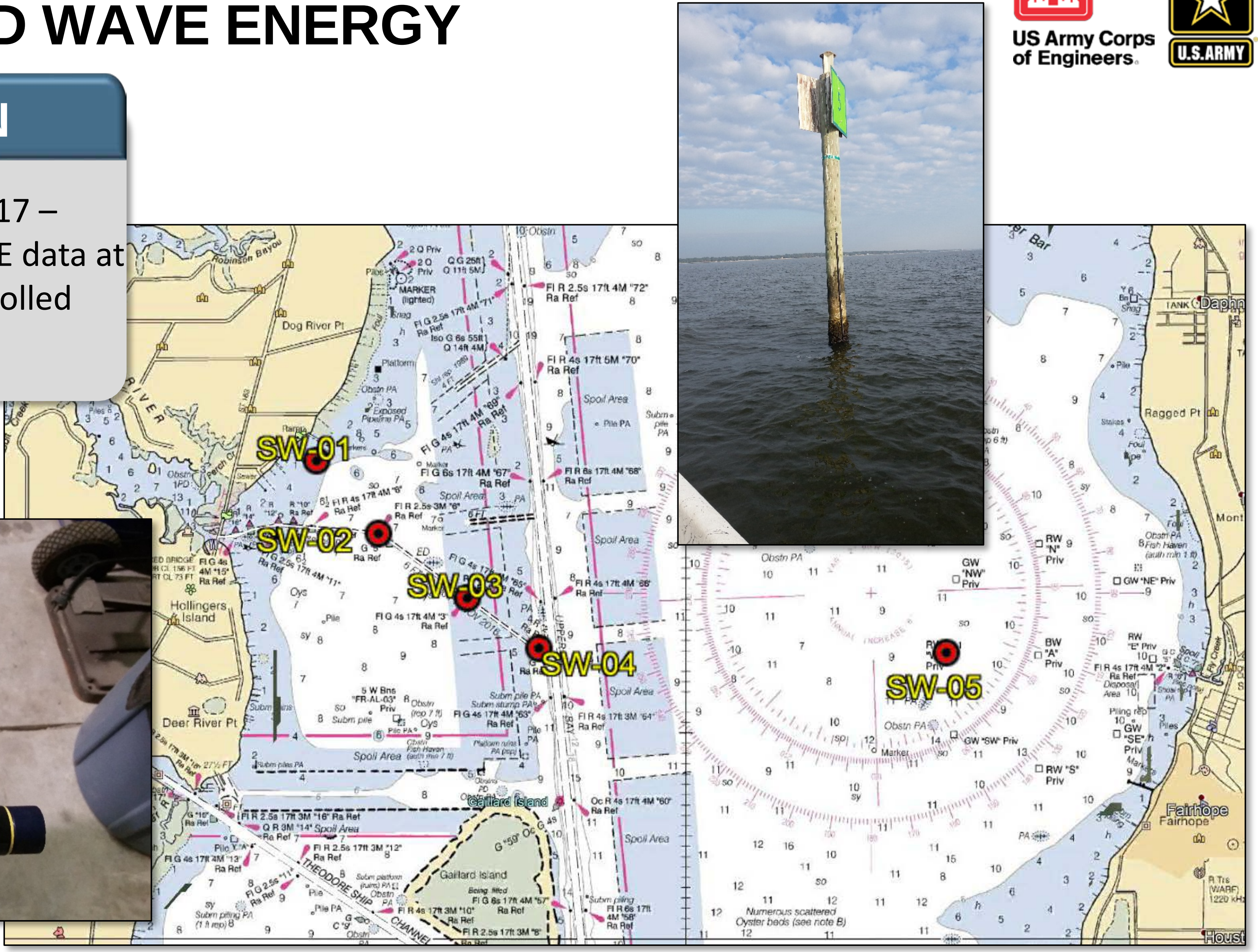
DATA COLLECTION

5 sites operated for 62 days (11/18/2017 – 01/19/2018) collecting continuous WSE data at 8Hz (8 samples per second). AIS data polled from USCG for vessel characteristics.

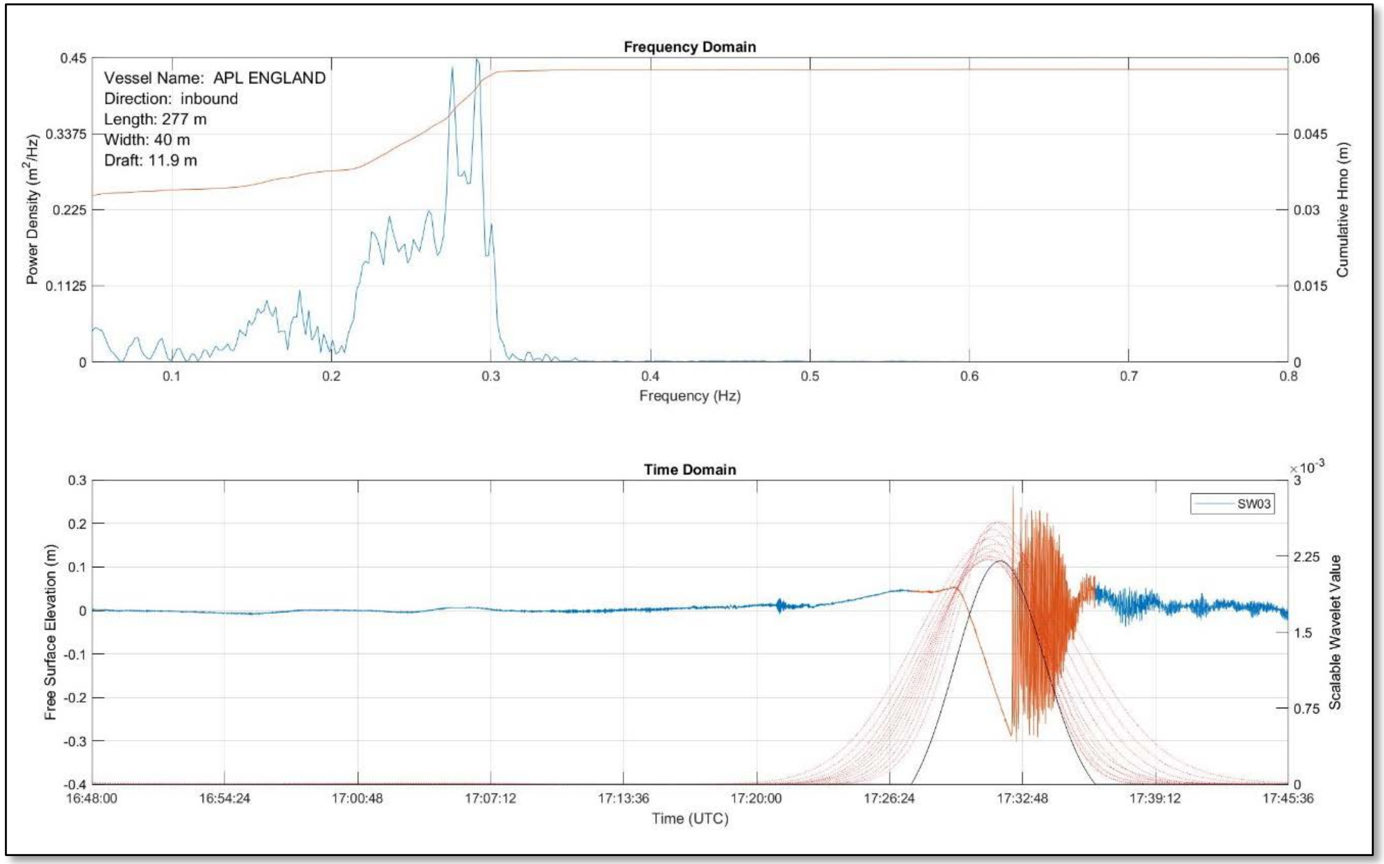


VESSEL GENERATED WAVE ENERGY

DATA PROCESSING

Steps:

1. Subsample WSE time series using AIS record.
2. Compute continuous wavelet transform to identify event and duration.
3. Compute Fourier Transformation on wavelet.
4. Integrate under the power vs. frequency plot for spectrally significant wave height (H_{mo}).
5. Compute dimensionless parameters of vessels based on dependencies identified in literature



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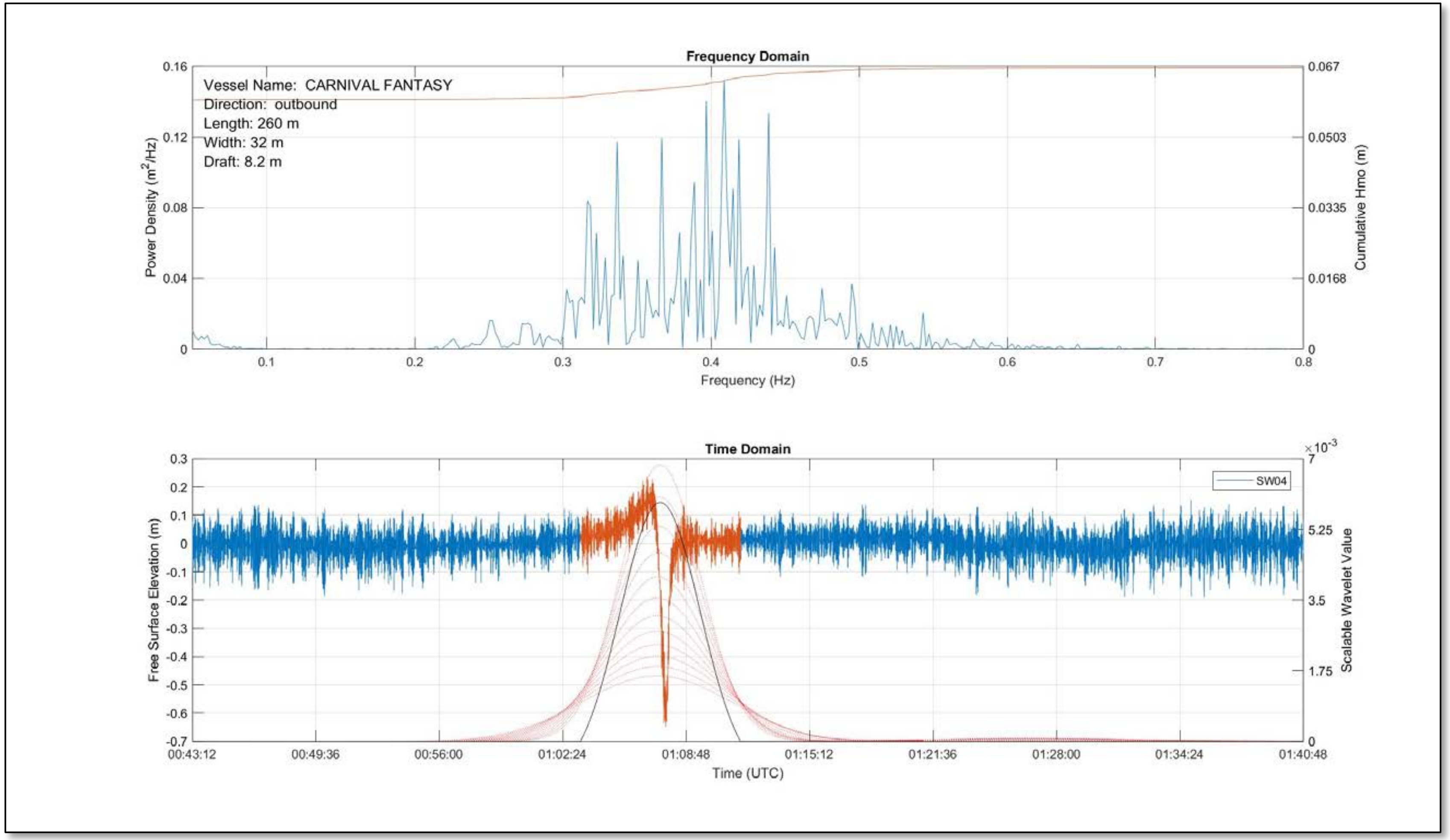

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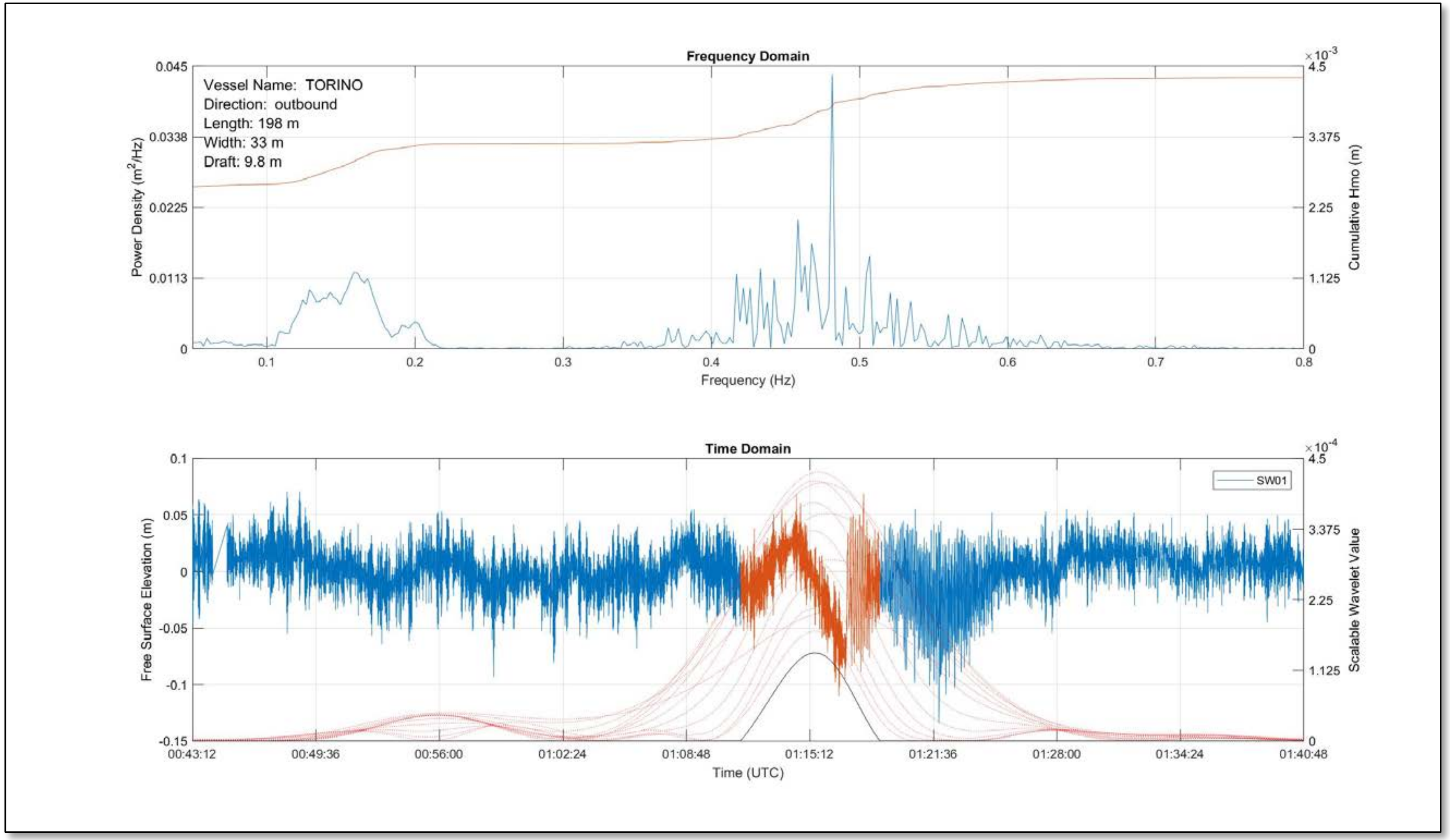
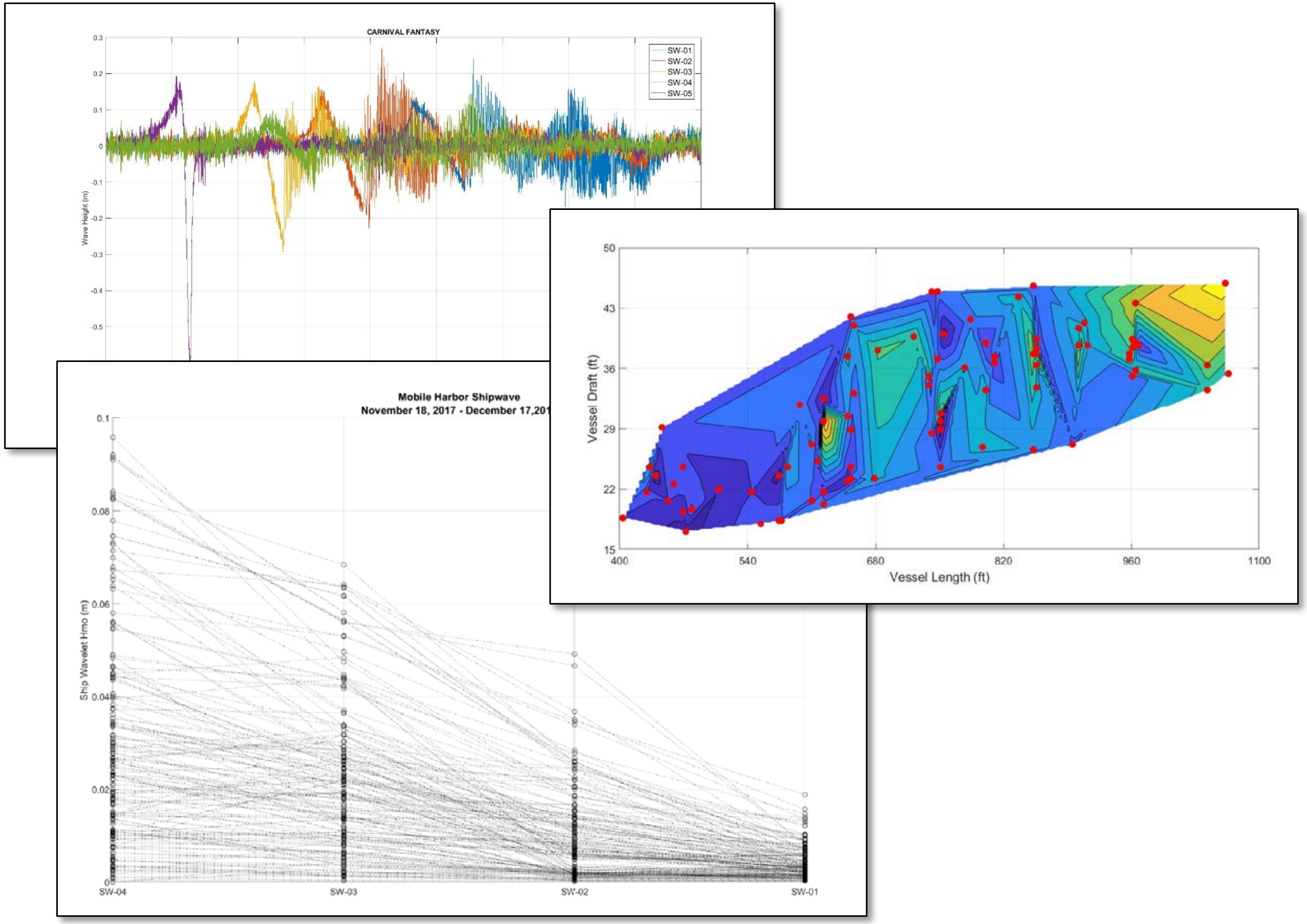


VESSEL GENERATED WAVE ENERGY

ANALYSIS

1. Compute correlation between dimensionless vessel parameters and vessel generated wave energy w.r.t. spatial orientation, vessel direction, speed, and climatology.
2. Use correlation to develop a “predictive” method to forecast future vessel generated wave energy.
3. Determine statistical difference in vessel generated wave energy and background wave energy.
4. Develop statistical comparisons of current and forecasted vessel wave energy.



