From: [redacted]
To:
Cc:
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)
Date: Tuesday, May 1, 2018 7:59:00 AM
Attachments: Ltr to LTG Seminote from Ms Myrt Jones -MobileAL.pdf
HQDA20180406NBZROW-A Channel Widening CG Letter.pdf

[redacted] Part of this letter speaks to the concern of aquifers.

[redacted] I need to be educated on the use of dredge material to cover the ALCOA site and what has come of it.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 01, 2018 7:43 AM
To: [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted] fyi.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 10:38 AM
To [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted]

Attached is the response to Ms. Myrt Jones - responding to her concerns about the Mobile Harbor GRR.

[redacted] - I assume that you will want to share a copy with LTC Jansen, the XO to the USACE CG.

[redacted] - copy for your files and to share with anyone else in Mobile.

The original is being mailed to Ms. Jones.

Best regards.

VR,

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 9:32 AM
To: [redacted]
Subject: Ms Myrt Jones Letter (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Vr,

[redacted]

CLASSIFICATION: UNCLASSIFIED

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SOUTH ATLANTIC DIVISION
60 FORSYTH STREET SW, ROOM 10M15
ATLANTA, GA 30303-8801

REPLY TO
ATTENTION OF

April 27, 2018

Ms. Myrt Jones
7359 Willow Point Drive N.
Mobile, AL 36695

Dear Ms. Jones:

Your March 1, 2018 letter to Lieutenant General Todd Semonite outlining your concerns about the Mobile Harbor General Reevaluation Report (GRR) evaluating the possible deepening and widening of the channel has been referred to me for response.

I can assure you that your input will be considered as part of the Environmental Impact Statement (EIS) process.

The Mobile District is scheduled to release the DRAFT GRR and EIS in June of this year. In July, following the release of these documents, Mobile District will hold a public hearing. The date and location will be announced in the near future. I recommend you attend this workshop to hear more specifics about the GRR and provide your input.

Thank you for your interest in the U.S. Army's Civil Works Program.

Sincerely,

Diana M. Holland

Diana M. Holland
Brigadier General, U.S. Army
Commanding

General Semonite -

Haven't been happy with COE District in a long ~~tem~~. time. My book relates some of the problems and also tells an interesting story @ Gen'l Drake and also tells an interesting story and I hit it off right at first. Wilson, DE - Heard I hit it off right at Just Was a smooth operator as he asked how does a person(s) improve or change the image of the Corps? I suggested he put together a Citizen's Advisory Committee out of those who receive the PN's - He did and the stories are in my book -

I noticed a Release no 18-014 posted on 2/9/18 requesting proposals for beneficial use of D.M. - I would bet Mobile was the first to use WES's idea - millions of cu yds were used to cover Alcoa's mud lakes - a superfund site as nothing would live in the alkaline waters - we signed a key placement - you'll read @ it as the Dr. of the Port & probably COE negated the document and destroyed the "paradise" - I am in touch with Alcoa but politics in AL can be very corrupt - anyway if the Contracts re: the recycling DM is interested encourage them to read Chronicle or ~~be~~ glad to talk with Gene Pawlik or

Doug Harman Please read on

[redacted]

March 1, 2018

Colonel James A. Delapp
Corp of Engineers
P.O. Box 2288
Mobile, Al. 36628

As an involved citizen of Mobile and a respected environmentalist of coastal Alabama for many years I hereby submit these comments for the **Corps of Engineers** (COE) **Record for the Public Hearing (PH) and Re: Alabama State Port Authority's** (ASPA) **Proposed Widening and Deepening of the Mobile Ship Channel** held February 22, 2018 in Mobile, Alabama. I attended the previous Corps Public Hearing in Bayou La Batre and couldn't stomach another dog and pony farce.!

A proper Public Hearing (PH) has not been held by the Corps of Engineers (COE) in coastal Alabama for many years. There may be reasons for believing the COE and ASPA have joined forces and are violating the laws of the land, specifically the **Public Trust Doctrine (PTD)** and the **National Environmental Policy Act (NEPA).**

I am being told by individuals attending the PH that the District Engineer of COE made it a point to take up a great deal of time at the beginning of the PH February 22 discussing at length Puerto Rico's situation-WHY?? **Did he due it intentionally** to shorten the public's time significantly in voicing their concerns and sharing their views for the Record?? People in the audience thought it very obvious and many now feel this **federal agency** may be **overstepping their boundaries** in supporting ASPA's bloated economics as well as this project over the public needs. A similar situation was discovered several years ago right after **BP's blowout**. The Department of Interior and Minerals Management Services ignored their responsibility and violated federal laws, even bending over backwards supporting the oil and gas industry every way they could. It became a national farce as MMS help cause the catastrophic blowout. The **acting inspector general** for the DOI quietly **recommended** the agency **adopt a scientific integrity policy**. They didn't.

If this project is somehow allowed to pass, then the container, maritime and automobile industries should be required to **assume all of the expenses and consequences** for their project? They should be required to request this permit in their names and for their needs and not make the taxpayer assume their debts.

The Public Trust Doctrine (PTD) protects and provides for the rights of the American public and Alabamians to enjoy public access and use of all of coastal Alabama's natural resources, in this case all that Mobile Bay offers. ASPA's proposed widening and deepening project poses significant threats to Mobile Bay's integrity, water quality, bottomlands/detritus, micro/macro marine life, underground water bodies (aquifers) and all of its other natural resources. The '**public** interests' or users of this body of water are commercial 'live li hood' families depending on fisheries/ recreational fishermen, shrimpers, oystermen, boaters and sailors, swimmers, tourists, families and bay side property owners.

As one who has focused half of her life and 'lain across barb wire to save' Mobile Bay from assaults, are AGAIN having to focus on another badly planned proposed project

which threatens this invaluable estuary almost out of existence—for special interests over the public interests! Why chance making our bay deeper and wider, and discover the containerships, marine traffic and 'projected cars' aren't coming; ASPA's economics are bloated and flawed, or just plain GREEDY in their wants! **A similar but possibly worst widening and deepening proposal by COE and ASD's was denied in 1985!**
The PTD should not be ignored as no-one should be so ignorant as to believe they can ignore the laws and people's NEEDS and VALUES! If they believe **Jimmy Lyons,** who is **not a biologist,** say **'open spraying'** is the safest and best option in spreading millions of gallons of dredge material into the air and over the bay's waters containing **unidentified toxic and hazardous chemicals** which may be threatening human lives then they are not smart enough to realize that 'others are losing their shirts.' (Oh by the way- Lyons also believes that coal dust is not harmful to humans?)
No-one truly knows **what the impacts have been** from this 'scatter brained idea' and it **should be a top priority** to identify the unknowns before this estuary is completely destroyed. Ralph Atkins, owner of **Southern Fish and Oyster** said "There are no oysters in Alabama right now. None. All the dredging you've been doing and have done for at least three years has covered up everything in the bay. If you stopped today, it'd take 10 years to get the pH factor back in the bay to produce local oysters."
The million cubic yards of sprayed sediment and heavy turbidity loads may be **filling the gills** of fish, shrimp and oyster with 'silt' making them have trouble breathing the vital dissolved oxygen needed from the water column? **Coastal Alabamians have similar problems** breathing as the local air contains unidentified toxic/hazardous pollution loads released from the heavily congested transportation corridors, McDuffie's coal handling facility, emissions from the numerous storage tanks and various chemical, cement and energy companies in Mobile/Baldwin Counties.
National Environmental Policy Act (NEPA) requires and supports citizen input and participation especially when a proposed project poses **'significant adverse affects** on the **environment** and **jeopardizes human life.**' These words trigger the need for an overall EIS. This story needs to be told. A retired COE speaker at a Sierra Club meeting in coastal Alabama alerted the attendees as to how Director Jimmy Lyons of the ASPA was 'illegally' meeting behind closed doors with other state and federal agencies discussing his proposed channel and dredging project for Mobile Bay. He planned on filling the northern portion of the bay with disposal islands which are presently public lands. A little history…the Fish & Wildlife Service estimated that in the early days the Alabama State Docks (ASD), now the ASPA, had historically "taken, diked and filled" over 5,000 acres of public lands in the Mobile Harbor now 'fast lands' being used by the Port. They are McDuffie, Blakeley, Pinto Island and Gaillard Island. Following the meeting individuals and groups became involved and required the current overall EIS being put together for the project, instead of the proposed EA the ASPA planned on doing. You may enjoy reading my book--"Chronicle of An Eco-Warrior Relating South Alabama's Environmental Issues",,,it covers the 70's until 2017.

These are few historical moments that someone in power may consider being useful::

****Other ports in the Nation have deeper channels and **presently accommodate** and easily handle these huge ships and automobiles-so why try something that **isn't going to work in our very shallow** Mobile Bay? The bay is so shallow it requires frequent costly maintenance and the COE adds to these costs as they forget their responsibility and never seem able to do something right the first time in an environmental friendly manner. They believe in using the least costly methods such as capturing and dumping the loads in deep Gulf of Mexico waters or spraying it over bay's waters. 'Out of sight out of mind process.

Dredg materia as resource

**** The Waterways Experiment Station in Vicksburg warehouses contained estuary models such as Mobile Bay and the COE scientific board announced that dredged material was considered a "**natural resource**" and should be used as such. **This was news** but it seemed to challenge the Mobile District as they were dredging the **new "Theodore Industrial Channel** for the Industrial Park." The ASPS and Chamber of Commerce wanted an island in the bay and refused to consider placing millions of cu. yds. of dredge material onshore that could be used in construction and roads. **Common sense was ruled out**-Greed came into play! Mobile Bay ended up with the badly planned, extremely costly **Gaillard Island** which destroyed over 5 square miles of bay bottoms and surface area in the beginning and has become a sinkhole for millions of taxpayers' dollars annually.

****A similar situation occurred in the 70's with **Radcliff Dredging**. During their 24 hour dredging operations in Mobile Bay it was finally discovered the **heavy turbidity** and **huge sediment loads** were destroying water quality, killing marine life and destroying wetlands and grass beds through out the bay. The **operation was stopped**.

restoring Alcoa's mud lakes = Dredge material

***** Dredge material was used in a pilot program in recovering a superfund site. The COE/ASD used Alcoa's area for 35 years '**freely**' dumping 15 million cubic yards of dredged material from the harbor into the six mud- lakes. According to the **Alcoa/ Ala's legal agreement** after that period **600 acres** would be turned into **a birding paradise** and re- turned to the people and state of Alabama as '**mitigation.**' This was beautifully done in the 600 acre area and contained lot of trees, shrubs and freshwater ponds caring for a variety of birds, butterflies and possibly wildlife, as it is close to the Mobile-Tensaw Delta. But the Director of the ASPA /COE violated this legal document and the birding paradise has been **destroyed completely**

***** There doesn't appear to be any kind of federal or biological oversight regarding the COE/ASPA operations in Mobile Bay as the deep holes or 'dead zones' throughout areas in the bay have been filled that once provided marine life a haven; the invaluable submerged and emergent grass beds and bay bottoms that were once lush in Arlington Point have been smothered; as have the Alabama's oyster beds and reefs.

*****The ASPA plans to dredge a deep holding area as anchorage for the huge container vessels in the Bay north of Fort Morgan Peninsula, but these ships need to stay in the Gulf. What happens when the Peninsula starts to disappear and slough off into the

dredged holding basin as Mother Nature's natural holding stability would have been disturbed and removed… what will the state do? In 1985 the ASD's planned a huge coal handling terminal in this same area, but thank heavens it was stopped-one has to watch out for land grabs such as these.
**** Jeff Childs, a noted biologist with MMS warned "bringing in these huge foreign ships are likely to introduce **invasive exotic species** that may well yield much greater **significant adverse affects** than expected." This happened before in Mobile Bay and ended being an economic horror and presented nightmares! Jimmy Lyons, put this in your **economic** statement!
****During the COE's Tenn.Tom/Black Warrior **'boondoggle'** a few years back… people discovered there was no water coming from their wells in their backyards as the aquifers had suddenly dried up. It was finally discovered the **new deep cuts** for the canal had destroyed and dried up the underground springs close to the farms and homes. No-one assumed responsibility for their losses. The PTD now requires that underground water supplies be fully protected in the Nation. The point that needs to be made is the COE and ASD's have again requested a **deeper draft and channel** in the bay and these **should be denied forever**. Water supplies are too vital and must be preserved for the rights of present and future generations. These underground rivers or aquifers provide diverse benefits as they also **refurbish** and **replenish surface rivers and streams**, which provide for recreational trout fishing and other needs. There are numerous rivers that need protecting on both sides of Mobile Bay such as Fish, Fowl and Dog Rivers and. fishermen need to be alerted and involved…
*****Costly and **catastrophic erosional processes** will occur within Mobile Bay with wider and deeper channels as more **ship waves** will threaten marshes, wetlands, the high banks on eastern shore and beaches of Mobile Bay will disappear and erode. This is probably why the **beach areas** on the **west side of Mobile Bay** are covered with rip rap? Alabama taxpayers will pay for the COE/ASPA short sightedness-AGAIN if this EIS is approved in near future! Will the Alabama taxpayer ever tire of footing the COE/ASPA bills for their badly planned 'special interests' projects?
The **Alabama Attorney General** needs to stay on top of this project and consider taking appropriate actions when necessary as the EIS hasn't been released yet. The citizens should be allowed a proper Public Hearing and have time to make comments on this questionable document. Citizen lawsuits need to be filed if this permit is granted and the AG hasn't done anything.

Yours,
Myrt Jones

Myrt Jones
7359 Willow Pointe Dr. No.
Mobile, Al. #6695

Copies to everyone

From: [redacted]
To:
Subject: RE: Ms Myrt Jones Letter (UNCLASSIFIED)
Date: Tuesday, May 1, 2018 8:03:00 AM

Got it. I believe it was concern, at least in part, from Ms. Jones that led to the removal of all material to the ODMDS as part of the 1986 WRDA authorization. She was a major player during the original study.

I have asked [redacted] for a little history on the placement of dredge material on the ALCOA site and passed along the concerns of impacting aquifers to [redacted]. Engineering is already looking at the impacts to aquifers and there is a study/report due out soon on the subject from an outside group.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 01, 2018 7:43 AM
To: [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted] - fyi.
[redacted]

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 10:38 AM
To: [redacted]
Cc [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted]

Attached is the response to Ms. Myrt Jones - responding to her concerns about the Mobile Harbor GRR.

[redacted] - I assume that you will want to share a copy with LTC Jansen, the XO to the USACE CG.

[redacted] - copy for your files and to share with anyone else in Mobile.

The original is being mailed to Ms. Jones.

Best regards.

VR,

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 9:32 AM
To: [redacted]
Subject: Ms Myrt Jones Letter (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Vr,

[redacted]

CLASSIFICATION: UNCLASSIFIED

From:	[redacted]
To:	
Subject:	FW: DI Lawsuit
Date:	Wednesday, May 2, 2018 8:04:00 AM
Attachments:	DIPOA Litigation Summary (003).docx

Hey [redacted]
See attached DI litigation summary (page 4 of the attached document). I should have included you on the e-mail below. In my defense, I think I thought you already had the document.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, January 18, 2018 10:58 AM
To: [redacted]
Cc:
Subject: RE: DI Lawsuit

[redacted]: I've been using the attached document that [redacted] prepared (see bottom of page 4). Please do not distribute.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, January 18, 2018 10:18 AM
To: [redacted]
Cc:
Subject: DI Lawsuit

[redacted] - can you send me the part of the lawsuit ya'll are reading that applies to our conversation today?

Thanks,

[redacted]

[redacted] (b)(6)

Attorney-Client Privileged Information or Work Product
Not Releasable Under FOIA or Discovery
Please Do Not Forward or Copy this Message

Litigation Summary of Dauphin Island Property Owner's Association
vs. The United States

[redacted]

(b)(5)

Pages 4 through 8 redacted for the following reasons:
- -
(b)(5)

From: [redacted]
To:
Cc:
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)
Date: Wednesday, May 2, 2018 2:03:00 PM
Attachments: Ltr to LTG Seminote from Ms Myrt Jones -MobileAL.pdf
HQDA20180406NBZROW-A Channel Widening CG Letter.pdf

[redacted] Please include the attached in our letters for the SEIS.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 01, 2018 7:43 AM
To: [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted] - fyi.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 10:38 AM
To: [redacted]
Subject: FW: Ms Myrt Jones Letter (UNCLASSIFIED)

[redacted]

Attached is the response to Ms. Myrt Jones - responding to her concerns about the Mobile Harbor GRR.

[redacted] - I assume that you will want to share a copy with LTC Jansen, the XO to the USACE CG.

[redacted] - copy for your files and to share with anyone else in Mobile.

The original is being mailed to Ms. [redacted]

Best regards.

VR,

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, April 30, 2018 9:32 AM
To: [redacted]
Subject: Ms Myrt Jones Letter (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Vr,

[redacted]

CLASSIFICATION: UNCLASSIFIED

From: [redacted]
To:
Cc:
Subject: Mobile Harbor GRR, Updated Plan and Schedule
Date: Wednesday, May 2, 2018 8:19:00 AM

All,
Over the next few weeks, we will be updating the economics for the Mobile Harbor GRR. We feel that there is an opportunity to achieve a justifiable deepening and widening to 50 feet. As such, for your report documentation, please assume the selected plan consists of the following:
Deepening: 50' (52' on the bar)
Widening: 500' widener, 3 miles long
Bend Easing
Turning Basin Modification

The schedule will be revised as follows:
DQC Review: May 24-Jun 06
Release of Draft Report (ATR, IEPR): Jun 19, 2018

Please let me know if you have any questions.

[redacted]

From: [redacted]
To:
Subject: RE: [redacted] accountability of maintenance material in new work costs: Mobile Harbor (UNCLASSIFIED)
Date: Wednesday, May 2, 2018 9:45:00 AM

This will be addressed in...the Report?

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 02, 2018 9:41 AM
To: [redacted]
Cc:
Subject [redacted] Concern: accountability of maintenance material in new work costs: Mobile Harbor (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

My spreadsheet notes state:

Approximately 4mcy is dredged annually from the Bay with O&M funds; therefore the assumption is any O&M material beyond 4mcy will be included in the new work. Somehow I had that 477,519 cy is included in all alternatives.

The Mobile Bar is dredged on a 3 year cycle. The last cycle was 1mcy. The bar however stays naturally deep to approximately 49' year round. There was an assumption that 2' of overdepth will be included with new work quantities minus a portion of the shoaling; therefore 1.14 mcy were included in each bar deepening alternative.

The risk analysis includes concerns for quantity scope growth for higher shoaling between phases. This will be addressed in

[redacted]

CLASSIFICATION: UNCLASSIFIED

From: [redacted]
To:
Subject: RE: Mobile Harbor GRR, Updated Plan and Schedule
Date: Wednesday, May 2, 2018 9:31:00 AM

Yes, I just used the same language we used in the TSP slides.

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 02, 2018 9:20 AM
To: [redacted]
Subject: RE: Mobile Harbor GRR, Updated Plan and Schedule

[redacted]

Is that a 100' widener? Isn't that total width, not just a widener.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 2, 2018 8:19 AM
To: [redacted]
Subject: Mobile Harbor GRR, Updated Plan and Schedule

All,
Over the next few weeks, we will be updating the economics for the Mobile Harbor GRR. We feel that there is an opportunity to achieve a justifiable deepening and widening to 50 feet. As such, for your report documentation, please assume the selected plan consists of the following:
Deepening: 50' (52' on the bar)
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Bend Easing
Turning Basin Modification

The schedule will be revised as follows:
DQC Review: May 24-Jun 06
Release of Draft Report (ATR, IEPR): Jun 19, 2018

Please let me know if you have any questions.

[redacted] (b)(6)

From: [redacted]
To:
Cc:
Subject: FW: Mobile Harbor Report and Appendices Page Counts
Date: Thursday, May 3, 2018 8:34:00 AM

[redacted],

Main Report assume 200 pages. Following are the page counts for the appendices...

A Engineering Main Appendix 75 pages (but includes the following attachments)
ERDC Modeling Report - 100 pages
USGS Modeling Report - 30 pages
Ship Simluation Report - 90 pages
Vessel Generated Wave Energy Assessment - 85 pages
Data Collection Report - 30 pages
Boring Logs - 300 pages

B Economics 100 pages
C Environmental 250 pages
D Real Estate 35 pages

[redacted]

From: [redacted]
To:
Subject: FW: Two Mobile Harbor Questions
Date: Thursday, May 3, 2018 8:35:00 AM

Weeks...funding info for [redacted] on the DQC Review is in the e-mail forwarded below...

-----Original Message-----
From: [redacted]
Sent: Thursday, May 03, 2018 7:38 AM
To: [redacted]
Subject: RE: Two Mobile Harbor Questions

I'm sorry, I thought we'd already let you know. [redacted] (NWS) will be the DQC econ reviewer.

40-hr equivalent rate: [redacted]
CEFMS Org Code [redacted]
Financial POC (Name, phone): [redacted];
Technical POC (Name, phone): [redacted]

I haven't seen the econ appendix but I would think 120 pages or less.

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 2, 2018 4:12 PM
To: [redacted]
Subject: Two Mobile Harbor Questions

[redacted],
Two questions:
1.) Who will be DQC Reviewer for the Mobile Harbor GRR Econ?
2.) Do you know the approximate number of pages of the econ appendix for Mobile Harbor? I am pretty certain [redacted] gave this to me but I cannot locate it anywhere. I really hate to bother her on vacation but [redacted] needs it for the contract. I thought you might have seen her draft.

[redacted]

From: [redacted]
To:
Subject: Minutes_Mobile Harbor_CoastGuard_01May18.docx
Date: Thursday, May 3, 2018 10:29:00 AM
Attachments: Minutes_Mobile Harbor_CoastGuard_01May18.docx

Let me know if either of you have revisions to the attached coast guard meeting minutes. I would like to send this out today.

[redacted]

CESAM-PM-C 03 May 2018

MEMORANDUM FOR RECORD

SUBJECT: Draft Minutes of the Mobile Harbor Coast Guard Meeting on 01 May 2018

Participants: [redacted]

1. Introductions
2. [redacted] provided an overview of the purpose of the meeting and agenda.
3. [redacted] presented an overview of the Tentatively Selected Plan
   - Channel Deepening: 50 feet
   - Channel Widening: 3 mi. long, 100 ft wide
   - Turning Basin Modification
   - Bar Channel Bend Easing
4. [redacted] presented the results of the ship simulation modeling (Ship Simulation Report Attached)
   - Bend Easing allowed for shorter passing distance
   - Simulated Passing at 5 miles. 3 miles works with easings
   - Simulated turns in Turning Basin
   - Additional Ship Simulation will be performed during design phase
5. [redacted] discussed development of the passing rules within the channel
   - Rules used in the development of the economic benefits
   - Ensure safety
6. [redacted] presented the ATON Discussion
   - Table of estimated quantity and costs presented
   - Previously worked with Mottel
   - Chief Officer [redacted] to confirm quantity/costs
   - ATONs to be funded by Coast Guard but will be considered project cost
7. Mobile District Corps of Engineers will provide plans and backup documentation. Will request official letter from the Coast Guard that plan is acceptable.

Comments on the plans are due by Thursday, 24-May 2018

[redacted]
Project Manager

From: [redacted]
To:
Subject: RE: GRR Petroleum Terminal Economics
Date: Thursday, May 3, 2018 10:01:00 AM

Thank you...Will call with [redacted] on Monday.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 03, 2018 9:31 AM
To: [redacted]
Cc: [redacted]
Subject: [Non-DoD Source] GRR Petroleum Terminal Economics

[redacted] In copy is [redacted] with Hunt. Hunt owns and operates the Alabama Bulk Terminal. He can address your questions regarding known growth or vessel call increases since 2016. Please feel free to send your questions to him directly. [redacted]

[redacted]

[redacted]

[redacted]

Alabama State Port
Authority

P.O. Box 1588

Mobile, AL 26622

+1 251-441-7003

[redacted]

Blockedwww.asdd.com <Blockedhttp://www.asdd.com/>

From: [redacted]
To:
Cc:
Subject: FW: Mobile Harbor Approval Authority
Date: Friday, May 4, 2018 12:58:00 PM
Attachments: Mobile Harbor MFR Report Approval Level.pdf

FYI. Delegation authority to Division has been approved for the Mobile Harbor GRR.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 04, 2018 11:01 AM
To: [redacted]
Subject: Fw: Mobile Harbor Approval Authority

Happy Friday!

[redacted]

www.corpsplanning.us
Original Message
From: [redacted]
Sent: Friday, May 4, 2018 11:53 AM
To: [redacted]
Cc: [redacted]
Subject: Mobile Harbor Approval Authority

Please find attached a Memorandum for the Record that identifies the MSC as the appropriate approval level for the Mobile Harbor GRR.

If you have any questions, please let me know.

[redacted]

CECW-PC 4 May 2018

MEMORANDUM FOR RECORD

SUBJECT: Concurrence with South Atlantic Division Approval for Mobile Harbor, General Reevaluation Report (GRR) and Integrated Environmental Impact Statement (EIS)

1. A Tentatively Selected Plan (TSP) meeting for the subject study was held on 28 March 2018. The plan presented to the vertical team included deepening to an interior depth of -49 feet Mean Lower Low Water (MLLW), channel widening of 100 feet for a length of approximately 3 miles, modifications to the existing turning basin for design vessel safety, and bend easing in the Bar Channel. This plan was presented to the vertical team as being within the currently authorized physical dimensions for Mobile Harbor, within the statutory Sec 902 limit, and no outstanding policy issues. By email on 19 April 2018, the South Atlantic Division requested Headquarters concurrence that decision making approval should fall to the Major Subordinate Command as established in ER 1165-2-502.

2. The policy review team has reviewed this request as it applies to applicable laws and policy and has reached unanimous consensus in concurrence that the South Atlantic Division is the appropriate approval level for the GRR/EIS. However, if at any time the TSP, as identified in paragraph 1, changes to a point that is determined to exceed statutory authority or is found to be non-policy compliant, HQUSACE must be re-engaged to determine the appropriate decision level.

WESLEY E. COLEMAN, JR.
Chief, Office of Water Project Review
Planning and Policy Division
Directorate of Civil Works

From: [redacted]
To:
Subject: FW: NOAA Surveying, Offshore of Alabama in Mississippi Sound, Report of Shoal Depts and Update to Charts
Date: Monday, May 7, 2018 3:51:00 PM
Attachments: image001.png
NOAA OCS Report of Shoaling and Depths Off of Alabama in Mississippi Sound.pdf

---

Probably need to get a response back to [redacted] I could not really follow what is happening. Are you aware of this?

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 3:03 PM
To: [redacted]
Cc: [redacted]
Subject: [Non-DoD Source] FW: NOAA Surveying, Offshore of Alabama in Mississippi Sound, Report of Shoal Depts and Update to Charts

Note shoaling off the end of Pelican Island. Could this be material moving from SIBU?

From: [redacted]
Sent: Monday, May 07, 2018 2:59 PM
To: [redacted]
Subject: NOAA Surveying, Offshore of Alabama in Mississippi Sound, Report of Shoal Depts and Update to Charts

Figure 1.1.3

H13068 DtoN Report #4 Soundings

Registry Number: H13068

State: Alabama

Locality: Mississippi Sound

Sub-locality: 5 NM Southeast of Dauphin Island

Project Number: OPR-J348-KR-17

Survey Date: 01/05/2018

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
11377	11th	11/01/2015	1:40,000 (11377_1)	USCG LNM: 8/29/2017 (9/12/2017) NGA NTM: 7/31/2010 (9/16/2017)
11378	35th	03/01/2008	1:40,000 (11378_7)	[L]NTM: ?

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	8ft Sounding	Shoal	2.36 m	30° 12' 31.0" N	088° 05' 38.6" W	---
1.2	7ft Sounding	Shoal	2.04 m	30° 12' 11.4" N	088° 05' 14.0" W	---
1.3	12ft Sounding	Shoal	3.52 m	30° 11' 55.7" N	088° 05' 11.5" W	---
1.4	6ft Sounding	Shoal	1.80 m	30° 12' 17.5" N	088° 05' 06.7" W	---
1.5	11ft Sounding	Shoal	3.41 m	30° 11' 45.0" N	088° 04' 57.4" W	---

1 - Dangers To Navigation

1.1) 8ft Sounding

DANGER TO NAVIGATION

Survey Summary

Survey Position:	30° 12' 31.0" N, 088° 05' 38.6" W
Least Depth:	2.36 m (= 7.74 ft = 1.290 fm = 1 fm 1.74 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2018-005.00:00:01.000 (01/05/2018)
Dataset:	H13068 DtoN SOUNDG.000
FOID:	US 0000272302 00001(0226000427AE0001/1)
Charts Affected:	11377_1, 11378_7

Remarks:

SOUNDG/remrks: 8ft sounding observed seaward of the 12ft depth curve and located within the 12ft to 18ft depth range.

Feature Correlation

Source	Feature	Range	Azimuth	Status
H13068 DtoN SOUNDG.000	US 0000272302 00001	0.00	000.0	Primary

Hydrographer Recommendations

Recommend to append the survey depth of 8ft to the chart.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

8ft (11377_1, 11378_7)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20180105
	SORIND - US,US,graph,H13068
	TECSOU - 3:found by multi-beam

Office Notes

Survey depth has been verified and is valid. Recommend applying the surveyed depth to the applicable largest scaled chart products RNCs 11377_1 and 11378_7, and ENC US5AL13M. Vertical datum is MLLW, with horizontal datum as NAD83.

Feature Images

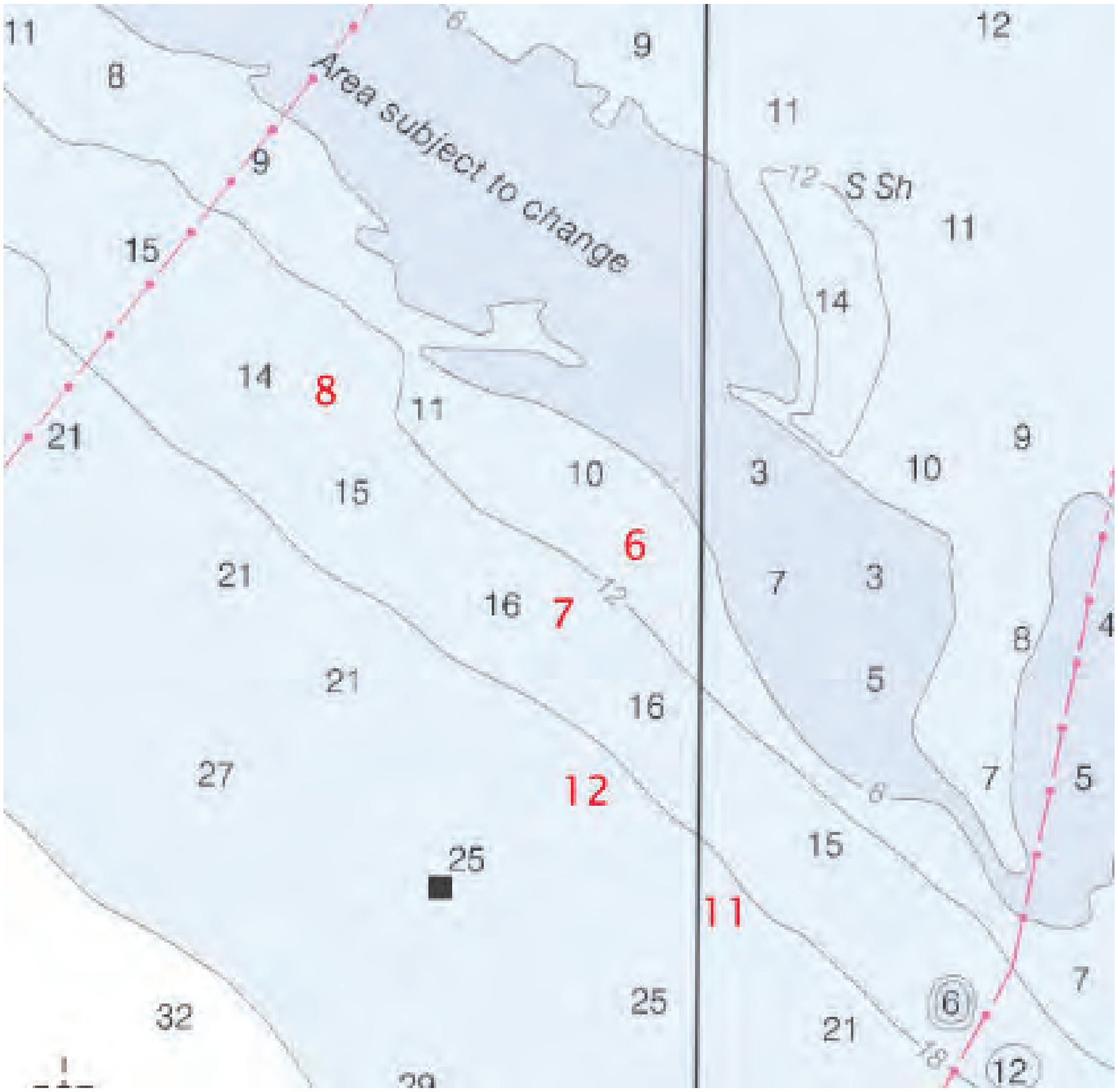

Figure 1.1.1

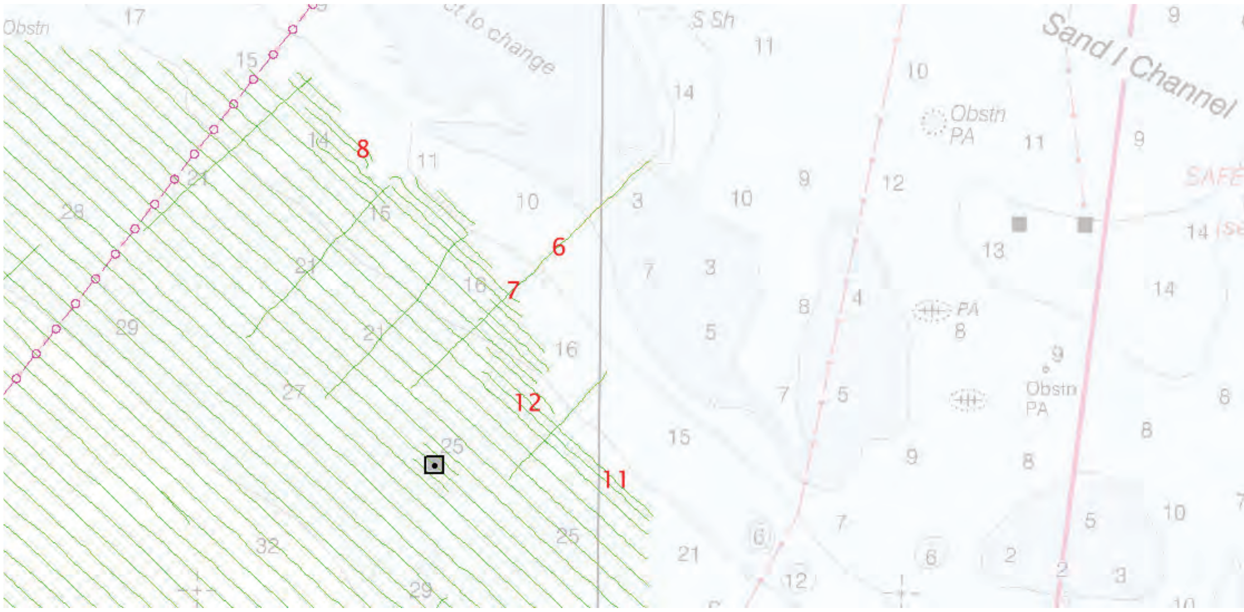

Figure 1.1.2

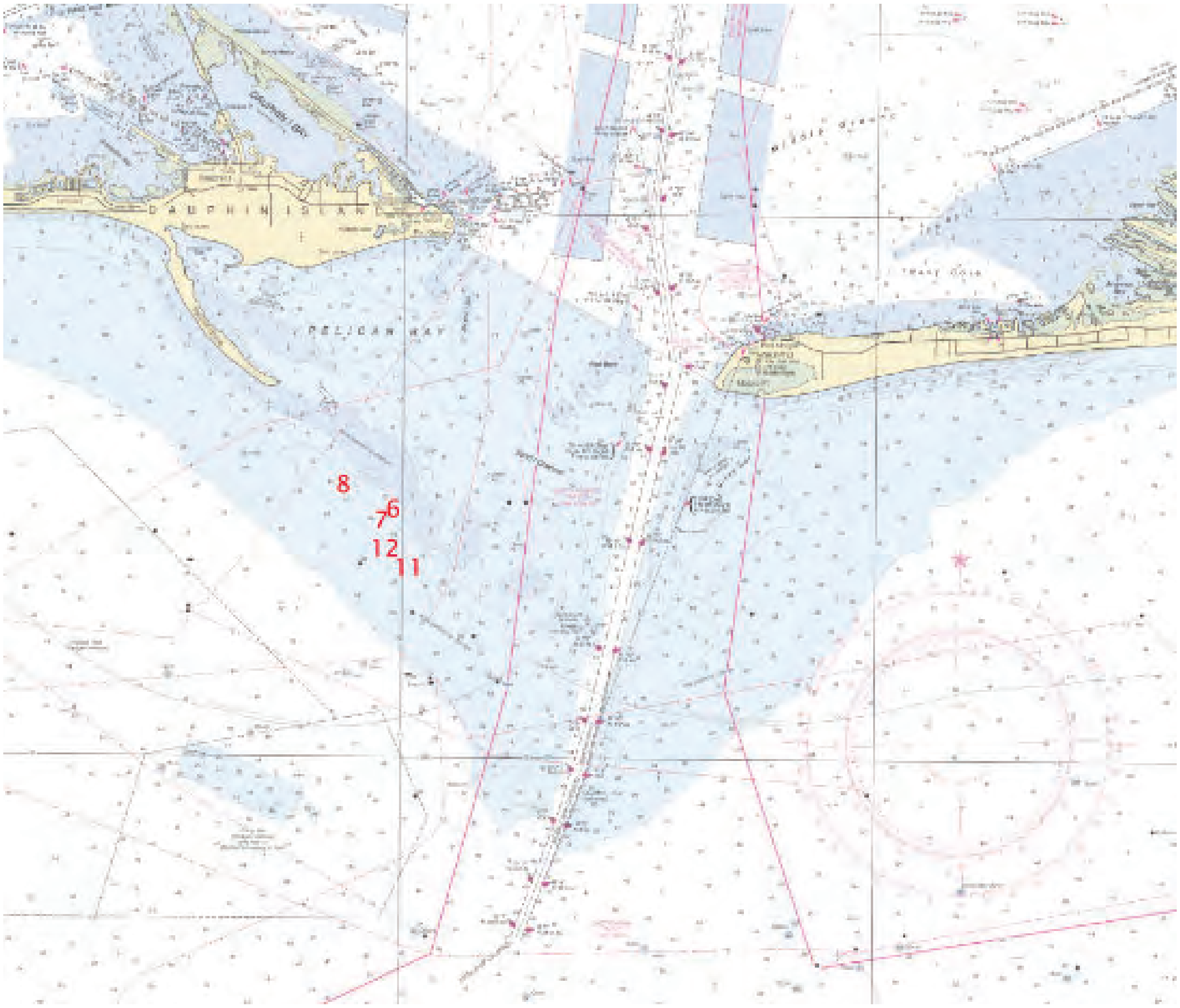

Figure 1.1.3

1.2) 7ft Sounding

DANGER TO NAVIGATION

Survey Summary

Survey Position:	30° 12' 11.4" N, 088° 05' 14.0" W
Least Depth:	2.04 m (= 6.71 ft = 1.118 fm = 1 fm 0.71 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2018-005.00:00:01.000 (01/05/2018)
Dataset:	H13068 DtoN SOUNDG.000
FOID:	US 0000272293 00001(0226000427A50001/1)
Charts Affected:	11377_1, 11378_7

Remarks:

SOUNDG/remrks: 7ft sounding observed seaward of the 12ft depth curve and located within the 12ft to 18ft depth range.

Feature Correlation

Source	Feature	Range	Azimuth	Status
H13068 DtoN SOUNDG.000	US 0000272293 00001	0.00	000.0	Primary

Hydrographer Recommendations

Recommend to append the survey depth of 7ft to the chart.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

7ft (11377_1, 11378_7)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20180105
	SORIND - US,US,graph,H13068
	TECSOU - 3:found by multi-beam

Office Notes

Survey depth has been verified and is valid. Recommend applying the surveyed depth to the applicable largest scaled chart products RNCs 11377_1 and 11378_7, and ENC US5AL13M. Vertical datum is MLLW, with horizontal datum as NAD83.

1.3) 12ft Sounding

DANGER TO NAVIGATION

Survey Summary

Survey Position:	30° 11' 55.7" N, 088° 05' 11.5" W
Least Depth:	3.52 m (= 11.54 ft = 1.923 fm = 1 fm 5.54 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2018-005.00:00:01.000 (01/05/2018)
Dataset:	H13068 DtoN SOUNDG.000
FOID:	US 0000272300 00001(0226000427AC0001/1)
Charts Affected:	11377_1, 11378_7

Remarks:

SOUNDG/remrks: 12ft sounding observed seaward of the 18ft depth curve and located within the 18ft to 30ft depth range.

Feature Correlation

Source	Feature	Range	Azimuth	Status
H13068 DtoN SOUNDG.000	US 0000272300 00001	0.00	000.0	Primary

Hydrographer Recommendations

Recommend to append the survey depth of 12ft to the chart.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

12ft (11377_1, 11378_7)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20180105
	SORIND - US,US,graph,H13068
	TECSOU - 3:found by multi-beam

Office Notes

Survey depth has been verified and is valid. Recommend applying the surveyed depth to the applicable largest scaled chart products RNCs 11377_1 and 11378_7, and ENC US5AL13M. Vertical datum is MLLW, with horizontal datum as NAD83.

1.4) 6ft Sounding

DANGER TO NAVIGATION

Survey Summary

Survey Position: 30° 12' 17.5" N, 088° 05' 06.7" W

Least Depth: 1.80 m (= 5.90 ft = 0.983 fm = 0 fm 5.90 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2018-005.00:00:01.000 (01/05/2018)

Dataset: H13068 DtoN SOUNDG.000

FOID: US 0000272298 00001(0226000427AA0001/1)

Charts Affected: 11377_1, 11378_7

Remarks:

SOUNDG/remrks: 6ft sounding observed seaward of the 6ft depth curve and located within the 6ft to 12ft depth range.

Feature Correlation

Source	Feature	Range	Azimuth	Status
H13068 DtoN SOUNDG.000	US 0000272298 00001	0.00	000.0	Primary

Hydrographer Recommendations

Recommend to append the survey depth of 6ft to the chart.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

6ft (11377_1, 11378_7)

S-57 Data

Geo object 1: Sounding (SOUNDG)

Attributes: QUASOU - 1:depth known

SORDAT - 20180105

SORIND - US,US,graph,H13068

TECSOU - 3:found by multi-beam

Office Notes

Survey depth has been verified and is valid. Recommend applying the surveyed depth to the applicable largest scaled chart products RNCs 11377_1 and 11378_7, and ENC US5AL13M. Vertical datum is MLLW, with horizontal datum as NAD83.

1.5) 11ft Sounding

DANGER TO NAVIGATION

Survey Summary

Survey Position: 30° 11' 45.0" N, 088° 04' 57.4" W

Least Depth: 3.41 m (= 11.18 ft = 1.863 fm = 1 fm 5.18 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2018-005.00:00:01.000 (01/05/2018)

Dataset: H13068 DtoN SOUNDG.000

FOID: US 0000272295 00001(0226000427A70001/1)

Charts Affected: 11377_1, 11378_7

Remarks:

SOUNDG/remrks: 11ft sounding observed seaward of the 18ft depth curve and located within the 18ft to 30ft depth range.

Feature Correlation

Source	Feature	Range	Azimuth	Status
H13068 DtoN SOUNDG.000	US 0000272295 00001	0.00	000.0	Primary

Hydrographer Recommendations

Recommend to append the survey depth of 11ft to the chart.

Arithmetically-Rounded Depth (Unit-wise Affected Charts):

11ft (11377_1, 11378_7)

S-57 Data

Geo object 1: Sounding (SOUNDG)

Attributes: QUASOU - 1:depth known

SORDAT - 20180105

SORIND - US,US,graph,H13068

TECSOU - 3:found by multi-beam

Office Notes

Survey depth has been verified and is valid. Recommend applying the surveyed depth to the applicable largest scaled chart products RNCs 11377_1 and 11378_7, and ENC US5AL13M. Vertical datum is MLLW, with horizontal datum as NAD83.

From: [redacted]
To:
Subject: IEPR 2018-04-17 Mobile Harbor - Charge.docx
Date: Monday, May 7, 2018 1:52:00 PM
Attachments: IEPR 2018-04-17 Mobile Harbor - Charge.docx

All: Please review the specific questions highlighted in yellow in the attached charge to reviewers for the IEPR Review of Mobile Harbor and let me know if you have additional questions or would like to revise the attached.

[redacted]

MOBILE HARBOR GRR, ALABAMA
DRAFT INTEGRATED FEASIBILITY REPORT AND
ENVIRONMENTAL IMPACT STATEMENT
MOBILE DISTRICT

INDEPENDENT EXTERNAL PEER REVIEW
REVIEW CHARGE

The following Review Charge to Reviewers outlines the objectives of the Independent External Peer Review (IEPR) for the subject study and identifies specific items for consideration for the IEPR Review Panel.

The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR Review Panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the Review Charge. The Review Panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback or issues outside those specific areas outlined in the Review Charge. The Review Panel can use all available information to determine what scientific and technical issues related to the decision document may be important to raise to decision makers. This includes comments received from agencies and the public as part of the public review process.

The Panel review is to focus on scientific and technical matters, leaving policy determinations for USACE and the Army. The Panel should not make recommendations on whether a particular alternative should be implemented or present findings that become “directives” in that they call for modifications or additional studies or suggest new conclusions and recommendations. In such circumstances the Review Panel would have assumed the role of advisors as well as reviewers, thus introducing bias and potential conflict in their ability to provide objective review.

Panel review comments are to be structured to fully communicate the Panel’s intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment. The IEPR Performance Work Statement (PWS) provides additional details on how comments should be structured.

The Review Panel is asked to consider the following items as part of its review of the decision document and supporting materials.

<u>Broad Evaluation Review Charge Questions</u>

1. Is the need for and intent of the decision document clear?
2. Does the decision document adequately address the stated need and intent relative to scientific and technical issues?

Given the need for and intent of the decision document, assess the adequacy and acceptability of the following:

3. Project evaluation data used in the study analyses;
4. Economic, environmental, and engineering assumptions that underlie the study analyses;
5. Economic, environmental, and engineering methodologies, analyses, and projections;
6. Models used in the evaluation of existing and future without-project conditions and of economic or environmental impacts of alternatives;
7. Methods for integrating risk and uncertainty;
8. Formulation of alternative plans and the range of alternative plans considered;
9. Quality and quantity of the surveys, investigations, and engineering sufficient for conceptual design of alternative plans, and;
10. Overall assessment of significant environmental impacts and any biological analyses.

Further,

11. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable, and;
12. Assess the considered and tentatively selected alternatives from the perspective of systems, including systemic aspects being considered from a temporal perspective, including the potential effects of climate change.
13. Does information or do concerns provided in the public comments raise any additional discipline-specific technical concerns with regard to the overall report?

Specific Technical and Scientific Review Charge Questions

14. Are there other areas of potential environmental impact that have not been considered in the report?
15. Have environmental impacts been reasonably and sufficiently captured and, if required, sufficient mitigation provided in accordance with regulations?
16. Is there 20 year disposal capacity provided for dredged material?
17. Have Environmental Justice concerns to include traffic, air, and noise been sufficiently addressed?
18. Have potential impacts on the cultural resources been sufficiently addressed?

From:	[redacted]
To:	
Subject:	RE: Hazardous materials
Date:	Monday, May 7, 2018 4:12:00 PM
Attachments:	Hazardous Materials-BAH2_crg_ab_BAH.DOCX

[redacted]: I read it, looks good to me. Let me think about the best time to forward for review...

[redacted] and I are okay with the attached document. Please review and let us know your thoughts.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 10:55 AM
To: [redacted]
Subject: [Non-DoD Source] Hazardous materials

Attached is the revised section on haz-materials … could you please review and comment … should I also send to [redacted] for comment?

[redacted]

AECOM

10 Patewood Drive

Building 6, Suite 500

Greenville, SC 29615

T +1-864-234-3000

aecom.com

Built to deliver a better world

LinkedIn <Blockedhttp://www.linkedin.com/company/aecom_15656>   Twitter
<Blockedhttp://twitter.com/AECOM>   Facebook
<Blockedhttp://www.facebook.com/AecomTechnologyCorporation>   Instagram
<Blockedhttp://instagram.com/aecom>

Pages 3 through 6 redacted for the following reasons:
- -
(b)(5)

From: [redacted]
To:
Subject: RE: Mobile Harbor Approval Authority (UNCLASSIFIED)
Date: Monday, May 7, 2018 1:41:00 PM

Thanks, [redacted]

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 12:17 PM
To: [redacted]
Subject: FW: Mobile Harbor Approval Authority (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 4, 2018 3:57 PM
To: [redacted]
Cc: [redacted]

[redacted]
Subject: FW: Mobile Harbor Approval Authority

Planning Team: this puts the ball squarely in our court to review and approve the GRR. Will need to discuss our approach to this, including appropriate coordination w/ HQ. This is a preview of coming delegation attractions!

Respectfully,

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 04, 2018 11:53 AM
To: [redacted]
Cc: [redacted]
Subject: Mobile Harbor Approval Authority

Please find attached a Memorandum for the Record that identifies the MSC as the appropriate approval level for the Mobile Harbor GRR.

If you have any questions, please let me know.

[redacted]

CLASSIFICATION: UNCLASSIFIED

From: [redacted]
To:
Cc:
Subject: RE: Mobile Harbor Report and Appendices Page Counts
Date: Monday, May 7, 2018 2:43:00 PM

[redacted]
Dates as follows...
IEPR Start Date: June 19, 2018
IEPR End Date: Aug 28, 2018
ADM Date: November 16, 2018

Working on the charge to reviewers.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 7:52 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Mobile Harbor Report and Appendices Page Counts

Thanks [redacted],

Almost there (see attached).

Still need official start/end dates for the review as well as the scheduled ADM date.

Also need your feedback on the draft Review Charge in the attached email.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 3, 2018 8:34 AM
To: [redacted]
Cc: [redacted]
Subject: FW: Mobile Harbor Report and Appendices Page Counts

[redacted]

Main Report assume 200 pages. Following are the page counts for the appendices...

A Engineering Main Appendix 75 pages (but includes the following attachments)
ERDC Modeling Report - 100 pages
USGS Modeling Report - 30 pages

Ship Simluation Report - 90 pages
Vessel Generated Wave Energy Assessment - 85 pages
Data Collection Report - 30 pages
Boring Logs - 300 pages

B Economics 100 pages
C Environmental 250 pages
D Real Estate 35 pages

[redacted]

From: [redacted]
To:
Cc:
Subject: RE: Mobile Harbor Report and Appendices Page Counts
Date: Monday, May 7, 2018 3:25:00 PM

Public Review period last day is somewhere between 03 August and 07 August. That provides 3 weeks after public comments have been completed before final submittal of IEPR comments.

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 3:10 PM
To: [redacted]
Cc:
Subject: RE: Mobile Harbor Report and Appendices Page Counts

Just to clarify, 28 Aug is the last day of the public review period?

-----Original Message-----
From: [redacted]
Sent: Monday, May 7, 2018 2:43 PM
To: [redacted]
Cc:
Subject: RE: Mobile Harbor Report and Appendices Page Counts

[redacted]
Dates as follows...
IEPR Start Date: June 19, 2018
IEPR End Date: Aug 28, 2018
ADM Date: November 16, 2018

Working on the charge to reviewers.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 7:52 AM
To: [redacted]
Cc:
Subject: RE: Mobile Harbor Report and Appendices Page Counts

Thanks [redacted]

Almost there (see attached).

Still need official start/end dates for the review as well as the scheduled ADM date.

Also need your feedback on the draft Review Charge in the attached email.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 3, 2018 8:34 AM
To: [redacted]
Cc: [redacted]
Subject: FW: Mobile Harbor Report and Appendices Page Counts

[redacted]

Main Report assume 200 pages. Following are the page counts for the appendices...

A Engineering Main Appendix 75 pages (but includes the following attachments)
ERDC Modeling Report - 100 pages
USGS Modeling Report - 30 pages
Ship Simluation Report - 90 pages
Vessel Generated Wave Energy Assessment - 85 pages Data Collection Report - 30 pages Boring Logs - 300 pages

B Economics 100 pages
C Environmental 250 pages
D Real Estate 35 pages

[redacted]

From: [redacted]
To:
Subject: RE: PDF"s for Mobile Harbor report (UNCLASSIFIED)
Date: Monday, May 7, 2018 10:19:00 AM

Okay, thanks...The natives are getting restless!

-----Original Message-----
From: [redacted]
Sent: Monday, May 07, 2018 9:29 AM
To: [redacted]
Subject: RE: PDF's for Mobile Harbor report (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

I have sent [redacted] some recommended revisions to incorporate. I believe today is his off day. We should be able to incorporate and send out tomorrow.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, May 7, 2018 8:57 AM
To: [redacted]
Subject: RE: PDF's for Mobile Harbor report (UNCLASSIFIED)

[redacted]: Let me know when I can send to the team.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 04, 2018 1:16 PM
To: [redacted]
Subject: RE: PDF's for Mobile Harbor report (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Reviewing them now. Sorry for the delay.

[redacted]

-----Original Message-----

From: [redacted]
Sent: Friday, May 4, 2018 10:09 AM
To: [redacted]
Subject: RE: PDF's for Mobile Harbor report

Thanks, [redacted].

[redacted], Let me know when I can forward to the team.

-----Original Message-----
From: [redacted]
Sent: Friday, May 04, 2018 9:29 AM
To: [redacted]
Subject: PDF's for Mobile Harbor report

[redacted] & [redacted]
[redacted] asked me yesterday to forward these to you as soon as I completed them.
CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED

From: [redacted]
To:
Cc:
Subject: RE: Congressional from Bradley Byrne
Date: Tuesday, May 8, 2018 9:21:16 AM
Attachments: Honorable Bradley Byrne(Roedder).docx

[redacted]

My suggestions.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 8, 2018 9:04 AM
To: [redacted]
Cc: [redacted]
Subject: Congressional from Bradley Byrne
Importance: High

All,

Attached is a constituent letter received from Mr. Byrne's office. Also attached is my proposed response. They particularly requested we address item 4, I believe I have done that without getting too specific to lock is in to something.

Please review and provide any comments.

Thanks

[redacted]

Page 2 redacted for the following reason:
- -
(b)(5)

From: [redacted]
To:
Subject: FW: Congressional from Bradley Byrne
Date: Tuesday, May 8, 2018 9:50:00 AM
Attachments: 2018-04-16.Letter to Bradley Byrne.pdf
Honorable Bradley Byrne(Roedder).docx
RE Congressional from Bradley Byrne.msg
Importance: High

FYI

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 08, 2018 9:04 AM
To: [redacted]
Cc [redacted]
Subject: Congressional from Bradley Byrne
Importance: High

All,

Attached is a constituent letter received from Mr. Byrne's office. Also attached is my proposed response. They particularly requested we address item 4, I believe I have done that without getting too specific to lock is in to something.

Please review and provide any comments.

Thanks

[redacted]

WILLIAM C. ROEDDER, JR.

[redacted] (b)(6)

Mobile, Alabama [redacted] (b)(6)

Home: [redacted] (b)(6)

Office: [redacted] (b)(6)

Fax: ([redacted] (b)(6)

April 16, 2018

U.S. First Class Mail
& Email to kathryn.miller@mail.house.gov

Bradley Byrne
11 N. Water Street, Suite 15290
Mobile, Alabama 36602

Re: Dauphin Island Erosion Problem
Caused by Mobile Ship Channel Dredging Practices

Dear Bradley:

As you know, a study is underway regarding a proposal to deepen and widen the Mobile Ship Channel. I am supportive of that project but if, *AND ONLY IF*, steps are taken to ensure that the beach erosion of the south side of Dauphin Island does not continue.

Here is how the ship channel, even as it currently exists, causes the erosion problem, which will be much worse if the ship channel is widened or deepened without correction of the dredging practices by the Corp of Engineers:

1. The natural Littoral System moves the sand near the shore from east to west, while the waves take this sand ashore. The problem is that this "river of sand" as it heads west, falls into the Mobile Ship Channel. It essentially drops into a 45-foot-deep hole and cannot move further west to Dauphin Island. This is the cause of sand deprivation on the south side of Dauphin Island.

2. This loss of sand is supposed to be replenished by the dredging that the Corp of Engineers does on a regular basis. The Corp dredges the sand out of the Mobile Ship Channel in order to maintain its depth and should be depositing this dredged sand at a point reasonably near to Dauphin Island in relatively shallow water so that the currents pick it up and move it to the southern shore of Dauphin Island.

3. The Corp has since 1999 been dumping this dredged sand in an area called the Sand Island Beneficial Use Area ("SIBUA") where the water is 27 feet deep or deeper. The Corp announced a month or so ago that it has discovered that half of the sand deposited in the

SIBUA area (approximately 7 million cubic yards of sand) has not reached Dauphin Island. The reason is that the water at the SIBUA area is too deep for the currents to pick it up and carry it to shore. To give you an idea of the volume of sand that Dauphin Island has lost, 7 million cubic yards of sand would cover an area the length of the entire gulf beach of Dauphin Island 845 feet wide and 3 feet deep.

4. The Corp also recently announced that they were going to move the dump site to a new location, but, as it turns out the new site is adjacent to the old site and is in water roughly the same depth as the SIBUA. In a recent meeting with the leadership of the Dauphin Island Property Owners Association (DIPOA) the Corp acknowledged that the shallower the water in which the sand was deposited, the greater the likelihood that the sand would be picked up by the currents and moved to Dauphin Island. The DIPOA has taken a stand on this issue and opposes the disposal practice of the Corps. Moreover, experts are also of the view that the water depth should be less than twenty feet in order to ensure that the bulk of the sand deposited would be picked up by the currents and moved to Dauphin Island. Obviously, the new site chosen by the Corp will not correct the problem, which will only grow worse if the ship channel is widened and deepened.

I have had a home on Dauphin Island for 35 or so years and my children and grandchildren along with my wife and I, continue to enjoy the beauty, tranquility, peace and slow pace of life on Dauphin Island. It would be a pity if my great-grandchildren and their grandchildren grow up to find that the island has eroded away to the point that it is virtually uninhabitable. This is exactly what will happen if the Corp is not made to find and use a dumping site that is 20 feet deep or less. I hope that you will take a keen interest in this problem and help ensure that the Corp selects a different and proper dumping site.

Sincerely yours,

William C. Roedder, Jr.

WCR/caj

cc: Dennis Knizley ([redacted])
President, DIPOA

Page 6 redacted for the following reason:
- -
(b)(5)

From: [redacted]
To:
Subject: FW: Another question (or more specifics)
Date: Tuesday, May 8, 2018 1:58:00 PM
Attachments: nb_b data input request 05.08.2018.docx

We probably need to discuss this...

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 08, 2018 1:27 PM
To: [redacted]
Cc:
Subject: [Non-DoD Source] FW: Another question (or more specifics)

Using the information received in the meeting last week, I spoke with my air quality expert and we need some further clarifications and have some further questions:

[redacted]

I really appreciate your support in responding to these questions. I realize that these are predictions, only … but we need something to base our assessment.

Thank you again for a quick response.

[redacted] (b)(6)

From: [redacted]
To:
Subject: FW: Utilities questions
Date: Tuesday, May 8, 2018 10:06:00 AM
Attachments: Utilities and infrastructure_AB_BAH_crg_BAH.docx

---

How much cover do we typically require over utility crossings on a Navigation Channel (I know, I know, you've told me before but I did not write it down).

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 08, 2018 8:52 AM
To [redacted]
Subject: [Non-DoD Source] FW: Utilities questions

[redacted] could you please look at [redacted] question and let me know how to respond?

[redacted]

From: [redacted]
Sent: Monday, May 07, 2018 5:44 PM
To [redacted]
Cc [redacted]
Subject: Utilities questions

[redacted]

[redacted]

Thanks! [redacted]

From [redacted]
Sent: Thursday, April 19, 2018 6:34 AM
To: [redacted]
Subject: RE: Mob Harbor - Draft REP and other docs

[redacted]

The file “ Utilities and infrastructure_AB.docx” is updated for the materials you sent.

The Real Estate Plan conclude [redacted]

[redacted] Please let me know if I interpreted the sent materials correctly.

Thanks!

[redacted]

-----Original Message-----

From: [redacted]

Sent: Wednesday, April 18, 2018 2:34 PM

To [redacted]

C [redacted]

Subject: FW: Mob Harbor - Draft REP and other docs

[redacted] We are using the attached table for the utility crossings. Also attached is the current draft status of the Real Estate Appendix to make sure that your efforts are not overlapping...

[redacted]

-----Original Message-----

From: [redacted]

Sent: Wednesday, April 18, 2018 1:31 PM

To [redacted]

Subject: Mob Harbor - Draft REP and other docs

[redacted]

Pages 5 through 10 redacted for the following reasons:
- -
(b)(5)

From: [redacted] (b)(6)
To:
Subject: RE: IEPR 2018-04-17 Mobile Harbor - Charge.docx
Date: Tuesday, May 8, 2018 8:29:00 AM

Great, thank you...

-----Original Message-----
From: [redacted] (b)(6)
Sent: Tuesday, May 08, 2018 7:11 AM
To: [redacted] (b)(6)
Subject: RE: IEPR 2018-04-17 Mobile Harbor - Charge.docx

[redacted] (b)(6)

It looks fine to me. I sent it to the EN team and asked for any feedback on additional questions by COB today.

[redacted] (b)(6)

-----Original Message-----
From [redacted] (b)(6)
Sent: Monday, May 07, 2018 1:53 PM
To: [redacted] (b)(6)

[redacted] (b)(6)

Subject: IEPR 2018-04-17 Mobile Harbor - Charge.docx

All: Please review the specific questions highlighted in yellow in the attached charge to reviewers for the IEPR Review of Mobile Harbor and let me know if you have additional questions or would like to revise the attached.

[redacted] (b)(6)

From: [redacted]
To:
Cc:
Subject: DQC of EJ/Air/Noise - Mobile Harbor GRR
Date: Tuesday, May 8, 2018 1:10:00 PM

[redacted] We need to add a very good and experienced DQC reviewer for the EJ, Traffic, Air, and Noise portion of the Mobile Harbor GRR.

Can you recommend anyone to do this for us?

[redacted]

From: [redacted]
To:
Subject: FW: Mobile Harbor GRR - Cultural Resource Assessment
Date: Wednesday, May 9, 2018 1:43:00 PM
Attachments: Existing Conditions-5-6-18 - CR edits.docx
A Cultural Resources Overview for Mobile Bay for the Mobile Harbor GRR.docx

---

Sorry...Meant to include you!

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, May 09, 2018 12:59 PM
To: [redacted]
Subject: Mobile Harbor GRR - Cultural Resource Assessment

[redacted] Attached is the latest existing conditions and the cultural resource overview for the Mobile Harbor GRR. The documents have not been updated to reflect the work that will be done in the widener but they do speak to the past work that will be used/referenced in the GRR. It is in paragraph 2.16 under "Survey Coverage" in the existing condition document and referenced under "Previous Survey Coverage" of the overview document (paragraphs have not been numbered).

[redacted] I may have overlooked it, but it appears that the CR documents need to be formatted to match the rest of the appendices/report and should explain our approach on the cultural resource assessments. This would include a discussion on the Relic Shell Mined Area and Widener portions of the study. The due date to begin the DQC review is 24 May 2018.

[redacted]

ENVIRONEMTAL APPENDIX

TABLE OF CONENTS

LIST OF FIGURES

LIST OF TABLES

SECTION 1. INTRODUCTION

This Environemtal Appendix characterizes the affected environment and provides descriptions of existing conditions for environmental and socioeconomic resources in the overall project area which includes Mobile and Baldwin Counties. This information will be used to assess potential impacts resulting from the implementation of the proposed Mobile Harbor channel improvements as described in Section X of the GRR. A comparative assessment of the alternatives and their potential environmental impacts is provided in Section 3.

1.1. Project Description

Pages 5 through 94 redacted for the following reasons:
- -
(b)(5) Draft

SECTION 3. REFERENCES

Pages 96 through 115 redacted for the following reasons:
- -
(b)(3) Cultural Resources & (b)(5) Draft

From: [redacted]
To:
Cc:
Subject: FW: Another question (or more specifics)
Date: Wednesday, May 9, 2018 3:57:00 PM

[redacted]

View in HTML…

QUESTION 1: We were initially basing our assumptions on the following: [redacted]

RESPONSE 1: Your initial assumption [redacted]

QUESTION 2: Is this statement [redacted]

RESPONSE 2 [redacted]

[redacted]

Page 2 redacted for the following reason:
- -
(b)(5)

[redacted]

QUESTION 3: [redacted]

RESPONSE 3: [redacted]

QUESTION 4: [redacted]

RESPONSE 4: [redacted]

[redacted]

[redacted]

-----Original Message-----

From: [redacted]

Sent: Tuesday, May 08, 2018 1:27 PM

To: [redacted]

Cc: [redacted]

Subject: [Non-DoD Source] FW: Another question (or more specifics)

Using the information received in the meeting last week, I spoke with my air quality expert and we need some further clarifications and have some further questions:

[redacted]

[redacted]

[redacted]

[redacted] (b)(5)

[redacted] (b)(5)

[redacted] (b)(5)

[redacted] (b)(5)

From: [redacted]
To:
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)
Date: Wednesday, May 9, 2018 1:47:00 PM

Just remember, you have three options:
1.) Deflect - blame someone else, send the wolves after that person.
2.) Diffuse - Make a joke that makes everyone laugh and forget about work.
3.) Obfuscate - Confuse the issue so badly that no one knows what's going on.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 09, 2018 12:30 PM
To: [redacted]
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

I will join so I can take a beating on schedule. :)

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 9, 2018 12:29 PM
To: [redacted]
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting

All: Just a reminder that today is the Mobile Harbor GRR Bi-weekly Meeting. Please attend if you are able. Attendance has been low and with all of the submittals coming up, we need to make sure that we are all tracking the due dates and other goings-on.

[redacted]

-----Original Appointment-----
From: [redacted]
Sent: Wednesday, February 01, 2017 12:39 PM
To [redacted]
Cc: [redacted]
Subject: Mobile Harbor GRR Bi-weekly Meeting
When: Wednesday, May 09, 2018 2:00 PM-3:00 PM (UTC-06:00) Central Time (US & Canada).
Where: MsCIP Conference Room

For those not in the district office, call-in Information is as follows:

USA Toll-Free [redacted]
Access Code: [redacted]
Security Code: [redacted]

All: The Mobile Harbor GRR bi-weekly meeting has been moved to Wednesdays at 2pm, beginning February 01, 2017. Please update your calendar accordingly. The purpose of the meeting remains to provide a brief update on the project, ensure all work is being performed, and ensure that the schedule is met.
Thanks,
[redacted]
CLASSIFICATION: UNCLASSIFIED

From: [redacted]
To:
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)
Date: Wednesday, May 9, 2018 1:50:00 PM

I think 2021...but let's confirm today wit [redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 09, 2018 1:50 PM
To: [redacted]
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

On a side note what base year are we using for plan formulation?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 9, 2018 1:49 PM
To: [redacted]
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Thanks I like having options.   :)

[redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 9, 2018 1:47 PM
To [redacted]
Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)

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[redacted]

-----Original Message-----

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Subject: RE: Mobile Harbor GRR Bi-weekly Meeting (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

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[redacted]

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Sent: Wednesday, February 01, 2017 12:39 PM
To [redacted]

[redacted]
Cc: [redacted]
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Thanks,
[redacted]
CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED

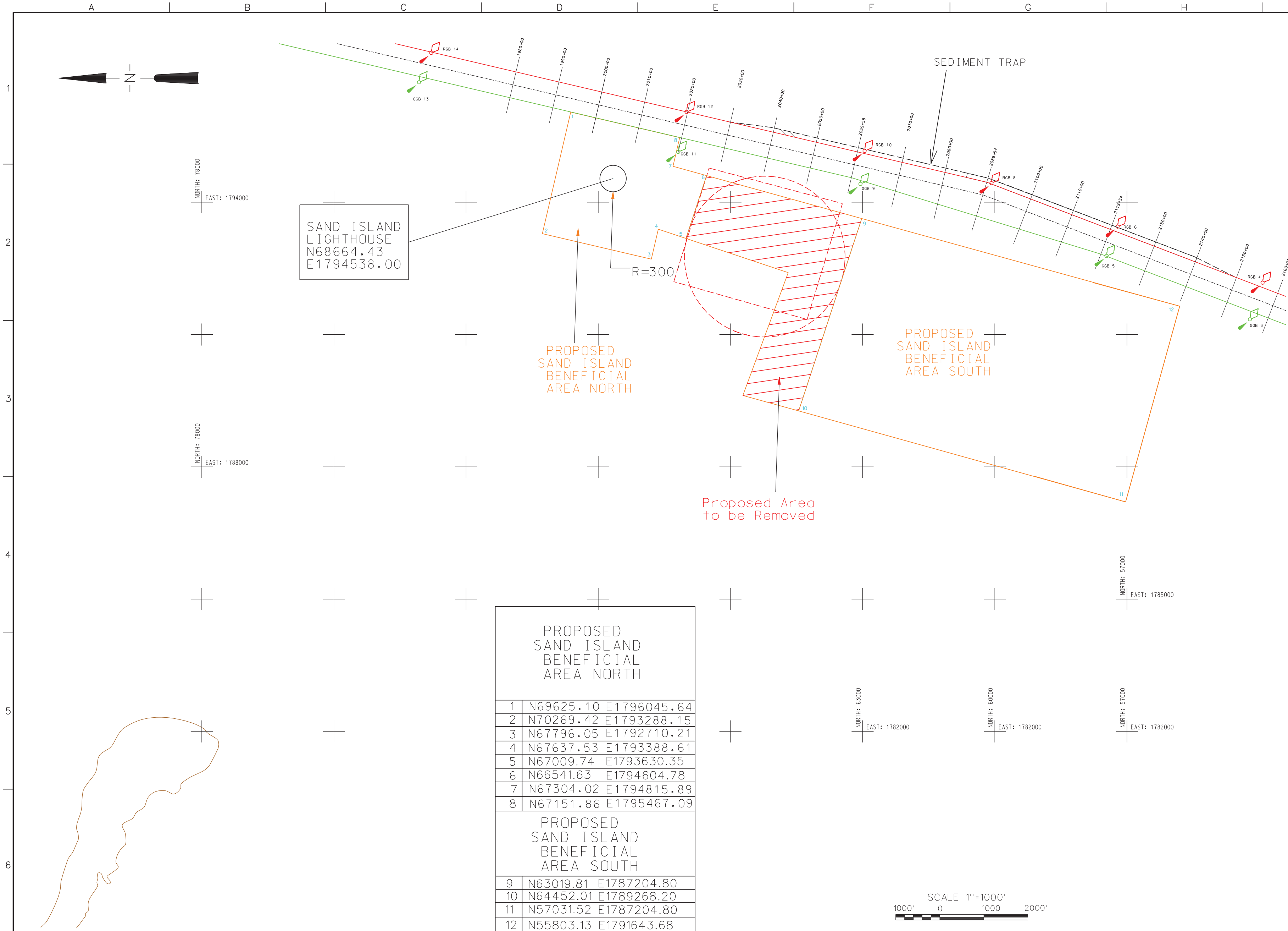
From:	[redacted]
To:	
Subject:	Emailing: SIBUA-NewExclusionZone2015.pdf
Date:	Wednesday, May 9, 2018 1:41:00 PM
Attachments:	SIBUA-NewExclusionZone2015.pdf Dauphin_Island_Dredging Costs.pptx

---

Your message is ready to be sent with the following file or link attachments:

SIBUA-NewExclusionZone2015.pdf

Note: To protect against computer viruses, e-mail programs may prevent sending or receiving certain types of file attachments. Check your e-mail security settings to determine how attachments are handled.



PROPOSED SAND ISLAND BENEFICIAL AREA NORTH	
1	N69625.10 E1796045.64
2	N70269.42 E1793288.15
3	N67796.05 E1792710.21
4	N67637.53 E1793388.61
5	N67009.74 E1793630.35
6	N66541.63 E1794604.78
7	N67304.02 E1794815.89
8	N67151.86 E1795467.09
PROPOSED SAND ISLAND BENEFICIAL AREA SOUTH	
9	N63019.81 E1787204.80
10	N64452.01 E1789268.20
11	N57031.52 E1787204.80
12	N55803.13 E1791643.68

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

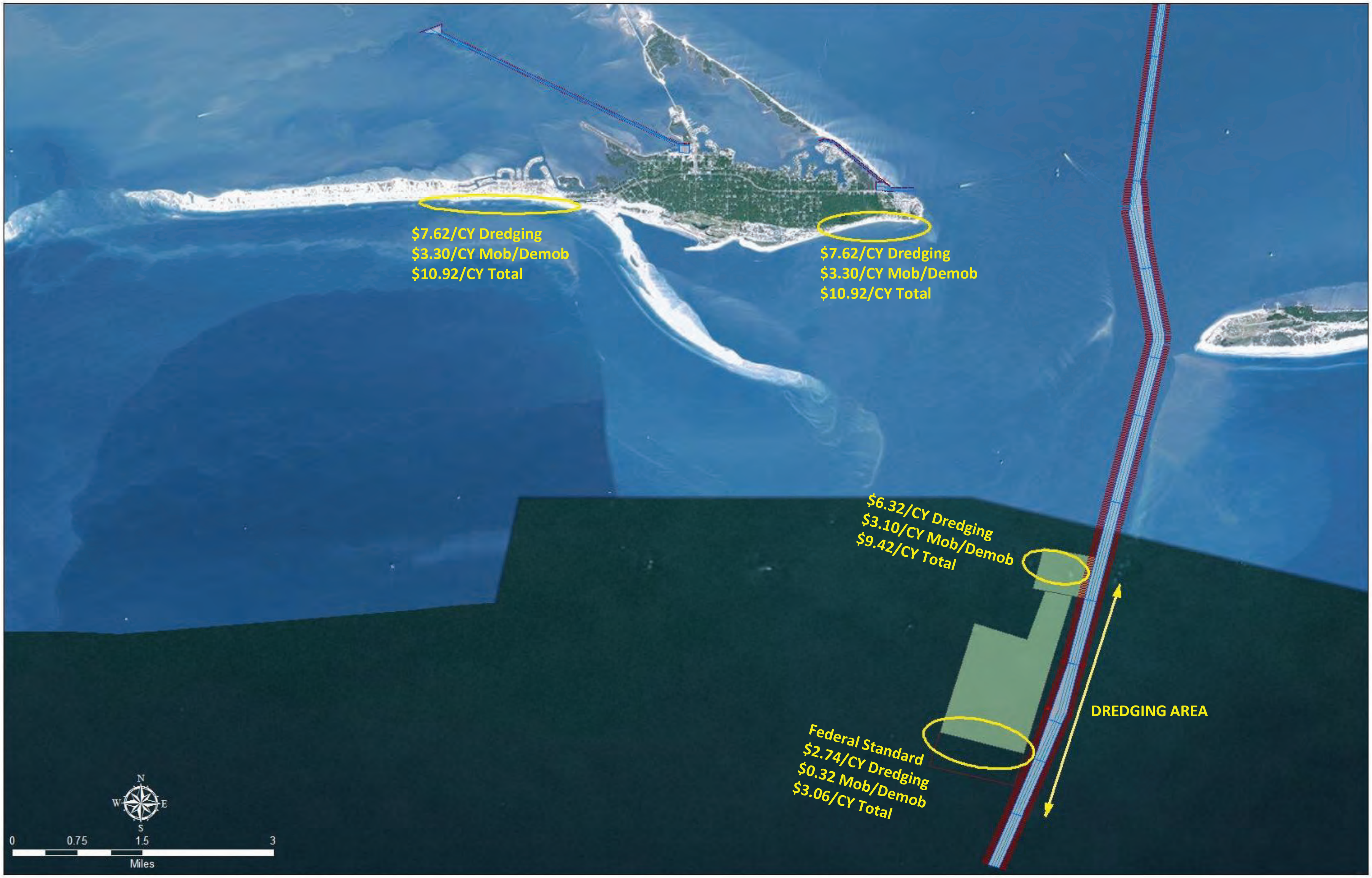
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

Designed By: D. CARTER
Drawn By: D. CARTER
Checked By:
Reviewed By:
Date: FEB. 13, 2013
File No. X
I.S.O. Sheet File Name: SIBUA3.DGN
Solicitation Number: MOBILE/OWDA/SIBUA

MOBILE HARBOR, ALABAMA

SAND ISLAND
BENEFICIAL USE AREA

Sheet Reference Number:
1 OF 1


$7.62/CY Dredging
$3.30/CY Mob/Demob
$10.92/CY Total
$7.62/CY Dredging
$3.30/CY Mob/Demob
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$6.32/CY Dredging
$3.10/CY Mob/Demob
$9.42/CY Total
DREDGING AREA
Federal Standard
$2.74/CY Dredging
$0.32 Mob/Demob
$3.06/CY Total
N
W
E
S
0
0.75
1.5
3
Miles

From: [redacted]
To:
Cc:
Subject: FW: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018
Date: Thursday, May 10, 2018 3:46:00 PM
Attachments: 11 May 2018 Environmental NGO Focus Meeting v2.pptx

---

[redacted]
Sorry, left you off the list. I added your slide to the deck.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 10, 2018 3:43 PM
To [redacted]
Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

All: Attached are the current slides with comments for tomorrow's Environmental NGO discussion.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 08, 2018 2:49 PM
To: [redacted]

[redacted]
Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

All: Just a reminder that we have the Environmental NGO Meeting this Friday, May 11 at 1300hrs CT. Attached are DRAFT slides for that meeting.
Please let me know if you would like to make additions or revisions to these slides by noon Thursday, May 10..

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, April 17, 2018 1:20 PM
To: [redacted]
Cc [redacted]
Subject: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

The U.S. Army Corps of Engineers (USACE), Mobile District is reconvening an environmental focus group meeting and requesting your participation for the Mobile Harbor General Reevaluation Report regarding the potential deepening and widening of the Mobile Harbor navigation channel. The meeting will be held at the Mobile District Office, 109 St. Joseph Street, Mobile, Alabama 36602, on Friday, 11th at 1:00 PM central. The meeting will focus on and provide the opportunity for those involved in environmental activities associated with Mobile Bay and its connected watersheds to hear about updated environmental evaluations that have been conducted as part of the study and to provide your comments and concerns related to potential impacts of the project. Members of the project team will be on hand to discuss and answer questions related to the proposed project. This meeting provides the opportunity for organizations such as yours to share comments and concerns that will be considered in the preparation of the Supplemental Environmental Impact Statement. Due to a limited capacity of the meeting room, we are asking that only one representative from your organization be in attendance. Please respond to let us know if your organization will be represented. For more information, on the proposed Mobile Harbor Federal Navigation Channel project, visit http://www.sam.usace.army.mil/.

Thank you and looking forward to meeting with you.