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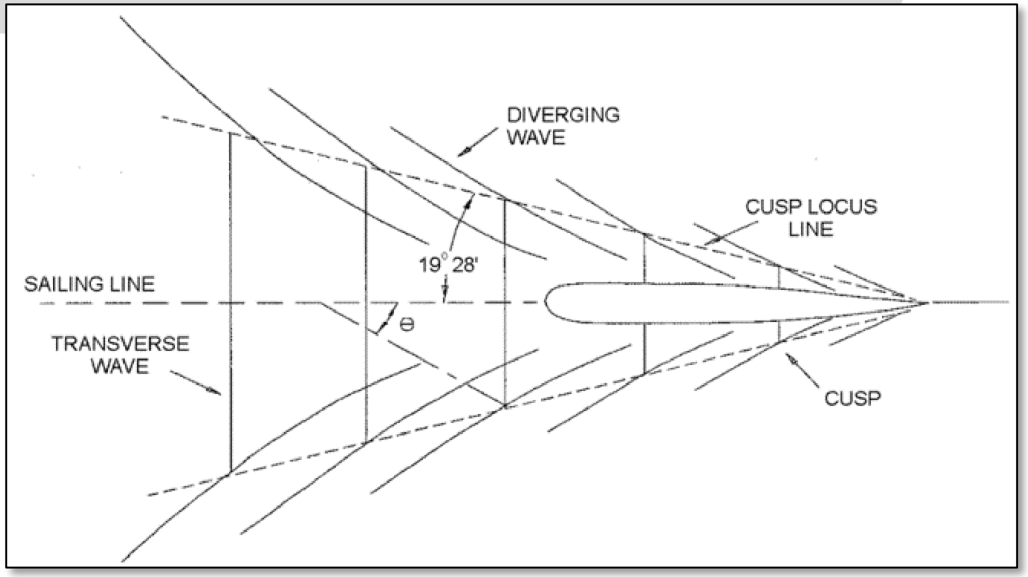

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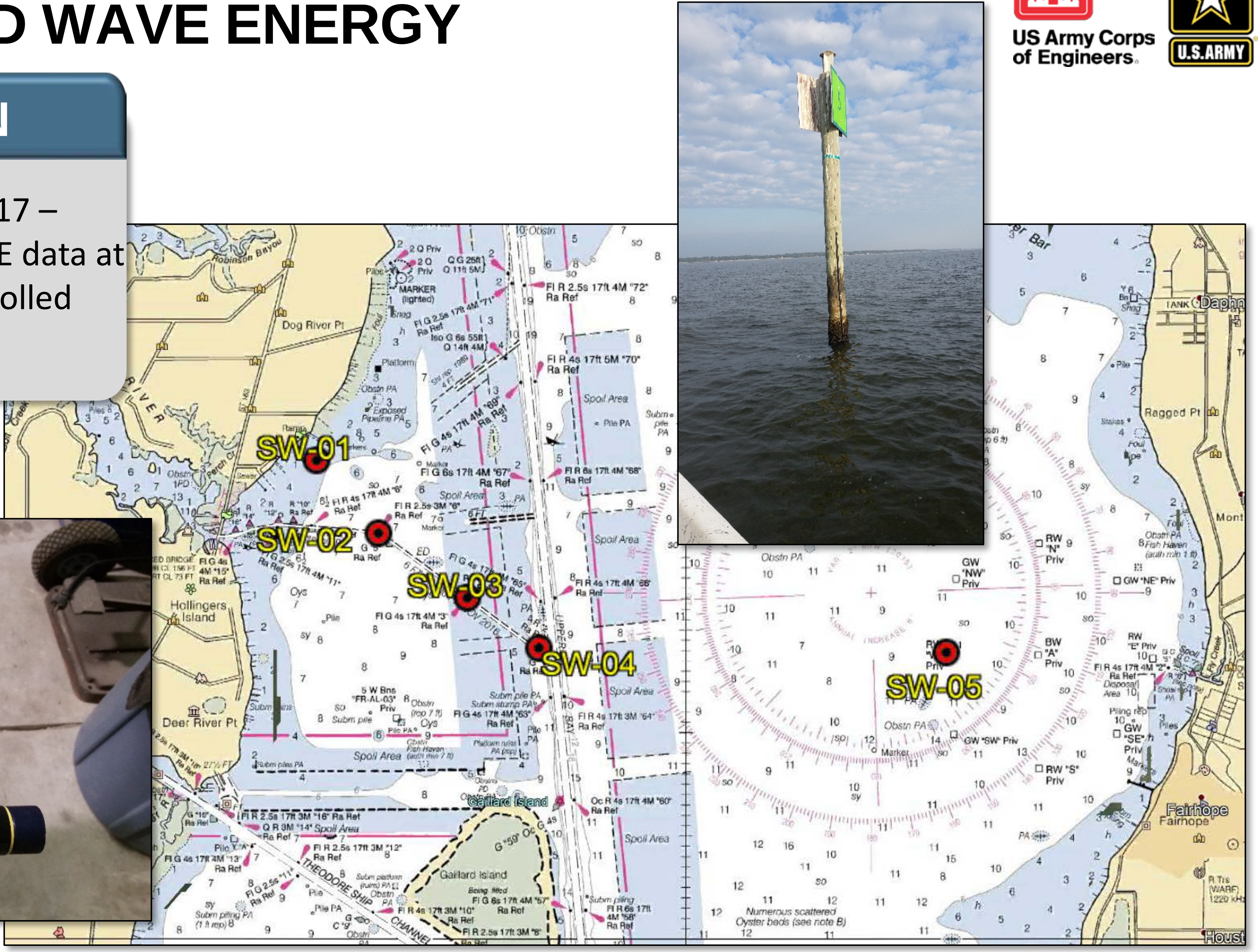

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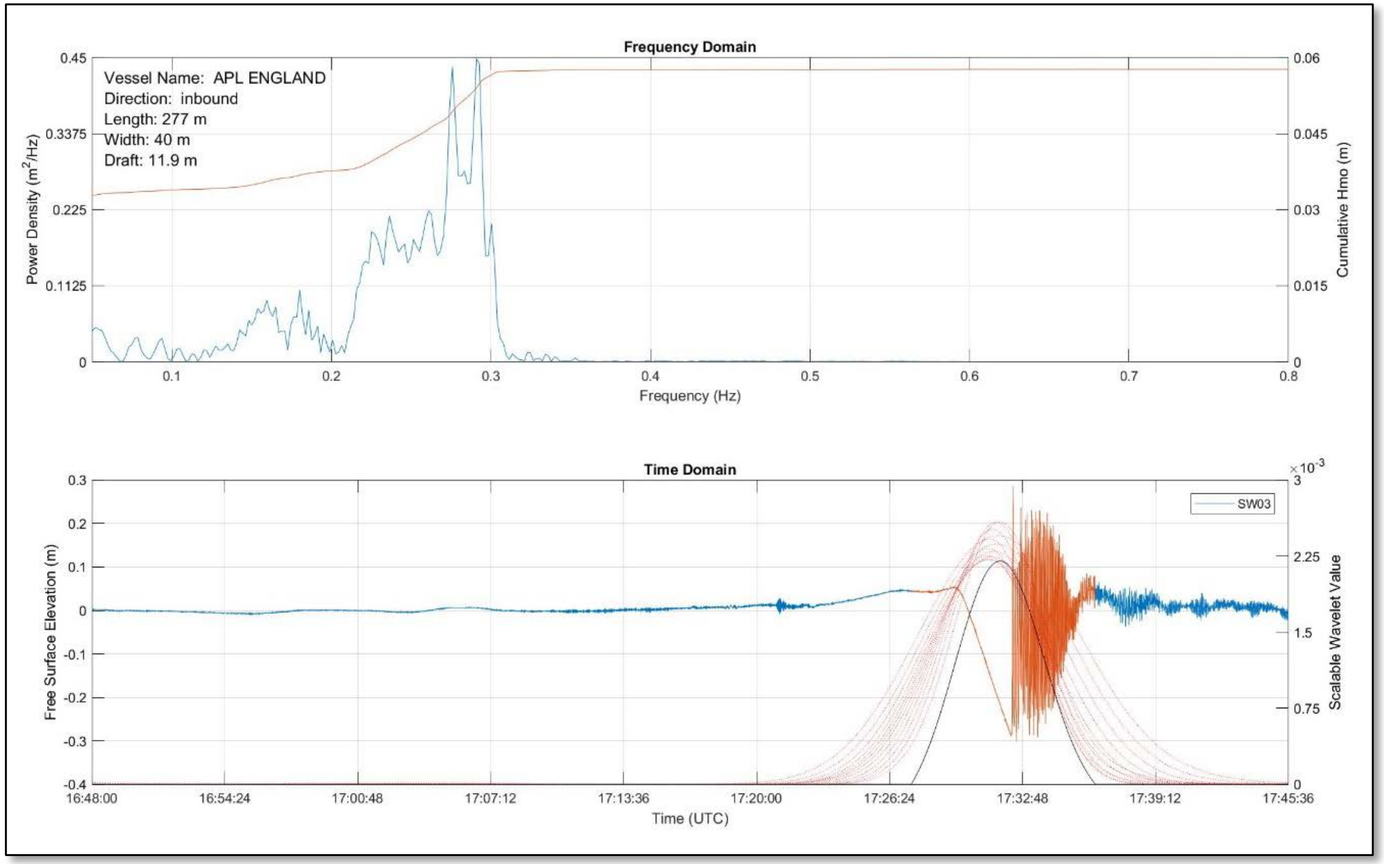

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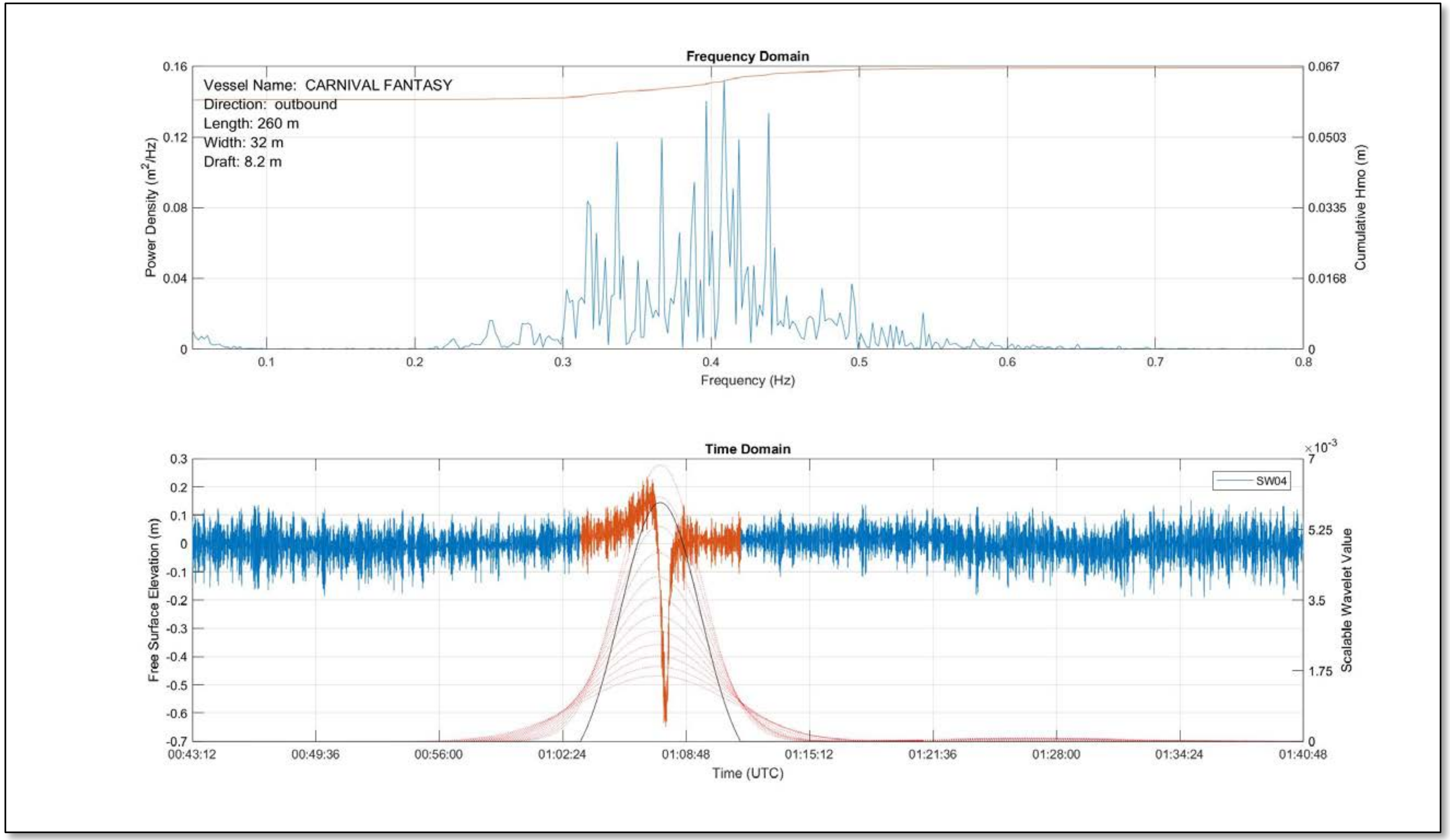

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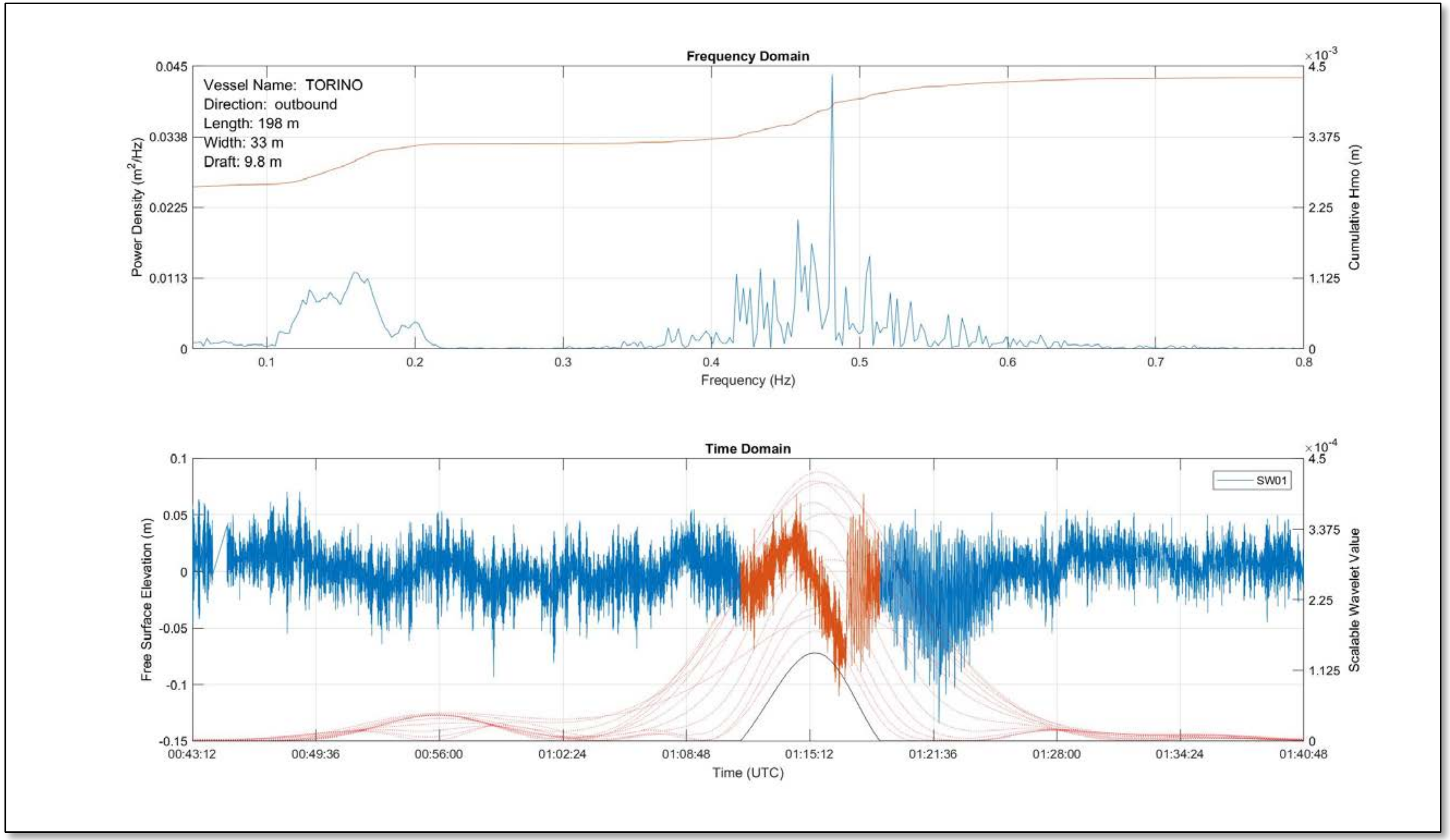

VESSEL GENERATED WAVE ENERGY

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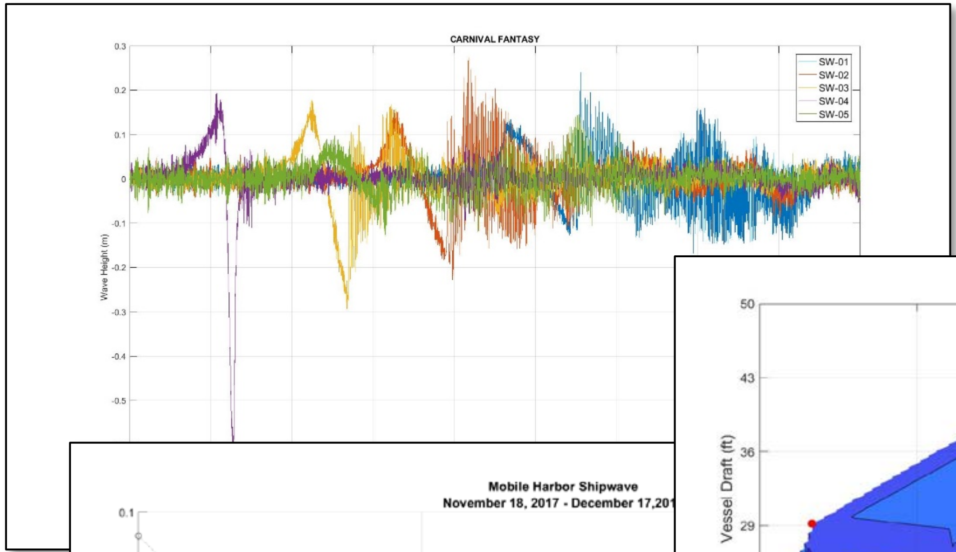

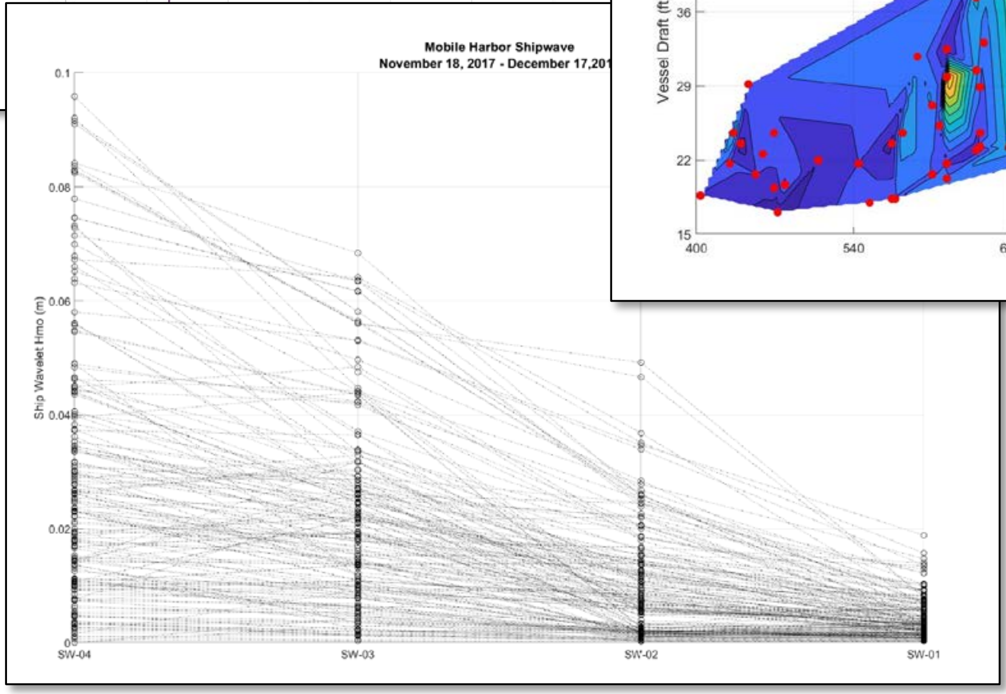

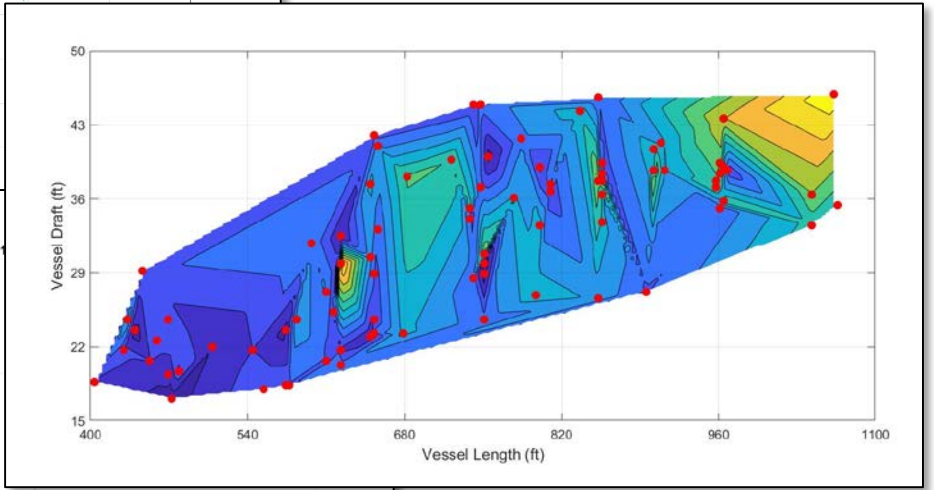

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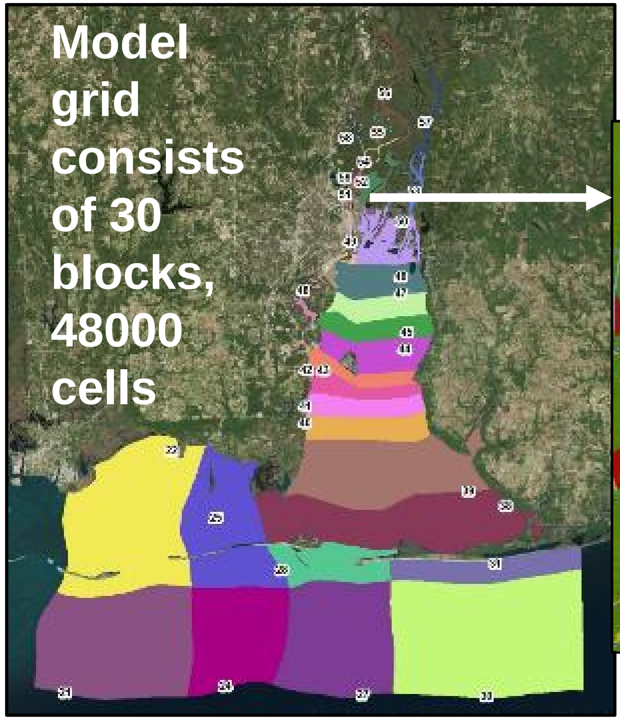
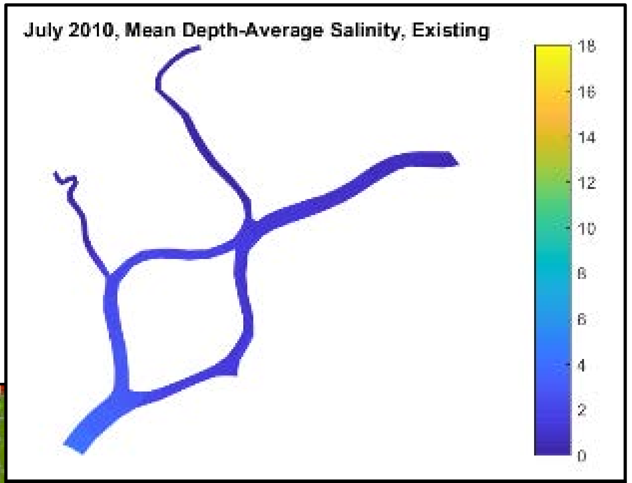
AQUATIC RESOURCES ASSESSMENT - OVERVIEW

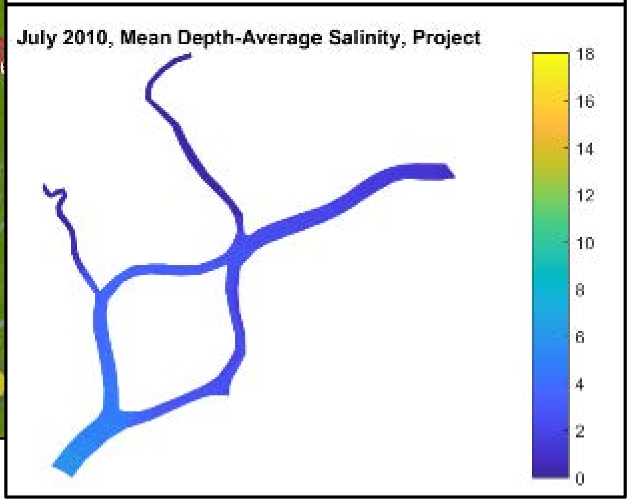
Assessing potential impacts to wetlands, SAV, benthic invertebrates, oysters, fish

Model outputs compare water quality using existing and post-project conditions

Sea level rise scenario - 0.5 meter







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AQUATIC RESOURCES ASSESSMENT

Data from State Resources

- Wetlands - State of AL
  Communications on existing data and shared locality information on state- listed species encountered in field mapping efforts.

- SAV – Mobile Bay National Estuary Program
  Shape files for 2008-2009, 2015 (via Vittor and Associates)

- Oysters – AL Department of Marine Resources
  Communications on and exchange of water quality data

- Fish – AL Department of Marine Resources
  Fisheries Assessment and Monitoring Program data from 2005-2015

SUBMERGED AQUATIC VEGETATION MAPPING IN MOBILE BAY AND ADJACENT WATERS OF COASTAL ALABAMA IN 2015

MOBILE HARBOR GRR

AQUATIC RESOURCES ASSESSMENT - WETLANDS

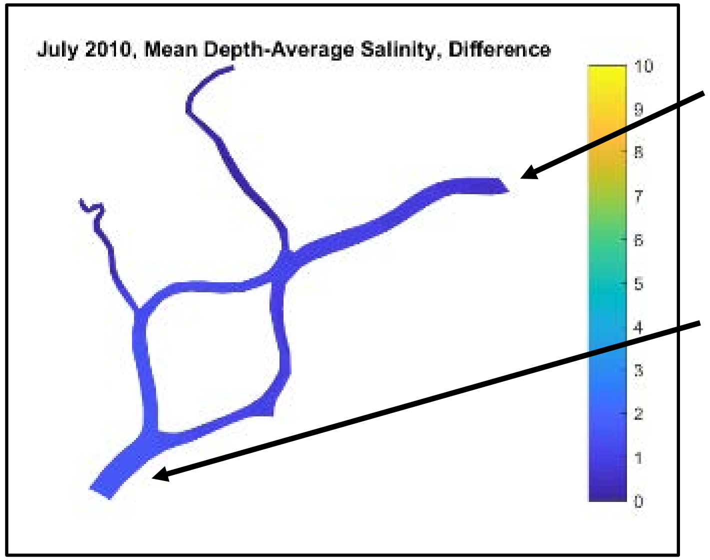
Assessment approach:

Wetland mapping → 43 community types; >800 on-site samples

Salinity tolerances derived from literature

Evaluated average (likely outcome) and 75th percentile (conservative) salinity increases

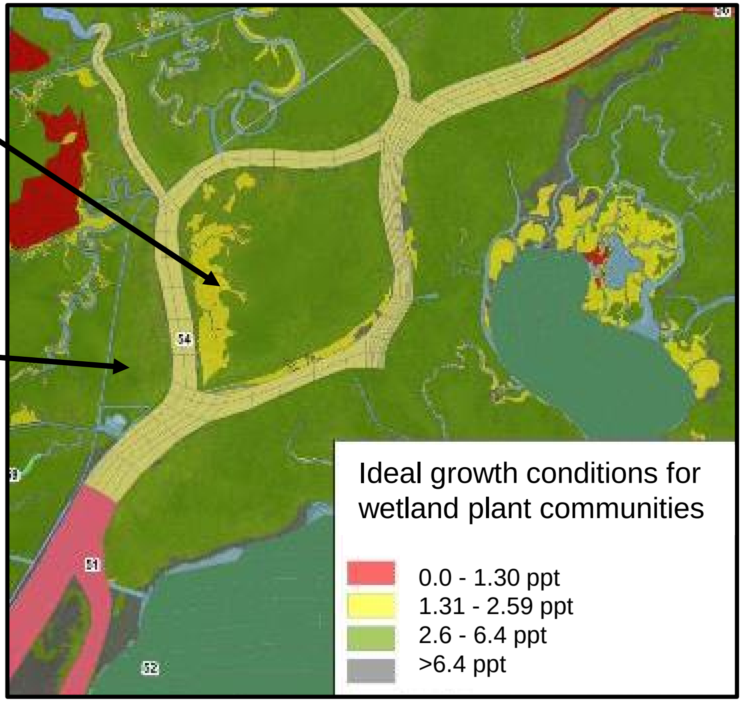
Assessed potential exceedance of salinity thresholds (ideal growth and mortality)



No salinity change in upper reach.

Projected increase of ~1 ppt in lower reach

Wetland plant communities adapted to predicted post-project salinity levels



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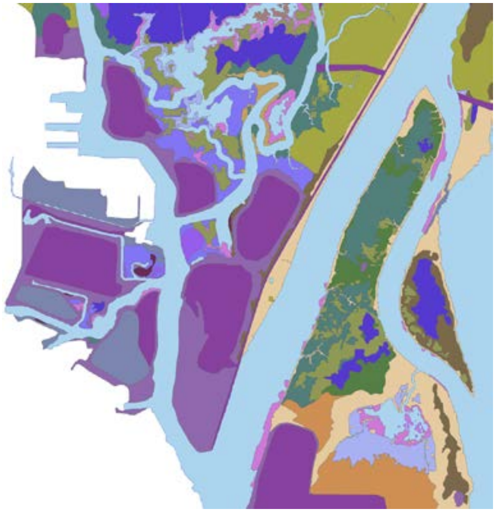
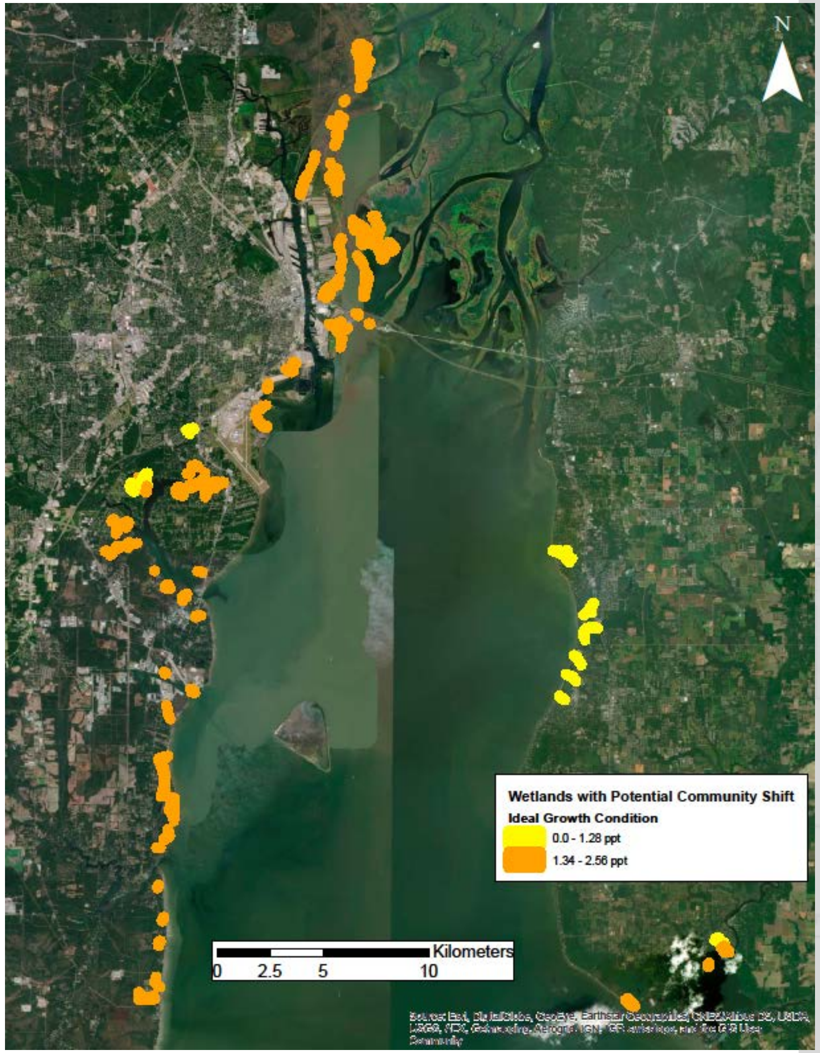
AQUATIC RESOURCES ASSESSMENT - WETLANDS

Assessment results:

- High resolution mapping of 77,000 ac within the project area
- No wetland losses anticipated based upon post-project salinity
- No vegetation mortality thresholds surpassed
- No wetlands exceed ideal growth condition under expected conditions
- At the 75th percentile salinity - potential for minor vegetation shift in some wetlands (600 ac) based upon short term productivity reduction
  - –No anticipated decrease in function
  - –No shift between community types (freshwater, estuarine, saltwater)
- Sea level rise will result in substantial inundation of existing wetlands
- Project impacts remain negligible under 0.5 meter sea level rise scenario