[redacted]

[redacted] (b)(6)

Update on the Mobile Harbor General Reevaluation Report

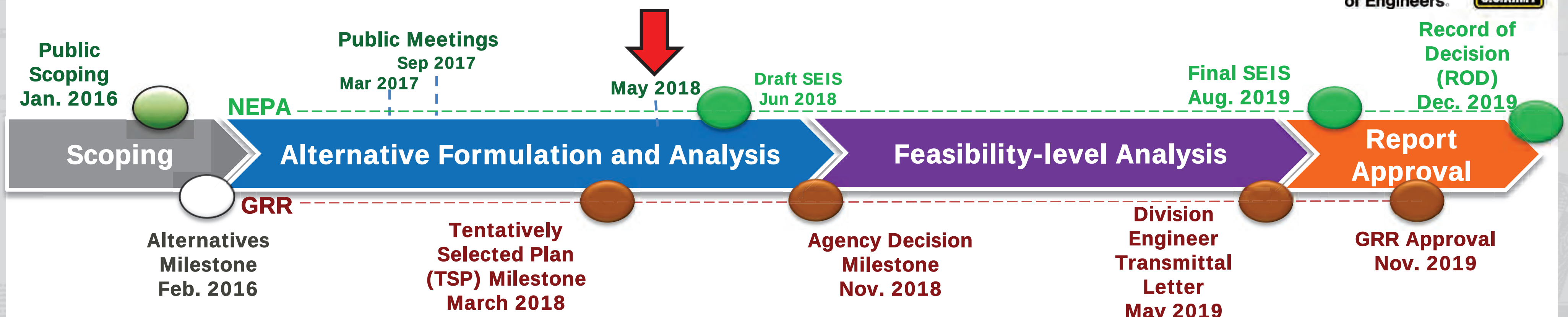
COL James DeLapp
DISTRICT COMMANDER

22 February 2018

US Army Corps of Engineers

U.S.ARMY

GENERAL REEVALUATION REPORT SCHEDULE



- 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

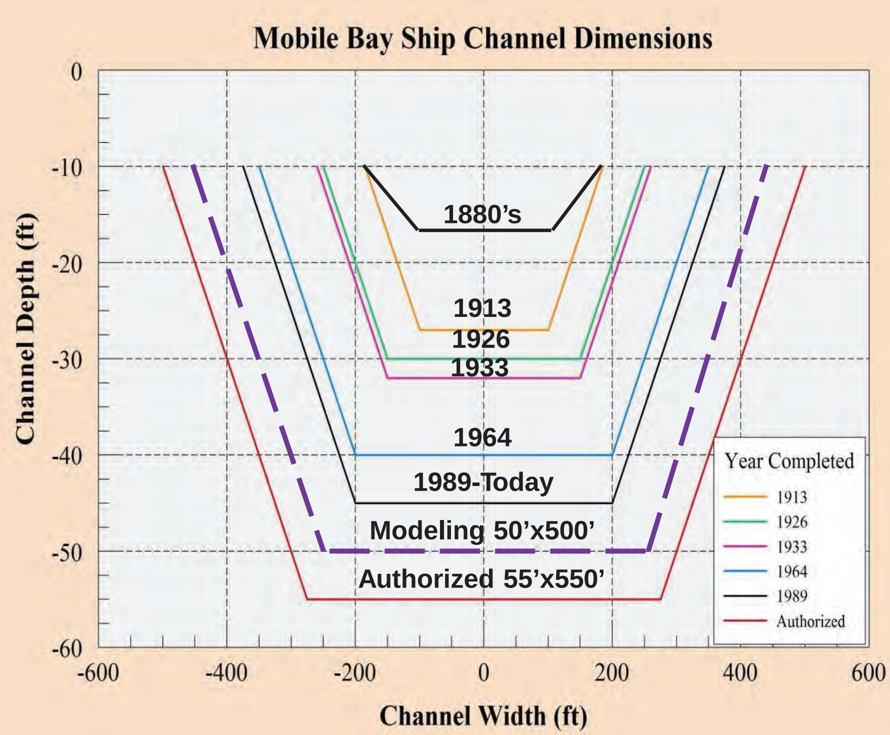
- Headquarters' review of final report
- Final SEIS; Alabama state and Federal agency review
- GRR approval
- Record of Decision signed

MOBILE HARBOR GENERAL REEVALUATION REPORT

US Army Corps of Engineers

U.S. ARMY

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



Tentatively Selected Plan

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

Tentatively Proposed Placement Locations

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

* Geotechnical data indicates minimal beach quality sand in new work

Release of Draft Supplemental Environmental Impact Statement scheduled for June 2018

MOBILE BAY ENVIRONMENTAL IMPORTANCE

US Army Corps of Engineers

U.S. ARMY

Setting for Mobile Bay

- Shallow bay (≈ 9'), long deep channel
- 2nd largest delta, 4th largest drainage area in U.S.
- High biodiversity
- Fresh, brackish, estuarine & marine habitats
- National Estuary designation, 1995

Coastal Considerations

- Ongoing Studies
- Beneficial use of dredged material
- Effects on coastal processes

Impacts to Other Resources

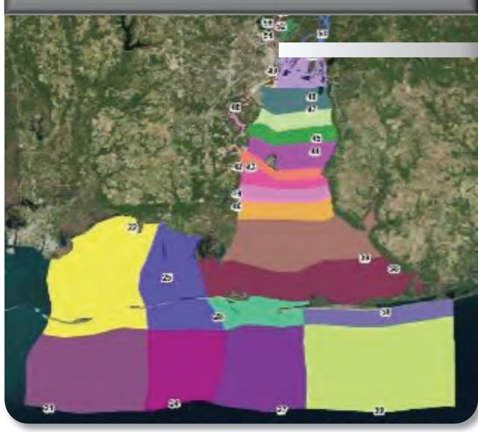
- Close coordination with State and Federal Agencies (USFWS, EPA, ADEM, ADCNR, NMFS)
- Endangered Species
- Wildlife
- Commercial fisheries
- Recreational fishing
- Sea level rise
- Cultural resources

AQUATIC RESOURCES ASSESSMENT

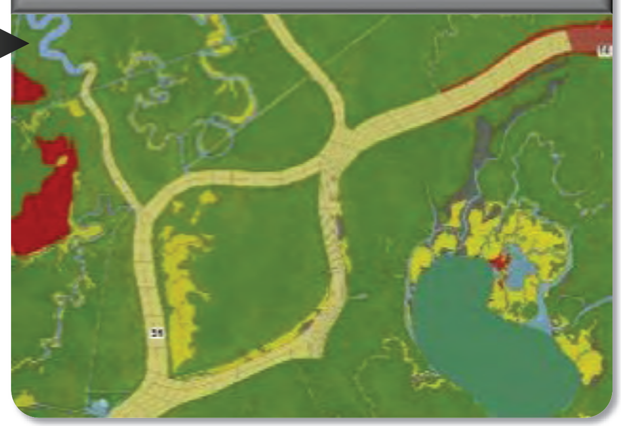
Overview

- Assessing potential impacts to wetlands, submerged aquatic vegetation, benthic invertebrates, oysters, fish
- Model outputs compare water quality (salinity, dissolved oxygen) using existing and post-project conditions
- Sea level rise scenario - 0.5 meter intermediate projection per USACE guidance at Dauphin Island

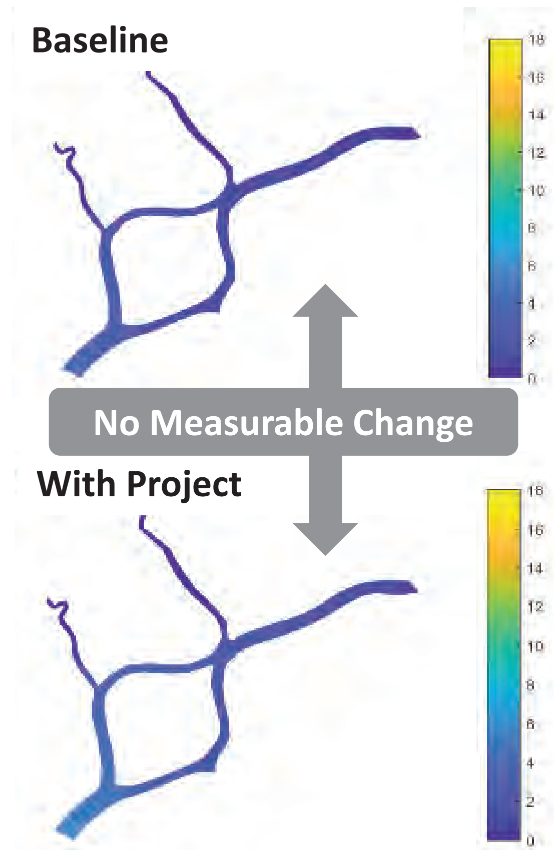
Model grid consists of 30 blocks & 48,000 cells



Model Block 54



Mean Salinity - July 2010



AQUATIC RESOURCES ASSESSMENT – WETLANDS

US Army Corps of Engineers

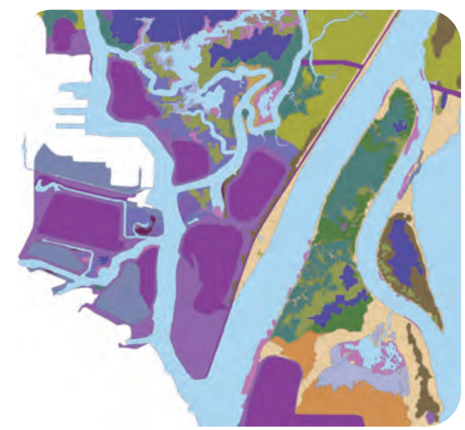
U.S. ARMY

Approach

- Wetland mapping - 77,000 ac mapped; 43 community types; >800 on-site samples
- Assessed potential exceedance of salinity thresholds

Results

- **No wetland losses anticipated**
- All vegetation within acceptable environmental tolerance ranges
- All wetlands within ideal growth conditions
- Sea level rise will result in substantial inundation of existing wetlands
- Project impacts remain negligible under 0.5 meter sea level rise scenario



SUBMERGED AQUATIC VEGETATION (SAVs)

US Army Corps of Engineers

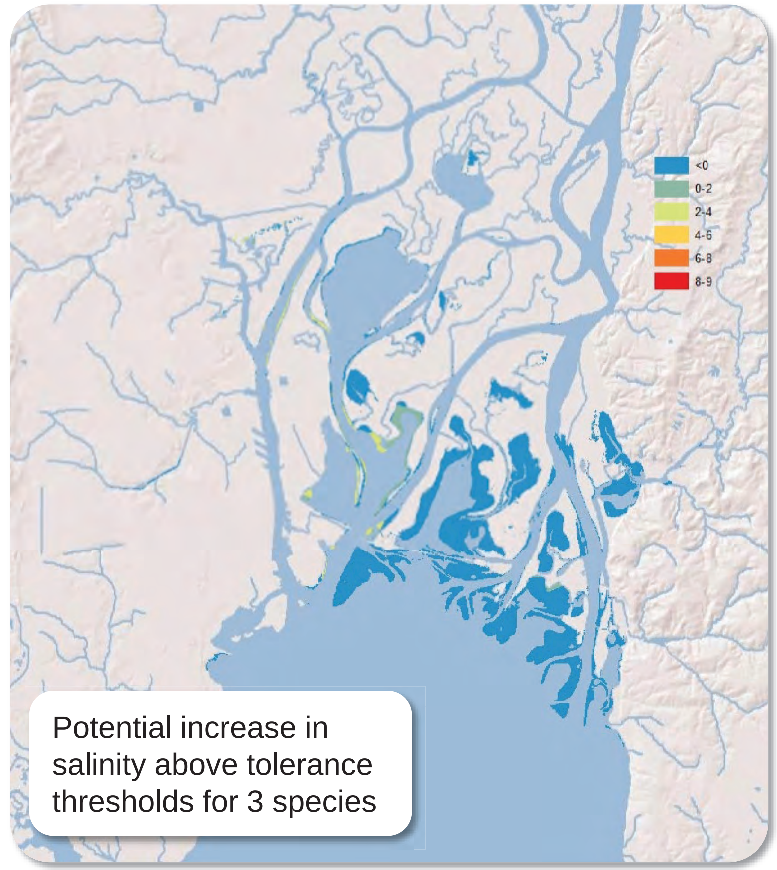
U.S. ARMY

Approach

- Mobile Bay SAV extent verified (>6,000 ac) across 55 community types
- Salinity tolerances established for each community and adjusted to local conditions

Results

- **No loss of SAV habitat expected**
- Sufficient dissolved oxygen present under all scenarios
- Under expected (average) salinity conditions few impacts expected for most species
- Potential stress of Eurasian watermilfoil (invasive species), water celery, and coon's tail for short duration
- No major differences seen between baseline and post-project conditions under sea level rise scenario



AQUATIC RESOURCES ASSESSMENT – OYSTERS

US Army Corps of Engineers

U.S. ARMY

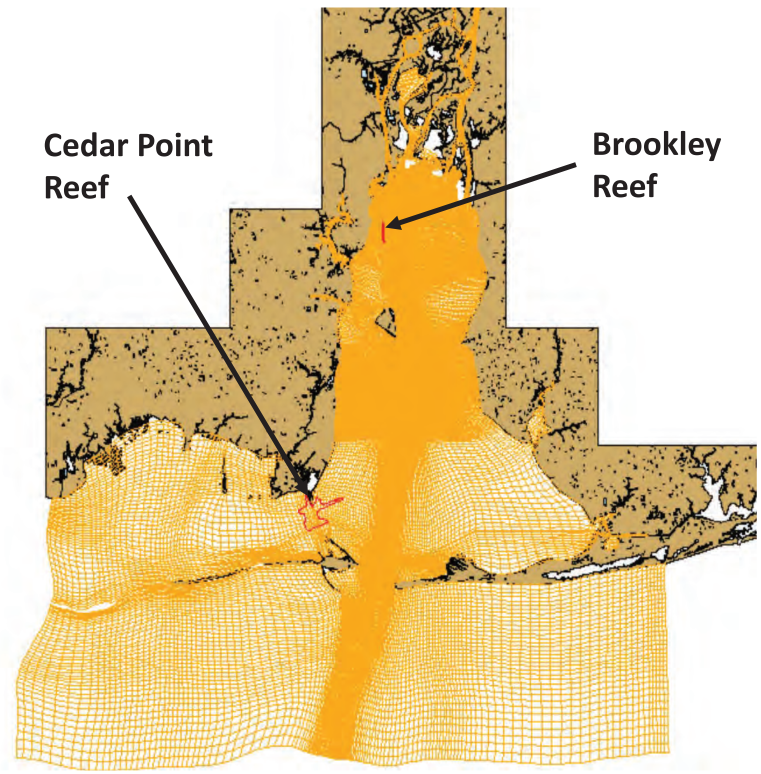
Approach

- 13 adult oyster reefs (>3600 ac) assessed for salinity and DO impacts
- Simulated oyster larval movement through integrated hydrodynamic, water quality, and larval tracking models

Results

- **Oyster larvae particle tracking displays 100% survivorship under all scenarios**
- Dissolved oxygen levels stay well above minimum oyster tolerances
- Salinity stays within oyster tolerance ranges
- Oyster model predicts no increase in larvae flushing out of Mobile Bay
- Sea-level rise scenario predicts no oyster mortality

Oyster Larvae Tracking Domain



AQUATIC RESOURCE ASSESSMENT – BENTHICS

Approach

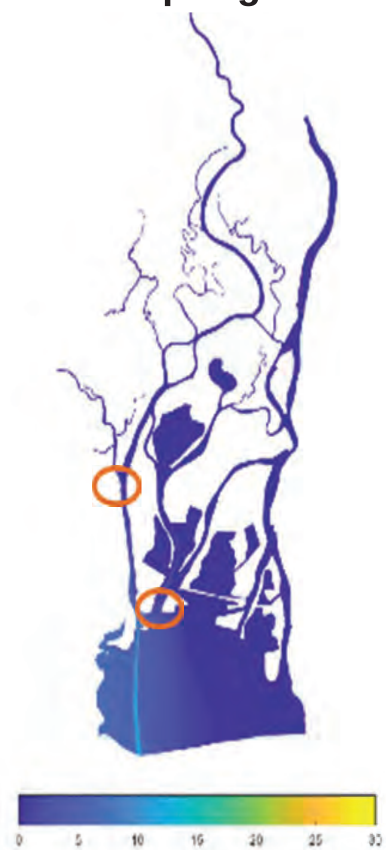
- 240 samples taken in freshwater, transitional, and upper bay habitats
- Locations of changes in invertebrate communities identified

Results

- **Community transitions from saline to freshwater will remain similar to baseline conditions.**
- Degree of freshwater (river) inputs dictates species transition locations
- Impacts to fish via prey availability appear negligible




Spring



Fall

AQUATIC RESOURCES ASSESSMENT – FISH

US Army Corps of Engineers

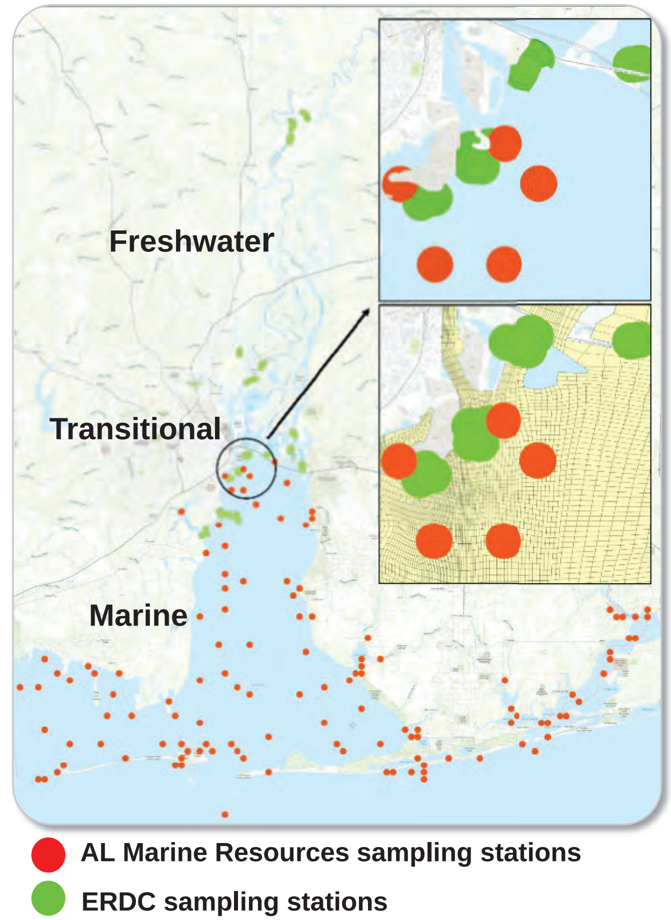
U.S. ARMY

Approach

- Data obtained from AL Marine Resources (2005-2015) and supplemented by USACE
- 98,000 individual fish, 140 species
- Linked salinity and abundance of community members

Results

- **No impacts expected due to salinity for:**
  - ✓ Freshwater species
  - ✓ Freshwater species entering estuary
  - ✓ Resident estuary species
  - ✓ Marine species entering estuary
  - ✓ Marine species



AQUATIC RESOURCES ASSESSMENT – SUMMARY

US Army Corps of Engineers

U.S. ARMY

- **No major impacts (i.e., loss of resources) anticipated for:**
  - ✓ **Wetlands**
  - ✓ **SAV**
  - ✓ **Oysters**
  - ✓ **Benthic Invertebrates**
  - ✓ **Fish**
- Project impacts remain negligible under 0.5 meter sea level rise scenario

DREDGED MATERIAL PLACEMENT

US Army Corps of Engineers

U.S. ARMY

New Work Placement

Geotechnical data indicates minimal beach quality sand in new work

Maintenance Dredging

ENGINEERING ANALYSIS – SEDIMENT TRANSPORT

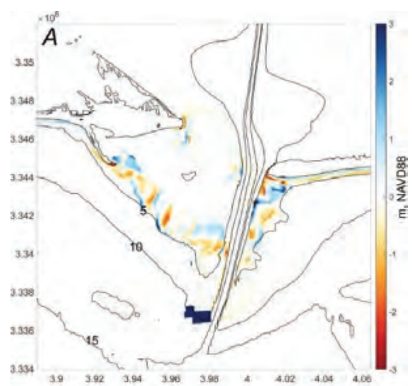
Approach: Conduct estuarine (fine-grained) and coastal (coarse-grained) sediment transport modeling to evaluate possible effects of widening and deepening the channel on sediment transport in Mobile Bay and on the ebb-tidal shoal/nearshore coastal areas.

Simulation Period: Estuarine (January 2010 – December 2010)

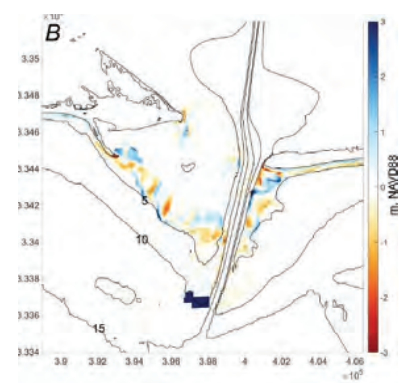
Coastal (10-yr simulation derived from data spanning from 1998 – 2016)

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

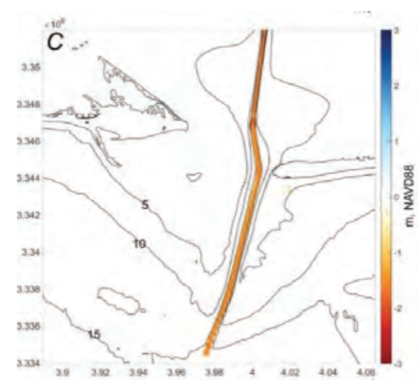
Results: Minimal bed level changes expected between the existing and with project conditions in the bay and on ebb-tidal shoal. Shoaling rates are expected to increase between 5 – 15%.



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



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



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

With Project Simulation
Percent Increase in Channel Shoaling

MOBILE HARBOR

FUTURE MAINTENANCE MATERIAL PLACEMENT

Approach: Compare short and long-term changes in bathymetry to quantify sediment transport rates and identify transport pathways along the ebb-tidal shoal to determine if adequate disposal capacity exists for future maintenance material placement in the Sand Island Beneficial Use Area (SIBUA).

Analysis Period: 1941 – 2015

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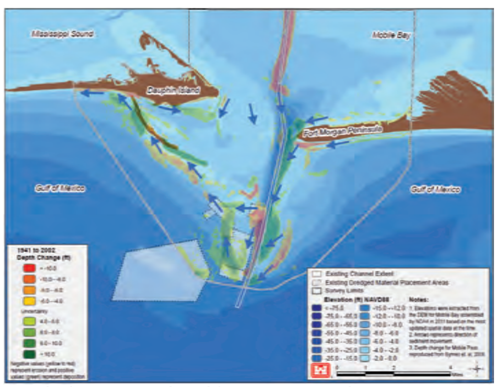
Mobile Pass Bed Level Change 1941 to 2002



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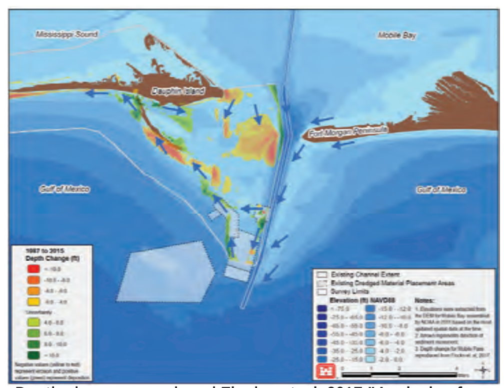

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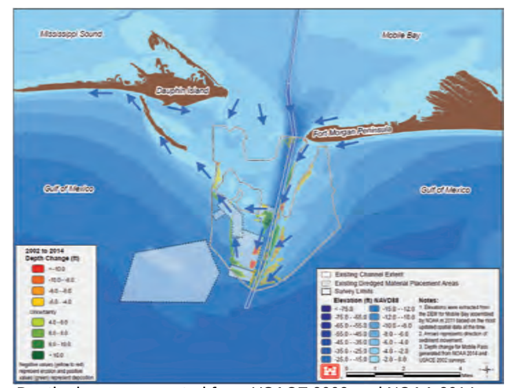

Depth change generated from USACE 2002 and NOAA 2014 surveys.

VESSEL GENERATED WAVE ENERGY (VGWE)

Approach

- Data collection at 5 stations over ~60 days
- Signal processing using Automatic Ship Identification (AIS) with respect to vessel characteristics.
- Validated existing predictive method for VGWE magnitude.
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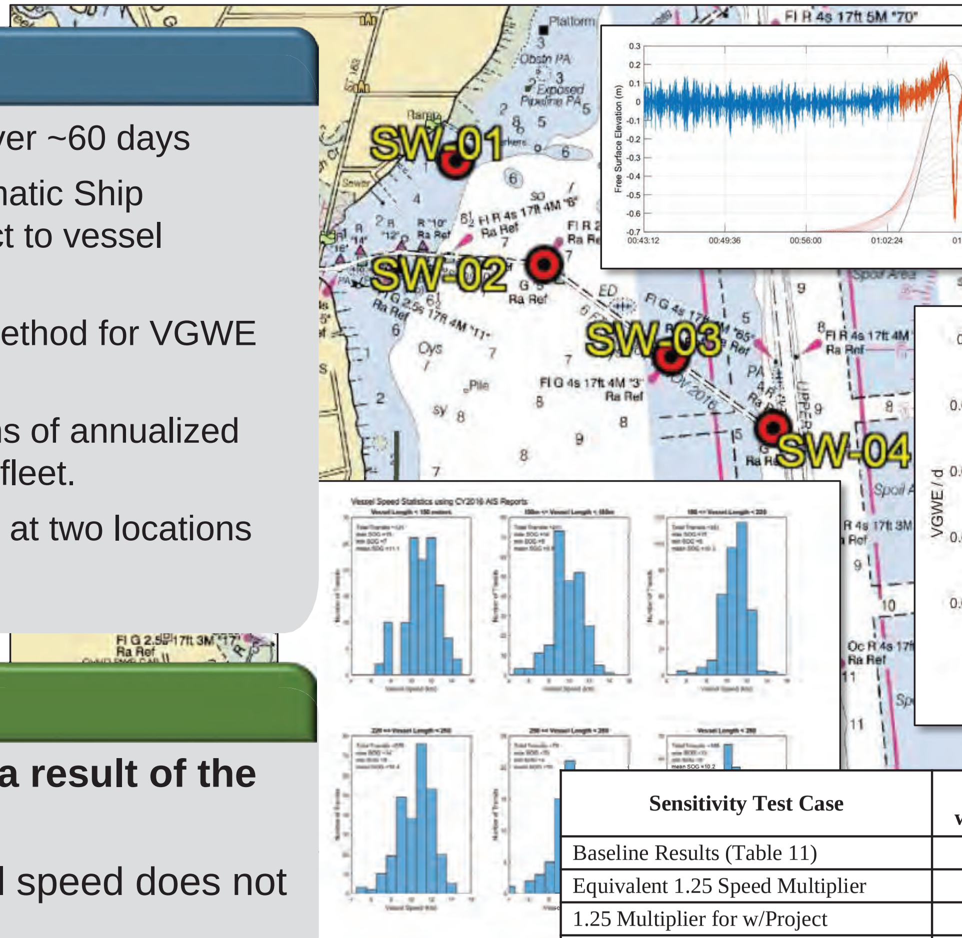
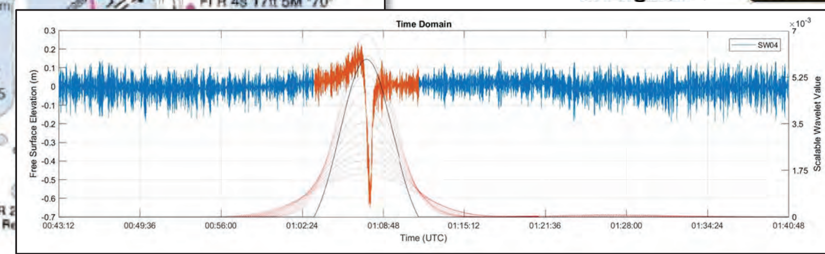
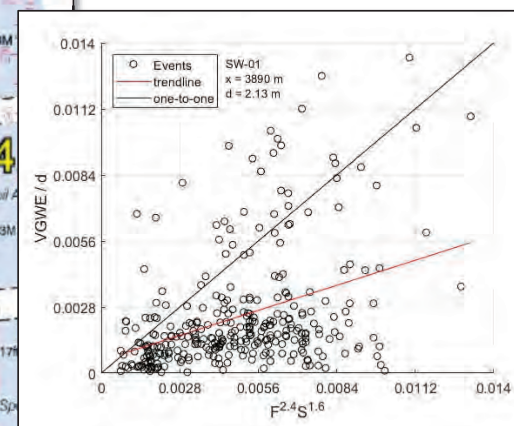
- Computed total annual VGWE at two locations along the Federal Channel.







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- Study is evaluating depth of 50 foot with a 100 foot, 3-mile widener
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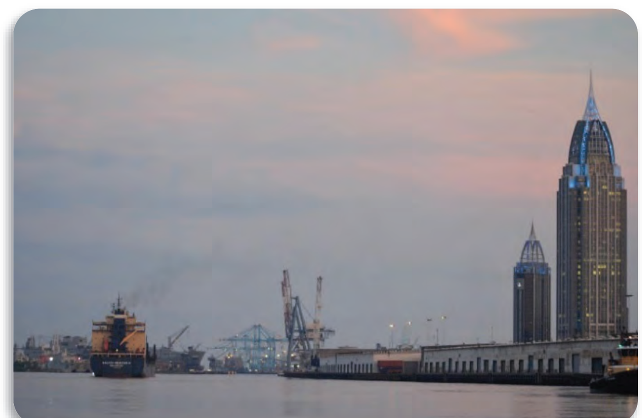

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E-mail: MobileHarborGRR@usace.army.mil

Postal Mail:
U.S. Army Corps of Engineers
Mobile District
P.O. Box 2288
Mobile, AL 36628-0001

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

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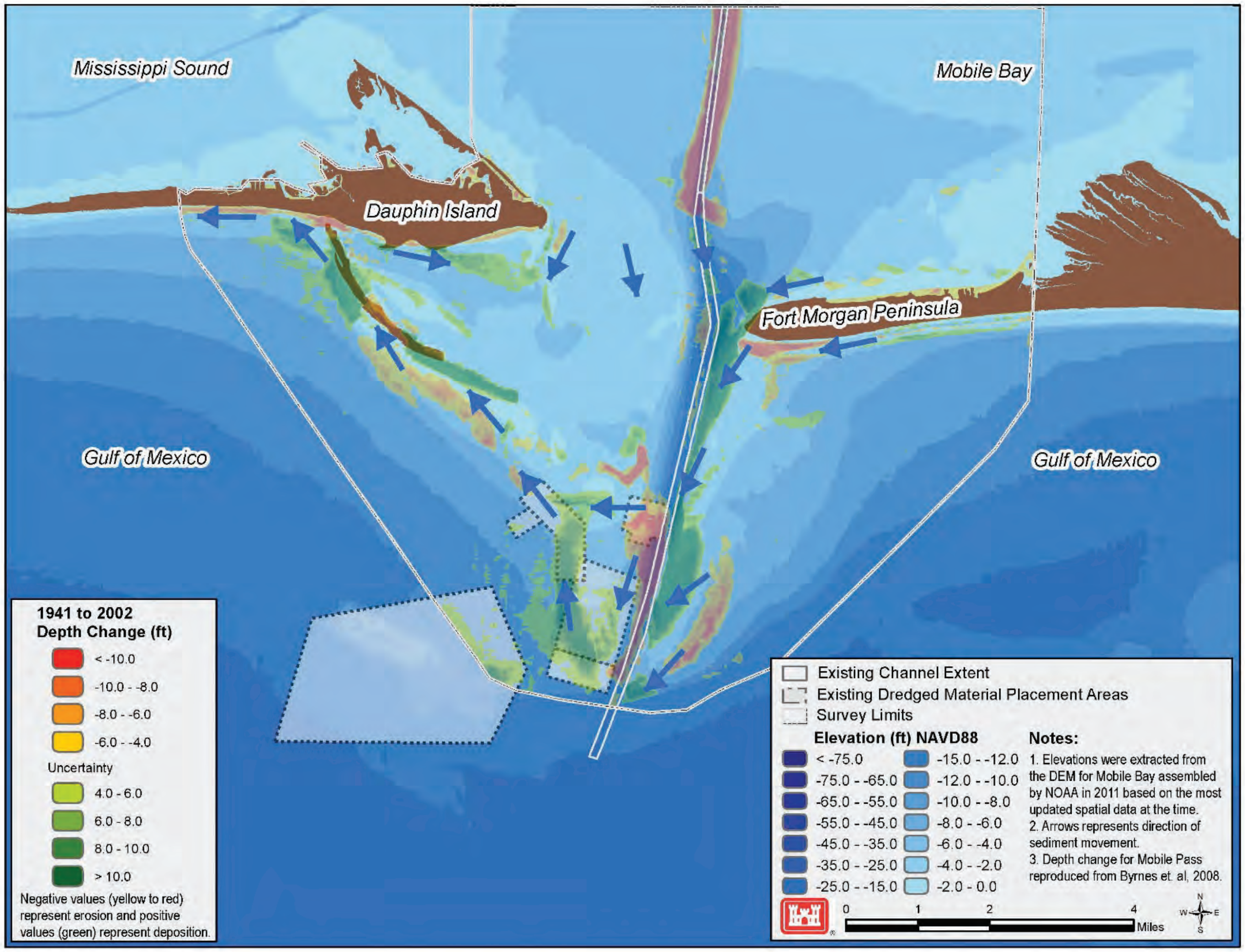

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(+/- Erosion/Deposition, ft)

US Army Corps of Engineers

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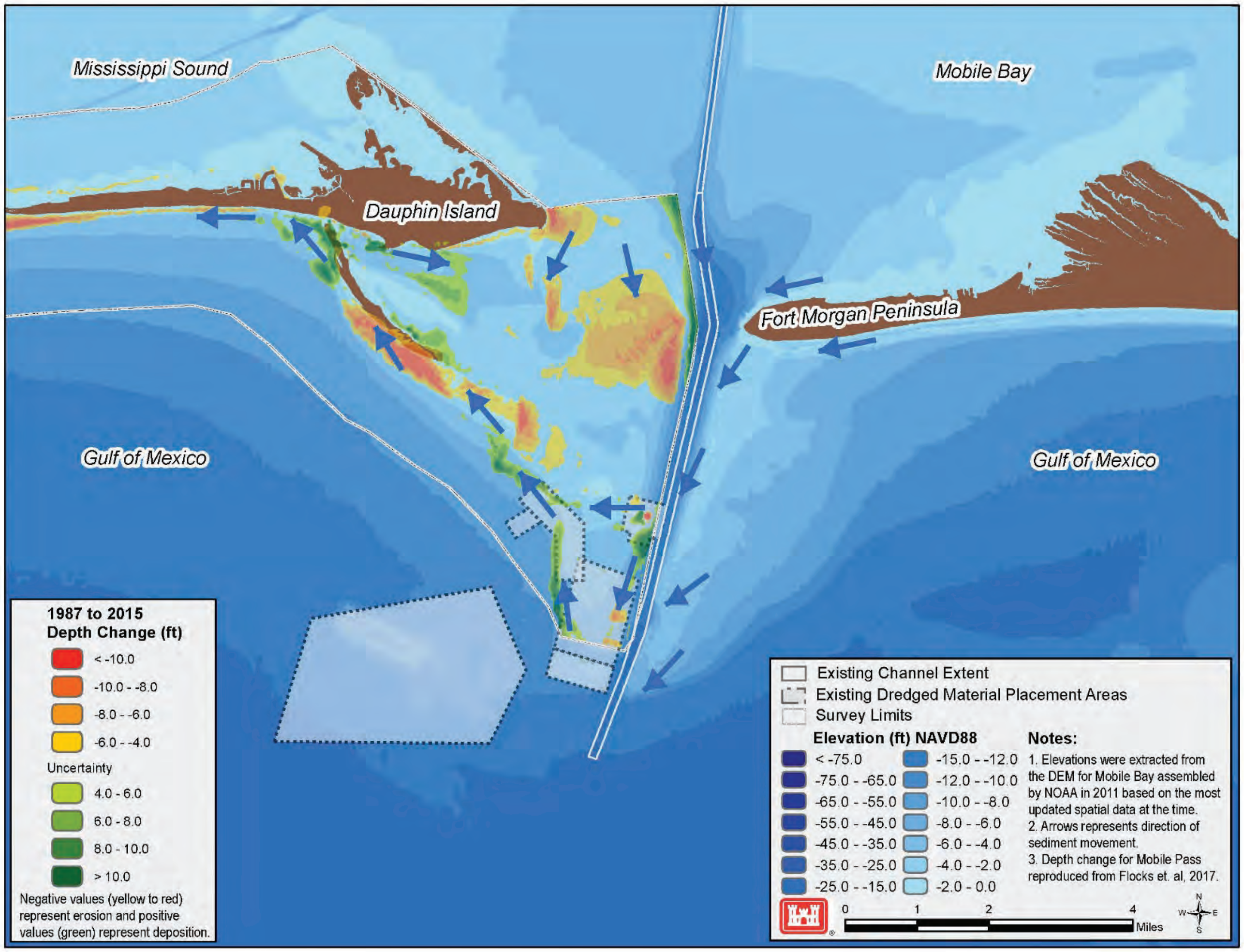

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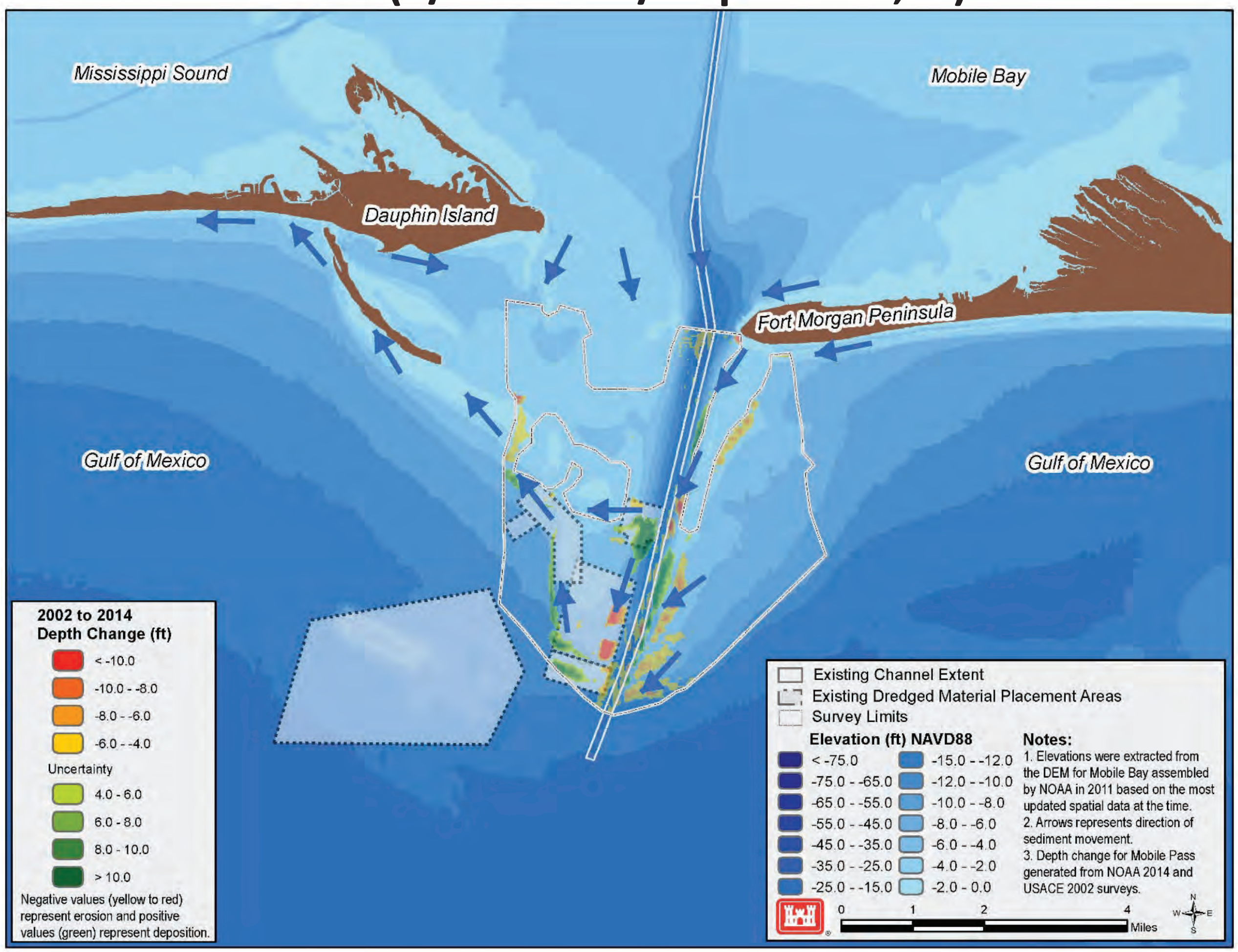


From: [redacted]
To:

Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018
Date: Thursday, May 10, 2018 3:43:00 PM
Attachments: 11 May 2018 Environmental NGO Focus Meeting v2.pptx

---

All: Attached are the current slides with comments for tomorrow's Environmental NGO discussion.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 08, 2018 2:49 PM
To: [redacted]
Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

All: Just a reminder that we have the Environmental NGO Meeting this Friday, May 11 at 1300hrs CT. Attached are DRAFT slides for that meeting.
Please let me know if you would like to make additions or revisions to these slides by noon Thursday, May 10..

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, April 17, 2018 1:20 PM
To: [redacted]

[redacted] (b)(6)

Cc: [redacted] (b)(6)

[redacted] (b)(6)

Subject: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

The U.S. Army Corps of Engineers (USACE), Mobile District is reconvening an environmental focus group meeting and requesting your participation for the Mobile Harbor General Reevaluation Report regarding the potential deepening and widening of the Mobile Harbor navigation channel. The meeting will be held at the Mobile District Office, 109 St. Joseph Street, Mobile, Alabama 36602, on Friday, 11th at 1:00 PM central. The meeting will focus on and provide the opportunity for those involved in environmental activities associated with Mobile Bay and its connected watersheds to hear about updated environmental evaluations that have been conducted as part of the study and to provide your comments and concerns related to potential impacts of the project. Members of the project team will be on hand to discuss and answer questions related to the proposed project. This meeting provides the opportunity for organizations such as yours to share comments and concerns that will be considered in the preparation of the Supplemental Environmental Impact Statement. Due to a limited capacity of the meeting room, we are asking that only one representative from your organization be in attendance. Please respond to let us know if your organization will be represented.   For more information, on the proposed Mobile Harbor Federal Navigation Channel project, visit http://www.sam.usace.army.mil/.

Thank you and looking forward to meeting with you.

[redacted] (b)(6)

Update on the Mobile Harbor General Reevaluation Report

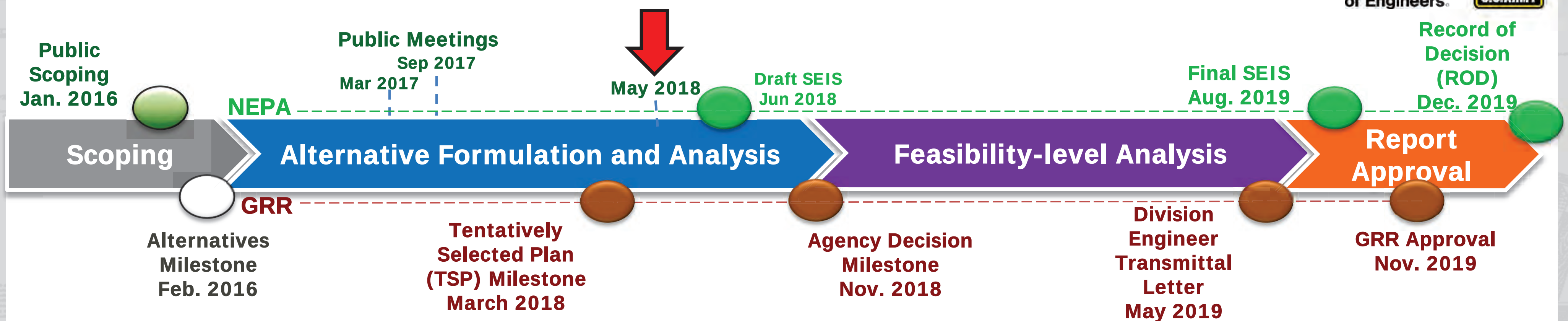
COL James DeLapp
DISTRICT COMMANDER

22 February 2018

US Army Corps of Engineers

U.S. ARMY

GENERAL REEVALUATION REPORT SCHEDULE



- 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

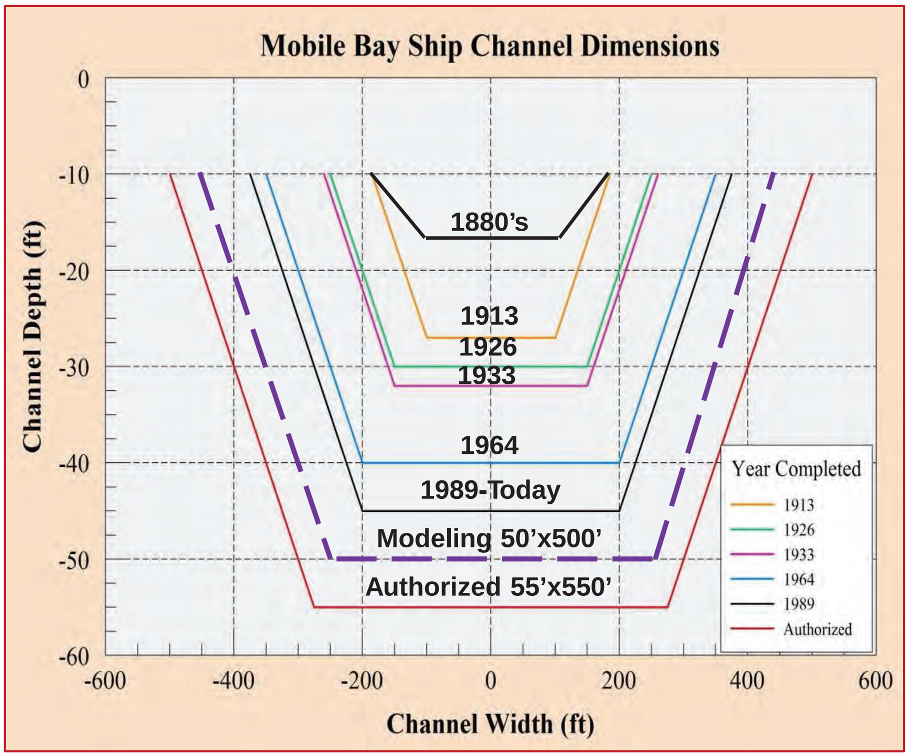
- Headquarters' review of final report
- Final SEIS; Alabama state and Federal agency review
- GRR approval
- Record of Decision signed

MOBILE HARBOR GENERAL REEVALUATION REPORT

US Army Corps of Engineers

U.S. ARMY

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



Tentatively Selected Plan

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

Tentatively Proposed Placement Locations

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

* Geotechnical data indicates minimal beach quality sand in new work

Release of Draft Supplemental Environmental Impact Statement scheduled for June 2018

MOBILE BAY ENVIRONMENTAL IMPORTANCE

US Army Corps of Engineers

U.S. ARMY

Setting for Mobile Bay

- Shallow bay (≈ 9'), long deep channel
- 2nd largest delta, 4th largest drainage area in U.S.
- High biodiversity
- Fresh, brackish, estuarine & marine habitats
- National Estuary designation, 1995

Coastal Considerations

- Ongoing Studies
- Beneficial use of dredged material
- Effects on coastal processes

Impacts to Other Resources

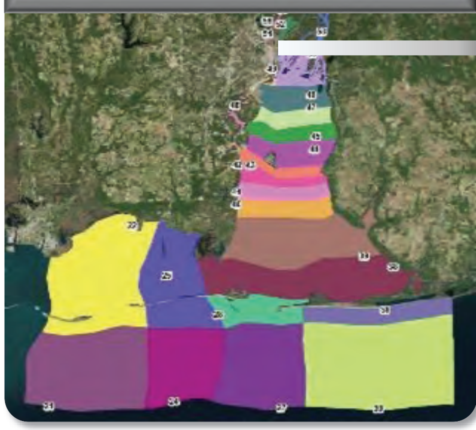
- Close coordination with State and Federal Agencies (USFWS, EPA, ADEM, ADCNR, NMFS)
- Endangered Species
- Wildlife
- Commercial fisheries
- Recreational fishing
- Sea level rise
- Cultural resources

AQUATIC RESOURCES ASSESSMENT

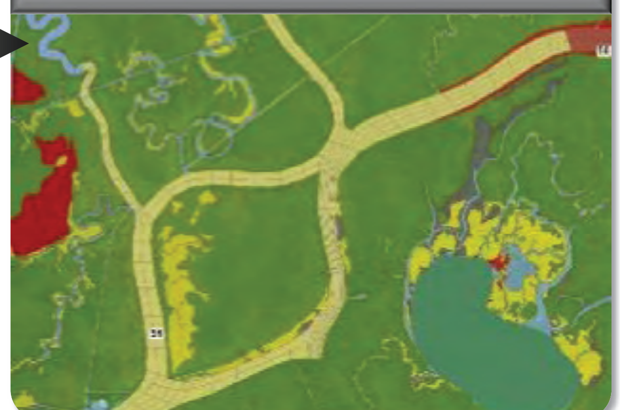
Overview

- Assessing potential impacts to wetlands, submerged aquatic vegetation, benthic invertebrates, oysters, fish
- Model outputs compare water quality (salinity, dissolved oxygen) using existing and post-project conditions
- Sea level rise scenario - 0.5 meter intermediate projection per USACE guidance at Dauphin Island

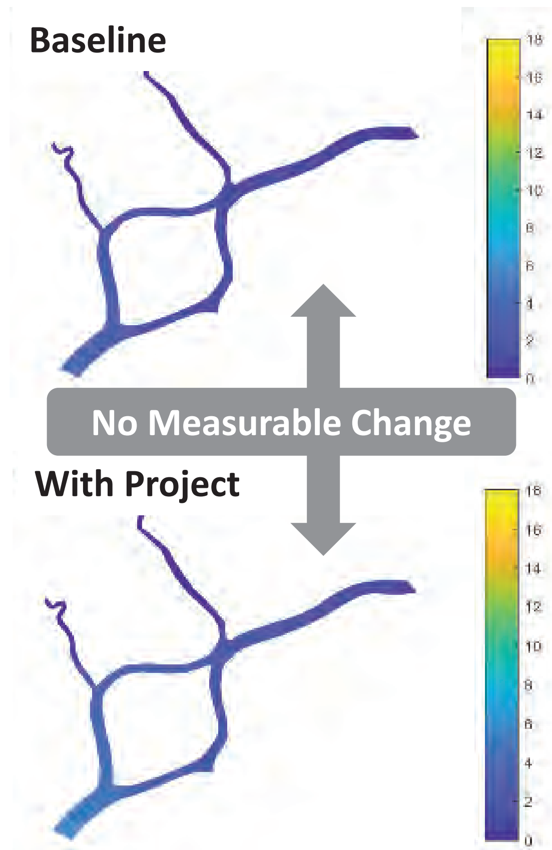
Model grid consists of 30 blocks & 48,000 cells



Model Block 54



Mean Salinity - July 2010



AQUATIC RESOURCES ASSESSMENT – WETLANDS

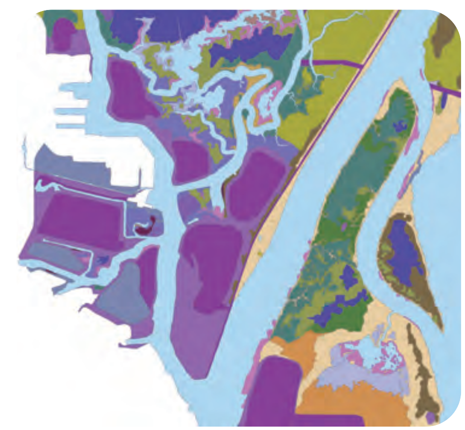
US Army Corps of Engineers

Approach

- Wetland mapping - 77,000 ac mapped; 43 community types; >800 on-site samples
- Assessed potential exceedance of salinity thresholds

Results

- **No wetland losses anticipated**
- All vegetation within acceptable environmental tolerance ranges
- All wetlands within ideal growth conditions
- Sea level rise will result in substantial inundation of existing wetlands
- Project impacts remain negligible under 0.5 meter sea level rise scenario



SUBMERGED AQUATIC VEGETATION (SAVs)

US Army Corps of Engineers

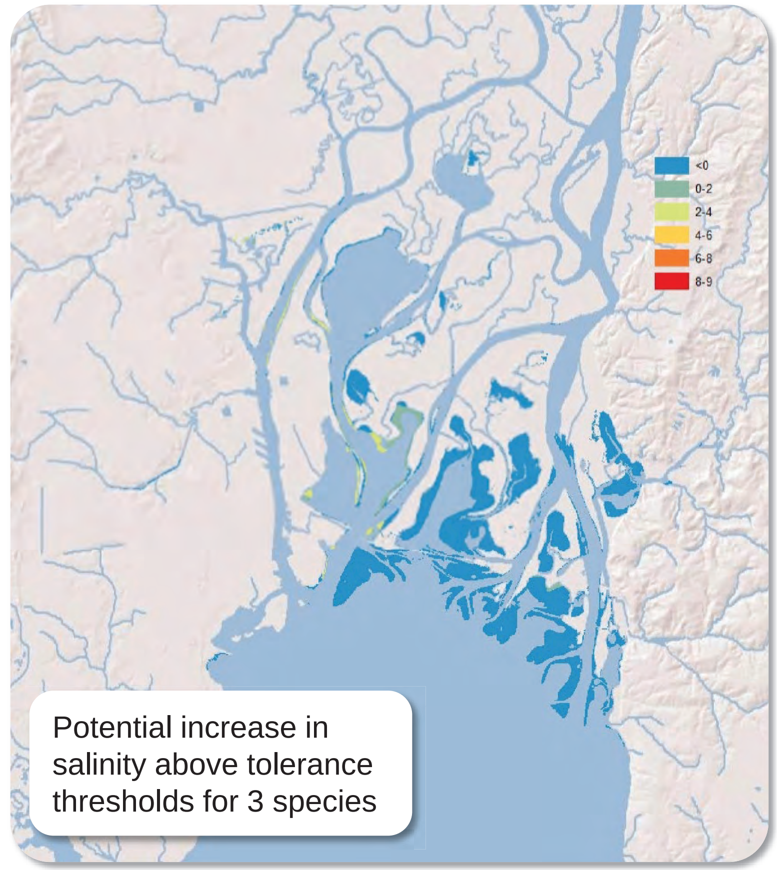
U.S. ARMY

Approach

- Mobile Bay SAV extent verified (>6,000 ac) across 55 community types
- Salinity tolerances established for each community and adjusted to local conditions

Results

- **No loss of SAV habitat expected**
- Sufficient dissolved oxygen present under all scenarios
- Under expected (average) salinity conditions few impacts expected for most species
- Potential stress of Eurasian watermilfoil (invasive species), water celery, and coon's tail for short duration
- No major differences seen between baseline and post-project conditions under sea level rise scenario



AQUATIC RESOURCES ASSESSMENT – OYSTERS

US Army Corps of Engineers

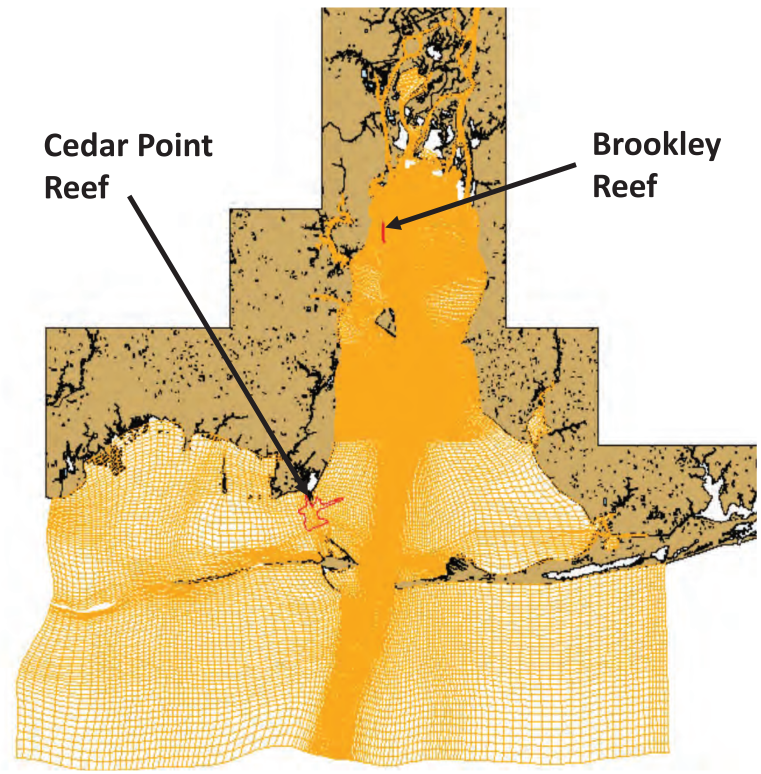
Approach

- 13 adult oyster reefs (>3600 ac) assessed for salinity and DO impacts
- Simulated oyster larval movement through integrated hydrodynamic, water quality, and larval tracking models

Results

- **Oyster larvae particle tracking displays 100% survivorship under all scenarios**
- Dissolved oxygen levels stay well above minimum oyster tolerances
- Salinity stays within oyster tolerance ranges
- Oyster model predicts no increase in larvae flushing out of Mobile Bay
- Sea-level rise scenario predicts no oyster mortality

Oyster Larvae Tracking Domain



AQUATIC RESOURCE ASSESSMENT – BENTHICS

US Army Corps of Engineers

U.S. ARMY

Approach

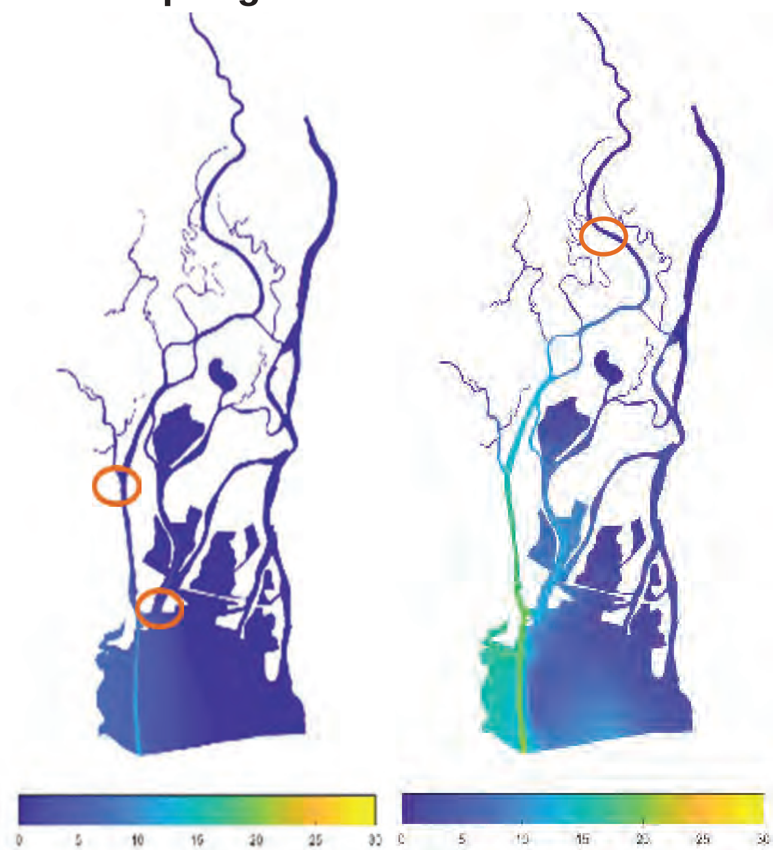
- 240 samples taken in freshwater, transitional, and upper bay habitats
- Locations of changes in invertebrate communities identified

Results

- **Community transitions from saline to freshwater will remain similar to baseline conditions.**
- Degree of freshwater (river) inputs dictates species transition locations
- Impacts to fish via prey availability appear negligible

Spring

Fall



AQUATIC RESOURCES ASSESSMENT – FISH

US Army Corps of Engineers

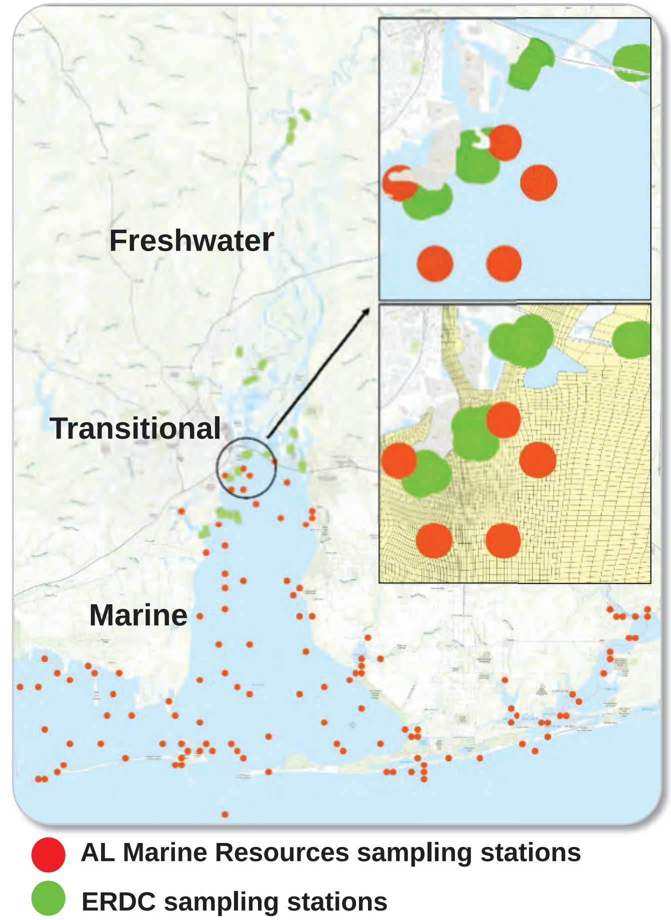
U.S. ARMY

Approach

- Data obtained from AL Marine Resources (2005-2015) and supplemented by USACE
- 98,000 individual fish, 140 species
- Linked salinity and abundance of community members

Results

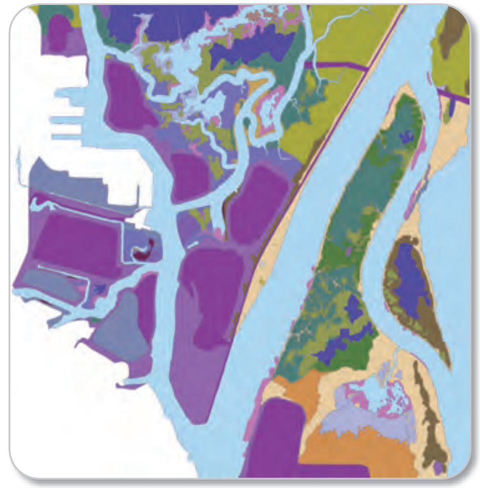
- **No impacts expected due to salinity for:**
  - ✓ Freshwater species
  - ✓ Freshwater species entering estuary
  - ✓ Resident estuary species
  - ✓ Marine species entering estuary
  - ✓ Marine species



AQUATIC RESOURCES ASSESSMENT – SUMMARY

US Army Corps of Engineers

- **No major impacts (i.e., loss of resources) anticipated for:**
  - ✓ **Wetlands**
  - ✓ **SAV**
  - ✓ **Oysters**
  - ✓ **Benthic Invertebrates**
  - ✓ **Fish**
- Project impacts remain negligible under 0.5 meter sea level rise scenario



DREDGED MATERIAL PLACEMENT

New Work Placement

Maintenance Dredging

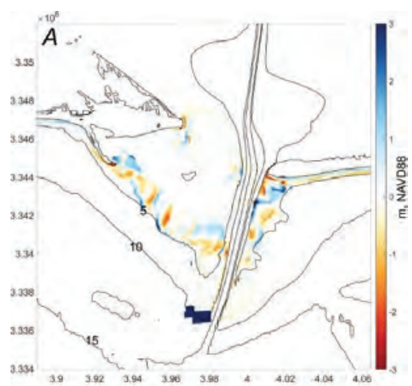
ENGINEERING ANALYSIS – SEDIMENT TRANSPORT

Approach: Conduct estuarine (fine-grained) and coastal (coarse-grained) sediment transport modeling to evaluate possible effects of widening and deepening the channel on sediment transport in Mobile Bay and on the ebb-tidal shoal/nearshore coastal areas.

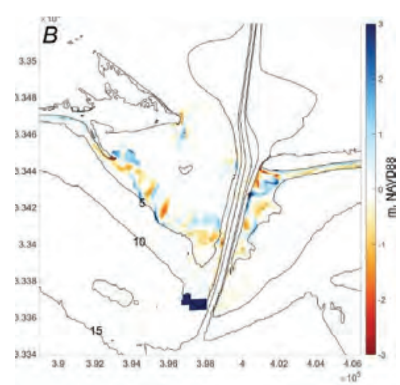
Simulation Period: Estuarine (January 2010 – December 2010)
Coastal (10-yr simulation derived from data spanning from 1998 – 2016)

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

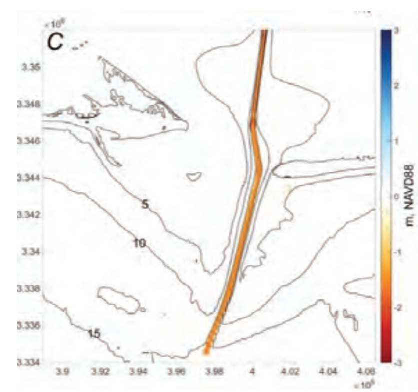
Results: Minimal bed level changes expected between the existing and with project conditions in the bay and on ebb-tidal shoal. Shoaling rates are expected to increase between 5 – 15%.



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



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



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

With Project Simulation
Percent Increase in Channel Shoaling

MOBILE HARBOR

FUTURE MAINTENANCE MATERIAL PLACEMENT

Approach: Compare short and long-term changes in bathymetry to quantify sediment transport rates and identify transport pathways along the ebb-tidal shoal to determine if adequate disposal capacity exists for future maintenance material placement in the Sand Island Beneficial Use Area (SIBUA).

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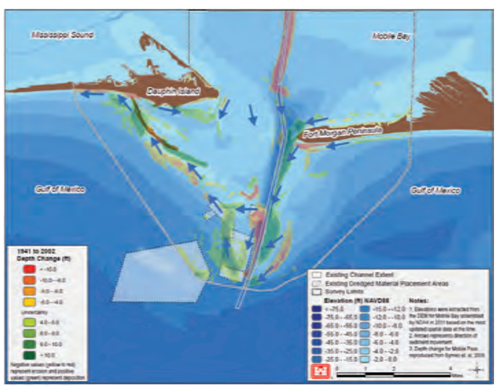

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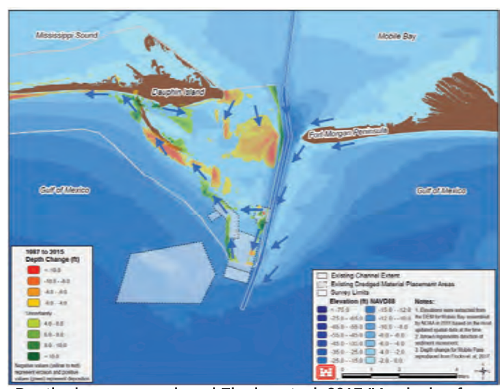

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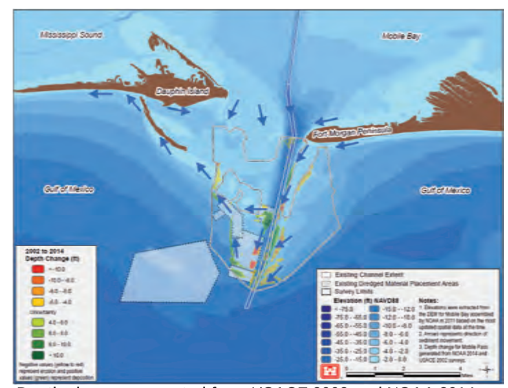

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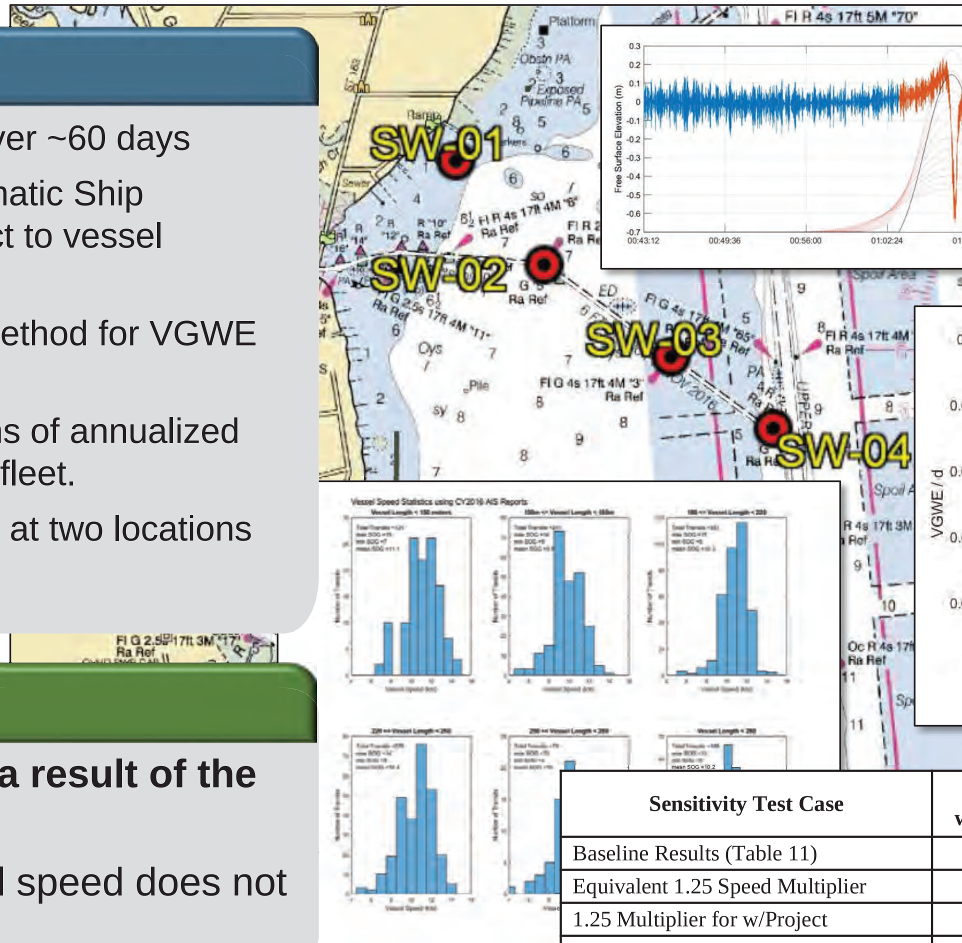

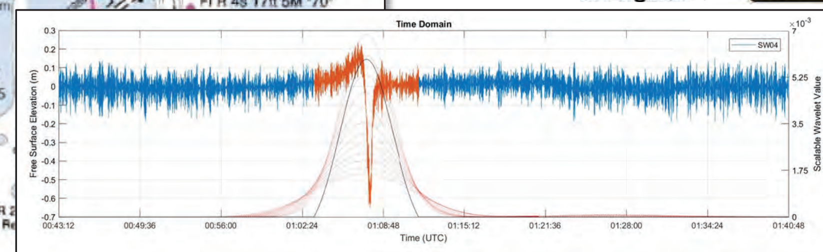

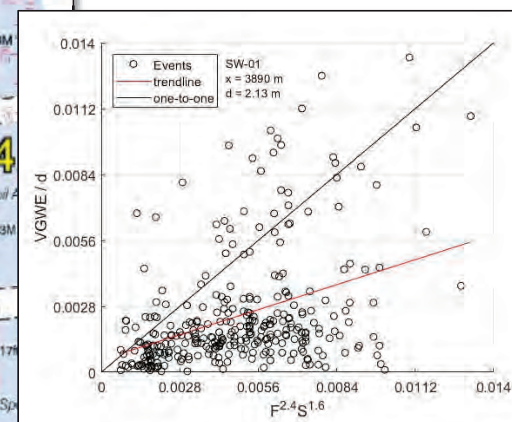

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US Army Corps of Engineers

U.S. ARMY

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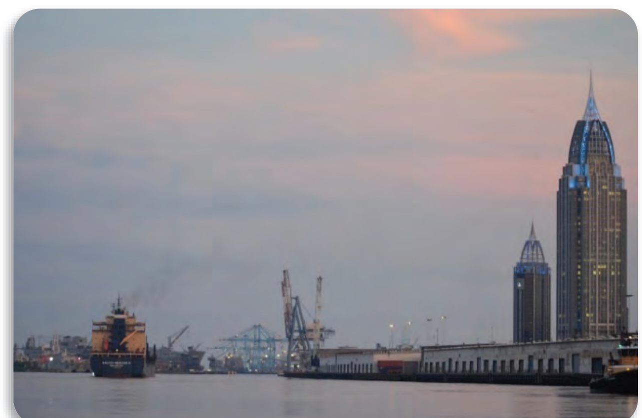

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Mobile District
P.O. Box 2288
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Mobile Pass Bed Level Change 1941 to 2002
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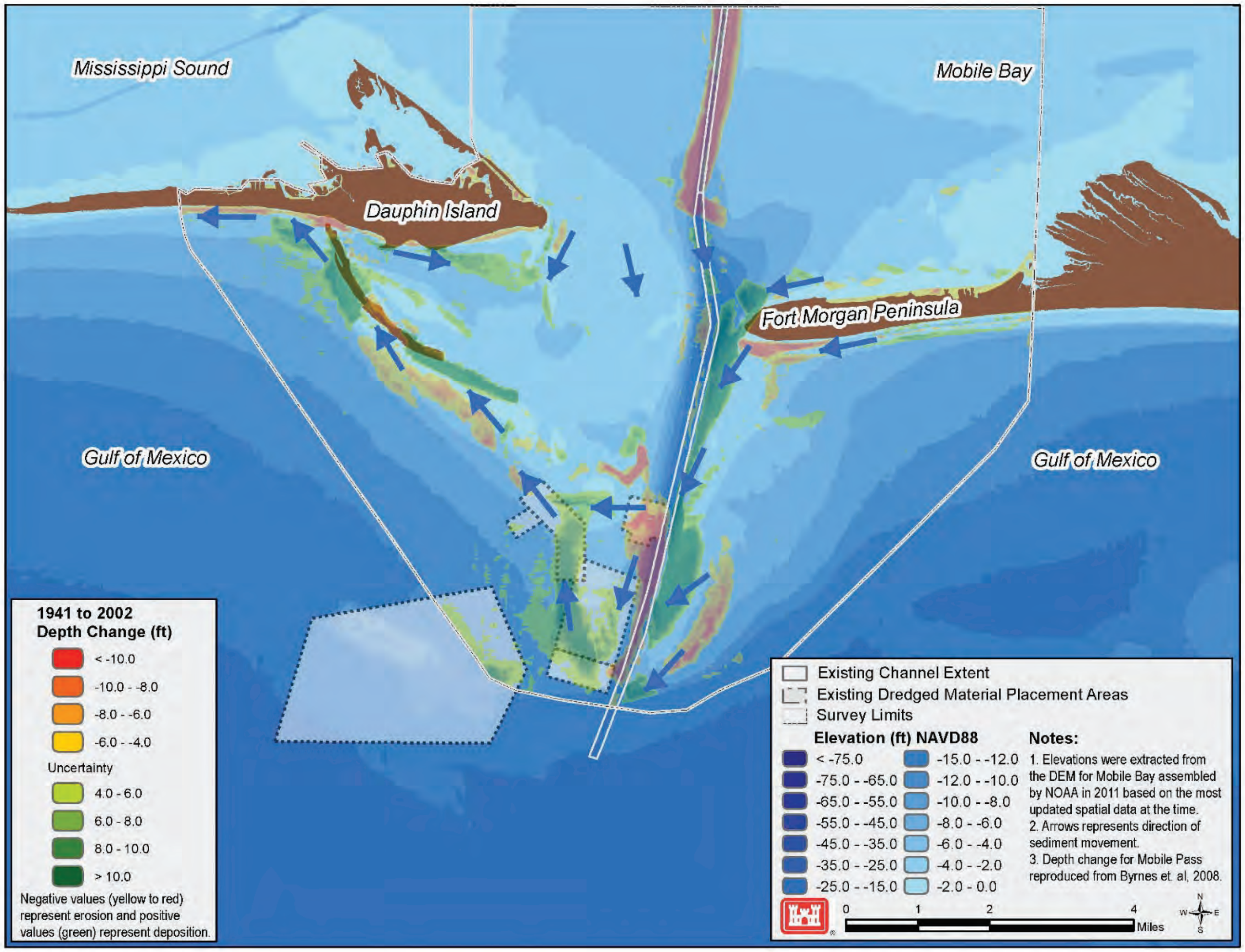

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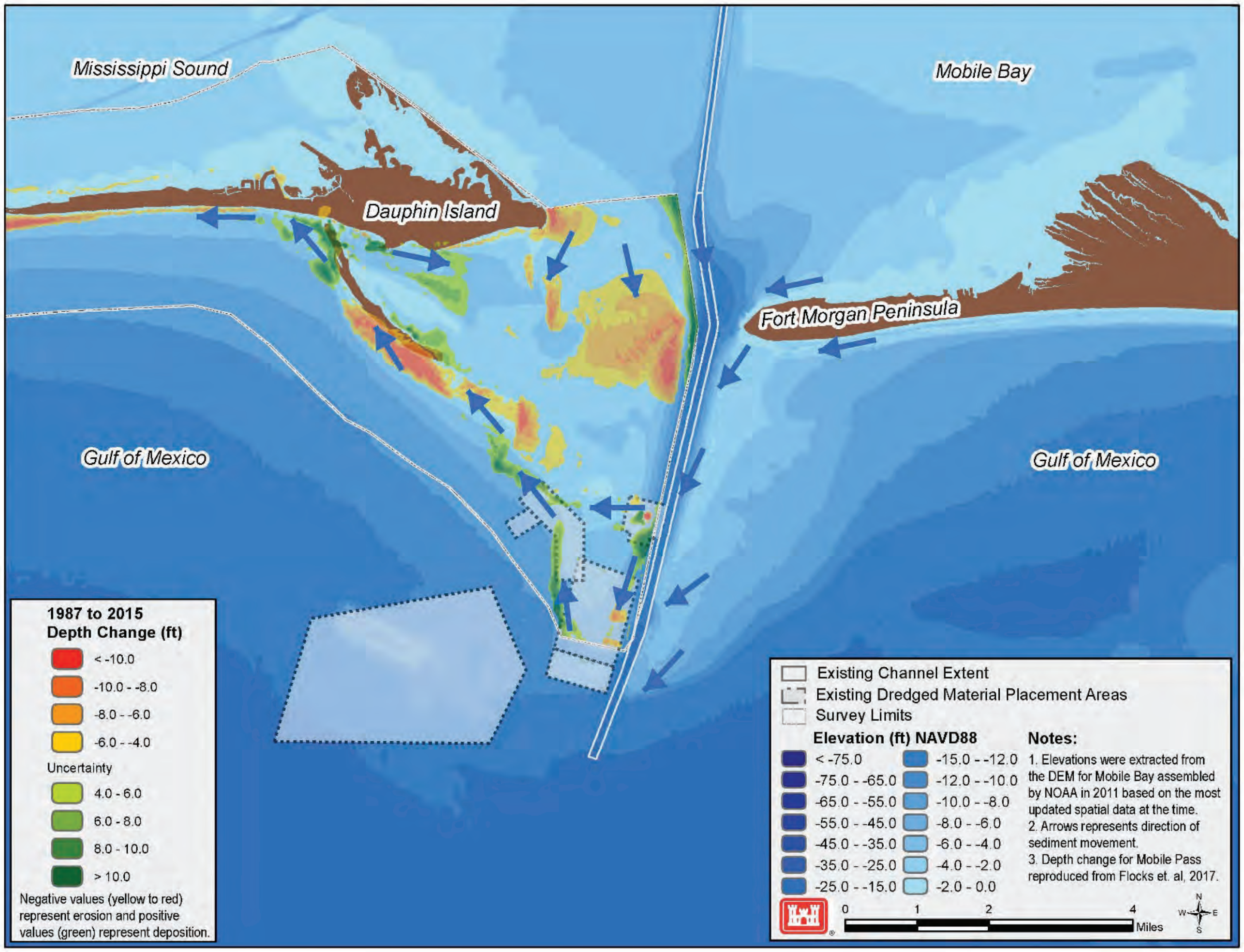

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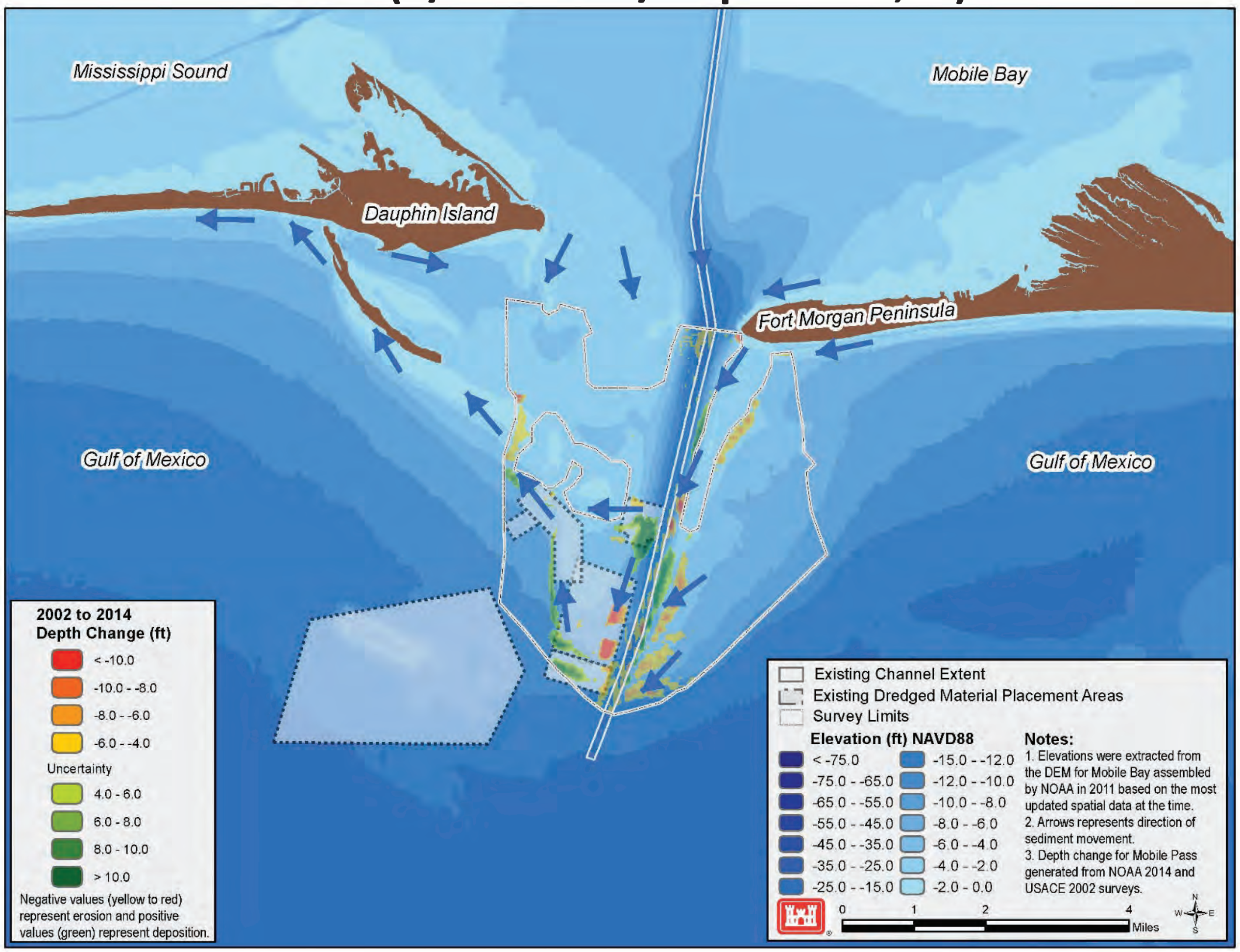

From: [redacted]
To:
Subject: Emailing: 28 Mar 2018 TSP Presentation_v7.pptx
Date: Thursday, May 10, 2018 2:31:00 PM
Attachments: 28 Mar 2018 TSP Presentation_v7.pptx

Your message is ready to be sent with the following file or link attachments:

28 Mar 2018 TSP Presentation_v7.pptx

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MOBILE HARBOR GRR

With Integrated Supplemental Environmental Impact Statement

Tentatively Selected Plan

Prepared by Curtis M. Flakes

28 March 2018

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

US Army Corps of Engineers ®

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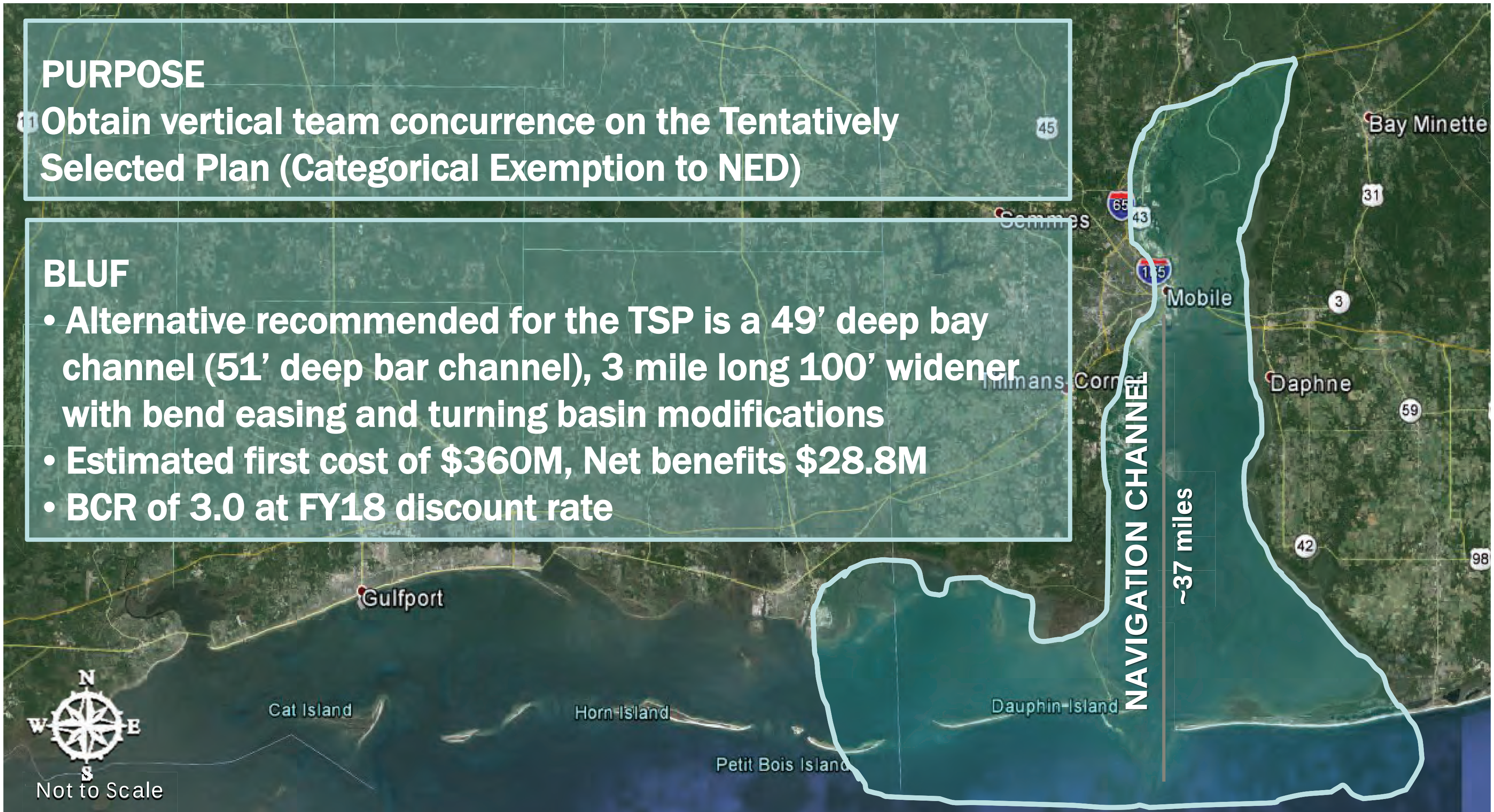
MOBILE HARBOR GRR
PURPOSE/BOTTOM LINE UP FRONT



PURPOSE

Obtain vertical team concurrence on the Tentatively Selected Plan (Categorical Exemption to NED)

BLUF

- Alternative recommended for the TSP is a 49' deep bay channel (51' deep bar channel), 3 mile long 100' widener with bend easing and turning basin modifications
- Estimated first cost of $360M, Net benefits $28.8M
- BCR of 3.0 at FY18 discount rate

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MOBILE HARBOR GRR
BACKGROUND

"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

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MOBILE HARBOR GRR
AGENCY COORDINATION

- Charrette Jan 28-29, 2015
- Cooperating Agency Meetings Dec 2015, Mar 2016, Sep 2016, Feb 2017, Sep 2017, and Feb 2018
- Beneficial Use Meetings May 2016 and Jan 2018

GENERAL NATURE OF AGENCY CONCERNS

- **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
  - Benthic Communities
  - Shoreline Erosion
- **Cultural Resources**

FEDERAL AND STATE COOPERATING AGENCIES

- Alabama Department of Environmental Management
- Alabama Department of Conservation and Natural Resources
- Alabama State Historic Preservation Office
- Alabama Department of Transportation
- Geological Survey of Alabama
- U.S. Fish and Wildlife Service
- NOAA National Marine Fisheries Service
- Environmental Protection Agency
- U.S. Geological Survey
- Federal Emergency Management Agency
- Mobile Bay National Estuary Program

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MOBILE HARBOR GRR
PUBLIC ENGAGEMENT

- Public scoping meeting Jan 2016
- Public Meetings Mar 2017, Sep 2017, and Feb 2018
- Focus Group Meetings with Seafood Interests, Environmental NGOs, Dauphin Island Interests, and Environmental Justice Communities
- Bi-weekly Updates, Quarterly Newsletters, Social Media, Listserv

GENERAL NATURE OF PUBLIC COMMENTS

- Erosion impacts to Dauphin Island
- Placing material on eroding shorelines
- Interruption of coastal processes
- Reestablishment of sand transport to Dauphin Island
- Beneficial use of dredged material
- Impacts to wildlife
- Impact to oysters and other commercial fisheries
- Impacts to recreational fishing
- Creating unwanted islands
- Climate change
- Impacts to cultural resources
- Support for project

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MOBILE HARBOR GRR

PROBLEMS/OBJECTIVES/OPPS/CONSTRAINTS

PROBLEMS AND OBJECTIVES

Problem #1: Larger size vessels experience transit delays due to existing width of channel

Objective 1. Reduce vessel congestion

Objective 2. Improve the efficiency of operations for cargo vessels within Mobile Harbor

Problem #2: Existing channel depths limit vessel cargo capacity

Objective 1. Accommodate current and anticipated growth in containerized and bulk cargo vessel traffic

Objective 2. Allow more efficient use of containerships and bulk carriers

Problem #3: Existing traffic congestion has increased safety concerns

Objective 1. Provide navigation improvements to improve vessel transit safety

OPPORTUNITIES

- Eliminate or reduce navigational restrictions and inefficiencies (*i.e.*, channel width and depth limitations)
- The protection, restoration, and creation of environmental resources through the beneficial use of dredged material
- Improve navigational safety

CONSTRAINTS

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

MOBILE HARBOR GRR
MEASURES AND INITIAL ALTERNATIVES

STRUCTURAL MEASURES

Channel Modification

- Deepening
- Widening
- Bend Easing
- Passing Lanes
- Meeting Areas
- Turning Basin

NON-STRUCTURAL MEASURES

- No-Action
- Relocation of buoys
- Additional Tugs
- Light-loading
- Lightering
- Topping-off offshore
- Scheduling

Initial Alternatives

Structural

Depth

- 46 ft to 55 ft in 1 ft increments (48 ft to 57 ft in Entrance Channel)
- Turning Basin Depth to match channel depth

Width

- 500 ft and 550 ft in Bay Channel
- Widen full channel length
- 650 to 700 ft in Entrance Channel
- Bend easing

Nonstructural

Nonstructural alternatives will match nonstructural measures listed above

MOBILE HARBOR GRR

FOCUSED ARRAY OF ALTERNATIVES

- Four general criteria are considered during alternative plan screening: ***Completeness, Effectiveness, Efficiency, and Acceptabilit***y
- Technical criteria considered in the evaluation of alternatives:

Engineering Criteria:

- Must represent a sound, acceptable, safe, efficient and reliable engineering solution

Economic Criteria:

- Must contribute benefits to NED
- Tangible benefits must exceed economic costs
- Each separable unit of improvement must provide benefits at least equal to costs

Environmental Criteria:

- Must fully comply with all relevant environmental laws, regulations, policies, and executive orders
- Must represent an appropriate balance between economic benefits and environmental sustainability
- Must be developed in a manner that is consistent with the USACE Environmental Operating Principles (EOPs)

Measure	Alternatives			
Deepening	47’	48’	49’	50’
Widening	Additional 100 feet of width for 3 miles for each depth alternative			
	Additional 100 feet of width for 5 miles for each depth alternative			

MOBILE HARBOR GRR
FOCUSED ARRAY REFINED VALUES

Preliminary Project Cost ($M)				
Measure	Depth (Feet)			
	47	48	49	50
Deepening	195.69	271.84	347.32	429.74
Deepening and Widening 100 ft for 3 miles	204.39	282.04	359.42	434.34
Deepening and Widening 100 ft for 5 miles	207.89	286.34	365.22	449.34

Preliminary Project Net Benefits ($M)				
Measure	Depth (Feet)			
	47	48	49	50
Deepening	13.7	21.2	28.7	34.0
Deepening and Widening 100 ft for 3 miles	13.9	21.3	28.8	33.9
Deepening and Widening 100 ft for 5 miles	13.5	19.9	28.3	33.5

Values based on FY18 discount rate and FY16 vessel operating costs

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MOBILE HARBOR GRR

BENEFIT UNCERTAINTY ANALYSIS

Net benefits expressed as a five number summary

Alternative	Minimum	Quartile 1	Median	Quartile 3	Maximum	Avg Net Benefits
47 Foot Deepening	$7,797M	$9,738M	$13,630M	$17,590M	$20,531M	$13,690M
48 Foot Deepening*	$15,018M	$17,369M	$20,402M	$25,591M	$28,245M	$21,203M
49 Foot Deepening	$22,231M	$24,990M	$27,165M	$33,583M	$35,950M	$28,717M
49 Foot Widening	-$920,700	-$29,400	$74,000	$148,200	$275,700	$56,800

Alternative	Minimum	Quartile 1	Median	Quartile 3	Maximum	BCR
47 Foot Deepening	2.0	2.3	2.8	3.3	3.7	2.8
48 Foot Deepening*	2.4	2.6	2.9	3.4	3.6	3.0
49 Foot Deepening	2.6	2.8	3.0	3.4	3.6	3.1
49 Foot Widening	-0.5	1.0	1.1	1.2	1.4	1.1

Risk informed planning requires transparency in the estimation of values. This table shows the range of net benefits for deepening and widening, as shown all deepening alternatives are positive. The 49' deepening alternative has the highest possible net benefits.

Results based on 20 HarborSym model iterations
*48 Foot benefits are interpolated; HarborSym modeled for 47FT and 49FT
**benefits from 49' depth HarborSym call list

MOBILE HARBOR GRR

FINAL ARRAY OF ALTERNATIVES

Combined Measures Preliminary Project Cost and Net Benefits ($M) Deepening, 3-Mile Widener, Bend Easing, Turning Basin			
	Alternative (Depth in Feet)		
	47	48	49
Cost	204.39	282.04	359.42
Net Benefit	13.9	21.3	28.8

Satisfies Categorical Exemption from NED based on Sponsor limitation

Widener size supported by Pilot Letter –Three Mile Passing Lane

Reduces Traffic Delay, Improves Vessel Cargo Capacities, Reduces Safety Concerns

TSP Plan:

★Deepening - 49 ft (51 ft bar)
★Widening - 3 miles by 100 ft
★Bend easing
★Turning basin modifications

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MOBILE HARBOR GRR
TENTATIVELY SELECTED PLAN

- ❑ Channel Deepening: 49 feet*
- ❑ Channel Widening: 3 mi. long, 100 ft wide*
- ❑ Turning Basin Modification
- ❑ Bar Channel Bend Easing

* Environmental impact analysis is based on a 50 foot depth and 100 foot widener for a distance of 5 miles

MOBILE HARBOR GRR
DREDGED MATERIAL PLACEMENT

Proposed Placement:

- ❑ Formerly mined relic shell area
- ❑ Sand Island Beneficial Use Area (SIBUA)
- ❑ Pelican/Sand Island Complex
- ❑ ODMDS

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MOBILE HARBOR

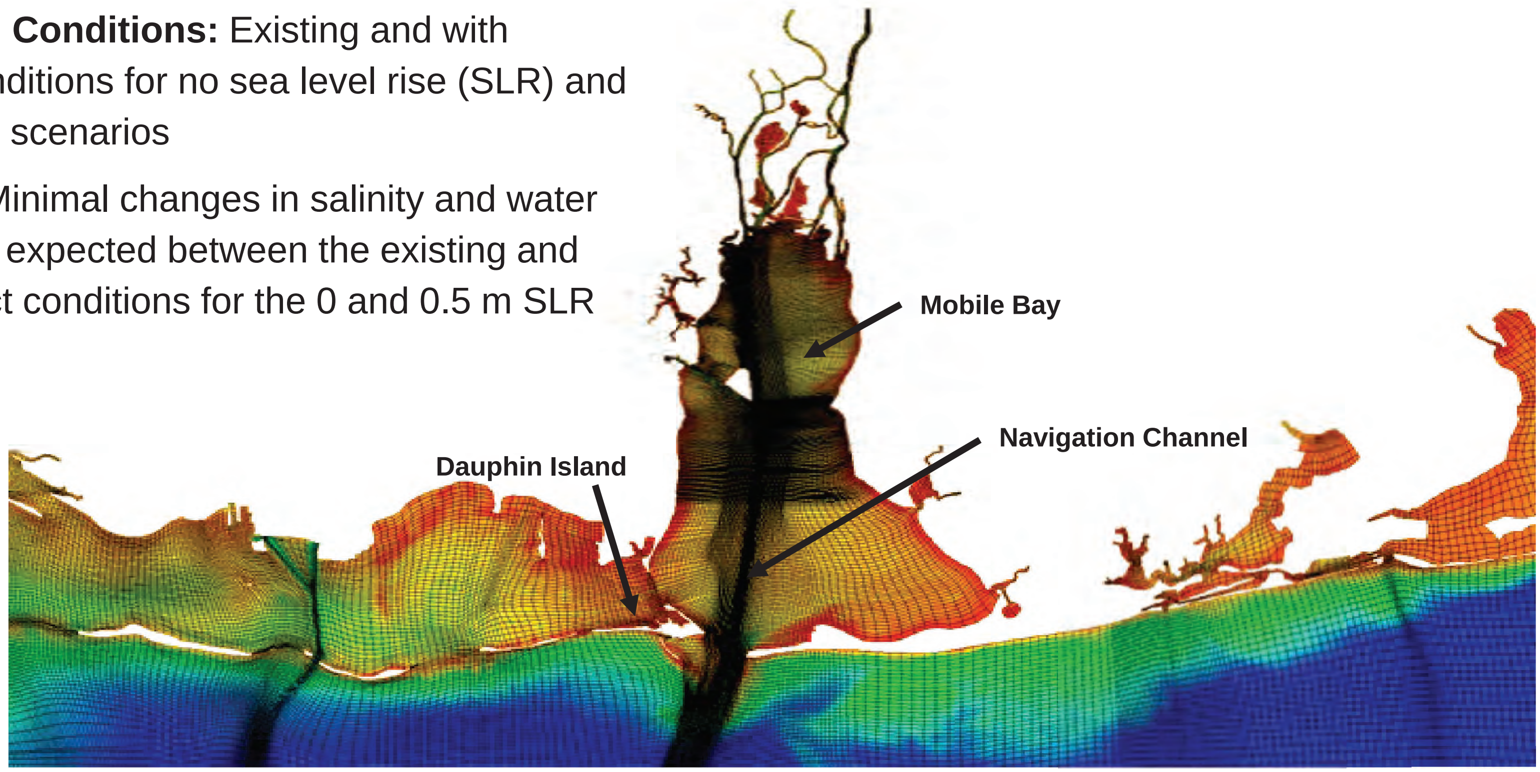
HYDRODYNAMIC & WATER QUALITY MODELING

Approach: Conduct hydrodynamic and water quality modeling to (1) characterize the physical conditions and processes of the study area and (2) determine the relative changes due to widening and deepening the channel (i.e., 5’ deeper for the entire channel with a 100’ wide x 5 mile long widener in the southern Bay).

Simulation Period: January 2010 – December 2010

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

Results: Minimal changes in salinity and water quality are expected between the existing and with project conditions for the 0 and 0.5 m SLR cases.



Model Extents

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MOBILE HARBOR

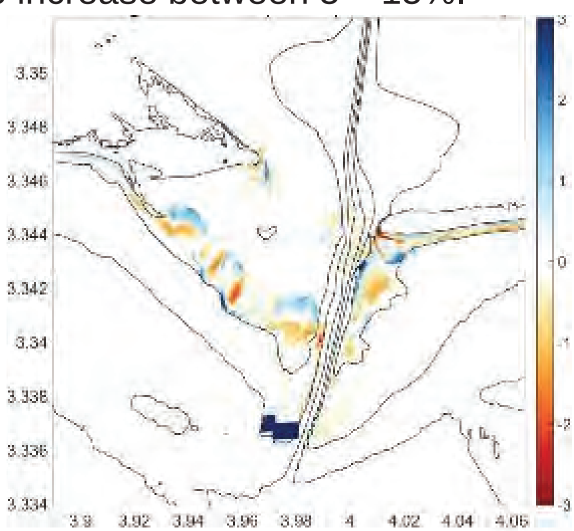
SEDIMENT TRANSPORT MODELING

Approach: Conduct estuarine (fine-grained) and coastal (coarse-grained) sediment transport modeling to evaluate possible effects of widening and deepening the channel on sediment transport in Mobile Bay and on the ebb-tidal shoal/nearshore coastal areas.

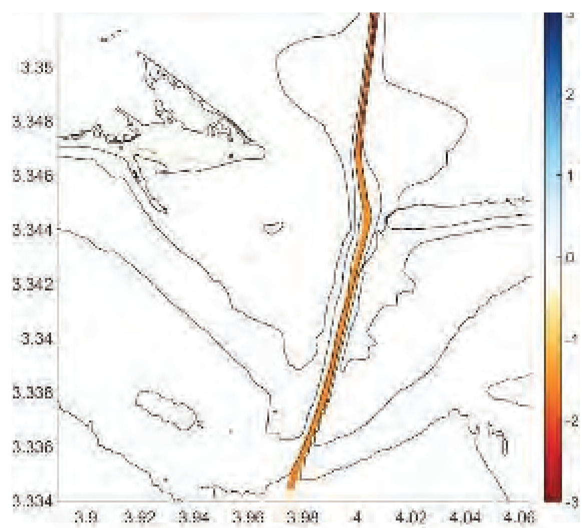
Simulation Period: Estuarine (January 2010 – December 2010)
Coastal (10-yr simulation derived from data spanning from 1998 – 2016)

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

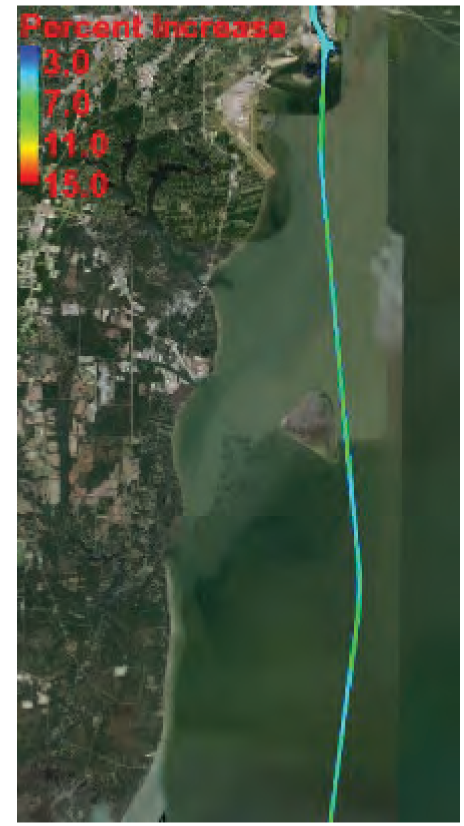
Results: Minimal bed level changes expected between the existing and with project conditions in the bay and on ebb-tidal shoal. Shoaling rates are expected to increase between 5 – 15%.



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



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



With Project Simulation
Percent Increase in Channel Shoaling

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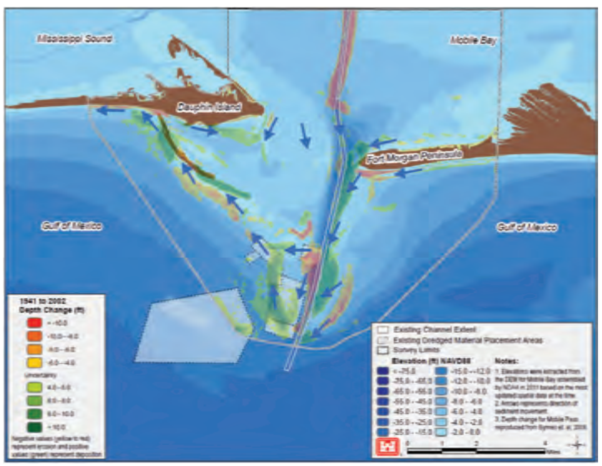
FUTURE MAINTENANCE MATERIAL PLACEMENT

Approach: Compare short and long-term changes in bathymetry to quantify sediment transport rates and identify transport pathways along the ebb-tidal shoal to determine if adequate disposal capacity exists for future maintenance material placement in the Sand Island Beneficial Use Area (SIBUA).

Analysis Period: 1941 – 2015

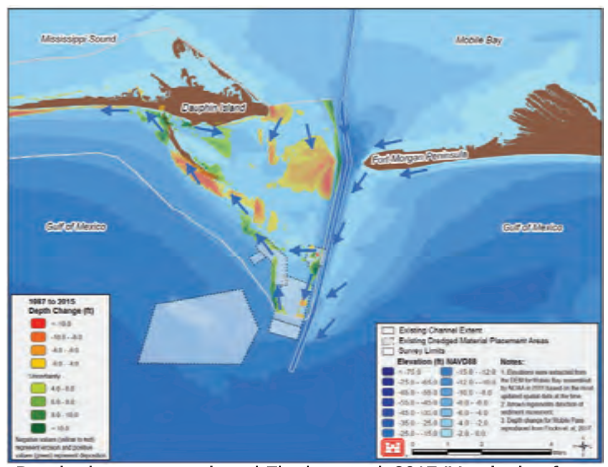
Results: Consistent sediment transport pathways are observed over the short and long-term periods. Material placed in SIBUA is in the active transport system; however, since placement in SIBUA was initiated in 1999, material has left the site at a lower rate than it has been placed in the site resulting in a need for expansion in the north/northwest direction to accommodate future needs.

Mobile Pass Bed Level Change 1941 to 2002



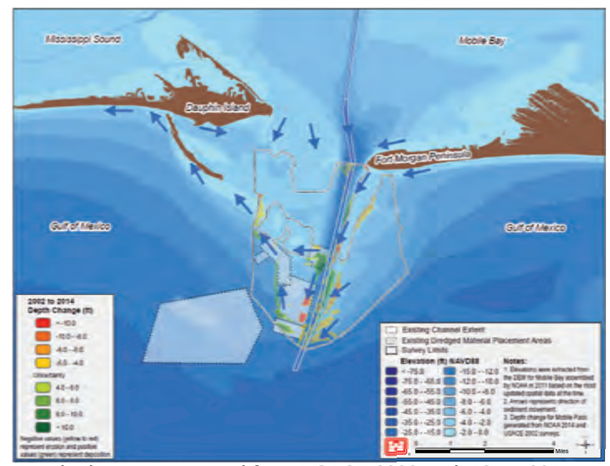
Depth change reproduced from Byrnes et. al, 2008 "Evaluation of Channel Dredging on Shoreline Response at and Adjacent to Mobile Pass, Alabama"

Mobile Pass Bed Level Change 1987 to 2015



Depth change reproduced 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



Depth change generated from USACE 2002 and NOAA 2014 surveys.

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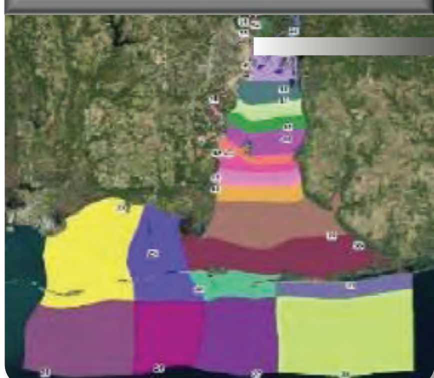
MOBILE HARBOR GRR

AQUATIC RESOURCES ASSESSMENT

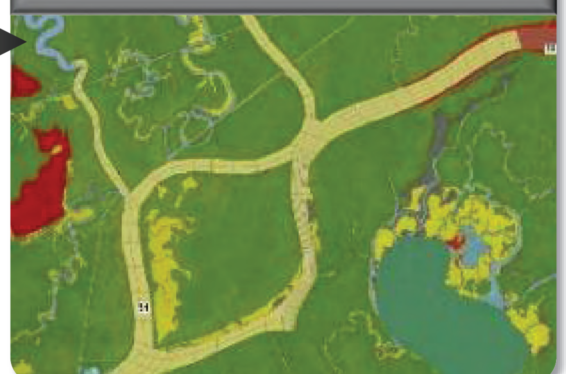
Overview

- Assessing potential impacts to wetlands, submerged aquatic vegetation, benthic invertebrates, oysters, fish
- Model outputs predicting changes in water quality (salinity, dissolved oxygen) comparing existing and post-project conditions
- Sea level rise scenario - 0.5 meter intermediate projection per USACE guidance at Dauphin Island

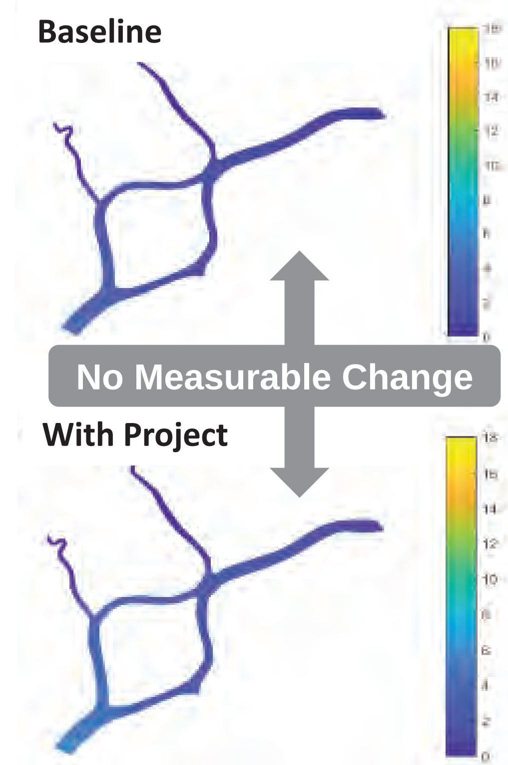
Model grid consists of 30 blocks & 48,000 cells



Model Block 54



Mean Salinity - July 2010



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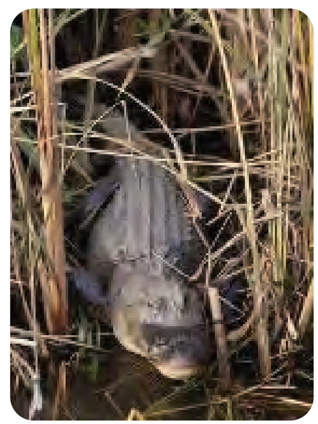
MOBILE HARBOR GRR
WETLANDS

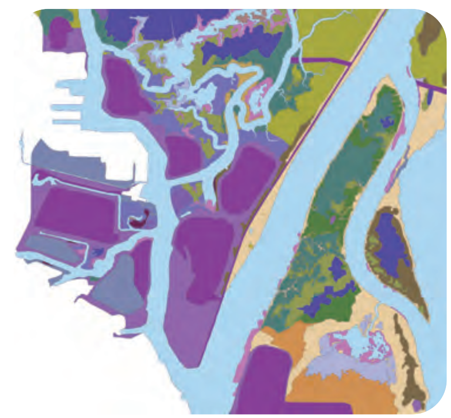
Approach

- Wetland mapping - 77,000 ac mapped; 43 community types; >800 on-site samples
- Assessed potential exceedance of salinity thresholds

Results

- **No wetland losses anticipated**
- All vegetation within acceptable environmental tolerance ranges
- All wetlands within ideal growth conditions
- 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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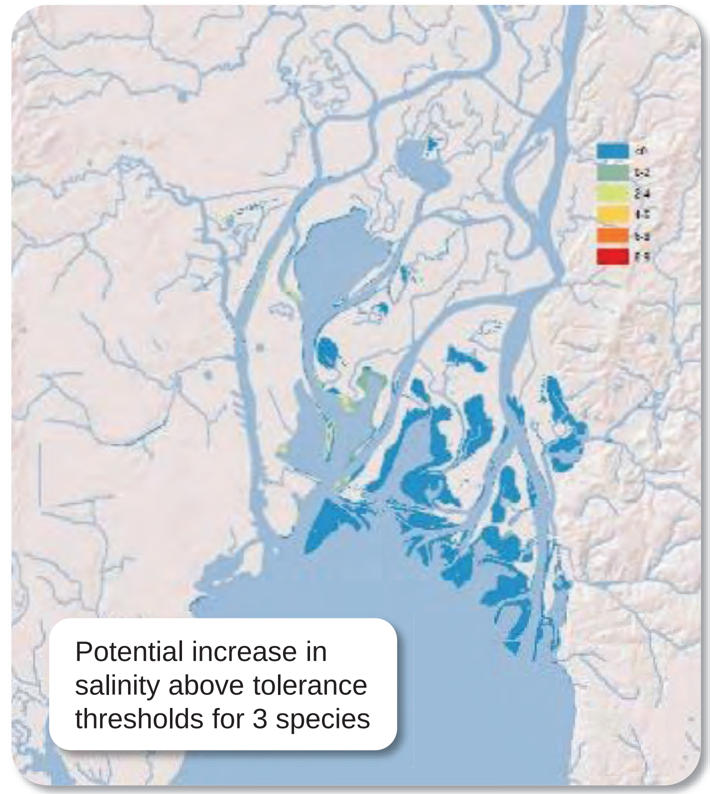
MOBILE HARBOR GRR
SUBMERGED AQUATIC VEGETATION

Approach

- Mobile Bay SAV extent verified (>6,000 ac) across 55 community types
- Salinity tolerances established for each community and adjusted to local conditions

Results

- **No loss of SAV habitat expected**
- Sufficient DO present under all scenarios
- Under expected (average) salinity conditions few impacts expected for most species
- Potential stress of Eurasian watermilfoil (invasive species), water celery, and coon's tail for short duration
- No major differences seen between baseline and post-project conditions under sea level rise scenario



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MOBILE HARBOR GRR
OYSTERS

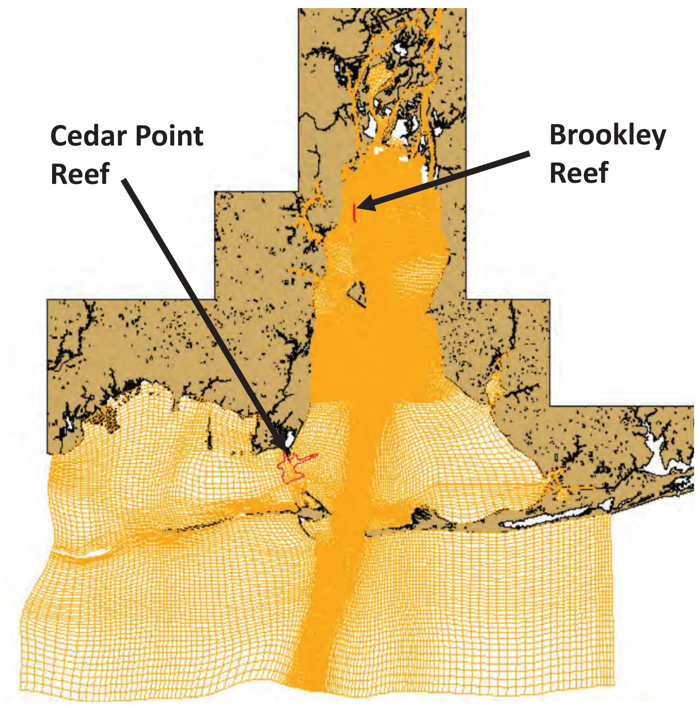
Approach

- 13 adult oyster reefs (>3600 ac) assessed for salinity and DO impacts
- Simulated oyster larval movement through integrated hydrodynamic, water quality, and larval tracking models

Results

- **Oyster larvae particle tracking displays 100% survivorship under all scenarios**
- Dissolved oxygen levels stay well above minimum oyster tolerances
- Salinity stays within oyster tolerance ranges
- Oyster model predicts no increase in larvae flushing out of Mobile Bay
- Sea-level rise scenario predicts no oyster mortality

Oyster Larvae Tracking Domain



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MOBILE HARBOR GRR

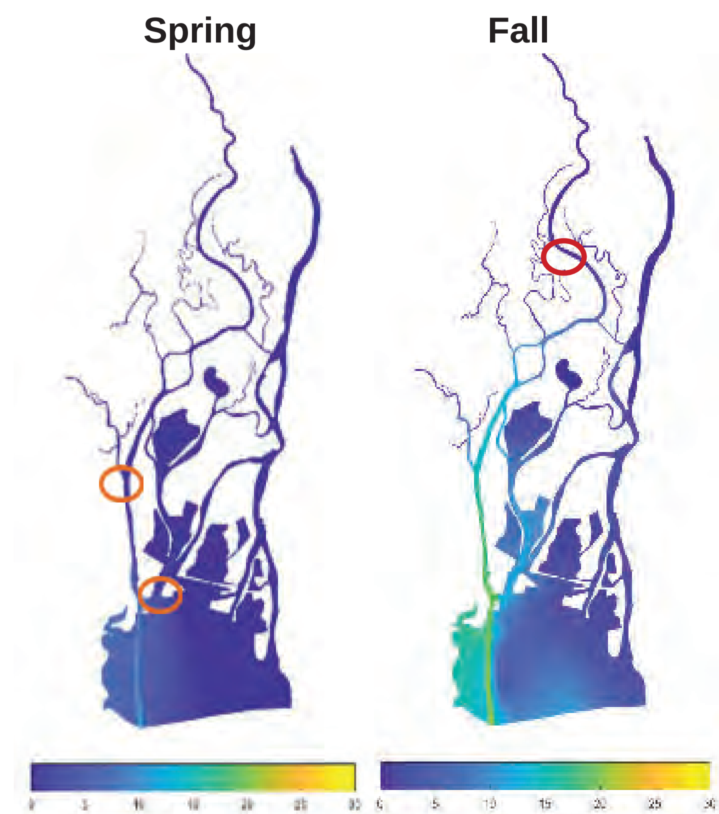
BENTHIC INVERTABRATES

Approach

- 240 samples taken in freshwater, transitional, and upper bay habitats
- Locations of changes in invertebrate communities identified

Results

- **Community transitions from saline to freshwater will remain similar to baseline conditions.**
- Degree of freshwater (river) inputs dictates species transition locations
- Impacts to fish via prey availability appear negligible



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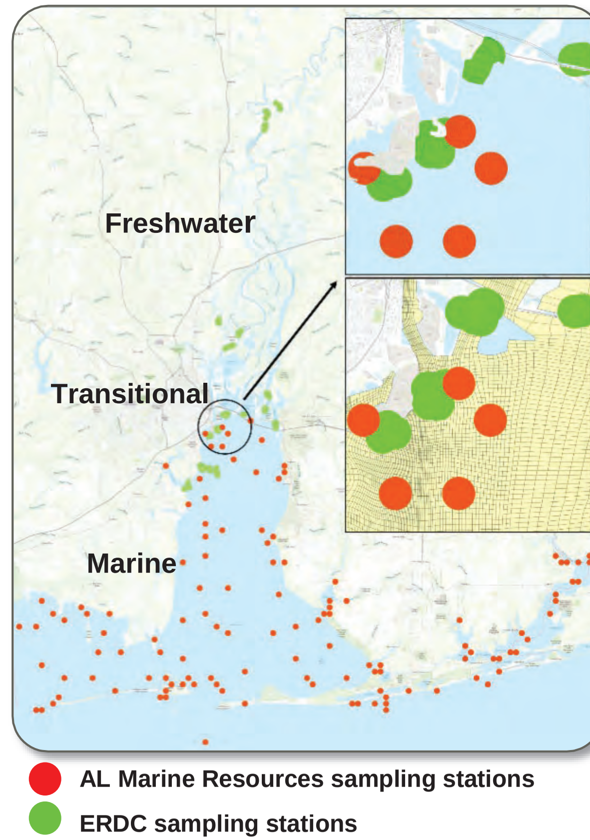
MOBILE HARBOR GRR
FISH

Approach

- Data obtained from AL Marine Resources (2005-2015) and supplemented by USACE
- 98,000 individual fish, 140 species
- Linked salinity and abundance of community members

Results

- **No impacts expected due to salinity for:**
  - ✓ Freshwater species
  - ✓ Freshwater species entering estuary
  - ✓ Resident estuary species
  - ✓ Marine species entering estuary
  - ✓ Marine species



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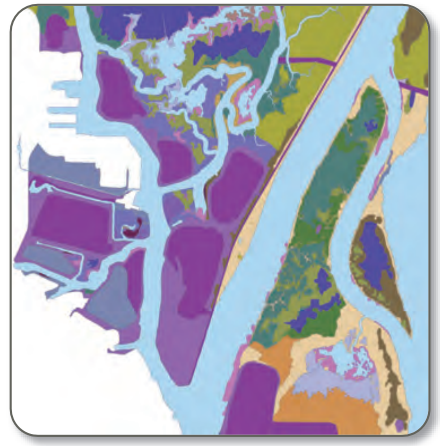
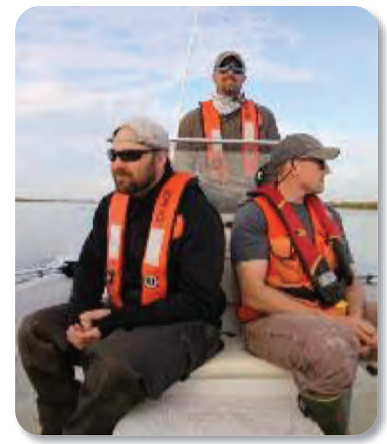
AQUATIC RESOURCES ASSESSMENT SUMMARY

- **No major impacts (i.e., loss of resources) anticipated for:**
  - ✓ **Wetlands**
  - ✓ **SAV**
  - ✓ **Oysters**
  - ✓ **Benthic Invertebrates**
  - ✓ **Fish**
- Project impacts remain negligible under 0.5 meter sea level rise scenario





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MOBILE HARBOR GRR
KEY RISKS/UNCERTAINTIES

Task	Risk Description	Risk Rating	Task	Risk Description	Risk Rating
Cultural Resource Surveys	Cultural resource survey limited to widening only. New discovery or discovery during construction could impact construction cost.	L	*Ship Simulations*	Limited ship simulations may not adequately capture dimensions required for safe and efficient travel. PED phase investigation could impact construction costs and plan selection.	M
Sediment Testing	Sediment testing delayed until PED phase. Construction cost for removal and placement of contaminated material could impact construction cost.	M	*Pipeline Crossings*	Unknown/undetected pipeline crossings could impact construction cost.	M
Geotechnical data	Limited geotechnical investigation performed in study phase. PED phase investigation could impact construction cost.	L	*Vessel Generated Wave Energy (i.e., Ship Wake) Assessment*	The assessment is ongoing; therefore, the effects are currently unknown and mitigation coordination (if necessary) has not begun.	M
Disposal Capacity	Expansion of both ODMDS and SIBUA dependent upon WQC & CZC certifications from the State and ESA, EFH, and NHPA concurrences.	M	*Public Acceptance*	Litigation on environmental/ Dauphin Island impacts could affect project schedule.	H

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MOBILE HARBOR GRR
WHAT'S NEXT

- DQC of DRAFT Report (May 2018)
- Vertical Team Teleconference for approval to release Draft Report (Jun 2018)
- Release Draft Report with NEPA for Public, Technical, Policy, and Legal Review (Jun 2018)
- Public Meeting on Draft Report (Jun 2018)
- Agency Decision Milestone (Nov 2018)

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MOBILE HARBOR GRR

QUESTIONS?

From:	[redacted]
To:	
Subject:	FW: Sierra Club
Date:	Friday, May 11, 2018 10:16:00 AM
Attachments:	New.pdf

Another one from the Sierra Club. You should probably share this one...

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:01 AM
To: [redacted]
Subject: FW: Sierra Club

[redacted] a letter from the Sierra Club re Mobile Harbor GGR and Dauphin Island. Recommend you read...we'll discuss sometime next week. Thanks.
[redacted]

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 9:06 AM
To: [redacted]
Cc:
Subject: Sierra Club

[redacted]

-----Original Message-----
From: [redacted]

Sent: Friday, May 11, 2018 8:56 AM
To [redacted]
Subject:

L James A. DeLapp, District Commander
US army Corps of Engineers – Mobile District
P.O. Box 2288
Mobile, AL 36602

Thursday, March 22, 2018

Sierra Club Alabama Chapter
C/O Jonathon Meeks
4075 Lawson Gap Rd.
Boaz, AL 35956-6507

SIERRA CLUB
ALABAMA CHAPTER

Dear COL DeLapp:

I am writing you on behalf of the Sierra Club's 28,000 members and supporters in Alabama to provide comments on the information presented at the Corps' February 22, 2018 public meeting on the Mobile Harbor General Reevaluation Report (GRR) Study.

I was fortunate in being able to attend the public meeting. I want to thank the Mobile District for conducting the meeting in a Town Hall format that allowed the public to ask questions in a group setting, with everyone hearing the Corps' answers. The attendees with whom I spoke favored this type of meeting and wished that the previous two public meetings on the Mobile Harbor GRR Study had been held in a similar manner. The Sierra Club requests all future public meetings be held in this format. Our only suggestion is that all future public meetings not be restricted to a strict two-hour time limit. The Corps introduction consumed almost half of the meeting timeframe and when the Corps closed the meeting, many attendees still had their hands up patiently waiting the opportunity to ask questions, including three Sierra Club representatives.

This letter concentrates on the Mobile District's statement that at least half of the sands being placed in the Sand Island Beneficial Use Area (SIBUA) from routine dredging the Outer Bar Channel are remaining in the disposal area instead of moving landward at an appreciable rate to rejoin the littoral drift system. That admission is significant because approximately half of the littoral drift sands moving from the Fort Morgan Peninsula are being prevented from naturally nourishing Dauphin Island's Gulf shoreline. The loss of these sands is also contributing to the sand-starved condition of the Mississippi barrier islands to the west as pointed out in independent reports prepared by both the National Park Service and the US Geological Survey.

The attached table shows the volume of sands the Mobile District has dredged from the Outer Bar Channel since 1980. The volumes were obtained from the Mobile District and were cross-checked with the Byrnes *et al* 2010 report that is frequently referenced by your staff as an important source document. The table shows around 500,000 cubic yards of sands are dredged from the Outer Bar Channel on an average annual basis. That quantity is consistent with Corps statements made at the public meeting. The table also shows the Corps began using the SIBUA in 1999, with a total of around 14 million cubic yards of sands having been deposited there over the last 19 years. Therefore, based on the Corps' acknowledgement that half of the sands placed in the site remain there, we deduce that around 7 million cubic yards of beach quality sands have been effectively removed from the natural littoral drift system since 1999.

Most people have difficulty relating to how the cumulative loss of 7 million cubic yards of sands could have affected Dauphin Island over the last two decades. For that reason, we examined the Town of Dauphin Island's design to restore the island's West End beach. The objective of the Town's project is to increase island's longevity by nourishing the beach and dune system. The design was prepared in 2011 with a $1.5 million federal grant, under the leadership of South Coast Engineers LLC and the assistance of Coastal Planning and Engineering, Inc. The design covered 4.25 miles of shoreline between the now sand-locked fishing pier and the end of the road and was based upon July 2010 surveys. We examined that segment of the design because the 7 million cubic yards dredged sands that have accumulated in the SIBUA would have been naturally transported by littoral drift to the island near the pier to nourish the 4.25-mile reach of shoreline. To address funding uncertainties, the Town prepared three alternative shoreline restoration designs. Relevant information for each alternative is provided in the following:

Alternative	Volume	Cost	Restoration Objective
1	3,580,000 yd^3	$59 million	Restore beach sand volume to 1990 level
2	2,251,000 yd^3	$38 million	Maintain 2010 shoreline for 10 years
3	1,120,000 yd^3	$21 million	Maintain 2010 shoreline for 5 years

The above Volumes indicate how the removal of 7 million cubic yards of sand from the littoral drift system over the last 19 years has significantly influenced erosion of Dauphin Island's West End. This is also confirmed by the observed steady erosion and loss of the Sand/Pelican Island complex and by Corps survey data demonstrating the large mounds of sand that have accumulated in the SIBUA since 1999.

The respective Restoration Objectives for the three above alternatives also make it clear the Town's project was not intended to solve the root cause of Dauphin Island's erosion – only at providing a temporary level of shoreline restoration. Now that the Corps has finally acknowledged its use of the SIBUA is interrupting natural littoral drift processes, the Corps is required by agency regulations to develop and implement an acceptable mitigation plan to restore the eroded shorelines, as well eliminating maintenance of the Mobile Harbor Outer Bar Channel as a contributing factor in any future erosion. Specifically, the introductory discussion in paragraph C-3e of Appendix C in ER 1105-2-100 (dated April 22, 2000) entitled "Mitigation Planning and Recommendations" requires the following:

> "(1) General. District commanders shall ensure that project-caused adverse impacts to ecological resources have been avoided or minimized to the extent practicable, and that remaining, unavoidable impacts have been compensated to the extent justified. The recommended plan and the NED plan, if not one in the same, shall contain sufficient mitigation to ensure that either plan selected will not have more than negligible adverse impacts on ecological resources (Section 906(d), WRDA`86). Any such mitigation measures will be fully justified."

Therefore, the Sierra Club fully expects the Tentatively Selected Plan presented in the Draft GRR will contain appropriate mitigation measures to restore the Sand-Pelican Island complex and the Dauphin Island shorelines to the conditions that existed in at least 1999 and to identify a new disposal area that will assure all littoral drift sands moving from the Fort Morgan Peninsula and dredged by the Corps are fully integrated back into the littoral drift system on the western side of the Mobile Pass ebb-tidal delta.

The cost of such mitigation should become a project cost, resulting in the Federal Standard for the Mobile Harbor project being modified accordingly. No longer should Dauphin Island, island residents, businesses, Alabama's western coastal natural resources, and the Mississippi barrier islands be expected to bear the brunt of the impacts and the costs of unchecked shoreline erosion that has plagued the Alabama-Mississippi barrier island system since 1958 according to the US Geological Survey.

We were pleased to hear the Corps state at the meeting it had already begun considering actions to mitigate the shoreline erosion problem, including the potential expansion of the SIBUA to the northwest. However, dissection of the Corps statements indicate expansion of the SIBUA is being driven more by operational needs to increase future disposal capacity than by the need to select an alternative disposal area in much shallower nearshore waters to mitigate the erosion problem. As stated above, from the Sierra Club's perspective, the necessity to mitigate both historic and future shoreline losses must be a central objective of any effective mitigation plan.

Based on statements made at the public meeting, the Corps appears to be continuing to maintain its position of separating the GRR Study to enlarge the Mobile Harbor channel from the ongoing Mobile Bay Regional Sediment Management Program that is exploring potential "beneficial uses" of sediments dredged during maintenance of the same channel. Any attempt to address the environmental impacts of these two simultaneous, "similar and connected actions" and "interdependent parts" of the overall Mobile Harbor project in separate NEPA documents will be considered by the Sierra Club to represent "segmentation" of the Mobile Harbor project which could expose the Corps to a potential lawsuit. It is patently clear that these two efforts should be considered in a single NEPA document since they are "similar, connected, and interdependent actions" that are being pursued concurrently on the Mobile Harbor project – one action being directed at enlarging the channel and the other providing additional disposal capacity for the channel in an admitted attempt to lessen future maintenance costs. In fact, both efforts identify the same Congressional statute as the authority to justify them. The Corps' present approach is in direct conflict with §1508.25 of the Council on Environmental Quality's (CEQ) "Regulations for Implementing the Procedural Provisions of the NEPA" that defines the scope (i.e., range of actions, alternatives, and impacts) to be considered in an environmental impact statement. The Sierra Club has consistently pointed out to the Mobile District this conflict with the CEQ regulations and the need to combine these two efforts in the same NEPA document. The most recent discussion occurred during a July 19, 2017 meeting with you that was attended by Joe Mahoney, Carol Adams-Davis, and Glen Coffee of our Sierra Club Mobile Bay Group.

Our "segmentation" concern is magnified by the fact that very little discussion was devoted at the public meeting to explaining how and where the increased volume of sediments to be dredged during maintenance of a deepened ship channel in Mobile Bay will be disposed. The Sierra Club is aware the Corps has plans to return to disposing of the sediments within Mobile Bay under the discretionary authority provided by Section 302 of the Water Resources Development Act of 1996, provided such disposal can be demonstrated to represent beneficial uses, including environmental restoration. To date, it appears the Corps plans to employ two disposal approaches. The first approach would spread the dredged sediments in a thin layer could impact thousands of acres of bay bottoms every year, both directly and possibly indirectly by the near bottom movement of sediment plumes. The second approach would involve the planned construction of a 1200-acre island in the upper bay from dredged sediments. The Corps has yet to provide any information proving either of these approaches will satisfy the "beneficial uses" criteria specified in Section 302 to justify a return to dredged material disposal within Mobile Bay. The impending Mobile Harbor Draft GRR provides the appropriate vehicle to provide the public and agencies a comprehensive evaluation of not only the economic benefits of enlarging the Mobile Harbor project, but also a full disclosure of all environmental impacts associated with both the initial enlargement of the ship channel and the impacts that will result from maintaining an enlarged channel over the economic life of the project. Since the provision of adequate maintenance disposal capacity will continue to be an important issue for the Mobile Harbor project, the Tentatively Selected Plan identified in the Draft GRR should also include a Dredged Material Management Plan (DMMP) in accordance with the principles espoused in paragraph E-15 of Appendix E in ER 1105-2-100 (dated April 22, 2000):

> "E-15. Dredged Material Management Plans. All Federally maintained navigation projects must demonstrate that there is sufficient dredged material disposal capacity for a minimum of 20 years. A preliminary assessment is required for all Federal navigation projects to document the continued viability of the project and the availability of dredged material disposal capacity sufficient to accommodate 20 years of maintenance dredging. If the preliminary assessment determines that there is not sufficient capacity to accommodate maintenance dredging for the next 20 years, then a dredged material management study must be performed."

The response received from the Mobile District to a recent Freedom of Information Act request made by a representative of the Sierra Club for a copy of the required Preliminary Assessment for the existing Mobile Harbor project stated "no records" existed for such a document. Since Mobile District staff had previously informed members of the public that a DMMP has not been prepared, we can only assume the existing Mobile Harbor Project fails to comply with paragraph E-15 of Appendix E in ER 1105-2-100. Thus, this issue alone makes it even more important that the Tentatively Selected Plan presented in the Draft GRR must also include the required Preliminary Assessment to correct the present compliance deficiency for the Mobile Harbor project. Otherwise, how can the public be assured that sufficient disposal capacity has been identified to exist for the increased dredging volumes that will result from an enlarged channel, as well as knowing where the Corps plans to dispose of the dredged sediments?

The Sierra Club appreciates the opportunity to comment on the Mobile Harbor GRR Study. Should you have any questions, please contact me at |256| 572 0400

Thank you,

Jonathon Meeks

Chair

Sierra Club Alabama Chapter

CC:

Governor Kay Ivey

Rep David R. Sessions

Sen Doug Jones

Sen Richard Shelby

Mayor Jeff Collier, Town of Dauphin Island

Jerry Carl, Mobile County Commission

LTG Todd T Semonite, Chief of Engineers, Corps, Washington, DC

BG Diana M. Holland, Commander South Atlantic Division, Atlanta, GA

Mark T. Esper, Secretary of the Army, Washington, DC

R.D. James, Acting Assistant Secretary of the Army for Civil Works, Washington, DC

Jimmy Lyons, Alabama State Port Authority

Louie Miller, Chapter Director, Sierra Club Mississippi State Chapter, Jackson, MS

Rose Johnson, Vice Chair, Sierra Club, Gulfport, MS

Casi Callaway, Mobile Baykeeper

Roberta Swann, Mobile Bay National Estuary Program

Chris Militscher, EPA, Atlanta, GA

Southern Environmental Law Center, Birmingham, AL

Alabama Gulf Coast Recovery Council

Gulf Coast Ecosystem Restoration Council (Federal Council)

Mobile Harbor Outer Bar Channel Dredging History (1980-2016)

(Source: USACE for the period 1980-2009 and estimated for the period 2010-2016 based on the average annual maintenance quantities reported for the preceding 30 years)

Dredging Date	Gross Quantity Dredged (yd^3)	Disposal Area Used [1/]
Feb-Dec 1980	1,129,337	Ocean DA
Jan-Mar 1981	610,623	Ocean DA
Dec 1982-Jan 1983	312,408	Ocean DA
Jan-Nov 1984	559,607	Ocean DA
Aug-Oct 1985	1,386,536	Ocean DA
Jan-Feb 1987	656,089	Nearshore Feeder Berm
Feb 1989-May 1990	[2/] 6,755,352	Ocean DA
Aug-Sep 1992	466,607	Ocean DA
Nov-Dec 1995	621,172	Ocean DA
Aug-Dec 1997	710,996	Ocean DA
Sep-Oct 1998	1,279,780	Ocean DA
Aug-Sep 1999	71,380	Ocean DA
	54,600	SIBUA
May-Sep 1999	[3/] 3,061,598	SIBUA
Apr-Jul 2000	758,280	Ocean DA
Mar 2002-May 2002	92,820	SIBUA
Jun 2004	230,110	SIBUA
Oct 2004-Nov 2004	1,184,817	SIBUA
Oct 2004-Jan 2005	1,808,765	SIBUA and at Lighthouse
Aug 2005	67,555	SIBUA
Apr-Jun 2006	487,975	SIBUA
Aug 2007	1,083,860	SIBUA
Nov-Dec 2008	585,430	SIBUA
Sept-Nov 2009	942,817	SIBUA
2010-2016 (estimated)	3,523,698	SIBUA
Total Dredged from Outer Bar Channel	29,442,209	For 30 years 1980-2016
Total Placed in Ocean DA	**14,672,078**	For 30 years 1980-2016
Total Placed at Nearshore Feeder Berm	**656,089**	For 1987 only
Total Placed in SIBUA or at Lighthouse	**9,600,347**	For 30 years 1980-2016
Average annual maintenance dredging quantity	503,385	For 37 years 1980-2016

[1/] Ocean DA – EPA approved open water disposal site in the offshore Gulf of Mexico
SIBUA – Sand Island Beneficial Use Area

[2/] New work deepening from 42 to 47 feet

[3/] New work deepening from 47 to 49 feet.

[4/] Excludes new work deepening in 1989-1990 and 1999

Method used to estimate maintenancedredging quantities 2010-2016 and total dredged 1980-2016:

Step 1: 24,918,514 - (6,755,352 + 3,061,598) = 15,101,564 (O&M dredging only for 1980 through 2009)

Step 2: 15,101,564 ÷ 30 = 503,385 yd^3/year average OM for 30-year period between 1980 and 2009

Step 3: 503,385 × 7 = 3,523,695 yd^3 estimated as being dredged for 7-year period between 2010 and 2016

Step 4: 24,918,514 + 3,523,695 = **29,442,209 yd^3** estimated dredged from Outer Bar Channel (1980 to 2016)

From: [redacted]
To:
Subject: RE: Sierra Club
Date: Friday, May 11, 2018 10:41:00 AM

THAT is an excellent point.

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:40 AM
To: [redacted]
Subject: RE: Sierra Club

There are so many programs that want to fund beneficial use projects that I cannot believe that DI hasn't had a restoration project done by now. Well, I guess they did on the east end but that material is already almost gone. AND we haven't dredged since it has been placed. [redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:36 AM
To: [redacted]
Subject: RE: Sierra Club

I was waiting for this one to come. It is the first by a large organization (not just property owners) requesting mitigation for the material that they contend has not moved to the island since 1999. I hate that the Sierra Club is pushing this.

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:33 AM
To: [redacted]
Subject: RE: Sierra Club

Thanks! Again, forwarded to no one in OP.

-----Original Message-----
From [redacted]
Sent: Friday, May 11, 2018 10:17 AM
To: [redacted]
Subject: FW: Sierra Club

Another one from the Sierra Club. You should probably share this one...

[redacted]

-----Original Message-----

From: [redacted]
Sent: Friday, May 11, 2018 10:01 AM
To: [redacted]
Subject: FW: Sierra Club

[redacted] - a letter from the Sierra Club re Mobile Harbor GGR and Dauphin Island. Recommend you read...we'll discuss sometime next week. Thanks.
[redacted]

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 9:06 AM
To: [redacted]
Cc: [redacted]
Subject: Sierra Club

[redacted]

-----Original Message-----
From [redacted]
Sent: Friday, May 11, 2018 8:56 AM
To: [redacted]
Subject:

From: [redacted]
To:
Subject: RE: Truck Traffic - Mobile Harbor GRR
Date: Friday, May 11, 2018 10:17:00 AM

Everyone else is in the planning conference room listening in. Are you too good for the rest of us?

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:14 AM
To: [redacted]
Subject: RE: Truck Traffic - Mobile Harbor GRR

On [redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:13 AM
To: [redacted]
Subject: RE: Truck Traffic - Mobile Harbor GRR

Must be with [redacted] otherwise you would have answered my call.

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:05 AM
To: [redacted]
Subject: RE: Truck Traffic - Mobile Harbor GRR

On a call...

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 9:05 AM
To: [redacted]
Cc: [redacted]
Subject: Truck Traffic - Mobile Harbor GRR

[redacted]
AECOM has requested the increase in truck traffic that we anticipate over the life of the Mobile Harbor Navigation Project. Per our conversation last night, we will assume the same ratio of rail to truck traffic at full build-out of the terminal facilities applies throughout the project life. That is, at full build-out the Terminal will handle 1.5M TEU's by truck and an additional 300k TEU's by rail for a total of 1.8M TEU's. The truck traffic would then represent 83% of that total.

Based on our economic analysis, we anticipate a maximum of 740,000 TEUs in the project life. As such, 83% or about 614,000 TEUs will be trucked. Our base year (2025) is estimated to be 579,000 TEU's, or 481,000 trucked.

Please confirm that this is a reasonable assumption and, if possible, about how many trucks does 614,000 TEU's represent?

[redacted]

[redacted] (b)(6)

From: [redacted]
To:
Cc:
Subject: RE: Truck Traffic - Mobile Harbor GRR
Date: Friday, May 11, 2018 10:39:00 AM

You would use the difference between the 740k TEUs and the 579k TEUs as the additional truck traffic. We still don't exactly know how many truck that represents.

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:37 AM
To: [redacted]
Cc:
Subject: [Non-DoD Source] RE: Truck Traffic - Mobile Harbor GRR

Would we use the full build-out or the lower number used in the economic analysis?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Friday, May 11, 2018 10:05 AM
To: [redacted]
Cc [redacted]
Subject: Truck Traffic - Mobile Harbor GRR

[redacted]
AECOM has requested the increase in truck traffic that we anticipate over the life of the Mobile Harbor Navigation Project. Per our conversation last night, we will assume the same ratio of rail to truck traffic at full build-out of the terminal facilities applies throughout the project life. That is, at full build-out the Terminal will handle 1.5M TEU's by truck and an additional 300k TEU's by rail for a total of 1.8M TEU's. The truck traffic would then represent 83% of that total.

Based on our economic analysis, we anticipate a maximum of 740,000 TEUs in the project life. As such, 83% or about 614,000 TEUs will be trucked. Our base year (2025) is estimated to be 579,000 TEU's, or 481,000 trucked.

Please confirm that this is a reasonable assumption and, if possible, about how many trucks does 614,000 TEU's represent?

[redacted]

[redacted] (b)(6)

From:	[redacted]
To:	
Cc:	
Subject:	FW: Harbor Study Hazmat
Date:	Monday, May 14, 2018 9:17:00 AM

[redacted]

Is Radcliffe the only hazmat terminal in Mobile Harbor? [redacted] and I could not find this information in our notes.

[redacted]

From: [redacted]@radcliffeconomy.com]
Sent: Thursday, May 10, 2018 4:04 PM
Cc: Newell, David P CIV CESAM CESAD (US); Hurley, Bobbie
Subject: RE: Harbor Study NEPA

Afternoon [redacted]

Could each of y'all, on your email confirm back the any information provide will be kept confidential and will only present it in aggregate form without identification of specific terminals.

Thanks,

[redacted]

Radcliff/Economy Marine Services

Office [redacted]

Fax: 251-434-4236

Cell: [redacted]

[redacted] RadcliffEconomy.Com [redacted]@RadcliffEconomy.Com>

From [redacted]
Sent: Thursday, May 10, 2018 10:42 AM
To [redacted] radcliffeconomy.com>
Cc [redacted]
Subject: Harbor Study NEPA
Importance: High

[redacted] Per our conversation, the Corps needs to identify truck data associated with the port. Can you provide the information to the two contacts in copy? I do not want this data. David Newell is the project manager, and Bobbie Hurley (woman) is handling the NEPA air quality study.

By Each Terminal

Number of trucks handled through the terminal(s) annually.

Identify the Direction said #trucks move. How many move East - # trucks moving west and North. (to the best of your ability – guestimate)

Number of Transload trucks annually from the AGR to Radcliff West

The assumption is that all of your volumes are hazardous cargo. The goal is to identify to the best of your ability the exact number of hazmat trucks moving through the US 90/98 Africatown corridor.

Many thank [redacted]

[redacted]

From: [redacted]
To:
Subject: FW: Draft Final Slides
Date: Tuesday, May 15, 2018 2:18:00 PM
Attachments: Final February 2018 Public Meeting Slides.pdf

-----Original Message-----
From [redacted]
Sent: Wednesday, February 21, 2018 2:55 PM
To: [redacted]
Cc:
Subject: [Non-DoD Source] RE: Draft Final Slides

Here are the final slides, can either of you please review before I send to the printer. I fixed "existing" on both slides 1 and 2 and also changed to "500" on both slides

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, February 21, 2018 2:14 PM
To: [redacted]
Cc: [redacted]
Subject: FW: Draft Final Slides

[redacted]
Misspelled existing and change the 3 mile passing lane to state 500'. Otherwise looks good...Thank you!

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, February 21, 2018 12:22 PM
To: [redacted]
Subject: RE: Draft Final Slides

...They misspelled existing and I'm asking them to change the 3 mile passing lane to state 500'

-----Original Message-----
From [redacted]
Sent: Wednesday, February 21, 2018 12:16 PM
To [redacted]
Subject: FW: Draft Final Slides

He [redacted]
These look good enough to me, before I forward my response, do these look okay to you?

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, February 21, 2018 11:25 AM
To: [redacted]
Cc: [redacted]
Subject: [Non-DoD Source] Draft Final Slides

H [redacted]

Here are the 5 slides. Please review and let me know if there are any more changes. I'm trying to get these sent to the printer before I board my next flight. [redacted] s in route to the SAME meeting so please make sure I'm copied on any comments or approval for printing.

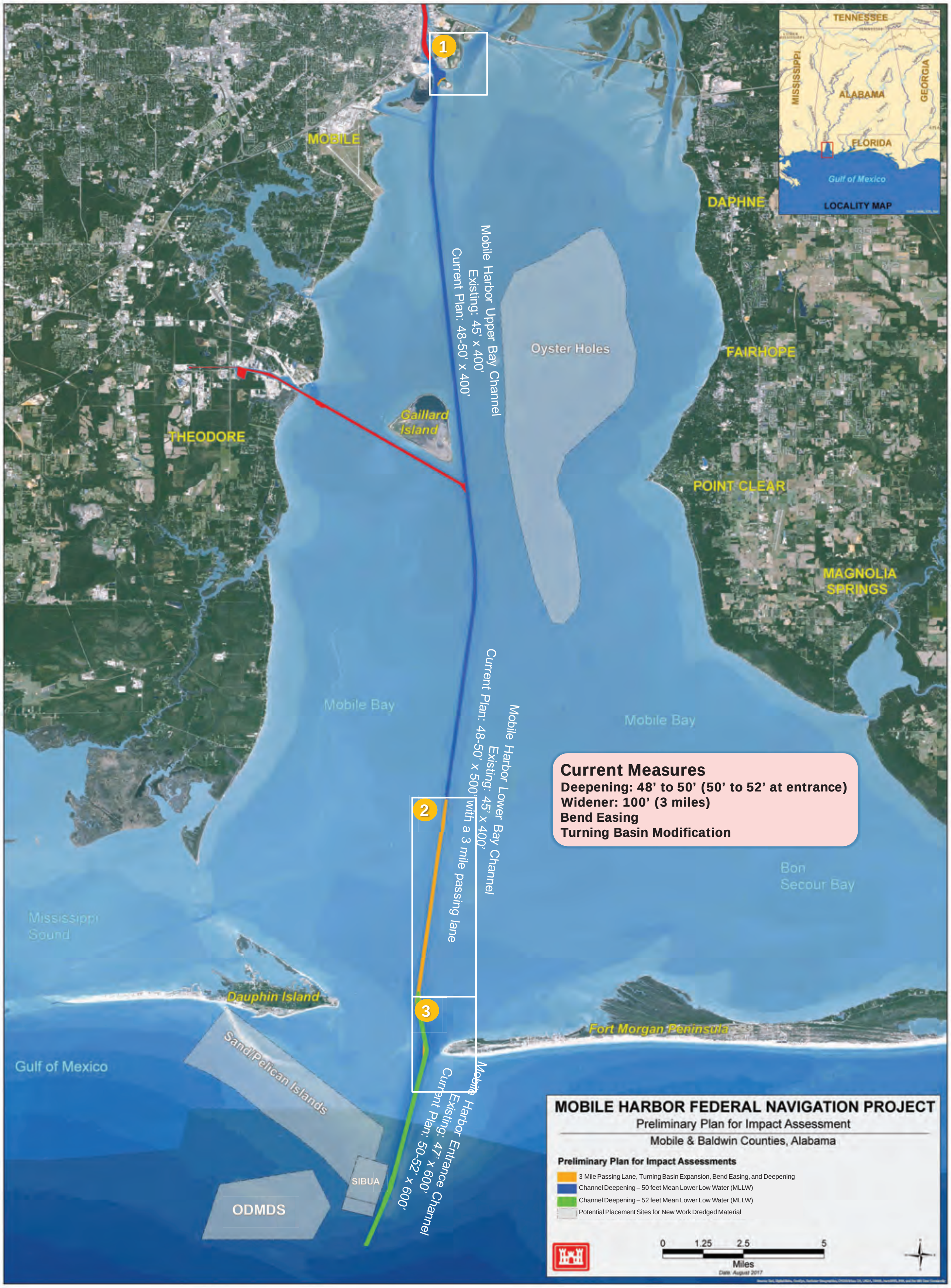
[redacted]

[redacted]

US Army Corps of Engineers

MOBILE HARBOR
GENERAL REEVALUATION REPORT

U.S. ARMY

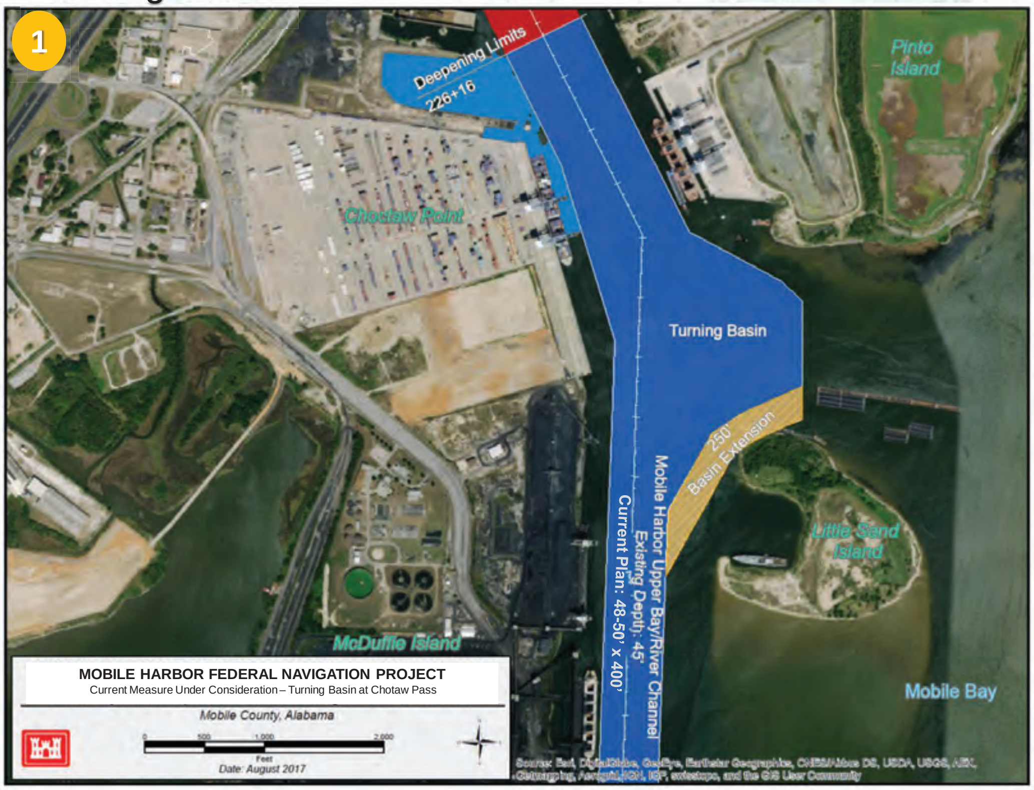


MOBILE HARBOR GENERAL REEVALUATION REPORT

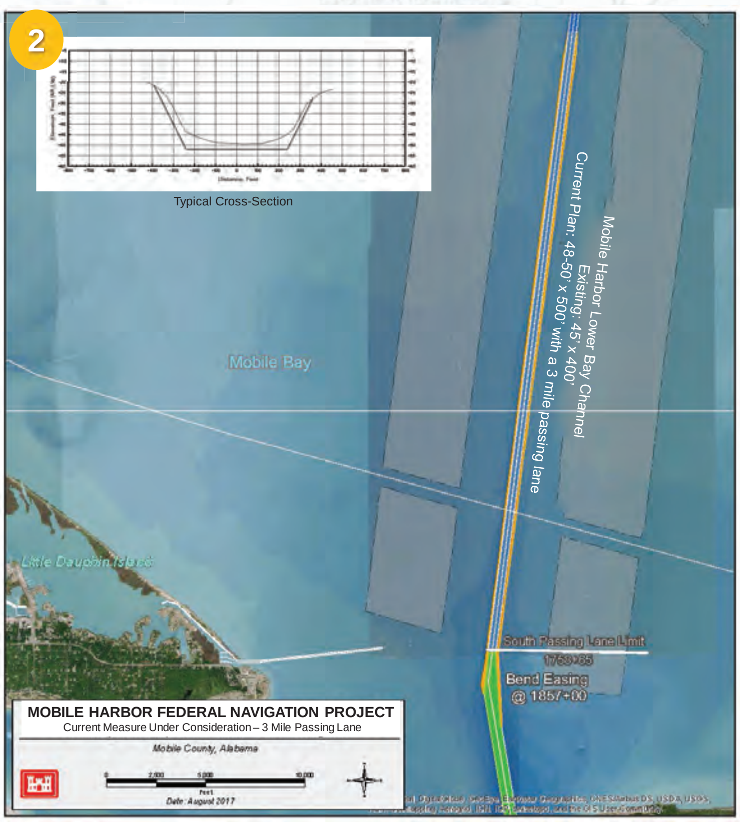
US Army Corps of Engineers

U.S. ARMY

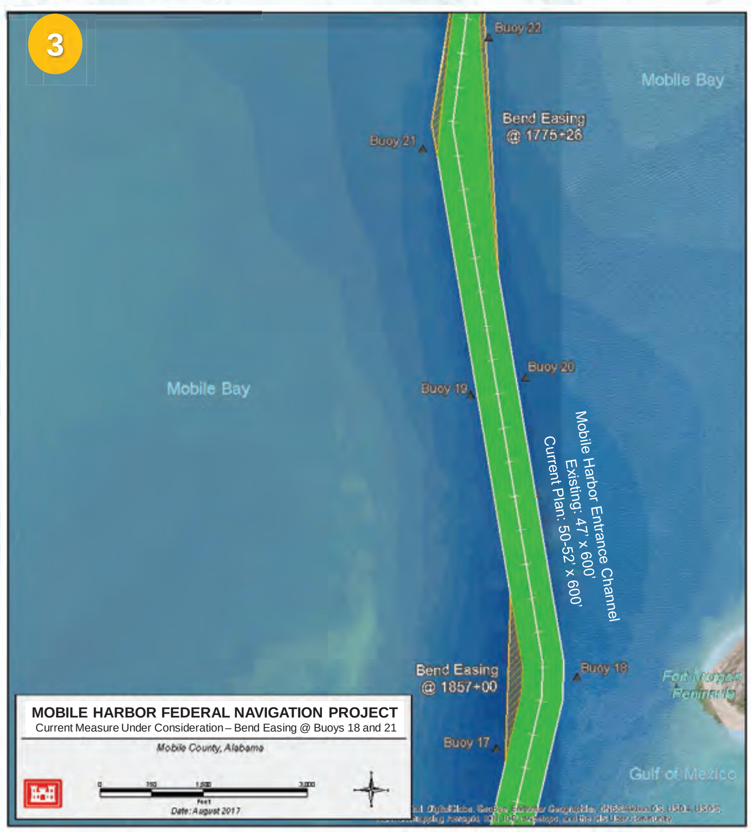
Turning Basin



Widener



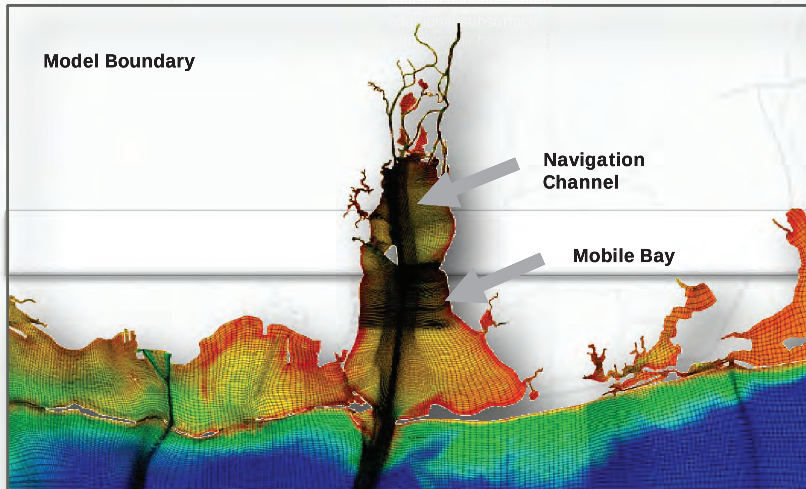
Bend Easing



MOBILE HARBOR GENERAL REEVALUATION REPORT

US Army Corps of Engineers

ENGINEERING CONSIDERATIONS



TASK: CLASSIFY SUBSURFACE CONDITIONS

Description: Compile and evaluate all existing subsurface data for the navigation channel. Collect additional subsurface samples/borings, as needed, to fill data gaps.

TASK: CHANNEL ANALYSES AND DESIGN

Description: The District team employed a Ship Simulator to evaluate the maneuverability of vessels for various channel alignments and dimensions.

TASK: NUMERICAL MODELING

Description: Collect baseline data and develop hydrodynamic, water-quality and sediment-transport models to characterize the physical conditions and processes of the study area.

TASK: COST ENGINEERING

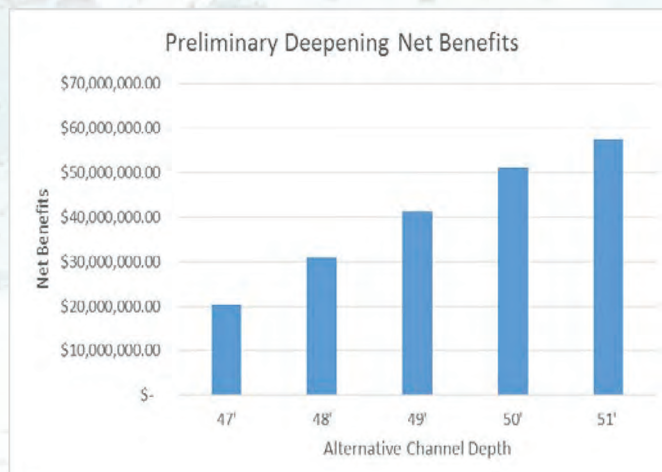
Description: Develop design, construction, and maintenance costs and identify potential cost contingencies for the project alternatives.

ECONOMIC CONSIDERATIONS

TASK: IDENTIFY THE PLAN THAT MAXIMIZES NET BENEFITS [1]

Description: Determine the transportation cost savings for each alternative and compare to the cost of the alternative.

[1] Net benefits are the alternative plans benefits, minus the alternative plans costs.



US Army Corps of Engineers

MOBILE HARBOR GENERAL REEVALUATION REPORT

U.S.ARMY

ENVIRONMENTAL CONSIDERATIONS

TASK: OYSTER MODELING

Description: Use historical data sets and maps obtained from the State of Alabama to determine distribution of oyster resources in order to evaluate existing adult oyster reefs and determine larvae-distribution patterns throughout the bay.

TASK: WETLAND ASSESSMENT AND MAPPING

Description: Use historical and field-verified data to identify and map the distribution of existing wetland communities and determine water-quality tolerances for wetland vegetation in areas potentially affected by channel modifications.

TASK: SUBMERGED AQUATIC-VEGETATION (SAV) ASSESSMENT AND MAPPING

Description: Use historical and field verified data to identify and map the distribution of existing submerged aquatic vegetation (SAV) and determine water-quality tolerances for SAV species in areas of potential effect associated with channel modifications.

TASK: BENTHIC COMMUNITY ASSESSMENT

Description: Collect sediment-benthic samples in critical ecological zones within the Mobile Bay including sediment and water-quality measurements. Conduct predictive analysis of water-quality changes to benthic invertebrates.

TASK: FISHERIES ASSESSMENT

Description: Conduct fish-populations assessments to evaluate recruitment, growth and spawning of fish within the upper bay and delta.

OTHER ENVIRONMENTAL CONCERNS BEING ADDRESSED

Threatened and Endangered Species

- Gulf sturgeon
- Alabama red-bellied turtle
- Sea turtles
- Shore birds
- Manatees

Essential Fish Habitat

- Shrimp
- Crabs
- Red drum
- Migratory species

Cultural Resources

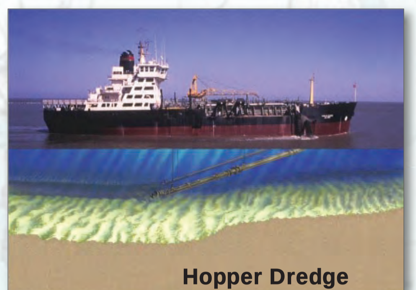
- Rich maritime history
- Coordination according to Natural Historic Preservation Act
- Dredging and placement areas evaluated
- Known and located resources evaluated for direct and indirect effects

Further Considerations

- Air quality
- Noise
- Environmental justice
- Cumulative impacts
- Consider comments received during recent public and focus group meetings regarding the effects of dredged material placement

MAINTENANCE DREDGING AND PLACEMENT

- Short-to-moderate disposal distance
- Best in calm water
- All material types – mud, sand, rock



- Deep-water dredging and disposal area
- Best dredge for rough seas
- Short- or long-haul distance
- Sand or mud

From: [redacted]
To:
Cc:
Subject: FW: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018
Date: Tuesday, May 15, 2018 2:22:00 PM
Attachments: zuErmgassen_etal_historical_ecology_2012.pdf
zuErmgassen etal 2012 Filtration by oysters in US estuaries.pdf
Kim_etal_2012_OysterRestoration.pdf
Kim_etal_2010_JC006115.pdf

[redacted]
Thank you! I'm cc'ing [redacted] o that we can get these documents to our oyster folks to make sure that we are considering everything.

It was nice to meet you last week. Working on a few notes from the meeting now.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 15, 2018 2:02 PM
To: [redacted]
Cc: [redacted]
Subject: [Non-DoD Source] RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

Hey [redacted]

I wanted to send you a couple of the papers I mentioned at the meeting on Friday that were done on oysters.

The zuErmgassen papers are about historical oyster coverage vs today and may have some good information in there. I know she looked specifically at Mobile Bay because I connected her with folks and the bottom line was that our footprint for oysters may be close to historical, but the vertical relief was gone. I know Line, so if you need to be connected with her directly, I can probably arrange that. Just let me know.

The Kim papers are the oyster larval transport modeling that was done for Mobile out of DISL. Kyeong Park is now at Texas A&M Galveston. Again, I could likely get you in touch with him if it would be helpful.

You likely have these, but just in case, I am passing them along!!

Thanks!

[redacted]

From: [redacted]
Sent: Friday, May 11, 2018 7:34 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

Just a quick reminder for the Mobile Harbor GRR environmental focus group meeting this afternoon at 1:00 at the Mobile District. Looking forward to seeing everybody.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, April 17, 2018 1:19 PM
To: [redacted]

[redacted]

Cc [redacted]

[redacted]

Subject: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

The U.S. Army Corps of Engineers (USACE), Mobile District is reconvening an environmental focus group meeting and requesting your participation for the Mobile Harbor General Reevaluation Report regarding the potential deepening and widening of the Mobile Harbor navigation channel. The meeting will be held at the Mobile District Office, 109 St. Joseph Street, Mobile, Alabama 36602, on Friday, 11th at 1:00 PM central. The meeting will focus on and provide the opportunity for those involved in environmental activities associated with Mobile Bay and its connected watersheds to hear about updated environmental evaluations that have been conducted as part of the study and to provide your comments and concerns related to potential impacts of the project. Members of the project team will be on hand to discuss and answer questions related to the proposed project. This meeting provides the opportunity for organizations such as yours to share comments and concerns that will be considered in the preparation of the Supplemental Environmental Impact Statement. Due to a limited capacity of the meeting room, we are asking that only one representative from your organization be in attendance. Please respond to let us know if your organization will be represented. For more information, on the proposed Mobile Harbor Federal Navigation Channel project, visit Blockedhttp://www.sam.usace.army.mil/ <Blockedhttp://www.sam.usace.army.mil/> .

Thank you and looking forward to meeting with you.

[redacted]

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Historical ecology with real numbers: past and present extent and biomass of an imperilled estuarine habitat

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Historic baselines are important in developing our understanding of ecosystems in the face of rapid global change. While a number of studies have sought to determine changes in extent of exploited habitats over historic timescales, few have quantified such changes prior to late twentieth century baselines. Here, we present, to our knowledge, the first ever large-scale quantitative assessment of the extent and biomass of marine habitat-forming species over a 100-year time frame. We examined records of wild native oyster abundance in the United States from a historic, yet already exploited, baseline between 1878 and 1935 (predominantly 1885–1915), and a current baseline between 1968 and 2010 (predominantly 2000–2010). We quantified the extent of oyster grounds in 39 estuaries historically and 51 estuaries from recent times. Data from 24 estuaries allowed comparison of historic to present extent and biomass. We found evidence for a 64 per cent decline in the spatial extent of oyster habitat and an 88 per cent decline in oyster biomass over time. The difference between these two numbers illustrates that current areal extent measures may be masking significant loss of habitat through degradation.

Keywords: shifting baseline; *Crassostrea virginica*; *Ostrea lurida*; native oyster; United States

1. INTRODUCTION

Humans have been modifying ecosystems and exploiting natural populations for millennia [1]; however, quantitative data on the impacts of our exploitation over large spatial scales, whether terrestrial or marine, are primarily limited to recent decades [2–4]. Even over this short time frame, many populations and habitats have undergone unprecedented change [5–7]. In the heavily modified ecosystems existing today, an understanding of historical conditions can provide a robust baseline for assessing change, modelling past ecosystem functions, assessing the need for conservation interventions, setting realistic restoration goals, planning restoration activities, and

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critically, for guiding management practices in the face of global change [8]. To these ends, improved methods for understanding the status and functioning of ecosystems prior to or during the early stages of anthropogenic impacts are needed.

In terrestrial settings, modelled potential vegetation maps are a widely used proxy for describing historic or original vegetation cover [9], although such maps cannot account for all variables, nor for the gradual and partial human modification of landscapes over millennial time-scales [10]. Such predictive approaches are even more challenging in marine and coastal environments, where poor understanding of driving variables and lack of data still prevent any reliable prediction of habitat distribution at large scales [11]. Historic baselines in the marine environment must therefore be pieced together using historical records of species, fisheries data, navigational maps and charts, and naturalists' descriptions. Recent studies have drawn on a wide range of such anecdotal and semi-quantitative historical evidence to draw a compelling picture of local to regional changes in marine and coastal environments [12–15]. While such works greatly enhance our understanding of historic conditions, they remain limited in their capacity to quantify change.

Detailed quantification of change is dependent on large-scale datasets. For a few habitat types, such information can be found in early land registries and charts [16,17], however, most marine habitats remained poorly documented until the mid to late twentieth century and the widespread availability of remote sensing technologies [4,18–20]. As a result, assessments of change in many marine habitats and populations are sensitive to shifting baselines [21,22]. Oyster grounds in the United States are a valuable exception to this data paucity in marine habitats, having been surveyed as early as 1878 [23].

Habitat-forming oysters are an ecologically important and historically dominant feature of North American estuaries [24,25], where they have significant cultural and economic value [26]. Two species within the family Ostreidae dominate: *Crassostrea virginica* (Gmelin 1791), the eastern oyster on the Atlantic and Gulf coasts, and *Ostrea lurida* Carpenter 1864, the Olympia oyster on the Pacific coast. In unmodified conditions, both have the capacity to build large reefs or beds—physical structures with a veneer of living oysters overgrowing non-living shell deposits of prior oyster generations. Such biogenic habitats are rich in associated species and offer a range of ecosystem service benefits, including enhancing non-oyster species of commercial value, coastal protection and biofiltration of the water column [27–29].

Oysters have been fished for thousands of years [1], however, drivers such as the intensification of exploitation, changes in coastal hydrology and the impact of diseases, have led to significant declines in this valuable habitat over the past 200 years or so [12]. A number of studies have sought to estimate the decline in oyster grounds over this time period, using expert syntheses and proxy records [13,14,30]. All illustrate significant changes expressed as fisheries collapse, population decline, change in areal extent or some combination thereof. Such studies undoubtedly have a powerful influence on perceptions of the habitat and on broad policy decisions, but greater detail is needed to influence management interventions. Moreover, the reliance on fishery-dependent data (e.g. landings, fishery-related legislation) in such analyses has resulted in some scepticism regarding the magnitude and causes of the documented declines [31,32].

Our study, to our knowledge, builds the first quantitative record of the historic and present extent and biomass estimates of oyster grounds in the United States (lower 48 States; hereafter termed US). Accurate inventories of oyster grounds were and are undertaken because of their considerable economic value and perceived decline, combined with their distribution predominantly in waters under state jurisdictions. Fisheries policies have often aimed to encourage the leasing of bottom for managed oyster harvest and aquaculture, but in order to do this, it was necessary to delimit existing grounds as public resources. This necessity, coupled with an interest in determining the condition of public oyster grounds, led to a large number of federally funded oyster mapping expeditions during the late 1800s and early 1900s ([23,33], see the electronic supplementary material for a full reference list). Mapping was facilitated by the nature of oyster reefs, which form structurally distinct patches in the soft mud or sand bottom of estuaries. In addition, their structure can be clearly determined by touch or physical sampling, thereby allowing subtidal mapping at a time when visual examination of the subtidal was not possible. Many of these surveys provided both details of oyster extent and quantitative information on the density of oysters.

While historic data incorporating both density and extent measures are available for some temperate forests over relatively large scales at a similar time period [34], the only coastal habitat data we are aware of, which combine both extent and some measure of habitat condition are for the Sundarbans mangroves of Bangladesh (1926–1997) [35]—a dataset that is both more recent and less extensive than our own. As such, these historic records provide an unrivalled resource with regards to the historic condition (areal extent; mean oyster shell height (SH); density, and biomass) of this critical coastal habitat. Modern stock assessments provide a similar suite of data that consequently permit assessment of long-term changes in habitat quantity and quality.

The decline of oyster habitats in the US, coupled with growing recognition of the importance of non-fishery-related ecosystem services provided by these habitats, has been increasing in recent years [27,28,36]. This has led to significant federal- and State-level investment in oyster reef restoration. More than 10 million US dollars was directed to oyster reef restoration by the National Oceanic and Atmospheric Administration (NOAA) through the American Recovery and Reinvestment Act of 2009, roughly equivalent to the previous 10 years of oyster reef restoration funding. As ecologists and natural resource managers strive towards restoring coastal ecosystems, quantitative assessment of the historic extent and habitat quality, whether for oysters or other habitats, will provide an invaluable tool to guide and inform restoration efforts.

2. MATERIAL AND METHODS

(a) *Data review*

We conducted a thorough review of quantitative information on the historic and present extent and condition of oyster reefs in the US, drawing on scientific literature, historic United States fishery reports, State fisheries reports and publicly available data (see the electronic supplementary material). Such data, even historically, were the result of highly detailed surveys, typically with boat-based sampling over a period of several weeks, involving tens of full-time researchers. We summarized the findings into sub-estuarine drainage areas (sub-EDA), as listed in NOAA's coastal assessment framework (CAF) [37]. Sub-EDAs equate to whole estuaries, with the exception of Chesapeake Bay and Puget Sound, which are subdivided into their major tributaries. Hereafter, we refer to all sub-EDA units as estuaries. The relevant data on extent, SH and density were extracted and catalogued, and the number of oysters per bushel was noted in order to derive an estimate of mean SH. Bushels are volumetric measures used by fishers and fisheries managers. A legally defined standard US bushel (3.52×10^4 cm^3) is sometimes used, although more typically legal bushels are defined at the state level. If not clearly stated in the source, then we were able to infer whether a state-defined or a standard bushel was used by more detailed investigation. For example, Moore states in his 1910 survey of the James River, VA, that 'oysters on this bed are large, averaging .... over 300 per bushel' [38, p. 15]. Oysters would have averaged 75 mm (approximately the cut off for market size, and thus not large) using a standard bushel, or 89 mm if the Virginia bushel is applied. If there was doubt as to the bushel size, then the standard US bushel was applied, because it resulted in a more conservative estimate of SH.

(b) *Oyster extent*

Universal definitions of the habitat classification allowed for a more robust assessment of change in spatial extent. The vast majority of historical and present-day oyster habitat surveys were conducted for fisheries management purposes and use a relatively consistent approach. For these cases, we used the term 'oyster grounds' that we define as the wider community complex of which oyster reefs and beds are clearly an important part, but that also includes areas of adjacent sediments and shell rubble. Such areas would broadly equate with 'fishable areas'. Historically, only areas with oysters at densities high enough to support fishing activity were included in surveys; isolated individuals and groups that were not forming beds or reefs were excluded. Such thresholds are still applied in modern mapping approaches. Consequently, it is possible for the species to persist in an estuary, but for there to be no remaining oyster grounds. We term this loss of habitat as the species being functionally extinct.

Most sources provided direct numerical estimates of the extent of oyster grounds. Where only maps were available, they were digitized, and the areal extent of mapped oyster grounds was calculated using Arc Geographical Information Systems. Maps were also digitized if the areas described straddled two estuary units, such that the extent in each estuary could be determined. In a small number of cases, areal extent had been estimated instead of being directly surveyed [39]. We considered the potential resolution of side-scan sonar (a popular modern technique) to be equal to the historic survey method of marking the boundaries of oyster grounds by dragging chains and probing the ground with poles. Where extent had been estimated, it was assumed to be an estimate of oyster grounds. Where historic oyster extent was determined multiple times, the surveys using the most direct measurement techniques were favoured. Where methods did not differ, the oldest report was used.

(c) *Oyster density*

Oyster density was recorded in several historic surveys undertaken towards the end of the nineteenth century and the early twentieth century. Frequently, the oyster count within size classes (typically greater than 76 mm, 76–25 mm, less than 25 mm) was documented. The majority of surveys determined oyster density by tonging a number of locations within each delineated oyster ground. A tong is a traditional harvesting tool composed of two rakes joined at approximately one-third of the length of the handles, such that oysters can be collected at depth with a scissor motion. A sample area was typically staked out, and tonged repeatedly until 'everything on the bottom' had been collected [40], we therefore assumed 100 per cent catch efficiency in our use of tonging data. A small number of historic and present-day datasets sampled oyster grounds using a dredge [23,41]. Dredges (a weighted frame dragged behind boats to collect shells and oysters scraped into the attached net) are an inefficient sampling gear, leaving many individuals behind in the area sampled. The percentage of the population collected in the sampled area (termed 'dredge efficiency') is highly variable, but frequently falls in the range of 15 per cent [42–46], and occasionally as low as 7.8 per cent in survey mode [43]. Therefore, as all but one series of dredge data used in our study were recent, dredge efficiency was assumed to be 8 per cent, so as to be conservative in our estimates of the change in oyster abundance. All dredge hauls with no oysters or those containing only spat (oysters less than 25 mm) were discounted to control for the potential that areas outside of oyster grounds had been sampled. The density of spat was not included in our study to control for seasonal variability, and inconsistency between studies in recording spat data. Where oyster density data for an estuary were absent, density data from the nearest estuary within the same ecoregion [47] were used as a proxy for density where appropriate (see the electronic supplementary material).

During the data-gathering process, every effort was made to understand the spatial scale at which density data were collected relative to areal extent. For a small number of estuaries, density data were collected at a fine spatial scale but mapping related to larger oyster ground units. In these cases, we applied a correction factor to account for the high mean densities reported. We determined that the proportion of barren ground within the area mapped as oyster grounds in Matagorda Bay, TX, by Moore [40] was 50 per cent (area-weighted mean). We used this correction factor to estimate the mapped oyster bottom area covered by oysters at the surveyed density.

The majority of our data represent subtidal oyster populations, which can have starkly different population structures from intertidal populations [48]. We therefore used only subtidal eastern oyster data when comparing mean market size and mean densities within each estuary over time.

(d) *Oyster size and biomass*

Mean oyster SH was rarely noted in early surveys, however, the mean number of oysters in a bushel was occasionally stated, or could be inferred through assessment of the number of bushels attributed to an acre of known density. Hopkins [49] noted that the mean oyster size could be inferred from the number of oysters in a bushel of known volume. We therefore fitted a regression to the log data from Hopkins [49], and subsequently tested the strength of the correlation between the SH estimated from the number of oysters in a bushel or sack of known volume and the mean SH reported in five studies from a broad geographical range ($n = 24$). The linear regression fitted to log length and number of oysters per sack was highly significant (adjusted $r^2 = 0.93$, $F_{58} = 809$, $p < 0.0001$), and yielded the following predictive relationship between the number of oysters in a known volume and the mean oyster length: $h = 10^{(-0.3537 \log b + 2.8361)}$, where h is SH (from umbo to growth edge) in millimetres, and b is the number of oysters in a 52.85 l volume (standard Louisiana sack). The estimated SH showed a near-perfect correlation with mean SH collected from the literature (Pearson's correlation coefficient = 0.94, $t_{21} = 12.9$, $p < 0.0001$), supporting our use of this equation to determine *C. virginica* SH across the US. SHs from nearest estuaries for which the data were available were used as proxies in estuaries where such data were not available.

It was frequently possible to derive the mean SH of two size classes of oysters (submarket and market) from the historic data: in these, the mean SH of the submarket oysters, termed 'culls', was conservative, as the number per bushel used included spat. With present-day data, we determined mean SH for the same-size categories (excluding spat) from size frequencies available from quadrat and dredge sampling undertaken by state fisheries managers. We then tested whether the SH data for market-sized oysters from this fishery independent data had changed over time (two-tailed *t*-test).

Oyster biomass scales with SH; however, the nature of that relationship varies regionally. In order to most accurately estimate the biomass of oysters in a given estuary, we collated SH to dry tissue mass conversions from 13 estuaries in seven states. Conversions were applied to the nearest estuaries within the same ecoregion.

(e) *Quantitative comparison*

We found data that allowed direct comparison of historic and present oyster grounds and biomass in 24 estuaries throughout the US and calculated per cent change in extent and biomass over time. An estimate of change within ecoregions was determined by summing the extent and biomass in estuaries for which data were available in both time periods, within each ecoregion. Nationwide change was similarly assessed by summing and comparing all historic and present oyster extent and biomass.

Comparable quantitative data were available for only present or historic time periods for a large number of estuaries ($n = 38$). In order to analyse the change over time, we calculated the proportion of the estuary area (as listed in CAF), containing oyster grounds, so as to ensure that all estuaries were equally represented. In SC, where modern habitat mapping has been undertaken throughout the marsh areas and creek margins, estimates of areal extent were limited to oyster grounds within 5 m of the creek edge. All estuaries for which data were available were included in this analysis and each coast was analysed independently. Data were non-normally distributed and were compared using a Kruskal–Wallis test. All statistical tests were run in R v. 2.13.1 (2011-07-08).

3. RESULTS

Data on oyster extent were identified for 62 estuaries (39 historically (1878–1935, predominantly 1885–1915) and 51 estuaries more recently (1968–2011, predominantly 2000–2010); figure 1). The most extensive oyster grounds surveyed historically included: 35 536 ha in Tangier and Pocomoke Sounds (MD and VA) in 1878 on the Atlantic coast, 16 679 ha in Matagorda Bay, TX in 1907–1915 on the Gulf coast, and 6225 ha in Willapa Bay, WA in the mid-1800s on the Pacific coast (see the electronic supplementary material). The proportion of estuary area containing native oyster grounds has decreased significantly across the US (figure 2*a*).

Direct estuary-by-estuary estimates of change over time were restricted by available data to 24 estuaries, representing 16 per cent of US estuaries by number and distributed across five marine ecoregions (figure 1*c*,*d*). Both overall extent and biomass of oyster grounds decreased precipitously (by 64% and 88%, respectively). Losses occurred in all ecoregions for both the extent and the estimated total biomass of oysters in oyster grounds (figure 1*c*,*d*). The Olympia oyster habitat on the west coast was recorded as functionally extinct in all estuaries for which data were available for comparison. Indeed, the current 4 ha of oyster habitat recorded in Netarts Bay, OR, is the result of recent and ongoing restoration work, and has yet to form a self-sustaining population [50]. It should, however, be noted that Puget Sound, WA, contains some apparently healthy US Olympia oyster beds but was not represented in this assessment owing to a lack of estuary scale data.

The most dramatic losses of eastern oyster habitat were recorded from the northeastern Atlantic coast, with less than 6 per cent of historic extent remaining in half of the 10 estuaries where data were available (figure 1*c*). Similarly, losses in biomass were evident in the Gulf of Mexico west of the Mississippi River (figure 1*d*). It is worth noting that not all estuaries have suffered decline in either oyster extent or biomass since our approximate 1900 baseline; two estuaries (Apalachicola Bay, FL; Sabine Lake, TX and LA) showed stable or even increasing extent and biomass on oyster grounds (figure 1*c*,*d*).

Across estuaries with size and density data, we found no significant difference in mean market eastern oyster size (greater than 76 mm) over time (two sample *t*-test, $t_{17.69} = -1.08$, $p = 0.29$), while the mean market-size eastern oyster density showed a non-significant trend towards lower densities over time (figure 2*b*). The median density of subtidal market size eastern oysters declined from five to two oysters per square metre nationally and from 14 to 2 oysters m^{-2} in the Gulf of Mexico.

While the overall percentage loss in oyster biomass is greater than the change in extent, this number hides some important regional variation. Excluding estuaries where oysters are deemed functionally extinct, the biomass and extent changes are closely allied in 10 of the 18 estuaries, but the remaining eight estuaries, all in the northern Gulf of Mexico, show a decline in biomass over three times greater than the decline in oyster reef extent (figure 1*c*,*d*). This substantial decline is primarily a consequence of declines in oyster density (see the electronic supplementary material).

4. DISCUSSION

The disappearance of previously productive oyster grounds was noted as far back as 1658 [12]. Scientists

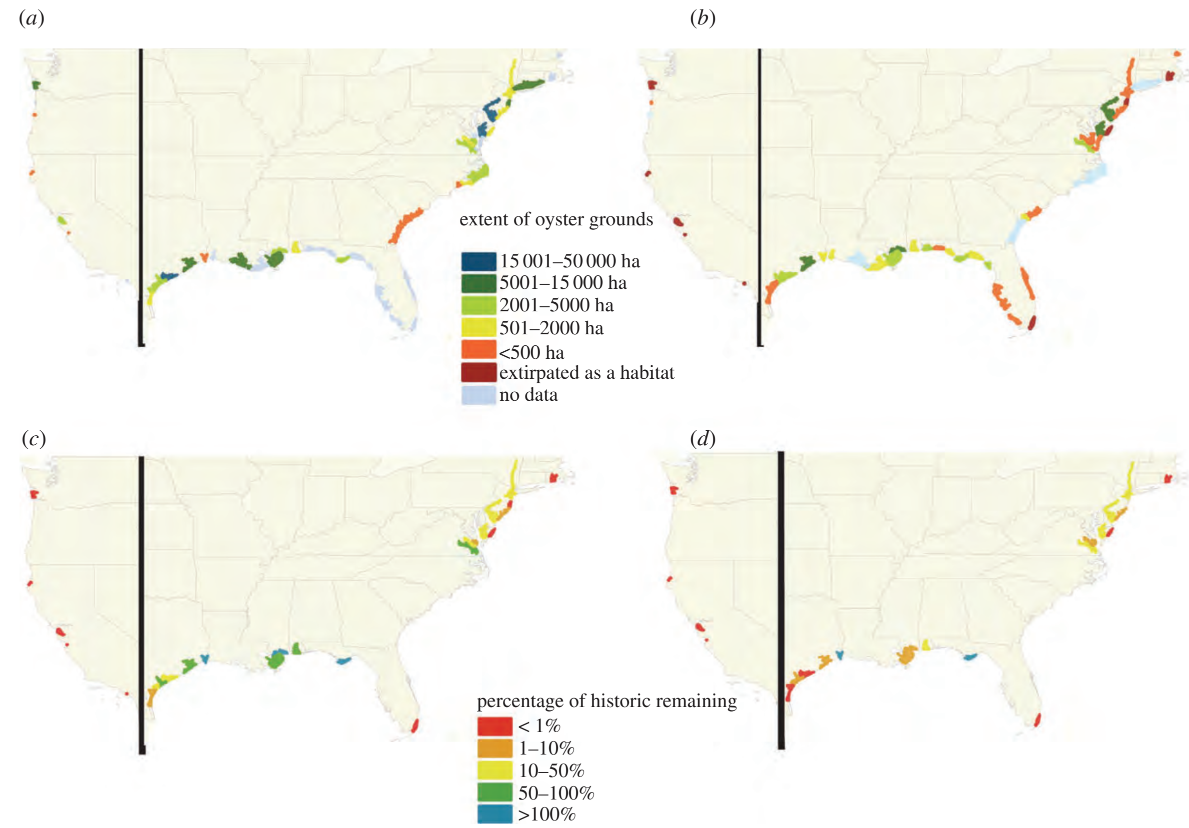

Figure 1. Maps illustrating: oyster ground areal extent (*a*) historically and (*b*) presently in estuaries in the US and the percentage change in (*c*) oyster ground extent and (*d*) oyster biomass in estuaries for which comparable historic and modern data were available.