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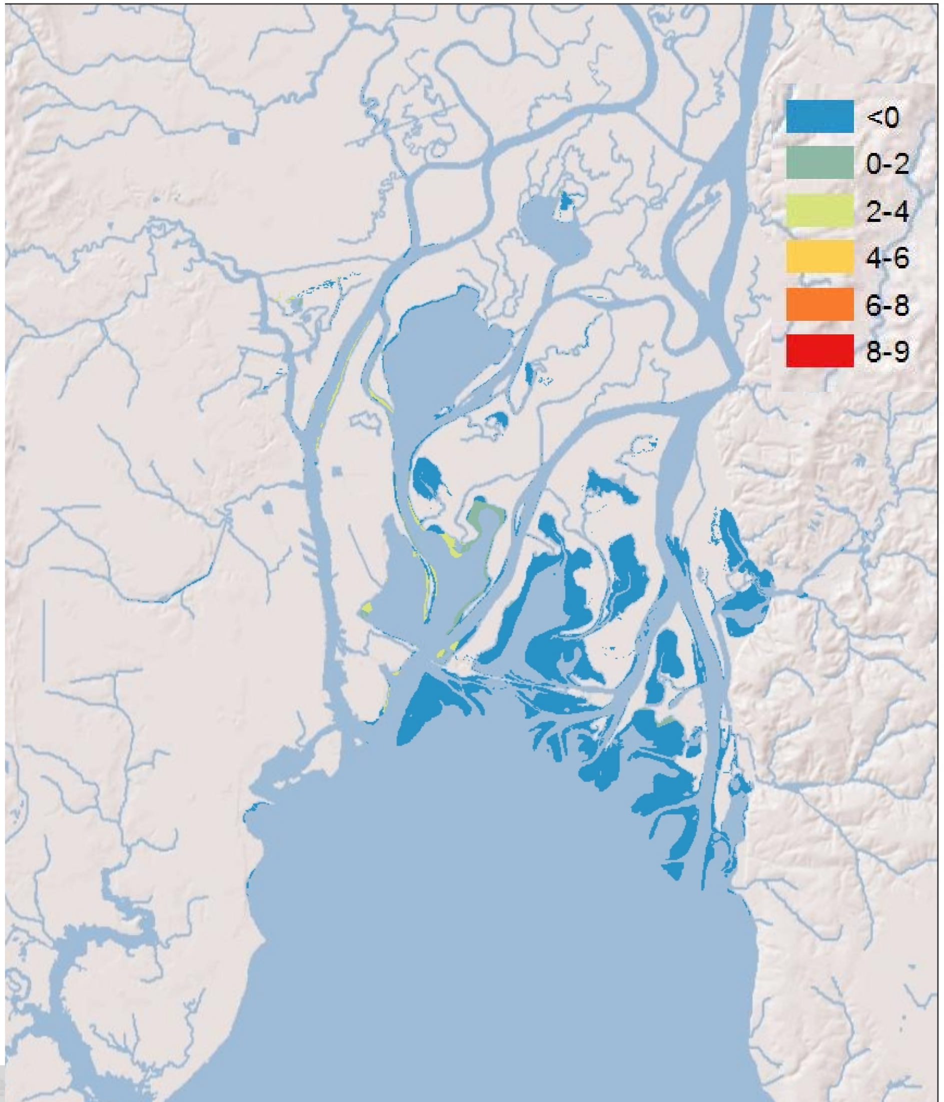
Aquatic resource assessment – SAV

With Project
Mean increase in salinity above
tolerance threshold values

- Salinity tolerances established from literature and adjusted to baseline conditions

- Salinity conditions for SAV patches outside of hydrodynamic model domain estimated using mean of nearest adjacent cells

- Assess impacts within georeferenced database by identifying areas where project increases salinity above baseline adjusted tolerance thresholds



With Project Salinity (ppt) above SAV tolerance threshold		
Range	**Mean Acres**	**75th Percentile Acres**
<0	7307	7217
0-1	212	0
1-2	47	53
2-3	121	218
3-4	35	76
4-5	11	22
5-6		106
6-7		33
7-8		7

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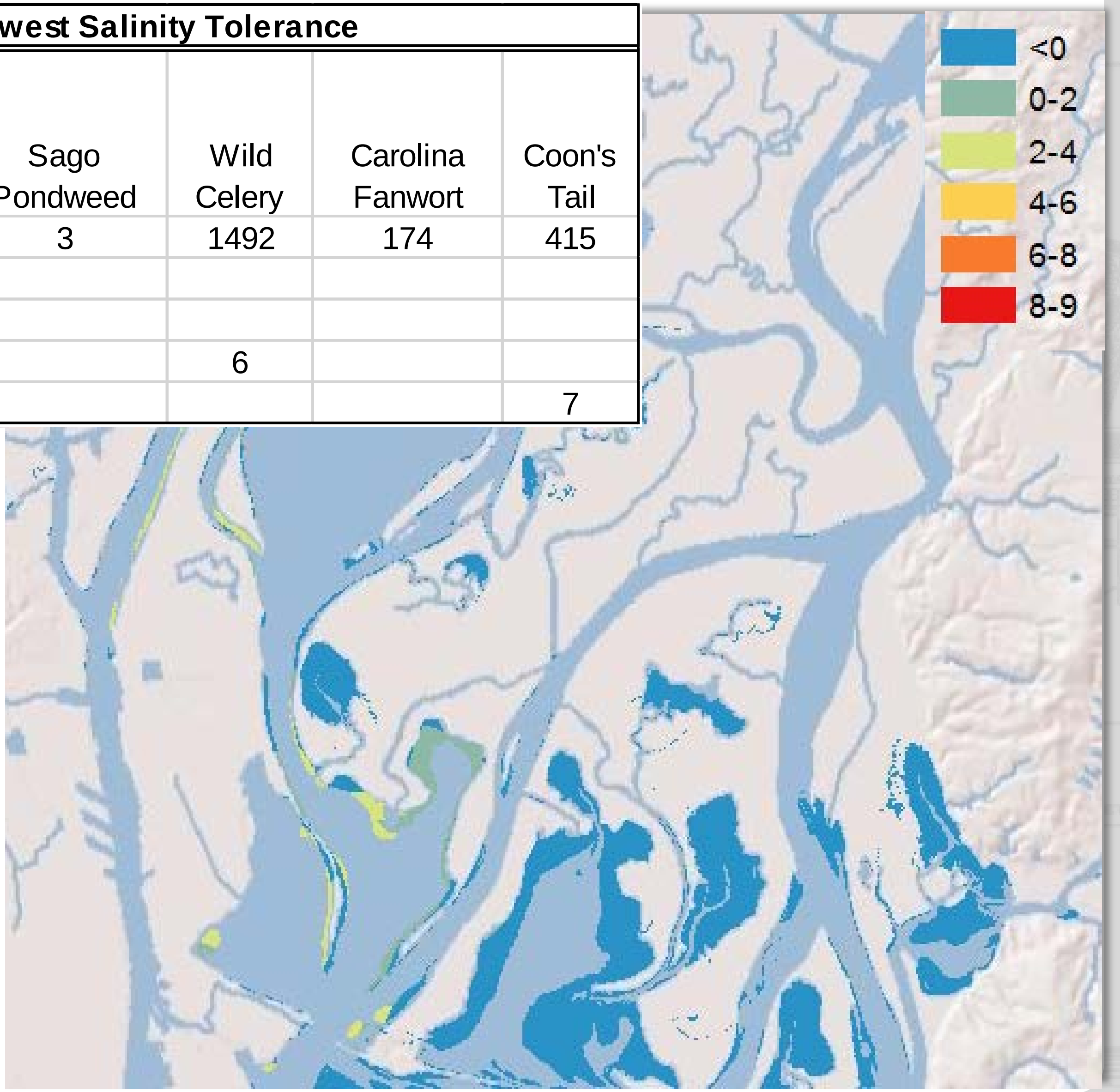
Aquatic resource assessment – SAV

	Species within SAV Bed with lowest Salinity Tolerance							
With Project Salinity (ppt) above SAV tolerance threshold	Water Star Grass	Eurasian Watermilfoil	Southern Naiad	Widgeon Grass	Sago Pondweed	Wild Celery	Carolina Fanwort	Coon's Tail
<0	2494	2300	307	23	3	1492	174	415
0-1		212						
1-2		47						
2-3		110				6		
3-4		38						7



- Three species show potential with project impacts due to increased salinity

- **Eurasian Watermilfoil** – Aquatic invasive species

- **Wild Celery** and **Coon's Tail**
  - Duration of elevated salinity is critical
  - Wild Celery can survive salinity up to 25ppt in pulses of less than 7 days (Fraser et al. 2006)
  - Coon's Tail can survive 12ppt for 7 days (Hinojosa-Garro etal. 2008)

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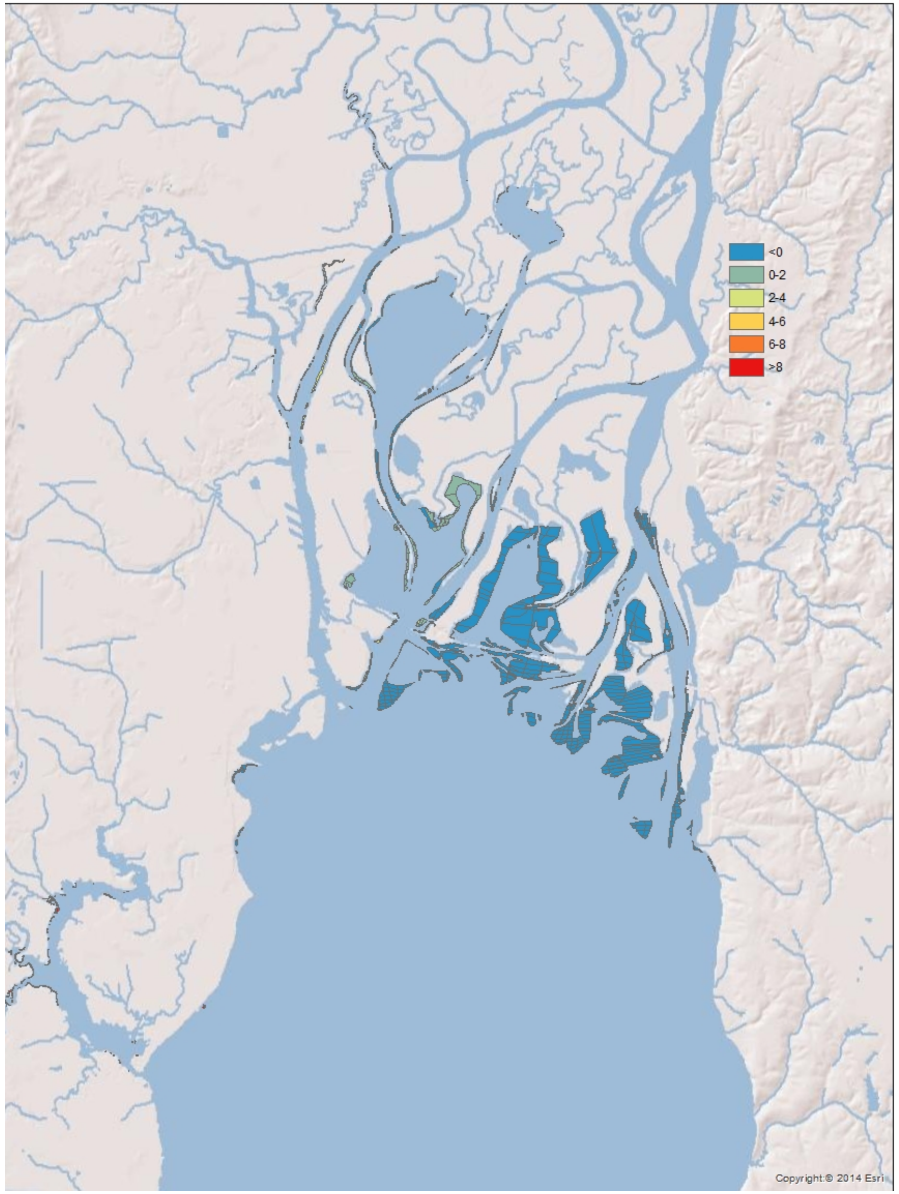
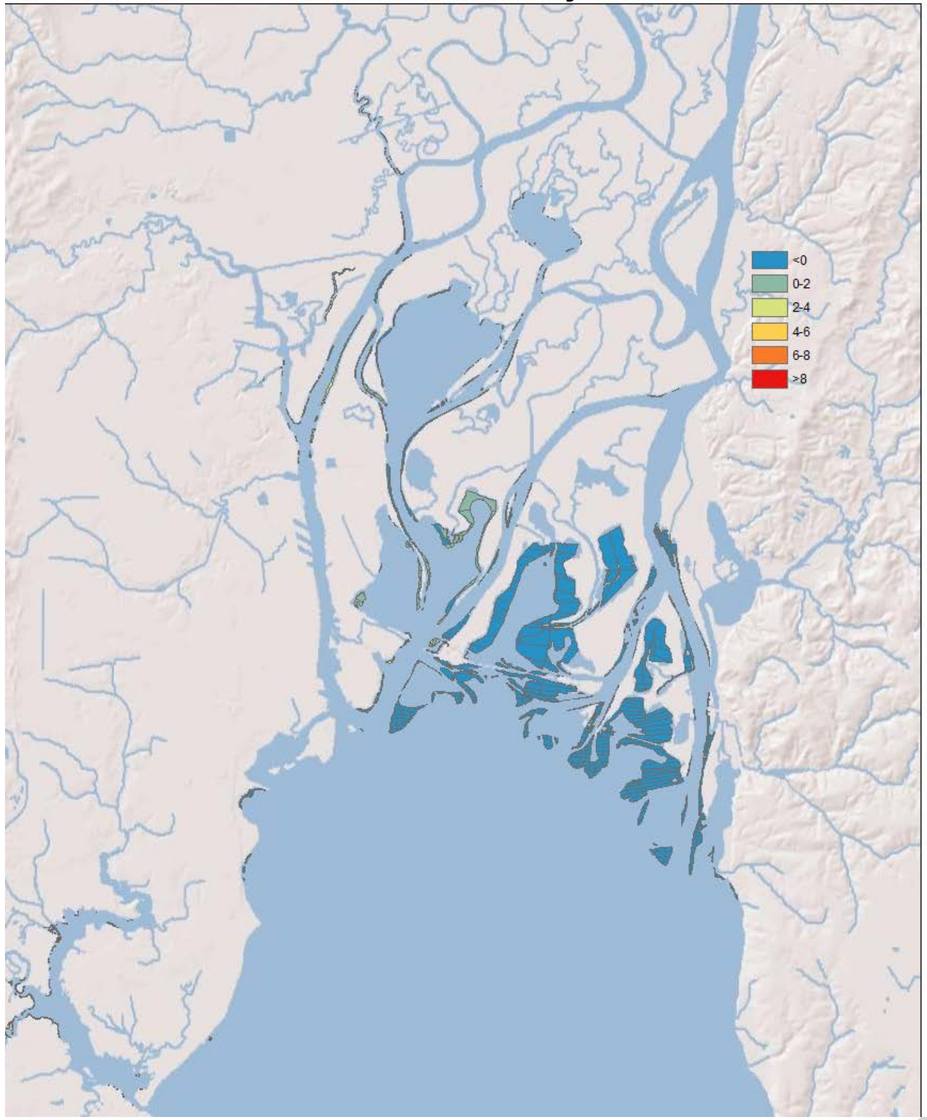
AQUATIC RESOURCES ASSESSMENT - SAV

Under 0.5 meter sea-level rise scenario, No major differences seen between baseline and post-project conditions.

SLR Baseline



SLR With Project



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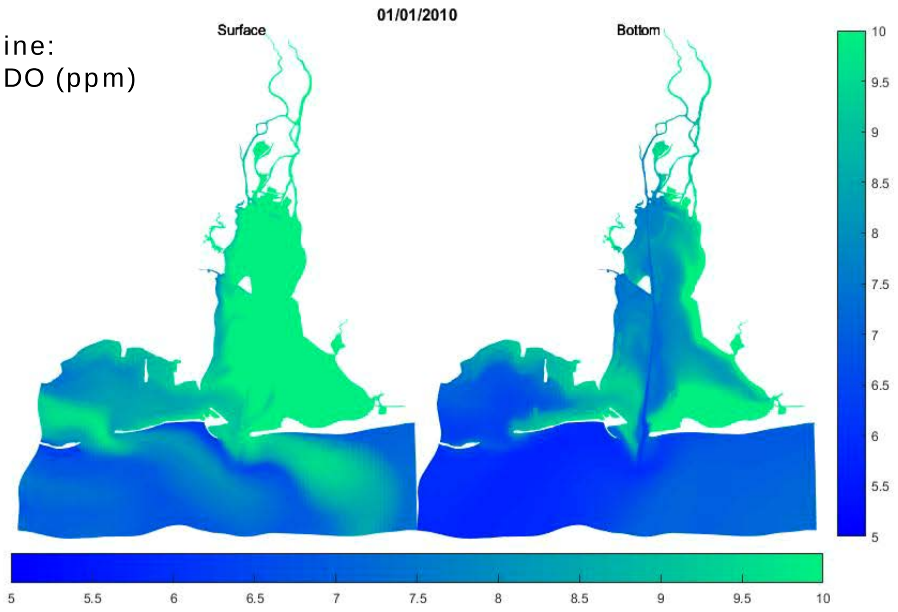
AQUATIC RESOURCES ASSESSMENT - OYSTERS

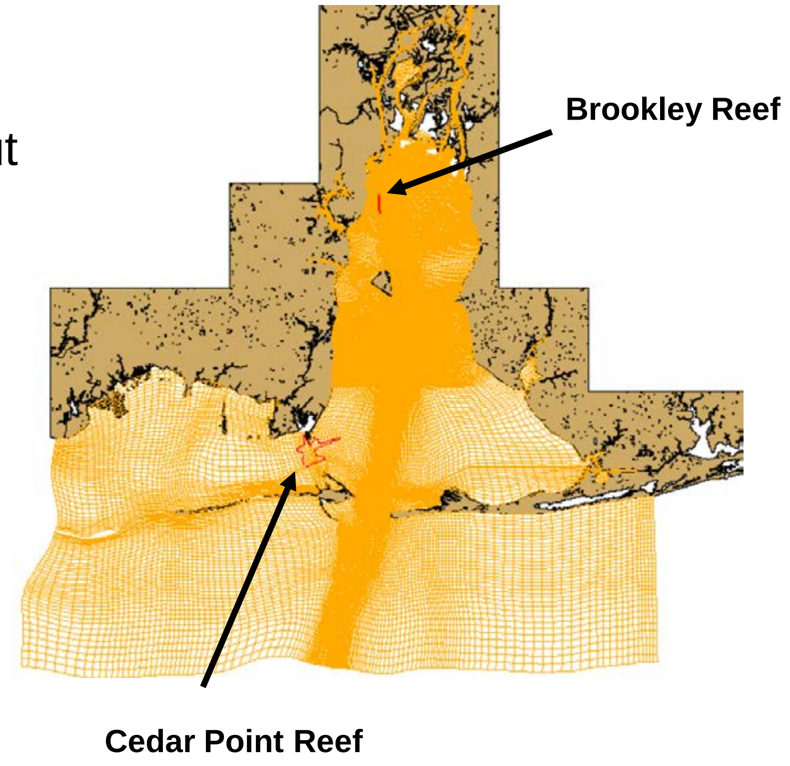
Assessment approach:

- Integrated hydrodynamic, water quality, and oyster behavior models
- Completed oyster particle release and fate simulations
- Determined potential oyster mortality
- Modeled larval particles potentially flushed out of Mobile Bay

Baseline:
Daily DO (ppm)