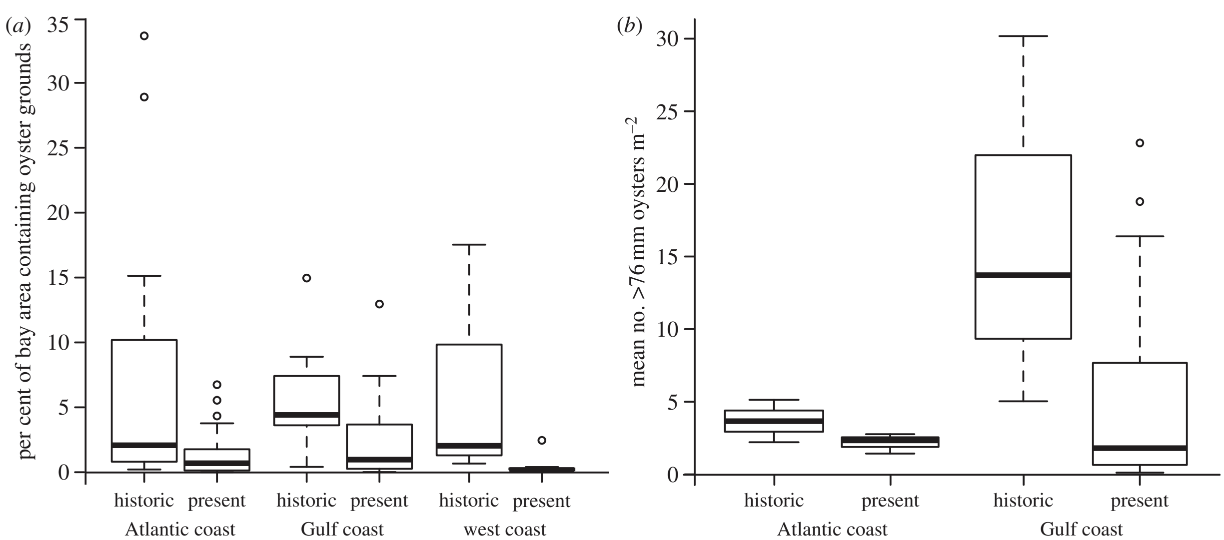

Figure 2. A box-whisker plot of (*a*) the percentage of estuary area containing oyster grounds past and present by coast. Proportion of estuary area occupied was significantly higher historically along all coasts (quasi-binomial generalized linear model; Kruskal–Wallis $\chi_1^2 = 5.1$, $p = 0.02$; $\chi_1^2 = 5.2$, $p = 0.02$; $\chi_1^2 = 8.3$, $p < 0.01$ for the Atlantic, Gulf and West coasts, respectively). (*b*) The mean estuary wide density of market-sized eastern oysters historically and presently on subtidal oyster grounds in the US (Atlantic estuaries $n = 6$; Gulf estuaries $n = 21$; Kruskal–Wallis $\chi_1^2 = 2.76$, $p = 0.05$).

in the US were able to draw on extensive documentation of the decline of the European oyster species, *Ostrea edulis* Linnaeus, 1758 in Europe, to express their concerns for both commercially important North American species throughout the 1800s [51]. Today, the European oyster is considered to be functionally extinct throughout much of its range [52]. Our findings suggest that despite more than 130 years of science and calls for conservation interventions in state and federal fisheries reports and in peer-reviewed literature, both the Olympia oyster and the eastern oyster appear to have followed suit in portions of their range. Clearly, the greatest declines in oyster grounds have been along the Pacific coast, where our data reflect what is widely agreed to be a regional trend of functional extirpation of native oysters. Declines have also been considerable along the northeastern portion of the Virginian ecoregion, where two-thirds of historic extent and biomass have been lost since the late 1800s alone (figure 1*c*,*d* and the electronic supplementary material).

All previous studies that illustrated collapse or decline in oyster extent drew on fisheries data [12–14,30,53]. Those studies therefore either make no attempt to quantify loss [12,13], or quantify loss through proxies (landings data) sometimes combined with delphic processes [14,30,53], resulting in high uncertainty [54]. By relying on fisheries-independent data, we seek to end the debate surrounding the extent of decline in oyster habitat in US estuaries [31,32,54]. It must, however, be stressed that despite the relative robustness of our historic dataset, our study does not reflect the decline from pristine baselines. For most estuaries assessed, the historic quantitative baseline was measured at a point in time when the estuaries were already impacted by fishing. Indeed, the major impetus for surveying the grounds historically was a perceived vulnerability or observed declines in natural oyster resources, with the declines frequently linked to overexploitation [33,55,56]. A review of the historic literature illustrates that such overexploitation can be traced back to well before our current historic baselines [57], indicating that the proportion of original grounds lost is undoubtedly greater than indicated by our figures.

The lack of a pristine baseline in our data is reflected in the oyster size and density statistics. Early historic reports refer to oysters a foot long in the eighteenth to mid nineteenth centuries [57,58], however, the quantitative assessments of beds used in this study were conducted decades later, once evidence of overfishing of oyster reefs was already apparent [59]. That we found no significant difference in size over the time period examined is therefore unsurprising. Our national-level statistics for oyster density similarly did not show a significant decline over time, possibly also owing to over exploitation prior to our centennial baseline, in particular on the Atlantic coast [12] (figure 2*b*). Nevertheless, our results indicate that oyster grounds have declined markedly in condition over the time period examined, with biomass in some areas declining to a far greater extent than area. In fact since 1884, a number of historic reports have highlighted the inadequacy of using areal extent measures alone to determine oyster abundance and reef condition, observing that fishing activity often resulted in the expansion of oyster extent through the spreading out of shell, without necessarily increasing oyster abundance [58,59]. Indeed, this expansion probably reduced reef height [33], placing oysters in locations where their survival was reduced and therefore contributing to long-term losses of natural oyster reefs [60].

The declines in oyster ground extent and oyster biomass were not universal. The current oyster population in Apalachicola Bay, FL exceeds historic oyster abundance. This estuary represents one of the few estuaries in which fishing is primarily restricted to harvest by tongs (see §2), combined with intensive management and shell planting. Similarly, Sabine Lake, TX exceeds our historic estimates of abundance and has been closed to oyster fisheries for over 40 years. As our analysis includes only two time periods, we have no measure of whether change is still occurring and are therefore unable to assess whether our results are the product of current management or historic change.

While our data are useful in estimating the loss of 'natural' oyster grounds, a significant but unknown proportion of oysters in several regions in the US are located on leased grounds, notably eastern oysters in LA, the northeastern Atlantic coast, and on the west coast, where there is extensive aquaculture of the non-native *C. gigas* (Thunberg, 1793). We were unable to collate data on the extent of oyster habitat on leased grounds as these are rarely surveyed. This omission has limited impact on the importance of our findings as relates to natural oyster grounds, as many leased areas are heavily manipulated, with oysters often relocated several times before harvest. Leases may make a marked contribution to extent, biomass and ecosystem services from oysters, but these populations represent an extractable resource as opposed to habitat-forming reefs or beds. For areas such as LA, CT and NJ where leasing is extensive, our findings probably underestimate overall native oyster populations, but the comparisons of historic and present-day extent of natural oyster grounds remain valid. Another issue concerns oyster habitat created by wild populations of *C. gigas* on the west coast. Wild populations of this species are currently small or absent in our study estuaries, with the exception of Willapa Bay where the population is subject to rotational harvest, similar to other leased grounds [61]. Where populations of *C. gigas* occur, they may perform many of the ecological functions previously provided by native oysters [61].

In a recent analysis based on expert opinion and literature review, oyster reefs worldwide were estimated to have declined by 85 per cent, with the US faring relatively well [30]; thus, our more quantitative analysis of 64 per cent decline in extent of oyster grounds in the US appears at first glance to support our current understanding. However, as biomass losses were often more extreme than extent, the status of oysters appears more dire than indicated simply by area. This also has potential implications for estimates of ecosystem service delivery, as function may scale nonlinearly with both area and density [62]. Despite these documented declines, North America remains a region with some hope; stable or increasing oysters in some estuaries underscore that management and restoration efforts can be successful. Our centennial baselines provide a quantitative context to inform and motivate stakeholders, prioritize efforts and set goals for restoration, and ultimately bring these critical habitats back from the brink.

Our results represent, to our knowledge, the first effort to quantify both extent and biomass for a marine habitat-forming species across a centennial time period. Indeed, we believe that these findings may be unique at this large scale even among terrestrial studies. While many studies have provided compelling evidence of change in habitat extent over the last 100 years [16], and others have been able to compile localized or point source evidence of changes in abundance of certain species [63], few have been able to combine an assessment of change in extent and in biomass across large spatial and temporal scales.

These findings thus have a broader resonance for conservation biology generally. While change in extent remains a predominant metric in many analyses of human impact [2,18,52], our work confirms, with real numbers, that this may be insufficient for assessing overall changes to habitats. The altered and degraded condition of many present-day habitats can also lead to the undervaluing of their potential in terms of ecological function and ecosystem service provision. Improved historic baselines that take into account both extent and condition of habitats will greatly improve ongoing conservation planning, the relatively new science of ecosystem 'red-listing' [64]; and the ever-growing efforts to restore or rehabilitate lost and degraded habitats.

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Quantifying the Loss of a Marine Ecosystem Service: Filtration by the Eastern Oyster in US Estuaries

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Abstract The oyster habitat in the USA is a valuable resource that has suffered significant declines over the past century. While this loss of habitat is well documented, the loss of associated ecosystem services remains poorly quantified. Meanwhile, ecosystem service recovery has become a major impetus for restoration. Here we propose a model for estimating the volume of water filtered by oyster populations under field conditions and make estimates of the contribution of past (c. 1880–1910) and present (c. 2000–2010) oyster populations to improving water quality in 13 US estuaries. We find that filtration capacity of oysters has declined almost universally (12 of the 13 estuaries examined) by a median of 85 %. Whereas historically, oyster populations achieved full estuary filtration (filtering a volume equivalent or larger than the entire estuary volume within the residence time of the water) in six of the eight estuaries in the Gulf of Mexico during summer months, this is now the case for only one estuary: Apalachicola Bay, Florida. By contrast, while all five estuaries on the North Atlantic coast showed large decreases in filtration capacity, none were achieving full estuary filtration at the time of our c. 1900 historic baseline. This apparent difference from the Gulf of Mexico is explained at least in part by our North Atlantic baseline representing a shifted baseline, as surveyed populations were already much reduced by exploitation in this region.

Keywords *Crassostrea virginica* · USA · Restoration · Estuarine habitat · Historical ecology · Water quality

Introduction

The accelerated loss of many habitats since the industrial revolution is widely documented (Winslow 1887; Roberts 2002; Fearnside 2005); however, the ecological and social ramifications of this loss have only recently gained recognition (Millennium Ecosystem Assessment 2005). Quantifying losses and the impact of habitat alteration is challenging, as long-term data on habitat area or condition are rare. The vast majority of habitats represented in historic datasets lack detailed insights beyond areal extent (e.g., Sommer 1976; Bromberg and Bertness 2005), yet habitat degradation is frequently a threat in addition to habitat loss (Lambin 1999; Turner et al. 1999; zu Ermgassen et al. 2012). In many marine environments, it is difficult, if not impossible, to determine the nature of pristine habitats that have been lost (Roberts 2007). This is problematic in deriving estimates of ecosystem service provision historically, as many services are strongly dependent on species abundance or species richness (Diaz et al. 2006; Gibbs et al. 2007). In these cases, knowledge of the change in habitat quality may be necessary to determine the change in ecosystem service delivery as habitats degrade.

Oyster reefs are among the most threatened of marine habitats having suffered substantial declines globally over the past century (Beck et al. 2011), primarily due to overfishing, hydrological changes, pollution, and disease (Winslow 1887; Mackenzie 2007; Powell et al. 2008; Wilberg et al.

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2011). These losses have been quantified for the USA, where zu Ermgassen et al. (2012) utilized data on oyster size and density alongside spatial extent measures to derive estimates of a 64 % decline in oyster extent and 88 % loss of oyster biomass between the early 1900s and the early 2000s. Such measures underpin efforts to formulate estimates of the loss of a critical coastal ecosystem service—water filtration.

Filtration by suspension feeders such as oysters impacts water quality by directly removing particulate matter from the water column, with oysters ingesting the edible particles and binding rejected particles with mucus, then depositing this as pseudofeces onto the sediment surface. Through this action, both phytoplankton and suspended sediment that would otherwise reduce water clarity are drawn from the water column to the benthos. The eastern oyster, *Crassostrea virginica* (Gmelin, 1791), is known to filter particles >5 μm in size with high efficiency (Riisgaard 1988) and can have a marked effect on light penetration in shallow, calm waters, which in turn may have positive impacts on other important adjacent habitats, such as seagrass beds (Newell and Koch 2004).

The physiology of oyster feeding and filtration is well studied, and filtration rate is known from laboratory studies to be influenced by a variety of environmental factors such as temperature, flow rate, salinity, seston concentration, and particle size, as well as oyster size (Loosanoff 1958; Walne 1972; Shumway et al. 1985; Riisgaard 1988). Although it is recognized that conditions in situ may significantly affect filtration rate (Doering and Oviatt 1986; Powell et al. 1992), few studies have sought to quantify rates under field conditions. To estimate the contribution of oyster filtration within an estuary, one can model field-based filtration rates by summing the effect of environmental variables, for which the relationships have been derived and for which field measurements are available. This has been done effectively for Chesapeake Bay (Cerco and Noel 2005; Fulford et al. 2007); however, such methods are expensive and require the input of a large amount of environmental data and computational capacity (Cerco and Noel 2005). While the required environmental data are available for well-studied estuaries such as Chesapeake Bay, they are not available for most other estuaries, and therefore, such high-resolution models are not widely applicable.

In addition to the challenges posed by the lack of data, there remain concerns that oysters in situ may not respond as predicted by models primarily based on filtration by few oysters in the laboratory. Oyster populations in situ may spend a different proportion of time with their valves shut, there is the potential for synergistic population-level influences and re-filtration, and physical attributes of the reef may influence flow dynamics and hence the uptake of particles (Dame et al. 1984; Harsh and Luckenbach 1999). Despite these concerns, it seems that models may be the only means available to estimate filtration rates at large scales.

In order to make broad, estuary-scale estimates of the volume of water filtered by oyster populations nationally, we derived a model of oyster filtration based on the only in situ measurements of oyster filtration currently available (Grizzle et al. 2006, 2008). We use this model to explore the estimated delivery of this ecosystem service historically versus presently across 13 US estuaries.

Methods

Of the multiple variables known to influence oyster filtration, we determined that water temperature and oyster size (shell height from umbo to the posterior edge; SH) were the key variables for which we could obtain data nationally (Table 1). Other variables included dissolved oxygen and salinity which illicit near "all or nothing" responses (Churchill 1920; Cerco and Noel 2005) and hence are likely to be transient features where oysters are found in abundance. Finally, variables such as flow rate and seston quality and concentration vary on small spatial and temporal scales (Berg and Newell 1986; Wilson-Ormond et al. 1997) and can therefore not be modeled on the estuarywide and national scale used in our study, but equally are likely to be of lesser importance in estimating filtration rates at these large scales.

In order to account for field conditions in our model, we used the field measurements of seston uptake over natural oyster reefs reported in Grizzle et al. (2006, 2008) to estimate filtration rates. Grizzle et al. measured seston drawdown over reefs with a known mean oyster SH and density, and under optimal temperature conditions. We assumed that all seston drawdown was the result of filtration by oysters and estimated the mean filtration rate per oyster for each reef surveyed. We subsequently fitted a standard filtration model (Eq. 1) to these field data. SH to dry tissue mass conversions from the respective regions (South Carolina and Florida) were applied. Field data were collected on intertidal reefs during both ebb and flood tides (Grizzle et al. 2006, 2008) and therefore captured the impact of the tidal cycle (Dame et al. 1984, 1992). Negative values caused by waves or other disturbances were excluded.

Filtration rates were estimated to increase nonlinearly as a function of oyster biomass following the relationship outlined in Eq. 1 (Newell and Langdon 1996).

$$FR = aW^b \tag{1}$$

where a and b are constants and W is oyster dry tissue mass in grams.

A recent review by Cranford et al. (2011) suggested that the constant b could be universally written as 0.58 for filter-

Table 1 Overview of variables effecting oyster filtration rate

Variable	Effect on filtration rate	Reference	Data description
Temperature	Unimodal with optimum filtration at ~27 °C	Newell and Langdon (1996)	Mean available nationally
Salinity	Steep decline in filtration rate between 14 and 10 ppt	Churchill (1920)	Varies dramatically spatially within estuaries
Dissolved oxygen	Unknown. Modeled as strong decrease <2 mg/l	Cerco and Noel (2005)	Rare, variable at a small spatial scale
Particle size	Retain particles >5 μm at high efficiency	Riisgaard (1988)	Rare, varies seasonally
Seston concentration	Maximal when seston concentration >5 and <10 mg/l	Epifanio and Ewart (1977), Newell and Langdon (1996)	Rare, varies seasonally
Flow rate	Effect poorly understood	Newell and Langdon (1996), Harsh and Luckenbach (1999)	Rare, variable at a small spatial scale
Oyster size	Increases as a function of dry mass by an exponent of 0.58	Newell and Langdon (1996), Cranford et al. (2011)	Mean available nationally

feeding bivalves. While species-specific estimates for *C. virginica* are rare, they have ranged from 0.59 (Pruder et al. 1976 cited in Epifanio and Ewart 1977) to 0.73±0.22 (Riisgaard 1988). Using the Levenberg–Marquardt nonlinear least squares method (Press et al. 2007) in Mathematica version 7, we fitted Eq. 1 to the field data, once allowing both a and b to be estimated and once setting b at the fixed value of 0.58. We then performed an F test to determine that we were not justified in estimating b and were justified in using the b value from the literature (F test; $F_{9,1}=0.07$, $P=0.2$; Fig. 1).

We combined the resulting equation with a function for the effect of temperature proposed by Cerco and Noel (2005) to give Eq. 2.

$$FR = 8.02W^{0.58}e^{(-0.015T-27)^2} \quad (2)$$

where T is temperature in degrees Celsius.

We selected 13 estuaries for which historic (ca. 1880–1910) and present (ca. 2000–2010) oyster data were

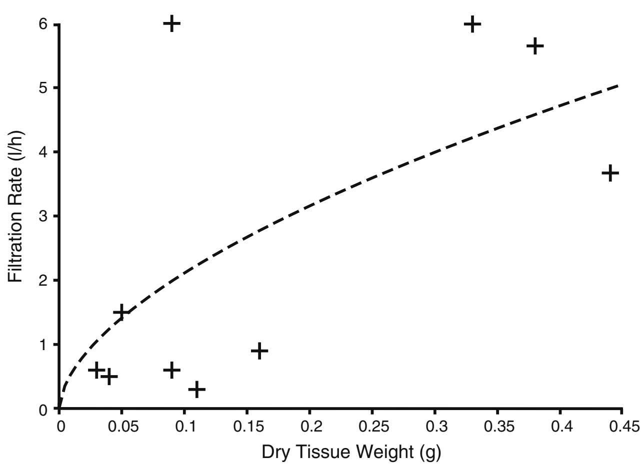

Fig. 1 Fitted model of filtration, as represented in Eq. 2, fitted to the field data collected in situ. Model as in Eq. 2, $R_{adj}^2=0.71$

available from zu Ermgassen et al. (2012) (Table 2). The motivations for mapping oyster reef habitat have remained constant over time, the primary goal being to determine the extent and status of oyster grounds available for fishing. The physical nature of oyster reefs, as islands of textured hard substrate in otherwise soft bottom, allowed for the early accurate mapping of this subtidal habitat. In this respect, oyster reefs provide a unique historical dataset. In the vast majority of cases, historical surveying entailed initial surveys of oystermen, followed by detailed transects of the estuary bottom, dragging chains to detect changes in the nature of the substrate and ground truthing through subsequent sampling (see Moore 1910 for a detailed overview of a typical sampling method and zu Ermgassen et al. 2012 for further information regarding data handling and comparisons). This methodology provides accuracy not dissimilar to modern day side-scan sonar that is typically used to determine the present day extent of subtidal oyster reefs. As in zu Ermgassen et al. (2012), we therefore assume equivalence in the spatial extent delimited by these two methods. Both modern and historic sampling provided data on the SH and density for two oyster size classes; those above 75 mm SH and those between 25 and 75 mm SH. Spat (oysters <25 mm SH) were excluded, as the quantification of spat is variable between studies. In some cases, historic density and SH data were proxied from neighboring estuaries within the same ecoregion (see zu Ermgassen et al. 2012). SH was converted to dry tissue mass in grams using regionally specific conversions (Liddel 2008; Mann et al. 2009a, b; Harding et al. 2010; Beseres Pollack et al. 2011; Bushek, unpublished data). Where estuary-specific conversions from SH to dry tissue mass were not available, conversions from the nearest available estuary within the same ecoregion (Spalding et al. 2007) were applied. All estuaries represented have predominantly subtidal oyster populations (see Table 2 for a complete list of estuaries).

We collated monthly mean water temperature data for all 13 estuaries from NOAA, USGS, and the National Estuarine

Table 2 Filtration by historic and present oyster populations, and for 1 ha of oyster ground at either historic or present oyster densities

Estuary	State	Historic volume filtered (1,000 m^3h^{-1})	Present volume filtered (1,000 m^3h^{-1})	Historic area (ha) and density (indm^{-2})	Present area (ha) and density (indm^{-2})	Volume filtered by 1 ha at historic density (1,000 m^3h^{-1})	Volume filtered by 1 ha at present density (1,000 m^3h^{-1})
Hudson River/Raritan Bay	NY/NJ	1,604 (0.07)	272 (0.01)	1,660 (17.5)	402 (15.5)	0.97	0.68
Delaware Bay	NJ/DE	23,718 (0.36)	7,567 (0.11)	25,149 (17.5)	11,471 (15.5)	0.94	0.66
Tangier and Pocomoke Sound	MD/VA	3,718 (0.31)	3,014 (0.25)	35,536 (1.5)	7,126 (11.9)	0.10	0.42
York River	VA	727 (0.24)	109 (0.04)	698 (19.2)	161 (14.8)	1.04	0.68
James River	VA	4,993 (0.47)	766 (0.07)	4,467 (14.5)	2,410 (8.4)	1.12	0.32
Apalachicola Bay	FL	2,646 (0.24)	22,573 (2.02)	2,695 (29.2)	3,491 (157.6)	0.98	6.47
Mobile Bay	AL	2,911 (0.31)	622 (0.07)	1,151 (31.4)	1,045 (11.2)	2.53	0.60
West Mississippi Sound	AL/MS	7,533 (1.08)	566 (0.08)	3,391 (57.5)	6,490 (1.7)	2.22	0.09
Galveston Bay	TX	73,997 (11.88)	2,313 (0.37)	12,950 (57.5)	10,795 (4.1)	5.71	0.21
Matagorda Bay	TX	87,007 (50.47)	499 (0.29)	16,679 (57.5)	2,229 (5.2)	5.22	0.22
San Antonio Bay	TX	13,875 (7.96)	444 (0.25)	2,590 (57.5)	2,158 (4.2)	5.36	0.21
Aransas Bay	TX	20,768 (17.47)	381 (0.32)	3,885 (57.5)	482 (12.4)	5.35	0.79
Corpus Christi Bay	TX	19,327 (13.89)	20 (0.01)	3,367 (57.5)	290 (1.4)	5.74	0.07

The proportion of the estuary filtered within the residence time is given in parentheses below the volume. All estimates represent mean summer filtration (June, July, August). Also shown are historic and present areas of oyster ground (in hectares) and, in parentheses, mean oyster density (ind per square meter)

Research Reserve network. We then applied our field-based filtration model to the present and historic extent, and the mean density of both size classes of oyster in each estuary, to determine the change in this ecosystem service over time. As we know of no published data illustrating differences in filtration rate between intertidal and subtidal oysters of the same size, we made no alteration to the model in order to represent subtidal reefs. We assumed no change in mean monthly water temperature or SH–biomass relationship between time periods. For each estuary, we estimated the filtration capacity of the population historically and presently, across all seasons. We summarized and examined the change in the total volume filtered and the volume filtered per unit area over time. We used the Sharipo–Wilk test to determine whether data were non-normally distributed. All statistics were run in R version 2.13.1 (2011-07-08).

We then estimated the potential ecological impact of the change, by relating the volume filtered to the estuary volume and residence time listed in Bricker et al. (2007). Residence time is defined as the mean transit time of freshwater through the estuary. We use the term *full estuary filtration* to describe the situation where the oyster population filters more than the entire volume of the estuary within the residence time of water in that estuary. We recognize that this does not equate to complete filtration of all estuarine waters and does not account for phytoplankton production, but believe that this number nonetheless provides a useful indicator of the volume of filtration relative to water flow (Smaal and Prins 1993; Dame 2011).

Results

We estimate that reefs with oyster densities typical of modern oyster populations would filter a median of $0.15\times10^3\,m^3\,ha^{-1}h^{-1}$ (range, 0.06×10^3 to $6.47\times10^3\,m^3ha^{-1}h^{-1}$) in summer months, as compared to $0.92\times10^3\,m^3ha^{-1}h^{-1}$ historically (range, 0.1×10^3 to $5.74\times10^3\,m^3ha^{-1}h^{-1}$). An overview of estuary-specific mean filtration rates is provided in Table 2.

The volume of water filtered by oyster populations in the USA has declined since c. 1900 in 12 of the 13 estuaries examined, with nine of the estuaries undergoing declines in mean summer filtration greater than 80 % and an 85 % median decline over all (Table 3). Both the Atlantic coast and the Gulf of Mexico coast were impacted (83 and 97 % median loss, respectively), although these could be characterized differently, with no significant difference in filtration per unit area on the Atlantic coast from Wilcoxon test (W= 20, p>0.05) and a dramatic decline in mean filtration per unit area from 4.9×10^3, s.e. 0.67, to 1.0×10^3, s.e. 0.77 $m^3\,h^{-1}ha^{-1}$ on the Gulf of Mexico coast (Wilcoxon test, W=56, p=0.01, Table 2). The notable exception to this trend was Apalachicola Bay, FL, which has an oyster population estimated at greater than historic, both with regard to areal extent and density (zu Ermgassen et al. 2012).

Historically, six of the estuaries contained oyster populations capable of full estuary filtration during summer months; this number has subsequently declined to one (Table 3). The proportion of the estuary volume filtered within its residence time varied widely across seasons and between estuaries

Table 3 Proportion of the volume of each estuary that may be filtered by the historic and current populations of oysters, across seasons

Estuary	State	Volume (1,000 m^3)	Residence time (days)	Historic proportion of bay filtered with the residence time				Present proportion of bay filtered with the residence time				Mean % change
				Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	
Hudson River/Raritan Bay	NY/NJ	4,897,870	9	0.00	0.07	0.03	0.00	0.00	0.01	0.01	0.00	−83
Delaware Bay	NJ/DE	12,668,400	8	0.02	0.36	0.19	0.00	0.01	0.07	0.06	0.00	−68
Tangier and Pocomoke Sounds	MD/VA	3,477,530	12	0.07	0.31	0.17	0.00	0.05	0.21	0.14	0.00	−19
York River	VA	786,920	11	0.04	0.24	0.13	0.00	0.01	0.03	0.02	0.00	−85
James River	VA	2,060,800	8	0.08	0.47	0.24	0.00	0.01	0.06	0.04	0.00	−85
Apalachicola Bay	FL	1,073,330	4	0.17	0.24	0.20	0.02	1.48	2.10	1.69	0.19	753
Mobile Bay	AL	2,060,890	9	0.21	0.31	0.24	0.02	0.04	0.07	0.05	0.00	−79
West Mississippi Sound	AL/LA	3,841,830	23	0.73	1.08	0.87	0.06	0.06	0.08	0.07	0.00	−92
Galveston Bay	TX	2,242,240	15	8.86	11.88	10.23	0.94	0.28	0.39	0.32	0.03	−97
Matagorda Bay	TX	1,572,150	38	45.13	50.47	51.18	6.49	0.26	0.32	0.29	0.04	−99
San Antonio Bay	TX	346,330	8	6.70	7.69	7.50	0.97	0.21	0.27	0.24	0.03	−97
Aransas Bay	TX	513,520	18	15.97	17.47	16.74	2.49	0.29	0.35	0.31	0.05	−98
Corpus Christi Bay	TX	1,535,990	46	11.12	13.89	13.94	2.42	0.01	0.01	0.01	0.00	−100

Seasons defined as: spring (March, April, May); summer (June, July, August), fall (September, October, November), and winter (December, January, February)

(Table 3). Estuaries in the western Gulf of Mexico were typically filtered multiple times within their residence times historically during the summer (six of eight), while estuaries in the northeast were not (zero of five) (Fig. 2).

Discussion

Coastal systems have undergone unprecedented change over the past century (Jackson et al. 2001). While the role that oysters play in improving water quality is increasingly valuable given the high incidence of eutrophication (Bricker et al. 2007), the provision of this ecosystem service has declined precipitously over the past century (Table 3, Fig. 2).

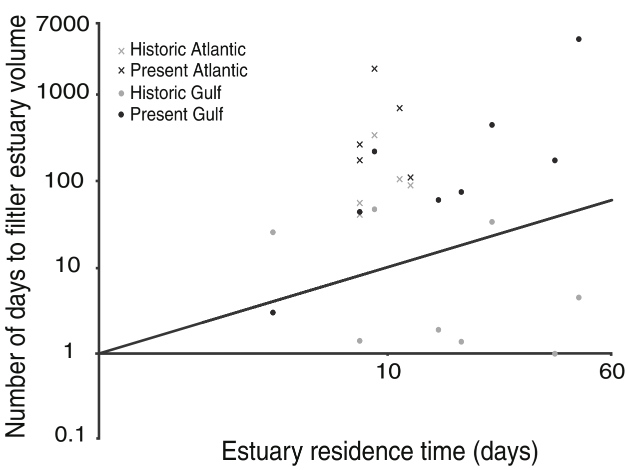

Fig. 2 Illustration of current and historic number of days until the oyster population filtered a volume equivalent to the volume of the estuary against the residence time of the estuary. The *black line* represents the point at which the filtration time equals the residence time. *Points* above the *line* are not filtering the full volume of the estuary within the residence time

We report a near universal decline of the filtering capacity of oyster habitats by more than 80 %. Our results suggest that 100 years ago, filtration by oysters was likely to have been a major ecological function, achieving full estuary filtration in many estuaries (Table 3, Fig. 2). This reduction in filtration capacity is likely to have caused substantial changes to the ecosystem function of estuaries (Newell 1988; Dame et al. 2002). While the ecological importance of a healthy oyster population has been the focus of much attention in the Chesapeake (e.g., Ulanowicz and Tuttle 1992; Fulford et al. 2007), the decline in the ecosystem services provided by healthy oyster habitats in US estuaries more generally remains poorly appreciated and understudied. Although increases in oyster filtration alone are unlikely to resolve the water quality concerns of many US estuaries (Cerco and Noel 2007), it may be possible to restore this ecosystem service to levels at which it will have some beneficial ecological impact locally (Newell and Koch 2004).

The decline in filtration capacity in estuaries spanning such a large area is striking. While the decline in filtration capacity appears to have been greater in the Gulf of Mexico than in the North Atlantic (Table 3, Fig. 2), this is certainly at least in part because the surveys conducted along the North Atlantic coast were undertaken after exploitation rates had peaked and thus reflected an already shifted baseline with low oyster densities (zu Ermgassen et al. 2012, Table 2). For example, our 1887 historic baseline for Tangier and

Pocomoke Sound (Chesapeake Bay, Atlantic coast) documented oyster densities 2–7-fold lower than observations from 30 years earlier (Winslow 1887), while even this earlier 1850s estimate is likely to have been dramatically lower than precolonial densities (Newell 1988; Kirby 2004). By contrast, the historic surveys undertaken in the Gulf of Mexico were conducted with the caveat that many oyster reefs remained undiscovered (Moore 1907). As such, our estimates of the historic level of services in the northeast likely represent a significantly shifted baseline.

All historic baselines should be considered relative to their date of origin, as they may be shifted from pristine conditions (Roberts 2007). This non-pristine baseline is further supported by observations that mean SH in precolonial shell deposits in South Carolina were found to be 62 % greater than mean harvested SH in 1938 (Lunz 1938). Such age and size truncation is typical of harvested species (Hutchings and Reynolds 2004) and would have a marked impact on population-level filtration rates (Mann et al. 2009a, b). If a moderate correction of assuming four-times-higher densities (6.5 oysters/m^2) and precolonial size distributions is applied to the historic extent in Tangier and Pocomoke Sound, this would result in approximately a 7-fold increase in filtration capacity and the estuary being filtered multiple times within its residence time. As such, it is reasonable to expect that oysters in many of the northeastern US estuaries would have exerted full estuary filtration capacity prior to the industrial exploitation of oysters.

We concur with a number of authors who have previously asserted that oysters would historically have been dominant filter feeders with significant ecological impacts through filtration in many estuaries (Newell 1988; Cerco and Noel 2007; Mann et al. 2009a, b). Our historical data represent a shifted baseline, particularly in the northeastern USA, but such quantitative historical data help to avoid further shifts in baselines and ensure that modern management goals are not misguided (Swetnam et al. 1999). Modern management goals should utilize such historical data, but in a broader context. For example, ecologically relevant restoration goals might best focus on delivery of the desired ecosystem services (Jackson and Hobbs 2009), aided by our understanding of their relative importance in the face of a changing environmental landscape (Swetnam et al. 1999). Our model and bay-specific data provide the basis for such comprehensive goal setting.

In contrast to the situation on the Atlantic Coast, it is noteworthy that for Apalachicola Bay in the Gulf of Mexico, we estimate present day levels of filtration that are greater than historic estimates. Apalachicola Bay has undergone intensive management of the oyster resource including extensive shell planting since the historic survey efforts which has led to increased areal extent of oysters, in addition to the recorded densities being higher (zu Ermgassen et al. 2012). It is noteworthy that this is one of the few estuaries in which harvesting is primarily by tonging, and dredging is not allowed. It is widely agreed that tonging is a less-destructive harvest method than dredging (Lenihan and Peterson 2004), and further work may well reveal that this has been a critical factor in ensuring the long-term sustainable benefits that appear to be delivered in these estuaries.

Our model of filtration rates is the first to incorporate field measurements from in situ oyster populations, and therefore to represent whole-reef filtration. When converted to the same unit, the filtration rate estimated by our model is lower than the maximum filtration rate of 11.5 lh^{-1} used by Cerco and Noel (2007) in their model for the Chesapeake. This is as would be expected if the use of field data were, as we have assumed, a useful surrogate where the environmental data required to modify maximum filtration rate are absent.

Considering filtration relative to residence time can be a useful indicator of the potential for oysters to have an ecologically significant impact on an estuary (Dame 2011). However, even when undisturbed, estuaries exhibit high variability in sediment load, planktonic productivity, depth, residence time, and natural abundance of oysters (Bricker et al. 2007; zu Ermgassen et al. 2012), all of which influence the extent to which oyster filtration may impact water quality (Officer et al. 1982; Pomeroy et al. 2006; Cerco and Noel 2007). Temporal mismatching between phytoplankton production and peak oyster filtration may also limit the potential for oyster populations to have a regulating influence. Additionally, the impact of filtration on seston drawdown on large scales cannot be directly inferred from filtration rates due to the influences of wave action (Porter et al. 2004), the unequal distribution of oysters (Cerco and Noel 2007), and imperfect mixing within the estuary (Pomeroy et al. 2006). This in turn may lead to variable impacts of oyster filtration on nutrient cycling within the bay, as the biodeposition of seston may stimulate enhanced denitrification and anammox in the sediments (Dame 2011). In this context, the point at which the population filtration rate matches the residence time simply represents a point on a continuum, albeit one that may provide a useful guide for estimating the ecological impact.

While our estimates of change over time stress the extreme nature of the losses of filtration by oysters, our results also highlight that changes in management of oyster reefs, particularly in their diminished condition, can have a significant influence on the amount of filtration provided in the future. In particular, management decisions that lead to higher average densities on existing reef footprint, or expansions of reef area through restoration coupled with increasing oyster size or density, could move a number of estuaries toward a state where oysters can once more play a role in supporting water quality (Table 3).

Currently, oyster restoration efforts and goals are accounted for by their areal extent (e.g., NOAA 2012); however, the volume of water filtered by oysters is not solely a function of the area of oyster habitat, but also of the density and size frequency of the oysters. Therefore, as restoration of oyster habitat for ecosystem services gains momentum, it will be critical to devise appropriate metrics to assess the contribution of restoration projects toward those target ecosystem services. Any restoration undertaken with the goal of water filtration needs to account for the density and size distribution of oysters in addition to the area restored. Without these data, the contribution of restoration projects and their progress toward their ecosystem service goals will remain unknown.

This study provides a unique numerical insight into the dramatic functional changes that can accompany the degradation of an estuarine habitat. Even from "non-pristine" historical baselines, it is clear that a significant and nearly universal loss of ecosystem services has occurred in US estuaries, which has gone hand in hand with the loss and degradation of oyster reef habitat.

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RESEARCH ARTICLE

Establishing Restoration Strategy of Eastern Oyster via a Coupled Biophysical Transport Model

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Abstract

For marine fish and invertebrates, larval dispersal plays a critical role in determining connections among source and sink habitats, and the lack of a predictive understanding of larval dispersal is a fundamental obstacle to the development of spatially explicit restoration plans for marine populations. We investigated larval dispersal patterns of eastern oyster in an estuary along the Northern Gulf of Mexico under different simulation scenarios of tidal amplitude and phase, river discharge, wind direction, and larval vertical migration, using a coupled biophysical transport model. We focused on the dispersal of larvae released from the commercially exploited (Cedar Point, CP) and non-exploited (Bon Secour Bay, BSB) oyster populations. We found that high flushing rates through the dominant inlet prevented larval exchange between the commercially exploited and non-exploited populations, resulting in negligible connectivity between them. Variations in tidal amplitude, river discharge and wind direction played a more important role in the amount of larvae retained in Mobile Bay when they are released from CP than from BSB. Under most of the scenarios, larvae from BSB were retained around the spawning area, while larvae from CP showed a predominant westward flow. Net sinking behavior of late-stage larvae increased larval retention in the bay, but physical transport showed a higher impact in the amount of larvae retained. These findings have enhanced our understanding of larval dispersal of eastern oyster in a wide, shallow estuarine system, and been used to establish spatially explicit strategies for oyster restoration in the Mobile Bay system, Alabama.

Key words: ***Crassostrea virginica*, larval dispersal, Mobile Bay, Northern Gulf of Mexico, oyster restoration, physical transport, population connectivity, vertical larval migration.**

Introduction

Among the various factors affecting successful recruitment of marine fish and invertebrates, larval dispersal plays a critical role in determining spatial and temporal patterns of abundance that are important components of restoration strategies (Cowen & Sponaugle 2009). The potential for larvae of marine organisms to travel long distances during their planktonic dispersal phase poses a unique challenge for spatially explicit restoration and enhancement efforts because this dispersal often results in a decoupling of local population abundance and recruitment (Pineda et al. 2010). However, if predictable pathways of larval dispersal can be established then this information can be used to determine sustainable local populations by ensuring a supply of recruits. These dispersal pathways can also be used to evaluate connectivity of presumed source populations of propagule as well as the location of demographic sinks. Equally important, areas of high retention of larvae could provide sustainable populations through self-recruitment. For species whose mobility is restricted at later developmental stages (e.g. plants and sessile invertebrates) establishing predictable larval corridors and patterns of retention could be key to successful restoration (Schulte et al. 2009).

Larval dispersal and retention is determined by both physical transport and biological movement of larvae (Young 1995). Although much controversy exists over the relative importance of biological movement on larval dispersal, the interactions between physical transport and biological movement have been suggested to explain the observed transport and retention of marine invertebrate larvae (Shanks & Brink 2005; Morgan & Fisher 2010). Recognizing the potential importance of both physical transport and biological movement, a coupled biological–physical transport model can be a useful tool to investigate larval dispersal and source–sink metapopulation relationships.

Biogenic reefs formed by the gregarious settlement of oysters have declined over the last decades in many estuarine and coastal ecosystems due to overharvesting, oyster diseases, and deteriorated water quality (Beck et al. 2011). The decline has lowered filtration capacity, degraded water quality, decreased

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stable habitats, and increased coastal vulnerability to extreme events. The Northern Gulf of Mexico provides the highest catches of wild oysters in the world; however, the abundance of native oysters significantly declined and it requires urgent restoration and conservation efforts (Beck et al. 2011).

The Mobile Bay system, Alabama, is a large shallow embayment bisected with a narrow deep ship channel in the Northern Gulf of Mexico (Fig. 1). The system is characterized by micro-tidal range, large river discharge, and exchange with the Gulf of Mexico via relatively narrow passes, all of which are common features of estuaries along the Northern Gulf of Mexico (Schroeder & Wiseman 1999). Oyster populations in the Mobile Bay system have shown distinctive spatial patterns over the past 90 years with much higher production in the southwest part of the study area (May 1971). The Cedar Point Reef complex (*CPR*) (Fig. 1) has been the single most productive area, contributing over 90% of the oyster harvest in Alabama (May 1971). Oyster harvesting historically had been reported in the east side of the Bay, for example, Fish River Reef (*FRR*), Bon Secour Reef (*BSR*), and Shell Bank Reef (*SBR*) (Fig. 1), but the oyster population is currently too small to support commercial harvest in the area (Stout 1998). The same gradient in oyster spat settlement, decreasing from west to east, has been observed over the past 40 years (Hoese et al. 1972; Kim et al. 2010). These studies have suggested that limited larval supply may be responsible for the poor oyster recruitment in the east side of the Bay. However, larval dispersal and the level of larval connectivity between both oyster populations in close proximity (~30 km apart) are poorly understood. The lack of spatially explicit knowledge of the larval dispersal has been a fundamental obstacle to establishing a comprehensive strategy for oyster restoration in the Mobile Bay system as well as other estuarine systems along the Gulf and U.S. east coast.

We conducted a series of model simulations with different physical transport under various tide, river discharge, and wind conditions to evaluate spatial patterns of larval dispersal and metapopulation connectivity of eastern oysters, *Crassostrea virginica*. We also tested the role of biological movement combined with the different physical transport conditions. Specifically, we addressed the following questions: (1) How do different forcing conditions affect larval dispersal; (2) How does biological movement affect larval dispersal under different forcing conditions; (3) Is there larval connectivity between oyster populations in the west and east sides of Mobile Bay; and (4) How do physical transport and biological movement affect the larval connectivity between oyster populations? We used the model results to evaluate spatially explicit management strategies for oyster restoration.

Methods

Biophysical Transport Model

We used a three-dimensional biophysical transport model that was previously developed for coastal Alabama to estimate larval dispersal patterns (Kim et al. 2010). This model employs the hydrodynamic model in the three-dimensional hydrodynamic-eutrophication model to simulate physical transport. The model application gave a good reproduction of the observed surface elevation, current velocity, and salinity for both total and subtidal components and was able to simulate the features observed to be important for physical transport in the Mobile Bay system (Kim & Park 2012).

We parameterized biological movement of oyster larvae as a function of swimming and sinking velocity estimated as a function of larval size by employing linear regressions (Eqs 2 and 3 in Kim et al. 2010). The present model employs neutrally buoyant net vertical velocity during the early-stage larval period and net sinking velocity with the rate increasing as larvae grow during the late-stage larval period (Fig. 2 in Kim et al. 2010). The model results showed significant correlations with observed larval concentration for an overall average time scale of 1 year ($R = 0.57-0.62$) as well as during spring ($R = 0.69-0.71$) and fall ($R = 0.62-0.82$) (Table 2 in Kim et al. 2010). The correlation decreased during the summer ($R = 0.37-0.39$, non-significant).

Forcing Functions

Hydrodynamic conditions show a great variability in response to tide, river discharge, and wind with their relative impacts varying spatially and temporally, which complicates efforts to define a typical circulation pattern of the study area (Kim & Park 2012). In consequence, it is difficult to assess the effect of each forcing condition on larval dispersal. In this study, therefore, idealized forcing functions were used, which were estimated based on long-term time series data to represent various forcing conditions ranging from typical to extreme in the Mobile Bay system. The forcing variables introduced in the model were tidal amplitude and phase, river discharge, and wind speed and direction.

Tides are predominantly diurnal in the study area. The harmonic constants at the NOAA's Dauphin Island tide station (Fig. 1) show that K_1 and O_1 tides are the two most important components, accounting for 67% of tidal range. A surface elevation by K_1 and O_1 tides shows a tropic–equatorial cycle, with tidal range varying from 0.04 m during equatorial tides to 0.56 m during tropic tides. For all scenario simulations, the surface elevation by K_1 and O_1 tides was used to specify open boundary conditions.

Mobile Bay receives 95% of freshwater input from the Mobile River system (Fig. 1) (Schroeder 1978). Daily river discharge data were obtained from two U.S. Geological Survey gauging stations, Claiborne L&D in Alabama River and Coffeeville L&D in Tombigbee River. We calculated the monthly statistics of daily river discharge for the oyster larval recruitment period in May–October between 1976 and 2006. The 25th, 50th, 75th, and 95th percentiles for this period are 359, 537, 983, and 3,294 m^3/s, respectively. Although daily discharge varies over a wide range between 161 and 8,184 m^3/s, daily discharge between 250 and 450 m^3/s occurs most frequently, accounting for 32% of the data. Six constant discharge conditions of 250, 359, 450, 537, 983, and

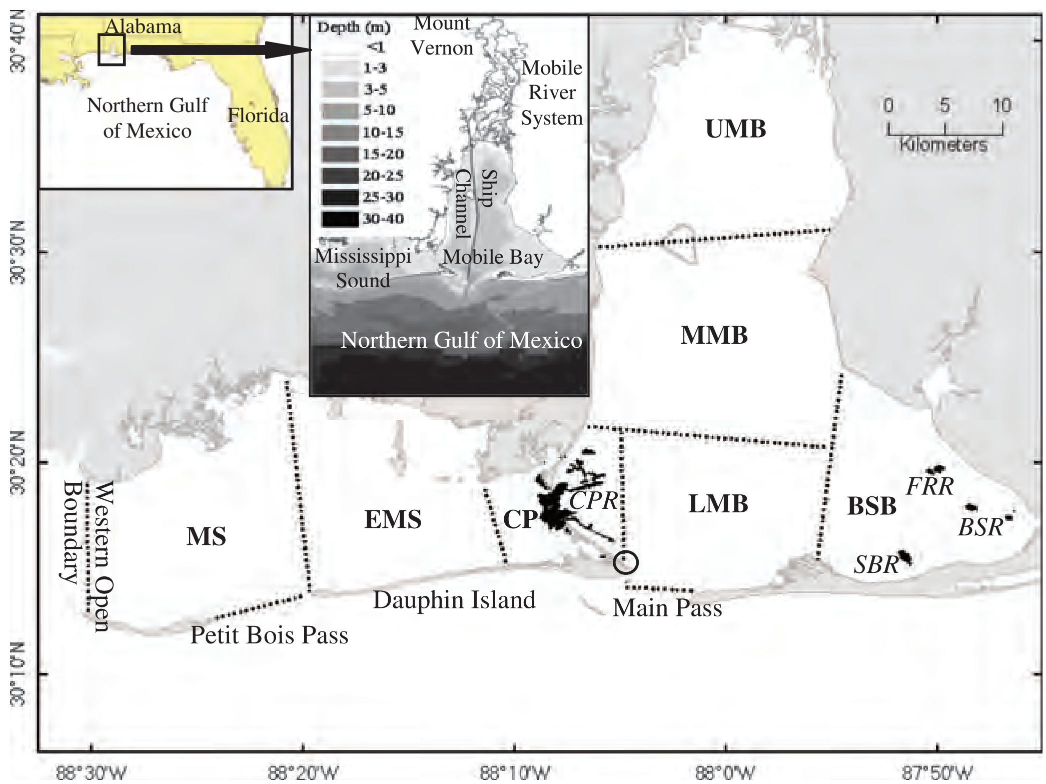

Figure 1. A map of Mobile Bay and eastern Mississippi Sound showing Dauphin Island station (◯) for tide and wind observation and existing oyster reefs (filled area) where oyster larvae were released in model simulations, including Cedar Point Reef complex (*CPR*), Fish River Reef (*FRR*), Bon Secour Reef (*BSR*), and Shell Bank Reef (*SBR*). The dashed lines denote boundaries of seven zones, including Mississippi Sound (MS), eastern Mississippi Sound (EMS), Cedar Point (CP), lower Mobile Bay (LMB), middle Mobile Bay (MMB), upper Mobile Bay (UMB), and Bon Secour Bay (BSB). The insert maps show the modeling domain with depth contours.

3,294 m^3/s were used for scenario simulations to specify the upriver boundary condition at Mount Vernon (Fig. 1).

The 20-year median wind speed in May–October is 4.3 m/s based on hourly data from 1987 to 2006 at the Dauphin Island station of the National Data Buoy Center (Fig. 1). Southerly winds, including southwest, south, and southeast winds, prevail during May–August, while north and northeast winds dominate during September–October (Fig. 2). The southerly winds account for 56% of spring and summer winds, and the northerly winds for 46% of fall winds. For wind directions, five 11-day periods were selected to represent conditions of dominant southwest (19–30 May 2006), south (10–21 June 2003), southeast (8–19 July 2006), northeast (4–15 September 2005), and north (11–22 October 2005) winds. These five periods were selected such that the dominant wind conditions occurred 45–55% of each period and used for scenario simulations to specify the surface boundary condition.

Scenario Simulations

Combinations of forcing functions were used for scenario simulations to investigate the variability in larval dispersal according to the representative values of the forcing variables during the oyster larval recruitment period (Table 1). To facilitate comparison between scenario simulations, typical forcing conditions of the Mobile Bay system were defined as larval release at slack-before-flood (SBF) during an equatorial tide with median river discharge (537 m^3/s) and wind with median speed (4.3 m/s) and random direction (T1 in Table 1). When the effect of one forcing function on larval transport was examined, the typical conditions were used for the other two forcing functions. The effect of tide on larval dispersal was examined by releasing larvae at different tidal phase, that is, SBF or slack-before-ebb (SBE) during either tropic or equatorial tide, T1–T4. The effect of river discharge was examined for six different discharge conditions, R1–R6. The effect of wind was examined for five dominant wind directions, W1–W5.

Larval period of oysters varied from 10 to 18 days in response to water temperature in the Mobile Bay system (Kim et al. 2010). We chose the most dominant larval period, 10 days, for all scenarios simulations. Over the 10-day larval period, a total of 14 scenario simulations were conducted for various combinations of forcing functions (Table 1). To investigate larval connectivity of oyster populations between the west and east side of Mobile Bay, each of the above 14 scenario simulations was conducted twice for two potential spawning habitats including reefs in CP and BSB (Fig. 1). To

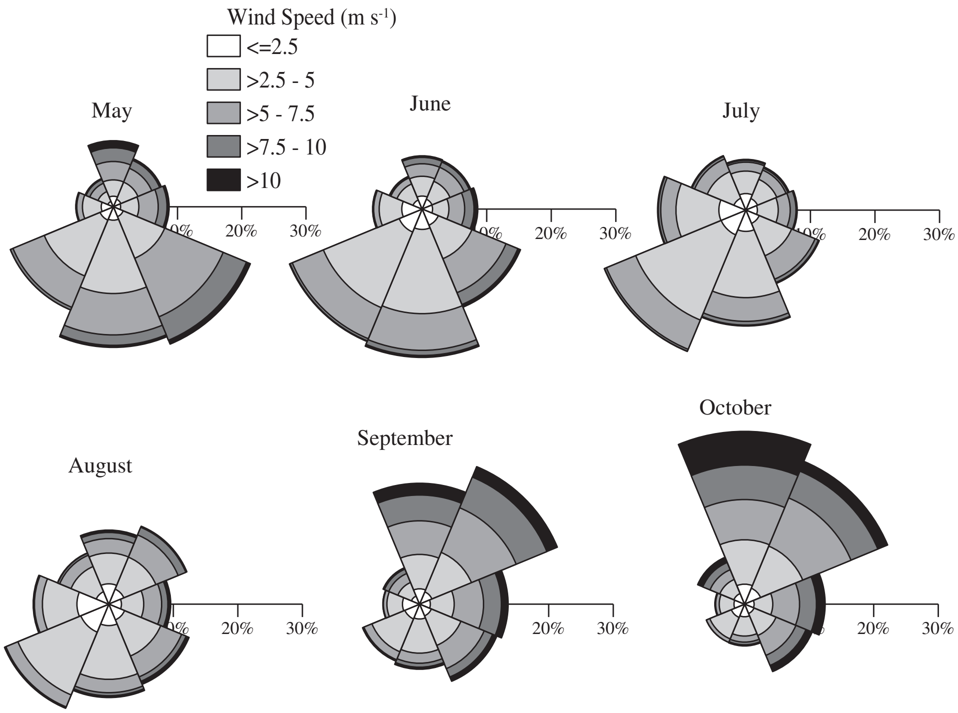

Figure 2. Wind roses showing monthly statistics of hourly data at the Dauphin Island station in 1987–2006 during the oyster larval recruitment period May–October.

Table 1. Design of scenario simulations.

				Wind	
Forcing Function	*Simulation ID*	*Larval Release Time*	*River Discharge[a] (m^3/s)*	*Speed[b] (m/s)*	*Direction [c]*
Tide	T1	SBF during equatorial tide	537	4.3	Random
	T2	SBE during equatorial tide			
	T3	SBF during tropic tide			
	T4	SBE during tropic tide			
River	R1	SBF during equatorial tide	250	4.3	Random
	R2		359		
	R3		450		
	R4[d]		537		
	R5		983		
	R6		3,294		
Wind	W1	SBF during equatorial tide	537	4.3	Southwest
	W2				South
	W3				Southeast
	W4				North
	W5				Northeast

[a] Discharges of 359, 537, 983, and 3,294 m^3/s are the 25th, 50th, 75th, and 95th percentiles, respectively, in May–October (1976–2006): see the text for 250 and 450 m^3/s.
[b] Median wind speed of 4.3 m/s (1987–2006).
[c] Dominant wind direction occurring 45–55% of each period: see the text.
[d] Note that simulation R4 is identical to T1.

investigate the effect of biological movement, another set of 14 scenario simulations with the larvae released from CP were conducted with biological movement. The model results with biological movement were compared with those from the corresponding 14 scenario simulations by physical transport only.

For analysis of the model results, Mobile Bay and eastern Mississippi Sound were divided into seven zones: Mississippi Sound (MS), EMS (Eastern Mississippi Sound), CP, Lower Mobile Bay (LMB), Middle Mobile Bay (MMB), Upper Mobile Bay (UMB), and BSB (Fig. 1). Net larval flux was calculated during the 10-day larval period across the boundaries of the seven zones, and then a tidal, 25-hour, average larval retention was calculated to represent the larvae remained in each zone. Larval flux among zones and retention within

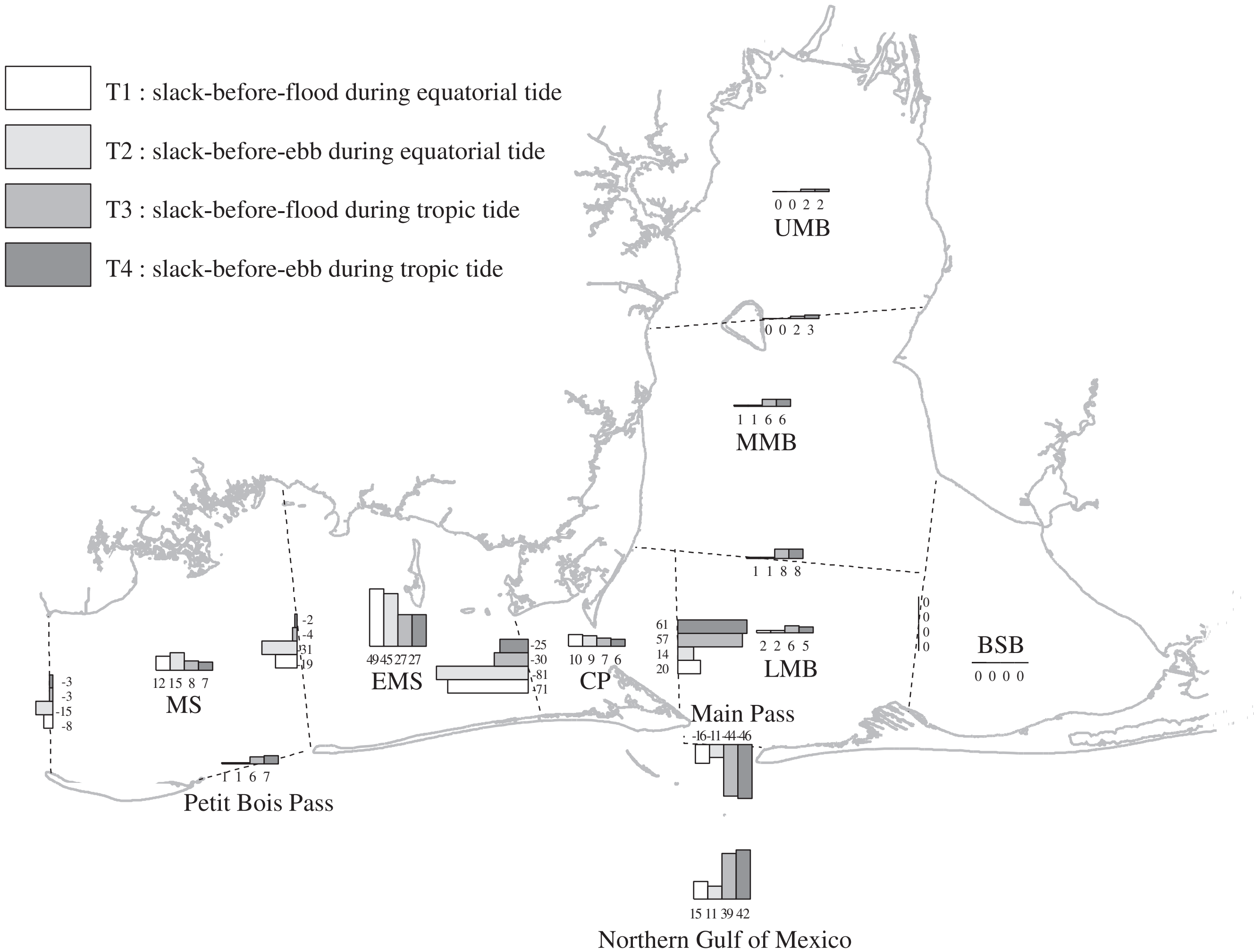

Figure 3. Percent larval retention and flux relative to the initial larvae released from CP for different tide conditions, T1–T4 in Table 1. The bars indicate larval retention in each zone and larval flux across each boundary, with positive values denoting eastward or northward larval flux.

each zone were expressed in percentages relative to an initial amount of larvae released from the spawning zone.

Results

Larvae Released from CP

When larvae were released from CP, the difference in release time between SBF and SBE caused little change in larval retention and flux (Fig. 3); however, variation existed between tropic and equatorial tides. For larvae released during equatorial tides (T1 and T2), 71–81% of larvae were transported westward away from the spawning zone, and many of them (54–59%) remained in the southwest part of the study area including CP and EMS. When released during tropic tides (T3 and T4), more larvae (57–61%) were transported eastward into LMB and many of them (44–46%) were transported out of the Bay through Main Pass, resulting in retention of fewer larvae (33–34%) in the southwest part. Regardless of tidal conditions, maximum larval retention occurred in EMS and no larvae were transported into the east side of the Bay (Fig. 3).

Larval flux and retention changed with river discharge (Fig. 4). For dry condition (R1), 32–25% of larvae remained in EMS and CP, with 30% flushed out of the Bay through Main Pass. As river discharge increased, more larvae were transported westward into EMS and fewer larvae lost through Main Pass. For the median discharge condition (R4), 49% of larvae remained in EMS but only 10% in CP. As river discharge further increased beyond the median, westward larval outflux rapidly increased, decreasing larval retention. Under flood discharge condition (R6), 75% of larvae were lost through the western boundary, with only 14% remaining in EMS, 1% in CP, and none in UMB, MMB, LMB, and BSB. Under all discharge conditions, no larvae were transported to the Bay's east side.

Wind condition played an important role in larval transport and retention (Fig. 5). The southwest wind (W1) transported 80% of larvae into LMB and many (52%) were flushed out of

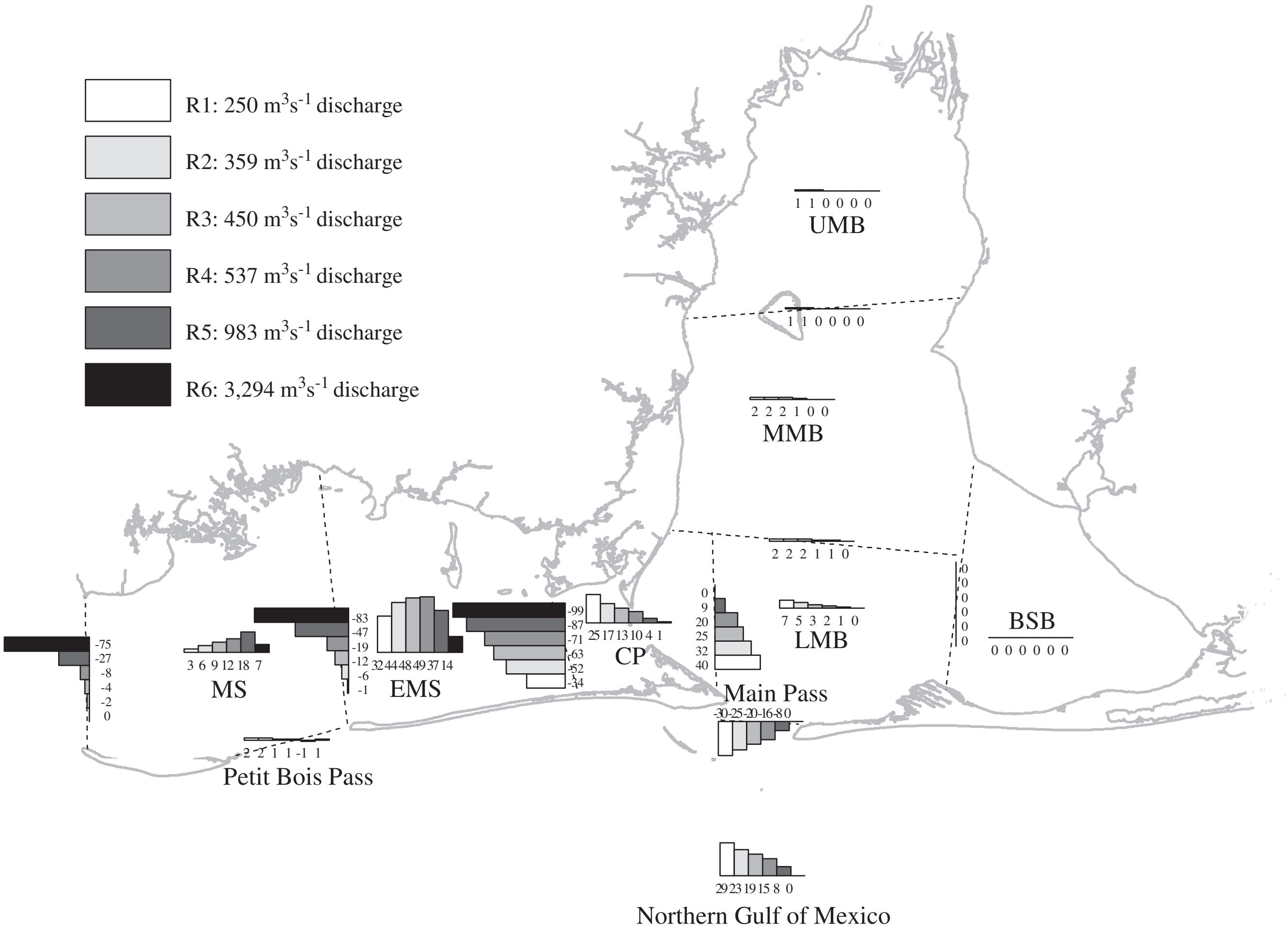

Figure 4. Percent larval retention and flux relative to the initial larvae released from CP for different river discharge conditions, R1–R6 in Table 1. The bars indicate larval retention in each zone and larval flux across each boundary, with positive values denoting eastward or northward larval flux.

the Bay through Main Pass. The south wind (W2), however, facilitated larval retention in the southwest part of the study area, remaining 27–44% of larvae. The southeast wind (W3) pushed most larvae (95%) further westward of CP, resulting in maximum retention of 57% in EMS. Under the northerly wind conditions (W4 and W5), 57–81% of larvae were transported out of the study area, resulting in low larval retention in the southwest part. As in the case of tide and river discharge, negligible numbers of larvae were transported into the east side of Mobile Bay under any wind conditions.

Total outflux/loss of larvae through Main Pass, Petit Bois Pass, and the western open boundary is compared between physical transport only versus inclusion of biological movement of larvae when released from CP. The loss of early-stage larvae showed great variability in response to forcing conditions, losing 2–75% of initial larvae (Fig. 6a). The larval loss during the late-stage larval period, with or without biological movement, varied not as much as that during the early-stage larval period (Fig. 6b). Under different wind conditions, for example, 2–75% of larvae were flushed out of the Mobile Bay system during the early stage, while 3–33% were flushed out during the late-stage larval period. For all forcing conditions, the net sinking late-stage larval behavior decreased the larval loss by 2–13%, resulting in increased larval retention (Fig. 6b).

Larvae Released from BSB

Larvae released from BSB showed little change in larval flux and retention for different tide conditions. Most larvae (68–86%) were remained in the spawning zone (BSB). Different from larvae released from CP, the tropic and equatorial tides did not influence much larval retention in the bay. Increases in river discharge from R1 to R6 enhanced flushing of larvae through Main Pass from 12 to 27%, but most larvae were still retained near the spawning zone. Under southwest (W1), south (W2), and north (W4) wind conditions, more than 80% of larvae remained in the spawning zone. Under the easterly wind conditions (W3 and W5), 44–63% of larvae were remained in the spawning zone and 37–57% were transported westward into LMB, with much of them (24–42%) flushed out of the Bay through Main Pass. Negligible larvae

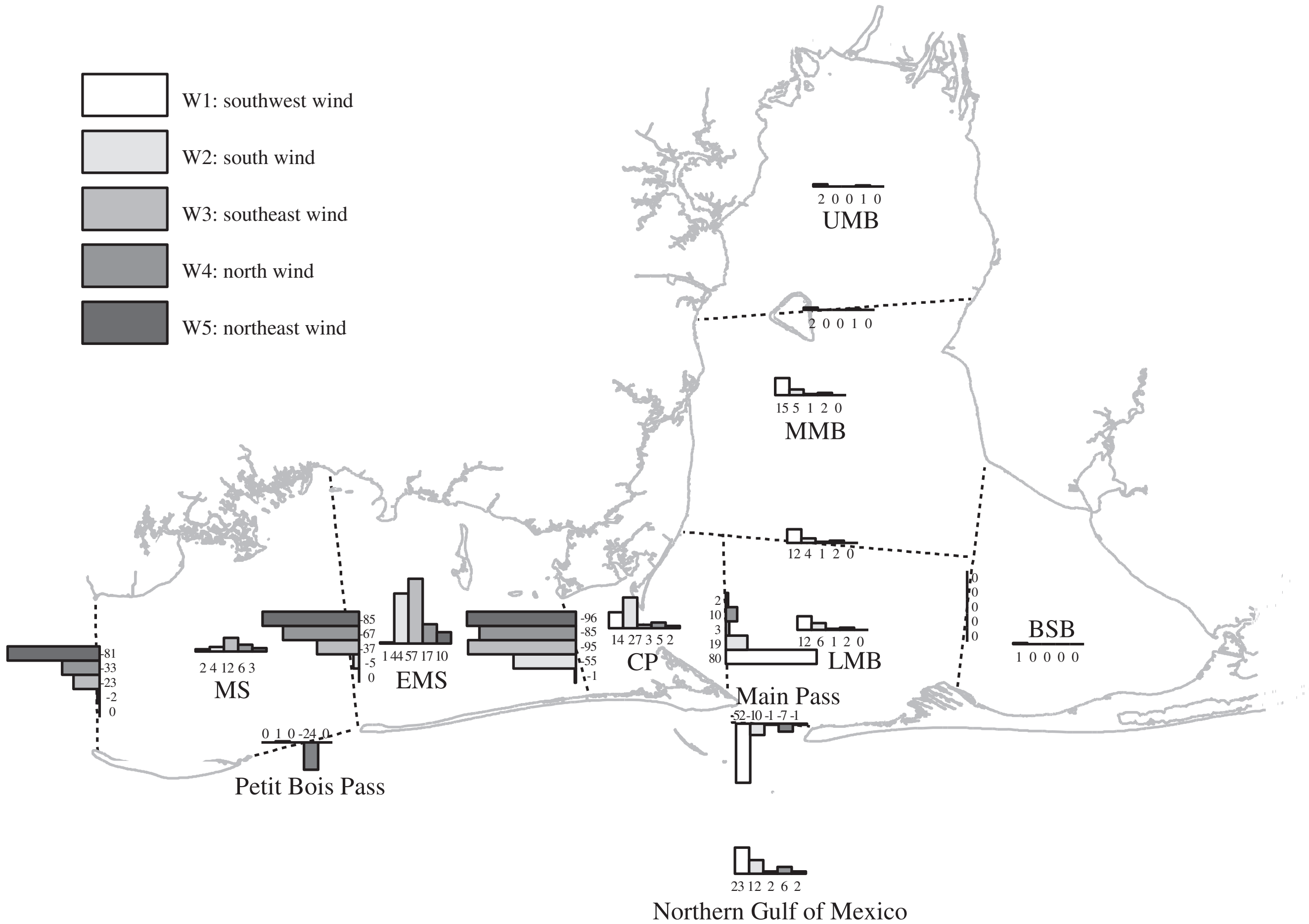

Figure 5. Percent larval retention and flux relative to the initial larvae released from CP for different wind conditions, W1–W5 in Table 1. The bars indicate larval retention in each zone and larval flux across each boundary, with positive values denoting eastward or northward larval flux.

reached the west side of the Bay regardless of forcing conditions.

Discussion

In most estuarine systems, more than 85% of oyster reef habitat has been lost and restoration of this critical habitat has proven to be a challenge (Beck et al. 2011); however, Mobile Bay and the eastern Mississippi Sound is one of few bays where reefs are in good condition and provides a real opportunity to achieve both goals for conservation and sustainable fisheries. Oyster reef restoration requires the addition of substrate suitable for oyster settlement; however, the addition of substrate alone is not sufficient to ensure success (Powers et al. 2009). Site-selection is a key determinant of success, largely because of spatial heterogeneity in larval recruitment. The majority of oyster reef creation is performed under the narrow goal of fisheries enhancement (Coen & Luckenbach 2000) and focuses on adding substrate to existing productive areas. Few resources are devoted to restoration in areas that historically supported oyster reefs but no longer support densities of oysters high enough for harvest. Broader goals now motivate many oyster reef restoration activities (e.g. water quality, fish habitat, shoreline stabilization) (Coen et al. 2007) and have increased the areas targeted for oyster reef restoration. Our model provides a spatially explicit resource to evaluate oyster reef restoration strategies that include restoration in areas of historic abundance, which no longer supports high densities of oysters, as well as current areas of high productivity.

In the Mobile Bay system, CP contains the most productive oyster reefs, accounting for over 90% of the oyster harvest in Alabama, thus supplying the majority of larvae in the Mobile Bay system. Our results showed a predominant westward larval transport from CP. On average 63% of larvae released in CP were transported to the west, resulting in a maximum retention in EMS. Only negligible numbers of larvae were transported into the east side of the Bay and the result is a gradient in larval supply decreasing from west to east for all ranges of forcing conditions. Variations in forcing conditions, therefore, seem to exert minor influences on the west-east gradient in larval supply in the Mobile Bay system. The persistent decreasing gradient from west to east in larval supply could be responsible for the corresponding gradient in

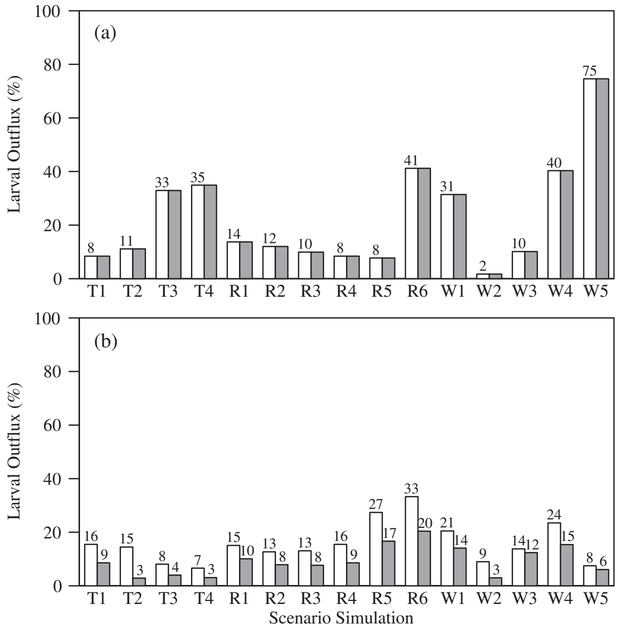

Figure 6. Total outflux/loss of larvae through Main Pass, Petit Bois Pass, and the western open boundary for (a) neutrally buoyant early-stage larvae and (b) net sinking late-stage larvae under different forcing conditions, comparing physical transport only (empty bar) and inclusion of biological movement of larvae (filled bar). Note that biological movement does not affect neutrally buoyant early-stage larvae in (a).

oyster spat settlement and adult oysters that has been observed over the past 40 and 90 years, respectively (May 1971; Hoese et al. 1972; Kim et al. 2010). Nonetheless, forcing conditions highly determined the amount of larvae retained in the west side of the bay.

Tidal amplitude did influence the transport and retention of larvae released from CP. The larger tidal excursion during tropic tides enhanced larval dispersion, with more larvae transported into LMB and EMS under both releasing-time scenarios for flood and ebb tides. Much of the larvae reaching LMB were flushed out of the Bay through Main Pass and considered as net larval loss for simplification of the model interpretation. Consequently, fewer larvae were retained in the southwest part of the study area when they were released during tropic tides.

Seasonal variations in river discharge affected westward transport of larvae released from CP. Relatively high river discharge prevailing in spring facilitated westward transport of larvae into eastern Mississippi Sound. Low discharge common in summer and fall favored larval retention in the southwest part of the study area. A flooding event larger than 95th percentile can occur at any time during the recruitment period of oyster larvae, and can greatly reduce larval retention, particularly in CP where the most productive oyster reefs exist.

Wind condition, along with shoreline configuration of the eastern Mississippi Sound, played an important role in the retention of larvae released from CP. Southerly winds prevailing in spring and summer pushed larvae toward the northern shore of EMS and CP, a shallow (<1 m) and well-protected region, facilitating larval retention. Northerly winds prevailing in fall pushed larvae into a relatively deeper southern part of EMS and CP and facilitated larval outflux through the western open boundary and Petit Bois Pass. In spring, both wind and river conditions favored larval supply to EMS and the consequent larval concentration was significantly correlated with spat settlement ($R = 0.69$) (Table 2 in Kim et al. 2010). These results suggest that the maximum spring peak in oyster spat settlement in EMS was likely due to the high larval supply driven by seasonal river and wind conditions.

Larval dispersal was predominantly westward when larvae were released from CP independently of the forcing conditions, but outflux/loss of early-stage larvae was sensitive to forcing conditions. The inclusion of sinking behavior in later stages of larval development reduced the outflux in every scenario. Nevertheless, according to our model, physical forcing showed a greater influence on loss of larvae than the behavioral component. This result agrees with a previous larval transport modeling experiment performed in the same area (Kim et al. 2010).

With regard to the larval supply to BSB, our results showed no larval interchange with the CP population, but most of the larvae released in this area were retained close to the parental habitat independently of the tides, seasonal variation in river discharge and non-easterly wind conditions. Easterly winds, however, could effectively transport larvae into LMB and most of them were flushed out of the Bay through Main Pass. The modeled residual current and salinity distribution showed that freshwater discharges favored transport to the western side of Mobile Bay as they approach the mouth of the bay, in agreement with Schroeder (1978). This may explain why larvae released from BSB were much less sensitive to the variation in river discharge than those from CP.

Variations in environmental and biological conditions may result in dramatic changes in larval dispersal of oysters within a small spatial and short time scale (Kennedy 1996). However, we employed rather simplified biological conditions, with the assumptions of a single spawning event for each scenario, a constant linear growth rate and larval period, simple biological behavior, and no mortality of oyster larvae. Such simplifications may be responsible for the model results being less dynamic than the data (Kim et al. 2010). Despite these potential limitations, we demonstrated that the scenario-driven modeling applications gave a good overall description of larval dispersal in the Mobile Bay system. The model reproduced average patterns of both larval concentration ($R = 0.57-0.62$) and oyster spat settlement ($R = 0.40-0.47$) (Table 2 in Kim et al. 2010).

Our scenario-driven study using a biophysical transport model can be used to establish spatially explicit restoration strategies for eastern oysters. The present model results show that high flushing rate through Main Pass prevented larval exchange between the west and east side of the Bay resulting in negligible connectivity between the commercially exploited and none-exploited oyster populations. These findings indicate that two oyster populations separated by only 30 km are isolated from each other, and might also need different restoration strategies. In contrast to the relatively simple restoration techniques that can be utilized in eastern Mississippi Sound, low spawning stock biomass and limited connectivity in BSB makes this environment substantially more challenging and likely costly to restore oyster reefs. BSB provides a well-protected environment for retention of locally spawned larvae, which suggests that increases in local population abundance may result in increases in local recruitment of the unproductive oyster population. Thus, planting oysters and creating spawning sanctuaries may be a good strategy to augment low levels of natural larval supply to the east side of the Bay. Because of the high fecundity of oysters, it is also possible that other factors affecting larval survival, settlement or post-settlement mortality were determining the size of the adult population. For example, high mortality caused by summertime anoxic events and siltation negatively affected oyster survivorship in BSB (Saoud et al. 2000); however, both factors could be mitigated by creating reefs with high vertical relief (Gregalis et al. 2008; Schulte et al. 2009).

Oyster reef restorations near our identified areas of high oyster recruitment may be relatively simple and require addition of suitable substrate. The most productive oyster reef complex (*CPR*) supplies maximum larvae into the southwest part of the study area including CP and EMS. Such high larval supply, however, did not produce successful recruitment of oysters in EMS because of a lack of suitable settlement surface (May & Bland 1969, Powers, unpublished data) and addition of hard substrate could enhance settlement in this area (Gregalis et al. 2008). Because of relatively high salinity in the area, however, oysters are more susceptible to oyster drills and diseases (May & Bland 1969) and an effort to reduce post-settlement mortality should be considered.

The lack of spatially explicit knowledge of larval dispersal and source-sink metapopulation relationships has been a fundamental obstacle to establish restoration strategies for exploited marine populations in many estuarine systems (Cowen & Sponaugle 2009). The present study clearly shows that a scenario-driven approach using a biophysical transport model can provide essential information on larval dispersal and help decision-makers/stakeholders establish spatially explicit restoration strategies. Although this study was designed specifically for *Crassostrea virginica* in the Mobile Bay system, the approach is applicable to many other marine invertebrates and fish with planktonic larval stages in various estuarine ecosystems. Especially, the findings in this study can be directly applicable to the other estuarine systems in the northern Gulf of Mexico, which share many common attributes.

Implications for Practice

- Spatially explicit models of larval transport can guide restoration plans.
- Strategies that sequentially "step-out" restoration from areas of current high oyster abundance over time is likely a cost-effective strategy to restore oyster reefs throughout an entire estuarine system.
- Biophysical models might help to identify connected and isolated populations, and also local limiting factors to develop adequate restoration projects.
- Increasing habitat availability in the predominant direction of larval dispersal might be an effective strategy.
- In isolated populations, larval supply might be the limiting factor even when physical transport conditions enhance larval retention, because of the small size of the adult population (BSB). Planting oysters and creating spawning sanctuaries may be a good recovery strategy for this situation.

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Oyster larval transport in coastal Alabama: Dominance of physical transport over biological behavior in a shallow estuary

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[1] Among the various factors affecting recruitment of marine invertebrates and fish, larval transport may produce spatial and temporal patterns of abundance that are important determinants of management strategies. Here we conducted a field and modeling study to investigate the larval transport of eastern oyster, *Crassostrea virginica*, in Mobile Bay and eastern Mississippi Sound, Alabama. A three-dimensional larval transport model accounting for physical transport, biological movement of larvae, and site- and larval-specific conditions was developed. A hydrodynamic model was used to simulate physical transport, and biological movement was parameterized as a function of swimming and sinking velocity of oyster larvae. Site- and larval-specific conditions, including spawning location, spawning stock size, spawning time, and larval period, were determined based on the previous studies. The model reasonably reproduced the observed gradient in oyster spat settlement and bivalve larval concentration, although the model results were less dynamic than the data, probably owing to the simplified biological conditions employed in the model. A persistent gradient decreasing from west to east in the model results at time scales of overall average, season, and each survey in 2006 suggests that the larval supply may be responsible for the corresponding gradient in oyster spat settlement observed over the past 40 years. Biological movement increased larval retention near the spawning area, thus providing a favorable condition for local recruitment of oysters. Inclusion of biological movement, however, caused little change in the overall patterns of larval transport and still resulted in a west-east gradient, presumably because of frequent destratification in the shallow Mobile Bay system.

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1. Introduction

[2] Persistence of exploitable populations of marine invertebrates and fish is dependent on a high influx of new recruits into a population. For most marine invertebrates and fish this influx occurs during the planktonic larval stage and is a function of both concentrations of larvae in the water column and horizontal advection into the region, that is, larval supply [*Yund et al.*, 1991]. Larval supply is influenced by a combination of physical transport and biological movement of larvae [*Morgan*, 1995; *Kennedy*, 1996]. Physical transport, defined as larval transport not affected by larval characteristics but solely determined by physical processes, includes advection and turbulent mixing. Physical transport processes that enhance larval retention play a critical role in successful recruitment of larval organisms within outflux-dominant estuaries [*Andrews*, 1983]. In the James River estuary, horizontal and vertical circulation and turbulent mixing associated with a frontal system combine to enhance upstream transport of oyster larvae and, thus, contribute to larval retention [*Andrews*, 1983; *Mann*, 1988; *Shen et al.*, 1999]. *Andrews* [1983] suggested that the ultimate fate of bivalve larvae is strongly dependent on current regimes and flushing rates of estuaries. Similarly, tidal currents, wind-driven circulation, and gravitational circulation promote transport of blue crab larvae into estuarine nursery areas and enhance their retention near settling areas in the northern Gulf of Mexico [*Rabalais et al.*, 1995; *Morgan et al.*, 1996; *Perry et al.*, 2003].

[3] Biological movement, defined as larval movement in the vertical direction influenced by larval characteristics such as larval size, density, and behavior, includes sinking and swimming of larvae, that is, all vertical transport except that due to vertical advection and turbulent mixing. Biological movement of larvae has been suggested to explain observed patterns of oyster larval distribution in several

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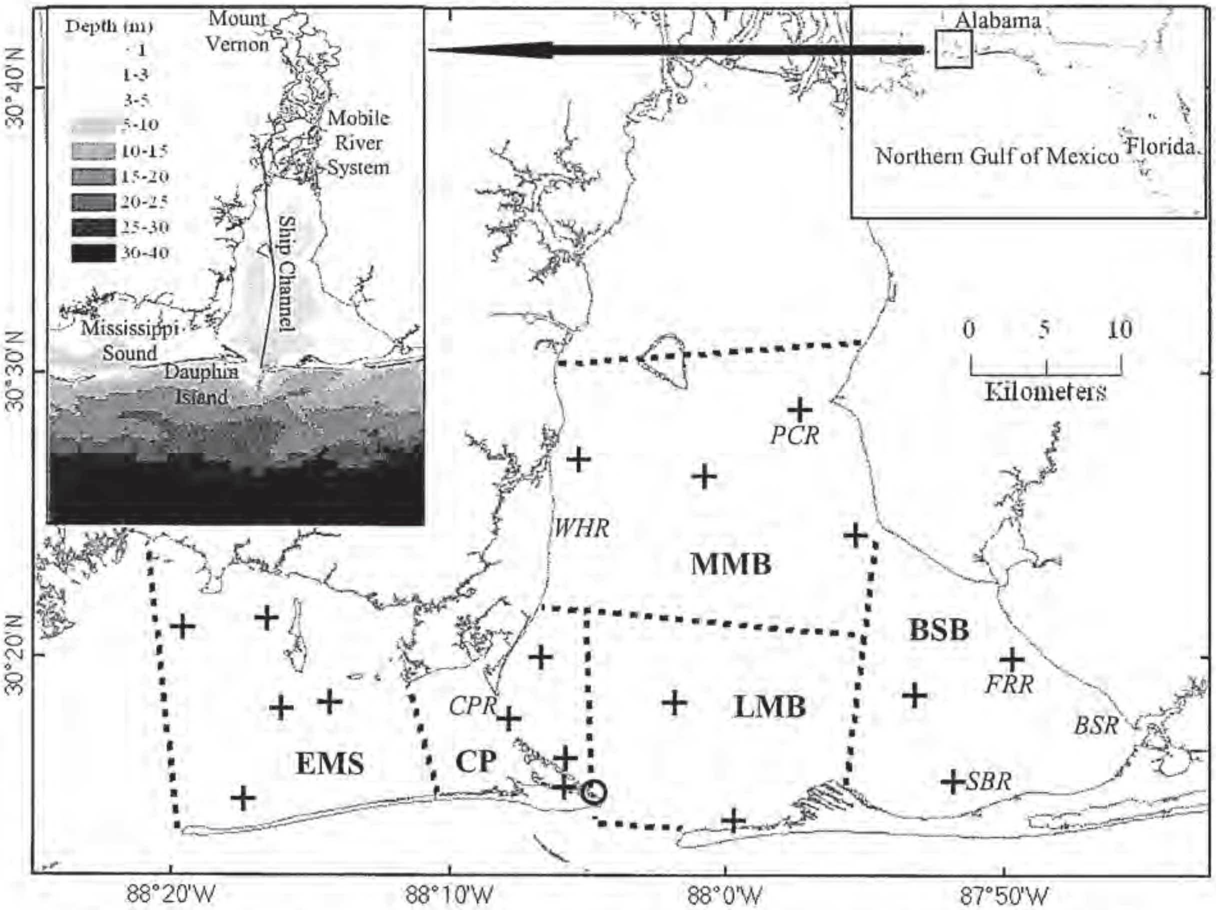

Figure 1. A map of Mobile Bay and adjacent eastern Mississippi Sound showing 18 mooring stations (crosses), Dauphin Island/Dauphin Island Sea Lab (DISL) station (open circle), and six existing oyster reefs, where oyster larvae were released in model simulations: Cedar Point Reef (CPR), White House Reef (WHR), Point Clear Reef (PCR), Fish River Reef (FRR), Bon Secour Reef (BSR), and Shell Bank Reef (SBR). Dashed lines denote boundaries of five zones: Eastern Mississippi Sound (EMS), Cedar Point (CP), Lower Mobile Bay (LMB), Middle Mobile Bay (MMB), and Bon Secour Bay (BSB). The map in the top left corner shows the modeling domain with depth contours.

estuaries. In New Jersey estuaries and Prince Edward Island, Canada, differential vertical distributions of oyster larvae were observed in relation to variations in biological movement with tidal phases and stratification [*Carriker*, 1951; *Kennedy*, 1996]. In estuaries of New Jersey [*Carriker*, 1951] and James River [*Andrews*, 1983], early-stage oyster larvae were randomly distributed throughout the water column and late-stage larvae were found frequently near the bottom. These distributions suggested that biological movement may play an important role in vertical positioning and the subsequent upstream transport of late-stage larvae. *North et al.* [2008] found that differences in biological movement of oyster larvae had greater influence on spatial patterns of larval transport than did interannual differences in circulation patterns in Chesapeake Bay. In contrast, earlier studies (see review by *Korringa* [1952]) found no evidence of biological movement for upstream transport of late-stage oyster larvae and that physical transport of larvae is the dominant factor. *Andrews* [1983], despite observations of continuous swimming of oyster larvae, concluded that physical transport dominates over biological movement. Despite these controversial arguments about the role of biological movement, the interaction between physical transport and biological movement has been suggested as the primary explanation for unidirectional horizontal transport or retention of invertebrate larvae in estuarine systems [*Wood and Hargis*, 1971; *Andrews*, 1983; *Rothlisberg et al.*, 1983; *Mann*, 1988; *Morgan et al.*, 1996; *North et al.*, 2008].