Oyster Larvae Tracking Domain



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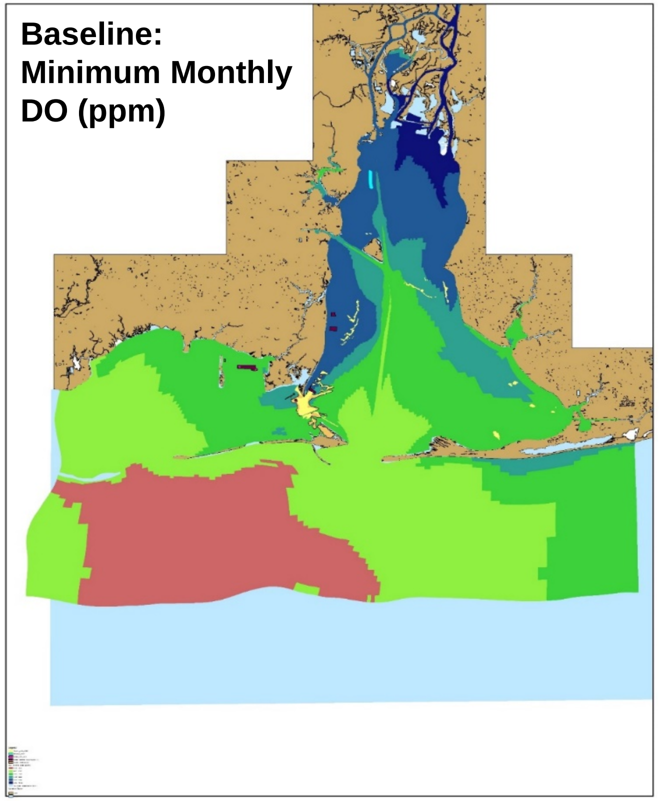
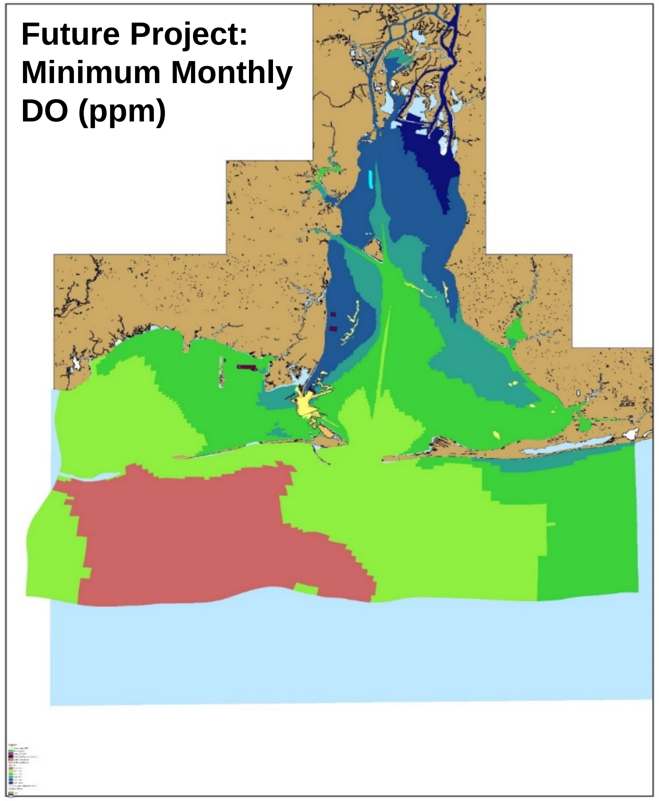
AQUATIC RESOURCES ASSESSMENT - OYSTERS

Assessment results:

Dissolved oxygen levels stay well above minimum oyster tolerances under post-project conditions

Oyster larvae particle tracking model displays zero mortality under all scenarios





	Number of Runs	Number of Oyster Larvae Deaths
Baseline	5	0
Project	5	0
Baseline (SLR)	3	0
Project (SLR)	3	0

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AQUATIC RESOURCES ASSESSMENT - OYSTERS

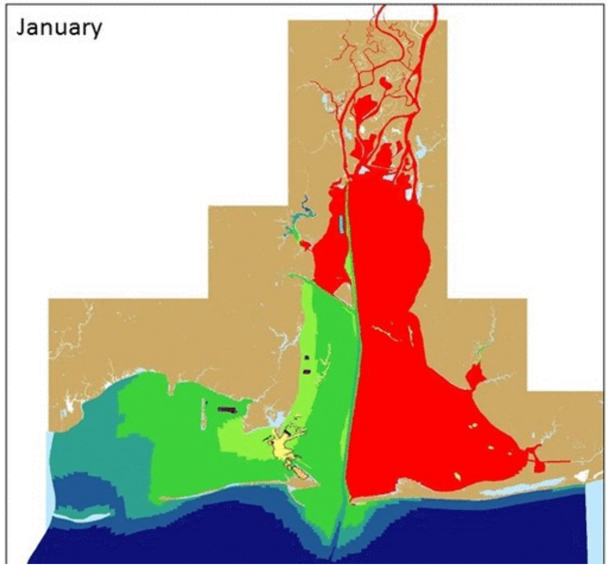
Assessment results:

Salinity data from all scenarios within minimum and maximum oyster tolerance thresholds post-project

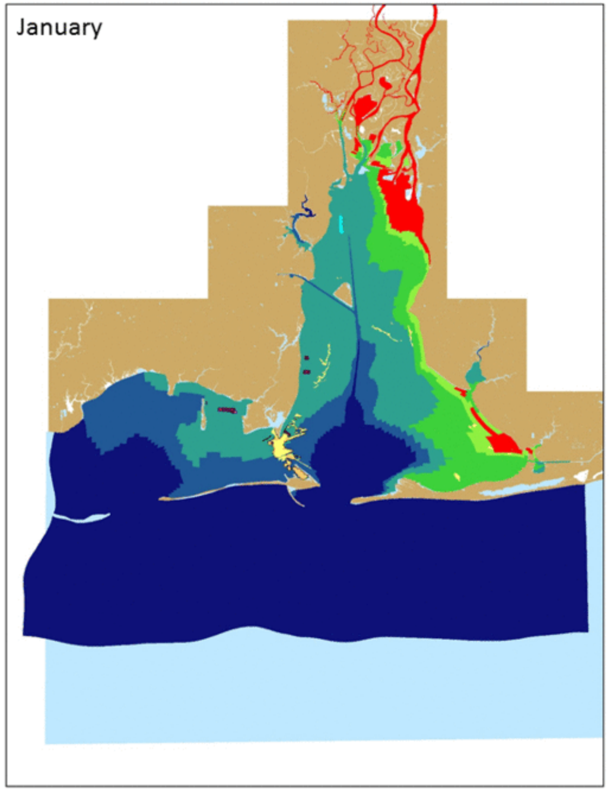
Sea-level rise scenario also predicts no oyster mortality

Oyster model predicts no increase in larvae flushing

Scenario	Particles released	Particles flushed	Particles attached	Particle mortality
Basline	42	1	41	0
Baseline with sea level rise	42	0	42	0
Post-project	42	1	41	0
Post-project with sea level rise	42	0	42	0



Minimum salinity post-project



Maximum salinity post-project

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AQUATIC RESOURCES ASSESSMENT - BENTHIC INVERTEBRATES

Assessment approach:

Sampling:

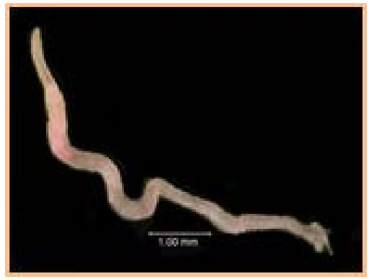
- Benthic samples (n = 240) taken in freshwater, transitional, and upper bay habitats in the fall and spring
- All individuals sorted and identified

Analysis:

- Statistical tests examined whether benthic macrofauna differed among habitat types,
- Tests determined how macrofauna were related to salinity,
- Locations of changes in macrofauna communities were identified.

Interpretation:

- Salinity changes due to deepening project were modeled for each benthic station
- Potential changes to macrofauna distributions were determined for fall and spring



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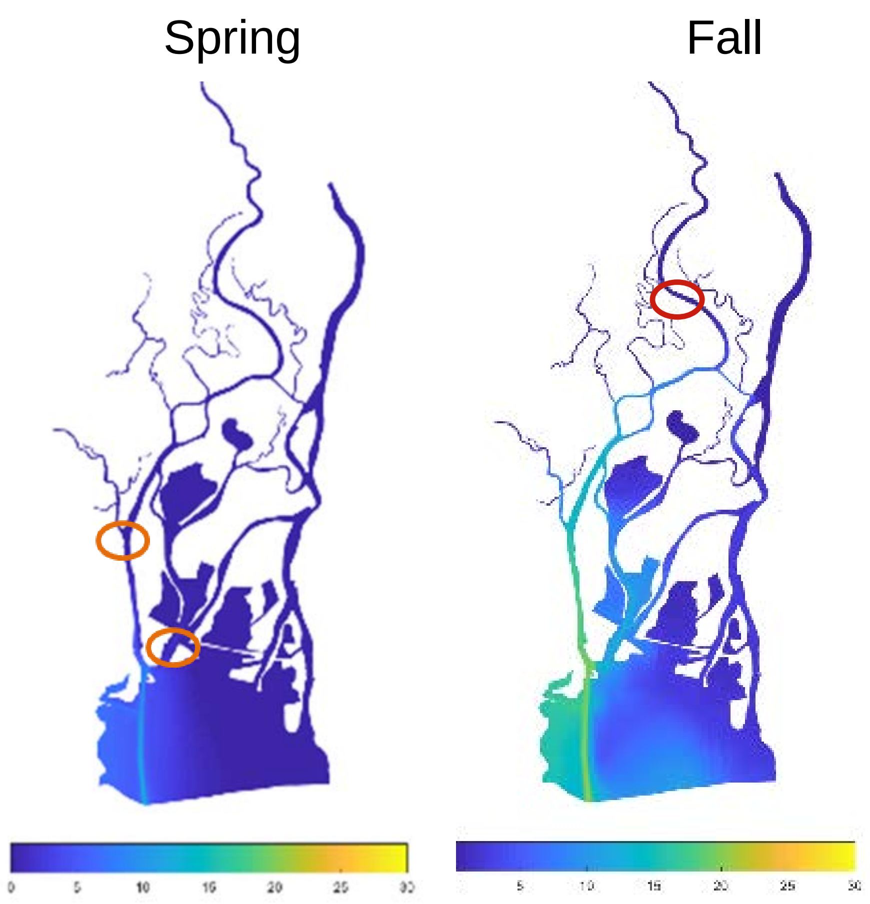
AQUATIC RESOURCES ASSESSMENT - BENTHIC INVERTEBRATES

Assessment results:

- Habitats with a saltwater influence are dominated by polychaete worms.
- Freshwater habitats are dominated by oligochaete worms and insects.
- Degree of freshwater inputs dictates species transition locations
- Model results suggest the locations of a transition to a freshwater benthic community (orange ovals) will remain similar to baseline conditions.
- Impacts to higher trophic levels (e.g., fish) via prey availability appear negligible because prey distributions are unlikely to be affected.



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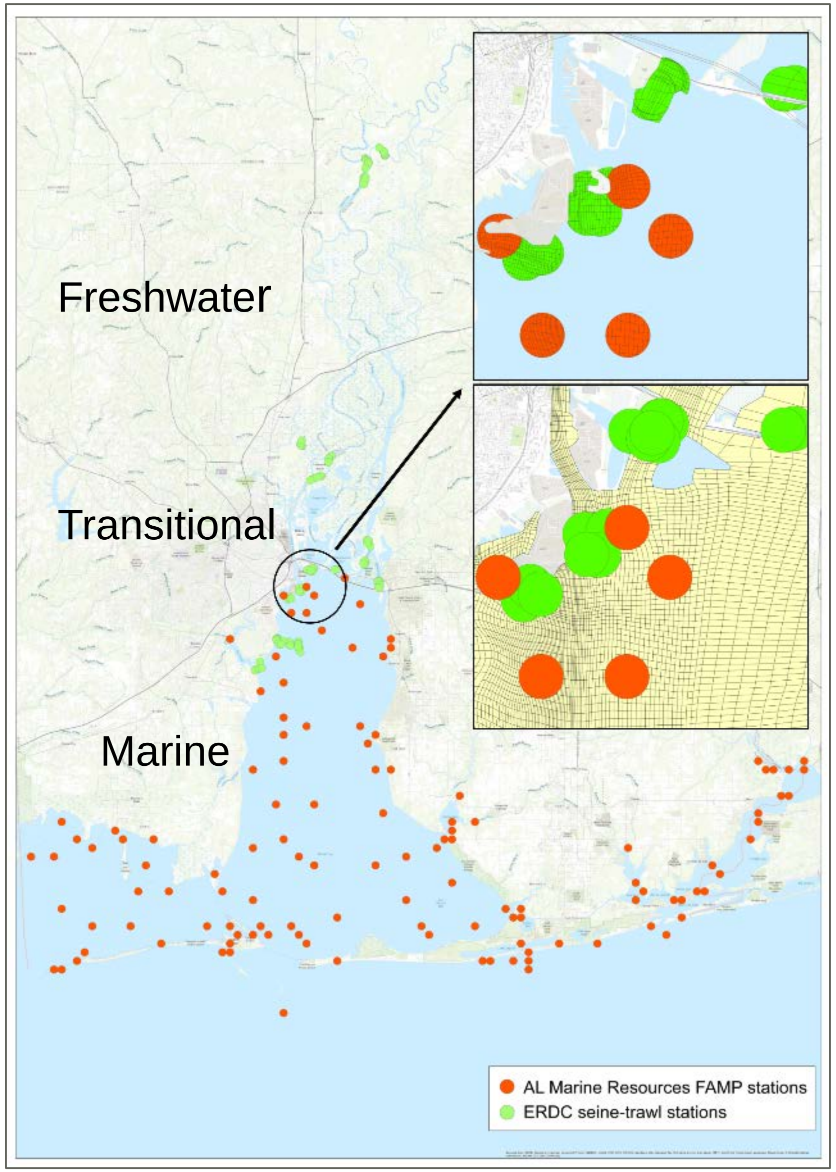
AQUATIC RESOURCES ASSESSMENT - FISH



Assessment approach:
Distribution of fisheries assessment and monitoring program (FAMP) stations sampled by AL Marine Resources (2005-2015).

FAMP data supplemented with ERDC sampling in bay, delta, and river habitats (2016-2017).

Stations plotted with 500 m buffer in ArcMap and layered with model grid for bottom and mean salinity values.

Intersecting cells from model grid and station buffer were extracted for evaluation.

98,000 individual fish, 140 species in assessment database

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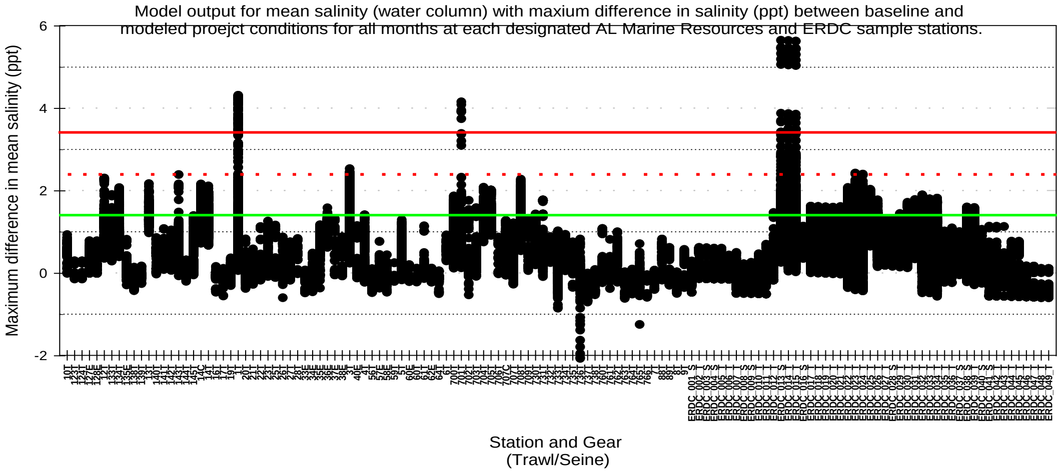
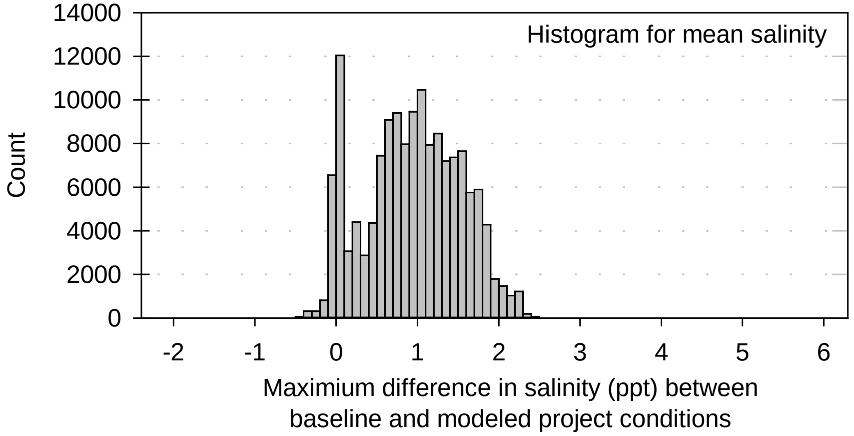
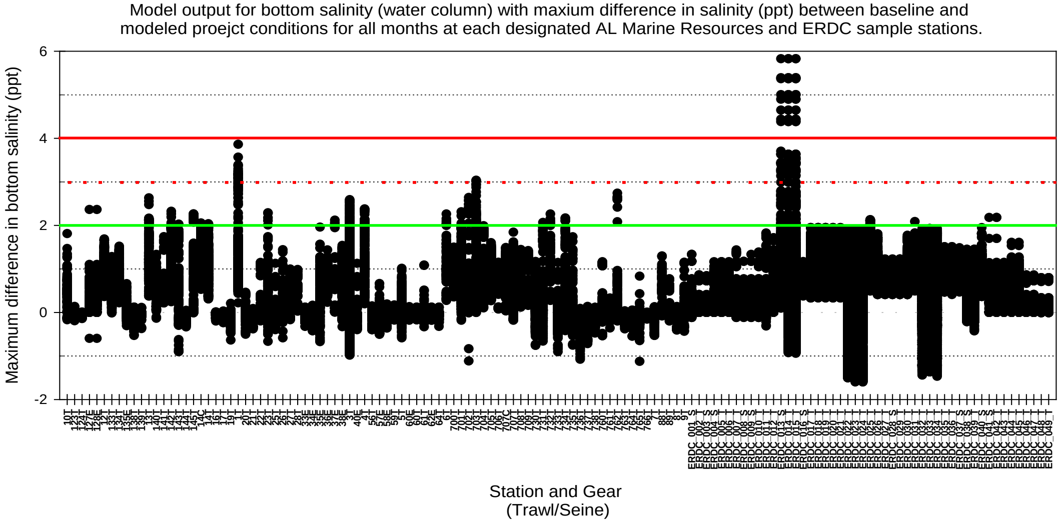
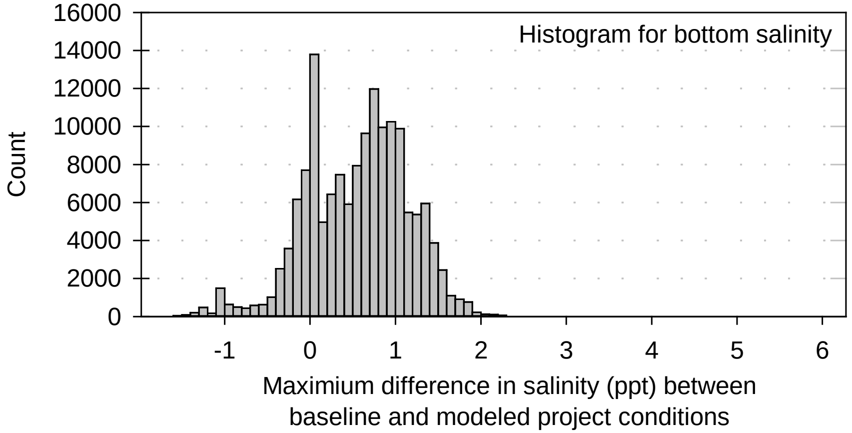
AQUATIC RESOURCES ASSESSMENT - FISH