[4] Mobile Bay is a broad, shallow (average depth of 3 m) estuary with a narrow (120 m) and deep (12–14 m) ship channel located in the northern Gulf of Mexico (Figure 1). Hydrodynamic conditions in Mobile Bay and eastern Mississippi Sound are influenced by tide, river discharge, and wind, with their relative impacts varying spatially and temporally [*Wiseman et al.*, 1988; *Schroeder et al.*, 1990; *Noble et al.*, 1996; *Ryan et al.*, 1997]. Observations in Mobile Bay and eastern Mississippi Sound, Alabama, showed a persistent gradient decreasing from west to east in oyster spat settlement over the past 40 years: significant settlement in the southwest side of Mobile Bay and eastern Mississippi

Table 1. Times and Other Conditions of Field Surveys in 2006

Survey ID	Survey Dates	Average Water Temperature[a] (°C)	Larval Period[b] (days)	Spawning Time[c]
11	16-22 May	24.7	14	1600 on 2 May
12	07–08 Jun	28.3	11	1500 on 25 May
13	27–29 Jun	29.4	10	1700 on 16 Jun
14	17–19 Jul	30.2	10	0800 on 7 Jul
15	07–09 Aug	30.4	10	1400 on 28 Jul
16	29–30 Aug	31.2	10	1400 on 16 Aug
17	20–21 Sep	29.3	10	0900 on 7 Sep
18	09–11 Oct	26.8	12	1000 on 25 Sep
19	30–31 Oct	22.0	18	0500 on 14 Oct

[a]Average bottom water temperature over the time period since the previous survey, calculated from the hourly data at the Dauphin Island Sea Lab station (Figure 1).

[b]Larval period estimated using equation (5).

[c]An increase in bottom-water temperature to a critical threshold of 25°C was used to detect the initial spring spawning for survey 11, and a rapid change over 2°C was used for the summer and fall spawning for surveys 12 to 19.

Sound and negligible settlement in the middle and east side of the Bay [*Hoese et al.*, 1972; *Lee*, 1979; *Saoud et al.*, 2000]. *Hoese et al.* [1972] attributed the lower spat settlement in the east side of the Bay to the relatively low larval supply. *Saoud et al.* [2000] suggested that different larval and water sources, controlled by different flow patterns, may be responsible for different peaks in larval supply, thus resulting in spatially different settlement intensity. Although the characteristics of larval transport have been inferred from spat settlement data, no direct studies have been conducted on oyster larval transport in the Mobile Bay system, and little is known about the controlling processes responsible for the persistent west-to-east gradient in oyster spat settlement.

[5] We conducted a field and modeling study to investigate the larval transport, supply, and settlement of eastern oyster (*Crassostrea virginica*) in Mobile Bay and eastern Mississippi Sound, Alabama. Data for oyster spat settlement and bivalve larval concentration were collected in 2006 to examine spatial and temporal distribution patterns. A three-dimensional larval transport model accounting for both physical transport and biological movement of oyster larvae was developed. The model results, with or without biological movement, were compared with data for oyster spat settlement and bivalve larval concentration. Model sensitivity was examined for the parameterization of biological movement, spawning time, and larval period. The larval transport model was used to investigate the characteristics of oyster larval transport in the Mobile Bay system with specific reference to the following questions: (1) Is larval transport responsible for the persistent gradient in oyster spat settlement decreasing from west to east observed over the past 40 years? (2) Are there seasonal variations in larval transport and retention? and (3) How does biological movement of oyster larvae influence their transport?

2. Materials and Methods

2.1. Field Data

[6] Two types of field data, spat settlement of oysters and larval concentration of bivalves, were collected at 18 mooring stations in Mobile Bay and eastern Mississippi Sound (Figure 1). Seven stations were located near existing oyster reefs, including Cedar Point Reef (CPR), White House Reef (WHR), Point Clear Reef (PCR), Fish River Reef (FRR), Bon Secour Reef (BSR), and Shell Bank Reef (SBR), with 11 additional stations located throughout the mesohaline portions of the study area. The field survey was conducted every 3 weeks from January to December in 2006, with CTD casting to collect water column information using a Sea-Bird profiler (SBE25).

[7] Spat settlement was measured using regular deployment of collection tiles. Two PVC circular panels 25 cm in diameter attached to a stainless-steel pipe anchored to a concrete mooring at each station. Both PVC panels were placed perpendicular to the mooring so that the plates rested in a horizontal position. Three settlement plates made by 12 × 12 cm cement board, similar to those used by *Hoese et al.* [1972], were placed on both upper and lower PVC panels attached 1.0 and 0.5 m from the bottom, respectively. One of the plates (covered plate) was enclosed with a 4 mm mesh plastic cage and the second plate (partially covered plate) had a partial cage with two sides open, that is, the top and two sides were enclosed, while the third plate (uncovered plate) was not modified. The covered plates were intended to measure oyster spat settlement in the absence of predation by excluding oyster drills and crabs from the cage. The uncovered plates allowed assessment of spat settlement in the presence of predators. The partially covered plates baffled water flow but allowed predator access, thus allowing assessment of hydrodynamic artifacts of caging on oyster spat settlement.

[8] Settlement plates were retrieved and replaced with new plates every 3 weeks. The plates were placed on ice following retrieval and then frozen at the lab until analysis. The total number of oyster spats on each plate was counted using microscopy. Covered plates were expected *a priori* to show the highest oyster spat settlement because predators were excluded; however, the highest settlement was normally observed in partially covered plates, suggesting that cage treatments did not work well. Maximum oyster spat settlement among three treatments was selected from each of the upper and lower panels as the best representation of the larval supply of oysters at each station, and their average was used for subsequent analysis. Although the field program was conducted from January to December in 2006, only the data from nine surveys, surveys 11 to 19, in May–October, when mass spat settlement (i.e., maximum settlement reaches up to 97–563 spat m^{-2} day^{-1}) occurred, are discussed in this paper. The times and other conditions of the surveys are reported in Table 1.

[9] During each spat settlement survey, bivalve larvae were sampled at 18 stations by collecting 10 L of seawater via pump (Rule Model 3700) from 0.5 m above the bottom and passing this water through a 35 μm mesh plankton net (Sea-Gear Corp., Melbourne, FL). The particles trapped in the net were immediately separated using a sieve array consisting of 500, 100, and 30 μm mesh screens. The resulting two size classes of particles, 30–150 and 150–500 μm (after allowing for diagonal length of screen mesh), were split via plankton splitter, and one-fourth of the total samples were preserved in 4% buffered formaldehyde for microscopic analysis. Since microscopic identification of bivalve larvae

at these sizes is extremely difficult [*Carriker*, 1996], all bivalve larvae including oyster larvae were counted using microscopy. We used the data for the size class of 150–500 μm as a measure of late-stage larval concentration.

[10] Both data for oyster spat settlement and bivalve larval concentration were $\log_{10}$ transformed due to variance exceeding means. To examine spatial differences, 18 stations were grouped into five zones based on the collected data and existing oyster reefs (Figure 1): eastern Mississippi Sound (EMS; $n = 5$), Cedar Point (CP; $n = 4$), lower Mobile Bay (LMB; $n = 2$), middle Mobile Bay (MMB; $n = 4$), and Bon Secour Bay (BSB; $n = 3$). To examine seasonal variations, nine surveys were grouped into three seasons: spring (surveys 11–13), summer (surveys 14–16), and fall (surveys 17–19). Average water temperature varied from 24.7° to 29.4°C, from 30.2° to 31.2°C, and from 22.0° to 29.3°C in spring, summer, and fall, respectively (Table 1). Seasonal patterns were also observed in salinity. Average salinity at the surface (bottom) was 18.0 psu (21.1 psu), 24.0 psu (25.3 psu), and 23.1 psu (24.3 psu) in spring, summer, and fall, respectively, representing the largest freshwater discharge in spring and the lowest in summer. Salinity, however, showed great spatial variability, for example, ranging from 3.0 to 31.3 psu in survey 11. One-way analysis of variance (ANOVA) was conducted to examine differences between zones with five levels. If ANOVA indicated significant differences between zones at $p < 0.05$, Tukey multiple-comparison tests were conducted to determine which zones were significantly different. Correlation analysis was conducted to investigate the relationship between spat settlement and larval concentration. All statistical tests were conducted in MINITAB V14.2.

2.2. Larval Transport Model

[11] The governing mass-balance equation for oyster larvae in Cartesian coordinates may be expressed as

$$\frac{\partial C}{\partial t} = -\frac{\partial(uC)}{\partial x} - \frac{\partial(vC)}{\partial y} - \frac{\partial(wC)}{\partial z} + \frac{\partial}{\partial x}\left(K_x\frac{\partial C}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_y\frac{\partial C}{\partial y}\right) + \frac{\partial}{\partial z}\left(K_z\frac{\partial C}{\partial z}\right) - w_{bi}\frac{\partial C}{\partial z}, \quad (1)$$

where t is time; x, y, and z are the east, north, and vertical coordinates, respectively; C is the larval concentration; u, v, and w are the current velocity components in the x, y, and z directions, respectively; K_x, K_y, and K_z are the turbulent diffusivities in the x, y, and z directions, respectively; and w_{bi} is the net vertical velocity for biological movement of larvae. The first term in equation (1) indicates the time rate change in larval concentration. The first three terms on the right-hand side represent advective transport and the next three terms represent turbulent diffusive transport, which combine to determine physical transport of larvae and are independent of a target organism. The last term indicates net biological movement of larvae, which varies as a function of larval characteristics such as larval size, density, and behavior, that is, all vertical transport except that due to vertical advection and turbulent mixing. Horizontal movement of oyster larvae is not considered because most small larvae cannot swim fast enough in a horizontal direction to influence their distribution over a strong horizontal velocity of physical transport [*Young*, 1995].

2.2.1. Physical Transport

[12] The hydrodynamic model in the three-dimensional hydrodynamic-eutrophication model (HEM3D), also referred to as the environmental fluid dynamics code (EFDC), was applied to simulate physical transport of oyster larvae. The model is based on turbulence-averaged governing equations, including continuity, momentum, salt-balance, and heat-balance equations, with hydrostatic and Boussinesq approximations [*Hamrick*, 1992]. Because the spatial density gradient is virtually determined by the salinity gradient in the study area (see section 3.1.1), the present model application did not solve the heat-balance equation and calculated density as a function of salinity only. For turbulence closure, the model employs the second moment turbulence model developed by *Mellor and Yamada* [1982] and modified by *Galperin et al.* [1988]. The model has been successfully applied to a number of systems [*Ji et al.*, 2001; *Lin and Kuo*, 2003], and a more detailed description of the model is given by *Hamrick* [1992, 1996].

[13] The modeling domain (88°30.18′–87°41.35′W, 29°50.70′–31°05.03′N) includes Mobile Bay, the Mobile River system, eastern Mississippi Sound, and the northern Gulf of Mexico (Figure 1). The seaward open boundary was extended southward to about 45 km south of Dauphin Island and the upriver boundary was at Mount Vernon. An orthogonal curvilinear grid was used to resolve the complex shoreline and bottom topography. The grid system has 21,705 surface water cells and five vertical σ layers, with the grid size varying from 58 to 2000 m. The finest grid cells are small enough to resolve the narrow ship channel and to allow us to turn off horizontal eddy diffusion.

[14] The model became stabilized within a few tidal cycles with arbitrary (0) initial conditions for surface elevation and velocity, that is, cold start. To estimate the initial condition for salinity, an ideal model run was conducted, forced by harmonic tide with the two most important constituents (K1 + O1), 31 year (1976–2006) median river discharge, and 20 year (1987–2006) median wind speed and random wind direction. The tidal average salinity field calculated after the ideal model run reached steady state was used for the initial salinity condition, which was specified after 5 days of initial warming-up of cold start. The model application gave a good reproduction of the observed surface elevation, current velocity, and salinity for both total and subtidal components and was able to simulate the features observed to be important for mass transport in the Mobile Bay system; see [*Kim*, 2009].

2.2.2. Biological Movement of Oyster Larvae

[15] Net biological movement of oyster larvae was parameterized as a function of swimming and sinking velocity, which varies with larval size.

2.2.2.1. Larval Size

[16] Larval swimming and sinking velocity varies as larvae grow. Fertilized eggs develop into trochophores in 6–9 h, and these develop into veligers in 24–48 h [*Galtsoff*, 1964; *Burrell*, 1986; *Carriker*, 1996]. After a 10–20 day larval period, veligers develop into pediveligers with a foot. Pediveligers tend to stay near bottom and can crawl short distances to find suitable substrates for settlement. If suitable substrates are found, pediveligers permanently settle on the substrates and metamorphose into oyster spats for the benthic life cycle. Larval size, about 40–60 μm for trocho-

phores, increases as they develop and settlement occurs when the larval size is between 300 and 350 μm [*Galtsoff*, 1964; *Carriker*, 1996; *Kennedy*, 1996]. The maximum larval size for the late-stage larvae varies depending on environmental conditions such as food availability, temperature, salinity, dissolved oxygen (DO), and turbidity [*Dekshenieks et al.*, 1993; *Kennedy*, 1996]. Because the maximum larval size tends to be smaller in southern than northern latitudes [*Kennedy*, 1996], the lower limit of maximum larval size, 300 μm, may be a better representative of oyster larvae in the Gulf of Mexico. In this study, oyster larval size is assumed to increase linearly from 50 to 300 μm during a larval period.

2.2.2.2. Swimming Velocity

[17] Swimming velocity represents the processes contributing to the retention of larvae in the water column and may be influenced by many processes including larval size, temperature, salinity and salinity gradient, DO, gravity, light, and chemical cues [*Hidu and Haskin*, 1978; *Mann and Rainer*, 1990; *Mann et al.*, 1991; *Turner et al.*, 1994; *Young*, 1995; *Dekshenieks et al.*, 1996; *Kennedy*, 1996; *Dekshenieks et al.*, 1997]. Although there is no consensus on what stimulates larval swimming behavior, the observed swimming velocity, despite the differences in experimental conditions, generally increases from 0.4 to 3.1 mm s^{-1} as oyster larvae grow.

[18] In the present study swimming velocity was parameterized as a function of larval size by employing a linear regression based on the data for eastern oyster larvae by *Hidu and Haskin* [1978, Figure 2], *Mann* [1988, Table 5], and *Mann and Rainer* [1990, Table 1]:

$$w_{\mathrm{swim}} = 0.0089L - 0.0076, \tag{2}$$

where w_{swim} is the swimming velocity (mm s^{-1}) and L is the larval length (μm). The linear regression shows a significant relationship between w_{swim} and larval size ($R^2 = 0.74$, $p < 0.001$; $n = 13$), and the estimated w_{swim} increases from 0.4 to 2.7 mm s^{-1} as larvae grow from 50 to 300 μm, comparable with the estimates of *Dekshenieks et al.* [1996], ranging from 0.0 to 2.4 mm s^{-1}.

2.2.2.3. Sinking Velocity

[19] Sinking velocity indicates the downward velocity of larvae and varies as a function of larval size. As larvae grow their size increases, their shells become thicker and heavier, and the mass-to-area ratio increases, thus resulting in an increased density and sinking velocity [*Galtsoff*, 1964; *Mann et al.*, 1991; *Dekshenieks et al.*, 1997; *Baker and Mann*, 2003]. *Hidu and Haskin* [1978] observed that the sinking velocity of eastern oyster larvae varied little for different salinities, but increased from 0.7 to 8.3 mm s^{-1} with increasing larval size. They suggested that sinking velocity could dominate over swimming velocity during the late stage of larvae, which can be advantageous for pediveliger larvae.

[20] Empirical formulations have been proposed for sinking velocity. *Mann et al.* [1991] expressed the sinking velocity of bivalve larvae including oyster larvae as a linear or square function of larval size. *Dekshenieks et al.* [1996] parameterized sinking velocity with an exponential function of larval size. These empirical equations all indicate a positive relationship between sinking velocity and larval size, but with different rates of increase in sinking velocity with larval growth.

[21] In the present study sinking velocity was parameterized as a function of larval size by employing a linear regression based on the data for eastern oyster larvae of *Hidu and Haskin* [1978, Figure 3]:

$$w_{\mathrm{sink}} = 0.0304L - 1.099, \tag{3}$$

where w_{sink} is the sinking velocity (mm s^{-1}). The linear regression shows a significant relationship between w_{sink} and larval size ($R^2 = 0.98$, $p < 0.001$; $n = 20$), and the estimated w_{sink} increases from 0.4 to 8.0 mm s^{-1} as larvae grow from 50 to 300 μm, comparable with the estimates of *Mann et al.* [1991], ranging from 0.0 to 8.2 mm s^{-1}.

2.2.2.4. Net Vertical Velocity

[22] Many studies have considered biological movement of bivalve larvae determined by a combination of swimming and sinking behavior [*Jonsson et al.*, 1991; *Dekshenieks et al.*, 1996; *Wang and Xu*, 1997]. Although it is still not clear how to combine the two opposing processes at various stages of oyster larvae, a consensus based on observations does exist concerning the vertical distribution of oyster larvae. Oyster larvae tend to stay in the water column at the early stage, often showing peaks near the pycnocline, but accumulate in the bottom layer for settlement at late stages [*Carriker*, 1951; *Andrews*, 1983; *Mann*, 1988; *Dekshenieks et al.*, 1996; *Kennedy*, 1996]. For early-stage larvae ranging between 50 and 150 μm, the sinking velocity varies from 0.4 to 3.5 mm s^{-1} (equation (3)). That is, sinking behavior alone would make them reach the bottom in 0.8–6.9 h for a water depth of 10 m. Early-stage larvae then should show swimming behavior so that net biological movement is either neutrally buoyant or even upward, for them to stay in the water column. For late-stage larvae, in contrast, sinking behavior should dominate over swimming behavior so that net biological movement is downward sinking to accumulate them in the bottom layer.

[23] *Dekshenieks et al.* [1996] expressed the net vertical velocity of oyster larvae as a function of swimming and sinking velocity using the concept of percentage time swimming:

$$w_{\mathrm{bi}} = \mathrm{TS}w_{\mathrm{swim}} - (1 - \mathrm{TS})w_{\mathrm{sink}}, \tag{4}$$

where w_{bi} is the net vertical velocity of oyster larvae (mm s^{-1}), and TS is the percentage time spent swimming by larvae. *Dekshenieks et al.* [1996] expressed TS as a function of salinity change and estimated it to vary from 64% to 83% for a typical salinity variation within a tidal cycle. Using TS = 74% (middle of the reported range), with the present parameterization methods of swimming (equation (2)) and sinking (equation (3)) velocity, equation (4) gives reasonable estimates of w_{bi} in light of the basic premise: net upward movement of early-stage larvae and net downward movement of late-stage larvae (crosses in Figure 2). *Dekshenieks et al.* [1996], using equation (4), simulated the vertical distribution of oyster larvae in a vertical one-dimensional model and compared the model results with the data of *Carriker* [1951]. Their model results for early-stage larvae show the peak larval concentration in the surface layer, while the observed peak was near mid depth [*Dekshenieks et al.*, 1996, Figure 6], suggesting that equation (4) may

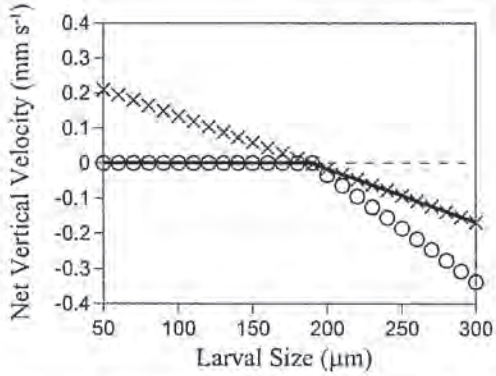

Figure 2. Net vertical velocity as a function of oyster larval size. VM (bold solid line) is for neutral buoyancy at the early stage and net sinking at the late stage, VM_{swim} (crosses) is for net swimming at the early stage and net sinking at the late stage, and VM_{sink} (open circles) is for neutral buoyancy at the early stage and twice-as-fast net sinking at the late stage.

overestimate net upward swimming for early-stage oyster larvae. For late-stage larvae both the model results and the data show peak concentration near the bottom.

[24] The present model employs neutrally buoyant net vertical velocity (w_{bi} = 0) for early-stage larvae from 50 to 190 μm and net sinking velocity for late-stage larvae from 190 to 300 μm (VM in Figure 2). For the latter the model uses w_{bi} estimated using equation (4). The model sensitivity was examined for net swimming of early-stage larvae (VM_{swim} in Figure 2) and twice-as-fast net sinking of late-stage larvae (VM_{sink} in Figure 2).

2.3. Model Setup

2.3.1. Forcing Functions

[25] Surface elevation, river discharge, and wind conditions were specified as forcing functions. Hourly surface elevation data at the National Oceanic and Atmospheric Administration (NOAA)'s Dauphin Island station (Figure 1) were used to specify the open boundary condition after being adjusted for amplitude and phase as described by *Kim* [2009]. Daily river discharge during the larval period for each survey shows that discharge greater than 4500 $m^3\ s^{-1}$ occurred for survey 11 and that relatively low and constant discharge, less than 500 $m^3\ s^{-1}$, prevailed for surveys 12 to 18 (Figure 3). Moderate river discharge, up to 1200 $m^3\ s^{-1}$, occurred for survey 19. Hourly wind data, observed at the Dauphin Island station by the National Data Buoy Center (NDBC), show a seasonal pattern. In spring (surveys 11–13) and summer (surveys 14–16), south winds were dominant. In fall (surveys 17–19) north winds became dominant, with a stronger speed.

2.3.2. Site- and Larval-Specific Conditions

[26] Conditions for spawning location, spawning time, spawning stock size, and larval period are required for larval transport simulations. Spawning location and time are needed to determine where and when to release larvae, spawning stock size determines how many larvae to be released, and larval period defines how long to simulate larval transport. These conditions vary with site- and larval-specific biological and environmental conditions of a target estuary [*Dekshenieks et al.*, 1996; *Kennedy*, 1996; *Shumway*, 1996; *Thompson et al.*, 1996].

2.3.2.1. Spawning Location and Stock Size

[27] Oysters tend to aggregate and form biogenic reefs in an estuarine system. *Moore* [1913], *Bell* [1952], and *May* [1971] conducted intensive surveys of oyster reefs throughout Mobile Bay and eastern Mississippi Sound, and *Smith* [1999] observed the oyster density in Mobile Bay. These observations suggested that a consistent pattern, significantly higher oyster production in the southwestern part of the study area than the middle and east side, has existed for the past 90 years. Especially, CPR, located at the intersection of Mobile Bay and eastern Mississippi Sound, has been the most productive reef area, contributing over 90% of the oyster harvest in Alabama [*May*, 1971]. *Smith* [1999] found a significantly higher oyster density in CPR than in unproductive oyster reefs such as WHR, FRR, and SBR. Existing oyster reefs were considered as potential spawning locations and the present study assumed that oyster larvae were released at six live oyster reefs: CPR, WHR, PCR, BSR, FRR, and SBR (Figure 1).

[28] Reproduction of oysters varies depending on the characteristics of oysters, for example, oyster size, health, and nutrient reserves, as well as environmental conditions, for example, temperature, DO, turbidity, food availability, and latitude [*Thompson et al.*, 1996]. Oysters may spawn multiple times during reproduction periods and their fecundity may change in time [*Thompson et al.*, 1996]. Therefore, it is hard to determine the absolute spawning stock size for each spawning event from an oyster reef. Instead, we may estimate the relative spawning stock size based on the number of adult oysters in oyster reefs. The size of an oyster reef and oyster density may be good indicators to estimate the potential spawning stock size of a reef. In the present study we used current oyster harvest information, which states that the most productive oyster reefs (CPR) contribute over 90% of the oyster harvest in Alabama [*May*, 1971], to estimate the relative spawning stock size from different reefs. Of the

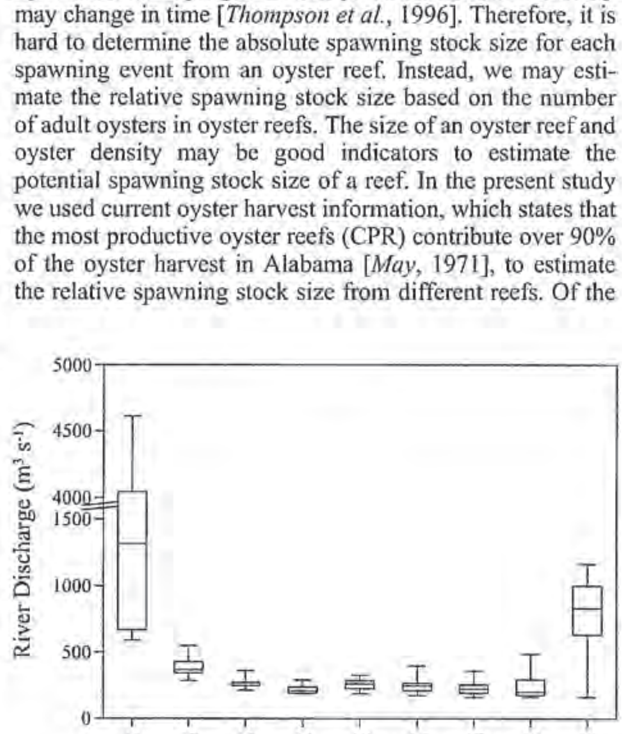

Figure 3. Box plot for daily river discharge during the larval period of surveys 11 to 19. The two end whiskers indicate the minimum and maximum, and the box is defined by the lower and upper quartiles, with the center line for the median.

total larval mass released in model simulations, 90% were released from CPR and the remaining 10% were released from the other unproductive oyster reefs in proportion to their surface area: 4.3% from WHR, 3.4% from PCR, and 2.3% from the reefs in Bon Secour Bay including BSR, SBR, and FRR.

2.3.2.2. Larval Period

[29] The larval period of oysters is affected by various factors such as water temperature, salinity, food availability, and turbidity [*Dekshenieks et al.*, 1993; *Kennedy*, 1996; *Shumway*, 1996]. *Kennedy* [1996, Table 8] reviewed the estimated larval period of eastern oyster as a function of water temperature and showed a negative relationship between larval period and water temperature. Larval period varied from 20 to 30 days at Prince Edward Island, Canada, for water temperature between 18° and 22°C and from 10 to 19 days in other areas for water temperature between 20° and 30°C. The minimum larval period of 10 days was observed for a water temperature of 30°C.

[30] In the present study, larval period was estimated by employing a linear regression between $\ln(T_{\mathrm{larvae}})$ and water temperature based on the oyster data of *Kennedy* [1996, Table 8].

$$T_{\mathrm{larvae}} = 110.76 \times \exp(-0.0825T_w), \tag{5}$$

where T_{larvae} is the larval period (days) and T_w is the water temperature (°C). The regression shows a significant relationship ($R^2 = 0.57$, $p < 0.001$; $n = 23$) between T_{larvae} and water temperature. For each of surveys 11 to 19 the average bottom water temperature was calculated over the time period since the previous survey (Table 1), using hourly data from the Dauphin Island Sea Lab (DISL) station (Figure 1), maintained by Mobile Bay National Estuary Program. The corresponding larval period was estimated using equation (5) and the minimum observed larval period of 10 days was specified. The estimated larval periods ranged between 10 and 18 days in the Mobile Bay system when the average water temperature varied between 22.0° and 31.2°C (Table 1). The estimates are comparable with those of *Saoud et al.* [2000]: 10 days in August 1999 and 18 days in September 1998.

2.3.2.3. Spawning Time

[31] Among various stimuli initiating spawning events of bivalves, several studies have stressed the importance of water temperature cue to stimulate spawning time of oysters [*Nelson*, 1928; *Hayes and Menzel*, 1981; *Kennedy*, 1996; *Shumway*, 1996; *Thompson et al.*, 1996; *Saoud et al.*, 2000]. Increases in water temperature to a critical threshold of 20°C initiated mass spring spawning in estuaries in New Jersey, and increases to 25°C did so in the northeastern Gulf of Mexico [*Nelson*, 1928; *Hayes and Menzel*, 1981]. Summer spawning was stimulated by rapid increases in water temperature by 2°C in Barnegat Bay, New Jersey [*Nelson*, 1928], and by 5°–10°C increases in Turkey Point and Alligator Harbor, Florida [*Hayes and Menzel*, 1981]. Widespread fall spawning was attributable to rapid decreases in water temperature in the northern Gulf of Mexico. For example, rapid decreases in water temperature by 3°–7°C initiated fall spawning of oysters in Fish River Reef in Mobile Bay, Alabama [*Saoud et al.*, 2000]. *Hayes and Menzel* [1981] argued that fall spawning caused by rapid decreases in water temperature may occur in the Gulf of Mexico as early as late July to early August.

[32] In the present study hourly bottom water temperature data at the DISL station were used to determine potential spawning events of oysters. An increase in water temperature to a critical threshold of 25°C, which initiated spring spawning in the northeastern Gulf of Mexico [*Hayes and Menzel*, 1981], was applied to detect initial spring spawning for survey 11. A rapid increase or decrease in water temperature by 2°C or more was applied to detect the summer and fall spawning events for survey 12 to 19. A single spawning event was assumed for each survey, and the estimated times of spawning events are reported in Table 1. Because more than one spawning event was possible from the temperature cues for some surveys, model sensitivity was examined for alternate spawning times.

2.4. Model Validation

[33] The larval transport model was run for 215 days between 1 April and 1 November 2006. For each survey larvae were released instantaneously at the estimated spawning time (Table 1) and simultaneously from the bottom layer at all spawning locations (Figure 1). Larvae were transported over the estimated larval period until the starting day of each survey, and then a tidal cycle, 25 h, average larval concentration was calculated in the bottom layer and compared with the data. Model-data comparisons were conducted at three time scales of overall average, season, and survey.

[34] For a quantitative model-data comparison, zone-based spatial aggregation was conducted; the median of the data and the model results were calculated for each of the five zones, EMS, CP, LMB, MMB, and BSB (Figure 1). The zone-median data showed an overall pattern consistent with the original data for both oyster spat settlement and bivalve larval concentration. To facilitate direct comparison, the zone-median model results were normalized by the median oyster spat settlement and bivalve larval concentration in EMS over nine surveys:

$$C_{M,\mathrm{spat}}(i,j) = \frac{C_M(i,j) \times C_{\mathrm{spat}}(\mathrm{EMS, median})}{C_M(\mathrm{EMS, median})}, \tag{6}$$

$$C_{M,\mathrm{larvae}}(i,j) = \frac{C_M(i,j) \times C_{\mathrm{larvae}}(\mathrm{EMS, median})}{C_M(\mathrm{EMS, median})}, \tag{7}$$

where $C_M(i,j)$ are the model results in the ith zone for the jth survey; $C_{M,\mathrm{spat}}$ and $C_{M,\mathrm{larvae}}$ are the normalized model results in units of spats (spats m^{-2} d^{-1}) and bivalve larval concentration (larvae per 10 L), respectively; C_M(EMS, median) is the median model result in EMS over nine surveys; C_{spat}(EMS,median) and C_{larvae} (EMS,median) are the median spat settlement and larval concentration, respectively, in EMS over nine surveys. Then, correlation analyses were conducted to compare the normalized model results with both types of data.

3. Results

3.1. Field Data

3.1.1. Water Column Stratification

[35] Water column stratification may play an essential role in larval transport in an estuarine system. Stratification

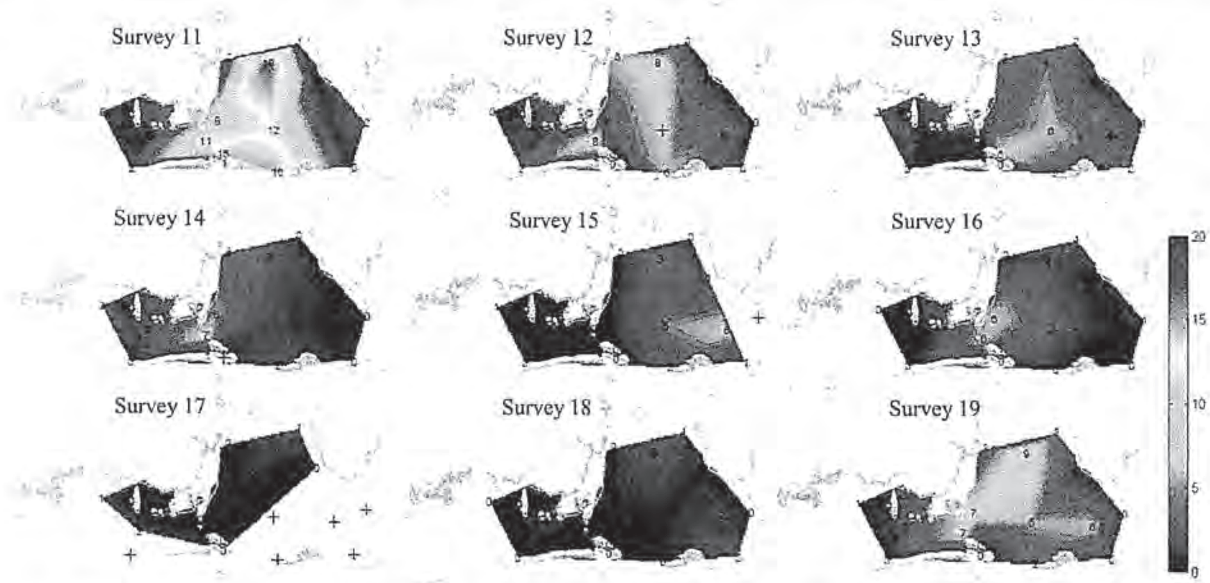

Figure 4. Observed bottom-surface salinity difference (psu) in surveys 11 to 19; crosses indicate missing data. Surface and bottom salinity was measured at 0.5 m from the surface and bottom, respectively, except at stations near the ship channel, where salinity at a 3 m depth was used for bottom salinity.

controls vertical mixing, which in turn affects the vertical distribution of planktonic larvae and thus may change their net horizontal transport [*Kennedy*, 1996; *Shen et al.*, 1999; *Pringle and Franks*, 2001]. The CTD casting data in 2006 showed that the bottom-surface density difference was mostly determined by the corresponding salinity difference ($R^2 > 0.99$, $p < 0.001$; $n = 152$), and thus stratification was described in terms of salinity difference.

[36] Spatial heterogeneity in water column stratification was apparent in the Mobile Bay system (Figure 4). The bottom-surface salinity difference in EMS was less than 2 psu for all nine surveys. A large salinity difference, over 5 psu, was observed in EMS only during the surveys conducted in February–March 2006, when the median river discharge was greater than 2000 $m^3 s^{-1}$ (not shown). In CP the bottom-surface salinity difference showed different responses to tidal and wind forcing depending on river discharge. When river discharge was less than 500 $m^3 s^{-1}$, a large salinity difference developed in CP during equatorial tide with calm winds, for example, surveys 14 and 16, and the large gradient disappeared during tropic tide or strong wind conditions, for example, surveys 13, 15, 17, and 18. When river discharge was relatively high during surveys 11 and 19, in contrast, a large salinity difference, over 5 psu, developed in CP even under tropic tide and strong wind conditions. A large bottom-surface salinity difference, over

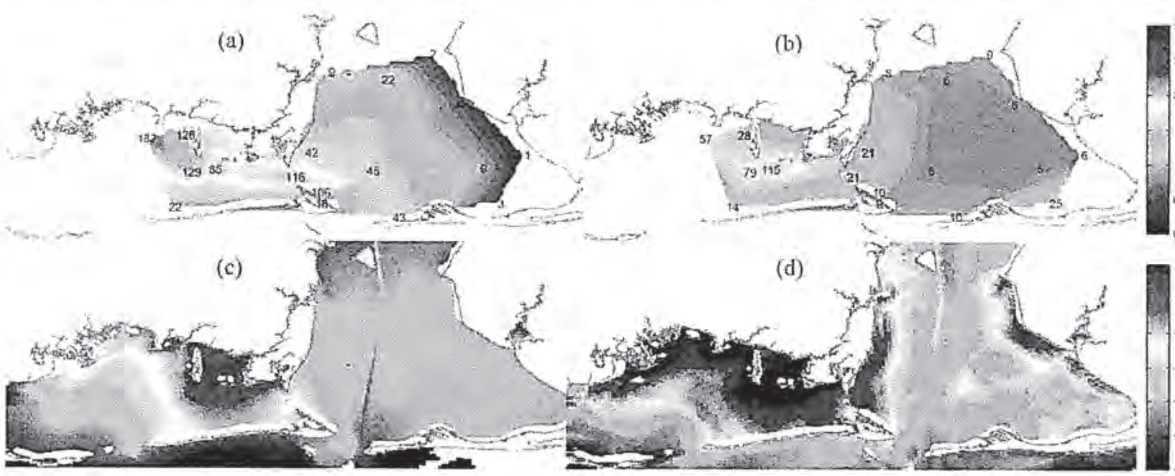

Figure 5. Observed (a) oyster spat settlement (spats $m^{-2} d^{-1}$) and (b) bivalve larval concentration (larvae per 10 L) compared with the model results (c) by physical transport only and (d) by physical transport and biological movement, averaged over surveys 11 to 19. Color bars indicate $\log_{10}$-transformed data and model results.

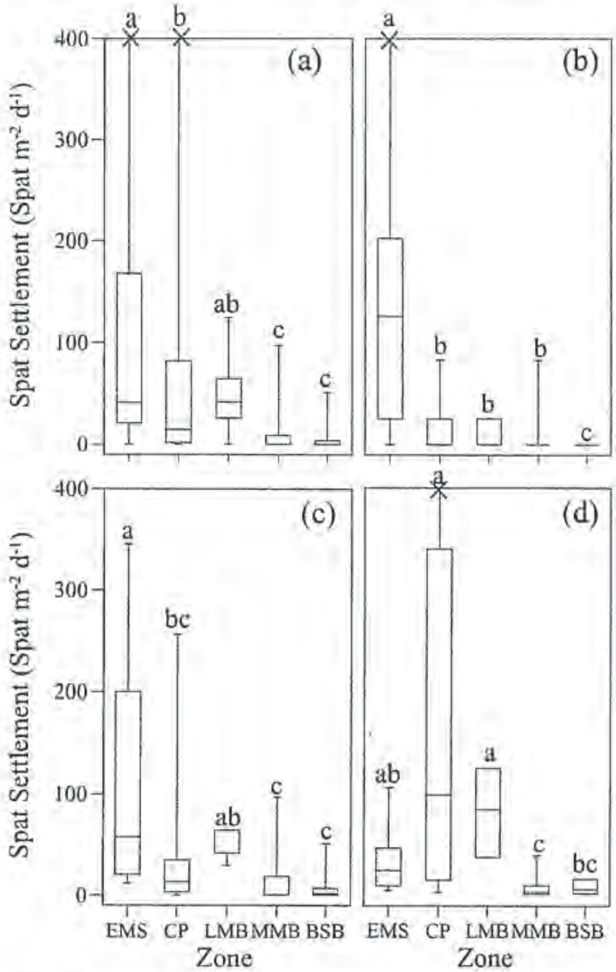

Figure 6. Box plot for the observed oyster spat settlement in five zones (a) for all surveys (surveys 11–19) and for seasons of (b) spring (surveys 11–13), (c) summer (surveys 14–16), and (d) fall (surveys 17–19). The two end whiskers indicate the minimum and maximum, and the box is defined by the lower and upper quartiles, with the center line for the median. Data larger than 400 spats m^{-2} d^{-1} are marked with a cross at the top of the plots. Different lowercase letters (i.e., a, b, and c) above the upper whiskers indicate a significant difference ($p < 0.05$) between zones.

5 psu, was observed in the upper 3 m water column near the ship channel: see surveys 11–13, 15, and 19. The salinity difference was always less than 2 psu in the shallow stations in BSB, but a large salinity difference was observed in the center of BSB during surveys 15 and 19, when the upper 3 m water column was strongly stratified along the ship channel.

3.1.2. Oyster Spat Settlement and Bivalve Larval Concentration

[37] Spat settlement of oysters averaged over surveys 11 through 19 showed a gradient decreasing from west to east (Figure 5a), consistent with previous observations [*Hoese et al.*, 1972; *Lee*, 1979; *Saoud et al.*, 2000]. The maximum settlement was observed in EMS, which was significantly higher than the second peak in CP, while MMB and BSB showed significantly lower settlement (Figure 6a). Seasonal variations were apparent in oyster spat settlement. EMS showed bimodal peaks in spring and summer, whereas CP had a single peak in fall. These peak settlements in EMS and CP were significantly higher than those in MMB and BSB. The distribution of oyster spat settlement showed a gradient decreasing from west to east in eight of nine surveys (Figure 7). The only exception was survey 14, when the maximum, yet relatively weak, spat settlement occurred along the ship channel in Mobile Bay.

[38] The larval concentration of bivalves averaged over surveys 11 through 19 also showed a gradient decreasing from west to east (Figure 5b). The maximum larval concentration was observed in EMS, which, unlike spat settlement, was not significantly higher than that in CP, and larval concentrations in LMB, MMB, and BSB were significantly lower than that in EMS (Figure 8a). Seasonal variations were also apparent in bivalve larval concentration. In spring the peak larval concentration occurred in EMS, which was significantly higher than that in MMB and BSB. In summer, unlike oyster spat settlement, the peak larval concentration occurred in BSB but the larval concentration was not significantly different between zones. In fall the maximum median larval concentration occurred in EMS and the second peak occurred in CP, but they were not significantly different. The distribution of bivalve larval concentration showed a gradient decreasing from west to east in eight of nine surveys (Figure 9). The only exception was survey 15, when the maximum larval concentration occurred in BSB. Note that the data from survey 12 show a quite low larval concentration throughout the study area, resulting in a weak gradient decreasing from west to east.

[39] Oyster spat settlement and bivalve larval concentration from all surveys were significantly correlated ($R = 0.50$) (Table 2), and both data, averaged over the nine surveys, exhibited a west-east gradient, with maximum abundance in the southwestern part of the Mobile Bay system (Figure 5). In seasonal comparisons a significant correlation between oyster spat settlement and bivalve larval concentration existed only in spring ($R = 0.69$) (Table 2). In particular, they showed the highest correlation in May (survey 11; $R = 0.76$, $n = 17$) and June (survey 13; $R = 0.68$, $n = 15$). No significant correlation existed between the two types of data in summer and fall (Table 2). In summer, oyster spat settlement showed the maximum peak in EMS (Figure 6c), while the maximum peak in bivalve larval concentration was in BSB (Figure 8c). In fall the maximum oyster spat settlement occurred in CP (Figure 6d), with four times higher settlement in surveys 18 and 19 than in survey 17 (Figure 7). In contrast, the maximum bivalve larval concentration occurred in CP for survey 17 only and in EMS for surveys 18 and 19 (Figure 9). Despite these relatively small-scale differences, a gradient decreasing from west to east persisted in both data in seven of nine surveys, all but surveys 14 and 15.

3.2. Model-Data Comparison

3.2.1. Physical Transport

[40] The model results by physical transport only (i.e., $w_{bi} = 0$ in equation (1)), averaged over surveys 11 to 19 (Figure 5c), showed good agreement with both oyster spat settlement and bivalve larval concentration. The maximum

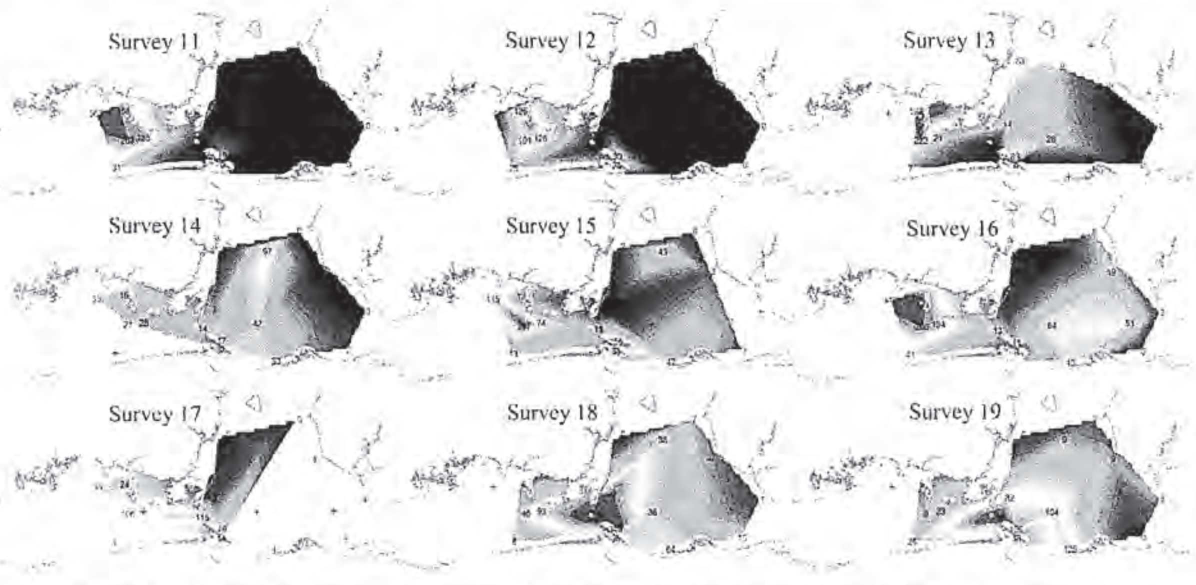

Figure 7. Observed oyster spat settlement (spats m^{-2} d^{-1}) in surveys 11 to 19. The color contour is based on the color bar in Figure 5 and crosses indicate missing data.

model results appeared in the northern part of EMS and CP, while concentrations in the middle and east sides of the bay were much lower, consistent with the observations. The normalized model results were significantly correlated with both spat settlement ($R = 0.47$) and larval concentration ($R = 0.57$) (Table 2). The model results agreed with the observed spat settlement in that both showed maximum medians in EMS and maximum variations in CP (Figure 10a). Both the model results and the bivalve larval concentration showed maximum medians in EMS, but the modeled maximum variation occurred in CP, whereas the observed maximum variation occurred in EMS (Figure 10b).

[41] The model results showed a consistent pattern for all three seasons (not shown): model results in the southwest part an order of magnitude higher than those in the middle and east sides of the bay. When oyster spat settlement and bivalve larval concentration showed the strongest correlation in spring ($R = 0.69$), the model results were mostly correlated with both types of data, with Rs of 0.62 and 0.69 for spat settlement and larval concentration, respectively (Table 2). No significant correlation existed between model and either type of data in summer when neither type of data showed a significant correlation. Both data showed no significant correlation in fall, and the model results were significantly correlated with larval concentration only.

[42] The model results by physical transport only consistently showed the typical gradient, decreasing from west to east, for each of surveys 11 to 19 (Figure 11). The model results were in good agreement with oyster spat settlement and bivalve larval concentration whenever the west-east gradient was present in the data. The west-east gradient was more persistent in model results than in data, such that the model could not reproduce the exceptional patterns observed in survey 14 for spat settlement or in survey 15 for larval concentration.

3.2.2. Biological Movement

[43] Figure 5d shows the model results by the combined effects of physical transport and biological movement averaged over surveys 11 to 19. The gradient decreasing from west to east was still apparent, with the peak concentration again occurring in the northern part of EMS and CP. Compared to the model results by physical transport only (Figure 5c), biological movement increased larval retention, especially in the southwest part of the study area and along the western and eastern shores of Mobile Bay (Figure 5d). In addition, it enhanced the patchiness in distribution, with small patches with a high concentration appearing in most zones, even in the east side of the bay. The normalized model results were significantly correlated with both oyster spat settlement ($R = 0.40$) and bivalve larval concentration ($R = 0.62$) (Table 2) and showed a distribution in each zone similar to that by physical transport only (Figure 10).

[44] Inclusion of biological movement did not change seasonal patterns in model results (not shown): higher model results in the southwest part than in the middle and east sides of the bay. As in the case of physical transport only, the normalized model results were significantly correlated with both spat settlement ($R = 0.53$) and larval concentration ($R = 0.71$) in spring (Table 2). In summer no significant correlation existed between model and either type of data. In fall the model results showed a significant correlation with larval concentration but not with spat settlement, as in the case of physical transport only.

[45] Inclusion of biological movement did not change the modeled patterns for each survey, which again consistently showed the typical gradient decreasing from west to east (not shown). As in the case of physical transport only, the west-east gradient was persistent in model results, such that the model could not reproduce the exceptional patterns

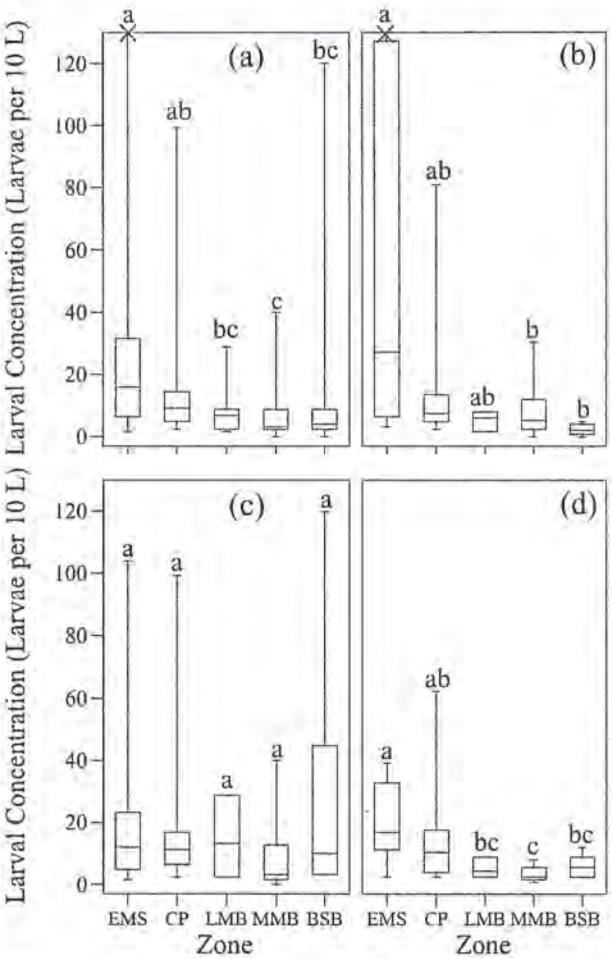

Figure 8. Box plot for the observed bivalve larval concentration in five zones (a) for all surveys (surveys 11–19) and for seasons of (b) spring (surveys 11–13), (c) summer (surveys 14–16), and (d) fall (surveys 17–19). The two end whiskers indicate minimum and maximum, and the box is defined by the lower and upper quartiles with the center line for the median. Data larger than 130 larvae per 10 L are marked with a cross at the top of the plots. Different lowercase letters (i.e., a, b, and c) above the upper whiskers indicate a significant difference ($p < 0.05$) between zones.

observed in survey 14 for spat settlement and in survey 15 for larval concentration.

3.3. Model Sensitivity

[46] For biological movement the present model employs neutrally buoyant early-stage larvae and net sinking late-stage larvae (VM in Figure 2). Inclusion of VM, compared to the case of physical transport only, increased larval retention in all zones, particularly in EMS and CP (Figures 5 and 12). Model sensitivity was examined for two other parameterization methods of biological movement (Figure 2), VM_{swim} (net swimming of early-stage larvae) and VM_{sink} (twice-as-fast net sinking of late-stage larvae). VM_{swim} caused relatively more early-stage larvae to stay in the water column, where they were subject to a stronger current, thus resulting in higher dispersion and decreased larval retention in most zones (Figure 12). VM_{sink}, in contrast, enhanced larval retention owing to increased net sinking velocity of late-stage larvae, particularly in the spawning zone, CP (Figure 12). Despite the differences in larval retention, however, the gradient decreasing from west to east was apparent in model results regardless of the modeling methods of biological movement. The model results with any modeling method of biological movement always showed the peak concentration in EMS and CP at time scales of overall average, season, and survey.

[47] More than one spawning event could have been selected for some surveys based on the criterion of a rapid temperature change over 2°C. Model sensitivity to alternate spawning times was examined. As the spawning time changed for a survey, the larval period, the time period between the spawning time and the time of the survey, also changed. Therefore, model sensitivity to larval period was also examined. Despite the differences in spawning time and larval period by 2–7 days, the model results showed consistent patterns of distribution for each survey (not shown). Because of dilution effects the modeled concentration decreased as the larval period increased, but without changing the overall patterns of distribution, confirming that the model results were not sensitive to spawning time or larval period. The model results were not sensitive to the period of time either, with the average ranging from one to five tidal cycles.

4. Discussion

[48] Production of larvae, larval transport and supply, larval settlement, and postsettlement survival to adults determine recruitment of marine organisms with planktonic larval stages, and variation in each of these components has the potential to regulate their populations [*Kennedy*, 1996; *Underwood and Keough*, 2001]. Among these processes, larval transport plays a critical role in determining spatial and temporal patterns of many marine invertebrates and fish [*Morgan*, 1995; *Kennedy*, 1996]. Therefore, studies of larval transport may provide valuable information for restoration or management of exploited marine populations [*Palumbi*, 2003; *Pineda et al.*, 2007]. Here we conducted a field and modeling study to investigate larval transport of eastern oyster, focusing on the controlling processes responsible for the persistent gradient decreasing from west to east in spat settlement, seasonal variations in larval transport and retention, and relevance of biological movement of larvae in Mobile Bay and eastern Mississippi Sound, Alabama.

[49] As with any numerical modeling study, model validation through model-data comparison is important to ensure model reliability and to evaluate limitations of model applications. We collected two types of field data, oyster spat settlement and bivalve larval concentration, throughout the study area in 2006. Neither, however, is an exact measure of oyster larval concentration, with each having its own positive and negative aspects as a proxy of potential oyster recruitment. Oyster spat settlement is the result of oyster larval supply, modified by settlement and postsettlement processes. If postsettlement mortality is significantly different among stations, the distribution in spat settlement may not properly represent the larval supply of oysters to the

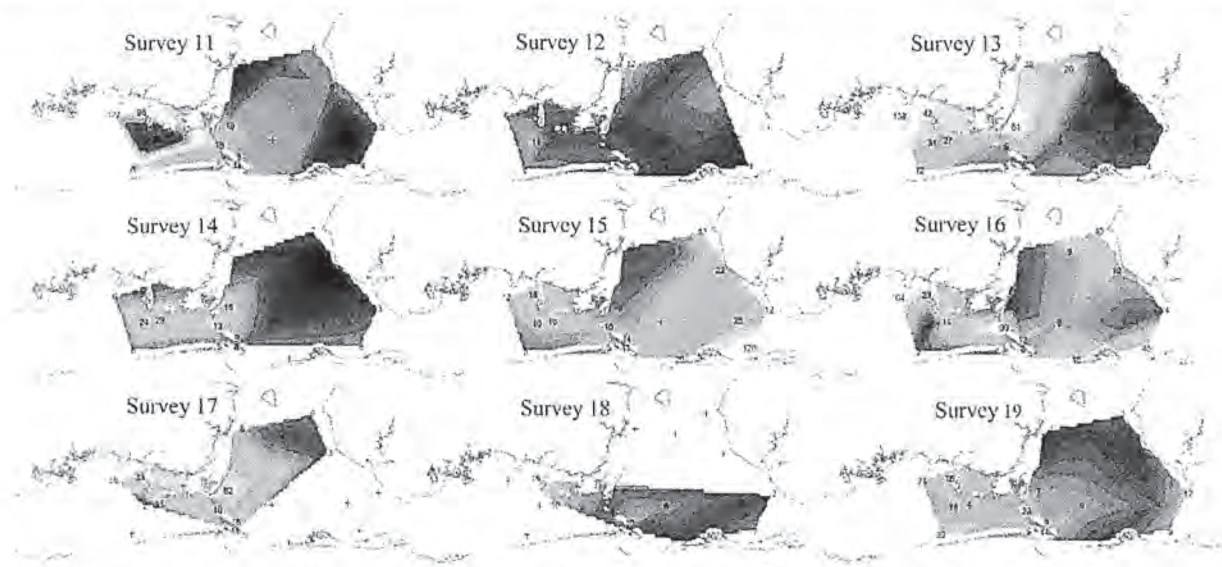

Figure 9. Observed bivalve larval concentration (larvae per 10 L) in surveys 11 to 19. The color contour is based on the color bar in Figure 5 and crosses indicate missing data.

stations. Bivalve larval concentration directly represents larval supply to each station not affected by settlement and postsettlement processes, but it includes larvae of all bivalves. Bivalve larval concentration, therefore, is determined by the most dominant larval organisms at each station during the survey. When both types of data show a consistent pattern, either may be considered a good proxy of oyster larvae.

[50] Both oyster spat settlement and bivalve larval concentration, averaged over the nine surveys, exhibited a gradient decreasing from west to east, with maximum abundance in the southwestern part of the study area (Figure 5). This agreement suggests that both oyster spat settlement and bivalve larval concentration may be good indicators of the overall average patterns of oyster larval supply. Seasonal patterns were apparent in oyster spat settlement (Figure 6) and bivalve larval concentration (Figure 8). Oyster spat settlement showed bimodal peaks in EMS in spring and summer, whereas CP had a single peak in fall, consistent with previous observations [*Hoese et al.*, 1972; *Lee*, 1979; *Saoud*, 2000]. Bivalve larval concentration showed bimodal peaks in EMS in spring and fall. Significant correlation between both types of data existed in spring, suggesting that the maximum spring peak in oyster spat settlement in EMS was likely due to the high larval supply. In summer the maximum peak in bivalve larval concentration in BSB (Figure 8c), with a very low corresponding spat settlement (Figure 6c), seems to be due to bivalves other than oyster larvae. In fall the bivalve larval concentration showed the maximum peak in EMS, while oyster spat settlement did so in CP. Both types of data showed gradients decreasing from west to east in seven of nine surveys, all except surveys 14 and 15.

[51] The model reproduced average patterns of both oyster spat settlement and bivalve larval concentration, showing a consistent west-east gradient (Figure 5). The model showed the best results in spring, when both types of data showed the strongest correlation (Table 2). No significant correlation, however, existed between the model and any of the data in summer, which may be attributable to the occurrence of exceptional patterns in both types of data. In fall the model results were significantly correlated with the bivalve larval concentration, both showing the maximum peak in EMS, but did not reproduce the maximum peak in CP observed in oyster spat settlement. Hence, larval supply alone may not be the controlling process for the observed fall peak settlement of oyster spat in CP. In a survey-by-survey comparison, the model reproduced the observed patterns when both types of data showed a gradient decreasing from west to east, but could not reproduce exceptional patterns (Figures 7, 9, and 11). The model results always showed a peak concentration in EMS and CP at time scales of overall average, season, and each survey, regardless of

Table 2. Correlation Coefficients (R) Among Oyster Spat Settlement, Bivalve Larval Concentration, and Model Result by Physical Transport[a]

Variables	Overall (Surveys 11–19)	Spring (Surveys 11–13)	Summer (Surveys 14–16)	Fall (Surveys 17–19)
Spat settlement vs. larval concentration	0.50*(n = 42)	0.69*(n = 15)	0.49(n = 15)	0.20(n = 12)
Model result vs. spat settlement	0.47*(0.40*)(n = 43)	0.62*(0.53*)(n = 15)	0.47(0.41)(n = 15)	0.35(0.26)(n = 13)
Model result vs. larval concentration	0.57*(0.62*)(n = 42)	0.69*(0.71*)(n = 15)	0.39(0.37)(n = 15)	0.62*(0.82*)(n = 12)

[a]Values in parentheses indicate correlation coefficients with the model result by the combined effects of physical transport and biological movement. Both zone-median data and normalized model results (equations (6) and (7)) were $\log_{10}$ transformed before correlation analysis. *Significant relationship at $p < 0.05$.

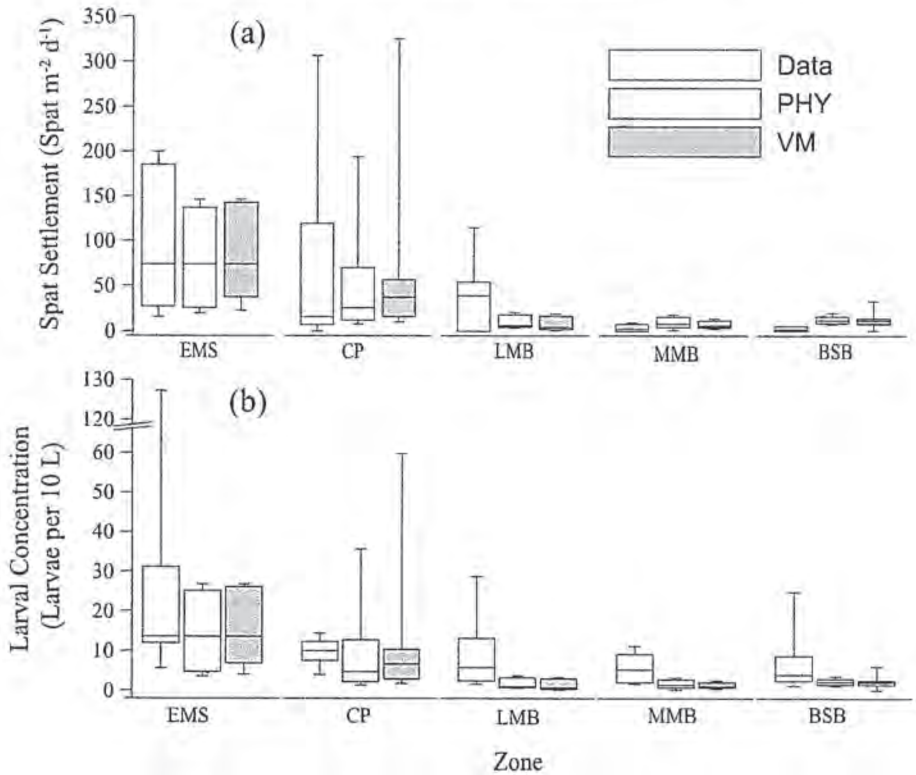

Figure 10. Model-data comparison for (a) oyster spat settlement and (b) bivalve larval concentration. Model results for physical transport only (PHY) and for physical transport and biological movement (VM) were normalized using equations (6) and (7). The two end whiskers indicate the minimum and maximum, and the box is defined by the lower and upper quartiles, with the center line for the median.

forcing conditions. Such a persistent gradient decreasing from west to east in the model results suggests that larval supply may be a controlling process for the corresponding gradient in oyster spat settlement observed over the past 40 years.

[52] Observations indicated that biological movement may enhance larval retention within estuarine systems [*Carriker*, 1951; *Andrews*, 1983; *Kennedy*, 1996; *Rose et al.*, 2006]. *Rose et al.* [2006] suggested that behavioral adjustment may be the mechanism allowing local recruitment of oysters in outflux dominant estuarine systems. The present model application showed similar results in that biological movement of oyster larvae enhanced their retention within the study area (Figures 5d and 12). Net sinking of late-stage

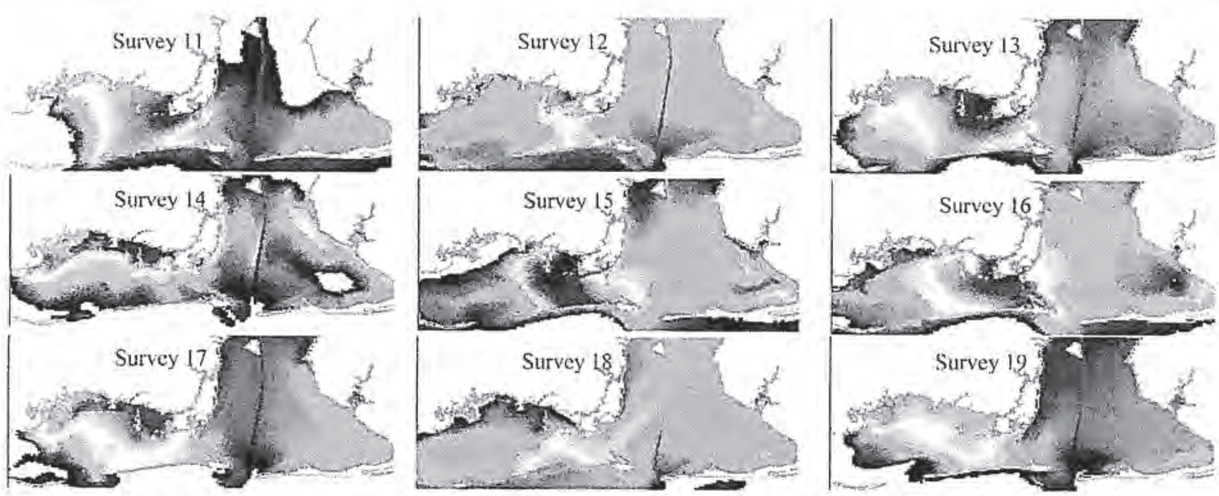

Figure 11. Model results by physical transport only for surveys 11 to 19. The color contour is based on the color bar in Figure 5.

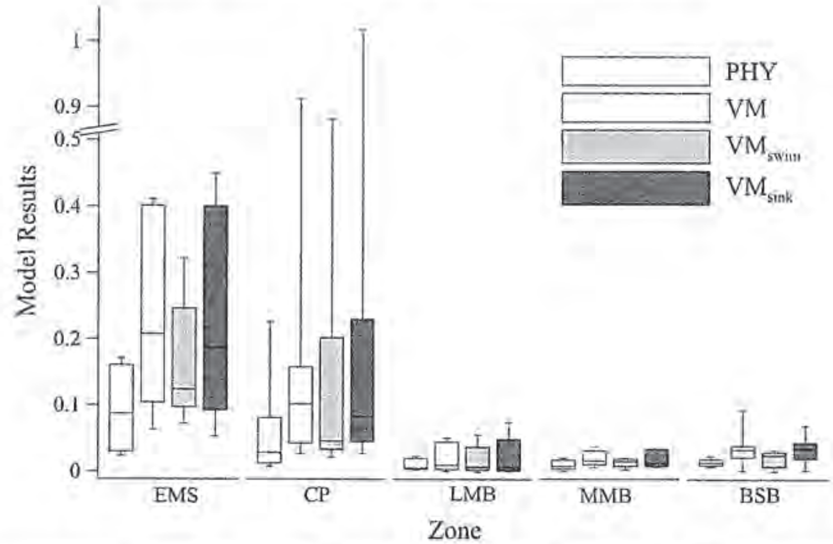

Figure 12. Comparison between the model results by physical transport only (PHY) and those with biological movement, including neutral buoyancy at the early stage and net sinking at the late stage (VM), net swimming at the early stage and net sinking at the late stage (VM_{swim}), and neutral buoyancy at the early stage and twice-as-fast net sinking at the late stage (VM_{sink}). The two end whiskers indicate the minimum and maximum, and the box is defined by the lower and upper quartiles, with the center line for the median.

larvae enhanced larval retention mainly in the southwestern part of the study area. Increases in net sinking velocity of late-stage larvae resulted in the largest increase in larval retention in CP, the spawning zone, which provides a favorable conditions for local recruitment of oysters. Biological movement also enhanced the patchiness in larval distribution (Figure 5d), consistent with the observations that late-stage oyster larvae exhibited pronounced patchiness in estuarine systems [*Kennedy*, 1996]. *Franks* [1992] suggested that the combined effects of behavioral larval movement and flow patterns may determine the horizontal and vertical scales of patchiness.

[53] In the Mobile Bay system, inclusion of biological movement resulted in little change in the overall patterns of oyster larval transport, resulting in a consistent west-east gradient compared to physical transport only. This may be attributable to frequent destratification in the southwestern part of the study area, EMS and CP, during larval recruitment periods in May–October, with seasonally low river discharge (Figure 3). The CTD casting data from nine surveys in 2006 showed a destratified water column, with the bottom-surface salinity difference less than 2 psu in EMS (Figure 4). In CP, five of nine surveys showed highly stratified conditions, with the bottom-surface salinity difference larger than 5 psu, but such strong stratification was readily destroyed during tropic tide or strong wind conditions when river discharge was less than 500 $m^3\ s^{-1}$. *Schroeder et al.* [1990] suggested that a current speed of 15 cm s^{-1} and a wind speed of 5 m s^{-1} are strong enough to mix a water column associated with a river discharge of 500 $m^3\ s^{-1}$. The present model results also showed frequent destratification of the water column in the southwest part of the study area. Such frequent destratification may prevent oyster larvae from utilizing horizontal transport by changing vertical position in the water column. As such, biological movement induced little change in the larval distribution due to physical transport in the Mobile Bay system and likely in other shallow estuarine systems experiencing frequent destratification.

[54] Oyster spat settlement and bivalve larval concentration are influenced by many biological conditions such as variations in spawning time, growth rate, and mortality of larvae and spat, as well as physical transport. *Saoud et al.* [2000] attributed the variability in spat settlement in Mobile Bay to different spawning times in each habitat. *Kennedy* [1996] reviewed that variations in transport patterns, salinity, DO, physiological tolerance, presence of competition and predators, and larval abundance may result in dramatic changes in settlement intensity within a small spatial and short time scale. The present model employed rather simplified biological conditions, with the assumptions of a single spawning event for each type of survey data, a constant linear growth rate, and no mortality of oyster larvae. Such simplifications may be responsible for the model results being less dynamic than the data. The model, nonetheless, gave a good overall description of the observed patterns of oyster spat settlement and bivalve larval concentration in the Mobile Bay system. This model application has been used to establish spatially explicit management strategies for oyster restoration in the Mobile Bay system [*Kim*, 2009]. The current field and modeling approach may be applicable for the study of recruitment of other marine invertebrates and fish, which may provide valuable information for management of exploited marine populations.

5. Conclusions

[55] We developed a larval transport model that accounts for physical transport, biological movement of larvae, and

site- and larval-specific conditions of eastern oysters. We validated the model with field data for oyster spat settlement and bivalve larval concentration collected throughout the Mobile Bay system in 2006. The model reproduced the dominant patterns of both types of data well, showing a consistent gradient decreasing from west to east. The model results always showed a peak concentration in the southwest part of the Mobile Bay system at time scales of overall average, season, and each survey. The persistent west-east gradient in the model results suggests that the larval supply may be responsible for the corresponding gradient in oyster spat settlement observed over the past 40 years. Net sinking of late-stage larvae increased larval retention near the spawning area, thus providing a favorable condition for local recruitment of oysters. Inclusion of biological movement, however, caused little change in the overall patterns of oyster larval transport resulting in a west-east gradient, which may be attributable to frequent destratification in the southwest part of the study area during the oyster larval recruitment period. The model results were not sensitive to model parameters such as spawning time, larval period, and parameterization of biological movement. This study enhances our understanding of the controlling processes for larval transport and retention of oysters in broad, shallow estuarine systems.

[56] **Acknowledgments.** We appreciate the anonymous reviewers' comments, which contributed greatly to the improvement of this paper. We would like to thank Drs. Richard A. Luettich and William W. Schroeder for their constructive comments and guidance throughout this study. We also thank Jason Herrmann, Mairi Miller, Zeb Schobernd, Crystal LouAllen, and Ben LaCour for their help with the field- and laboratory work. This study was funded by the National Marine Fisheries Service, NOAA, via a grant from the University of South Alabama's Alabama Oyster Reef Restoration Program.

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From: [redacted]
To:
Subject: FW: Slides presented at the Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018
Date: Tuesday, May 15, 2018 10:31:00 AM
Attachments: 11 May 2018 Environmental NGO Focus Meeting.pdf
11 May Focus Group Sign-in Sheet.jpg

Dang it...just realized that you weren't on the e-mail.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 15, 2018 9:45 AM
To: [redacted]
Subject: Slides presented at the Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

All: Please review the following notes from our meeting last Friday to make sure that I captured them accurately before I send to the NGO's.

All,
Attached are the slides presented at the focus group meeting and the sign-in sheet. The key discussion topics/concerns were as follows:

1.) [redacted] asked that the study address the environmental impacts during stressed conditions. For example, what are the environmental impacts of widening and deepening the channel during conditions such as the 2007 drought.

2. [redacted] stated that all oyster reefs have not been identified. Mobile District will contact the following individuals to ensure that all oyster reef locations are captured:
a. [redacted]
b.
c.
d.
e. [redacted]

3. [redacted] requested to see the results of the in-Bay Sediment Transport analysis. This will be presented in the Draft Report.

4.) [redacted] expressed [redacted] the Peninsula group's concerns in regards to the impacts of ship wake.

[redacted] stated that ship wake is also a major concern of Baykeeper. In addition to the cumulative impacts, the group requested that Mobile District provide the impact per vessel. The group also requested that we show the impact of the existing wake (baseline condition) against the design vessel.

5.) Mobile District continues to look for ways to beneficially use the new work dredge material [redacted] mentioned that they may have additional options.

[redacted]

-----Original Message-----
From [redacted]
Sent: Friday, May 11, 2018 7:34 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

Just a quick reminder for the Mobile Harbor GRR environmental focus group meeting this afternoon at 1:00 at the Mobile District. Looking forward to seeing everybody.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, April 17, 2018 1:19 PM
To: [redacted]
Cc: [redacted]
Subject: Reconvening of Mobile Harbor GRR Environmental Focus Group Meeting - 11 May 2018

The U.S. Army Corps of Engineers (USACE), Mobile District is reconvening an environmental focus group meeting and requesting your participation for the Mobile Harbor General Reevaluation Report regarding the potential deepening and widening of the Mobile Harbor navigation channel. The meeting will be held at the Mobile District Office, 109 St. Joseph Street, Mobile, Alabama 36602, on Friday, 11th at 1:00 PM central. The meeting will focus on and provide the opportunity for those involved in environmental activities associated with Mobile Bay and its connected watersheds to hear about updated environmental evaluations that have been conducted as part of the study and to provide your comments and concerns related to potential impacts of the project. Members of the project team will be on hand to discuss and answer questions related to the proposed project. This meeting provides the opportunity for organizations such as yours to share comments and concerns that will be considered in the preparation of the Supplemental Environmental Impact Statement. Due to a limited capacity of the meeting room, we are asking that only one representative from your organization be in attendance. Please respond to let us know if your organization will be represented. For more information, on the proposed Mobile Harbor Federal Navigation Channel project, visit http://www.sam.usace.army.mil/.

Thank you and looking forward to meeting with you.

[redacted]

Update on the Mobile Harbor General Reevaluation Report

COL James DeLapp
DISTRICT COMMANDER

22 February 2018

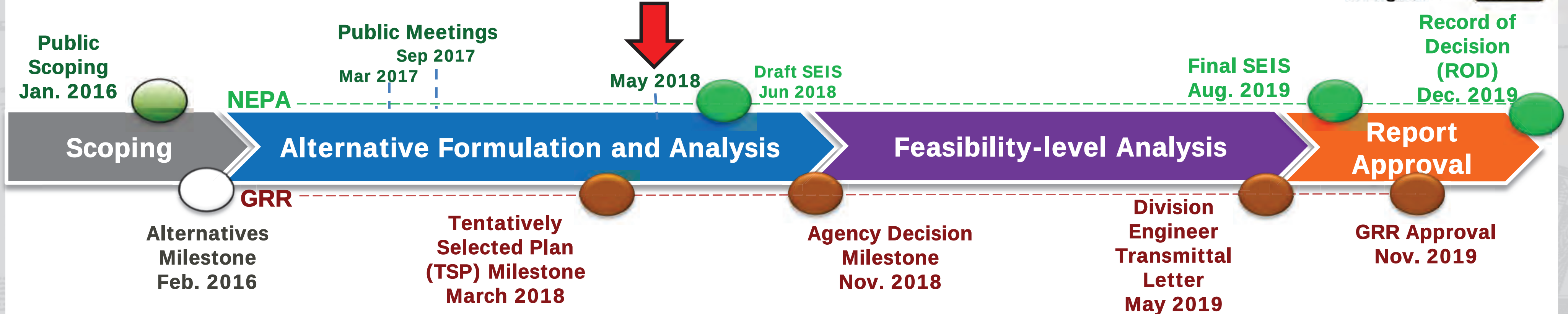
US Army Corps of Engineers

U.S.ARMY

GENERAL REEVALUATION REPORT SCHEDULE

US Army Corps of Engineers

U.S. ARMY



- 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)

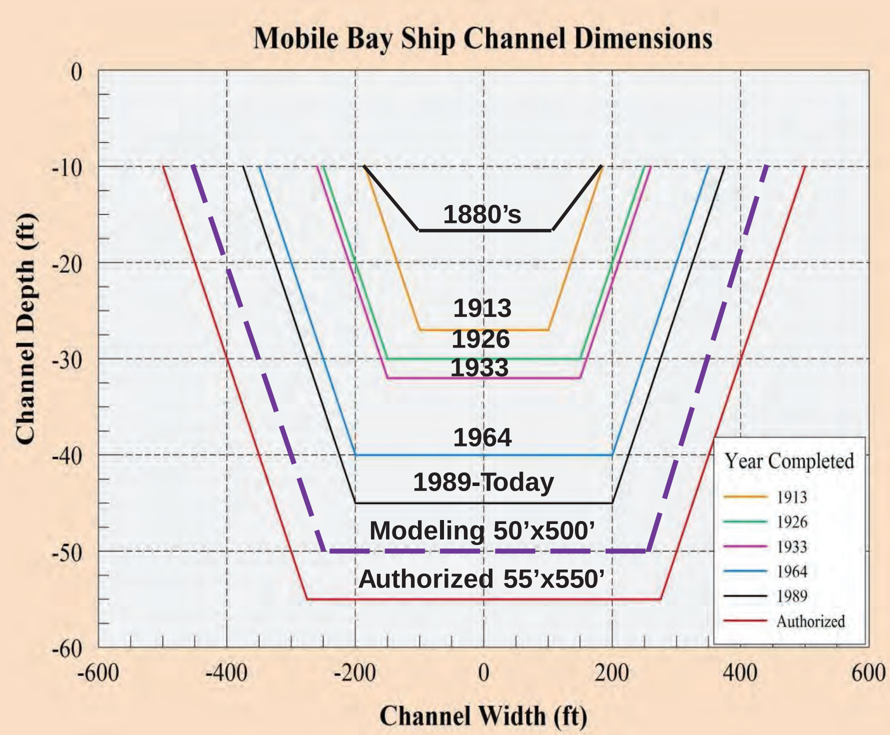
- Respond to comments in the SEIS
- Agency consultation activities
- Agency endorsement of recommended plan
- Prepare the Final Integrated GRR and SEIS
- Final integrated report package transmitted to Corps Headquarters

- 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

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



Tentatively Selected Plan

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

Tentatively Proposed Placement Locations

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

* Geotechnical data indicates minimal beach quality sand in new work

Release of Draft Supplemental Environmental Impact Statement scheduled for June 2018

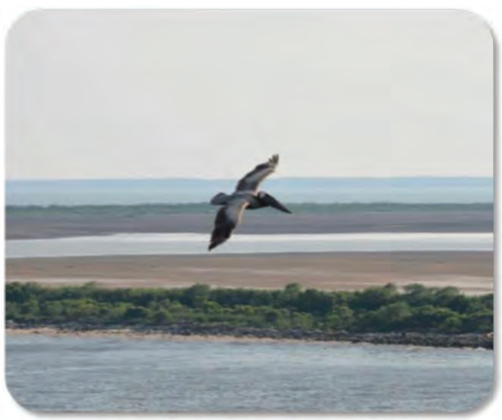
MOBILE BAY ENVIRONMENTAL IMPORTANCE

US Army Corps of Engineers

U.S. ARMY

Setting for Mobile Bay

- Shallow bay (≈ 9’), long deep channel
- 2nd largest delta, 4th largest drainage area in U.S.
- High biodiversity
- Fresh, brackish, estuarine & marine habitats
- National Estuary designation, 1995



Coastal Considerations

- Ongoing Studies
- Beneficial use of dredged material
- Effects on coastal processes

Impacts to Other Resources

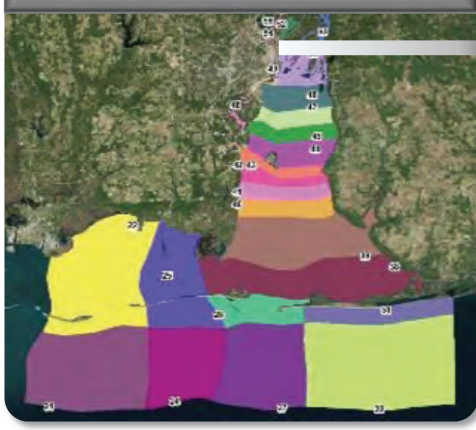
- Close coordination with State and Federal Agencies (USFWS, EPA, ADEM, ADCNR, NMFS)
- Endangered Species
- Wildlife
- Commercial fisheries
- Recreational fishing
- Sea level rise
- Cultural resources

AQUATIC RESOURCES ASSESSMENT

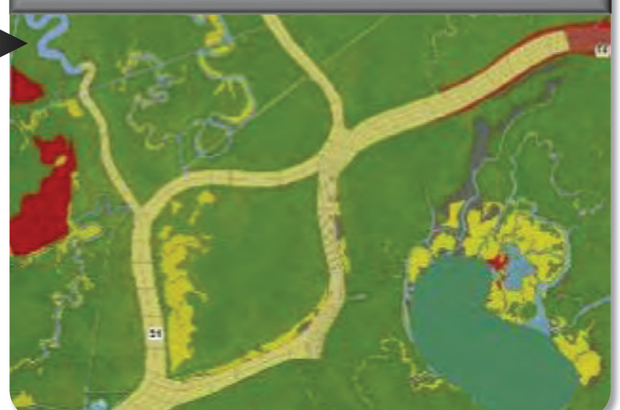
Overview

- Assessing potential impacts to wetlands, submerged aquatic vegetation, benthic invertebrates, oysters, fish
- Model outputs compare water quality (salinity, dissolved oxygen) using existing and post-project conditions
- Sea level rise scenario - 0.5 meter intermediate projection per USACE guidance at Dauphin Island

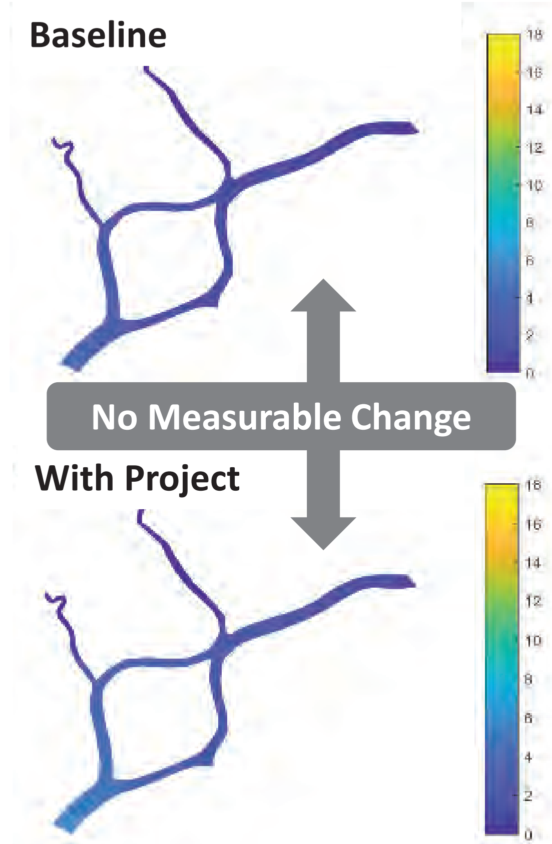
Model grid consists of 30 blocks & 48,000 cells



Model Block 54



Mean Salinity - July 2010



AQUATIC RESOURCES ASSESSMENT – WETLANDS

US Army Corps of Engineers

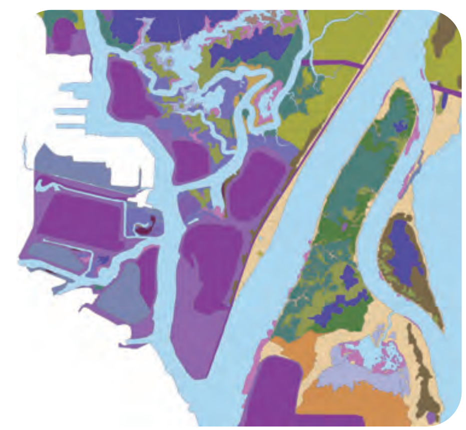
U.S. ARMY

Approach

- Wetland mapping - 77,000 ac mapped; 43 community types; >800 on-site samples
- Assessed potential exceedance of salinity thresholds

Results

- **No wetland losses anticipated**
- All vegetation within acceptable environmental tolerance ranges
- All wetlands within ideal growth conditions
- Sea level rise will result in substantial inundation of existing wetlands
- Project impacts remain negligible under 0.5 meter sea level rise scenario



SUBMERGED AQUATIC VEGETATION (SAVs)

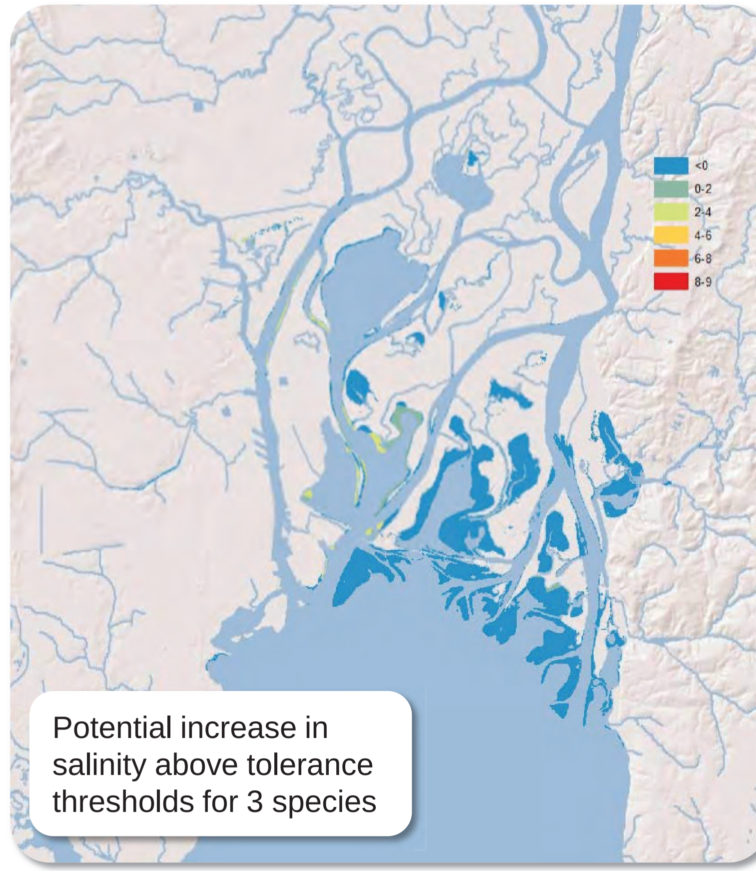
US Army Corps of Engineers

Approach

- Mobile Bay SAV extent verified (>6,000 ac) across 55 community types
- Salinity tolerances established for each community and adjusted to local conditions

Results

- **No loss of SAV habitat expected**
- Sufficient dissolved oxygen present under all scenarios
- Under expected (average) salinity conditions few impacts expected for most species
- Potential stress of Eurasian watermilfoil (invasive species), water celery, and coon's tail for short duration
- No major differences seen between baseline and post-project conditions under sea level rise scenario



AQUATIC RESOURCES ASSESSMENT – OYSTERS

US Army Corps of Engineers

U.S. ARMY

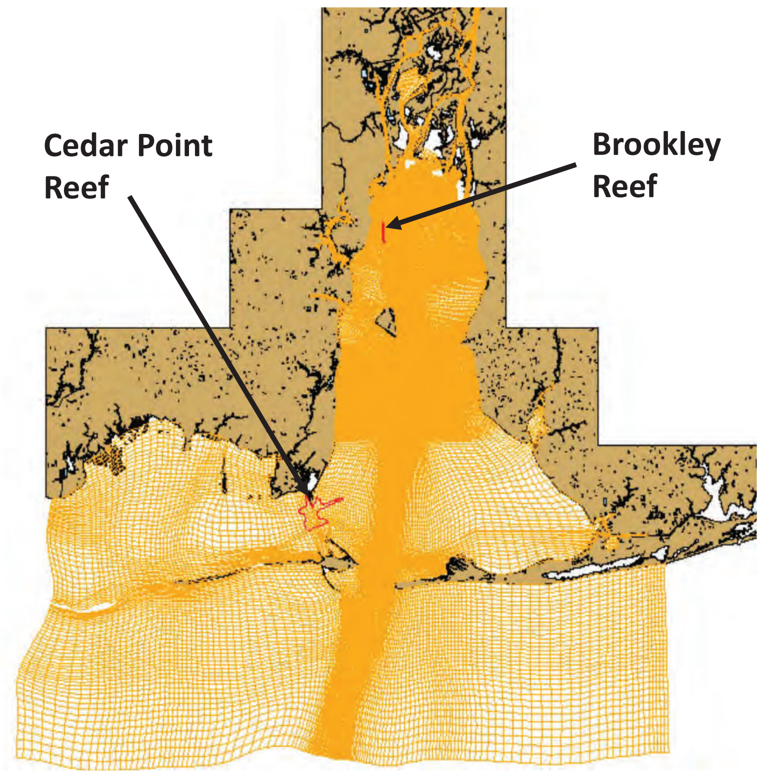
Approach

- 13 adult oyster reefs (>3600 ac) assessed for salinity and DO impacts
- Simulated oyster larval movement through integrated hydrodynamic, water quality, and larval tracking models

Results

- **Oyster larvae particle tracking displays 100% survivorship under all scenarios**
- Dissolved oxygen levels stay well above minimum oyster tolerances
- Salinity stays within oyster tolerance ranges
- Oyster model predicts no increase in larvae flushing out of Mobile Bay
- Sea-level rise scenario predicts no oyster mortality

Oyster Larvae Tracking Domain



AQUATIC RESOURCE ASSESSMENT – BENTHICS

US Army Corps of Engineers

U.S. ARMY

Approach

- 240 samples taken in freshwater, transitional, and upper bay habitats
- Locations of changes in invertebrate communities identified

Results

- **Community transitions from saline to freshwater will remain similar to baseline conditions.**
- Degree of freshwater (river) inputs dictates species transition locations
- Impacts to fish via prey availability appear negligible

AQUATIC RESOURCES ASSESSMENT – FISH

US Army Corps of Engineers

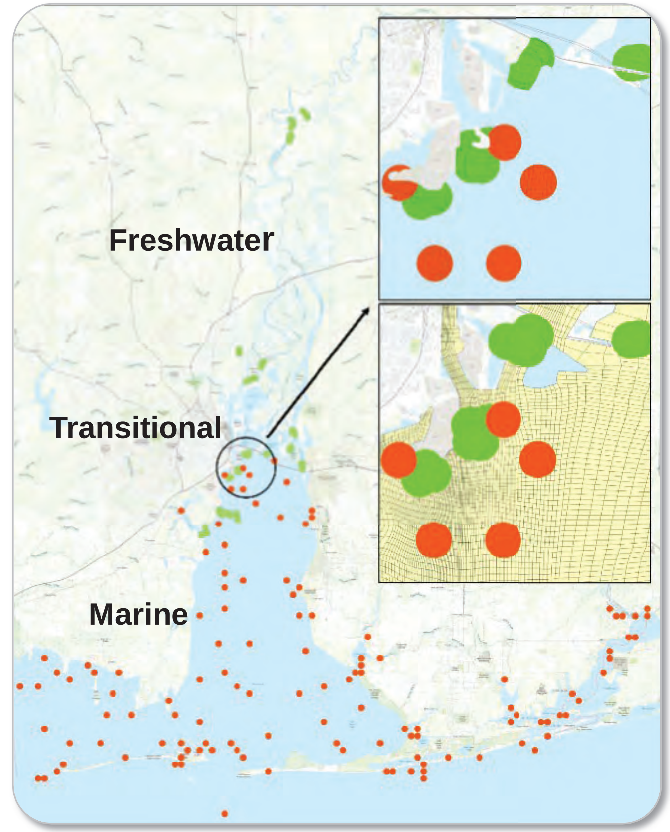
U.S. ARMY

Approach

- Data obtained from AL Marine Resources (2005-2015) and supplemented by USACE
- 98,000 individual fish, 140 species
- Linked salinity and abundance of community members

Results

- **No impacts expected due to salinity for:**
  - ✓ Freshwater species
  - ✓ Freshwater species entering estuary
  - ✓ Resident estuary species
  - ✓ Marine species entering estuary
  - ✓ Marine species



AL Marine Resources sampling stations

ERDC sampling stations

AQUATIC RESOURCES ASSESSMENT – SUMMARY

US Army Corps of Engineers

U.S. ARMY

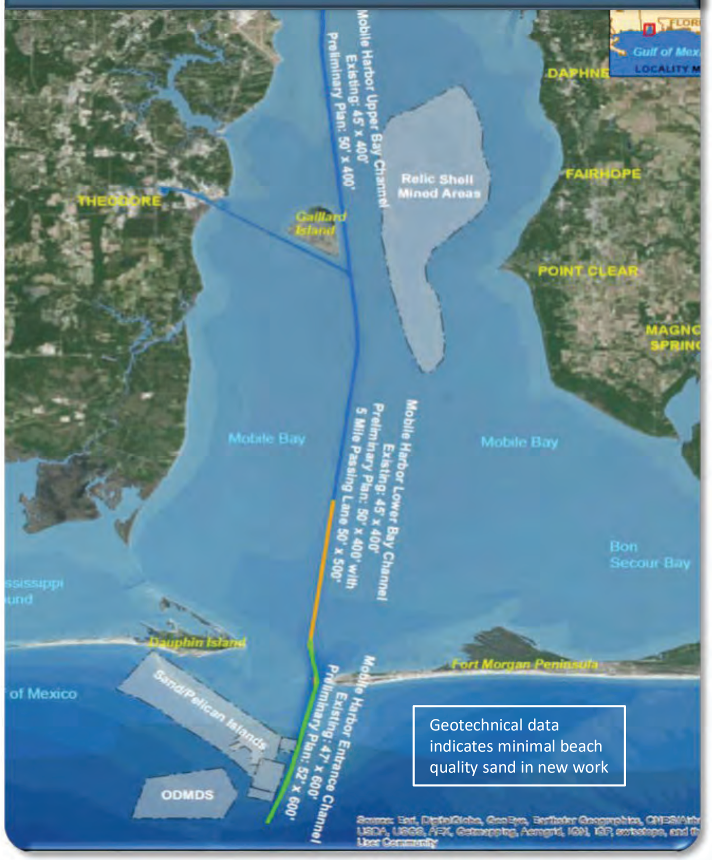
- **No major impacts (i.e., loss of resources) anticipated for:**
  - ✓ **Wetlands**
  - ✓ **SAV**
  - ✓ **Oysters**
  - ✓ **Benthic Invertebrates**
  - ✓ **Fish**
- Project impacts remain negligible under 0.5 meter sea level rise scenario

DREDGED MATERIAL PLACEMENT

US Army Corps of Engineers

U.S. ARMY

New Work Placement



Maintenance Dredging

ENGINEERING ANALYSIS – SEDIMENT TRANSPORT

US Army Corps of Engineers

U.S. ARMY

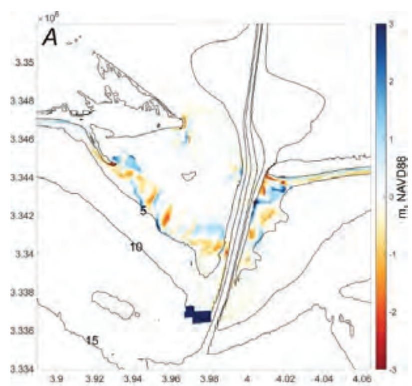
Approach: Conduct estuarine (fine-grained) and coastal (coarse-grained) sediment transport modeling to evaluate possible effects of widening and deepening the channel on sediment transport in Mobile Bay and on the ebb-tidal shoal/nearshore coastal areas.

Simulation Period: Estuarine (January 2010 – December 2010)

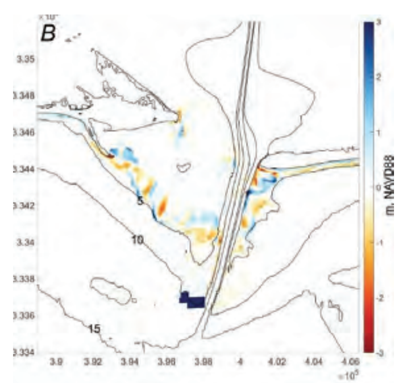
Coastal (10-yr simulation derived from data spanning from 1998 – 2016)

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

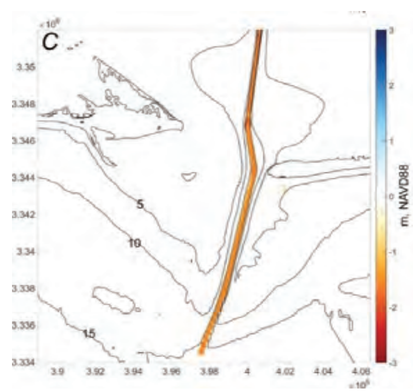
Results: Minimal bed level changes expected between the existing and with project conditions in the bay and on ebb-tidal shoal. Shoaling rates are expected to increase between 5 – 15%.



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



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



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

With Project Simulation
Percent Increase in Channel Shoaling

MOBILE HARBOR

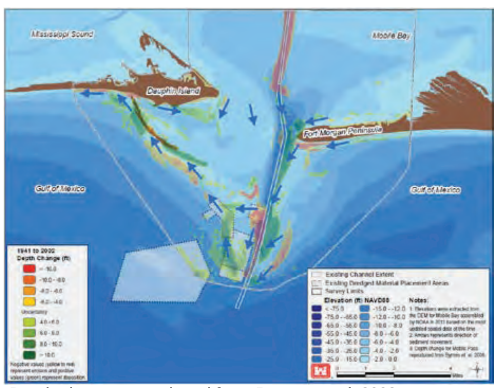
FUTURE MAINTENANCE MATERIAL PLACEMENT

Approach: Compare short and long-term changes in bathymetry to quantify sediment transport rates and identify transport pathways along the ebb-tidal shoal to determine if adequate disposal capacity exists for future maintenance material placement in the Sand Island Beneficial Use Area (SIBUA).

Analysis Period: 1941 – 2015

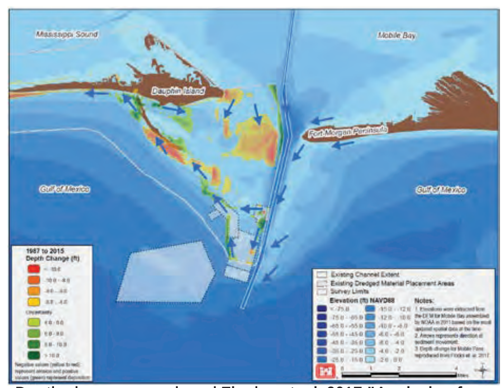
Results: Consistent sediment transport pathways are observed over the short and long-term periods. Material placed in SIBUA is in the active transport system; however, since placement in SIBUA was initiated in 1999, material has left the site at a lower rate than it has been placed in the site resulting in a need for expansion in the north/northwest direction to accommodate future needs.

Mobile Pass Bed Level Change 1941 to 2002



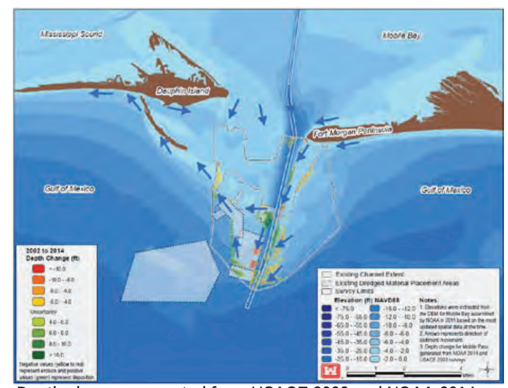
Depth change reproduced from Byrnes et. al, 2008 "Evaluation of Channel Dredging on Shoreline Response at and Adjacent to Mobile Pass, Alabama"

Mobile Pass Bed Level Change 1987 to 2015



Depth change reproduced 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



Depth change generated from USACE 2002 and NOAA 2014 surveys.

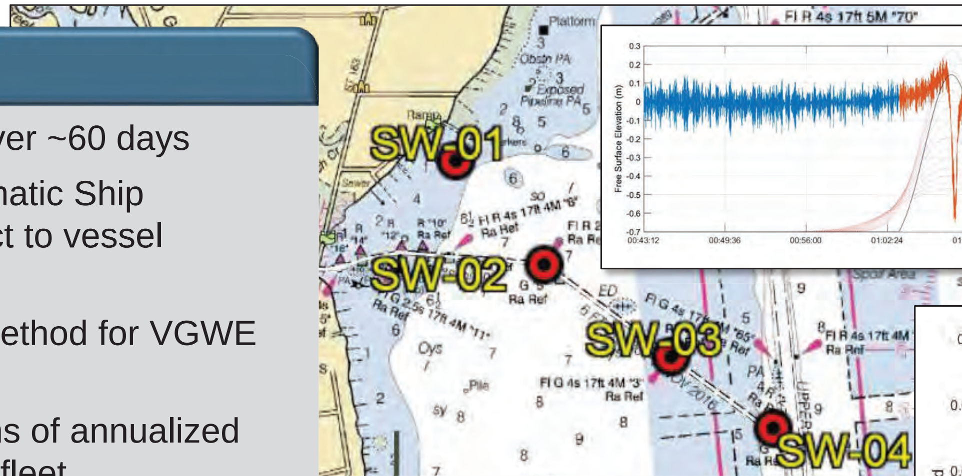
VESSEL GENERATED WAVE ENERGY (VGWE)

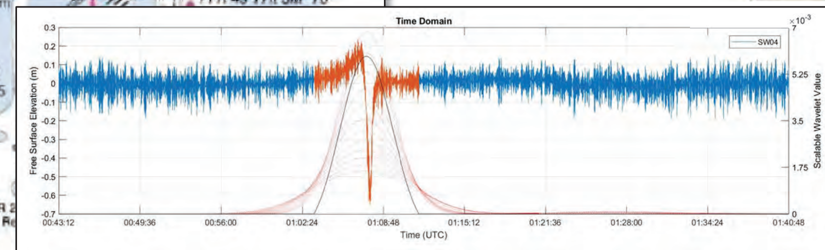
Approach

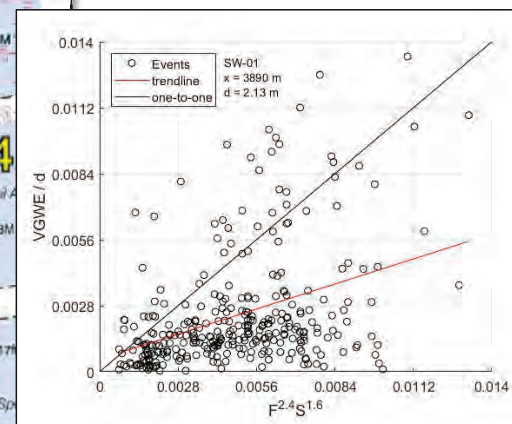
- Data collection at 5 stations over ~60 days
- Signal processing using Automatic Ship Identification (AIS) with respect to vessel characteristics.
- Validated existing predictive method for VGWE magnitude.
- Develop statistical comparisons of annualized current and forecasted vessel fleet.
- Computed total annual VGWE at two locations along the Federal Channel.

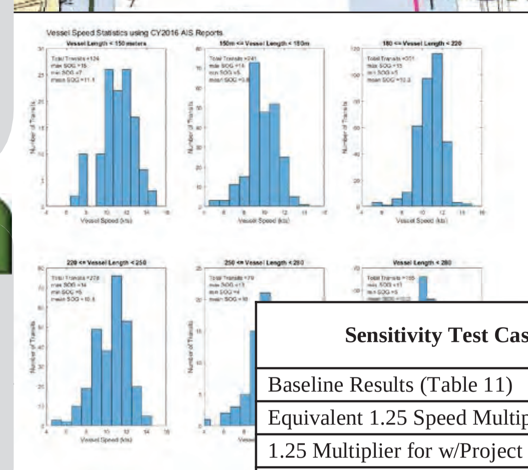
Results

- **No increase in VGWE as a result of the project**
- Practical increase in vessel speed does not induce impacts









Sensitivity Test Case	VGWE w/o Project	VGWE w/ Project	Difference
Baseline Results (Table 11)	19.337	14.366	4.971
Equivalent 1.25 Speed Multiplier	26.28	19.524	6.756
1.25 Multiplier for w/Project	19.337	19.524	-0.187
Baseline Equivalent Froude Number	19.337	15.883	3.454

IN CONCLUSION…

US Army Corps of Engineers

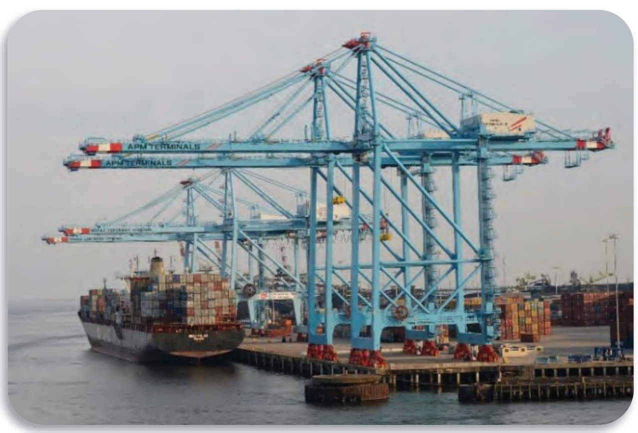
U.S. ARMY

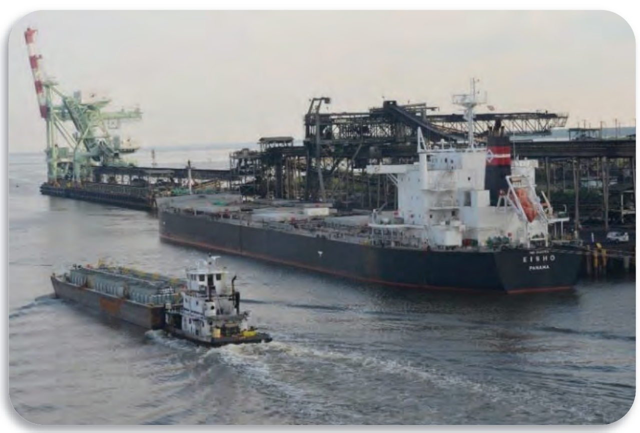
Summary

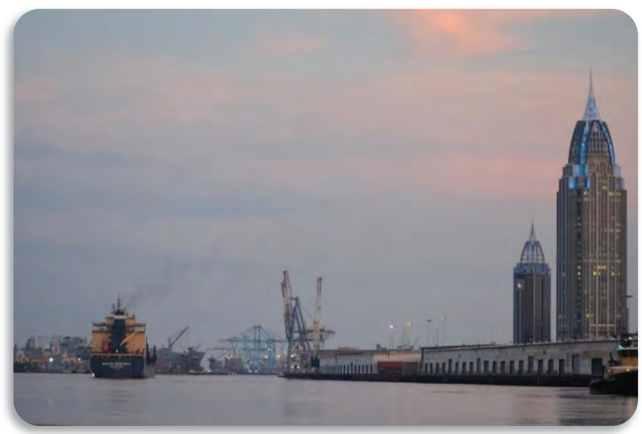
- Study is evaluating depth of 50 foot with a 100 foot, 3-mile widener
- Based on the predicted impacts, no mitigation measures are warranted
- Alternate placement sites are being considered for bar channel maintenance material

What's Next

- Complete Draft Report with SEIS June 2018
- Public Meeting July 2018
- Agency Decision Milestone Nov 2018







MOBILE DISTRICT CONTACTS

US Army Corps of Engineers

U.S. ARMY

Internet and Social Media

sam.usace.army.mil

facebook.com/**usacemobile**

twitter.com/**usacemobile**

Instagram.com/**usacemobile**

flickr.com/photos/**usacemobile**

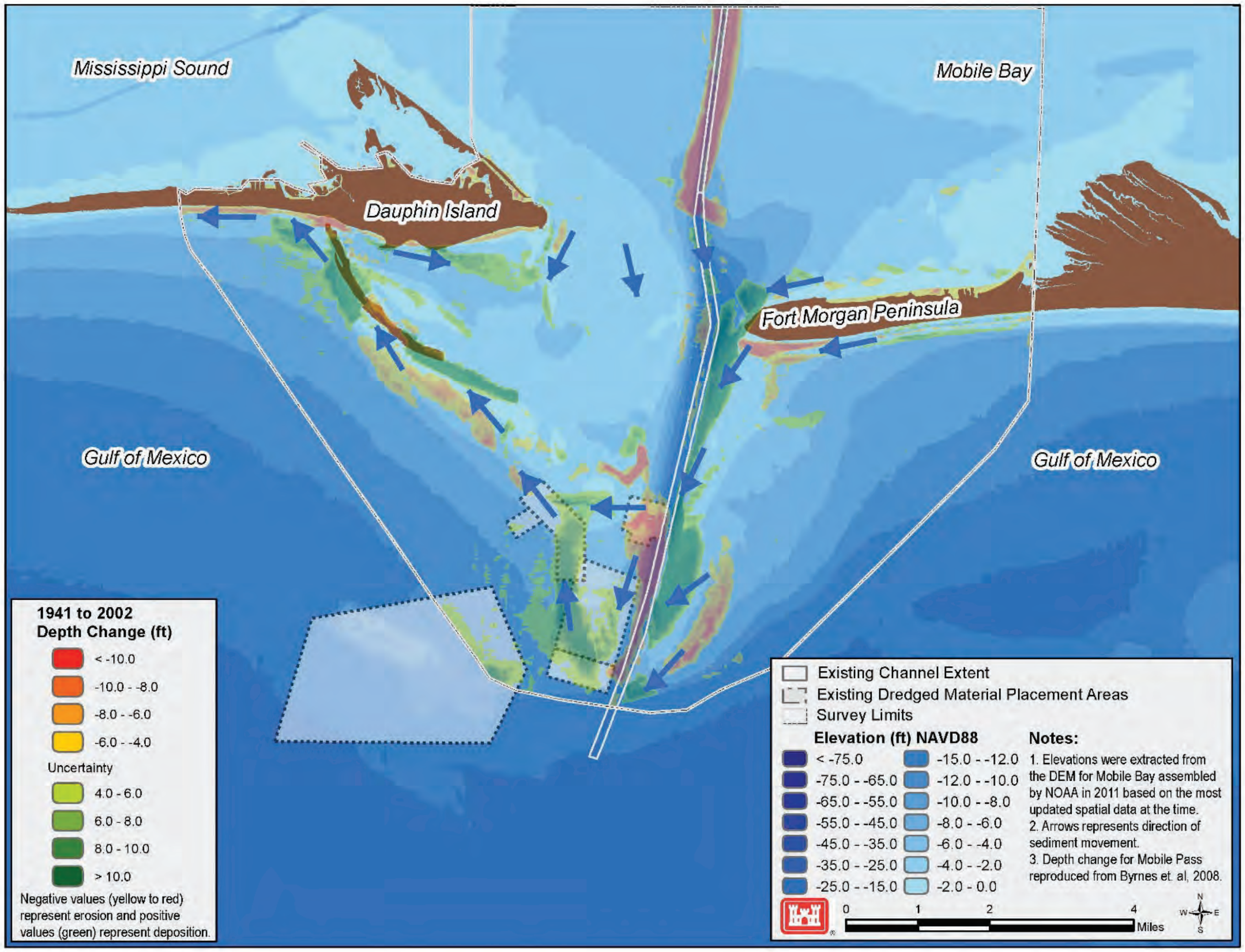
Phone, Email, Mailing Address

Public Affairs Office (General Information)
(251) 690-2505

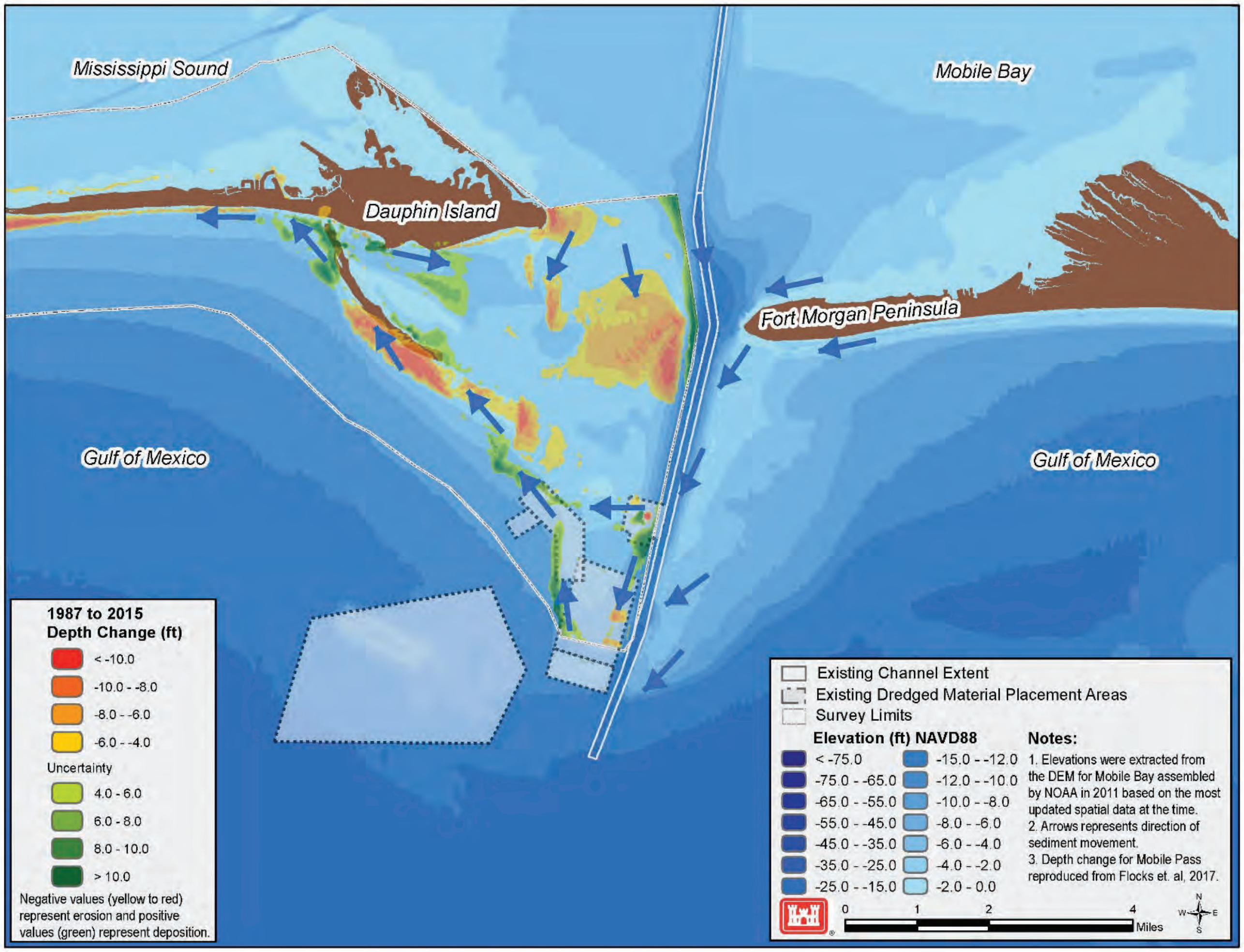
E-mail: MobileHarborGRR@usace.army.mil

Postal Mail:
U.S. Army Corps of Engineers
Mobile District
P.O. Box 2288
Mobile, AL 36628-0001

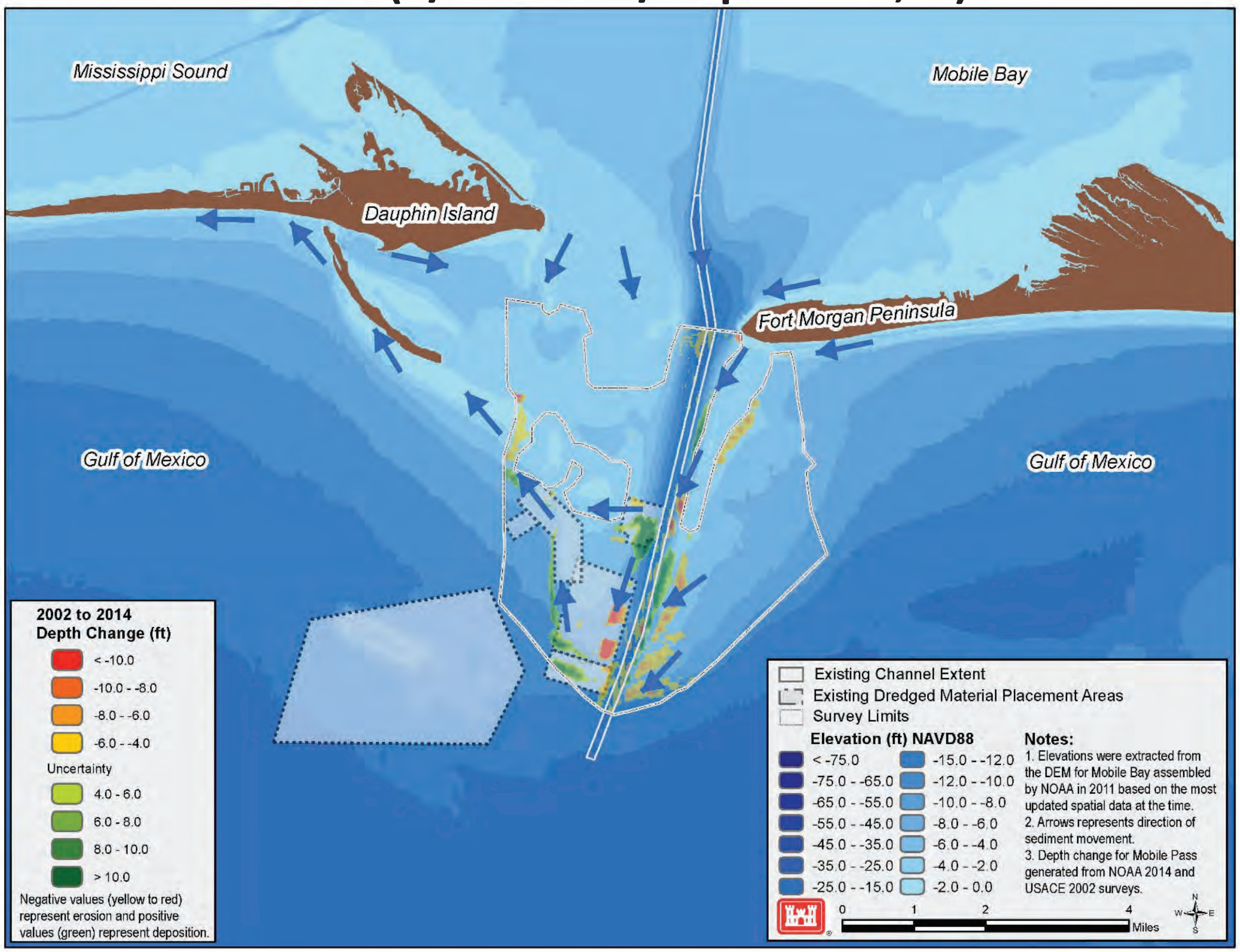
Mobile Pass Bed Level Change 1941 to 2002
(+/- Erosion/Deposition, ft)



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



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



From: [redacted]
To:
Cc:
Subject: FW: Utilities and infrstructure
Date: Tuesday, May 15, 2018 3:56:00 PM
Attachments: Utilities and infrastructure_Draft.docx

[redacted]
I believe that [redacted] s updating the table on the pipeline crossings. Let me coordinate with him.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 15, 2018 3:42 PM
To: [redacted]
Subject: [Non-DoD Source] Utilities and infrstructure

Please see attached [redacted] there are a couple of notes for you in this one

[redacted]

Pages 2 through 7 redacted for the following reasons:
- -
(b)(5)

From:	[redacted]
To:	
Subject:	FW: DCNR Offshore Infrastructure Map
Date:	Wednesday, May 16, 2018 1:19:00 PM

[redacted] Are you able to get this website to work? I am not.

[redacted]

From: [redacted]
Sent: Wednesday, May 16, 2018 10:55 AM
To: [redacted]
Subject: [Non-DoD Source] FW: DCNR Offshore Infrastructure Map

[redacted]

Please see if the attached link gets you what is needed.

[redacted]

From: [redacted]
Sent: Wednesday, May 16, 2018 9:38 AM
To: [redacted]
Subject: RE: DCNR Offshore Infrastructure Map

[redacted]

See if this works..

Blockedhttps://ogb.state.al.us/apps/offshore/ <Blockedhttps://urldefense.proofpoint.com/v2/url?u=https-3A__ogb.state.al.us_apps_offshore_&d=DwMGaQ&c=8K0mnSt5E4j4U_dMGxZxbA&r=TSWb2qfoz7JAcYMAfwhNGfsoPpBfxA2rWoDQyjWqwos&m=vAa7ygD44BwuM5jNFGQxuH1ZwG-IzsBK8nalkiwyDss&s=MsEB96ZGsECu2rsDIqKtGnJkGtX8NMf5LGftrwAkHcY&e=>

From: [redacted]
Sent: Thursday, September 14, 2017 1:05 PM
To: [redacted]
Subject: RE: DCNR Offshore Infrastructure Map

I was able to get it to half work.. Some of the tools appear to be incompatible with our ArcGIS Server now. I was mentioning to Jeremiah Kolb that I was going to try to make a new application with updated web technologies. Would that be ok?

[redacted]

From: [redacted]
Sent: Thursday, September 14, 2017 1:03 PM
To: [redacted]
Subject: Re: DCNR Offshore Infrastructure Map

[redacted]

We're you able to make any progress with the map?

Sent from my iPhone

On Aug 30, 2017, at 2:13 PM [redacted] > > wrote:

[redacted]

Thanks. That would be great. It's not a priority for us, but I think the COE would find it very useful for their project. Just let me know what you find out.

[redacted]

From [redacted]
Sent: Wednesday, August 30, 2017 1:48 PM
To: [redacted]
Subject: RE: DCNR Offshore Infrastructure Map

[redacted]

I'm pretty certain that most of the functionality of the tools in the map won't work like expected anymore. The map we were hosting was used as a demo to show DCNR folks after the CIAP project had been completed. I passed all the code and data back to DCNR as a deliverable with the belief that DCNR would maintain it and host it themselves. I left the demo up figuring DCNR would eventually put it on their site. I don't think that ever happened. We just released a new website and the offshore app was left behind on the old one.

Afte [redacted] mail asking where it was, I copied it over to the new site but I haven't had time to fix anything on it. Let me see if I can fix it real quick and if I can, I'll demo it for you. I'll keep you posted. I'm hoping I can get it working by the end of today.

[redacted]

From: [redacted]
Sent: Wednesday, August 30, 2017 11:41 AM
To: [redacted]
Subject: DCNR Offshore Infrastructure Map

[redacted]

The COE is doing project planning regarding increasing the size of the Mobile Harbor Federal Navigation Channel and wanted to cross-check their information against what we have regarding the location of submerged pipelines currently crossing the channel. My boss [redacted] told me about the on-line map and got me the link to it. I am reluctant to pass this link on to the COE until I am confident it will work for them. I have tried to use it and have not been successful and getting the information that I think they want. If you have time to run me through the use of the map, I would really appreciate it. I can do this at your convenience. Thanks.

[redacted]

From: [redacted]
To:
Subject: Mobile Harbor O&M Navigation Funding Needs
Date: Wednesday, May 16, 2018 7:54:00 AM

I was thinking something like this....

In response to the question on whether additional O&M Funds are required to ensure that the Mobile Harbor Navigation Channel will be maintained to its full dimensions prior to construction of the channel modifications, It is assumed that the first phase of construction will be awarded in [redacted] Accordingly, the following O&M dredging needs apply:

The River Channel is dredged annually and the Upper Bay Channel is continuously dredged [redacted]

The Lower Bay Channel is dredged as required [redacted]

The bar channel is dredged about 3 years. [redacted]

Please let me know if you have any additional questions.

[redacted]

From: [redacted]
To:
Subject: RE: Mobile Harbor Draft Econ Appendix
Date: Wednesday, May 16, 2018 2:43:00 PM

Thank you, [redacted] You really are awesome!!!

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 16, 2018 2:38 PM
To: [redacted]
Cc: [redacted]
Subject: Mobile Harbor Draft Econ Appendix

[redacted]

I have placed (and attached) the DRAFT Mobile Harbor Economic Appendix on the N drive (Mobile Harbor►Appendices►Economics) for inclusion into the main report. As discussed, the cost tables are blank as I will receive updated cost early next week as well as complete the updated widening benefits.

[redacted]

From: [redacted]
To:
Cc:
Subject: RE: Mobile Harbor Federal Nav Channel - Pipeline Crossings
Date: Wednesday, May 16, 2018 8:35:00 AM

[redacted]
Can you find out if the map is up and running to show the Mobile Harbor Navigation Channel pipeline crossings?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Monday, September 18, 2017 10:29 AM
To: [redacted]
Subject: [EXTERNAL] RE: Mobile Harbor Federal Nav Channel - Pipeline Crossings

I had contact wit [redacted] f the OGB on Thursday. He worked on the original on-line map. He has tried to tweak the original application but some of the map's interactive tools aren't compatible with the newer version of their ARCGis Server. He is going to try and modernize the map, but I don't have a firm timetable on that work. Did you have any success contacting the PSC Pipeline Safety Group?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Sunday, September 17, 2017 10:13 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Mobile Harbor Federal Nav Channel - Pipeline Crossings

[redacted] any news since your 31 August email?

[redacted]

From: [redacted]
To:
Subject: RE: Mobile Harbor GRR existing and TSP maps
Date: Wednesday, May 16, 2018 7:59:00 AM

Good morning [redacted]
These are the maintenance sites known as Open Water Disposal, or, colloquially as "thin layer disposal." No new work material from our project will be placed in these sites. They have already been approved and are currently used for maintenance dredging of the channel.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 15, 2018 5:54 PM
To: [redacted]
Subject: RE: Mobile Harbor GRR existing and TSP maps

Hey [redacted]
I have a question about the "Mob_Exist_May_2018_Plate2B.pdf". There are dredged material placement areas listed on both sides of the channel numbering from 1-29 (E and W). I don't see them falling into the category of any of the four proposed placement areas. Those placement areas consist of a large number of acres - are these still supposed to be in the TSP?

Thanks,
[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 15, 2018 3:33 PM
To: [redacted]
Subject: Mobile Harbor GRR existing and TSP maps

All: Existing maps are attached for the existing channel and TSP. Please use these as the project maps in your portion of the report.

[redacted]

[redacted] (b)(6)

-----Original Message-----
From [redacted] (b)(6)
Sent: Tuesday, May 15, 2018 3:16 PM
To: [redacted] (b)(6)
[redacted] (b)(6)
Subject: FW: Mobile harbor existing and tsp maps

Mobile Harbor maps are attached for the existing channel and TSP.

[redacted] (b)(6)

-----Original Message-----
From [redacted] (b)(6)
Sent: Tuesday, May 15, 2018 2:46 PM
To: [redacted] (b)(6)
Subject: Mobile harbor existing and tsp maps

From: [redacted]
To:
Subject: FW: Naming Conventions for the Report/Appendices - Mobile Harbor GRR
Date: Thursday, May 17, 2018 3:00:00 PM
Attachments: Naming Convention for Mobile Harbor GRR.docx

-----Original Message-----
From: [redacted]
Sent: Thursday, April 12, 2018 5:02 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Naming Conventions for the Report/Appendices - Mobile Harbor GRR

Team,

A list of the naming conventions of the placement areas, channel features, and modifications is attached for your use in preparation of the report.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, April 12, 2018 3:07 PM
To: [redacted]

[redacted]

Cc: [redacted]

Subject: RE: Naming Conventions for the Report/Appendices - Mobile Harbor GRR

All,
Per yesterday's discussion, please update the Mobile Harbor GRR names in the report as follows:
REVISE "Sand Island Beneficial Use Area Extension" to "Sand Island Beneficial Use Area Northwest Extension" and,
"Widener" to "Widener for passing"

[redacted]

-----Original Message-----
From [redacted]
Sent: Thursday, March 01, 2018 10:21 AM
To [redacted]

Cc: [redacted]

[redacted]
Subject: Naming Conventions for the Report/Appendices - Mobile Harbor GRR

All,
For consistency, please use the following names for the harbor segments and placement sites within the Mobile Harbor Report:
Choctaw Pass Turning Basin
Bay Channel
Bar Channel
Relic Shell Mined Area
Sand Island Beneficial Use Area (SIBUA)
Sand Island Beneficial Use Area Extension
Ocean Dredge Material Disposal Site (ODMDS)

[redacted]

-----Original Appointment-----
From [redacted]
Sent: Wednesday, February 01, 2017 12:39 PM
To [redacted]
Cc: [redacted]
Subject: Mobile Harbor GRR Bi-weekly Meeting
When: Wednesday, February 28, 2018 2:00 PM-3:00 PM (UTC-06:00) Central Time (US & Canada).
Where: MsCIP Conference Room

For those not in the district office, call-in Information is as follows:

USA Toll-Free [redacted]
Access Code [redacted]
Security Code [redacted]

All: The Mobile Harbor GRR bi-weekly meeting has been moved to Wednesdays at 2pm, beginning February 01, 2017. Please update your calendar accordingly. The purpose of the meeting remains to provide a brief update on the project, ensure all work is being performed, and ensure that the schedule is met.
Thanks,
[redacted] (b)(6)

NAMING CONVENTION FOR MOBILE HARBOR GRR

Placement Areas:

- Ocean Dredged Material Disposal Site (ODMDS)
- Relic Shell Mined Area
- Sand Island Beneficial Use Area (SIBUA)
- Sand Island Beneficial Use Area Northwest Extension

Channel Features:

- Bar Channel
- Bay Channel
- Choctaw Pass Turning Basin
- River Channel

Channel Modifications

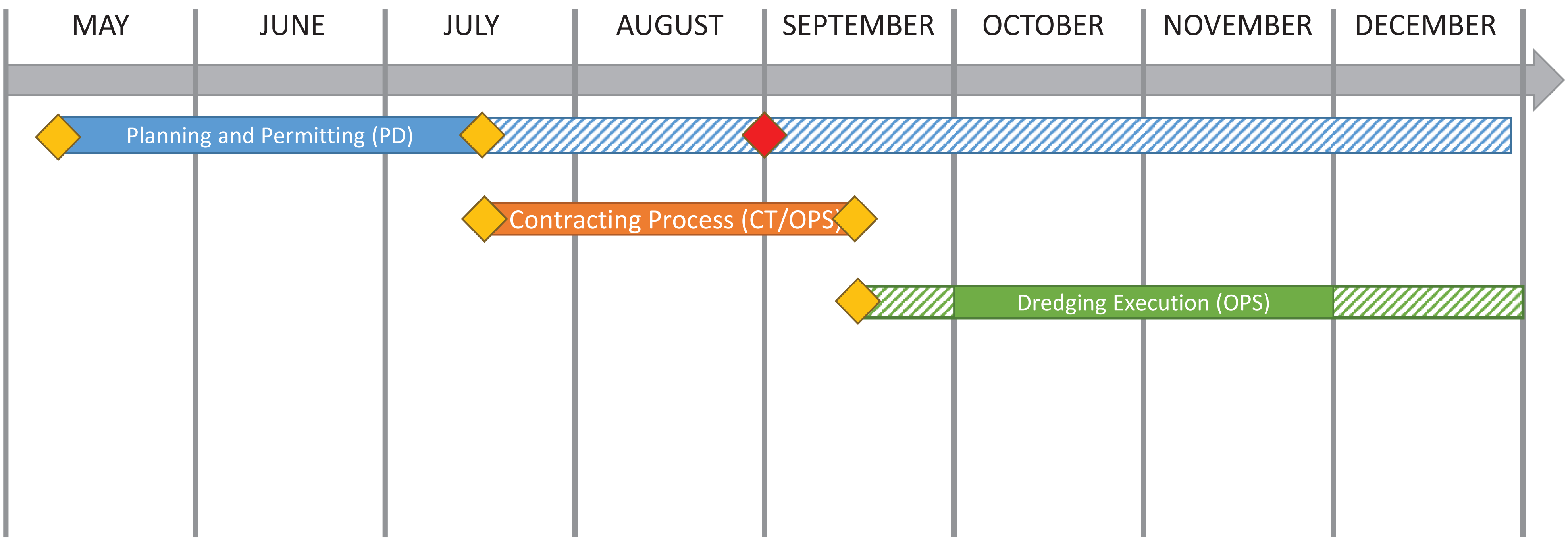
- Bend Easing
- Deepening
- Widener for Passing

From: [redacted] (b)(6)
To:
Subject: NW SIBUA Extension.pptx
Date: Friday, May 18, 2018 1:45:00 PM
Attachments: NW SIBUA Extension.pptx

See second slide. Oh, I need the estimated bar channel dredging cost as well.

[redacted] (b)(6)

TIMELINE NORTHWEST SIBUA EXTENSION



US Army Corps of Engineers

U.S. ARMY

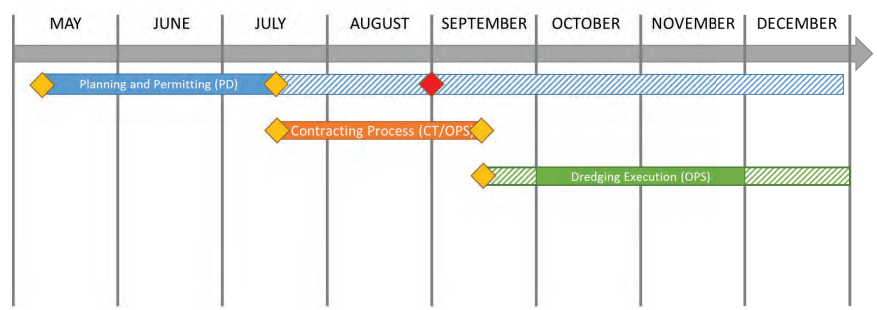
ALABAMA ,CONTINUED

OPERATIONS AND MAINTENANCE:

MOBILE HARBOR BAR CHANNEL DREDGING

- **Project Manager: David Newell 251-690-2328**
  Technical Project Manager: Herb Bullock 251-694-3703
- **Sponsor: Alabama State Port Authority**
- **Estimated Bar Channel Dredging Cost:**
- **Description:**
  Maintenance of the bar channel is accomplished in October and November to ensure availability of dredge equipment. Operations will begin working with contracting NLT mid-July to ensure NTP issued by October. Planning requires cultural phase I Survey, possible cultural phase II survey, public notice and comment period, Environmental Assessment, and FONSI for approval to use SIBUA Northwest Expansion for disposal of bar channel material.

- **Milestones**
  - **Advertise: 16 July 2018**
  - **Open Bids: 15 August 2018**
  - **Award Contract: 12 September 2018**
  - **Issue NTP: 01 October 2018**
- **Status:**
  Engineering is finalizing the dimensions of the SIBUA Northwest Extension. Operations is evaluating locations in the northern permitted area SIBUA as an alternate should the Northwest Extension not be permitted on time.



From: [redacted]
To:
Cc:
Subject: FW: TSP Briefing Discussion Information
Date: Friday, May 18, 2018 8:20:00 AM

[redacted] Forwarded below is an update that [redacted] rovided in March on the status of the Mobile Harbor Disposal Sites.

[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, March 27, 2018 3:42 PM
To [redacted]
Subject: TSP Briefing Discussion Information

Aquatic Resources Model Review
The ERDC team has been coordinating with [redacted] from ECO-PCSX and moving forward with the model review for the ecological impact assessment models/approach. The PCX has been provided funding for development and approval of a model review plan and further coordination with ERDC. The PCX is already in discussions with the ERDC team to outline the documentation requirements and review process to identify the appropriate and available reviewers at ERDC for the ELEMRS (Environmental Laboratory Electronic Manuscript Review System) review.

Status of Disposal Sites
ODMDS - The majority of dredged material from the proposed channel modifications, an estimated 27MCY, will be placed in the ODMDS. The existing Mobile ODMDS is 4.75 square nautical miles (nmi2). The Mobile District is pursuing a modification to expand the ODMDS to 24 nmi2 to meet the future needs of O&M and new work material. Coordination with EPA on the expansion is in progress pending a USACE determination on cultural resource survey requirements. Once EPA receives the EA from the Corps, the process is expected to be complete in about 10 months. EPA has indicated that the cultural resources decision will not hold up their process. Once the expansion is finalized, Section 106 consultation will be conducted and a modification of the WQC will be pursued to include the updated ODMDS.

Relic Shell Mining Area - The proposed placement within this site is the result of beneficial use discussions with the cooperating agencies where it was suggested that Mobile District conduct open bay thin-layer placement in areas of historic relic shell mining operations. It has been calculated that there is capacity for approximately 5.5 MCY. Existing depths within these sites generally range from 10 to 14 feet. Although volume estimates are based on an average thickness of approximately 1.5 feet, it is anticipated that placement would be accomplished with a maximum thickness of approximately 3 feet due to the characteristics of the new work material. 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 sediment transport system. This disposal area has been coordinated with the cooperating agencies during the agency scoping process.

SIBUA - As part of this study, bathymetric change analysis and coastal sediment transport modeling indicated that material moving out of the SIBUA moves at a slower rate than what is needed to ensure adequate disposal capacity for the anticipated increase of maintenance material within the bar channel. It will be necessary for the Mobile District to pursue modifications to extend the site beyond the existing boundaries of SIBUA that meet the requirements of the legal settlement and provide sufficient movement of material and capacity for new work and maintenance material. Currently, an analysis is being conducted to determine the location and size of the expanded footprint to ensure future capacity in the site. It is anticipated that the expansion of the SIBUA will extend its boundaries to include areas within the Sand Island-Pelican Island complex. When the expansion dimensions have been determined, the necessary coordination actions will be conducted to modify the WQC. Is should be understood that the proposed expansion is being conducted under O&M and not as part of this study. Any suitable bar channel new work material dredged in sufficient quantity to warrant placement within the SIBUA will be accomplished accordingly. Based on existing geotechnical information, it is anticipated that the new work material does not contain enough suitable sandy material to warrant placement within SIBUA.

I will forward the status of the noise, air, EJ, and cumulative impacts sections when I receive it from [redacted]

From: [redacted]
To:
Subject: FW: IEPR Charge - Mobile Harbor GRR
Date: Monday, May 21, 2018 8:15:00 AM
Importance: High

All: Please confirm your page counts for the report below by noon today.

[redacted] Just go with what you have if we don't receive updates by noon.

[redacted]

From: [redacted]
Sent: Monday, May 21, 2018 8:01 AM
To: [redacted]
Cc: [redacted]
Subject: RE: IEPR Charge - Mobile Harbor GRR
Importance: High

[redacted]

View in html. Thanks for sending the charge back. I'm on my last step to confirm the IGE but need your final blessing on the report page counts. The size of the report is a major driver for the IGE so the better data we have on this table the more time we'll save not having to go back and forth with the OEO on their proposals. Please either confirm the table below is accurate or provide new page count updates. I'm hoping to get all the docs out the door today so your prompt response is appreciated.

Report Title for IEPR Panel Review

Anticipated Date of Report/Data

Approximate Number of Pages

Draft Integrated GRR and SEIS

June 2018

200

Appendix A: Engineering

June 2018

75

Appendix A, Attachment 1: ERDC Modeling Report

June 2018

100

Appendix A, Attachment 2: USGS Modeling Report

June 2018

30

Appendix A, Attachment 3: Ship Simulation Report

June 2018

90

Appendix A, Attachment 4: Wave Energy Assessment

June 2018

90

Appendix A, Attachment 5: Data Collection Report

June 2018

30

Appendix A, Attachment 6: Boring Logs

June 2018

300

Appendix B: Economics

June 2018

50

Appendix C: Environmental

June 2018

80

Appendix C: Real Estate

June 2018

60

Public Comments [1] [2]

June 2018

50

Risk Register [1]

June 2018

20

Total

1,175 [3]

Thanks!

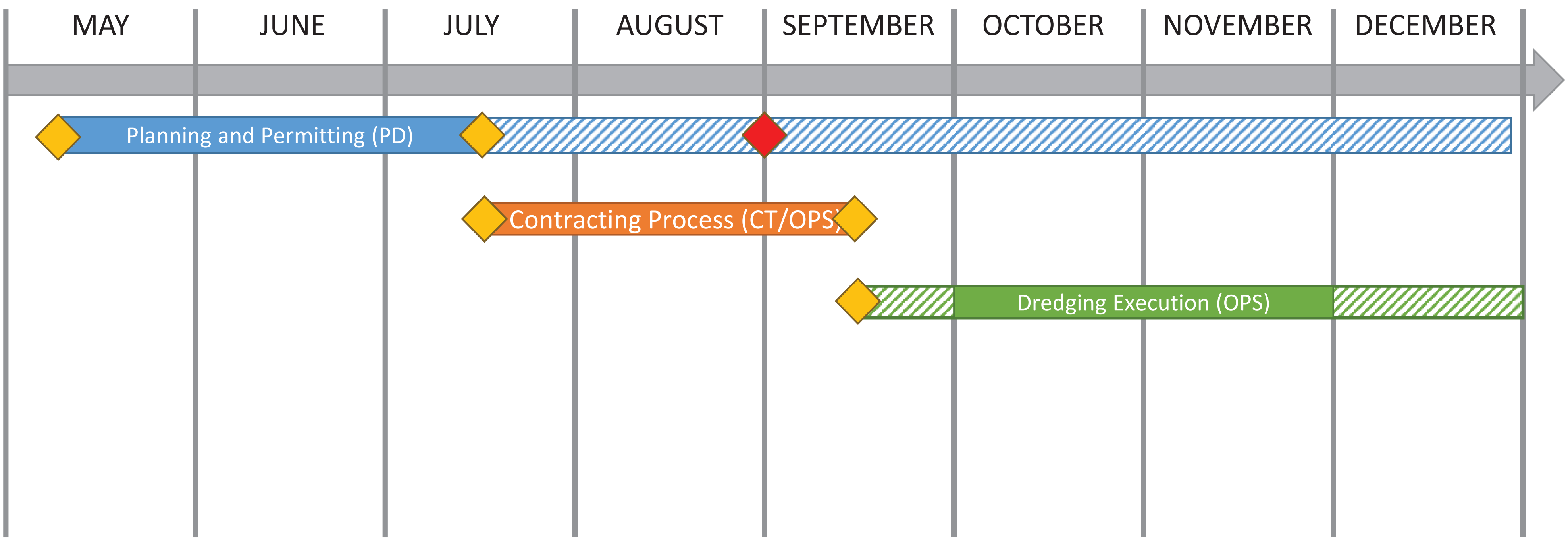
[redacted]

-----Original Message-----
From [redacted]
Sent: Friday, May 18, 2018 2:59 PM
To: [redacted]
Cc: [redacted]
Subject: IEPR Charge - Mobile Harbor GRR

[redacted]

From: [redacted]
To: [redacted]
Subject: NW SIBUA Extension.pptx
Date: Monday, May 21, 2018 9:27:00 AM
Attachments: NW SIBUA Extension.pptx

TIMELINE NORTHWEST SIBUA EXTENSION



US Army Corps of Engineers

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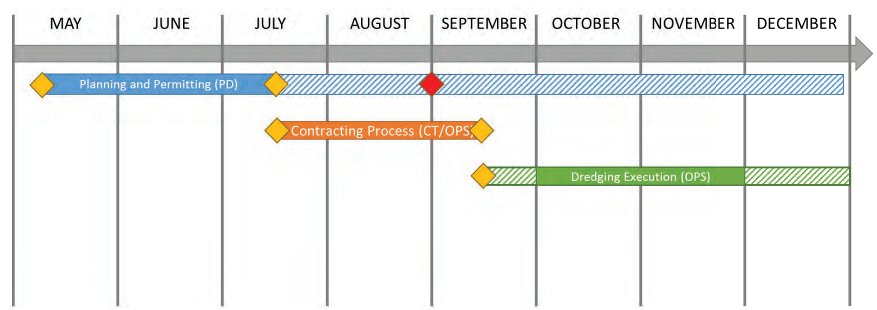
ALABAMA ,CONTINUED

OPERATIONS AND MAINTENANCE:
MOBILE HARBOR BAR CHANNEL DREDGING

- **Project Manager: David Newell 251-690-2328**
  Technical Project Manager: Herb Bullock 251-694-3703
- **Sponsor: Alabama State Port Authority**
- **Estimated Bar Channel Dredging Cost: $12M (Shallow SIBUA)**
- **Description:**
  Maintenance of the bar channel is accomplished in October and November to ensure availability of dredge equipment. Operations will begin working with contracting NLT mid-July to ensure NTP issued by October. Planning requires cultural phase I Survey, possible cultural phase II survey, public notice and comment period, Environmental Assessment, and FONSI for approval to use SIBUA Northwest Expansion for disposal of bar channel material.

- **Milestones**
  - ➢ **Advertise: 16 July 2018**
  - ➢ **Open Bids: 15 August 2018**
  - ➢ **Award Contract: 12 September 2018**
  - ➢ **Issue NTP: 01 October 2018**
- **Status:**
  Engineering is finalizing the dimensions of the SIBUA Northwest Extension. Operations is evaluating locations in the northern permitted area of SIBUA as an alternate should the Northwest Extension not be permitted on time.



US Army Corps of Engineers
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From: [redacted]
To:
Subject: Paragraph 4.2 Detailed Cost Estimates and Benefits
Date: Monday, May 21, 2018 5:29:00 PM

[redacted]
I've pulled in the Charleston Write-up into our main report in paragraph 4.2 Detailed Cost Estimates and Benefits. It's on the PD Shared Drive and the file name is "Mobile Harbor Main Report 05-21-2018.docx." This may be useful to you. If not, you can just delete it.

I wonder why para. 4.2.8 With-Project Sea Level Change and para. 4.29 Storm Surge and Coastal Erosion are under para. 4.2 Detailed Cost Estimates and Benefits???

See you tomorrow.

[redacted]

From: [redacted]
To:
Subject: RE: Beneficial Use Discussion
Date: Monday, May 21, 2018 2:21:00 PM

Understood and will correct on the first comment.

I'll work on language to address the second comment.

-----Original Message-----
From: [redacted]
Sent: Monday, May 21, 2018 1:45 PM
To: [redacted]
Subject: RE: Beneficial Use Discussion

[redacted]

A couple of comments:

Last sentence, first paragraph: " ER 1105-2-100 at E-69 states . . . ." I assume that page or paragraph reference (E-69) is to Appendix E of the ER. If so, it should specify the appendix and not just E-69.

Second paragraph [redacted]

[redacted]

Attorney-Client Privileged Information or Work Product Not Releasable Under FOIA or Discovery Please Do Not Forward or Copy this Message

-----Original Message-----
From: [redacted]
Sent: Monday, May 21, 2018 1:30 PM
To: [redacted]
Subject: Beneficial Use Discussion

[redacted] Does the language below look okay for the beneficial use paragraph in the Mobile Harbor GRR Report?

4.1.1.6. Beneficial Use of Dredged Material
The Federal Government has placed considerable emphasis on using dredged material in a beneficial manner. Statutes such as the Water Resources Development Acts of 1992, 1996, 2000, and 2007 demonstrate that beneficial

use has been a Congressional priority. The USACE has emphasized the use of dredged material for beneficial use through such regulations as 33 CFR Part 335, ER 1105-2-100, and ER 1130-2-520 and by Policy Guidance Letter No. 56. ER 1105-2-100 at E-69 states that "all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction".

[redacted]

(b)(5)

From:
To: [redacted]
Subject: FW: Mobile harbor existing and tsp maps
Date: Tuesday, May 22, 2018 4:09:00 PM
Attachments: Mob_May_2018.pdf
Mob_Exist_May_2018.pdf

Both...

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 15, 2018 3:16 PM
To: [redacted]
Subject: FW: Mobile harbor existing and tsp maps

Mobile Harbor maps are attached for the existing channel and TSP.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 15, 2018 2:46 PM
To: [redacted]
Subject: Mobile harbor existing and tsp maps

MOBILE
DAPHNE
FAIRHOPE
THEODORE
GAILLARD ISLAND
POINT CLEAR
MAGNOLIA SPRINGS
DAUPHIN ISLAND
FORT MORGAN
Gulf Coast Intracoastal Waterway
Bay Channel (Upper 3.6 miles)
Existing: 45' x 400'
Authorized: 55' x 650'
TSP: 50'x400'
Bay Channel
Existing: 45' x 400'
Authorized: 55' x 550'
TSP: 50'x400'
3 Mile Widener for Passing: 50' x 500'
Bar Channel
Existing: 47' x 600'
Authorized: 57' x 700'
TSP : 52' X 600'
1
2
3
4
TENNESSEE
ALABAMA
FLORIDA
Gulf of Mexico
LOCALITY MAP
MOBILE HARBOR FEDERAL NAVIGATION PROJECT
Tentatively Selected Plan (TSP)
Bar Channel
Bay Channel
3 Mile Widener for Passing
Choctaw Pass Turning Basin
River Channel
Plate Reference
N
W
E
S
2.5 1.25 0 2.5 5
Miles
DATE: May 2018

TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
Gulf of Mexico
LOCALITY MAP
MOBILE
River Channel
0+00 to 226+16
Existing and Authorized: 40' x 600'
226+16 to 244+66
Existing:45' x 600'
Authorized: 55' x 600'
Arlington Channel
Bay Channel (Upper 3.6 Miles)
Existing: 45' x 400'
Authorized: 55' x 650'
DAPHNE
THEODORE
Dog River Channel
FAIRHOPE
Gaillard Island
Theodore Ship Channel
POINT CLEAR
Mobile Bay
MAGNOLIA SPRINGS
Mon Louis Island
Raccoon Island
Bay Channel
Existing: 45' x 400'
Authorized: 55' x 550'
Bon Secour Bay
Mississippi Sound
Gulf Coast Intracoastal Waterway
Dauphin Island
Fort Morgan Peninsula
Bar Channel
Existing: 47' x 600'
Authorized: 57' x 700'
Gulf of Mexico
MOBILE HARBOR FEDERAL NAVIGATION PROJECT
EXISTING AND AUTHORIZED CHANNEL DIMENSIONS
Mobile County, Alabama
Bar Channel
Bay Channel
Choctaw Pass Turning Basin
River Channel
N
W
E
S
2.5 1.25 0 2.5 5
Miles
DATE: May 2018

From: [redacted]
To:
Cc:
Subject: FW: Proposed SIBUA West Expansion Limits (UNCLASSIFIED)
Date: Tuesday, May 22, 2018 9:03:00 AM
Attachments: SIBUA West Extension May2018.pdf
SIBUA_West_Extension_May2018.lpk
SIBUA_West_Extension_May2018.kmz

FYI

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 22, 2018 8:03 AM
To: [redacted]
Cc: [redacted]
Subject: Proposed SIBUA West Expansion Limits (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

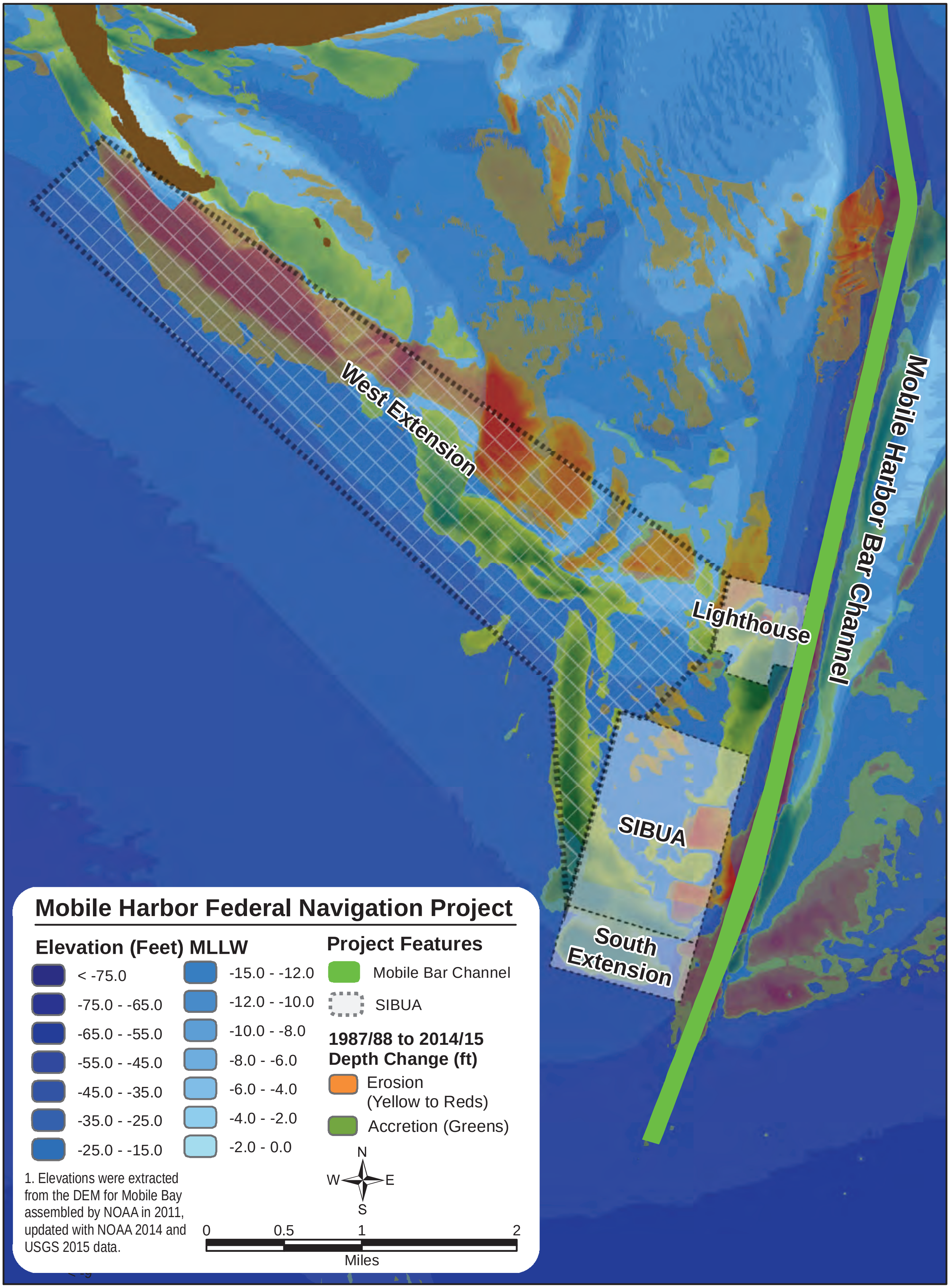
Sorry for the delay. Please find enclosed boundaries for the SIBUA wests expansion. If you have any questions, comments or concerns please let me know as soon as possible. If everyone is good with the limits I will wrap up the capacity write-up. Also if I left anyone off the email that needs to be included please forward this email on for me as I have not fully regained my focus and likely forgot someone important.

Sincerely,

[redacted]

[redacted]

CLASSIFICATION: UNCLASSIFIED



West Extension
Lighthouse
SIBUA
South Extension
Mobile Harbor Bar Channel
Mobile Harbor Federal Navigation Project
Elevation (Feet) MLLW
< -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
Project Features
Mobile Bar Channel
SIBUA
1987/88 to 2014/15 Depth Change (ft)
Erosion (Yellow to Reds)
Accretion (Greens)
1. Elevations were extracted from the DEM for Mobile Bay assembled by NOAA in 2011, updated with NOAA 2014 and USGS 2015 data.
N
W
E
S
0
0.5
1
2
Miles

From: [redacted]
To:
Cc:
Subject: FW: Pipeline Maps
Date: Tuesday, May 22, 2018 10:22:00 AM
Attachments: MBO Area map 5280.pdf
2011-12-16 Pipeline Corrosion Map.pdf

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 31, 2017 9:17 AM
To: [redacted]
Cc: [redacted]
Subject: [Non-DoD Source] Pipeline Maps

[redacted]

I have attached the two maps in which we were using in yesterday's meeting. I agree with [redacted] that the meeting was very productive with most questions being answered. Some follow ups still to come.

Regards,

[redacted]

From: [redacted]
To:
Cc:
Subject: RE: Mobile Harbor GRR, Updated Plan and Schedule
Date: Tuesday, May 22, 2018 9:45:00 AM

[redacted]
In section 4 of the main report, it is currently called the Recommended Plan. Should it be called that for the DRAFT or the Tentatively Selected Plan?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 02, 2018 9:03 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Mobile Harbor GRR, Updated Plan and Schedule

[redacted]

Once the economics are updated and we coordinate again with the Vertical Team, I would think that what we put in the draft will continue to be referred to as the Tentatively Selected Plan or TSP.

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, May 02, 2018 8:19 AM
To: [redacted]
Cc: [redacted]
Subject: Mobile Harbor GRR, Updated Plan and Schedule

All,
Over the next few weeks, we will be updating the economics for the Mobile Harbor GRR. We feel that there is an opportunity to achieve a justifiable deepening and widening to 50 feet. As such, for your report documentation, please assume the selected plan consists of the following:
Deepening: 50' (52' on the bar)
Widening: 500' widener, 3 miles long
Bend Easing
Turning Basin Modification

The schedule will be revised as follows:
DQC Review: May 24-Jun 06
Release of Draft Report (ATR, IEPR): Jun 19, 2018

Please let me know if you have any questions.

[redacted]

From: [redacted]
To:
Subject: Mobile Harbor Project History
Date: Wednesday, May 23, 2018 11:03:00 AM

Sorry, was supposed to send this two days ago...

Project History. When originally authorized, the sponsor did not have funds available to construct the entire authorized project; however, portions of the project have been constructed as funds became available to pay the required cost share. Phase I construction to 45-feet depth was completed in FY 94. The 1300 foot extension was a separable element new start with the PPA signed in FY98 and construction completed in FY00. The 1200-foot and 2100-foot extensions were also separable element new starts with the PPA signed in FY04 and work completed in FY08. The Turning Basin was also a separable element new start with the PPA signed in FY09 and construction completed in Aug 10. The design agreement for the Mobile Harbor Channel Widening Limited Reevaluation Report (LRR) was executed on 14 Aug 12. Subsequently, the Corps initiated an LRR for 4.2 miles of widening at the constructed depth of 45-feet in the Mobile Bay Channel with proposed upland dredge disposal at Gaillard Island.

[redacted]

From: [redacted]
To:
Cc:
Subject: RE: Draft SIBUA and Mobile Harbor GRR SOW and IGE
Date: Wednesday, May 23, 2018 11:10:00 AM

[redacted] I have not said that SIBUA extension is not reasonable for this fall. Based on the preliminary dates that I have seen BECAUSE of the cultural timelines it appears to not be reasonable but that really depends on the finalized dates that [redacted] provide.

[redacted]

-----Original Message-----
From [redacted]
Sent: Wednesday, May 23, 2018 10:52 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Draft SIBUA and Mobile Harbor GRR SOW and IGE

Hey all,
After getting dug in to the GRR project, a need was previously identified to survey portions of the ODMDS. I haven't found any maps yet of those specific areas, but additional survey was conveyed to me b [redacted] uring the handoff and in discussions wit [redacted] We should probably add those areas to this contract.

Also, and this was something discussed when the SIBUA extension project came in hot, [redacted] During that brainstorming session, adding a Phase II survey option was discussed. [redacted]

I'll be reviewing the attached documents, but I wanted to get these two big things out to folks asap.

Thanks,
[redacted]

-----Original Message-----
From [redacted]
Sent: Tuesday, May 22, 2018 1:34 PM
To: [redacted]
Cc: [redacted]

Subject: Draft SIBUA and Mobile Harbor GRR SOW and IGE

[redacted]

Attached is the SIBUA and Mobile Harbor GRR Marine Survey SOW and IGE for your review and comment. Please review to ensure I have the correct costs in the IGE and edits in the SOW. This is my first attempt at a Marine Survey. I used [redacted] old work products as a go by.

The MHGRR area is 62.5 acres with an estimate of 2 days to survey. The SIBUA is 3,305 acres with an estimate of 20 days to survey. I should have your labor number later today or by tomorrow. Thanks

[redacted]

From: [redacted]
To:
Subject: RE: Link to PD Drive
Date: Thursday, May 24, 2018 9:59:00 AM

Thank you for this and the help earlier!

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 24, 2018 8:03 AM
To: [redacted]
Cc:
Subject: RE: Link to PD Drive

Direct link to report folder-[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 24, 2018 7:58 AM
To: [redacted]
Cc:
Subject: Link to PD Drive

[redacted],
Can you send [redacted] the link that [redacted] sent you to Planning's shared drive?

[redacted]

From: (b) (6) [redacted]
To: (b) (6) [redacted]
Subject: RE: DQC Review - Mobile Harbor GRR
Date: Friday, May 25, 2018 8:12:00 AM
Attachments: Mobile Harbor GRR DQC Kick-off Meeting Slides 25 May 2018.pptx

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All,
For those not in the district, attached are the slides that we'll quickly run through this morning to introduce everyone to the project.

(b) (6) [redacted]

-----Original Appointment-----
From: (b) (6) [redacted]
Sent: Thursday, May 03, 2018 10:41 AM
To: (b) (6) [redacted]
Subject: DQC Review - Mobile Harbor GRR
When: Friday, May 25, 2018 9:00 AM-10:00 AM (UTC-06:00) Central Time (US & Canada).
Where: Main 3rd floor PM Conference Room (in hall across from restrooms)

For those not in the district office, call-in Information is as follows:

USA Toll-Free: [redacted]
Access Code: [redacted]
Security Code: [redacted]

All: You have been selected as part of the DQC Review Team for the Mobile Harbor General Reevaluation Report. Please make plans to attend a DQC kick-off discussion on Friday, 25 May at 0900hrs in the main PM-Conference Room. The Report will be provided electronically to you that morning. Your labor numbers for this effort are as follows:

(b) (6)

[redacted]

(b) (6)

[redacted]

MOBILE HARBOR GRR

With Integrated Supplemental Environmental Impact Statement

DQC Kick-off Meeting

25 May 2018

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

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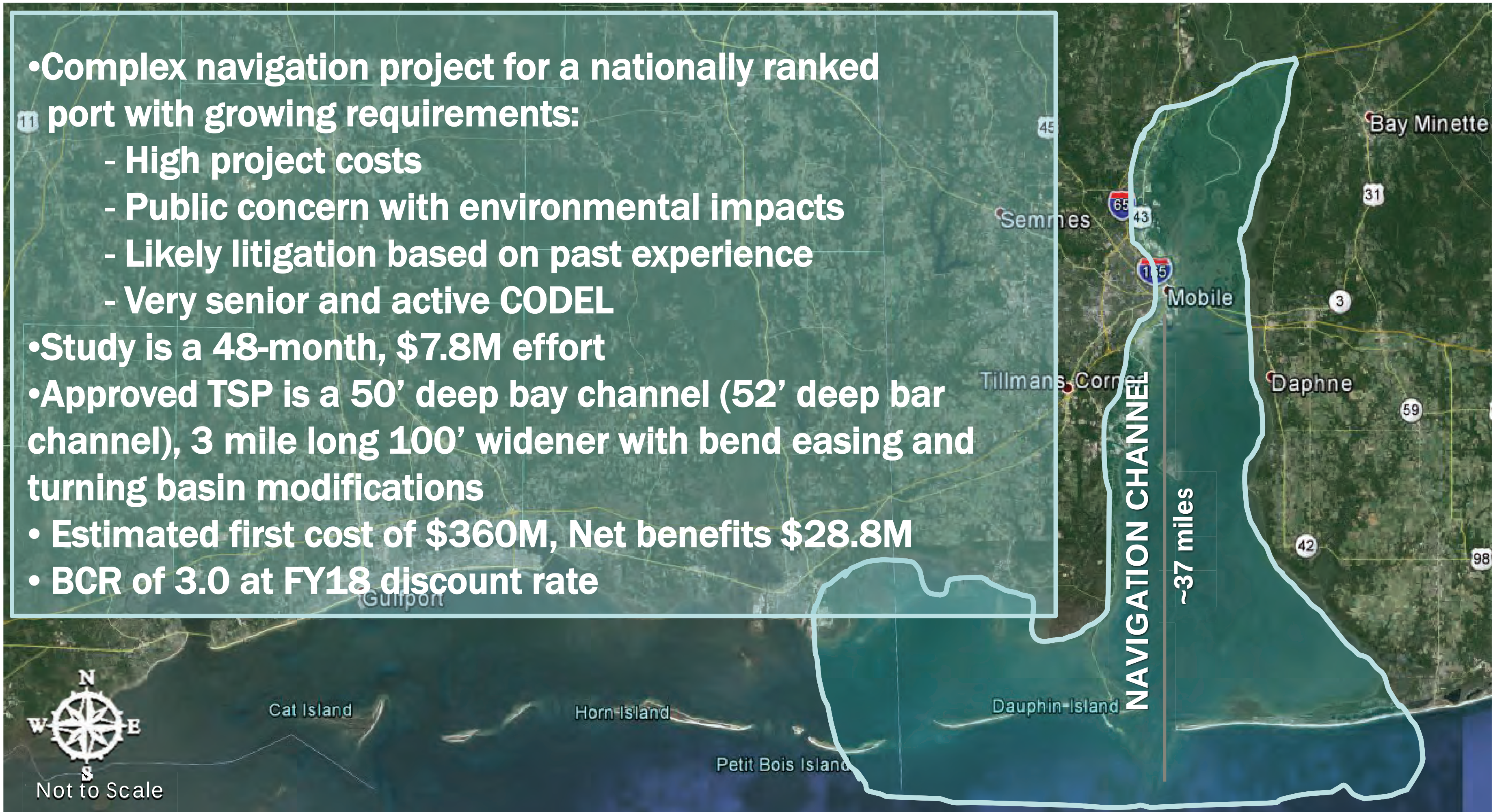
MOBILE HARBOR GRR
BOTTOM LINE UP FRONT

- Complex navigation project for a nationally ranked port with growing requirements:
  - High project costs
  - Public concern with environmental impacts
  - Likely litigation based on past experience
  - Very senior and active CODEL
- Study is a 48-month, $7.8M effort
- Approved TSP is a 50’ deep bay channel (52’ deep bar channel), 3 mile long 100’ widener with bend easing and turning basin modifications
- Estimated first cost of $360M, Net benefits $28.8M
- BCR of 3.0 at FY18 discount rate



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MOBILE HARBOR GRR
BACKGROUND

"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

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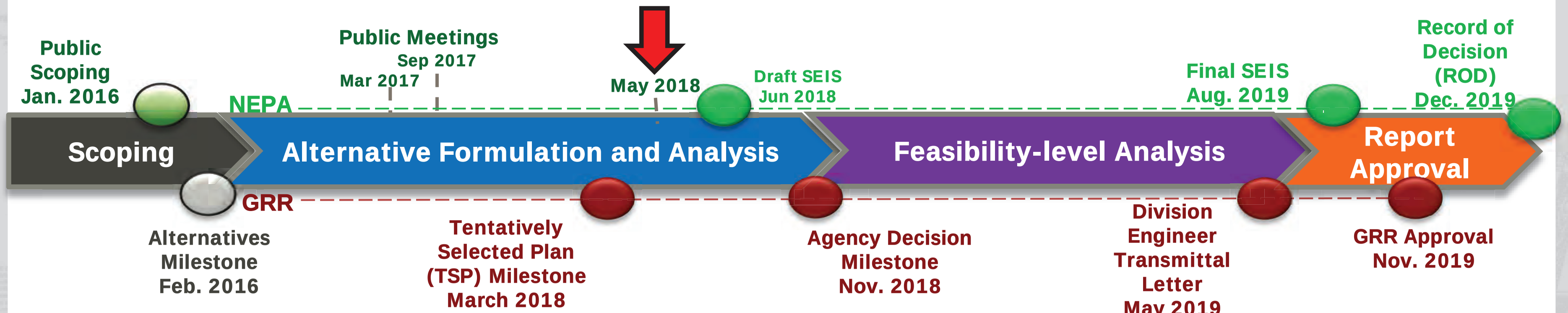
MOBILE HARBOR GRR
REPORT SCHEDULE



- 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

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MOBILE HARBOR GRR
AGENCY COORDINATION

- Charrette Jan 28-29, 2015
- Cooperating Agency Meetings Dec 2015, Mar 2016, Sep 2016, Feb 2017, Sep 2017, and Feb 2018
- Beneficial Use Meetings May 2016 and Jan 2018

GENERAL NATURE OF AGENCY CONCERNS

- 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
  - Benthic Communities
  - Shoreline Erosion
- Cultural Resources

FEDERAL AND STATE COOPERATING AGENCIES

- Alabama Department of Environmental Management
- Alabama Department of Conservation and Natural Resources
- Alabama State Historic Preservation Office
- Alabama Department of Transportation
- Geological Survey of Alabama
- U.S. Fish and Wildlife Service
- NOAA National Marine Fisheries Service
- Environmental Protection Agency
- U.S. Geological Survey
- Federal Emergency Management Agency
- Mobile Bay National Estuary Program

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MOBILE HARBOR GRR
PUBLIC ENGAGEMENT

- Public scoping meeting Jan 2016
- Public Meetings Mar 2017, Sep 2017, and Feb 2018
- Focus Group Meetings with Seafood Interests, Environmental NGOs, Dauphin Island Interests, and Environmental Justice Communities
- Bi-weekly Updates, Quarterly Newsletters, Social Media, Listserv

GENERAL NATURE OF PUBLIC COMMENTS

- Erosion impacts to Dauphin Island
- Placing material on eroding shorelines
- Interruption of coastal processes
- Reestablishment of sand transport to Dauphin Island
- Beneficial use of dredged material
- Impacts to wildlife
- Impact to oysters and other commercial fisheries
- Impacts to recreational fishing
- Creating unwanted islands
- Climate change
- Impacts to cultural resources
- Support for project

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MOBILE HARBOR GRR
TENTATIVELY SELECTED PLAN

- ❑ Channel Deepening: 50 feet
- ❑ Channel Widening: 3 mi. long, 100 ft wide*
- ❑ Turning Basin Modification
- ❑ Bar Channel Bend Easing

* Environmental impact analysis is based on a 50 foot depth and 100 foot widener for a distance of 5 miles

MOBILE HARBOR GRR
DREDGED MATERIAL PLACEMENT

Proposed Placement:

- ❑ Formerly mined relic shell area
- ❑ Sand Island Beneficial Use Area (SIBUA)
- ❑ Pelican/Sand Island Complex
- ❑ ODMDS

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MOBILE HARBOR

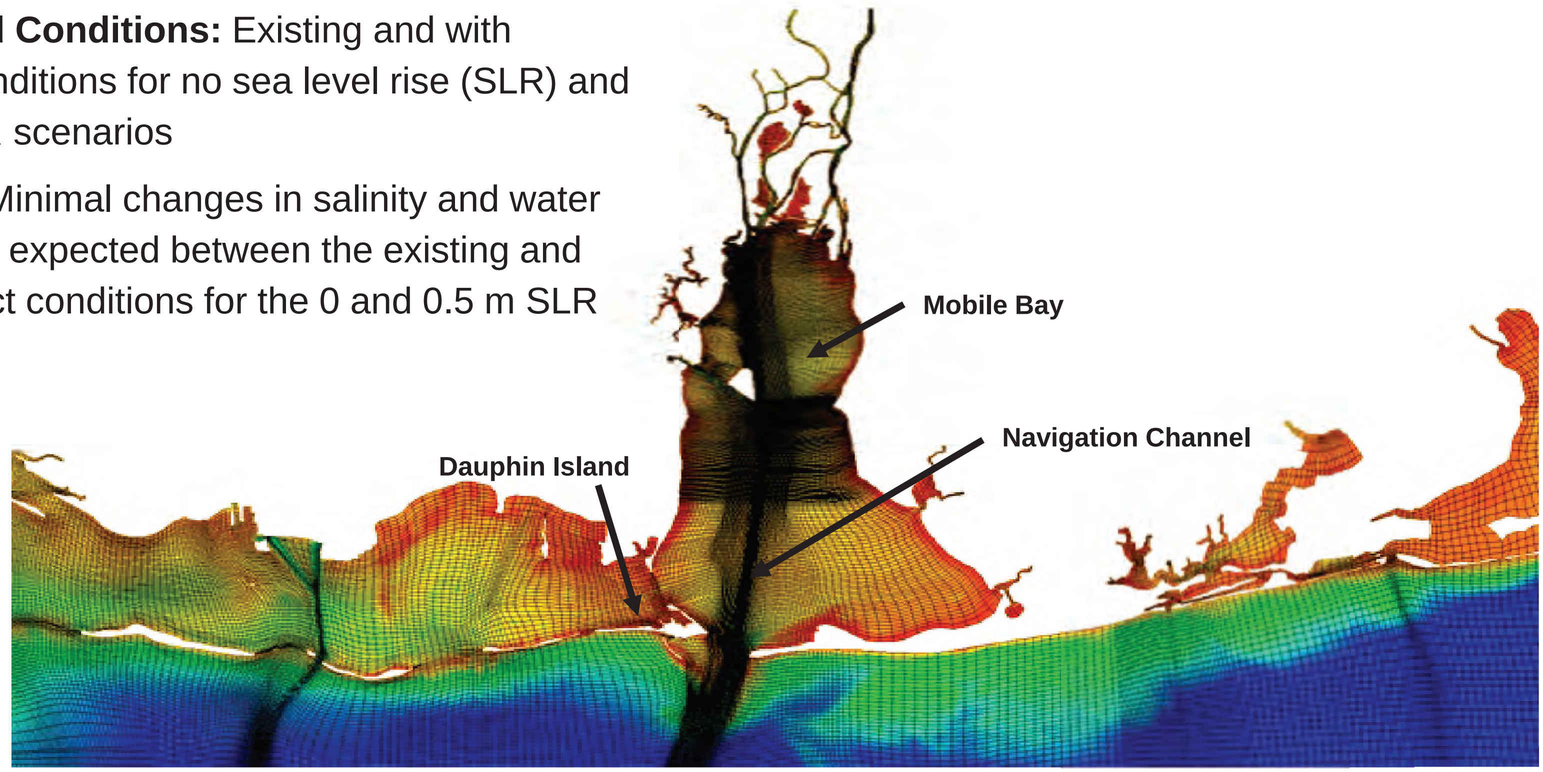
HYDRODYNAMIC & WATER QUALITY MODELING

Approach: Conduct hydrodynamic and water quality modeling to (1) characterize the physical conditions and processes of the study area and (2) determine the relative changes due to widening and deepening the channel (i.e., 5' deeper for the entire channel with a 100' wide x 5 mile long widener in the southern Bay).

Simulation Period: January 2010 – December 2010

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

Results: Minimal changes in salinity and water quality are expected between the existing and with project conditions for the 0 and 0.5 m SLR cases.



Model Extents

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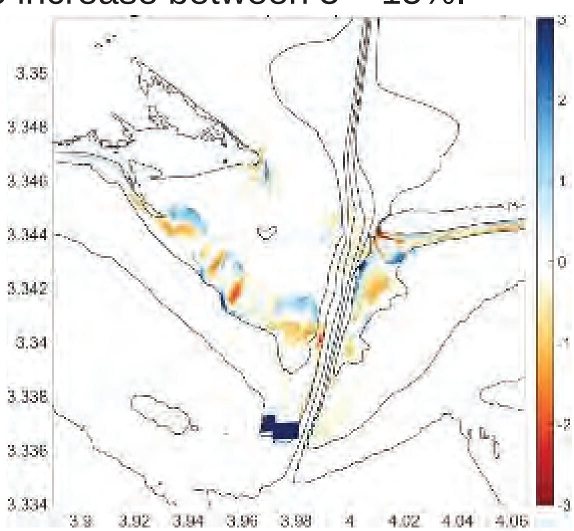
MOBILE HARBOR
SEDIMENT TRANSPORT MODELING

Approach: Conduct estuarine (fine-grained) and coastal (coarse-grained) sediment transport modeling to evaluate possible effects of widening and deepening the channel on sediment transport in Mobile Bay and on the ebb-tidal shoal/nearshore coastal areas.