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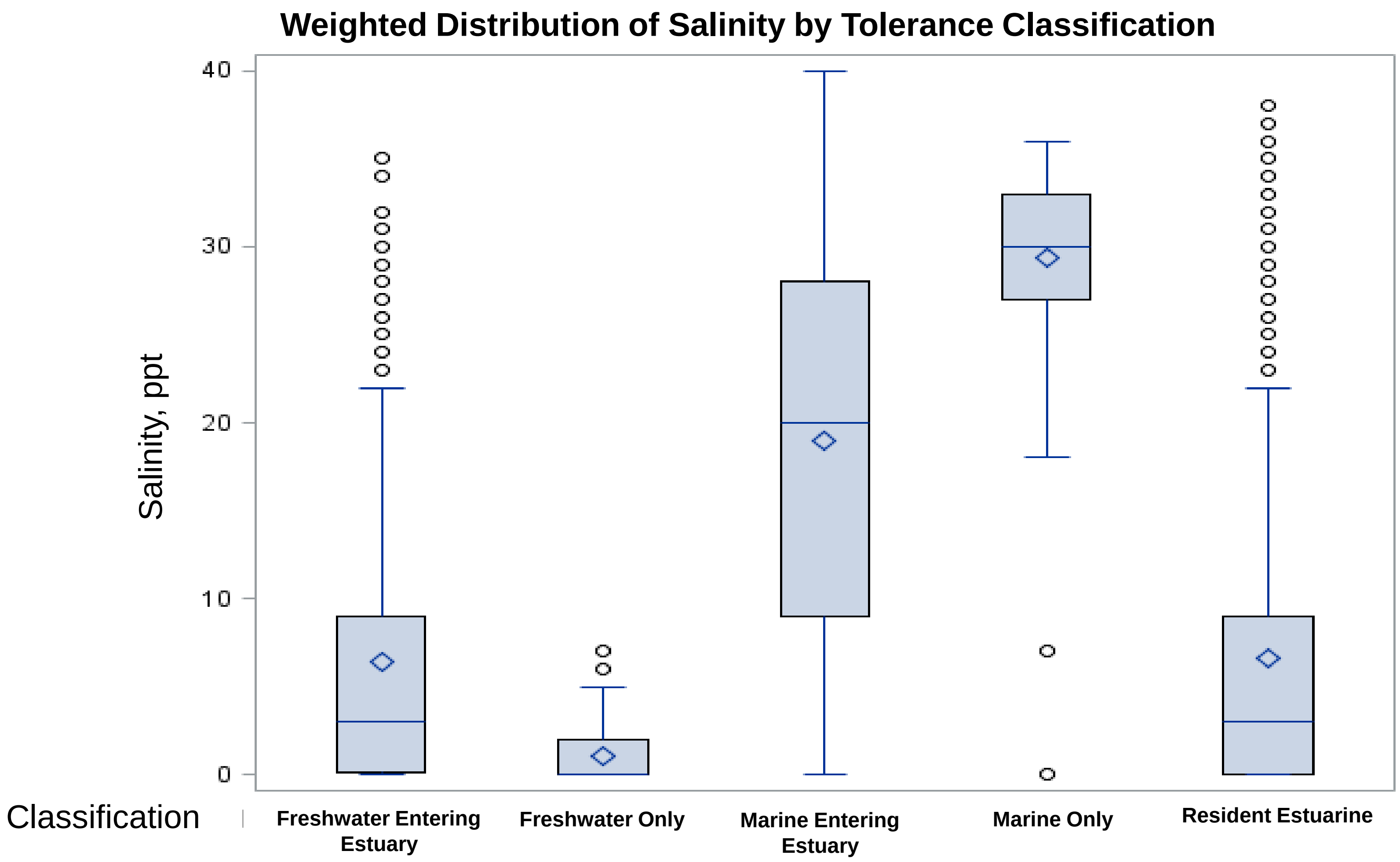
Aquatic resource assessment - Fish



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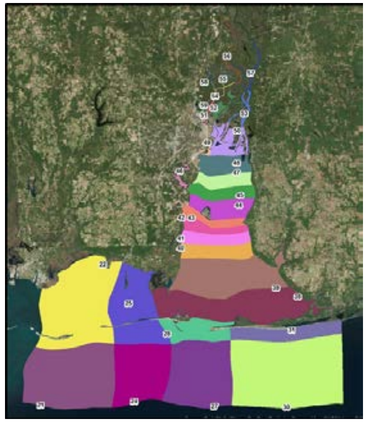
AQUATIC RESOURCES ASSESSMENT - SUMMARY

Baseline resources identified across five aquatic resources

Water quality thresholds established

No major impacts (i.e., loss of resources) anticipated under post-project conditions

Project impacts remain negligible under 0.5 meter sea level rise scenario



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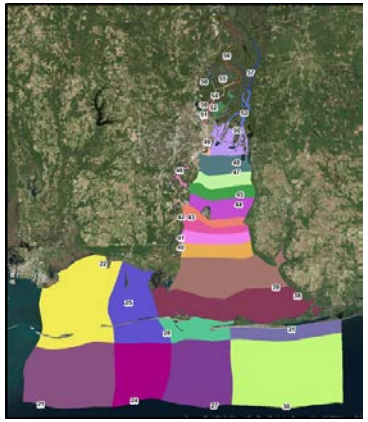
MOBILE HARBOR GRR
MITIGATION DISCUSSIONS



- Mitigation planning three major steps
  - Avoid Impacts, reduce Impacts, replacement/Compensation
- Mitigation can include
  - Restoration, enhancement, establishment, and preservation
  - Should offset impacts, be practicable, and environmentally preferable
- Hierarchy for mitigation alternatives
  - Mitigation Bank credits
  - In-Lieu fee program credits
  - Mitigation under a watershed approach
  - On-site mitigation
  - Off-site mitigation
- Should the determination be made that a project does not require mitigation:
  - State that no mitigation required because adverse effects of the project on resources are negligible
  - Provide rationale for determination

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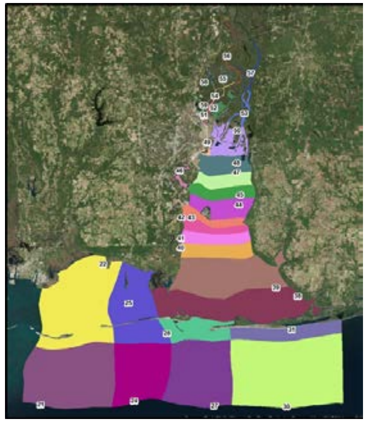
MOBILE HARBOR GRR
MITIGATION DISCUSSIONS



- No major impacts (i.e., loss of resources) anticipated under post-project conditions
- Wetlands
  - Potential for minor vegetation shift in some wetlands based upon short term productivity reduction
- SAVs
  - Potential with project impacts due to increased salinity (invasive species)
  - Potential shift in species composition (short term)
- What level of impacts will require mitigation?
- 404 Regulatory Process
  - Beyond the scope of what would be considered routine impacts (filling, clearing, draining or converting from one wetland form (forested) to another (emergent))
- Impacts here are potential of minor shift or reduction in productivity
  - Not captured by any SAD District Regulatory Mitigation Standard Operating Procedure

US Army Corps of Engineers

U.S. ARMY

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 14 February 2017

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Beneficial Use Sub-group Webinar for Mobile Harbor General Reevaluation Report (GRR) Consideration of Beneficial Use Alternatives

1. On January 5, 2017 the U.S. Army Corps of Engineers (Corps), Mobile District hosted an agency beneficial use (BU) sub-group meeting/webinar for the Mobile Harbor GRR. As a follow up to the BU subgroup webinar held May 17, 2016, the study is at a point where the beneficial use options are being refined, especially those that can be considered as part of the project least cost alternatives. The purpose of the webinar was to discuss those potential placement options that factor into the least cost options, specifically placement in the historic oyster shell mining areas and the Sand Island/Pelican Island complex, both of which were included as potential BU options at the May 17, 2016 meeting. The status of the other options were also addressed.

The meeting participants included representatives from the following agencies:

- U.S. Army Corps of Engineers, Mobile District
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama State Port Authority (ASPA)
- Alabama Dept. of Environmental Management (ADEM)
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- Environmental Protection Agency (EPA)
- National Marine Fisheries Service (NMFS)

A list of the BU sub-group participants and the slides presented during the webinar are attached.

2. The meeting opened with a round of introductions from the meeting participants. To open discussions, a summary of potential dredged material volumes were presented in order to put the potential volumes in perspective. The lower and upper volume bounds where presented for the Mobile River, Mobile Bay, and Mobile bar channel reaches. In summary, the total combined volumes could be as little as 13.7 million cubic yards (MCY) for the lower bounds and as much as 37.2 MCY for the upper bounds. A break

out of the sediment type for each of the reaches can be found in the attached presentation slides. A question was raised on the sand quantities and what data set was used to derive the volume information? The material percentages and classifications were derived from a number of investigations conducted by the Corps, Mobile District dating back to 1964. The investigations consisted of both vibracore and standard penetration test (SPT) sampling. Visual and lab classifications were used to make the determination on material type and information from the SPT sampling were used to gage the density of the material. The term “sand” encompasses anything that was greater than 50% sand and includes silty sands, clayey sands, and clean sands. Within some areas, the sediment exhibited interbedded layers of clay which may make it difficult segregate the material in the dredging process. The historical data show that the upper bay has a consistent layers of sand which includes silty and clayey sands in the upper layers and becomes more of clean sand with depth. This most consistent stretch of material, which is predominantly soft clays spans from the middle bay down to the lower bay.

3. The meeting continued with a list of beneficial use options that were identified by the BU subgroup during the May 17, 2016 webinar which can be reviewed in the attached presentation slides. At that point, the Corps identified the oyster shell mining areas in the upper bay and Sand Island/Pelican Island complex as the beneficial use options evaluated as the preferred dredged material placement options. These sites were chosen as they have the greatest placement capacity that can also be considered as a potential least cost alternative. As presented in the attached slides, potential beneficial use areas were identified in the areas where fossilized oyster shell mining occurred prior to 1982. The potential placement areas were where laid out in sections where there were disturbances with 15-foot depths or greater based on surveys from 1960/61 and 1984/87. These areas are believed to become hypoxic during summer conditions as discussed during the May 17, 2016 meeting. Assuming a layered placement in these areas, it has been calculated that there is capacity of approximately 8.74 MCY. Existing depths at these potential sites generally range from 10 to 14 feet.

With the oyster mining area being considered as a potential BU placement area, the area was incorporated into benthic sampling being conducted. The map presented in the attached slides lays out benthic sampling locations with in the middle bay region where the shell mining occurred. Samples were laid out at locations in areas where there was known disturbance of the bay floor. The primary focus of impacts were in the areas chosen based on proximity to channel, dredge cut depth greater than 20 feet and at least 4 data points greater than 20 feet for spatial extent. Control sites were placed in two areas which did not exhibit disturbance of the bay bottom based on review of the 1960/61 and 1984/87 surveys. Other areas were gridded generally following the grid pattern selected for the benthic study. Sampling was conducted this past summer/fall to establish a baseline of the area. The information collected is summarized in the attached slides

There were further discussions pertaining to the history of the dredged fossilized oyster shell areas. According to state and federal records the first permit allowing commercial dredging of fossilized oyster reef shell was issued in 1946. Reports indicate that during the time period of 1947 through 1968 a total of 40 million cubic yards of shell were removed from the bay. Permitted dredging of shell deposits continued until 1982, at which time operations halted due to environmental concerns following observations that the mined areas were not filling back in at the rates predicted and that the depressions were areas containing high salinity and hypoxic to anoxic conditions.

Some questions were raised pertaining to the similarity of past placement and fill actions such as Brookley and how it compares in depth to the oyster mining areas? The depth of Brookley Hole prior to filling with dredged material from the upper Mobile Bay channel was approximately 20 to 25 feet. Unlike Brookley Hole, the region of fossilized oyster shell mining were partially backfilled during mining operations and have filled in with silts and clays over time leaving regions of depressions. In contrast, the intent Brookley Hole was direct placement of sediment to fill the hole up the elevations of the surrounding bay bottom whereas placement of new work material in the oyster shell mining areas will be done in layers over a broader area.

Issues were also discussed pertaining to the potential of mudflow resulting from placement of the new work material over areas of highly fluidized mud. It was discussed that mud flows will be dependent on the type and consolidation of the material found within the distributed areas proposed for placement of dredged material with thicknesses of 1 to 2 feet. Missouri University of Science and Technology, while testing electrical resistivity tools within an area approximately 3.1 miles east of Gaillard Island, found that the areas of mining had been filled in with approximately 20 feet of clayey silt that was overlaid with a thin layer of approximately 3 feet of clay. Recent observations made this fall by the Corps, while conducting probing and grab samples in some of the areas with the largest disturbance (20 feet or greater), found one prominent area where there was little resistance to penetration. In this region the team was unable to find the bottom of the hole. In this area we may need to avoid direct placement over the region of greatest disturbance to prevent the possibility of mud flow. It should be understood that placement would not be conducted in a manner that would target the holes specifically, but would be conducted in layers over larger areas which is believed to minimize the potential of mud flows.

4. Another potential BU opportunity that factors into the project least cost alternatives involves returning sandy material to the Sand Island/Pelican Island complex. The group recommended during May 17, 2016 meeting that this action be considered particularly using the predominantly sandy material removed during any widening or deepening of the entrance channel. This option would involve optimizing placement areas accelerating the return of sediment for maintenance of the Sand Island/Pelican Island complex which in turn may provide downdrift sediment transport to Dauphin Island. The presentation slides shows historic placement sites in this area and their potential capacities for this action. The Mobile Harbor GRR will leverage information derived from tools being developed under the current Nation Fish and Wildlife Foundation (NFWF) study which will help inform optimized placement areas. Work being conducted under NFWF includes development of a sediment budget using updated

topographic/bathymetric change maps (baseline is Byrnes et al., 2010 & 2012) highlighting new regions of erosion/deposition as well as volumetric change and sediment transport pathways. The study is also evaluating hydrodynamic and morphological change utilizing a Delft3D model being developed by the USGS under NFWF to conduct a comprehensive analysis of waves, tides, and sediment transport.

5. A brief status of the other BU options identified from the May 17, 2016 meeting were discussed. Although not considered as part of the least cost alternatives, the other options identified in the meeting slides have not been completely removed from consideration. However, if not part of the least alternatives for the study at this point, additional BU actions must be conducted either under separate authorities with a co-sponsor for costs above normal dredging, or funded as part of another existing project, or an action that may be considered as part of satisfying mitigation requirements, if applicable. The Corps will be coordinating with agencies and other stakeholders and is open to any existing and ongoing projects that may be applicable as BU options

A question was raised to what are the limiting distances and other factors that would make a particular option considered to be uneconomical? One criteria is the distance that sediment needs to be transported to a BU site. When pumping material through the use of cutter head dredges, 5 miles is a reasonable distance. After that, a booster pump must be used which increases the dredging and placement costs. Another criteria considered is containment of the sediment. Having to construct containment structures to accept BU material drastically increases the cost of a BU action. Such measures may be justified under different authorities to cover additional costs for potential mitigation requirements if found necessary.

7. In closing discussions, Corps representatives asked the group that considering the information presented and discussions during this meeting, does the BU subgroup feel that the assumptions being made to progress the study are valid towards meeting dredged material placement and BU objectives?

ADEM expressed that the agency is not opposed to those options that keep the sediment in the natural system, but still encourages the consideration of the other options that have been identified.

NMFS suggested that the Corps remain open to options such as using clays to build up elevations and capping with coarser material in the context of oyster restoration.

The EPA stated that they are likely to require grain size information at placement sites and new work material, total organic contentment (TOC), as well as other sediment quality information. The Corps responded that grain size and TOC information is already being collected as part of the benthic study. Limited grain size information is also available for the new work material from the previous authorization studies.

Other than the above concerns expressed, the BU subgroup did not provide any further objections to the assumptions and direction the project is moving to satisfy the placement of dredged material and BU objectives.

8. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/s/ Larry Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team
Planning and Environmental Division

Mobile Harbor GRR Beneficial Use (BU) Sub-group Webinar Participants

Larry Parson – U.S. Army Corps of Engineers, Mobile District
Jennifer Jacobson - U.S. Army Corps of Engineers, Mobile District
Elizabeth Godsy - U.S. Army Corps of Engineers, Mobile District
Nathan Lovelace - U.S. Army Corps of Engineers, Mobile District
Ashley Kleinschrodt - U.S. Army Corps of Engineers, Mobile District
David Newell - U.S. Army Corps of Engineers, Mobile District
LeKesha Reynolds - U.S. Army Corps of Engineers, Mobile District
Joe Paine - U.S. Army Corps of Engineers, Mobile District
Joe Givhan - U.S. Army Corps of Engineers, Mobile District
Ashley Kleinschrodt - U.S. Army Corps of Engineers, Mobile District
Jacob Berkowitz - Engineer Research and Development Center
Bob Harris – Alabama State Port Authority
Scott Brown - Alabama Dept. of Environmental Management
Allen Phelps - Alabama Dept. of Environmental Management
Rusty Swafford – National Marine Fisheries Service
Lena Weiss – U.S. Environmental Protection Agency
Dan Holliman – U.S. Environmental Protection Agency

Mobile Harbor GRR
Beneficial Use Subgroup Meeting

U.S. Army Corps of Engineers, Mobile District

January 5, 2017

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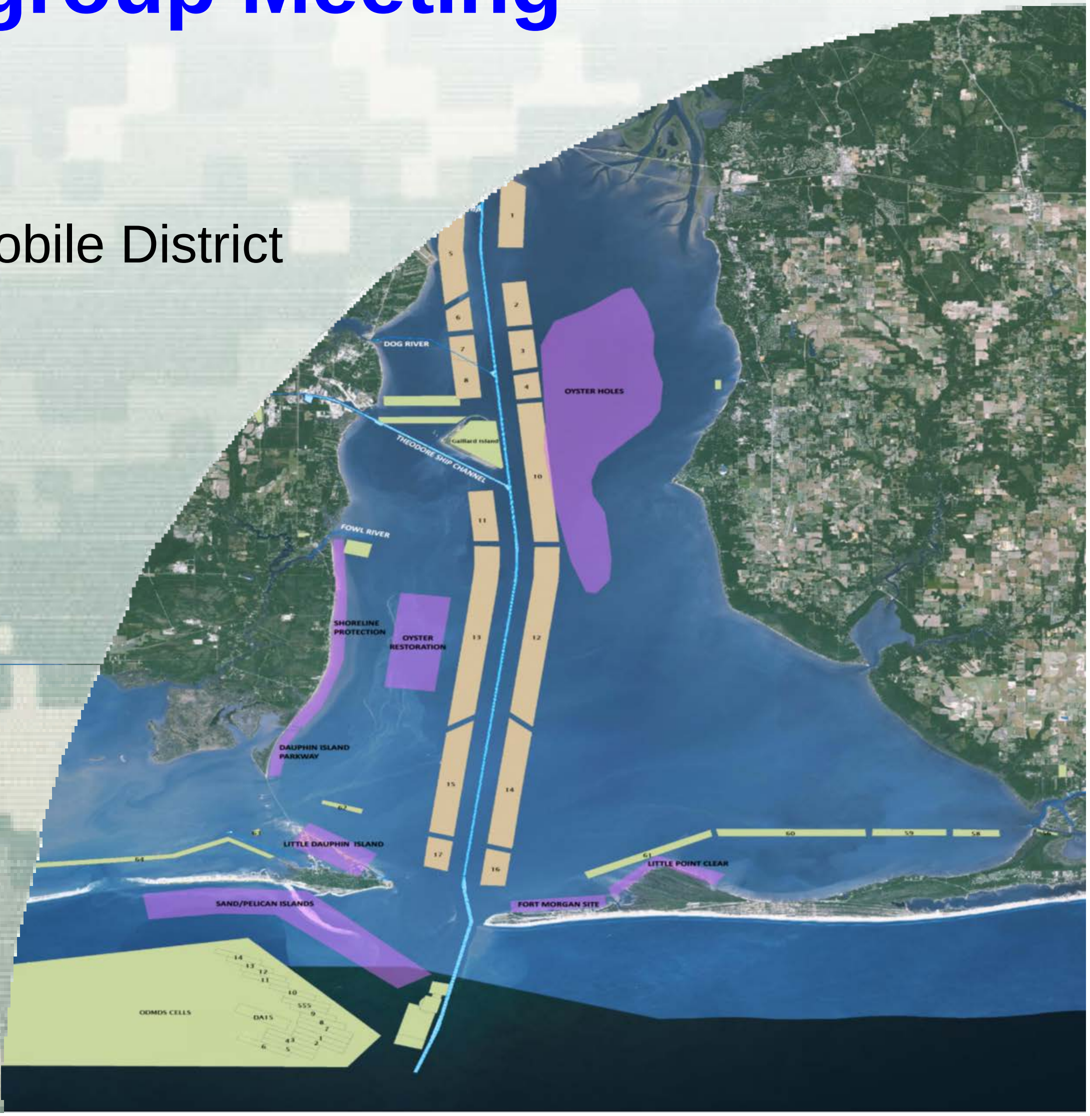

MOBILE HARBOR GRR

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Potential New Work Volume (CY)	General Classification of Material Type	Mobile River Reach	Mobile Bay Reach	Mobile Bar Reach
Lower Bound	*Sand*	140,000	2,789,000	1,151,000
	Firm Clay	16,000	411,000	1,087,000
	Soft Clay	0	6704000	1405000
	Total	**156,000**	**9,904,000**	**3,643,000**
Upper Bound	*Sand*	382,000	8,422,000	2,770,000
	Firm Clay	42,000	1,961,000	2,970,000
	Soft Clay	0	16956000	3726000
	Total	**424,000**	**27,339,000**	**9,466,000**

Note: All values shown are general rough order magnitude estimates for purposes of initial alternative screening only and are subject to change. The lower bound assumes a minimum 2 ft of deepening and the upper bound assumes a 7 ft of deepening.

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BU Options - Summary

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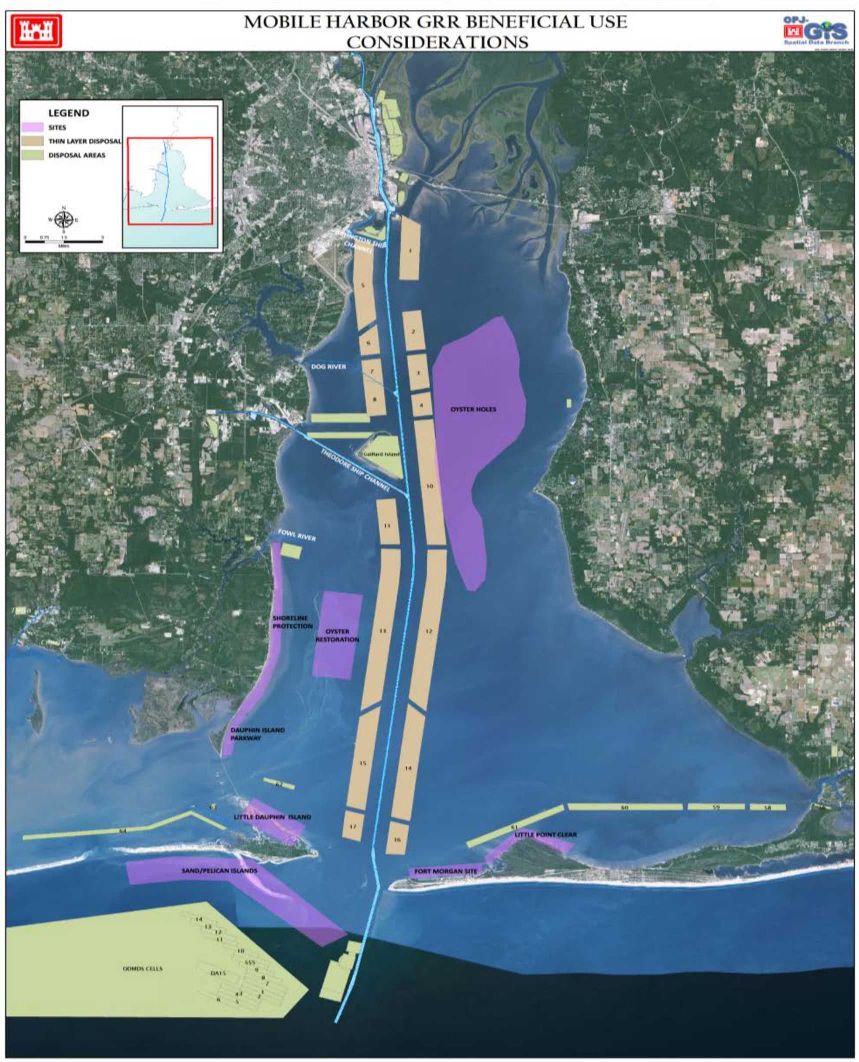
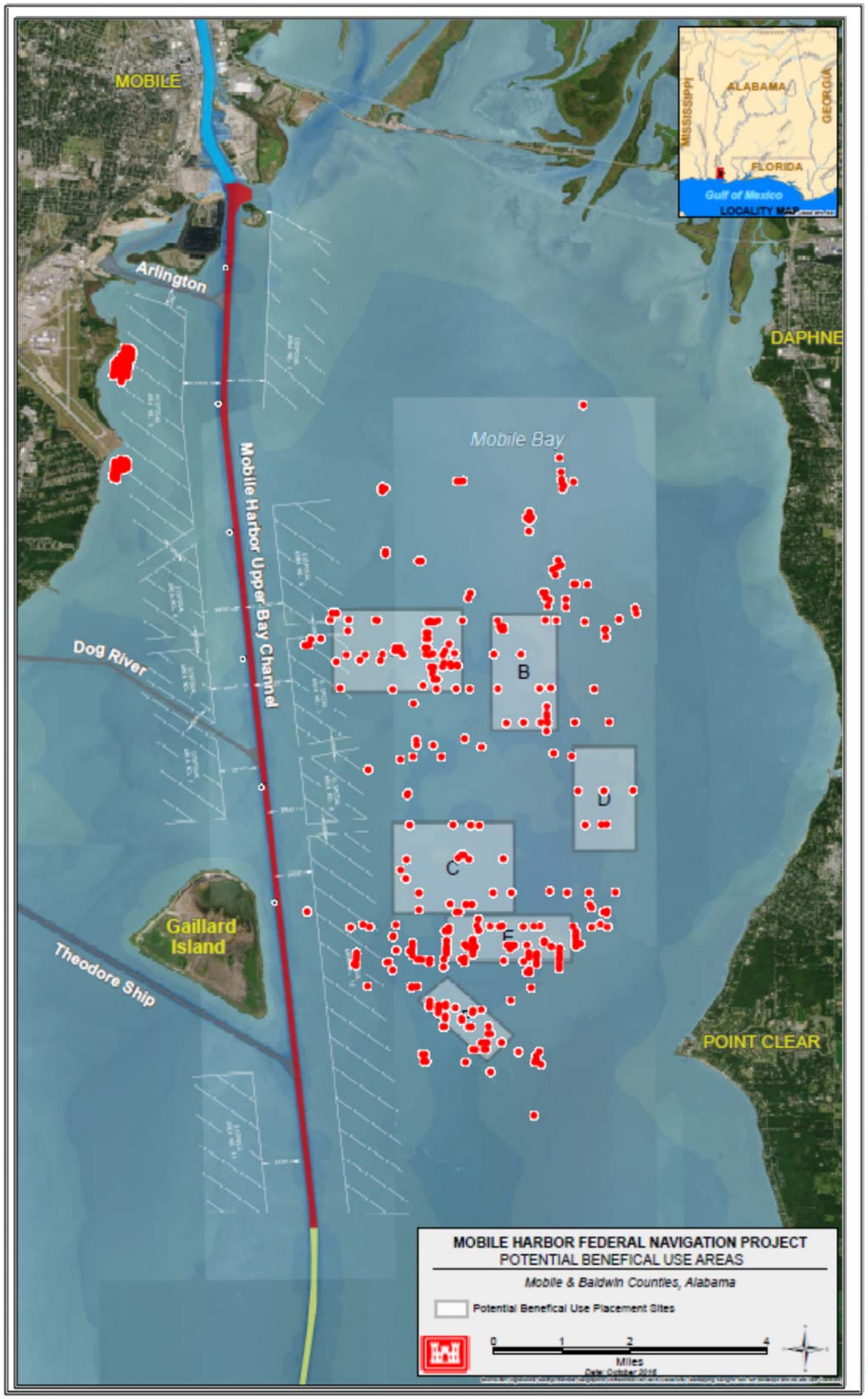


- Fort Morgan Peninsula – north shore
  - Owned by Alabama State Historic Commission
  - Restore to historic dimensions
- Sand Island/Pelican Island Complex
  - Return sandy material to littoral system
- Little Dauphin Island and Little Point Clear
  - Bon Secour National Wildlife Refuge
  - Protect and conserve sensitive habitats
- Dauphin Island Causeway
  - Natural shoreline associated with protection of roadway
- Creation of in-bay/nearshore reefs or containment structures
  - Use of cohesive clay material - chunks
- Thin-layer placement to reduce hypoxia
  - Areas of oyster shell mining operations
- Use if existing thin-layer placement sites
  - Already considered environmentally acceptable for maintenance material



POTENTIAL BENEFICAL USE SITES FOSSILIZED SHELL MINING AREAS

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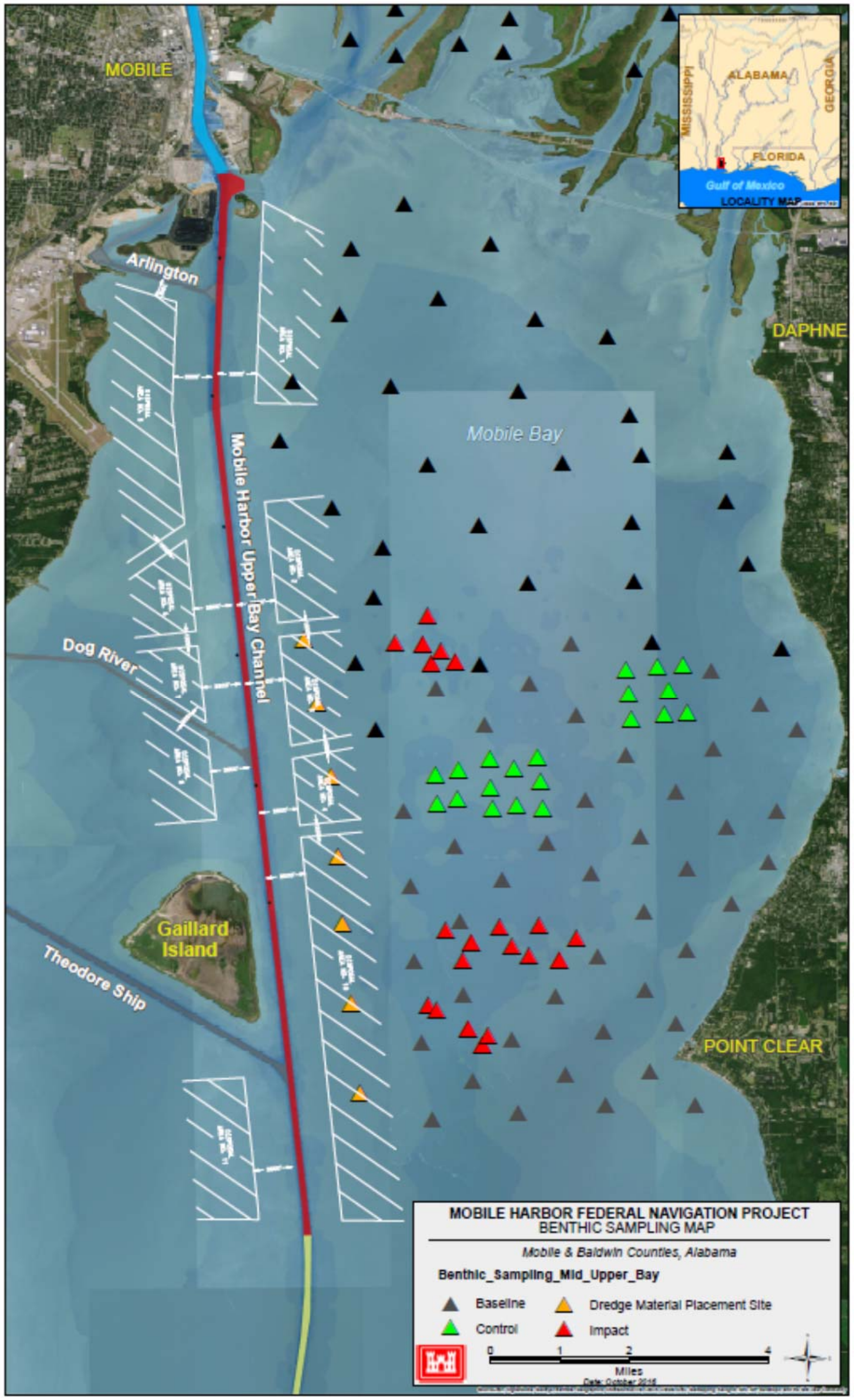
	Area (acres)	Placement Volume (cy) Placement Thickness assumed 1 foot
A	1281	2,067,000
B	920	1,484,000
C	770	2,106,000
D	1306	1,243,000
E	702	1,133,000
F	403	650,000
Total	**5382**	**8,683,000**

Note: All values shown are general rough order magnitude estimates for purposes of initial alternative screening only and are subject to change.



BENTIC SAMPLING

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- Benthic invertebrates were sampled during the fall of 2016.
- 90 samples were collected in the mid region of the bay and 30 samples in the upper region of the bay.
- Water quality vertical profiles (surface to bottom) were collected at each sampling station. Dissolved Oxygen (mg/l), Temperature (^{o}C), pH, Salinity (ppt), Specific Conductance (uS/Cm @ 25C), and Depth (m) were measured with a Hydrolab M S5 Sonde manufactured by Hatch Corporation.
- Surface sediment and Benthic communities were collected with a Ponar Sampler, or 'Grab Sampler.
- Samples are being processed based on currently accepted practices in benthic ecology (e.g. Holme and McIntyre, 1971) and on specific protocols described in the EMAP-E Lab Methods Manual (U. S. EPA 2001; 1995).

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HISTORIC SAND ISLAND/EBB SHOAL PLACEMENT SITES

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	Area (acres)	Estimated Site Capacity 2015*
Sand Island		
Light house	200	1,500,000
Feeder Berm	100	2,000,000
Feeder Berm II	350	4,000,000
Sand Island BU	600	10,000,000
Total	**650**	**5,500,000**

Note: All values shown are general rough order magnitude estimates for purposes of initial alternative screening only and are subject to change. Capacity assumes sites can be filled to -10 ft MLLW outside of the lighthouse area which assume previous 2011 placement volume. Optimized placement zone for new work material will be determined based on capacity, updated sediment budget analysis, hydrodynamic and sediment transport modeling and costs.

Other Site Considerations

- If not part of the least alternatives for the study:
  - Must be conducted under separate authority with co-sponsor for costs above normal dredging costs, or
  - Could be conducted and funded as part of another existing project, or
  - Could be considered under mitigation requirement if applicable

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REPLY TO
ATTENTION OF:

CESAM-PD-EC 2 March 2017

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Teleconference between the U.S. Army Corps of Engineers (Corps), Mobile District and EPA Region 4 on Beneficial Use (BU) Sediment Suitability and Cumulative Impacts for the Mobile Harbor General Reevaluation Report GRR and SEIS.