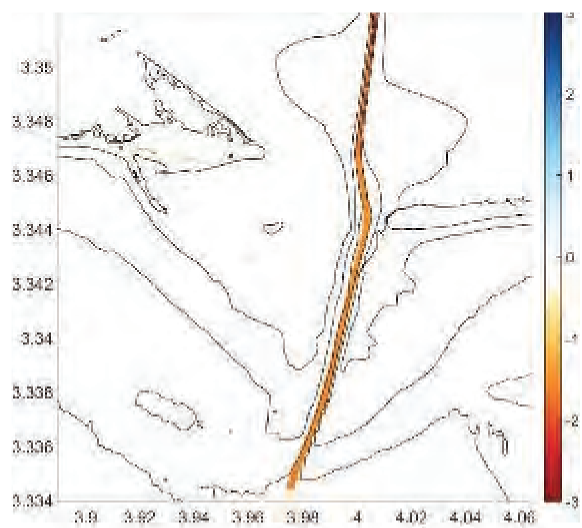
Simulation Period: Estuarine (January 2010 – December 2010)
Coastal (10-yr simulation derived from data spanning from 1998 – 2016)

Simulated Conditions: Existing and with project conditions for no sea level rise (SLR) and 0.5 m SLR scenarios

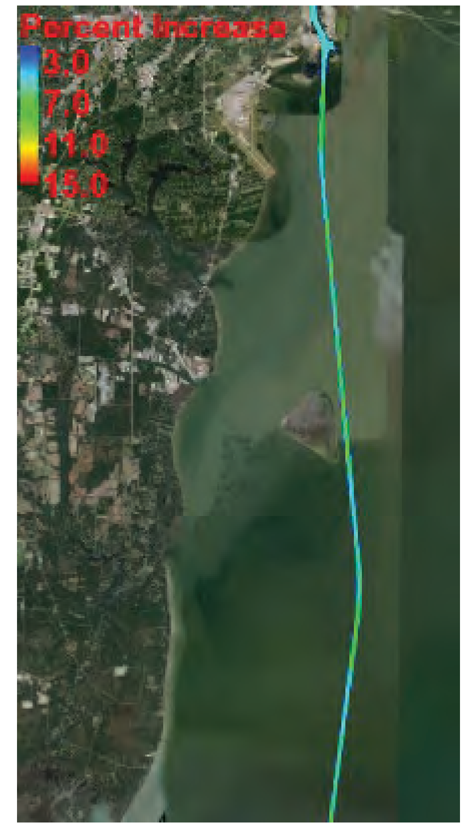
Results: Minimal bed level changes expected between the existing and with project conditions in the bay and on ebb-tidal shoal. Shoaling rates are expected to increase between 5 – 15%.



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



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



With Project Simulation
Percent Increase in Channel Shoaling

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MOBILE HARBOR

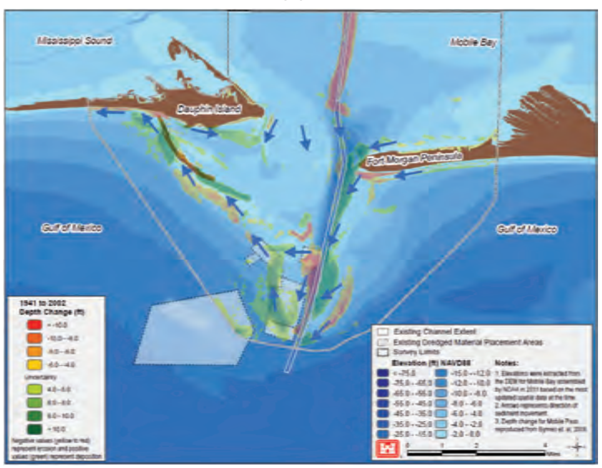
FUTURE MAINTENANCE MATERIAL PLACEMENT

Approach: Compare short and long-term changes in bathymetry to quantify sediment transport rates and identify transport pathways along the ebb-tidal shoal to determine if adequate disposal capacity exists for future maintenance material placement in the Sand Island Beneficial Use Area (SIBUA).

Analysis Period: 1941 – 2015

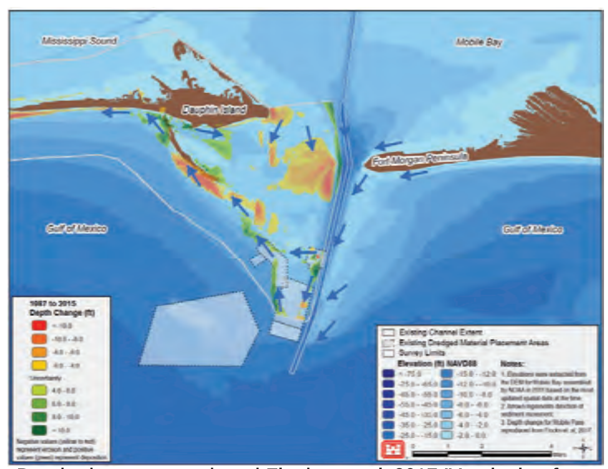
Results: Consistent sediment transport pathways are observed over the short and long-term periods. Material placed in SIBUA is in the active transport system; however, since placement in SIBUA was initiated in 1999, material has left the site at a lower rate than it has been placed in the site resulting in a need for expansion in the north/northwest direction to accommodate future needs.

Mobile Pass Bed Level Change 1941 to 2002



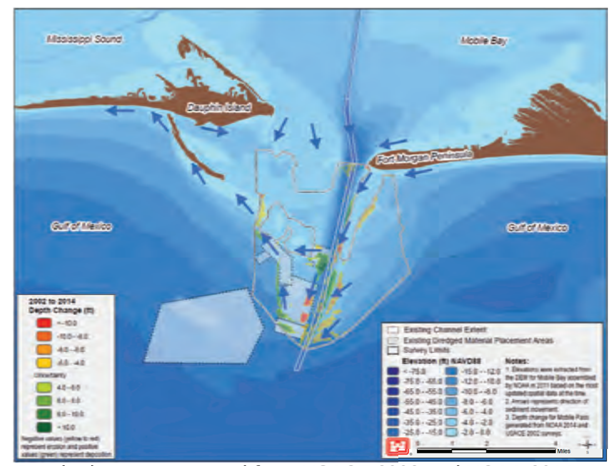
Depth change reproduced from Byrnes et. al, 2008 "Evaluation of Channel Dredging on Shoreline Response at and Adjacent to Mobile Pass, Alabama"

Mobile Pass Bed Level Change 1987 to 2015



Depth change reproduced 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



Depth change generated from USACE 2002 and NOAA 2014 surveys.

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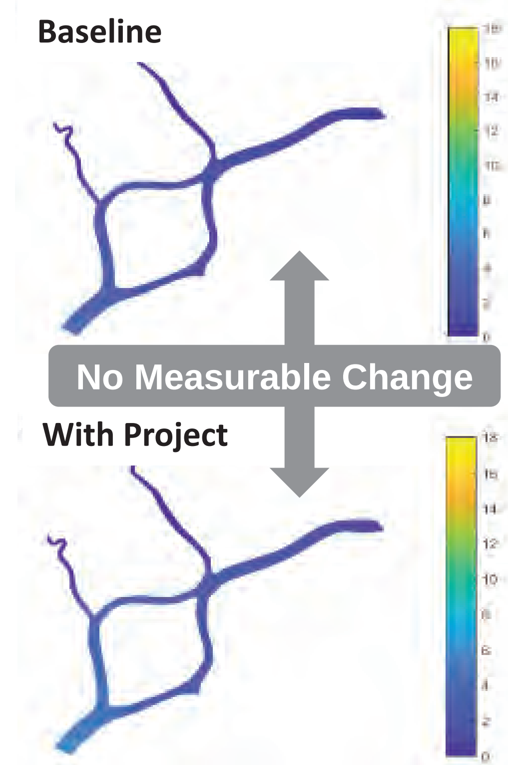
MOBILE HARBOR GRR
AQUATIC RESOURCES ASSESSMENT

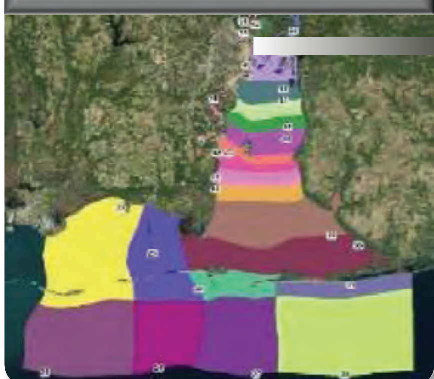
Overview

- Assessing potential impacts to wetlands, submerged aquatic vegetation, benthic invertebrates, oysters, fish
- Model outputs predicting changes in water quality (salinity, dissolved oxygen) comparing existing and post-project conditions
- Sea level rise scenario - 0.5 meter intermediate projection per USACE guidance at Dauphin Island

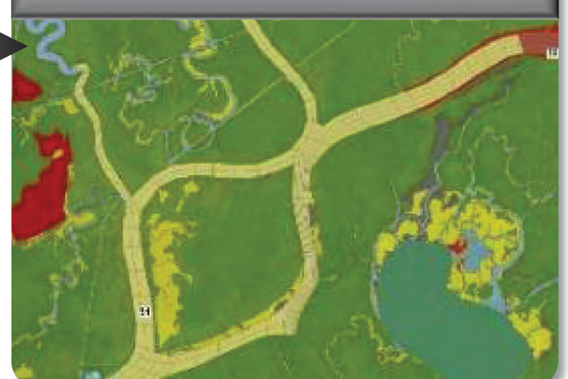
Mean Salinity - July 2010



Model grid consists of 30 blocks & 48,000 cells



Model Block 54



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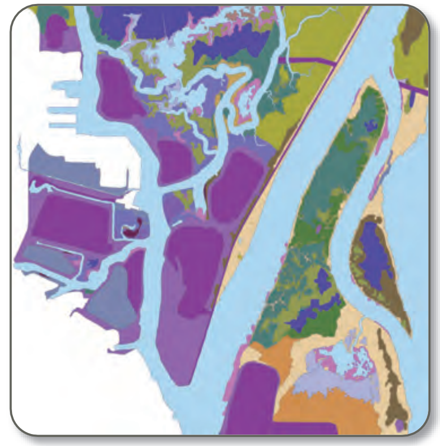
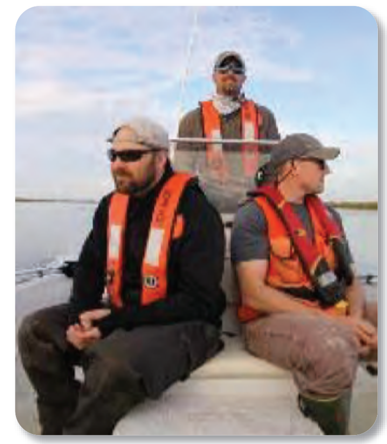
MOBILE HARBOR GRR

AQUATIC RESOURCES ASSESSMENT SUMMARY

- **No major impacts (i.e., loss of resources) anticipated for:**
  - ✓ **Wetlands**
  - ✓ **SAV**
  - ✓ **Oysters**
  - ✓ **Benthic Invertebrates**
  - ✓ **Fish**
- Project impacts remain negligible under 0.5 meter sea level rise scenario





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MOBILE HARBOR GRR
KEY RISKS/UNCERTAINTIES

Task	Risk Description	Risk Rating	Task	Risk Description	Risk Rating
Cultural Resource Surveys	Cultural resource survey limited to widening only. New discovery or discovery during construction could impact construction cost.	L	*Ship Simulations*	Limited ship simulations may not adequately capture dimensions required for safe and efficient travel. PED phase investigation could impact construction costs and plan selection.	M
Sediment Testing	Sediment testing delayed until PED phase. Construction cost for removal and placement of contaminated material could impact construction cost.	M	*Pipeline Crossings*	Unknown/undetected pipeline crossings could impact construction cost.	M
Geotechnical data	Limited geotechnical investigation performed in study phase. PED phase investigation could impact construction cost.	L	*Vessel Generated Wave Energy (i.e., Ship Wake) Assessment*	The assessment is ongoing; therefore, the effects are currently unknown and mitigation coordination (if necessary) has not begun.	M
Disposal Capacity	Expansion of both ODMDS and SIBUA dependent upon WQC & CZC certifications from the State and ESA, EFH, and NHPA concurrences.	M	*Public Acceptance*	Litigation on environmental/ Dauphin Island impacts could affect project schedule.	H

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MOBILE HARBOR GRR
WHAT'S NEXT

- Vertical Team Teleconference for approval to release Draft Report (Jun 2018)
- Release Draft Report with NEPA for Public, Technical, Policy, and Legal Review (Jun 2018)
- Public Meeting on Draft Report (Jul 2018)
- Agency Decision Milestone (Nov 2018)

US Army Corps of Engineers

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From: (b) (6) [redacted]
To: (b) (6) [redacted]
Subject: RE: Mobile Harbor Appendices
Date: Friday, May 25, 2018 8:02:00 AM

All: Just a reminder on the proposed lettering system for the appendices. See e-mail from Joe below.

(b) (6) [redacted]

-----Original Message-----
From: (b) (6) [redacted]
Sent: Wednesday, May 02, 2018 9:30 AM
To: (b) (6) [redacted]
Cc: (b) (6) [redacted]
Subject: Mobile Harbor Appendices

(b) [redacted],

Looks like these are the Appendices we will have (and my proposed lettering system). I think you may have already gotten a page count? For the Main Report assume 200 pages.

A Engineering
B Economics
C Environmental
D Real Estate

(b) (6) [redacted]

[redacted]

MOBILE HARBOR GRR

QUESTIONS?

US Army Corps of Engineers®

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From: [redacted]
To:
Subject: RE: DQC Review - Mobile Harbor GRR
Date: Tuesday, May 29, 2018 8:09:00 AM
Attachments: Mobile Harbor GRR - Review Plan 03 February 2016.docx

---

Attached.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 29, 2018 8:03 AM
To: [redacted]
Subject: RE: DQC Review - Mobile Harbor GRR

[redacted],

Can I get a copy of the Review Plan? One of my roles as DQC Lead is making sure the RP is still correct and has appropriate time and budget identified.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Tuesday, May 29, 2018 7:08 AM
To: [redacted]

REVIEW PLAN

Mobile Harbor, Alabama, General Reevaluation Report (GRR)

Mobile District

February 2016

P2: 353199

MSC Approval Date:
Last Revision Date:

US Army Corps
of Engineers ®

REVIEW PLAN

Mobile Harbor General Reevaluation Report (GRR)

TABLE OF CONTENTS

1. PURPOSE AND REQUIREMENTS

a. Purpose. This Review Plan defines the scope and level of peer review for the Mobile Harbor, AL General Reevaluation Report (GRR). This Review Plan is being developed as part of the Project Management Plan (PMP) for the Mobile Harbor GRR, dated March 2015.

b. References

(1) Engineering Circular (EC) 1165-2-214, Water Resources Policies and Authorities, Civil Works Review, 15 Dec 2012
(2) EC 1105-2-412, Assuring Quality of Planning Models, 31 Mar 2011
(3) Engineering Regulation (ER) 1110-1-12, Quality Management, 30 Sep 2006
(4) ER 1105-2-100, Planning Guidance Notebook, Appendix H, Policy Compliance Review and Approval of Decision Documents, Amendment #1, 20 Nov 2007
(5) Review of Civil Works Projects, Planning SMART Guide, 31 May 2012
(6) ECB 2007-6 "Model Certification Issues for Engineering Software in Planning Studies" dated 10 April 2007
(7) EM 1110-2-1613, Hydraulic Design of Deep Draft Navigation Projects, 31 May 2006.

c. Requirements. This review plan was developed in accordance with EC 1165-2-214, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R). The EC outlines four general levels of review: District Quality Control/Quality Assurance (DQC), Agency Technical Review (ATR), Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. The decision documents shall also be reviewed by the Civil Works Cost Engineering and Mandatory Center of Expertise (Cost MCX) to obtain cost certification per EC 1165-2-214. All planning and engineering models used are approved/certified in accordance with EC 1105-2-412.

d. Types of Review

(1) District Quality Control/Quality Assurance (DQC). All work products and reports, evaluations, and assessments shall undergo necessary and appropriate District Quality Control/Quality Assurance (DQC). DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). Mobile District shall manage DQC and the documentation of DQC activities.

(2) Agency Technical Review (ATR). ATR is mandatory for all decision and implementation documents. The objective of ATR is to ensure consistency with established criteria, guidance, procedures, and policy. The ATR will assess whether the analyses presented in the GRR are technically correct and comply with published US Army Corps of Engineers (USACE) guidance, and that the document explains the analyses and results in a reasonably clear manner for the public and decision makers. ATR is managed within USACE by a designated Review Management Organization (RMO) and conducted by a qualified team from outside the Mobile District that is not involved in the day-to-day production of the project/product. The RMO for this effort is the Deep Draft Navigation Planning Center of Expertise, DDNPCX. ATR teams will be comprised of senior level USACE personnel and may

be supplemented by outside experts as appropriate. To assure independence, the ATR lead shall be from outside SAD.

(3) Independent External Peer Review (IEPR). IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. Any work product, report, evaluation, or assessment that undergoes DQC and ATR also MAY be required to undergo IEPR under certain circumstances. A risk-informed decision, as described in EC 1165-2-214, is made as to whether IEPR is appropriate. IEPR panels will consist of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. There are two types of IEPR: Type I is generally for decision documents and Type II is generally for implementation products.

(a) Type I IEPR. Type I IEPR panels assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analysis, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in the evaluation of environmental impacts of proposed projects, and an biological opinions of the project study. Type I IEPR will cover the entire decision document or action and will address all the underlying engineering, economics, and environmental work, not just one aspect of the study. For decision documents where a Type II IEPR (Safety Assurance Review) is anticipated during project implementation, safety assurance shall also be addressed during the Type I IEPR per EC 1165-2-214.

(b) Type II IEPR. Type II IEPR, or Safety Assurance Review (SAR), are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

(4) Policy and Legal Compliance Review. Guidance for policy and legal compliance reviews is addressed in Appendix H, ER 1105-2-100. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the Chief of Engineers. DQC and ATR augment and complement the policy review processes by addressing compliance with pertinent published Army policies, particularly policies on analytical methods and the presentation of findings in decision documents.

(5) Cost Engineering Agency Technical Review and Cost Certification. The Cost Engineering Appendix of the GRR will undergo ATR. The Cost Reviewer, designated by the Cost MCX, will serve as an ATR team member. The Cost MCX will provide certification of the total project cost for the final GRR.

2. REVIEW MANAGEMENT ORGANIZATION (RMO) COORDINATION

The RMO is responsible for managing the overall peer review effort described in this Review Plan. The RMO for decision documents is typically either a Planning Center of Expertise (PCX) or the Risk Management Center (RMC), depending on the primary purpose of the decision document. The RMO for the peer review effort described in this Review Plan is the National Deep Draft Navigation Planning Center of Expertise (DDNPCX).

The RMO will coordinate with the Cost MCX to conduct ATR of cost products.

3. STUDY INFORMATION

a. Work Product. The objective of the GRR is to document the results of an updated analysis of the Survey Report on Mobile Harbor completed in 1980. The GRR will provide an evaluation of the economics and environmental effects based on current policies, criteria, and guidelines. A Supplemental Environmental Impact Statement (SEIS) will be prepared in accordance with the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) to analyze potential impacts from the improvements to Federal navigation channel and subsequent placement of dredged material.

The GRR, together with the 1981 Chief's Report on Mobile Harbor, will provide the factual basis for entering into a Project Partnership Agreement (PPA). A PPA is a legally binding agreement between the Federal government and the non-Federal sponsor, the Alabama State Port Authority (ASPA), for construction of a navigation project. It describes the project and describes the responsibilities of the Government and non-Federal sponsor in cost-sharing and execution of project work. The Mobile Harbor GRR outlines the cost-sharing for design, construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R)during the 50 year period of analysis. After the GRR is approved at SAD, a PPA will be prepared for execution between the Corps and the non-Federal sponsor, the ASPA.

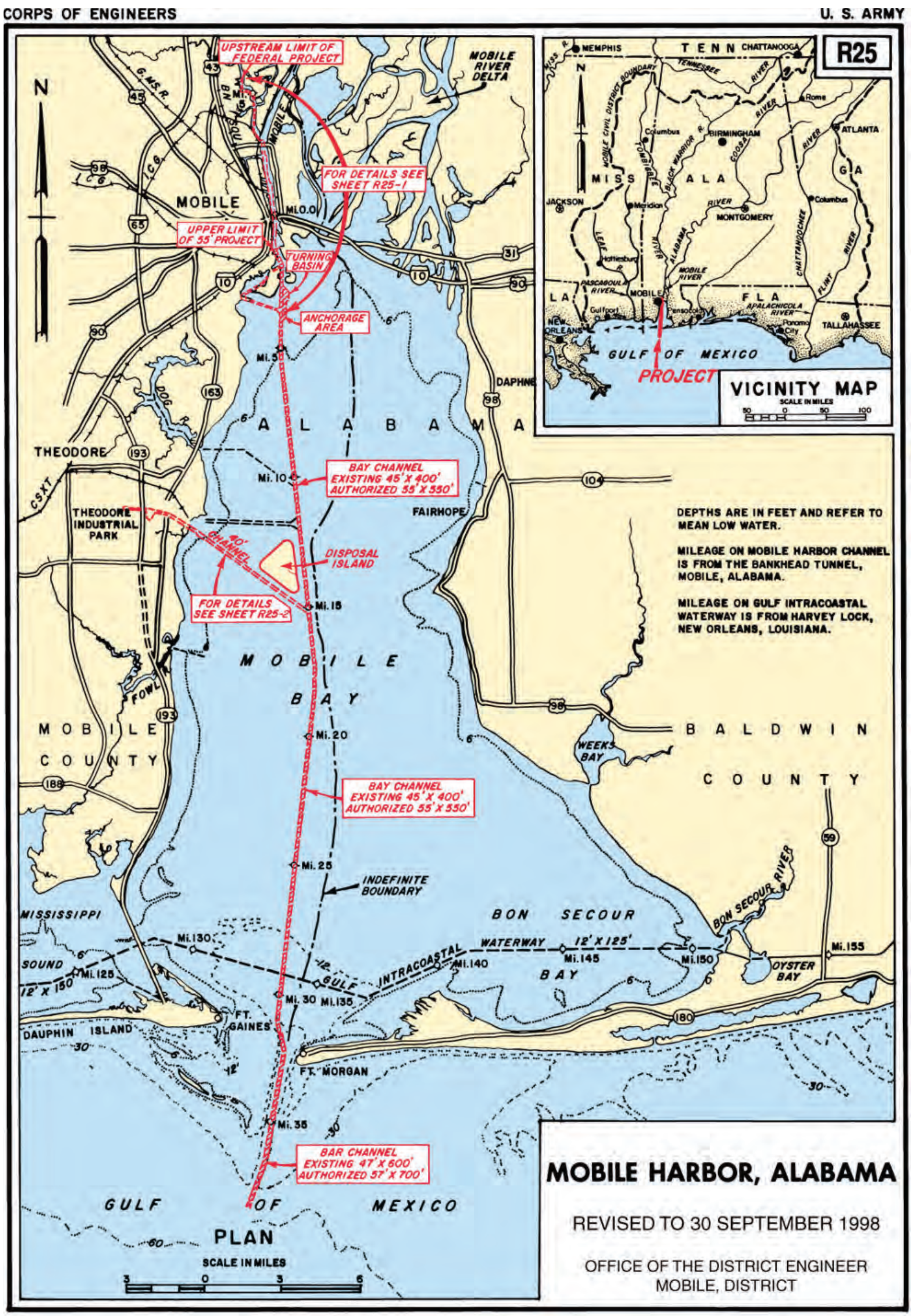
b. Study/Project Description. The Mobile Harbor Federal navigation project is located in southwest Alabama. The port of Mobile is the 12th largest port in terms of tonnage in the United States. Its primary commodities have been coal, crude oil, and petroleum products; however, the port has seen a large increase in steel commodities due to the recently completed $4.6 billion steel facility that was constructed just north of Mobile. In addition, the port also expects to see increased container ship traffic in 2016 when the airbus assembly plant begins production.

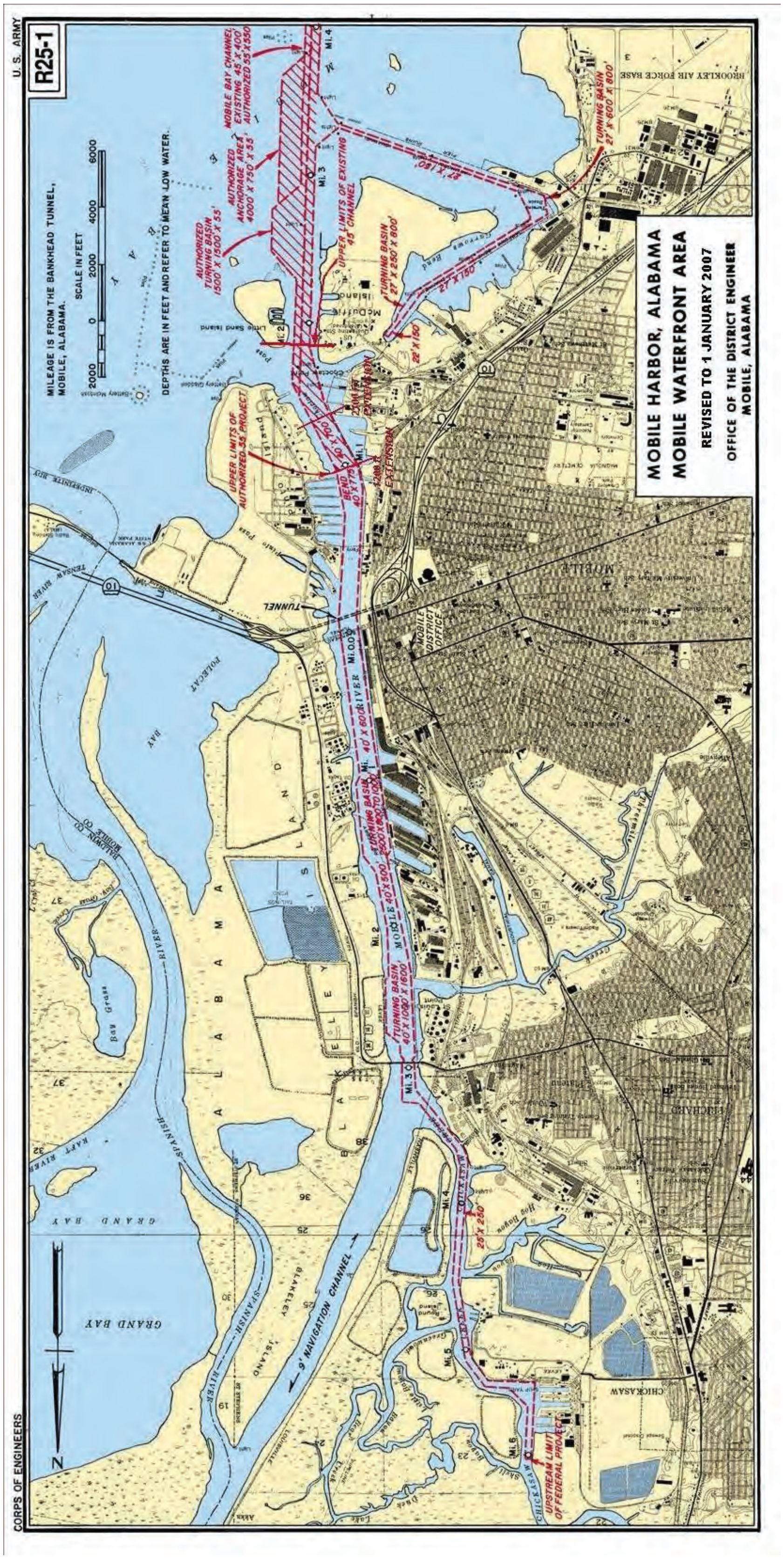
The Chief's Report on Mobile Harbor, Alabama was approved on 18 November 1981. The Report included deepening and widening of the channel, an anchorage and turning basin, and a dredged material placement site.

Based on the sponsor's request to pursue channel widening and deepening in Mobile Harbor within the limits of the original authorization and because of the changed conditions since the 1980 Survey Report, Mobile District has determined an update is needed to the Report. The update will provide reevaluation of the economics and environmental effects against current policies, criteria, and guidelines. This report will also ensure that the design will accommodate current ship sizes and that adequate capacity for dredged material placement is available. This project was authorized by Section

201 of the 1986 Water Resources Development Act (WRDA). No additional Congressional authorization will be needed in order to implement the GRR.

Figures R25 and Figure R25-1 show the authorized limits of the Mobile Harbor Federal Navigation Channel.


CORPS OF ENGINEERS
U. S. ARMY
R25
UPSTREAM LIMIT OF FEDERAL PROJECT
MOBILE RIVER DELTA
FOR DETAILS SEE SHEET R25-1
MOBILE
UPPER LIMIT OF 55' PROJECT
TURNING BASIN
ANCHORAGE AREA
A L A B A M A
THEODORE
BAY CHANNEL EXISTING 45' X 400' AUTHORIZED 55' X 550'
FAIRHOPE
THEODORE INDUSTRIAL PARK
40' CHANNEL
DISPOSAL ISLAND
FOR DETAILS SEE SHEET R25-2
M O B I L E
B A Y
M O B I L E
C O U N T Y
B A L D W I N
C O U N T Y
WEEKS BAY
BAY CHANNEL EXISTING 45' X 400' AUTHORIZED 55' X 550'
INDEFINITE BOUNDARY
MISSISSIPPI SOUND
BON SECOUR BAY
GULF INTRACOASTAL WATERWAY 12' X 125'
OYSTER BAY
DAUPHIN ISLAND
FT. GAINES
FT. MORGAN
BAR CHANNEL EXISTING 47' X 600' AUTHORIZED 57' X 700'
GULF OF MEXICO
PLAN
SCALE IN MILES
DEPTHS ARE IN FEET AND REFER TO MEAN LOW WATER.
MILEAGE ON MOBILE HARBOR CHANNEL IS FROM THE BANKHEAD TUNNEL, MOBILE, ALABAMA.
MILEAGE ON GULF INTRACOASTAL WATERWAY IS FROM HARVEY LOCK, NEW ORLEANS, LOUISIANA.
VICINITY MAP
GULF OF MEXICO
PROJECT
MOBILE HARBOR, ALABAMA
REVISED TO 30 SEPTEMBER 1998
OFFICE OF THE DISTRICT ENGINEER
MOBILE, DISTRICT


U.S. ARMY
R25-1
CORPS OF ENGINEERS
MILEAGE IS FROM THE BANKHEAD TUNNEL, MOBILE, ALABAMA.
SCALE IN FEET
DEPTHS ARE IN FEET AND REFER TO MEAN LOW WATER.
MOBILE HARBOR, ALABAMA
MOBILE WATERFRONT AREA
REVISED TO 1 JANUARY 2007
OFFICE OF THE DISTRICT ENGINEER
MOBILE, ALABAMA

c. Factors Affecting the Scope and Level of Review.

This section discusses the factors affecting the risk informed decisions on the appropriate scope and level of review. The discussion is intended to be detailed enough to assess the level and focus of review and support the PDT, PCX, and vertical team decisions. Factors affecting the risk informed decisions on the appropriate scope and level of review include the following:

- *If parts of the study will likely be challenging (with some discussion as to why or why not and, if so, in what ways – consider technical, institutional, and social challenges, etc.);*

  This GRR is an update of an authorized Survey Report. The report will include a reevaluation of the economics and environmental aspects of the project to ensure that it meets current policies, criteria, and guidelines. The report will also ensure that the design will accommodate current and forecasted ship sizes and that environmental impacts associated with the improvement project are analyzed in accordance with NEPA. The updated document will then serve to support a PPA by outlining the construction and cost-sharing requirements. Historically, Dauphin Island residents have raised concerns with the Federal navigation project's potential disruption of the natural sediment transport along the Alabama coast and have previously requested that sandy dredge material be placed directly on the beach. The SEIS will analyze channel widening and deepening impacts to the estuarine and coastal sediment transport processes. In addition, the SEIS will address the suitability of the dredged material to meet ocean disposal criteria and for other beneficial uses.

- *A preliminary assessment of where the project risks are likely to occur and what the magnitude of those risks might be (e.g., what are the uncertainties and how might they affect the success of the project);*

  Project risks include potential changes to the estuarine and coastal sediment transport processes, water quality changes, suitability of dredged material per the Marine Research Protection and Sanctuaries Act criteria to be disposed offshore, insufficient ship traffic to economically justify the project, and OMRR&R costs. These risks could impact the ability to implement the proposed work;

- *If the project is likely to have significant economic, environmental, and/or social effects to the Nation (with some discussion as to why or why not and, if so, in what ways);*

  The widening and deepening of the channel will provide beneficial economic effects to the Nation by reducing shipping time and cost because larger ships will not be required to wait at dock or offshore while another ship is in the channel. Local concern of the existing Federal channel's effects on littoral sand transport along the Alabama Coast, potential water quality changes, and suitability of dredge material as well as dredged material placement options will be addressed. Past studies, such as the *Survey Report on Mobile Harbor including the Final Environmental Impact Statement* (1980) and the *ERDC/CHL TR10-8 Channel Dredging and Geomorphic Response at and Adjacent to Mobile Pass, Alabama* (2010), have characterized natural sediment transport and budgets within the project area. Based on existing legal agreements, if the dredge material contains suitable sandy material, it will be placed within an existing dredged material placement area known as the Sand Island Beneficial Use Area. All other dredged material will be disposed in other approved areas.

- *If the project likely involves significant threat to human life/safety assurance (with some discussion as to why or why not and, if so, in what ways – consider at minimum the safety assurance factors described in EC 1165-2-214 including, but not necessarily limited to, the consequences of non-performance on project economics, the environmental and social well-being [public safety and social justice; residual risk; uncertainty due to climate variability, etc.;*

  This project does not add significant threat to human life/safety assurance. This project only considers the widening and deepening of an existing navigation channel. All work currently performed during operations will remain the same with only an increase in the volume of dredging and maintenance.

- *If the project/study is likely to have significant interagency interest (with some discussion as to why or why not and, if so, in what ways);*

  The project will have significant interagency interest because of the potential for environmental impacts on salinity and various natural resources due to the increased channel dimensions. The GRR will be coordinated with the appropriate agencies which will include organizing Interagency Working Group meetings on a regular basis to discuss agency concerns and potential mitigation requirements. Formal agency consultations will also be conducted to assure the project meets all of the applicable environmental laws and regulations.

- *If the project/study will be highly controversial (with some discussion as to why or why not and, if so, in what ways);*

  This project considers the widening and deepening of the existing ship channel. All work currently performed during operations will remain the same but with an increase in the volume of dredging and maintenance. As noted above, there is local concern that the existing Federal channel has affected littoral transport of sand and has impacted nearby Dauphin Island.

- *If the project report is likely to contain influential scientific information or be a highly influential scientific assessment (with some discussion as to why or why not and, if so, in what ways);*

  The project report does not contain influential scientific information and is not a highly influential scientific assessment.

- *If the information in the decision document or proposed project design will likely be based on novel methods, involve the use of innovative materials or techniques, present complex challenges for interpretation, contain precedent-setting methods or models, or present conclusions that are likely to change prevailing practices (with some discussion as to why or why not and, if so, in what ways);*

  The information in the GRR is not based on novel methods, does not use innovative materials or techniques, does not present complex challenges, is not precedent setting, and is not likely to change prevailing practices.
- *If the proposed project design will require redundancy, resiliency, and/or robustness (with some discussion as to why or why not and, if so, in what ways – see EC 1165-2-214, Appendix E, Paragraph 2 for more information about redundancy, resiliency, and robustness); and*

The project design is not expected to require any additional redundancy, resilience, or robustness.

- *If the proposed project has unique construction sequencing or a reduced or overlapping design construction schedule (with some discussion as to why or why not and, if so, in what ways).*

  The construction schedule and sequencing is unknown at this time. There is potential for unique construction sequencing or construction schedule due to environmental or construction constraints.

d. Risk Informed Decisions on Appropriate Reviews. The following questions shall be explicitly considered, in accordance to EC 1165-2-214 paragraph 15b:

(1) Does it include any design (structural, mechanical, hydraulic, etc)?
Yes.

(2) Does it evaluate alternatives?
Yes. Ship Simulation and CADET modeling will be used to optimize the channel improvement feature and Harborsym will be used to evaluate the economic benefits of variations of deepening and widening. Additionally, hydrodynamic, water quality, and sediment transport modeling will be utilized to evaluate the potential environmental impacts of deepening and widening.

(3) Does it include a recommendation?
Yes, the report will include a recommendation.

(4) Does it have a formal cost estimate?
Yes; the cost estimate included within the report will be certified by the Cost MCX.

(5) Does it have or will it require a NEPA document?
Yes, an SEIS will be prepared.

(6) Does it impact a structure or feature of a structure whose performance involves potential life safety risks?
No.

(7) What are the consequences of non-performance?
If the recommended project is built and fails, no lives are at risk. If the recommended project is not built, no lives will be at risk but there will be negative economic effects.

(8) Does it support a significant investment of public monies?
Yes.

(9) Does it support a budget request?
Yes.

(10) Does it change the operation of the project?
No, however, the current channel dimensions currently maintained will be deepened and widened.

(11) Does it involve excavation, subsurface investigations (drilling or sampling or both), or placement of soil?
Yes, the dredging operations will disturb the bay bottom in an effort to establish and maintain the required width and depth. Subsurface investigations may also be performed in support of the development of the GRR.

(12) Does it affect any special features, such as cultural resources, historic properties, survey markers, etc, that should be protected or avoided?

Channel modifications are not expected to impact any cultural resources or historic properties. If additional dredged material placement sites are needed, cultural resource investigations will have to be conducted.

(13) Does it involve activities that trigger regulatory permitting such as Section 404 or stormwater/NPDES related actions?

New dredge material excavated during dredging operations may contain some level of contaminants. The dredged material will be tested to determine the presence of possible contaminants. The suitability of sediments will be determined for possible disposal/placement alternatives including upland, open water within-bay, and ocean disposal. A 404(b)(1) evaluation will be used to determine compliance with Section 404 of the Clean Water Act regulating the placement of dredged or fill materials in waters of the United States. In addition, compliance with Section 103 of the MPRSA will be demonstrated to show that material being taken to the Ocean Dredged Material Disposal Site (ODMDS) meets the ocean dumping criteria.

(14) Does it involve activities that could potentially generate hazardous wastes and/or disposal of materials such as lead based paints or asbestos?

No.

(15) Does it reference use of or reliance on manufacturers' engineers and specifications for items such as prefabricated buildings, playground equipment, etc?

No.

(16) Does it reference reliance on local authorities for inspection/certification of utility systems like wastewater, stormwater, electrical, etc?

No.

(17) Is there or is there expected to be any controversy surrounding the Federal action associated with the work product?

As noted above, there is local concern that the existing Federal channel has affected littoral transport of sand and is impacting nearby Dauphin Island.

e. In-Kind Contributions. Products and analyses provided by the non-Federal sponsor as in-kind services are subject to DQC and may be subject to ATR and IEPR.

No in-kind products to be provided by the Non-Federal sponsor are expected at this time. However, if any Lands, Easements, Rights-of-Way, Relocations (LERR) are to be provided by the Non-Federal sponsor in conjunction with the project, in-kind credits may be allowable.

4. DISTRICT QUALITY CONTROL (DQC)

a. Documentation of DQC. All decision documents (including supporting data, analyses, environmental compliance documents, etc.) shall undergo DQC. DQC will be conducted by the SAM Mobile Harbor GRR PDT, SAM independent reviewers, as well as chiefs of relevant key disciplines, where each of the reviewers will review the documents for accuracy. SAM will engage the appropriate regional CoPs to ensure reviews are done in a timely manner by qualified experts. All reviewers are listed in Attachment 1. All DQC comments and responses will be documented by the senior planner. The comment and response package, along with the DQC signature sheet, will be part of the report's transmittal package under the "Peer Review" section, and will be provided to the Agency Technical Review Team.

b. Products to Undergo DQC. The GRR and SEIS will undergo DQC at draft report and final report stage..

c. Required DQC Expertise. The SAM Mobile PDT consists of key disciplines relevant to Deep Draft Navigation Planning: Navigation, Operations, Geotechnical, Hydraulics, Environmental, Navigation Plan Formulation, Legal, Cost, Real Estate, and Economics. DQC reviewers consist of non-PDT experts and experts in the supervisory chain of the same disciplines.

5. AGENCY TECHNICAL REVIEW (ATR)

a. Products to Undergo ATR. The GRR and SEIS will undergo ATR at the draft and final report stage. The Cost Appendix and all associated materials will be provided to the cost reviewer. All ATR reviewers will be listed in Attachment 1.

b. Required ATR Team Expertise. It is expected that the ATR Team would generally reflect the major technical disciplines of the Mobile Harbor GRR PDT. As such, it is expected that the ATR team would consist of the following disciplines: Plan Formulation, Navigation Operations, Geotechnical, Hydraulics, Environmental, Cost, Real Estate, and Economics.

ATR Team Members/Disciplines	Expertise Required
ATR Lead	The ATR lead will be a senior professional with extensive experience in preparing Civil Works decision documents and conducting ATR. The lead should also have the necessary skills and experience to lead a virtual team through the ATR process. The ATR lead may also serve as the reviewer for another discipline. The ATR Lead will be from a District outside the MSC.
Plan Formulator	The plan formulator should be a senior water resources planner with experience in navigation projects and associated planning reports and documents.
Economics	Expertise in economics appropriate for a GRR level to verify trends and commodities within the affected Port. Knowledge of procedures for deep draft navigation and containership analysis. Knowledge of tools employed for economic analysis, including Harborsym, risk analysis and multiport analysis.
Environmental Resources	Expertise in NEPA compliance. Knowledge of all applicable environmental laws and regulations. Expert in coastal and estuarine habitats and associated natural and cultural resources and environmental impacts of harbor deepening, as well as, familiarity with dredged material disposal and offshore dredge material disposal sites.
Geotechnical Engineering	Expertise in geotechnical considerations and USACE guidance related to the classification, dredging, and disposal of material for deep draft navigation projects.
Hydraulic Engineering	The hydraulic reviewer should have knowledge of USACE guidance related to engineering requirements for the deep

	draft navigation studies. In addition the reviewer should have expertise in conducting hydrodynamic model studies of navigable waterways to assess whether or not hydrodynamic modeling analyses and conclusions are reasonable. The reviewer should be experienced with ADCIRC, STWAVE, CE-QUAL-ICM, SEDZLJ, MPFATE and/or similar models.
Cost Engineering	Expertise in cost engineering requirements for deep draft navigation studies including the development of parametric (Class 4), construction costs (i.e. MCACES costs) using MII Cost Estimating Software, dredging costs using Corps of Engineers Dredge Estimating Program (CEDEP), Corps issued Total Project Cost Summaries (TPCS) , and formal cost risk analyses using Abbreviated Risk Analysis (ARA) or the Crystal Ball software for projects over $40,000,000.
Navigation Construction/Operations	Expertise in O&M requirements associated with design of deep draft navigation projects.
Real Estate	Expertise in implementation of deep draft navigation projects. Specifically navigational servitude and non-federal sponsor acquisition of beneficial use sites, facility/utility relocation.

c. Documentation of ATR. DrChecks review software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment will normally include:

(1) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;
(2) The basis for the concern – cite the appropriate law, policy, guidance, or procedure that has not be properly followed;
(3) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and
(4) The probable specific action needed to resolve the concern – identify the action(s) that the reporting officers must take to resolve the concern.

In some situations, especially where there appears to be incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist.

The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points in any discussion, including any vertical team coordination (the vertical team includes the District, RMO, and MSC), and the agreed upon resolution. If an ATR concern cannot be satisfactorily resolved between the ATR team and the PDT, it will be elevated to the vertical team for further resolution in accordance with the policy issue resolution process described in either ER 1110-1-12 or ER 1105-2-100, Appendix H, as appropriate. Unresolved concerns can be closed in DrChecks with a notation that the concern has been elevated to the vertical team for resolution.

At the conclusion of each ATR effort, the ATR team will prepare a Review Report summarizing the review. Review Reports will be considered an integral part of the ATR documentation and shall:

- Identify the document(s) reviewed and the purpose of the review;
- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions;
- Identify and summarize each unresolved issue (if any); and
- Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

ATR may be certified when all ATR concerns are either resolved or referred to the vertical team for resolution and the ATR documentation is complete. The ATR Lead will prepare a Statement of Technical Review certifying that the issues raised by the ATR team have been resolved (or elevated to the vertical team). A Statement of Technical Review should be completed, based on work reviewed to date, for the draft report, and final report. A sample Statement of Technical Review is included in Attachment 2.

6. INDEPENDENT EXTERNAL PEER REVIEW (IEPR)

a. Decision on IEPR.

After a preliminary assessment, it has been determined that a Type I IEPR will need to be performed for the feasibility report decision document for the following reasons:

(1) Several mandatory triggers appear to be met, including:

- The estimated cost of the project is anticipated to exceed the $200M ceiling.
- A Supplemental Environmental Impact Statement (SEIS) will be performed.
- As is typical for a project study of this nature and scope, it is anticipated that there may be a public dispute involving some stakeholders regarding the size, nature, or effects of the Project, or regarding the economic or environmental cost or benefits of the Project.

(2) In addition, since the project is not routine and an SEIS will be performed, there is no exclusion applicable to the study.

b. Products to Undergo Type I IEPR. Draft Report and SEIS

c. Required Type I IEPR Panel Expertise. The following provides a description of the proposed panel members and expertise. The proposed four member panel includes the necessary expertise to assess the engineering, environmental, and economic adequacy of the decision document, as required by EC 1165-2-214, Appendix D. The Outside Eligible Organization (OEO) will determine the final participants on the panel. The following table lists the suggested types of disciplines that might be included on the panel. The following disciplines are recommended based on the high risk factors as described in the risk register.

IEPR Panel Members/Disciplines	Expertise Required
Plan Formulation	This individual will be a scientist from academia, public agency, non-governmental entity, or an Architect-Engineer or Consulting Firm with a minimum 10 years demonstrated experience in evaluating and comparing alternative plans for USACE.
Economics	The Economics Panel Member will have knowledge of procedures for deep draft navigation and containership analysis. Knowledge of tools employed for economic analysis, including HarborSym, risk analysis multiport analysis and trade forecasts.
Environmental	Knowledge of all applicable environmental laws and regulations Expert in coastal, and estuarine habitats and associated natural resources and the environmental impacts of harbor deepening as well as a familiarity with dredged material disposal and Offshore Dredge Material Disposal Sites.
Engineering	Hydraulic Engineer – Knowledge of USACE guidance related to engineering requirements for the deep draft navigation studies. Knowledge of coastal processes to evaluate the impacts of deepening and/or widening the navigation channel on hydrodynamics, water quality, sediment transport, ship wake induced erosion, and channel design. Geotechnical Engineer - An understanding of the behavior of aquifers and soils, as well as the classification, dredging, and disposal of material for deep draft navigation projects.

d. Documentation of Type I IEPR. The IEPR panel will be selected and managed by an Outside Eligible Organization (OEO), per EC 1165-2-214, Appendix D. Panel comments will be compiled by the OEO and should address the adequacy and acceptability of the economic, engineering and environmental methods, models, and analyses used. IEPR comments should generally include the same four key parts as described for ATR comments in Section 5.c above. The OEO will prepare a final Review Report that will accompany the publication of the final decision document and shall:

- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions; and
- Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

The final Review Report will be submitted by the OEO no later than 60 days following the close of the public comment period for the draft decision document. USACE shall consider all recommendations contained in the Review Report and prepare a written response for all recommendations adopted or not adopted. The final decision document will summarize the Review Report and USACE response. The Review Report and USACE response will be made available to the public, including through electronic means on the internet.

7. POLICY AND LEGAL COMPLIANCE REVIEW

Office of Water Project Review (OWPR), Policy and Policy Compliance Division, HQUSACE (aka CECW-PC) performs HQUSACE policy compliance reviews for decision documents that MSCs cannot approve under delegated authority (see ER 1165-2-502). OWPR is also responsible for the final policy compliance review. This will be a final checkpoint on the need for an ASA(CW) policy exception.

District and Division Counsel are responsible for ensuring the legal sufficiency of each decision document. Legal review should begin early in the study process. Legal certification is required prior to release of the draft decision document for public review, and legal review must continue as the final report is developed, with specific focus on changes in the decision document.

8. COST ENGINEERING AND ATR MANDATORY CENTER OF EXPERTISE (Cost MCX) REVIEW AND CERTIFICATION

All decision documents shall be coordinated with the Cost MCX, located in the Walla Walla District. The Cost MCX will assist in determining the expertise needed on the ATR team and Type I IEPR team and in the development of the review charge(s). The Cost MCX will also provide the Cost Engineering certification. The RMO is responsible for coordination with the Cost MCX.

9. MODEL CERTIFICATION AND APPROVAL

EC 1105-2-412 mandates the use of certified or approved models for all planning activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. Planning models, for the purposes of the EC, are defined as any models and analytical tools that planners use to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision making. The use of a certified/approved planning model does not constitute technical review of the planning product. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR (if required).

EC 1105-2-412 does not cover engineering models used in planning. The responsible use of well-known and proven USACE developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed. As part of the USACE Scientific and Engineering Technology (SET) Initiative, many engineering models have been identified as preferred or acceptable for use on Corps studies and these models will be used whenever appropriate. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR (if required).

a. **Planning Models.** The following planning models are anticipated to be used in the development of the decision document:

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study	Certification / Approval Status
Regional Economic System (RECONS)	RECONS is a modeling tool that estimates jobs, income, sales and value added associated with Corps Civil Works and ARRA spending, as well as stemming from effects of additional economic activities.	Certified
HarborSym	HarborSym is a planning level simulation model designed to assist in economic analyses of coastal harbors. With user-provided input data, the model calculates vessel interactions within the harbor and cost associated with the ocean voyage of vessels.	Certified

b. Engineering Models. Ship simulation modeling will be conducted at ERDC. Cost Estimating Dredge Estimating Program (CEDEP) will be utilized.

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study
MPFATE - Multiple Placement Fate of Dredged Material	MPFATE was developed under the Corps' Dredging Research Program (DRP) (Hales 1995) and was formerly known as Open Water Disposal Area Management Simulation (ODAMS) program (Moritz and Randall 1995).). MPFATE is a site management tool that bridges the gap between the Short Term FATE of dredged material (STFATE) model and the Long Term FATE of dredged material (LTFATE). It will be used to study the disposal of material in the ODMDS.
STFATE – Short Term Fate of Dredged Material	STFATE simulates the placement of a single load of dredged material STFATE models conventional placement (bottom dumping) where the vast majority of the dredged material released from a barge or hopper dredge descends rapidly to the bottom in a relatively high density jet known as the convective descent phase. The dynamic collapse phase begins when the jet impacts the bottom. The more dense material immediately deposits, while the less dense particles are spread outward as a density flow when the vertical energy is transferred into horizontal momentum. Over time the less dense material also deposits. It will be used to study the disposal of material in the ODMDS.
LTFATE – Long Term Fate of Dredged Material / Geophysical Scale Transport Modeling System (GSMB)	The SEDZLJ module within LTFATE and the GSMB predicts the long term stability (days to years) of dredged material mounds. The LTFATE model combines hydrodynamics (waves, currents, and tides) and sediment transport algorithms from SEDZLJ to predict the stability of dredged material mounds. It is a multi-grain (sand, silt, clay) transport model that includes a three-dimensional representation of the sediment bed. It will be used to

	study the disposal of material in the ODMDS and to evaluate changes sediment transport within the Navigation channel and surrounding Mobile Bay due to channel modifications.
Delft 3D	Delft 3D is a multi-dimensional suite of hydrodynamic, sediment transport, and morphologic modules for estuarine and coastal environments. The FLOW module of Delft3D is a multi-dimensional hydrodynamic and transport simulation program which calculates non-steady flow and transport phenomena resulting from tidal and meteorological forcing on a curvilinear, boundary fitted grid or spherical coordinates. The MOR module computes sediment transport (both suspended and bed total load) and morphological changes for an arbitrary number of cohesive and non-cohesive fractions. Both currents and waves act as driving forces. An essential feature of the MOR module is the dynamic feedback with the FLOW and WAVE modules, which allow the flows and waves to adjust themselves to the local bathymetry and allows for simulations on any time scale from days (storm impact) to centuries (system dynamics). It will be used to evaluate shoaling due to littoral transport and to assess the potential changes to the transport system due to channel modifications.
Advance Circulation Model (ADCIRC) 2DDI (2003)	Finite element 2-D hydrodynamic model; the version 2DDI is vertically-integrated and solves a vertically-integrated continuity equation for water surface elevation; no storm or hurricane windfield models or statistical analysis tools are included with model, they must be acquired separately; ADCIRC performs well using Vince Cardone's planetary boundary layer model windfields; statistical analyses using ADCIRC model storm surge simulations are compatible with the USACE Empirical Simulation Technique (EST) as well as joint probability methods. It will used to assess changes to the storm surge due to the deepening of the entrance channel.
CH3D-WES-Muliti-block Hydrodynamic Model (CH3D-WS-MB)	CH3D-WES-MB is a 3-D, multi-block hydrodynamic module of the GSMB. The model performs baroclinic hydrodynamic computations on a non-orthogonal curvilinear or boundary-fitted grid. Physical processes impacting circulation and vertical mixing that are modeled include tides, wind, wave radiation stress gradients, density effects (salinity and temperature), freshwater inflows, turbulence, and the effect of the earth's rotation. The boundary-fitted coordinate feature of the model provides grid resolution enhancement

	necessary to adequately represent the deep navigation channels and irregular shoreline configurations of the flow system. It will be utilized to simulate current and elevation within Mobile Bay and will provide forcing to the sediment transport and water quality models for assessment of changes due to the channel modifications.
Adaptive Hydraulic Modeling (ADH)	ADH is a state-of-the-art Adaptive Hydraulics Modeling system. It is capable of handling both saturated and unsaturated groundwater, overland flow, three-dimensional Navier-Stokes flow, and two- or three-dimensional shallow water problems. ADH contains other essential features such as wetting and drying and wind effects. It will be used to provide model forcing in the Ship/Tow Simulator to evaluate the safety of ship maneuverability of the alternatives.
STWAVE – Steady State spectral WAVE	STWAVE simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth- and steepness-induced wave breaking, diffraction, parametric wave growth because of wind input, and wave-wave interaction and white capping that redistribute and dissipate energy in a growing wave field. It will be used to provide model forcing in the sediment transport, water quality and Ship/Tow Simulator models.
(CE-QUAL-ICM)	State-of-the-art hydrodynamic model used to simulate aquatic systems. The GSMB WQ module CE-QUAL-ICM is a multi-dimensional, time variable eutrophication and water quality model developed by the US Army Engineer Research and Development Center. CEQUAL-ICM uses an unstructured grid, finite volume modeling approach, within which mass is conserved. The model contains a suite of over 30 individually activated water quality constituents including multiple forms of nitrogen, phosphorus, organic carbon, algae and benthic algae. It will be used to investigate eutrophication and living resources water quality changes within the estuary due to the channel modifications.
ERDC Ship/Tow Simulator	The Ship/Tow Simulator features two bridges set up for real-time ship maneuvering, and were specifically developed for evaluating navigation channel designs, modifications, and safety issues. Located at the U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, the accurately portray currents, wind and wave conditions, shallow water effects, bank forces, ship handling, ship to ship interaction (in a meeting and passing or overtaking and passing situation), fender forces, anchor forces, and tug assistance. It will be used to evaluate the safety of ship maneuverability of the alternatives.

Channel Design and Evaluation Tool (CADET)	Probabilistic risk analysis techniques to evaluate the accessibility of channel reaches for multiple vessel geometries, loading, and wave conditions.

10. REVIEW SCHEDULES AND COSTS

a. **ATR Schedule and Cost.** ATR of the draft document is planned for July 2018 and the final report in February 2019. The estimated cost for this effort is $95,000.

b. **Type I IEPR Schedule and Cost.** Type I IEPR of the GRR and SEIS is planned for July 2018. It is estimated to cost $225,000.

c. **Model Certification/Approval Schedule and Cost.** All models to be used have been certified in accordance with EC 1105-2-412, Planning: Assuring Quality of Planning Models, and Enterprise Standard (ES)-08101, Software Validation for the Hydrology, Hydraulics, and Coastal Community of Practice.

11. PUBLIC PARTICIPATION

A NEPA/Scoping Meeting was held 12 January, 2016. The public was invited to comment on the Draft SEIS during the public review period in accordance with NEPA and the Coastal Zone Management Program. The public comment period for the Draft SEIS is currently scheduled from 19 July 2018 to 04 September 2018. These comments, along with ATR, IEPR, and MSC comments, will be incorporated before finalizing the SEIS.

12. REVIEW PLAN APPROVAL AND UPDATES

The South Atlantic Division Commander is responsible for approving this Review Plan, including by delegation within the MSC. The SAD Commander's approval reflects vertical team input (involving District, MSC, RMO, and HQUSACE members) as to the appropriate scope and level of review for the work product. Like the PMP, the Review Plan is a living document and may change as the study progresses. Mobile District is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last SAD Commander approval will be documented in Attachment 3. Significant changes to the Review Plan (such as changes to the scope and/or level of review) must be re-approved by the MSC Commander following the process used for initially approving the plan. The latest version of the Review Plan, along with the SAD Commander's approval memorandum, should be posted on the Mobile District's webpage. The latest Review Plan should also be provided to the RMO and SAD.

13. REVIEW PLAN POINTS OF CONTACT

Public questions and/or comments on this review plan can be directed to the following points of contact:

- Mobile District Project Manager, [redacted]
- Review Management Organization, DDNPCX, [redacted]
- South Atlantic Division Senior Plan Formulator, [redacted]

ATTACHMENT 1: TEAM ROSTERS

PROJECT DELIVERY TEAM (PDT)

Discipline	Agency/Org Code	Team Member Name and Contact Information
Lead Planner	USACE-SAJ, CESAJ-PD-PN	[redacted] (b)(6)
Real Estate	USACE-SAM, CESAM-RE-P	
Economics	National Deep Draft Navigation Planning Center of Expertise	
Navigation Operations	USACE-SAM, CESAM-OP-TN	
Cost Estimating	USACE-SAM, CESAM-EN-E	
Hydraulic Design	USACE-SAM, CESAM-EN-HH	
Ship Simulation	ERDC, CEERD-HN-ND	
Environmental (NEPA)	USACE-SAM, CESAM-PD-EC	
Cultural Resources	USACE-SAM, CESAM-PD-EI	
Geotechnical	USACE-SAM, CESAM-EN-GG	
Plan Formulation	USACE-SAM, CESAM-PD-FP	
Office of Counsel	USACE-SAM, CESAM-OC	
Engineering Technical Lead	USACE-SAM, CESAM-EN-H	
Project Manager	USACE-SAM, CESAM-PM-CM	

INDEPENDENT DISTRICT QUALITY CONTROL (DQC) REVIEWERS

Title	Agency	Name
Economics	USACE-SAM, CESAM-PD-FE	[redacted] (b)(6)
Navigation Operations	USACE-SAM, CESAM-OP-TN	
Cost Estimating	USACE-SAM, CESAM-EN-TC	
Hydraulic Design	USACE-SAM, CESAM-EN-H	
Environmental (NEPA)	USACE-SAM CESAM-PD-EC	

Geotechnical	USACE-SAM, CESAM-EN-GG	[redacted]	
Real Estate	USACE-SAM, CESAM-RE		

ATR TEAM (Draft Report)

Discipline/Expertise	**Name**	**District/Division**
DDNPCX ATR Manager	[redacted]	Mobile/SAD
District ATR Coordinator	TBD	
Agency Technical Review Team		
ATR Team Leader/Plan Formulation	TBD	
Cost MCX	TBD	
Economics	TBD	
Navigation Dredging	TBD	
Environmental	TBD	
Geotech	TBD	
Hydraulic Design	TBD	
Real Estate?		

*****The composition of the ATR review team members is being developed. This document will be updated to reflect the review team members once known*****

ATTACHMENT 2: SAMPLE STATEMENT OF TECHNICAL REVIEW FOR DECSION DOCUMENTS

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the *<type of product>* for *<project name and location>*. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks^{sm}.

SIGNATURE
Name
ATR Team Leader
Office Symbol/Company

Date

SIGNATURE
Name
Project Manager
Office Symbol

Date

SIGNATURE
Name
Architect Engineer Project Manager[1]
Company, location

Date

SIGNATURE
Name
Review Management Office Representative
Office Symbol

Date

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows: *Describe the major technical concerns and their resolution.*

As noted above, all concerns resulting from the ATR of the project have been fully resolved.

SIGNATURE
Name
Chief, Engineering Division
Office Symbol

Date

SIGNATURE
Name
Chief, Planning Division
Office Symbol

Date

[1] Only needed if some portion of the ATR was contracted

ATTACHMENT 3: REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number

From: [redacted]
To:
Subject: FW: [Non-DoD Source] Draft Supplemental EIS/GRR for the Mobile Harbor
Date: Tuesday, May 29, 2018 4:24:00 PM
Attachments: 1993 sand berm January 4 MEM Bar Channel.pdf picture.png
Slides GRR 22 Feb 2018 Public Meeting - Final - (SLIDES) copy.png

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FYI...

[redacted]

-----Original Message-----
From: DeLapp, James Andrew (Jim) COL USARMY CESAM (US)
Sent: Tuesday, May 29, 2018 2:38 PM
To: [redacted]
Cc: [redacted]
Subject: FW: [Non-DoD Source] Draft Supplemental EIS/GRR for the Mobile Harbor

Team,

FYSA, below is the recent email I received from [redacted]

v/r
COL D

-----Original Message-----
From [redacted]
Sent: Wednesday, May 23, 2018 4:20 PM
To: DeLapp, James Andrew (Jim) COL USARMY CESAM (US) <James.A.Delapp@usace.army.mil>
Subject: [Non-DoD Source] Draft Supplemental EIS/GRR for the Mobile Harbor

Dear Col. DeLapp,

I am putting you on notice of the Federal Laws governing the 2018 Draft Supplemental EIS/GRR for the Mobile Harbor.

§ 1502.9 Draft, final, and supplemental statements which states:

“The draft statement must fulfill and satisfy to the fullest extent possible the requirements established for final statements in section 102(2)(C) of the Act. If a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion.The agency shall make every effort to disclose and discussat appropriate points in the draft statement all major points of view on the environmental impacts of the alternatives including the proposed action.”

I wanted to makes sure that the Draft Supplement Environmental Impact Statements for the Mobile Harbor and channels discloses all major points of the Corps' past and present maintenance dredging and the environmental and erosional impacts to Dauphin Island.

Since there has been no transparency of the Corps mitigating the erosion on Dauphin Island, and the Corps not fully answering the public questions at the Corps' meetings before the 2018 Supplemental Environmental Impact Statement/Mobile Harbor GRR and the Corps not disclosing any details about the Island's erosion in the Draft Alabama Barrier Island Restoration Assessment Report for Dauphin Island. Nor has the Corps answers significant questions about the Mobile Harbor project or the past consequences of the Corps action. The Corps must fully disclose all things pertaining to the maintenance dredging of the Outer Bar Channel and Dauphin Island's environmental and erosional impacts, in the 2018 Draft Supplement Environmental Impact Statement.

Col. DeLapp, once again, I am informing you that the Mobile District employees are not telling you the truth.

A 1993 document shows the same picture of a "near shore" dumpsite as the Corps' picture of the dumpsite shown at the February 2018 meeting.

The 1993 picture was shown to Congressman Bevill and other, as the "near shore"dumpsite for dredged sand to protect Dauphin Island, but in a Corps' internal document relating to the picture, the Corps employees stated:

"As I understand it, a presentation was made recently (included Mr. Bevil) indicating that when the Corps dredges the Mobile Bar (maintenance) in the future both the "off shore" and "near shore" berms would be offered in our contract as disposal areas. This does not mean we would direct the Contractor to use one over the other, but rather give him that choice."

1993 picture of "near shore"site shown to Congressman Bevill

The Corps knew that Congressman Bevill was extremely concerned about the erosion to Dauphin Island from the District Colonel's letter in 1992. In Oct. 1992, the Corps briefed Congressman Bevill on the severe erosion on Dauphin Island.

Why did the Corps show the picture of the "near shore" site to Mr. Bevill, if the Corps was not going to use "near shore" site to protect Dauphin Island?

The Corps made Congressman Bevill falsely rely on the Corps' pictures of the "near shore" site, including putting his trust that the Corps would use the "near shore" dumpsite to protect Dauphin Island.

The Corps showing the picture of the "near shore" dumpsite and then countering the picture with a Corps' internal memo stating "This does not mean we would direct the Contractor to use one over the other" to deliberately deceive Congressman Bevill is beyond incredible.

Col. DeLapp, how does the Corps explain that at the 2018 Corps' public meeting on new massive expansion to the Mobile Harbor Channels, the Corps showed the same "near shore" dumpsite in one of their poster, The poster also showed the outline of SIBUA and the feeder berm.

Corps' 2018 poster of "near shore"site for Dauphin Island

I hope the Corps is not going to try trick the public again, and use the same deceptive practices as they used in 1993, to get out of mitigating to the erosion on Dauphin Island; that the site can be used as dumpsite, but the Corps would not require their dredging contractors to use it.

If the “near shore”site did not work over 25 years ago, why does the Corps think it will work now?

Col. DeLapp, the Corps employees are not telling you the truth that either the feeder berm or the Sand Island Beneficial Use Area (SIBUA) has helped the Corps’ mitigation of the erosional impacts to Dauphin Island.

According to Corps documents, the feeder berm did not help Dauphin Island and the Corps dumpsite SIBUA, is in too deep of water and was only changed from the feeder berm site to SIBUA to save the Alabama State Port Authority $73 thousand dollars, NOT TO HELP DAUPHIN ISLAND.

According to a Corps’ 1997 document, the Feeder Berm (Sand Island Bar) does not work, because it broke into three segments.
The northernmost segment migrated northeastward,
the middle segment gradually lost volume and disappeared,
and part of the southern segment remained where placed initially.

That means that none of the sand in the Feeder berm has made it to Dauphin Island.

According to a Corps’ 1996 document, the Corps wanted to change the dumpsite to SIBUA to decrease hauling distance and use “greater depths for equipment suitability” and “Potential for significantly reducing the local cost share and could eliminate it”the cost to the Port Authority of $73 thousand dollars.

The Corps did not tell the people of Dauphin Island that they were changing the site to SIBUA so that the Port Authority did not have to pay any money to protect Dauphin Island, according to the Corps documents, they told the people that the SIBUA would help nourish the beaches of Dauphin Island.

In the Corps’ March 1997 Joint Public Notice Sand Island Beneficial Use Areawere untrue statements:

“Erosion has occurred in the vicinity of Dauphin Island and suitable material placed in the proposed Sand Island Beneficial Use Area would aid in beach nourishmentthrough the littoral transport process.”

The Corps statement about SIBUA in 1997:
“We agree that the rate of disposal material migration would be increased by placement of the material in shallower depths. Our intentions for designation of this beneficial use area generally included cost-efficient disposal within the littoral zone. The operational cost to place the material in average depths of 15 feet as suggested in the comments will likely be increased over that expected for disposal of the material in deeper water”

In 1998, the Corps lies in their statement,
“Additional efforts to provide for beneficial uses of the material dredged from the main ship channel started in 1995 with the proposed designation of the Sand Island Beneficial Use Area. The characteristics of this area are similar to those of the ‘feeder berm’ site and therefore material placed within this area should augmentthe littoral drift system of Sand - Pelican Islands as well as western Dauphin Island.”

In a 2001 Corps’ document about SIBUA:
“Dredge disposal material from the Mobile bar channel was composed of fine sand material and was placed on the upper part of the SIBUA above the -7.6-m (-25-ft) contour. There is little evidence that this material moved very far from the placement site based on the bathymetric changes and grain-size analysis”

The Corps finally admitted they do not know where the sand in SIBUA goes, in a December 12, 2017 meeting, and they admitted that only one-half of the sand has moved out of SIBUA in over 20 years, in the Corps’ public meeting in February 2018, but again the Corps didn’t say where the 7.5 million cubic yards of sand went.

I sure hope the Corps employees are not relying on the feeder berm or the SIBUA dumpsite in the 2018 SEIS/GRR for the Mobile Harbor, to restore sand to Dauphin Island, because according to Corps' documentation neither one helps the erosion to the shoreline.

I am putting you on notice of the Federal Law for the 2018 DRAFT SEIS/GRR for the Mobile Harbor and to make sure the Corps puts in their reports, all of their options and costs to place sand to mitigate the erosion to the adjacent shoreline of Dauphin Island, caused by the Corps maintenance dredging of the Federally Authorized Mobile Harbor Project.

In the 2018 Mobile Harbor Draft SEIS/GRR, the Mobile District Corps needs to disclose that the Corps is not following the Federal Laws, which state that the non-Federal interests is responsible for paying their part of the costs to mitigate the erosion on Dauphin Island.
33 U.S. Code § 2211 – Harbors
(b) Operation and maintenance
(c) Erosion or shoalingattributable to Federal navigation works:Costs of constructing projects or measures for the prevention or mitigation of erosion or shoaling damages attributable to Federal navigation works shall be shared in the same proportion as the cost sharing provisions applicable to the project causing such erosion or shoaling. The non-Federal interests for the project causing the erosion or shoaling shall agree to operate and maintain such measures.

Col. DeLapp, I hope the Corps will not rely on its only one single study, the Byrnes 2008, paid-for-by-the-Corps Lawsuit study, as the basis to not mitigate the erosion and not give sand to Dauphin Island.

The Corps' single study, Byrnes 2008, is contradicted by all other studies including:

* All of the past US Geological Survey studies that state the Corps dredging of the Mobile Pass is the cause of the erosion to the Dauphin Island's shoreline, Morton's 2004, 2007, 2008, and 2013.
* All of Scott Douglass' studies on Dauphin Island
* All of Robert Dean's statements and studies on Dauphin Island.

In addition, the Corps knew that during the lawsuit, the eminent Coastal Engineer, Dr. Robert Dean, University of Florida (Plaintiffs) "indicated that the [Byrnes 2008] Final Report was fundamentally flawed, not reliable and at best inconclusive."   The Corps knew that in Dr. Dean's "Concluding Report", he questioned multiple facts about the Corps' sediment data in the "2008 Final Report"for the lawsuit.

Also, the Corps refuses to admit, Dr. Robert Dean, DID NOT AGREE WITH BYRNES 2008 STUDY during the lawsuit and the fact that
Dr. Dean's report is still part of the lawsuit.

Furthermore, according to an internal Corps' 2011 Memo, the Corps' sediment budget analysis was incorrectand it was used in the 2008 Byrnes lawsuit study.

For your information, District Engineer, COL Drake Wilson who was one of the most revered and respected District Engineers to have led the Mobile District over the last +40 yearsstated in 1975:
"We take this material out to sea about 10 to 15 miles and dump it. We have in inventory some equipment that can take this material out and pump it onto the beach approximately there near Fort Gaines, and our studies thus far indicate that the littoral drift, that is the drift of the current, would generally carry that material on down along the island. This solution appeals to us because it costs nothing. That is, we have to dredge the harbor anyway - - we pay for that under the maintenance of the harbor expenditures and we can pump it out and put it onto the beach for just about the same price that we could take it out into the Gulf and dump it…We have already set in motion those steps necessary to get the proper type of equipment that would do this.It will probably be a year and a half or two years before we would have all that ready."

Col. DeLapp, the facts shows the Corps' blatant dishonesty. The Corps' deception surrounding Dauphin Island is too deep, and I hope you have the courage and strength of character to take a stand against the Mobile District's Corps' past and present exploitation of Dauphin Island.

Sincerely,

[redacted]

Dauphin I Spit
Sand Island
DAUPHIN
Pelican
Bay
West Bank
MAIN SHIP CHANNEL
DUMP SITE


Mobile Bay
Fort Morgan Peninsula
Mobile Harbor Lower Bay Channel
Existing: 45' x 400'
Preliminary Plan: 50' x 400' with
5 Mile Passing Lane 50' x 500'
Mobile Harbor Entrance Channel
Existing: 47' x 600'
Preliminary Plan: 52' x 600'
Mobile Bay
Dauphin Island
Sand/Pelican Islands
ODMDS

From: [redacted]
To:
Subject: RE: HarborSym DQC Files
Date: Wednesday, May 30, 2018 9:00:00 AM

[redacted]

Yes! I'll do it within the next 30 minutes!

-----Original Message-----
From: [redacted]
Sent: Wednesday, May 30, 2018 8:43 AM
To: [redacted]
Subject: HarborSym DQC Files

Good morning,

I've uploaded the HarborSym Files for DQC in the Mobile Harbor GRR appendices▶economics folder. [redacted] would prefer them to be sent via ARMDEC. Do you want to send them to her?

[redacted]

From: [redacted]
To:

Subject: RE: Review of Air/Noise/Traffic EJ inputs for the Mobile Harbor GRR
Date: Wednesday, May 30, 2018 10:43:00 AM

Just a reminder about the discussion this afternoon.

[redacted]

-----Original Appointment-----
From: [redacted]
Sent: Friday, May 18, 2018 8:36 AM
To: [redacted]
Subject: Review of Air/Noise/Traffic EJ inputs for the Mobile Harbor GRR
When: Wednesday, May 30, 2018 1:00 PM-3:00 PM (UTC-06:00) Central Time (US & Canada).
Where: 3rd floor PM Conference Room

Meeting time changed to 1pm.

All,
Please plan on attending a meeting Wednesday, 30 May at 0900hrs in the Mobile District Office to discuss the Air/Noise/Traffic EJ inputs for the Mobile Harbor GRR. Read-ahead documents will be provided prior to the meeting.

[redacted]

From: [redacted]
To:
Cc:
Subject: FW: DQC Review - Mobile Harbor GRR
Date: Thursday, May 31, 2018 6:54:00 PM
Attachments: EC_1165-2-217 - Review Policy for Civil Works.pdf

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Have you been given access to shared planning drive to access the report for review?

-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 6:53 PM
To: [redacted]
Cc: [redacted]
Subject: DQC Review - Mobile Harbor GRR

All,
The Mobile Harbor GRR Report has been uploaded to Dr. Checks for the DQC Review. Please have your review complete and all comments submitted in Dr. Checks NLT 14 June, 2018. If possible, please complete your review sooner than the deadline because the PDT has very little time to turnaround the report prior to release of the DRAFT Report.

Attached is the new Review Policy guidance for Civil Works (Refer to Section 8 District Quality Control and MSC Quality Assurance) [redacted] is the DQC Review Lead.

Let me know if you have any questions.

[redacted]

-----Original Message-----

From [redacted] (b)(6)
Sent: Tuesday, May 29, 2018 7:08 AM
To: [redacted] (b)(6)
Cc [redacted] (b)(6)
Subject: RE: DQC Review - Mobile Harbor GRR

All: We are still completing the report. Will let everyone know when it has been uploaded to Dr. Checks.

[redacted] (b)(6)

-----Original Appointment-----
From: [redacted] (b)(6)
Sent: Thursday, May 03, 2018 10:41 AM
To: [redacted] (b)(6)
Subject: DQC Review - Mobile Harbor GRR
When: Friday, May 25, 2018 9:00 AM-10:00 AM (UTC-06:00) Central Time (US & Canada).
Where: Main 3rd floor PM Conference Room (in hall across from restrooms)

For those not in the district office, call-in Information is as follows:

USA Toll-Free: [redacted]

Access Code [redacted]
Security Code [redacted]

All: You have been selected as part of the DQC Review Team for the Mobile Harbor General Reevaluation Report. Please make plans to attend a DQC kick-off discussion on Friday, 25 May at 0900hrs in the main PM-Conference Room. The Report will be provided electronically to you that morning. Your labor numbers for this effort are as follows:

[redacted] (b)(6)

[redacted] (b)(6)

DEPARTMENT OF THE ARMY *EC 1165-2-217
U.S. Army Corps of Engineers
CECW Washington, D.C. 20314-1000

Circular
No. 1165-2-217 20 February 2018

EXPIRES 31 MARCH 2020
Water Resources Policies and Authorities
REVIEW POLICY FOR CIVIL WORKS

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*This circular supersedes EC 1165-2-214, dated 15 December 2015.

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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.D. 20314-1000

EC 1165-2-217

CECW

Circular
No. 1165-2-217

20 February 2018

EXPIRES 31 MARCH 2020
Water Resource Policies and Authorities
REVIEW POLICY FOR CIVIL WORKS

1. Purpose. This Circular establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). It provides the procedures for ensuring the quality and credibility of U.S. Army Corps of Engineers (USACE) decision, implementation, and operations and maintenance documents and work products. This Circular puts quality and comprehensive review on equal footing with cost and schedule compliance. It presents a framework for establishing the appropriate level of independence of reviews, as well as detailed requirements to accomplish this, including documentation and dissemination. This Circular addresses Office of Management and Budget (OMB) peer review requirements under the "Information Quality Act" (Public Law [P.L]) 106-554) and the Final Information Quality Bulletin for Peer Review by the Office of Management and Budget (referred to as the "OMB Peer Review Bulletin"). It also provides guidance for the implementation of Independent External Peer Review (IEPR) according to both Sections 2034 and 2035 of the Water Resources Development Act (WRDA) of 2007 (P.L. 110-114), as amended by Sections 1044 and 3028 of the Water Resources Reform and Development Act (WRRDA) of 2014 (P.L. 113-121). Feedback is requested to improve follow-on policy and guidance related to Civil Works Reviews. For improvement in the next version of this guidance please send concerns or issues to EC217@usace.army.mil.

2. Applicability. This Circular applies to all USACE Headquarters (HQUSACE) elements, major subordinate commands (MSCs), districts, laboratories, centers of expertise, and field operating activities that have civil works planning, engineering, design, construction, and operations and maintenance (O&M) responsibilities. (See Paragraph 14 for further clarification on HQUSACE policy and legal review.)

3. Distribution Statement. Approved for public release; distribution is unlimited.

4. References. References are provided as Appendix A.

5. Policy.

a. It is the policy of USACE that all of its Civil Works products will undergo an open, dynamic, and rigorous review process. Technical, scientific, engineering, and other information that is relied upon to support recommendations in decision documents or form the basis of designs (at any scale), specifications, and/or O&M requirements and/or other assessments will be reviewed to ensure technical quality and practical application.

b. A review performed outside the "home" district must be completed on all decision and implementation documents, unless otherwise specified. Review approaches will be scalable and customized for each effort, commensurate with the level of complexity and relative importance of the actions being supported. All decisions on the types and scopes of review required on a particular product will be risk-informed, as described in Paragraph 15, and documented.

c. Depending on the particular circumstances, reviews may be managed entirely within USACE or in various combinations with external parties. In cases requiring the most independence, the management of the review will be performed by an organization other than USACE and will involve independent experts. Commanders must be actively involved in establishing effective review approaches for all work products. The quality management procedures of each MSC, as contained in its Quality Management Plan, must comply with the principles of this Circular.

d. All civil works planning, engineering, and O&M products must undergo review. As illustrated in Figure 1, all products must undergo District Quality Control/Quality Assurance (DQC/QA), described in Paragraph 8. A subset of these work products will undergo Agency Technical Review (ATR), described in Paragraph 9. Smaller subsets of the ATR group will undergo one or both types of IEPR described in Paragraphs 10 through 12. For simplicity, HQ Policy Compliance Review and Legal Certification are not shown. See Figure 2 for a broad overview of civil works stages of development and review requirements.

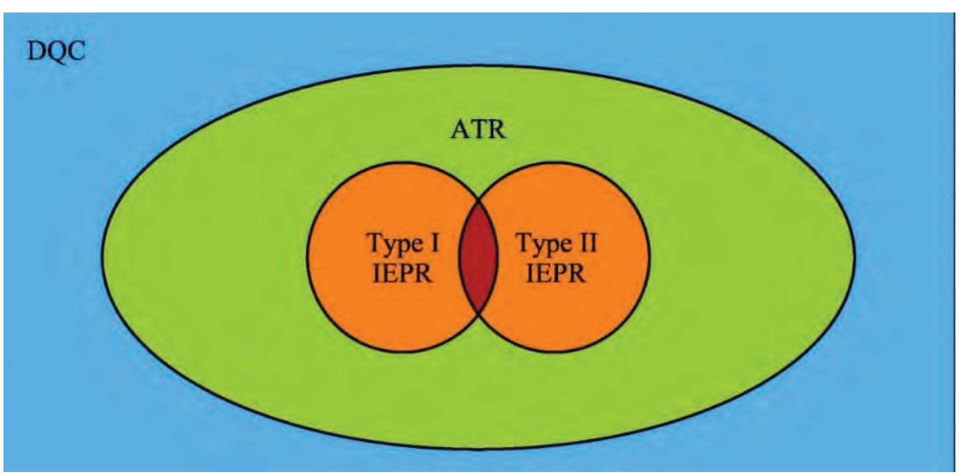

Figure 1. Civil Works Review Products

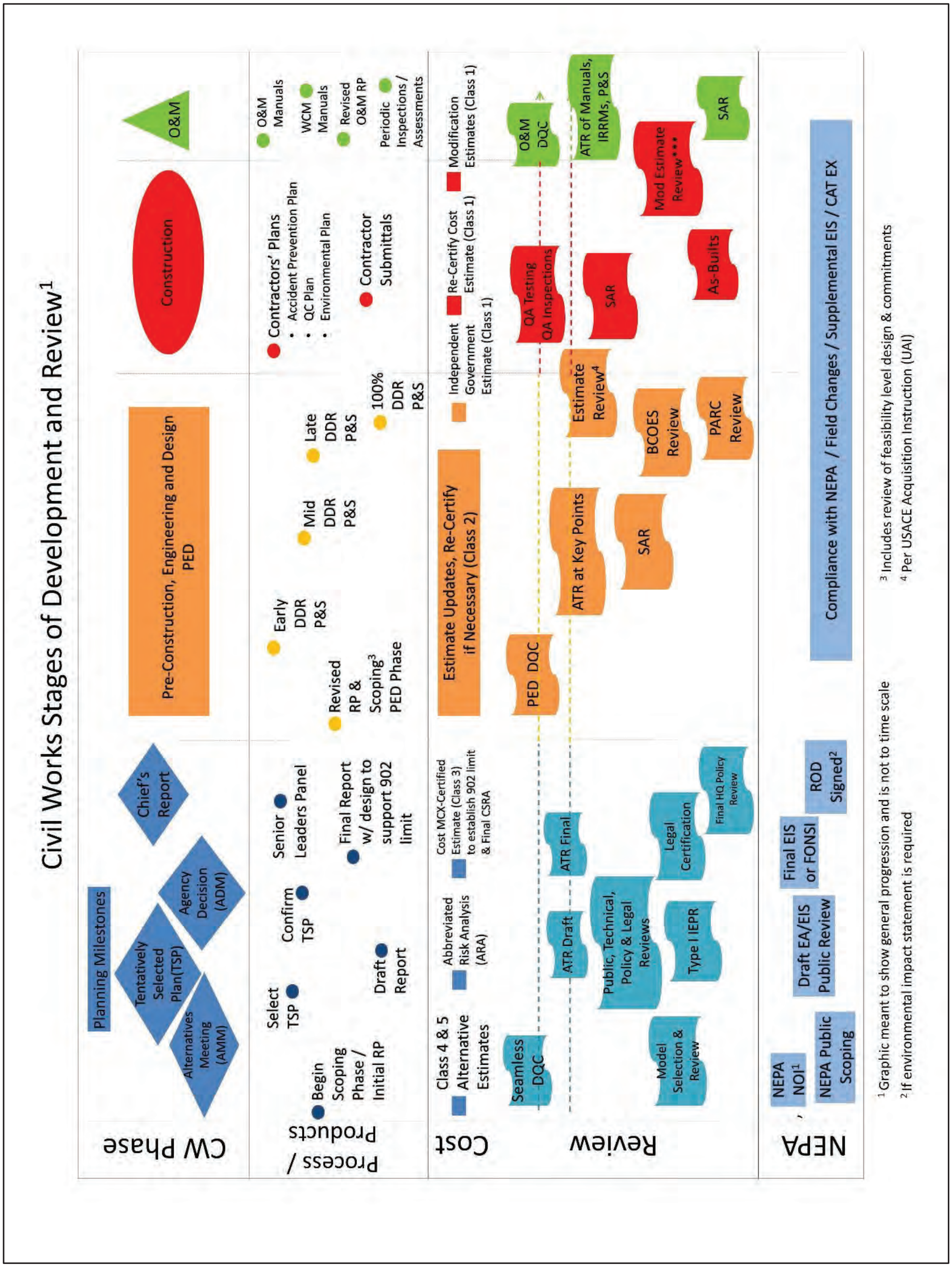

Figure 2. Civil Works Stages of Development and Review

6. Background.

a. The mission of the USACE Civil Works program is to serve the public by providing the Nation with quality and responsive management of the Nation's water resources. USACE review processes are essential to confirming the planning analyses, optimization of design, project safety, reliability, and quality of the decisions and products USACE provides to the Nation. The following reports demonstrate the importance of external peer review in improving USACE plans, projects, and programs:

(1) Review Procedures for Water Resources Project Planning, report of the National Research Council (NRC 2002);

(2) Decision-Making Chronology for the Lake Pontchartrain and Vicinity Hurricane Protection Project, report of the (USACE 2008);

(3) Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, final report of the Interagency Performance Evaluation Taskforce (USACE 2006);

(4) The New Orleans Hurricane Protection System: Assessing Pre-Katrina Vulnerability and Improving Mitigation and Preparedness, report of the Committee on New Orleans Regional Hurricane Protection Project appointed by the National Academy of Sciences (CNORHPP 2009).

b. The USACE Civil Works review process is based on the following fundamental principles:

(1) Consistent review policy must be applied to all Civil Works work products.

(2) Peer review contributes to improved quality of work.

(3) Reviews must be scalable, deliberate, life-cycle, and concurrent with normal business processes.

7. The Review Plan.

a. The Review Plan (RP) is the foundational document that presents the endorsed/approved documentation of accountability and the steps to produce a credible product, consistent with this Circular. The RP is also the basis for compliance with the Information Quality Act requirement to confirm and maximize the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency. To the extent practical, reviews should not extend the schedule but should be embedded in the development of the product. DQC reviewers (including Office of Counsel) must be involved at key decision points and should be included throughout project development. The RP describes the scope of review for the current and/or upcoming phase of work (feasibility, pre-construction engineering and design [PED], construction, etc.) and is a component of the Project Management Plan (PMP) or Program Management Plan (PgMP). All appropriate levels of review (DQC, ATR, IEPR, policy and legal, biddability, constructability, operability, environmental, and sustainability [BCOES]) should be included in the RP and any levels not included will require documentation in the RP of the risk-informed decision not to undertake that level of review (as discussed in Paragraph 15). The endorsement by the Review Management Organization (RMO) and the MSC Commander's approval of the RP are the essential first steps in product accountability, and are required to assure that the plan complies with the principles of this Circular and the MSC's Quality Management Plan and that all elements of the command have agreed to the review strategy. Like the PMP, the RP is a living document and must evolve with the study to reflect the proper scale and scope of the anticipated reviews. It is the responsibility of the Project Manager to implement the RP and validate the execution and appropriate documentation of each step.

(1) The RP provides the primary opportunity to scale reviews appropriate to project size, level of complexity, and level of risk throughout the project life cycle. In addition to the "Charge" discussed in Paragraph 7.i. (which will indicate the specific advice sought), the RP will identify the most important skill sets needed in each review (which will dictate the number of reviewers), and will also identify the objective of the review, thus setting the appropriate scale and scope of review for a product. A RP must be detailed enough to assess the necessary level and focus of review, including potential challenges, use of Architect-Engineers (A-Es), models and data to be used, model certification needs, etc. RPs must anticipate and define the appropriate level of review from the very start of the effort, based upon a preliminary assessment of project risks and their magnitude.

(2) To the maximum extent practicable, reviews will be scheduled and conducted early in the process to avoid or minimize any delays in completion of the study or project. The PMP or PgMP must list all review requirements (in the RP that is appended to the PMP or PgMP), costs, and schedules as integrated features of the overall project execution. This is particularly pertinent in the case of IEPR. The following guidance is essential to timely review:

(a) The project budget will include adequate funds for all necessary reviews.

(b) The project schedule will provide sufficient time for all reviews, and at the appropriate points in the schedule.

(c) For decision documents, all required reviews, with the exception of final USACE policy compliance review, will be completed before the District Commander signs the report. The USACE policy compliance review will be completed before approval by the appropriate HQUSACE office.

(d) In developing a RP, the home district will provide an opportunity for public comment by posting the approved RP on its public website. This is not a formal comment period and there is no set timeframe for the opportunity for public comment. If and when comments are received, the project delivery team (PDT) should consider them and decide if RP revisions are necessary. This engagement will allow for a review approach responsive to the wide array of stakeholders and customers, both within and outside the Federal government.