1. On January 26, 2017 the U.S. Army Corps of Engineers (Corps), Mobile District hosted a teleconference with the EPA Region 4 to discuss sediment suitability requirements for the potential BU options for the Mobile Harbor GRR. The approach for the Cumulative Impacts section for the SEIS was also addressed. The BU discussions were carry-over issues from the BU agency sub-group meeting held on January 5, 2017 where EPA expressed their concerns regarding the suitability of the dredged material being placed in the BU sites. The focus on the Cumulative Impacts approach was initiated out of the need to address concerns and issues that have been raised by a specific public coalition. The Cumulative Impacts section will be the forum for addressing their issues and concerns.

The teleconference participants from EPA Region 4 included: Dan Holliman, Calista Mills, Lena Weiss, and Ntale Kajumba. Participants from the Corps included: David Newell, Joe Paine, Elizabeth Godsey, Rita Perkins, Michael Creswell, Katherine Rooney, and Larry Parson.

2. The Corps expressed the need to revisit concerns voiced by EPA during the January 5, 2017 BU webinar where sediment suitability must be considered in the placement areas, specifically pertaining to grain size and chemical testing. EPA suggested that the Corps should follow the testing procedures according to the Marine Protection, Research and Sanctuaries Act (MPRSA) for the new work dredge material, which is used for placement criteria of material in the ODMDS that includes grain size analysis and toxicity testing. MPRSA Section 103 testing will occur on any new work and O&M sediments going to the ocean. It was acknowledged that chemical testing could be very costly and is dependent on the volume of material proposed to be dredged. It is for this reason that the Corps will determine the sediment testing needs based on the selected alternative. This will enable concentrating sediment testing efforts in the areas where dredging of new material is most likely to occur.

In addition to the chemical testing according the MPRSA, Section 404 of the Clean Water Act (CWA) addresses suitability of sediments at disposal sites, which would apply to both the oyster shell mining areas and placement at the Sand/Pelican Island complex. Material such as that intended to be used beneficially will also need to undergo testing based on the procedures in the Inland Testing Manual (ITM). The intent of placement in the shell mining areas is not to match the dredged material to the current sediment characteristics in those areas, but rather to improve the sediment quality for enhancement of benthic communities and reduction of hypoxic conditions. However, placement of dredged material into the Sand/Pelican Island complex is intended to return similar sandy material for a more natural maintenance of the littoral sediment transport process to Dauphin Island. Placement of the sandy material in the Sand/Pelican Island complex would be done similarly to placement of maintenance material from the bar channel into the Sand Island Beneficial Use Area (SIBUA). Material placed in SIBUA has up to approximately 30% fines but is predominantly sand. The finer grained sediment is winnowed out during the dredging and placement process.

EPA's main concern with placement in the oyster shell mining area is the organic content of the sediment and the ability to support benthic recovery. EPA inquired if the Corps had any previous experience and examples of dredged sediment being placed to fill holes in Mobile Bay. The Corps pointed out that an area known as Brookley Hole is a good example of maintenance dredged material from the upper bay navigation channel that was used to fill a borrow hole. The borrow material was used during the construction of the Brookley Air Field. A baseline study and monitoring was conducted. The hole, as deep as 26 feet in the deepest portion of the basin, was filled twice to bring the bottom elevation up the surrounding bay bottom. The intent was to alleviate hypoxic/anoxic conditions and restore the area to more productive bay bottom. A Technical Report was prepared summarizing the baseline and monitoring efforts. The Corps will provide a copy of the report to EPA.

Although placing sediment in the oyster shell mining areas is similar but not necessarily directly comparable to filling Brookley Hole, the smaller holes in the oyster shell mining areas have already filled in with fine-grained material through natural processes. However, the mining process resulted in an overall deepening of that area of the bay. The purpose of sediment placement in the oyster shell mining area is to generally raise the bed elevation in that portion of the Bay to relieve hypoxic conditions believed to exist during warm water conditions.

Another concern that was discussed was the placement of hard clay new work material into the oyster shell mining areas. The Corps expressed that only material north of the Theodore Ship Channel would be placed in the oyster mining areas. Borings from a geotechnical study from the previous Mobile Harbor reauthorization indicated that there are some hard clay present and that it would be nearly impossible to avoid all hard clay that are intermixed. The Corps will provide information from the geotechnical report to the EPA team. The Corps and EPA will continue to coordinate for the material to be placed in these areas as to clay content. The Corps also explained that because these areas are being considered as a potential BU placement area, it was included into benthic sampling being conducted. The intent of placing the material in these areas was to improve environmental conditions and productivity of the bay bottom. Representatives from the Alabama Department of Environmental Management (ADEM) had expressed concerns that these areas exhibit hypoxia under the warm summer conditions.

Both the EPA and Corps concluded that it would be acceptable for placement of new work material from north of the Theodore Ship channel being placed in the oyster mining areas as long as efforts were made to minimize hard clay material and that proper testing of the sediments were conducted. It was suggested that EPA follow-up with the Corps after reviewing geotechnical report. The Corps will be providing the latest water quality information to EPA.

3. The remainder of the meeting dealt with the approach for the cumulative impacts section of the SEIS. Prior to the meeting, the Corps prepared a table of contents for this section and provided a copy to EPA. The focus on the cumulative impacts approach was initiated out of the need to address concerns and issues that have been raised by a specific public coalition concerning the effects of past actions on Dauphin Island. The Cumulative Impacts section will be the forum for addressing their issues and concerns. Although this study does not include the authorization to mitigate for any past impacts, this section should acknowledge effects of the navigation project from past, present, and reasonably perceived future actions. EPA advised the Corps that previous reports prepared by the Corps such as the 1978 report referenced in public comment letters should be acknowledged. EPA also recommended that the cumulative impacts section capture and acknowledge ongoing studies conducted under the Natural Resources Damage Assessment (NRDA), National Fish and Wildlife Foundation (NFWF), and RESTORE.

Letters and comments received from a component of the public were also concerned with the BU project being proposed in the upper Mobile Bay and funded under RESTORE. It was recommended that this project also be addressed in the cumulative impacts section. Past, present, and future placement activities at the SIBUA should also be acknowledged and discussed. If these elements are included in the cumulative impacts section, this may alleviate some of the concerns that the public has pertaining to impacts to Dauphin Island.

One last recommendation from EPA was to be sure that the area of impact be well defined. The Corps identified this area as all of Mobile and Baldwin Counties from the coastal regions extending north into the delta. By taking measures to incorporate the recommendations discussed during this meeting, the EPA concurred with the Corps' cumulative impacts approach.

4. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/s/ Larry Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team
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MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 23 June 2016

MEMORANDUM FOR RECORD (MFR)

SUBJECT: Agency Sub-group Webinar for Mobile Harbor General Reevaluation Report (GRR) for Beneficial Use Opportunities

1. On May 17, 2016 the U.S. Army Corps of Engineers (USACE), Mobile District hosted an agency beneficial use (BU) sub-group meeting/webinar for the Mobile Harbor GRR. As a follow up to the agency meeting held for the Mobile Harbor GRR on March 31, 2016 the sub-group was established that included agency team members who indicated an interest in BU considerations. The purpose of the meeting was to begin the process of identifying realistic beneficial use opportunities associated with the proposed widening and deepening activities. The meeting participants included representatives from the following agencies:

- U.S. Army Corps of Engineers, Mobile District
- U.S. Army Corps of Engineers Corps, Engineer Research and Development Center (ERDC)
- Alabama Dept. of Environmental Management (ADEM)
- Alabama Dept. of Conservation and Natural Resources (ADCNR), State Lands Division
- ADCNR, Marine Resources Division (MRD)
- Geological Survey of Alabama (GSA)
- U.S. Fish and Wildlife Service (FWS)
- Environmental Protection Agency (EPA)
- Mobile Bay National Estuarine Preserve (MBNEP)

A list of the BU sub-group participants is attached.

2. The meeting opened with a round of introductions from the meeting participants. A brief summary of the Mobile Harbor existing and authorized channel dimensions including a table listing the focused array of potential alternatives being considered in the GRR was presented. Also included was a list of BU opportunities that was prepared by the agencies during the January 2015 Charrette and revisited in the initial December 2015 agency scoping meeting. The slides presented to the group are attached. The list of initial BU opportunities include:

- Shoreline protection measures such as living shorelines
- Oyster reef restoration
- Creation of islands
- Thin-layer placement in strategic areas to reduce hypoxia
- Thin-layer placement for marsh conservation and restoration
- Raising bottom elevation in strategic locations to promote productivity
- Strategic placement of berms for shoreline protection

The following captures specific discussions of realistic BU opportunities the group felt merits further consideration for this study.

3. Discussions of beneficial use opportunities began with an alternative that was considered during the preparation of the Limited Re-evaluation Report (LRR) for channel improvements in the lower bay navigation channel. This option considered placement of material on the northern shoreline of the Fort Morgan Peninsula just east of the western tip of Fort Morgan known to be exhibiting rapid shoreline recession. The area consists of 40 to 80 acres in which approximately 250,000 to 500,000 cubic yards of material could potentially be placed to restore the shoreline to historic dimensions. It is intended that sandy material be used to re-establish the position of the shoreline with finer grained material use to backfill and create tidal marsh. The area is owned by the Alabama State Historic Commission, who at the time this was being considered for the LRR, was receptive to this action. Not only would this option restore the eroding shoreline and marshes, it could also serve to protect the historically significant resources that exist in the area. A map of this proposed option is attached.

4. Another potential BU opportunity involves returning sandy material to the Sand Island/Pelican Island complex. The group recommended that this action be considered particularly using the predominantly sandy material removed during any widening or deepening of the entrance channel. This option would involve placement of sand around the Sand Island Lighthouse as was done during the Sand Island 406 Oil Mitigation efforts where 2 million cubic yards of sand was placed around the lighthouse and Sand Island in an effort to prevent submerged oil from entering the mouth of the bay. This option is considered to provide an excellent opportunity towards accelerating the return of sediment into the local littoral system consistent with regional sediment management approaches. It is anticipated that this approach would promote natural sediment transport and maintenance of the Sand Island/Pelican Island complex which in turn would provide downdrift sediment transport to Dauphin Island.

5. Placement of material on Little Dauphin Island and Little Point Clear around the areas associated with the Bon Secour National Wildlife Refuge was discussed as an option. This option includes the placement of feeder berms to return sediment to the natural system as well as provide needed protection of the adjacent shorelines which protect and conserve sensitive habitats. Preliminary communications with the refuge staff indicated that they would be open to pursuing this option.

6. Yet another option mentioned by the group was the use of the material removed from the channel expansion for the shoreline restoration activities being planned for the Dauphin Island Causeway project. This would provide opportunities to create a more natural shoreline associated with protection of the roadway.

7. When excavating certain segments of the expanded channel, some of the material will likely consist of highly cohesive and consolidated clay sediment. If removed using large clamshell dredging equipment, it may be possible to excavate large chunks of the cohesive clays that may be suitable for various beneficial uses. One consideration could be to use the large chunks for the creation of in-bay or nearshore reefs. Over time, the consolidated clay material could become encrusted, thus creating a more stable and productive reef. A second consideration discussed for utilizing large chunks of cohesive clay is the potential to use the material in the formation of containment structures or berms that could be used to increase bay bottom elevations for oyster restoration. Containment structures of this nature could also be used for other applications where containment of sediment is required for options like marsh restoration. It was pointed out that the equipment required to remove the material in large chunks may be restricted for certain applications by water depth.

8. Discussions were also directed to conducting open bay thin-layer placement of the dredged material in strategic areas of the bay to reduce hypoxic conditions. One of the primary concerns expressed by the group were the areas in the northeastern portion of the bay where oyster dredging operations were conducted to mine relict oyster shell deposits. These operations were conducted as early as the late 1800's and continued into the 1970's. These operations have resulted in an overall deepening of the bay bottom in that area and believed to be the cause of decreased ecological productivity resulting from hypoxia during certain times of the year. A map of the oyster dredging area is attached. Placement of dredged material into portions of this area would not only potentially help to increase the ecologically productivity of the bay bottom areas, but in general, would also keep the sediment within the system.

It was discussed that the Corps, under the regional sediment management program, is currently examining the areas where the mining operations occurred to evaluate the nature of the sediments that filled the holes resulting from these activities. Preliminary results thus far have indicated that the holes have filled with a fine-grained fluidized sediment that may not be conducive to benthic productivity. One of the study objectives is to determine if there may be some restorative measures that can be taken to use dredged material to increase the productivity of the bay bottom in these areas. A possible follow on to the RSM study may be a Section 204 study under the Continuing Authorities Program to further evaluate restoration possibilities. Results from a Section 204 study can be leveraged to help make decisions on BU opportunities in these areas.

9. In 2014 the Corps added the open bay thin-layer disposal as a permanent option for disposal of dredged material from the maintenance of the Mobile Bay navigation channel. This was done as a result of extensive modeling and monitoring of a demonstration action to show how the material behaves once placed on the bay bottom

in this fashion. Results of the studies indicated that once placed, the material is remobilized into the water column and re-enters the bay's natural sediment system. Based on this information and the success of the thin-layer placement actions currently in practice, the group recommended that the thin-layer placement areas re-established for maintenance dredged material be considered as a placement opportunity for some of the new work material from the channel expansion. The main benefit is that this is already considered as an environmentally acceptable alternative that returns the sediment back to the natural system.

10. It is envisioned that this beneficial use sub-group will meet as needed to help guide and provide inputs to the beneficial use alternatives being considered. As a result of this meeting, the USACE study team will screen the beneficial use options recommended by the sub-group for those alternatives that are considered reasonable and should receive further consideration for the project. The USACE will present the findings of the screening process to the sub-group for their continued input and guidance in this process.

11. Please address any questions, comments, or concerns pertaining to this meeting to Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

Larry E. Parson
U.S. Army Corps of Engineers, Mobile District
Coastal Environment Team

Mobile Harbor GRR Beneficial Use (BU) Sub-group Meeting Participants

Larry Parson – U.S. Army Corps of Engineers, Mobile District
Elizabeth Godsy - U.S. Army Corps of Engineers, Mobile District
Nathan Lovelace - U.S. Army Corps of Engineers, Mobile District
Ashley Kleinschrodt - U.S. Army Corps of Engineers, Mobile District
David Newell - U.S. Army Corps of Engineers, Mobile District
Christine VanZomeren - U.S. Army Corps of Engineers, Mobile District, ERDC
Scott Brown - Alabama Dept. of Environmental Management
Allen Phelps - Alabama Dept. of Environmental Management
Carl Ferraro - Alabama Dept. of Conservation and Natural Resources, State Lands Division
John Mareska - Alabama Dept. of Conservation and Natural Resources, Marine Resources Division
Steve Jones - Alabama Geological Survey
Patric Harper - U.S. Fish and Wildlife Service
Josh Rowell - U.S. Fish and Wildlife Service
Calista Mills – U.S. Environmental Protection Agency


Potential BU Option on the north shore of the Fort Morgan Peninsula
Navy Cove
180
Fort Morgan Road
4112 ft
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Image NOAA
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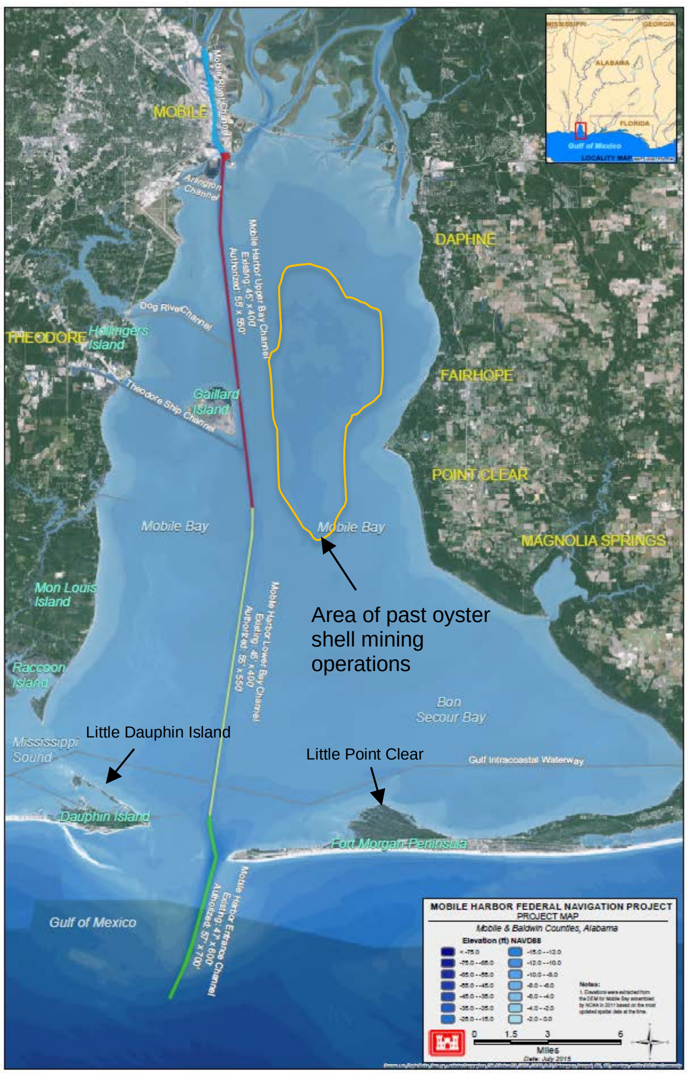
MOBILE
Arlington Channel
Mobile Harbor Upper Bay Channel
Existing: 45' x 400'
Authorized: 55' x 550'
DAPHNE
Dog River Channel
THEODORE
Hollingers Island
Theodore Ship Channel
Gaillard Island
FAIRHOPE
POINT CLEAR
Mobile Bay
Mobile Bay
MAGNOLIA SPRINGS
Area of past oyster shell mining operations
Mon Louis Island
Mobile Harbor Lower Bay Channel
Existing: 45' x 400'
Authorized: 55' x 550'
Raccoon Island
Bon Secour Bay
Mississippi Sound
Little Dauphin Island
Little Point Clear
Gulf Intracoastal Waterway
Dauphin Island
Fort Morgan Peninsula
Mobile Harbor Entrance Channel
Existing: 47' x 600'
Authorized: 57' x 700'
Gulf of Mexico
MISSISSIPPI
GEORGIA
ALABAMA
FLORIDA
Gulf of Mexico
LOCALITY MAP
MOBILE HARBOR FEDERAL NAVIGATION PROJECT
PROJECT MAP
Mobile & Baldwin Counties, Alabama
Elevation (ft) NAVD88
< -75.0
-75.0 - -65.0
-65.0 - -55.0
-55.0 - -45.0
-45.0 - -35.0
-35.0 - -25.0
-25.0 - -15.0
-15.0 - -12.0
-12.0 - -10.0
-10.0 - -8.0
-8.0 - -6.0
-6.0 - -4.0
-4.0 - -2.0
-2.0 - 0.0
Notes:
0 1.5 3 6
Miles
Date: July 2015