(e) Project managers will ensure that the P2 schedule for the project identifies the required activities for both Type I IEPR and Type II IEPR, when required, including any meetings to be held with the project team and the independent reviewers. The P2 schedule will also be resourced for the various organizations involved in the review (DQC, ATR, RMO, IEPR contractor, etc.).

b. Applicability. In general, all products or activities will be covered by a RP. For large projects, whether in planning, design, construction, or an operating project, a single RP covering all the various work associated with the project should be developed. However, when a product generally covered under such an overarching RP involves complexities, controversy, or other attributes that would require review beyond that envisioned in the overall RP, a separate RP is required for that activity. For example, at an operational USACE reservoir, most routine activities and their associated products, such as inspection reports, would be covered under an overarching RP while other products such as major rehabilitation studies, dam safety modification reports, activities requiring a separate Environmental Impact Statement (EIS), etc. would require individual RPs. Similarly, to ensure consistency, MSCs may develop programmatic RPs for the Continuing Authorities Program (CAP) that describe the regional review process and also describe cases when an individual RP must be developed. Programmatic RPs may be appropriate in other cases, such as work performed under regional environmental infrastructure authorities. Prior to initiating RP development, the RMO should coordinate with HQUSACE for guidance on whether a programmatic RP is appropriate. Approval of all programmatic RPs (except for CAP, see 13.2.1) rests with the Director of Civil Works (DCW), HQUSACE.

c. Responsibilities. The development of the RP is generally the responsibility of the PDT, in concert with the RMO. The PDT is responsible for recommending the necessary type(s) of reviews as well as the particular disciplines/expertise required, including an assessment by district counsel on the scope of legal reviews. The RP will be published on the district's public internet site following review by district leadership/counsel, endorsement by the RMO and signature approval by the MSC Commander. The district, MSC, or RMO should periodically examine older RPs and invalidate them when appropriate and then require an updated RP.

d. Development of RPs.

(1) The RP will be prepared within the district or other USACE office responsible for the project, in coordination with the appropriate RMO, and approved by the MSC Commander. For prospective projects, an initial RP will be developed within the first 90 days after executing a Feasibility Cost Sharing Agreement (FCSA). As the scope of the study is developed, the draft

RP will be updated and presented at the Alternatives Milestone for a single phase planning study. The RP will then be endorsed by the RMO and sent to the MSC for approval. The RP will be revised prior to the completion of the feasibility phase to detail the reviews in subsequent phases. The RP must be updated and re-approved by the MSC as the project moves through the PED and Construction Phases. For projects not initiated in the planning phase, RPs must be developed at the beginning of the work effort and be updated as appropriate.

(2) The RP is a living document and must be kept up-to-date, in coordination with the MSC and RMO, to reflect the proper scale and scope of the anticipated reviews. The PDT will update the RP to reflect minor changes as they occur without the need for re-approval. Re-approval of RPs by the MSC will be required when there are significant changes, such as in the level of review (i.e., if Type I or Type II IEPR is added to or deleted from the RP). Other situations requiring RMO re-endorsement and MSC re-approval should be very limited but could include significant changes in study/project scope (e.g., adding or subtracting a purpose, etc.).

e. Content of RPs. The following paragraphs identify and describe required content of a RP.

(1) Overview. An overview should include the project title, purpose of the work product, and designated points of contact (titles only) in the home district, MSC, and RMO, to whom inquiries about the plan may be directed.

(2) Documentation of Issues/Risk. The RP should include a section that documents risk and related issues, which should provide the following at a minimum:

(a) Documentation of risk-informed decisions (see Paragraph 15) on which levels of review are appropriate for the product. This documentation is to include:

- The district Chief of Engineering's assessment prior to RMO endorsement as to whether there is a significant threat to human life associated with aspects of the study or failure of the project or proposed projects. When appropriate, this should be done in consultation with the Dam Safety Officer/Levee Safety Officer (when they are not the same person as the Chief of Engineering).

- Basic background information on the project or study area, maps, satellite images, and plan and cross-section views, to provide an overview for the PDT, RMO, review teams, and vertical team (involving district, MSC, RMO, and HQUSACE members). The documentation should briefly describe the project or study area with special emphasis on the inherent risk(s) involved; should indicate whether existing conditions, failure of the project, or future conditions would pose a significant threat to the environment or to human life; identify the population at risk; the problem(s) the study/project is addressing; the study/project goals and objectives; the description of the action, the timing of implementation/construction; and the estimated cost (or range of cost) for proposed projects or the specific construction features for the portion of the project under review.

- Discussion of the risk during construction, which is especially important when modifying an existing project; discussion of whether the level of service is compromised during modifications; discussion of risk for cofferdams, overtopping risk, and other inherent risks during construction, etc.

- Appropriate protection of sensitive or security related information such as detailed drawings or information revealing infrastructure vulnerabilities. These items should be placed in an appendix of the RP and removed prior to posting on the district's website.

- A list of the anticipated deliverables/products that are expected to be technically evaluated during study/project development and the schedule for their delivery.

(b) The discussions must be detailed enough to support the PDT, RMO, and vertical team decisions on the appropriate level of review and types of expertise to be represented on the various review teams.

The timing and sequence of the reviews (including deferrals). Refer to ER 1105-2-100, Planning Guidance Notebook, Appendix H for further procedures on timing and sequence of public, technical, legal, and policy reviews of feasibility studies and reports.

(3) How and when there will be opportunities for the public to comment on the study or project to be reviewed.

(4) When significant and relevant public comments will be provided to the reviewers.

(5) A succinct description of the primary disciplines or expertise needed in the review.

(6) The anticipated number of reviewers for each review.

(7) Whether the public, including scientific or professional societies, will be asked to nominate potential reviewers.

(8) A list of the models expected to be used in developing recommendations, and the model certification/acceptance status of those models.

(9) A list of expected in-kind contributions to be provided by the sponsor.

(10) Whether a site visit will be required for members of ATR Team and/or IEPR Panel.

(11) An execution plan that explains how all the reviews will be accomplished and documented. The following are factors that must be considered in developing the RP and selecting reviewers:

(a) Reviewers' Expertise and Balance. Subject matter experts (SMEs) from USACE or outside USACE may conduct ATR. Selections will be based on expertise, experience, and skills, including specialists from multiple disciplines as necessary to ensure comprehensive review. The group of qualified reviewers will be formed into panels that are sufficiently broad and diverse to fairly represent the relevant scientific and engineering perspectives and fields of knowledge.

(b) Reviewers' Conflicts. RMOs will ensure that Federal employees serving as reviewers (including special government employees) comply with applicable Federal ethics requirements. In selecting reviewers who are not Federal government employees, the National Academy of Sciences (NAS) Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports (NAS Policy on selecting reviewers; NAS 2003) for selecting reviewers with respect to evaluating the potential for conflicts (e.g., those arising from investments; agency, employer, and business affiliations; grants, contracts, and consulting income) will be adopted or adapted.

(c) Reviewers' Independence. For independence, ATR reviewers will be selected by the RMO and IEPR reviewers by the RMO, contractor, or Outside Eligible Organization (OEO), as appropriate. IEPR must be performed by SMEs from outside of USACE. Peer reviewers will not have participated in development of the report, appendix, or other work product to be reviewed. RMOs are encouraged to rotate membership on standing panels across the pool of qualified reviewers. OEOs will bar participation of scientists currently employed by USACE.

(d) Reviewers' Privacy. Peer reviewers will be advised whether information about them (name, credentials, and affiliation) will be disclosed prior to initiating reviews. The RMO will comply with the requirements of the Privacy Act of 1974 (Public Law 93-579) and the following Privacy Act Statement should be included in all external peer review contracts.

- Authority: Sections 2034 and 2035 of the Water Resources Development Act (WRDA) of 2007 (P.L. 110-114), as amended by Sections 1044 and 3028 of the Water Resources Reform and Development Act (WRRDA) of 2014 (P.L. 113-121).

- Purpose: To notify potential peer reviewers of the requirement to make public the review reports and the names and qualifications of panel members.

- Routine Uses: Peer reviewer’s information will be shared with Congress and posted on the internet, as required by law.

- Effects of nondisclosure: Disclosure of the information sought is voluntary, however, failure to agree will not allow reviewers to participate in reviews.

(e) Confidentiality. Review will be conducted in a manner that protects confidential business information and intellectual property.

(f) Choice of Review Mechanism. The choice of a review mechanism (including the make-up of the review panel and the number of external reviewers) will be based: on the novelty and complexity of the information to be reviewed, the importance of the information to decision making, the risks associated with the decision or technical details being reviewed, the extent of prior reviews, and the expected benefits and costs of review; and also the factors regarding transparency described below. For decision documents undergoing Type I IEPR, the RMO must commission eligible entities to manage the review process, including the selection of reviewers, consistent with this Circular.

(g) Reviewers' Access to Information. The RMO will provide reviewers with sufficient information, including background information about key studies or models, to enable them to understand the data, analytic procedures, and assumptions used to support the key findings or conclusions. Reviewers will be informed of applicable access, objectivity, and other quality standards under the federal laws governing information access and quality. The information provided is pre-decisional and is not to be shared with others who do not have the need to know or without authorization granted by the agency from which it came; sensitive material must be handled in a manner that provides reasonable assurance that unauthorized persons do not gain access.

(12) Disclaimer. Information distributed for review must include the following disclaimer: "This information is distributed solely for the purpose of pre-dissemination review under applicable information quality guidelines. It has not been formally disseminated by USACE. It does not represent and may not be construed to represent any agency determination or policy."

(13) Public Participation on Products. Depending on the Civil Works product, soliciting public feedback on that specific product may be necessary. Whenever feasible and appropriate the RMO will provide reviewers with access to public comments received. The RMO will ensure reviewers are aware of scheduled public participation activities as they relate to the review schedule.

(14) Transparency. The RMO will notify reviewers in advance regarding the extent of disclosure and attribution of their comments planned by USACE. The RMO, ATR Team Lead, or OEO will prepare a Review Report after the ATR or IEPR is complete that will:

(a) Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer.

(b) Include the Charge to the reviewers.

(c) Describe the nature of their review and their findings and conclusions.

(d) Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole and include any disparate and dissenting views.

(15) Documentation of Responses. The RP will document how written responses to the review report will be prepared to explain the agreement or disagreement with the views expressed in the report, the actions undertaken or to be undertaken in response to the report, and the reasons those actions are believed to satisfy the key concerns stated in the report (if applicable). The plan will detail how the PDT will disseminate the final Review Report, USACE responses, and all other materials related to the review, and include them in the applicable decision document. The final decision document for project studies that undergo Type I IEPR will summarize the Review Report and USACE responses.

f. Approval of the Review Plan.

(1) The MSC Commander that oversees the home district is responsible for approving the RP. An MSC approval memorandum (Figure 3) is required for each RP and must be included in the internet-posted version of the RP. The MSC Commander approves and signs each RP; the MSC Commander may delegate signature authority for RPs to either the MSC Programs Directorate Chief or the MSC Regional Business Directorate Chief, but no further. If there is disagreement over the scope, content or other aspects of the RP, the MSC should coordinate resolution between the district and the RMO. The MSC Commander's approval should: reflect vertical team input; indicate whether the covered subject matter (including data, use of models, assumptions, and other scientific and engineering information) has life safety concerns, is novel, is controversial, is precedent setting, has significant interagency interest, or has significant economic, environmental and social effects to the nation; and indicate whether specific requests for IEPR are likely. For decision documents, if the RP does not include Type I IEPR, the MSC must obtain an exclusion from IEPR from the DCW prior to approval of the RP.

(2) Upon MSC approval of each RP, the MSC will provide a copy of the signed MSC Approval Memorandum to the RMO and its respective HQUSACE Regional Integration Team (RIT). An approved RP does not supersede or waive regulatory requirements.

Date: *Subject: Review Plan approval for (work product name here)* *The attached Review Plan for the (work product name here) has been prepared consistent with EC 1165-2-217.* *The Review Plan has been coordinated with the (RMO name here) which is the lead office to execute this plan. For further information, contact the RMO at xxx-xxx-xxxx. The Review Plan (includes /does not include) independent external peer review.* *I hereby approve this Review Plan, which is subject to change as circumstances require, consistent with study development under the Project Management Business Process. Subsequent revisions to this Review Plan or its execution due to significant changes in the study/scope or level of review will require new written approval from this office.* *MSC Commander Signature Block*

Figure 3. Sample MSC Commander's RP Approval Memorandum

(3) Like any aspect of a PMP, the RP is a living document and may change or be updated as the study/project progresses, to reflect the proper scale and scope of the anticipated reviews. These updates are especially important in those rare cases where an exclusion from IEPR has been granted. As part of the update, the specific conditions and circumstances that supported the exclusion must be reassessed. The PDT, RMO, and the vertical team will jointly recommend whether or not the exclusion should be withdrawn and IEPR be undertaken. For studies where IEPR has been planned but not yet initiated, the RP updates will include an assessment of whether IEPR initiation should occur earlier than previously planned. Re-approval of a RP due to significant changes in the study/scope or level of review should be approved by following the process used for initially approving a RP. In all cases the MSCs will review the decision on the level of review and any changes made to the RP.

(4) The district and MSC should ensure that, at a minimum, the next phase of work is covered by an up-to-date RP that outlines the upcoming reviews and milestones. If the next phase of the project has never been covered in a previously approved RP (including RMO endorsement memorandum and MSC Commander's signature), then the formal process for RP approval is required.

g. Posting Review Plans. Each district will maintain an internet (i.e., publicly accessible) website with electronic versions of RPs with links to the current documents for its studies/projects along with their RMO endorsements and MSC approval memos. The RP should use titles in lieu of names as much as possible, in posted documents, the names of USACE reviewers should not be displayed. Internet-posted references to the RPs by the respective Planning Center of Expertise (PCX), the respective MSC, and HQUSACE Civil Works Planning Community of Practice (CECW-CP) will link to the district's site. Each district will establish a mechanism on their RP-postings internet site for allowing the public to comment on the adequacy of the RPs, and will consider public comments on RPs (see Paragraph 7.e.(14).

h. Review Management Organization. The management of a review effort is a critical factor in assuring the level of independence of the review, as required by law, USACE policy, or both. With the exception of DQC and special cases in Paragraph 13, all reviews will be managed by an office outside the home district and will be accomplished by professionals that are not associated with the work that is being reviewed. The USACE organization managing a particular review effort is designated the RMO for that effort. Different levels of review and reviews associated with different phases of a single project can have different RMOs.

i Charge Questions. When preparing to initiate review of a USACE product, the Charge to the reviewers for both the ATR Teams and IEPR panels will contain the instructions regarding the objective of the review and the specific advice sought. Review should be conducted to identify, examine, and comment upon assumptions that underlie analyses (i.e., public safety, economic, engineering, environmental, cultural, real estate, and other types of assumptions) appropriate to the Charge, as well as to evaluate the soundness of models and analytic methods. The Charge should be determined in advance of the selection of the reviewers. It should include specific technical questions while also directing reviewers to offer a broad evaluation of the overall document. Panels should also be able to evaluate and provide comment on whether the information presented supports the conclusions. To provide effective review, in terms of both usefulness and credibility of results, the Charge should give reviewers the flexibility to bring important issues to the attention of decision makers. However, for decision documents, reviewers should be explicitly instructed in the Charge to not make a recommendation on whether a particular alternative should be implemented, as the Chief of Engineers is ultimately responsible for the final decision on USACE work products. The RMO, with project-specific input from the PDT, will prepare the Charge questions.

j. DrChecks^{sm} will be the official system for the continuity of the review record, see ER 1110-1-8159. DrChecks^{sm} will be used to document all ATR comments, responses, and associated resolutions accomplished throughout the review process. MSC and district Quality Manuals will establish procedures for documenting DQC.

<u>8. District Quality Control and MSC Quality Assurance</u>.

a. District Quality Control (DQC). District Quality Control is the backbone of the Corps of Engineers' quality process. All work products and reports, evaluations, and assessments will undergo necessary, robust, and appropriate District Quality Control (DQC). It is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the PMP. DQC is an integrated review approach that includes a Quality Management Plan providing for seamless review, Quality Checks (first line supervisory reviews, PDT reviews), a detailed peer review/checking of the documents, computations, and graphics, etc. Reliance on subsequent levels of review by external teams is not an acceptable substitute for DQC. A DQC review may also feature the use of checklists, templates, and/or other standardized DQC tools. The DQC of products and reports will also cover any necessary

National Environmental Policy Act (NEPA) documents and other environmental compliance products and any in-kind services provided by local sponsors. DQC efforts will include the necessary expertise to address compliance with current USACE policy and procedures. When policy and/or legal concerns arise during DQC efforts between the PDT and the DQC reviewers that are not readily and mutually resolved by the DQC Review Lead, the district leadership/Counsel will try to resolve, then seek issue resolution support from the MSC, RMO, and HQUSACE according to the procedures outlined in Engineer Regulation (ER) 1105-2-100, Appendix H, Amendment #1, or other appropriate guidance.

(1) DQC Review Lead. The home district will manage and document DQC. The home district will assign a DQC Review Lead to each study who is responsible for ensuring that a formal DQC review is performed by all members who have been assigned to the DQC Review Team. The DQC Review Lead ensures coordination and interaction of team members, completeness of reviews, quality of review comments, and comment closeout and DQC Certification. The DQC Review Lead will be a qualified senior staff member (Supervisor, Regional Technical Specialist, Lead Planner, Engineering Technical Lead, or PM) who has no production role in the study/project. Note, for small projects the DQC Review Lead may be the only reviewer. The DQC Review Lead will assist in RP development and will regularly review the RP to ensure it is adequate and up to date for the current phase of the study. The DQC Review Lead ensures adequate DQC time and budget are identified in the RP, support Districts' risk identification and assessment, and leads in coordination of risk assessment with District management and the vertical team. As a minimum, the requirements consistent with this Circular will be followed, beyond which the home district and MSC can require more stringent DQC. The DQC Review Lead is responsible for coordinating ATR that is triggered by key risk-informed decisions and high risk items/features that warrant additional evaluation. Additional reviews occur when key risk-informed decisions are made. Product issues identified via DQC should be resolved prior to final ATR and IEPR. The DQC Review Lead is responsible for documenting commitments where changes are to be incorporated in the next phase of work (see Paragraph 8.g.(2)) and this information should be provided to the next level of review, i.e. ATR.

(2) Quality Assurance (QA). Quality Assurance (QA) are those procedures to verify that effective QC was performed. QA includes those processes employed to verify that QC activities are being accomplished consistent with planned activities and that those QC activities are effective in producing a product that meets the desired end quality to assure that the districts are able to plan, design, and deliver quality projects on schedule, within budget, and acceptable to the customer and the Federal government. For QA, the responsible MSC has the primary role to verify that quality control was performed; i.e., the PDT (including assuring that QC was performed by A-E partners), Supervisors, the ATR Team, and the MSC, RMO, and HQUSACE. To verify performance of DQC (including QA) the RMOs may conduct audits as necessary. MSC and district quality manuals will prescribe specific procedures for the selection of DQC team members and the conduct of DQC including documentation requirements that require inclusion of comments and responses, and maintenance of associated records for internal audits to check for proper DQC implementation. MSCs are responsible for evaluating and

recommending changes to subordinate districts' QC processes. The MSC has the responsibility to ensure vertical and lateral integration of organizational capabilities, to include resource sharing, technical expertise, project management, and project delivery to broaden and enhance the range of services and quality within its region. In addition to their oversight role in assuring the PDT is technically qualified, the MSC is also QA responsible is to assure the adequacy and capability of the DQC teams and supplementing the team members from outside the district when necessary. The MSC's QA process will verify that the QC for each project is appropriate.

b. Documents. Documents and records produced should present information in a manner that takes into account assumptions, analyses and rationale for achieving the final conclusion. Documents include Feasibility Reports, NEPA documents/environmental compliance products, Feasibility Reports' Engineering Appendices and Real Estate Plans, Design Documentation Reports, Engineering Documentation Reports, Plans and Specifications, In-Kind products, etc. The documents need to be prepared consistent with applicable policies, such as ER 1105-2-100 Planning Guidance Notebook and ER 1110-2-1150 Engineering and Design for Civil Works Projects, including "telling the story" as explained in these two documents and other guidance. The documents will contain a full record of design decisions, assumptions and methods. Documents should be sufficiently clear so that a reviewer or other individual not familiar with the project could review the documents and understand how the project/analysis evolved into its final recommendation/configuration, and why each key decision was made. Documents should be sufficiently detailed, for each technical specialty, so that the criteria that were used, the critical assumptions that were made, and the analytical methods that were used will be evident for purposes of review and historical documentation. The documents should also contain summaries of important model/calculation results and selected example calculations for all critical elements of the study or design. The documents should usually be sufficient to support execution of the review process without reference to other records, except for confirming that all supporting documents/computations have been checked. The use of a technical editor is highly recommended for decision and implementation documents.

c. Quality Checks. Quality Checks are rigorous independent reviews that occur during the development process and are carried out seamlessly as a routine management practice. Quality Checks are performed by staff responsible for the work, such as supervisors, work leaders, team leaders, designated individuals from the senior staff, or other qualified personnel. However, they should not be performed by the same people who produced the original work or who managed/reviewed the work in the case of contracted efforts. If districts do not have the required expertise, they should coordinate with the MSC to consider qualified personnel from other districts or A-Es to supplement the DQC team. Comments and their resolution should be documented.

(1) As a minimum, the following questions, and any appropriate additional questions, should be considered (see Paragraph 9.k. for additional considerations):

(a) Is the identified water resource problem well understood and are the risks properly characterized?

(b) Has an appropriate array of alternatives been selected that could solve the water resource problem?

(c) Does the Tentatively Selected Plan solve the water resource problem needs and have implementation risks been appropriately considered?

(d) Are the proposed construction methods appropriate?

(e) Are the schedules and cost estimates reasonable?

(f) What is the risk of potential cost and schedule growth?

(g) Are there lessons learned that need to be considered?

(h) Does the product comply with USACE criteria and policy requirements including environmental compliance requirements?

(2) PDT reviews are performed by members of the PDT to ensure consistency and effective coordination across all project disciplines. Additionally, the PDT is responsible for a complete reading of any reports and accompanying appendices prepared by or for the PDT to assure the overall coherence and integrity of the report, technical appendices, and the recommendations before approval by the District Commander. The DQC comments and PDT responses and associated resolutions accomplished will be made available to the ATR to demonstrate a thorough DQC was performed, see Paragraph 8.g. DrChecks^{sm} may be used to document all DQC throughout the review process.

d. Checking Computations. All computations will undergo a rigorous independent check during DQC. Sufficient time will be allocated in the project schedule to allow for a thorough quality check. The computations will be appropriately annotated by the designer with annotations that include, but are not limited to: all assumptions, loadings, design parameters, constraints, equations, model inputs, quantities, and references (including edition and page number) used to complete the design and/or analysis. A narrative will explain the conclusions drawn from the computations. Annotation will be thorough enough that the reviewer/checker can follow the computation process independently. For engineering products/documents and construction products/documents, for example, the author performing the computations will initial and date each computation sheet. A qualified reviewer/checker with experience and a thorough understanding of the computation will perform a quality check to assure all computations, calculations, assumptions, and models used are correct. The reviewer/checker will highlight (e.g., place a “red dot”) on each annotation and number on a computation sheet indicating concurrence with the correctness of the information shown and then initial and date each and every computation sheet being reviewed/checked. Since this is for verification of agreement by the reviewer/checker, typed initials are not allowed on the computations; however, an electronic PDF signature is encouraged.

(1) For computations using computer models (software name and version identified if applicable) and other complex methods of analysis, the planner/ designer/ economist/ architect/ geologist, etc. should perform a review, hand check, or other independent verification of the output and assumptions to demonstrate the conclusions from the model being used are appropriate. The reviewer/checker will highlight (e.g., place a "red dot" on) these computations/annotations as well as the model input parameters. Spreadsheets should be laid out with sufficient clarity so that a reviewer/checker not familiar with the project could review the computational thought process.

(2) The reviewer/checker assumes the same level of responsibility as the author of the computations (planner/designer/economist/architect/geologists, etc.) for determining that the conclusions from the computations are valid and used for the intended purpose. For Engineering and Construction documents, as an example, the first sheet of the computations should include the full name of the originator and reviewers/checkers. The computation sheets will be sequentially numbered. These reviewed/checked sheets will be scanned and made available to the ATR Team to demonstrate a thorough DQC was performed (see Paragraph 8.g.).

e. Checking Graphics/Plans. All graphics/plans will undergo a rigorous independent check as part of the DQC process. Sufficient time will be allocated in the project schedule to allow for a thorough quality check. The plans, drawings, sketches, charts, diagrams, maps, profiles, or other graphical information will clearly illustrate the design intent. The person designing the graphic (planner/designer/economist/architect/geologists, etc.) will initial and date each graphic/plan. A qualified reviewer/checker (planner/designer/economist/architect/geologists, etc.) with experience and a thorough understanding of the design intent will perform a "quality check" to assure all graphical information is correct. The reviewer/checker will place a highlight—e.g., "red dot"—on critical graphic/plan elements, e.g., dimension/elevation, note, or reference, showing concurrence with the correctness of the information shown and then initial and date each and every graphic/plan being reviewed/checked. Since this is for verification of agreement by the reviewer/checker, typed initials are not allowed on the graphics/plans; however, an electronic PDF signature is encouraged. Note: typed initials are acceptable for the contract set of plans. The checked verification set of graphics/plans will be scanned and made available to the ATR Team to demonstrate a thorough DQC was performed, (see Paragraph 8.g.).

f. DQC Certification. The DQC certification will be signed by the lead author of the product, the product reviewer(s), the DQC Review Lead, the supervisor of the author, and the PM, in a format similar to the example shown in Figure 4. A supervisor may grant exceptions from the DQC certification requirement based on a risk-informed decision for minor reports or for design or computations that do not involve life safety, operational adequacy, or large economic consequences.

(1) Within large PDTs there are usually several authors or work group leaders who guide, within their span of control, the development of a component or sub-component of work products. The work products may be decision, implementation, or operations and maintenance documents, or other products. These authors/work group leaders may be team leaders, and they may be in roles that include lead planner, designer, economist, architect, geologist, and others. The work group leaders support the PM, Lead Planner, and/or Engineering Technical Lead. The DQC certification that includes signature of the author or work group leader will provide ownership and accountability for the study/design process.

(2) Upon completion of the DQC reviews, the author or work group leader will sign a DQC certification sheet, similar to the example shown in Figure 4, for the study product/project feature under their leadership. Larger products will usually have multiple certification sheets (separate sheets for components/sub-components of the reviewed work product); smaller reports may have only a single certification sheet. Cross checking among the narrative documentation (the "write-up"), computations, and plans and specifications is critical for the DQC process. The reviewer/checker will then sign to certify that appropriate and effective DQC has been performed.

g. Control of Documents/Record of Design.

(1) Once the documents, computations, graphics/plans, DQC comments and responses (unless DrChecks^{sm} is used), and certification sheets have been reviewed/checked and initialed, they will be converted or scanned into a PDF or equally accessible format to record the design and store it in the district's electronic file system. Reviewers are encouraged to use electronic files whenever possible but if documents are checked via hardcopy they will be converted to an electronic format for documentation purposes.

(2) File directories should be set up to maintain documentation of intermediate efforts, such as Draft Report, Preliminary Design, Intermediate Design, Ready to Advertise, As-Builts, etc. However, a directory should also be set up for the DQC documents/graphics/plans/certifications that show the reviewers' markups and commitments and should be made available to the ATR Team for their QA to demonstrate DQC has occurred.

(3) A clear page numbering system will be used so an accurate reference can be made to any portion of the Study or Record of Design.

(4) Appropriate protection of detailed project cost estimates must be taken for document control.

Project Name
Document Name
100% Review

DQC Certification of PRODUCT/FEATURE NAME
Project Team

As the (lead planner/designer/economist/architect/geologists, etc.) for the PRODUCT/FEATURE NAME, I certify the following work shown herein was completed using the appropriate USACE guidance or industry standard if applicable. I certify the work is based on:

- Appropriate assumptions, methods, procedures, computations (including quantities) and materials used in the analyses
- Evaluation of alternative designs, if applicable
- Appropriate data and level of data
- Reasonable results that meet the customer's needs consistent with law and existing USACE policy.

I certify that the write-up (page 1-xx), computations (page 1-xx), drawings, (page 1-xx) and specifications (sec no.) meet the customer requirements shown herein. For items previously designed by others and included as the design basis shown herein, I certify that I have verified the work for adequacy, completeness, and accuracy.

Name Title Office Symbol (Signature)

Project Team: (optional)
Name Title Office Symbol (Initials)

Name Title Office Symbol (Initials)

Name Title Office Symbol (Initials)

As the Reviewer/Checker I have performed DQC and concur with the findings of the (lead planner/designer/economist/architect/geologist, etc.) for the PRODUCT/FEATURE NAME.

Name Title Office Symbol (Signature)

DQC Review Lead
Name Title Office Symbol (Signature)

Project Manager/Lead Planner/Technical Lead
Name Title Office Symbol (Signature)

Supervisor (of the author or section where the product is produced)
Name Title Office Symbol (Signature)

Figure 4. Sample DQC Certification form

9. Agency Technical Review.

a. Agency Technical Review (ATR). ATR is undertaken to "ensure the quality and credibility of the government's scientific information" consistent with this Circular and the Quality Manual of the responsible MSC. All Civil Works products will undergo necessary and appropriate ATR, as well as DQC. This level of review will also cover a comprehensive review of the conclusions to ensure that the results and decisions are clearly supported by the information presented and are in compliance with current agency policy and procedures. Any necessary NEPA documents, other environmental compliance products, in-kind services provided by local sponsors or their A-Es, and other supporting documents are also part of the ATR. The level of review should be commensurate with the significance of the information being reviewed, which should be determined in a risk-informed manner, see Paragraph 15. Each ATR will be conducted by a qualified team of senior highly experienced experts in the type of work being reviewed who are from outside of the home district and are not involved in day-to-day production of the project/product. To ensure independence, the ATR Team Lead will be from outside the home MSC as selected by the RMO. ATR will not serve as a substitute for DQC. The DQC Review Lead will coordinate with the ATR Team Lead for reviews triggered by key risk-informed decisions and high risk items/features that warrant additional evaluation. If the ATR Team is asked to review any products for which the DQC activities do not appear to be appropriate and effective, the ATR Team Lead should work through the RMO to return those products to the PDT "with no action" and provide general guidance for revision. The role of ATR is to perform an assessment of DQC, validate PDT decisions, bring up important issues, concerns, and lessons learned. The ATR Team is not to make project decisions; the PDT is responsible for the product/design. The PDT must assess each ATR comment and then can either implement the comment or provide a logical, well-thought-out response as to why not to implement the comment. The dispute resolution process (see 9.l.(3) and 9.l.(4)) is available when an impasse develops. The ATR Team will document any significant concerns or any unresolved comments for draft products in the ATR Certification. The objective is for ATR to be involved as appropriate throughout the project life cycle at an appropriate, scalable level based on the complexity, size and level of risk associated with the project, see Figure 2. Civil Works Stages of Development and Review. The ATR Team will furnish the PDT written feedback at critical points during project formulation and design, and will conduct formal reviews as products are completed. ATR Team members along with other SMEs will be available, knowledgeable, and willing to offer suggestions as major issues arise, saving time and money, and minimizing unproductive design effort and rework, however care must be taken to ensure independence of the ATR Team from the production team. Formal ATR of products occurs when a holistic, comprehensive review of the overall product(s) is performed.

b. ATR is mandatory for all decision and implementation documents. For other work products, a case-specific, risk-informed decision, as described in Paragraph 15, will be made as to whether ATR is appropriate. Refer to ER 1105-2-100, Planning Guidance Notebook, Appendix H, for further procedures on ATR for feasibility studies and reports. For cost products, refer to ER 1110-2-1302 Civil Works Cost Engineering ATR requirements.

c. Management of ATR reviews is dependent upon the phase of work (planning, design, or construction), and may be managed by different RMOs for different phases.

(1) Decision Documents. For ATR on decision documents, the RMO generally will be the appropriate PCX; e.g., for flood risk management (FRM) decision documents, the FRM PCX would manage the effort. For dam or levee safety modification studies, the RMC will be the RMO, in close coordination with the FRM PCX or the Coastal Storm Risk Management (CSRM) PCX, as appropriate. For inland navigation studies, the RMO will be the PCXIN, in coordination with the Inland Navigation Design Center (INDC-MCX). See Paragraph 13 for special provisions associated with the Continuing Authorities Program (CAP).

(a) When decision documents are for multiple project purposes (or project purposes not clearly aligned with the PCXs), the home MSC should designate a lead PCX to conduct the review after coordinating with each of the relevant PCXs.

(b) For decision documents, there must be appropriate consultation by the RMO throughout the review with the allied CoPs such as engineering and real estate, other relevant CXs, and other relevant offices to ensure that a review team with appropriate independence and expertise is assembled and a cohesive and comprehensive review is accomplished.

(c) For decision documents there must be coordination with the Cost Engineering Mandatory Center of Expertise for Civil Works and Support for Others (Cost Engineering MCX), located in the Walla Walla District, which will provide the cost engineering review and resulting certification for the feasibility level cost estimate for the project.

(2) Other Work Products. For other work products, ATR must be managed and performed outside of the home district with exceptions outlined in Paragraph 13. The RMC must serve as the RMO for projects whose failure would pose a significant threat to human life. The INDC-MCX must serve as the RMO for products for inland navigation. For all other projects, the MSC must serve as the RMO. As with decision documents, ATR for other work products must have appropriate coordination and processing through CoPs, relevant PCXs, and other relevant offices to ensure that a review team with appropriate independence and expertise is assembled and a cohesive and comprehensive review is accomplished.

d. Definition of Success. The corporate intent is for an ATR to not only ensure technical analyses are correct but to also guide compliance with all pertinent USACE guidance, to achieve adequate quality and vertical alignment early in studies. The scope, extent and type of subsequent HQUSACE policy compliance review comments may be considered a measure of the effectiveness of the PDT, DQC, ATR, QA and IEPR efforts.

e. Supporting Principles.

(1) Each Commander is responsible for assuring that work products comply with all applicable statutory and policy requirements and, most importantly, have been read thoroughly and reviewed for consistency as well, prior to forwarding to higher authority.

(2) The PDT is responsible for project success and for delivering a quality product consistent with ER 5-1-11. The PDT is responsible for developing work products according to the procedures and policies set forth in USACE Engineer Regulations, Engineer Circulars, Engineer Manuals, Engineer Technical Letters, Engineer Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE. The PDT, supported by the appropriate CoPs, is knowledgeable of USACE water resources policies and procedures, and has the expertise to support the project development process.

(3) The home district Office of Counsel is responsible for the legal review of each decision document and signing a certification of legal sufficiency.

(4) MSC Commanders are responsible for ensuring policy and legal compliance, QA, and documenting technical, policy and legal compliance for decision documents that have been delegated to MSCs for review and approval consistent with ER 1165-2-502, Delegation of Review and Approval Authority for Post-Authorization Decision Documents.

(5) HQUSACE is responsible for: confirming the technical, cost, policy, and legal compliance of planning products; supporting the resolution of issues requiring HQUSACE, Assistant Secretary of the Army for Civil Works (ASA(CW)) or OMB decisions; continuously evaluating the overall project development process, including the review and policy compliance processes (including responsibilities delegated to MSCs); and recommending appropriate changes when warranted.

f. Objectives and Scope of ATR.

(1) Objectives.

(a) The ATR will ensure that proper and effective DQC has been conducted as evidenced in the products provided for review, DQC documentation, and the signed certification.

(b) The ATR will ensure that the product is consistent with established criteria, guidance, procedures, and policy.

(c) The ATR will assess whether the analyses presented are technically correct and comply with published USACE guidance, and whether the document explains the analyses and results in a reasonably clear manner for the public and decision makers.

(2) Scope.

(a) The ATR will examine the materials submitted to ensure the adequacy of the presented methods, assumptions, criteria, decision factors, applications, and explanations.

(b) Policy compliance is explicitly within the scope of ATR. The corporate intent is for ATR to identify and, through participation of the vertical team, resolve common policy concerns early, and prior to HQUSACE policy compliance reviews. The scope, extent, and type of subsequent HQUSACE policy compliance review comments may be considered a measure of the efficacy of the study and ATR efforts.

g. Planning for ATR.

(1) The ATR tasks and related resource, funding, and schedule needs for decision documents will be addressed in the RP after the FCSA is executed or, for design efforts, before the Design Agreement is executed.

(2) The PDT will coordinate the RP with the appropriate RMO to ensure that ATR activities are reasonably represented in the PMP, particularly the schedule and resource needs. The ATR efforts should be integrated into the product development schedule to avoid or minimize impacts on the schedule as much as possible, and to avoid rework and delays that would likely occur if reviews are deferred to the end of the effort.

(3) Once a review is opened for reviewers' comments (for one or more product components), a reasonable time should be established for both issue identification and issue resolution. Reviews will not be left open for indefinite periods and all comments should be backchecked prior to closing a review, see Paragraph 9.l.(3). for comments involving disagreement. All comments should be backchecked prior to closing a review in DrChecks[sm] (see Paragraphs 9.l.(3) and 9.l.(4) concerning resolution of comments).

h. ATR Team.

(1) The disciplines represented on the ATR Team should generally mirror the significant disciplines involved in the accomplishment of the work. The ATR Team will be established shortly after the PDT is established, and in the case of feasibility studies, after the FCSA is executed and the scope of the study is established, generally after the Alternatives Milestone. ATR efforts will include the necessary expertise to address compliance with applicable published policy. The ATR Team member should be senior USACE personnel with expertise in the subject area being reviewed. ATR Teams will be assigned by the appropriate RMO and comprised of senior USACE personnel who have been vetted and certified by their respective CoP for their specific areas of expertise. The goal of ATR Team selections should be to find the most experienced subject matter experts available whose qualifications are commensurate with

the complexity of the product(s) being reviewed. ATR Teams may be supplemented by experts outside of USACE, as long as the experts are endorsed by the respective technical sub-CoP Leader. For several major disciplines, the following paragraphs identify the CoP or sub-CoP that maintains a list of experts approved as ATR reviewers.

(a) The Planning Community of Practice (PCoP) utilizes a certification process for planning disciplines that include Plan Formulation, Environmental, Economic, and Cultural Resources. ATR Team members in these disciplines must be certified by their respective Planning sub-CoP and listed in the Planners Database, which can be accessed at http://sme.planusace.us/.

(b) The Engineering and Construction (E&C) CoP utilizes the Corps of Engineers Reviewer Certification and Access Program (CERCAP) as the process for the nomination, review and certification of ATR reviewers. To serve as an E&C reviewer on an ATR Team, USACE personnel must be listed in CERCAP. CERCAP can be accessed at https://maps.crrel.usace.army.mil/apex/f?p=105:LOGIN:15561893545473. The Cost Engineering MCX trains and maintains a list of qualified cost reviewers. The Cost Engineering MCX ATR coordinator will assign a qualified reviewer who is knowledgeable in the types of applied engineering and construction solutions. The Real Estate CoP (CEMP-CR) also maintains a list of approved reviewers.

(2) For decision documents involving hydrologic, hydraulic, and/or coastal related risk management measures, the ATR Team will include a subject matter expert in multi-discipline flood risk analysis to ensure consistent and appropriate identification, analysis, and written communication of risk and uncertainty.

(3) At least one member of an ATR Team for inland hydrology and coastal studies, designs, and projects must be certified by the Climate Preparedness and Resilience CoP in CERCAP.

i. ATR Timing.

(1) Each application of ATR should build upon any and all prior cycles of review for any product. Each ATR review iteration needs to address only incremental changes and additions to documents and analyses addressed in prior ATR reviews, unless the ATR Team determines that certain subjects or aspects warrant revisiting due to other changes or a need to adequately understand a larger portion of the product or project. The risk-informed decision process outlined in this Circular should help guide whether ATR should also be applied at different times in the project development process.

(2) The scheduling of ATR should be presented as part of the RP. ATR will normally occur during key stages in the development of the particular work product and be discussed at milestone meetings, briefings, and in-progress reviews (IPRs).

(3) Decision documents must adhere to review requirements in ER 1105-2-100, Planning Guidance Notebook, and will be documented in the RP. ATR will be certified for the draft and final decision documents and supporting analyses.

(a) The draft report and supporting analyses must undergo ATR because they provide the basis for HQUSACE to determine whether vertical team agreement with the future without-project condition and support for the tentatively selected plan is warranted.

(b) The final report and supporting analyses must undergo ATR because they will provide the basis for the Chief of Engineers interagency coordination and the Chief's approval or further recommendation to the Secretary of the Army and the Congress, as needed.

(4) During the design and construction phases, the timing of ATR will be dependent on the complexity of the project and will be explicitly laid out in the RP, with the concurrence of the vertical team, including the RMO.

(5) All portions of the final work product submittal will have undergone ATR, including any recent revisions that impact cost, schedule, or scope. ATR certification of the final product cannot be completed until the DQC is certified.

j. Review Criteria for ATR.

(1) Products will be reviewed against published guidance, including Engineer Regulations, Engineer Circulars, Engineer Manuals, Engineer Technical Letters, Engineer Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE. Any justified and approved waivers for any deviations from USACE guidance should be obtained from HQUSACE before the start of review.

(2) For any work product undergoing ATR, key considerations include the following.

(a) The project meets the scope, intent, and quality objectives as defined in the PMP.

(b) Formulation and evaluation of alternatives are consistent with applicable regulations and guidance.

(c) Concepts and projected project costs are valid.

(d) The non-Federal sponsor is aware of their requirements and concurs with the proposed recommendations.

(e) The project is feasible and will be safe, functional, constructible, environmentally sustainable, within the Federal interest, and economically justified according to policy.

(f) All relevant engineering and scientific disciplines have been effectively integrated.

(g) Appropriate computer models and methods of analysis were used and basic assumptions are valid and used for the intended purpose.

(h) The source, amount, and level of detail of the data used in the analysis are appropriate for the complexity of the project.

(i) The project complies with accepted practice within USACE.

(j) Content is sufficiently complete for the current phase of the project and provides an adequate basis for future development effort.

(k) Project documentation is appropriate and adequate for the project phase.

(3) Additional considerations for Decision Documents.

(a) Recognizing that the quality of each decision document has a direct and immediate impact on the credibility of the Corps of Engineers and the Department of the Army, ATR on decision documents should address the basic communication aspects of the documents. Quality decision documents allow the public and stakeholders to understand the planning effort and its results, and enable decision makers to reach the same conclusions as the reporting officers (i.e., quality decision documents are not a simple reporting of PDT findings or a record repository of PDT activities).

(b) The main decision document and appendices should form an integrated and consistent product.

(c) As an initial guide, the ATR Team should consider the Project Study Issue Checklist ER 1105-2-100, Planning Guidance Notebook, Appendix H, which includes many of the more frequent and sensitive policy areas encountered in studies.

(d) Other key considerations include:

- Are the existing and future without-project conditions reasonable and appropriate?

- Are the planning objectives, constraints and assumptions consistent with the without-project conditions?

- Do the alternative plans provide a reasonably complete array of solutions, make sense relative to the planning objectives and the without-project conditions, and are they complete, effective, efficient and acceptable?

- Are sufficient alternatives formulated to determine the appropriate combination of measures and a reasonable scale for the selected plan (the National Economic Development (NED), National Ecosystem Restoration (NER) or NED/NER Plan)?

- Are the required plans included, such as nonstructural flood risk management plans?

- Are alternatives safe, functional, constructible, economical, reasonable and sustainable?

- Are calculations and results of analyses essentially correct? There should be documentation in the DQC record on this issue.

- For final report ATR, is the engineering content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?

- For final report ATR, is the real estate content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?

- For final report ATR, is the environmental mitigation content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?

- Are comparable cost products used to compare, screen and select alternative plans? For final ATR does the baseline cost estimate include a construction schedule and studied risk-based contingency? Are the cost products and supporting products up to date?

- For final report ATR, are analyses for the engineering, economic, environmental, real estate and other disciplines fully described, technically correct, and do they comply with established policy requirements and accepted practices within USACE?

- Is the appropriate plan selected based on the National Objectives and evaluation criteria expressed in Principles and Guidelines and USACE policy?

- Does the implementation plan have an appropriate division of responsibilities?

k. ATR Comments.

(1) Each review comment should be succinct and enable timely resolution of the concern. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment normally include:

(a) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;

(b) The basis for the concern – cite the appropriate law, ASA(CW)/USACE policy, guidance or procedure that has not been properly followed;

(c) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and

(d) The probable specific action needed to resolve the concern – identify the action(s) that must be taken to resolve the concern.

(2) In some situations, especially addressing incomplete or unclear information, comments may seek clarification to then assess whether further specific concerns may exist. In such situations, the comments generally would defer identifying a probable solution as indicated under dispute resolution below.

(3) The ATR Team may share value added lessons learned for consideration, keeping in mind the considerations in Paragraph 9.k.(4).

(4) ATR comments should generally not include:

(a) Attempts to enforce personal preferences over otherwise acceptable practices; i.e., alternate solutions or analysis methods, when the practitioners have already used appropriate methods to develop an adequate solution.

(b) Any other issues that do not add value toward the planning decisions and recommendations, or do not make the recommended plan safe, functional, or more economical.

l. ATR Process.

(1) The ATR process will be conducted using the DrChecks^{sm} review documentation software. The ATR Team will provide a written summary of its actions and written specific concerns to the PDT through the RMO.

(2) Upon receipt of the ATR comments, the PDT will develop responses to the specific concerns and coordinate those responses with the ATR team through the RMO. Technical responses will be made by product author or by an individual experienced in that discipline area. Responses will acknowledge and specifically address the comments, indicating resolution steps taken or to be taken.

(3) Dispute Resolution. The ATR Team will complete its review in DrChecks^{sm}. Thereupon, the PDT will develop and coordinate responses with the ATR Team for each

comment. The responses and the ensuing discussion are to seek resolution of the ATR concerns to the mutual satisfaction of the PDT and the ATR Team. The RMO should be engaged by the ATR Team Lead if issues arise between a reviewer and the PDT that cannot be fully resolved. When resolution is not readily achievable, the RMO should engage the PCX/RMC or MSC SMEs to help facilitate resolution, and they in turn may choose to engage HQUSACE SMEs. When policy and/or legal concerns arise during ATR efforts that are not readily and mutually resolved among the PDT members and the reviewers, the district will seek issue resolution support from the MSC and HQUSACE consistent with the appropriate guidance. For planning products, resolution will follow the procedures outlined in ER 1105-2-100 (Appendix H). Unresolved comments involving disagreement between the ATR Team and the PDT will be closed with the notation that the comment has been elevated for resolution (except as described in 9.l.(4)). Any such issues will be explicitly listed on (or attached to) the ATR certification form prior to being routed for signature.

(4) For ATR of decision documents and/or supporting analyses prior to the Agency Decision Milestone (ADM), significant unresolved concerns will be documented by the RMO in the ATR summary review report Those comments may remain open in DrChecks^{sm} until resolution. At the ADM, the path forward for addressing those comments, if necessary, would be documented. For remaining concerns post-ADM, the PDT with RMO support will forward the concerns through the MSC to the HQUSACE RIT, including basic research of USACE guidance and an expression of desired outcome, for further resolution or engagement with the vertical team through an IPR. Subsequent submittals of final reports for MSC and/or HQUSACE review and approval will include documentation of the issue resolution process.

(5) The ATR Team will identify significant issues that they believe are not satisfactorily resolved and will note these concerns in the Statement of Technical Review Report/Certification documentation. Review reports will be considered an integral part of the ATR documentation process.

(6) The ATR documentation in DrChecks^{sm} will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points from discussions, including any vertical coordination, and the agreed upon resolution.

(7) Statement of Technical Review. The ATR Team Lead must complete a statement of technical review for all final products and final documents. For each ATR event, the ATR Team will examine relevant DQC records and previous ATR reports, and will provide written comment in the Statement of Technical Review Report as to the apparent adequacy of the DQC effort for the associated product or service. This report includes a summary of each unresolved issue, the Charge questions, a brief resume of ATR reviewers, and a printout of all DrChecks^{sm} comments with resolution in order for the process to be certified as complete. In the case of civil works decision documents forwarded to HQUSACE for review, the ATR Team Lead must complete a Statement of Technical Review Report for both draft and final decision documents. The ATR Team Lead, project manager, RMO, and the chief(s) of the function will certify that the issues raised by the ATR Team have been resolved, or have been escalated for resolution. By signing

the ATR certification, the district leadership certifies policy compliance of the document and also that the DQC activities were sufficient and documented. Before the ATR certification is completed, the PDT will ensure that all agreed upon changes have been incorporated into the final product. For those cases where commitments are made to incorporate changes in the next phase of work (e.g. advancing from Planning into PED), agreed upon deferrals will be documented in the ATR certification. A sample Statement of Technical Review (ATR Completion) and Certification of ATR is included in Figure 5. The statement should always include signatures from the ATR Team Lead, RMO, and Project Manager and senior level staff as indicated in the sample. When an A-E contractor performs the ATR, the appropriate principal of the contractor will sign the statement.

m. Architect-Engineer (A-E) or Sponsor Work. All parties that produce deliverables for USACE (studies, designs, etc.), are responsible for the quality of those deliverables, whether by A-E or other non-USACE entity; examples of such deliverables include environmental compliance products or any in-kind services provided by local sponsors. That party's plan to manage quality should be presented in their Quality Control Plan (QCP) for the product and the district's quality assurance procedures must ensure reasonable adherence to the approved QCP. The QCP, including Quality Checks documentation and A-E QC certification sheets, similar to the USACE DQC certification sheet, will be submitted to USACE for a QA review. The A-E contractor will follow the quality control requirements described in Paragraph 8. The Contractor QCP is the Contractor's management plan for ensuring quality in the contract. The Contractor QCP describes the way in which the Contractor will produce the deliverables, and the step-by-step approach that will be taken to ensure the quality of the engineering and design services and the products derived from those services. The formal ATR of the product will be the responsibility of the RMO. The A-E contractor or sponsor will be accountable for the resolution of any issues with their deliverable products identified during the ATR. If IEPR is required, A-E or Sponsor deliverables will be treated in the same manner as any other in-house product except that issue resolution will be a dual responsibility between the product provider and USACE, with USACE having the final authority.

COMPLETION OF AGENCY TECHNICAL REVIEW

This Statement of Technical Review has been completed by the ATR Team for the [product type & short description of item] for [project name and location], see attached summary of unresolved issues and future commitments, the Charge questions, a brief resume of ATR reviewers, and a printout of all DrChecks[sm] comments with resolution. The ATR was conducted as defined in the project's RP to comply with the requirements of EC 1165-2-217. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing USACE policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have either been resolved or have been elevated and are attached. All comments in DrChecks[sm] are closed.

SIGNATURE

[Name] | Date
ATR Team Lead
[Office Symbol or Name of A-E Firm]

SIGNATURE

[Name] | Date
Project Manager (home district)
[Office Symbol]

SIGNATURE

[Name] | Date
Architect Engineer Project Manager[1]
[Company, location]

SIGNATURE

[Name] | Date
Review Management Office Representative
[Office Symbol]

1 Only needed if some portion of the ATR was contracted

1 of 2

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:
[Describe the major technical concerns and their resolution and specifically list any agreed-upon deferrals to be completed in the next phase of work or state "There are no significant concerns or any unresolved comments".]

As noted above, all concerns resulting from the ATR of the project have been fully resolved or have been elevated and documented with this certification.

SIGNATURE

[Name] — Date
Chief, Engineering Division (home district)
[Office Symbol]

SIGNATURE

[[Name] — Date
Chief, Planning Division[2] (home district)
[Office Symbol]
Add appropriate additional signatures (Operations, Construction, A-E principal for ATR solely conducted by A-E, etc.) and/or modify to accommodate local organizational structure.

SIGNATURE

[Name] — Date
[as appropriate]
[as appropriate]

SIGNATURE

[Name] — Date
[as appropriate]
[as appropriate]

2 Only needed for Decision Documents

2 of 2

*** Instructions: [Input] – Information in Blue brackets and text is required. Once the input is provided, text should be formatted in black and the brackets should be deleted. Delete these instructions in the completed form.*

Figure 5. Sample ATR Completion / Certification form

10. Independent External Peer Review.

a. Independent External Peer Review (IEPR) is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. Any work product, report, evaluation, or assessment that undergoes DQC and ATR may also be required to undergo IEPR under certain circumstances. A risk-informed decision, as described in Paragraph 15, will be made as to whether IEPR is appropriate for that product and documented in the RP.

b. Review Teams and Panels. IEPR panels will be made up of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. Selection of review panel members for IEPR efforts will adhere to the NAS Policy on selecting reviewers, which sets the standard for "independence" in review processes and for complexity in a national context.

c. IEPR teams are not expected to be knowledgeable of Army and administration policies, nor are they expected to address such concerns. However, an IEPR team should be given the flexibility to bring important issues to the attention of decision makers.

d. The Water Resources Development Act of 2007 (WRDA 2007) includes two separate requirements for review by external experts. The first, Section 2034, requires Independent Peer Review (IEPR), hereafter called Type I IEPR, of project studies under certain conditions. The second, Section 2035, requires a Safety Assurance Review (SAR), also referred to as Type II IEPR, of "the design and construction activities for hurricane and storm damage reduction and flood damage reduction projects." USACE has extended this policy for Type II IEPR to all projects with life safety issues. Therefore, Districts/MSCs must consider life safety implications of the design of other projects and make a risk-informed determination whether a Type II IEPR would be beneficial. These statutory requirements, as well as the USACE existing requirements for review of work products, are the basis for this Circular. Sections 2034 and 2035, besides having different foci, also differ significantly in legislative language. This necessitates some variation in the scope and procedures for IEPR, depending on the phase and purposes of the project under review. For clarity, IEPR is divided into two types, Type I is generally for decision documents and Type II is generally for implementation documents. The differing criteria for conducting the two types of IEPR can result in work products being required to have Type I IEPR only, Type II IEPR only, both Type I and Type II IEPR, or no IEPR. The Water Resources Reform and Development Act of 2014 (WRRDA 2014) includes two changes from requirements stated above for review by external experts. The first, Section 1044, amends Section 2034 of WRDA 2007 to raise the threshold value from $45,000,000 to $200,000,000. The second, Section 3028, amends Section 2035 of WRDA 2007 to make the Federal Advisory Committee Act (5 U.S.C. App.) not applicable for a SAR.

e. Where appropriate and reasonable, the district can conduct the ATR and IEPR concurrently if it enhances the review process of an implementation document. Concurrent ATR and IEPR review is standard for draft (non-CAP) decision documents.

f. Publishing comments and responses to IEPR. Regardless of whether or not the views expressed in the IEPR Report are adopted, the home district, with assistance from the RMO, will prepare a written USACE proposed response to the report, detailing any actions undertaken or to be undertaken in response to the report, and the reasons those actions are believed to satisfy the key concerns stated in the review report (if applicable). All issues in the IEPR must be addressed. The proposed USACE response will be coordinated with the MSC District Support Teams (and HQUSACE for Type I IEPR) to ensure consistency with law, policy, project guidance, ongoing policy and legal compliance review, and other USACE or National considerations.

11. Type I IEPR.

a. Type I IEPR is conducted on project studies (decision documents). It is of critical importance for those decision documents and supporting work products where there are public safety concerns, significant controversy, a high level of complexity, or significant economic, environmental, and social effects to the nation, see Paragraph 11.d.(1). However, it is not limited to only those cases and most studies should undergo Type I IEPR.

b. The requirement for Type I IEPR is based upon Section 2034 of WRDA 2007 and Section 1044 of WRRDA 2014, the OMB Peer Review Bulletin and other USACE policy considerations.

c. Type I IEPR reviews are managed outside the USACE; panel members will be selected by an OEO using the NAS policy for selecting reviewers. Although the NAS is frequently cited for the Type I IEPR process the USACE should follow, actual reviews by the NAS are expected to be rare. Decisions to approach NAS must be made by the DCW based on the recommendation of the appropriate RIT at HQUSACE in coordination with the appropriate CoP, generally the Planning and Policy CoP. Each Type I IEPR review will cover the entire project concurrent with the product development.

d. In keeping with the principle that IEPR should be scalable to the work product being reviewed, there may be cases that warrant a project study or decision document, which would otherwise be required to undergo a Type I IEPR, being excluded from the Type I process. For IEPR on decision documents, the RMO will be the appropriate PCX or, in the case of dam or levee safety modification reports, the USACE RMC in close coordination with the appropriate PCX. If exclusion is sought, the vertical team (involving district, MSC, RMO [PCX or RMC] and HQUSACE) will advise the MSC Commander as to whether Type I IEPR is appropriate or whether sufficient rationale exists to support a request for exclusion. Requests seeking an exclusion from Type I IEPR must comply with requirements in Paragraph 15, Risk-Informed

Decisions on Appropriate Reviews. The conditions determining whether Type I IEPR will be undertaken are as follows:

(1) Type I IEPR is mandatory if any of the following are true:

(a) Significant threat to human life. The decision document phase is the initial concept design phase of a project. Therefore, USACE has determined when life safety issues exist, a Type I IEPR that includes a Safety Assurance Review is required;

(b) When the estimated total cost of the project, including mitigation costs, is greater than $200 million based on a reasonable estimate made after execution of the FCSA and prior to the Alternatives Milestone, with few exceptions. In considering the $200 million cost trigger, the term “total cost” means the cost of construction (including designing) of the project and includes lands, easements, rights of way, relocations, and disposal areas (LERRDs). In the case of a project for hurricane and storm risk management or flood risk management that includes periodic nourishment over the life of the project, the “total cost” term includes total cost of the renourishment cycles. If a project has a cost estimate of less than $200 million at initial RP development, but the estimated costs subsequently increase to more than $200 million during the course of the study, a determination will be made by HQUSACE whether a Type I IEPR is required. There is a potential, albeit an extremely limited one, for projects costing over $200 million to be excluded from Type I IEPR. This potential only exists when no other mandatory conditions listed in this section are met, the project does not include an EIS, the various aspects of the problems or opportunities being addressed are not complex, and there is no controversy surrounding the study. An exclusion from Type I IEPR for a project costing more than $200 million can only be granted by the Chief of Engineers or their delegate.

(c) When the Governor of an affected State requests a peer review by independent experts. (An affected State is all or a portion of a State which is within the drainage basin in which the project is or would be located and would be economically or environmentally affected as a consequence of the project.)

(d) When the Chief of Engineers determines the project study is controversial due to significant public dispute over the size, nature, or effects of the project or the economic or environmental costs or benefits of the project.

(e) There is significant public dispute as to size, nature, or effects of the project.

(f) There is significant public dispute as to the economic or environmental cost or benefit of the project.

(g) Is required by USACE for cases where information is based on novel methods, presents complex challenges for interpretation, contains precedent-setting methods or models, or presents conclusions that are likely to change prevailing practices.

(h) Any other circumstance that leads the Chief of Engineers to determine Type I IEPR is warranted.

(2) Type I IEPR is discretionary when the head of a Federal or state agency charged with reviewing the project study determines that the project is likely to have a significant adverse impact on environmental, cultural, or other resources under the jurisdiction of the agency after implementation of proposed mitigation plans and he/she requests a Type I IEPR.

(a) A decision whether to conduct Type I IEPR must be made within 21 days of the date of receipt of the request by the head of the Federal or State agency.

(b) If the Chief of Engineers decides not to conduct a Type I IEPR following such a request the Chief will make publicly available the reasons for not conducting the Type I IEPR.

(c) If the Chief of Engineers decides not to conduct a Type I IEPR after such a request, it may be appealed to the Chairman of the Council on Environmental Quality within 30 days of the Chief's decision. The Chairman will decide the appeal within 30 days of the date of the appeal.

(3) Section 2034 of WRDA 2007, as amended, permits project studies to be excluded from independent peer review under certain circumstances. In most cases, requests for exclusions will be decided by the DCW. As noted in Paragraph 11.d.(1)(b), requests for exclusions for projects costing over $200 million will be routed through the DCG-CEO with the decision made by the Chief of Engineers or their delegate.

(4) A project study may be excluded from Type I IEPR in cases where none of the mandatory triggers listed above are met (with the limited exception noted in Paragraph 11.d.(1)(b) AND if any of the following three sets of conditions apply (11.d.(4)(a), 11.d.(4)(b) or 11.d.(4)(c):

(a) If the project study:

- Does not include an EIS; AND
- The Chief of Engineers determines it is not controversial; AND
- It has no more than negligible adverse impacts on scarce or unique tribal, cultural, or historic resources; AND
- It has no substantial adverse impacts on fish and wildlife species and their habitat prior to the implementation of mitigation measures; AND

- It has, before implementation of mitigation measures, no more than a negligible adverse impact on a species listed as endangered or threatened species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) or the critical habitat of such species designated under such Act.

OR

(b) If the project study:

- Involves only the rehabilitation or replacement of existing hydropower turbines, lock structures, or flood control gates within the same footprint and for the same purpose as an existing water resources project; OR

- Is for an activity for which there is ample experience within the USACE and industry to treat the activity as being routine; AND

- Has minimal life safety risk.

OR

(c) The project study does not include an EIS and is under CAP.

e. Type I IEPRs are exempted by law from the Federal Advisory Committee Act.

f. Type I IEPR will be performed if the triggers specified in the subsections of Paragraph 11.d.(1) are met. This information will documented in the approved RP.

g. Type I IEPR Panels. Panels should be able to evaluate whether the interpretations of analysis and conclusions based on analysis are reasonable. To provide effective review, in terms of both usefulness of results and credibility, review panels should be given the flexibility to bring important issues to the attention of decision makers. However, review panels should be instructed to not make a recommendation on whether a particular alternative should be implemented, as the Chief of Engineers is responsible for the final decision on a planning or re-operations study. External panels may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation. Type I IEPR panels will accomplish a concurrent review that covers the entire decision document or action. The panel will address all the underlying engineering, economics, and environmental work, not just one aspect of the project. This level of review is governed primarily by Sections 2034 and 2035 of WRDA 2007, as amended by Sections 1044 and 3028 of WRRDA 2014 and the OMB Peer Review Bulletin.

(1) Establishment of Panels.

(a) For Type I IEPR, an OEO will select the reviewers according to the guidance in Paragraph 11.e.(2).

(b) OEO. Type I IEPR panels will be established by the RMO through contract with an independent scientific and technical advisory organization that must be a Section 501(c)(3) (Internal Revenue Code of 1986) organization or with the National Academy of Sciences.

(c) The highest degree of credibility of external reviews will be achieved if the responsibility for coordinating the external review process is granted to an organization independent of USACE. Such an independent OEO must be in charge of selecting reviewers, all of whom should be independent of USACE and free of conflicts of interests. The OEO will also be assessed for potential organizational conflict of interest on a task order basis.

(d) The OEO should be knowledgeable about the USACE mission, its statutory authorities and related administrative regulations, and other evaluation procedures.

(e) The OEO must have the following qualifications:

- Is described in Section 501(c)(3), and exempt from Federal tax under Section 501(a) of the Internal Revenue Code of 1986.

- Is independent.

- Is free from conflicts of interest.

- Does not carry out or advocate for or against Federal water resources projects.

- Has experience in establishing and administering independent review panels.

- Has proven ability to deliver on time as agreed, in spite of significant time constraints.

- Type I IEPR reviews will be more effective if the review panel maintains communication with USACE during the review. This communication, which should not compromise the reviewers' independence, can help the panel understand USACE assumptions and methods, as well as the practical implications of the review panel's finding and recommendations. The OEO should coordinate this communication among the PDT, RMO (usually PCX for planning studies or RMC for dam and levee safety modification studies), and review panel, as well as communication among the panel and relevant federal agencies, interest groups, and the public.

(2) Guidelines for Selection. The three most important considerations in selecting reviewers are the credentials of the reviewers (which include affiliations as well as expertise), the absence of conflict of interest, and the independence of the group that selects the reviewers. The OEO should select reviewers and structure the review such that good science, sound engineering, and public welfare are the most important factors producing a sound review.

(a) All potential reviewers carry professional and personal biases, and it is important that these biases be disclosed when reviewers are considered and selected. The OEO leading the review will determine which biases, if any, will disqualify prospective reviewers.

(b) The OEO will also develop criteria for determining if review panels are properly balanced, in terms of both professional expertise and points of view on the study or project at hand.

(c) The necessity for reviewers to have adequate knowledge of USACE's guidance and analytical methods, which are often highly complex, increases the challenge of selecting review panels that are viewed as credible and balanced.

(3) Panel Responsibilities. The panel of experts established for a project review for a will:

(a) Conduct reviews in a timely manner consistent with the study and RP schedule.

(b) Assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analyses, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in evaluation of economic or environmental impacts, and any biological opinions.

(c) For those decision documents that require a SAR as described in Paragraph 12, the panel should address the following additional questions for the selected alternative:

- Consistent with ER 1110-2-1150, is the quality and quantity of the surveys, investigations, and engineering sufficient for a concept design?

- Are the models used to assess hazards appropriate?

- Are the assumptions made for the hazards appropriate?

- Does the analysis adequately address the uncertainty and residual risk given the consequences associated with the potential for loss of life for this type of project?

(d) Assess the considered and recommended alternatives from the perspective of systems. This includes (but is not limited to) aspects such as the hydraulic and hydrologic effects throughout a watershed; the impact on competing ports within an area of influence; the impacts on resources used by transiting migratory species; and the systemic aspects considered from a temporal perspective, including the potential effects of climate change.

(e) Receive from USACE and consider any public written and oral comments provided on the project.

(f) Provide timely written and oral comments throughout the development of the project, as specified in the scope of work with the OEO; and

(g) Submit a final report, no more than 60 days following the close of the public comment period for the draft project study to enable the district to address all necessary actions before the final report is signed. The report will contain the panel's economic, engineering, and environmental analysis of the project study, including the panel's assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used. All comments in the report will be finalized prior to their release to USACE for each project phase. If the panel does not complete its review in this period, the processing of the report will continue without delay.

(4) Panel Findings.

(a) The panel will submit to USACE through the managing organization a final report containing the panel's economic, engineering, and environmental analysis of the project study, including the panel's assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used by USACE.

(b) The report from the panel of experts will be considered and documentation will be presented on how issues were resolved or will be resolved by the District Engineer (DE) before the district report is signed by the DE. The findings and responses will be presented to the DCG-CEO by the District Engineer with a Type I IEPR panel or OEO representative participating, preferably in person.

(c) After receiving a report on a project from a panel of experts, USACE will consider all recommendations contained in the report and prepare a written response for all findings adopted or not adopted. Upon satisfying any reviewers' concerns, HQUSACE will determine the appropriate command level for issuing the formal USACE response to the Type I IEPR Review Report. When the USACE response is issued, the district will post the final Type I IEPR Review Report, USACE response, and all other materials related to the review on its website and include them in the applicable decision document. Chief of Engineers' reports for decision documents that undergo Type I IEPR will summarize the Type I IEPR Review Report and provide full USACE responses to each concern raised by the Type I IEPR panel. The panel's final report and the responses of USACE must also accompany the publication of any report of the Chief of Engineers for the project. In cases where there is no Chief's report, the DCW will certify the agency response. The Type I IEPR documentation will become a critical part of the review record and will be addressed in recommendations made by the Chief of Engineers.

(5) Guidelines for Developing the “Charge.”

(a) Reviews should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. A review panel should bring important issues to the attention of the agency. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. However, review panels should be instructed to not present a final judgment on whether a project should be constructed or whether a particular operations plan should be implemented, as the Chief of Engineers is ultimately responsible for this final decision.

(b) Peer reviews, no matter how useful, should not be expected to resolve fundamental disagreements and controversies. Reviewers should aim to draw distinctions between criticisms of the regulations and guidelines and criticisms of how well USACE conformed to the guidance. Reviews should focus on assumptions, data, methods, and models.

(c) Reviews will assist USACE in making decisions, but reviewers should not be asked to make decisions. Reviewers should avoid findings that become “directives” in that they call for modifications or additional studies or suggest new conclusions and recommendations. In such circumstances, the reviewers may have assumed the role of advisors as well as reviewers, thus introducing bias and potential conflict in their ability to provide objective review later in the project. Reviewers engaged in the review processes should be selected based upon their independence and professional expertise and should not be “stakeholders.”

(d) The MSC’s choice about the appropriate level of review should be informed by deliberation with the vertical team.

(e) Frequent communication facilitated by the OEO will help the review panel understand the technical and practical implications of their comments. Review panels should highlight areas of disagreement and controversies that may need resolution.

(f) Defining a review panel’s boundaries of inquiry is an issue that frequently arises in review and is not always easily agreed upon. It is not uncommon for an agency or other administrative group to try to limit a review panel’s deliberation. However, the line between technical and policy issues is often blurred, and it is often difficult to clearly separate them. USACE should accept comments but make a distinction in responses when comments pertain to policy which is beyond the scope of a Type I IEPR and have been elevated to HQUSACE for consideration under a non-project-specific policy review. It is important that panelists focus on their review and not become defenders of their findings.

(6) Record of Review. USACE must make all written findings of a reviewer or panel of reviewers and related USACE responses available to the public, including through electronic means on the internet.

h. Planning Centers of Expertise.

(1) The appropriate PCX (or the RMC for dam and levee modification studies) is responsible for the accomplishment and quality of Type I IEPR for documents covered by this Circular. In cases of Type I IEPR that include a SAR and are managed by a PCX, the PCX will coordinate with the RMC in developing the Charge. An OEO must be used to manage the selection of panels, the conduct of the review, and the organization and disposition of comments.

(2) Review will be assigned to the appropriate PCX based on business programs. Districts will develop RPs in coordination with the appropriate PCX based on the primary purpose of the decision document to be reviewed.

(3) For decision documents with multiple purposes (or project purposes not clearly aligned with the PCXs), the home MSC will designate a lead PCX to conduct the review after coordinating with each relevant PCX. The assigned RMO will coordinate with other PCXs, RMC, and offices to ensure that a review team with appropriate expertise is assembled.

(4) Each PCX must coordinate with the Cost Engineering MCX at the Walla Walla District. In cases where the Cost Engineering MCX identifies the need for Type I IEPR, it will inform the assigned PCX and will assist with establishing the Charge.

i. Reporting Requirements.

(1) Type I IEPR Decision and Congressional Notification. Section 2034 of WRDA 2007, as amended, applies to project studies initiated prior to 8 November 2019.

(a) Decision to Conduct Type I IEPR. Upon MSC approval of any RP that includes performing Type 1 IEPR, the MSC commander will immediately transmit the approved RP and the MSC Commander's Approval Memorandum to the responsible RIT. The responsible RIT will prepare and transmit a letter, signed by the HQ Chief Planning and Policy, to the Committee on Environment and Public Works of the Senate (EPW) and the Committee on Transportation and Infrastructure of the House of Representatives (T&I) with a copy to the ASA(CW). The letter will notify Congress of the intent to conduct Type I IEPR and will be transmitted within seven days of RP approval. The decision to conduct Type I IEPR will be made available to the public by the district posting the RP on the USACE public website within seven days of MSC approval of the RP. The RP will include documentation of the Type I IEPR decision.

(b) Decision to Exclude from Type 1 IEPR. Upon the Chief of Engineers' approval of an exclusion from conducting Type I IEPR for a study, the responsible RIT will prepare and transmit a letter, signed by the HQ Chief of Planning and Policy, to the Senate EPW and House T&I Committees with a copy to the ASA(CW). The letter will notify Congress of the Chief of Engineers' or their delegate's decision not to conduct Type I IEPR and will be transmitted within seven days of approval of the Type I IEPR exclusion. The decision not to conduct Type I IEPR will be made available to the public by the district posting the RP on the USACE public website within seven days of approval of the Type I IEPR exclusion. The RP will include documentation of the Type I IEPR exclusion decision.

(c) Changes in Decision to Conduct Type I IEPR. Information developed as part of the study process may cause the Chief of Engineers to revisit the decision whether or not Type I IEPR will be conducted. Any change in the decision to conduct or not conduct Type I IEPR on a study will require re-notification of Congress and the public following the procedures described above.

(2) Public Availability of Type I IEPR Information. Information regarding the conduct of Type I IEPR will be posted on the USACE public website. Following award of a task order to conduct Type I IEPR, the responsible Review Management Organization (RMO) will provide the responsible RIT with the scheduled dates for the beginning and end of review and the name of the Outside Eligible Organization (OEO) that has the task order for the review. The beginning of review is the date the panel of experts initiates the review and the end of the review is the date the OEO submits the Type I IEPR Final Report to USACE. The information will be made available to the public by the responsible RIT posting the information on the USACE public website not later than seven days after the task order is awarded. When the OEO completes subcontracts with the panel of experts, the responsible RMO will provide the names and qualifications of the panel of experts to the responsible RIT. The information will be made available to the public by the responsible RIT posting the names and qualifications of the panel of experts on the USACE public website not later than seven days after the subcontracts with the panel are completed.

(3) Type I IEPR Report and Agency Response Public Availability and Submission to Congress. A copy of the Final Type I IEPR report documenting the comments and recommendations of the Type I IEPR panel and a copy of the responses to the panel comments and recommendations by the Chief of Engineers will be promptly submitted to Congress and will be made available to the public on the USACE public website.

(a) Upon acceptance of the Final Type I IEPR Report from the OEO by the RMO, the responsible RMO will transmit the report to the responsible RIT. The responsible RIT will prepare and transmit a letter, signed by the DCW, to the Senate EPW and House T&I Committees with a copy to the ASA(CW) and USACE Commanding General (CG) within seven days of receipt from the RMO. The letter will submit the Final Type I IEPR Report to the Congressional committees. In order to make the tight timeline, the letter will be transmitted electronically and will include a pdf of the Final Type I IEPR Report. The responsible RIT will post the Final Type I IEPR Report on the USACE public website within seven days of receipt from the RMO.

(b) Upon completion of the Agency Response, the responsible RIT will prepare and transmit a letter for signature by the DCW to the Senate EPW and House T&I Committees with a copy to the ASA(CW) and CG within three days of completion of the Agency Response. The letter will submit the Agency Response to the Congressional committees. In order to make the tight timeline, the letter will be transmitted electronically and will include a pdf of the Agency Response. The Agency Response will be posted to the USACE public website within three days of completion of the Agency Response.

(4) Type I IEPR Information in the Final Decision Document. For project studies that undergo Type I IEPR, the Final Type I IEPR Report and Agency Response will be included in an appendix to the final decision document. For project studies that are excluded from Type I IEPR, the exclusion decision and rationale will be included in the decision document for the project study.

(5) Annual Report. By 1 November each year, each MSC will provide HQUSACE, through their respective RIT, a summary of the Type I IEPRs undertaken by the MSC during the previous fiscal year. HQUSACE Planning (CECW-P) will consolidate the summaries received by the RITs and will provide the Administrator of the Office of Information and Regulatory Affairs in OMB with a consolidated summary of USACE Type I IEPRs by 15 December of each year. Annual summaries of Type I IEPRs will include:

(a) The number of Type I IEPRs conducted subject to this Circular and the authorities under which each Type I IEPR was conducted.

(b) The number of times alternative procedures were invoked.

(c) The number of times exclusions or deferrals were invoked (and in the case of deferrals, the length of time elapsed between the deferral and the Type I IEPR).

(d) Any decision to appoint a reviewer under any exception to the applicable independence or conflict of interest standards of the OMB Peer Review Bulletin, including determinations by the Secretary of Defense per Section III (3)(c) of the OMB Peer Review Bulletin.

(e) The number of Type I IEPR panels that were conducted in public and the number that allowed public comment.

(f) The number of public comments provided on each Civil Works RP.

(g) The number of peer reviewers that were recommended by professional societies.

12. Type II IEPR Safety Assurance Review (SAR).

a. A Type II IEPR (SAR) will be conducted on design and construction activities for any project where potential hazards pose a significant threat to human life (public safety). This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities.

b. The requirement for Type II IEPR is based upon Section 2035 of WRDA 2007, Section 3028 of WRRDA 2014, the OMB Peer Review Bulletin, and other USACE policy considerations.

c. External panels will conduct reviews of the design and construction activities prior to the initiation of physical construction and periodically thereafter until construction activities are completed. The reviews must consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health, safety, and welfare.

d. The RMO for a SAR is the RMC. Panel members will be selected using the NAS policy for selecting reviewers. See Paragraph 12.m. for further discussion of panels.

e. Type II IEPRs are exempted by Section 3028 of WRRDA 2014 from the Federal Advisory Committee Act.

f. A Type II IEPR (SAR) will be conducted on design and construction activities for any project where potential hazards pose a significant threat to human life. The District Chief of Engineering, as the Engineer-In-Responsible-Charge, will assess whether the threat is significant and document that in the RP. A recommendation to not conduct a SAR will also be documented in the RP and will (like any RP recommendation) have the endorsement of the RMO prior to approval of the RP. This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities. External panels will review the design and construction activities prior to initiation of physical construction and periodically thereafter until construction activities are completed. Because design is initiated in the decision document phase, the SAR is incorporated into the Type I IEPR (see Paragraph 11.d.(1)(a). This section provides guidance for reviews conducted on design and construction activities performed after the approval of a decision document. The reviews must be on a regular schedule sufficient to inform the Chief of Engineers on the adequacy, appropriateness, and acceptability of the design and construction activities for the purpose of assuring that good science, sound engineering, and public health, safety, and welfare are the most important factors that determine a project's outcome.

g. When a Type II IEPR is included in the project's approved RP, the District Chief of Engineering, as the Engineer-In-Responsible-Charge, is responsible for ensuring the Type II IEPR is conducted consistent with this Circular, and will fully coordinate with the Chief of Construction, the Chief of Operations, and the project manager through the PED and construction phases. The project manager will coordinate with the RMO to develop the review requirements and include them in the RP. The default RMO for flood risk management projects and SAR is the USACE Risk Management Center (RMC). The Type II IEPR (SAR) will be coordinated through the RMC, whether it is performed through contract acquisition or by another government agency. If the RMC and MSC agree that a SAR does not need to be conducted, the MSC may assume RMO responsibilities for the implementation phase. Any such a transfer of responsibility should be mutually agreed upon and mindful of all the remaining phases of the project.

h. Risk-Informed Decision. For any design and construction activities that are justified by life safety or for which the failure of the project would pose a significant threat to human life a Type II IEPR (SAR) is required. A recommendation for an exclusion from this requirement must be documented in the RP with a thorough discussion of why there are no potential failure modes for the project that would pose a significant threat to human life. A project is determined to have a "significant threat to human life" if at any time during the construction or operation, failure could result in a substantial life safety concern. The consequences of failure and the population at risk are paramount for the SAR determination. Existing risk information, including risk assessments, should be used to facilitate and inform this determination.

(1) The following are examples where a SAR should be seriously considered if a significant life safety risk is identified:

(a) Major rehabilitation of a deficiency for a hurricane and storm damage risk reduction or flood risk management project for a densely populated area.

(b) Modifications to the line of flood risk reduction.

(c) Modifications that could introduce new failure modes or lead to progression of existing failure modes that could result in the potential for loss of life.

(2) In the case of a coastal storm risk management project, the expected impact of project-feature failures on loss of life must be assessed to make the SAR determination. This criteria is not all-inclusive; reasonable conclusions need to be drawn and each project requires an assessment by the District Chief of Engineering.

(3) Decisions concerning what is "significant" loss of life cannot be reduced to a simple number; it is a combination of the consequences and the likelihood of failure. Not all projects or modifications to projects rise to the level of concern that the Chief of Engineers would determine the project would benefit from a SAR. Appropriate USACE risk assessments for the project previously performed should be utilized in this determination. For comparison, the following situations that might pose significant threat to human life provide contrasting examples—one that typically would and one that typically would not be determined to pose such risk. Note that these are only examples and an individual assessment of whether a SAR is needed must be made for each item of work.

(a) A new dam above a community would require a SAR. However, if the offices within an existing dam are being renovated and the work will not affect the dam operation, that project would not require a SAR.

(b) A levee section being replaced next to an adjacent residential area would require a SAR. However, an agricultural levee being raised a few inches to account for settlement would not require a SAR.

(c) A new set of spillway gates for a high hazard potential dam would require a SAR. However, if a single gate out of six gates for an intake structure is being replaced in-kind and results of its failure would be contained within the downstream safe channel capacity, the project would not require a SAR.

(d) A new hydro-electric generator unit replacing an existing unit for a high-lift navigation dam would require a SAR. However, if a new miter gate is being replaced on a low-lift navigation lock where failure of the gate would not cause flooding to exceed the flood stage, the project would not require a SAR.

(e) A new Water Control Manual (WCM) that was put in place due to a water reallocation reducing flood control storage would require a SAR because it introduces new failure modes. However, a minor modification to the WCM not involving concern for life safety would not require a SAR.

(f) A new coastal protection system including berms for a community would require a SAR. However, a beach re-nourishment project that does not affect life safety does not require a SAR.

(g) Repairs for a slide on a dam crest (for a dam with a potential for life loss) being that are performed with emergency funding when there is time to wait until the low-flow season to make the correction will require a SAR. However, where time is of the essence to save the dam, a SAR is not required, allowing for maximum expediency.

(h) A temporary cofferdam that will serve part of the levee alignment for a levee with potential for life loss would require a SAR. However, a temporary cofferdam for which breach would not pose a life safety risk (albeit the workers inside are vulnerable) does not rise to the level that SAR is required.

(i) For a new U-framed flood relief channel that is built in a congested city that has steep flow gradients and is designed with super-critical flows to lessen impact on available real estate, would require a SAR since failure of the wall could cause blockage and flood the city. However, a new concrete lined flood relief channel that is built below grade with a gentle flow gradient would not require a SAR.

(j) For a 33 USC 408 (Section 408) request to place new utilities across the toe of a dam and across the spillway, such that these modifications introduce new failure modes, a SAR will be required. However, if the Section 408 requester is building a hydropower project on a low-head navigation project, it would not require a SAR.

i. Other factors to consider for deciding whether to conduct a Type II review of a project or project components are:

(1) The project involves the use of innovative materials or techniques and the engineering is based on novel methods, presents complex challenges for interpretations, contains precedent-setting methods or models, or presents conclusions that are likely to change prevailing practices.

(2) The project design requires redundancy, resiliency, and robustness.

(a) Redundancy is the duplication of critical components of a system with the intention of increasing reliability of the system, usually in the case of a backup or fail-safe.

(b) Resiliency. Resiliency is the ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use.

(c) Robustness. Robustness is the ability of a system to continue to operate correctly across a wide range of operational conditions (the wider the range of conditions, the more robust the system), with minimal damage, alteration, or loss of functionality; and to fail gracefully outside of that range.

(3) The project has unique construction sequencing or a reduced or overlapping design construction schedule; for example, significant project features accomplished using the Design-Build or Early Contractor Involvement delivery systems.

j. RPs. As detailed in Paragraph 7, the RP will include the reason for a SAR or an explanation as to why a SAR is not required. The MSC Commander's approval of the RP is required to assure that the plan is in compliance with the principles of this guidance and the MSC's Quality Management Plan and that all elements of the command have agreed to the review approach. The RP must define the appropriate level of review.

k. Timing of Reviews. At a minimum, the SAR team will perform reviews and site visits consistent with milestones identified in the RP. Milestones to consider for a SAR are at the midpoint and final design in the Design Documentation Report; at the completion of the plans, specifications, and cost estimate; at the midpoint of construction for a particular contract, prior to final inspection, or at any critical design or construction decision milestones. The SAR panel may recommend to the RMO additional or alternate milestones. The MSC should approve these recommendations when they are warranted and reasonable. The SAR is an extension (not a replacement) of the ATR requirements outlined in ER 1110-1-12, Quality Management (or successor document); however, the intent of the SAR is to complement the ATR and to avoid impacts to program schedules and cost. The SAR is a strategic level review and reasonable effort should be made to avoid having the SAR duplicate the ATR.

l. Guidelines for Developing the Scope of Work or "Charge".

(1) The SAR review will cover the design and construction phase of the project as outlined below. Reference Paragraph 11.g.(5) for guidelines for developing the "Charge".

(2) The RP should establish a milestone schedule aligned with critical features of the project design and construction. The SAR should complement the ATR and focus on unique features and changes from the assumptions made and conditions that formed the basis for the design during the decision document phase.

(3) SAR panels should be able to evaluate whether the interpretations of analysis and conclusions based on analysis are reasonable. In terms of both usefulness of results and credibility, review panels should be given the flexibility to bring important issues to the attention of decision makers. However, review panels should be instructed to not make a recommendation on whether a particular alternative should be implemented, as the Chief of Engineers is ultimately responsible for the final decision. External panels may, however, offer their opinions as to whether there are sufficient analyses upon which to base a recommendation. All SARs should have these basic Charge questions:

(a) Are there any critical design considerations missing?

(b) Is the overall direction of the project appropriate?

(c) Is there anything the panel would like USACE to consider?

(4) Decision Phase. For the decision document phase, the review requirements are defined in Paragraph 11 in the Type I IEPR.

(5) Design or PED Phase. For the design or PED phase, at a minimum the SAR will address the following questions:

(a) Do the assumptions made in the decision document phase for hazards remain valid through the completion of design as more knowledge is gained and the state-of-the-art evolves?

(b) Do the project features and/or components effectively work as a system?

(c) Is the QC/QA effort appropriate?

(d) For those unique projects authorized and appropriated or approved without a decision document and in the PED or design phase, the SAR will address the review requirements defined in Paragraph 11 in the Type I IEPR.

(6) For the construction phase, at a minimum the SAR will address the following questions:

(a) Do the assumptions made during design remain valid through construction as additional knowledge is gained and the state of the art evolves?

(b) For O&M manuals, will requirements listed in the manual adequately maintain the conditions assumed during design and validated during construction; and will the project monitoring adequately reveal any deviations from assumptions made for performance?

m. Requirements for Establishing Type II IEPR Panels.

(1) RMO Responsibilities.

(a) The RMO is responsible for establishing panels consistent with this Circular.

(b) The RMO will define the required competencies for each of the panel members, insuring a balance of perspectives, and may specify a particular expertise as the team lead. The RMO can recommend candidates for consideration.

(2) Review teams can be led by and composed of other government employees (non-USACE).

(3) Review teams can be led by and composed of contractors.

(a) A contractor can be used to carry out these panels, including selecting members for the Type II IEPR panel. Unlike Type I IEPRs, competition for Type II IEPR contractors may not be limited to OEOs. The solicitation for such a contract should include the minimum professional requirements for panel members, but should not be so narrowly written that only specific persons may be selected.

(b) Due to potential organizational conflicts of interest and the potential for contractors to have access to other contractors' information, contracting officers must be particularly aware of potential conflicts of interest and avoid or mitigate them according to Federal Acquisition Regulations Part 9 when procuring Type II IEPR panel services. Solicitations must include nondisclosure agreements and language analogous to that found in the Army Source Selection Supplement (AS3) for contractors who assist in evaluations of proposals to ensure that contractor information is protected from disclosure by reviewing contractors. If an existing contract is considered for use, the Contracting Officer must determine that this work would be in scope of the contract scope and determine, if non-disclosure agreements and organizational conflict of interest language is not included in the contract, whether they could be added to the contract as an in-scope modification before the existing contract may be used for a Type II IEPR panel.

(4) Guidance for the contractor (or USACE) for establishing review teams.

(a) If the panel meetings will be closed to the public, then the contractor should establish a process for members of the public to apply for membership on the panel. The contractor, however, is not under any obligation to select any of these public applicants.

(b) The RMO and other USACE officials may approve the panel members selected by the contractor, but should not participate in the vetting or selection of members. Moreover, USACE officials should not veto or disapprove of a selected panel member unless the selected panel member does not meet the objective criteria for panel members provided to the contractor.

(c) The contractor will be required in the solicitation and instructions to apply the National Academy of Sciences policy for selecting reviewers to ensure the panel members have no conflict of interest with the project being reviewed. The following website provides academy guidance for assessing composition and the appropriate forms for prospective panel members in General Scientific and Technical Studies: http://www.nationalacademies.org/coi/index.html. The contractor will also develop criteria for determining if review panels are properly balanced, as defined by criteria in the contract, both in terms of professional expertise as well as in points of view on the study or project at hand. If necessary, the contractor will remove and replace panel members during a review if a conflict arises.

(d) In developing a solicitation package for Type II IEPR services, the District should consider the following from Review Procedures for Water Resources Project Planning (NRC et al. 2002). All potential reviewers carry professional and personal biases, and it is important that these biases be disclosed when reviewers are considered and selected. The contractor leading the review will determine which biases, if any, will disqualify prospective reviewers. It should also develop criteria for determining if review panels are properly balanced, both in terms of professional expertise as well as in points of view on the study or project at hand. There is also a challenge of selecting review panels that are viewed as credible and balanced, but that also have adequate knowledge of USACE's often highly complex guidance and analytical methods. The most important considerations in selecting reviewers are the credentials of the reviewers (which include affiliations as well as expertise) and the absence of conflict of interest. Note that WRDA 2007 requires the panel members to be "distinguished experts in engineering, hydrology, or other appropriate disciplines."

(e) The contractor will be responsible for adjusting the panel membership to maintain the skill set necessary as the project progresses and the need for different expertise arises.

(f) USACE officials may attend panel meetings, but may not participate in the management or control of the group; USACE cannot be a voting member of the group, may not direct activities at the meetings, and may not develop the agenda for the meetings.

(g) USACE officials must refrain from participating in the development of any reports or final work product of the group.

(h) The peer review panel can take the form of a panel of consultants, but the members are limited to reviewing and commenting on the work being done by others. The peer review work can be concurrent with ongoing work, be interactive as needed, and provide real-time over-the-shoulder input. Timely input on the appropriateness of hazard analyses, models and methods of analysis used, and the assumptions made is critical to maintaining project schedules.

(i) At a minimum, one member is required, but the number of panel members will be appropriate for the risk, size, and complexity of the project. Composition of the panel can change depending on the need of the particular phase of review.

(j) Reviewers' Compensation. Type II IEPR Reviewers will be paid labor and any necessary travel and per diem expenses according to their contract with the RMO, NAS, or OEO.

n. Panel Responsibilities. The panel of experts established for a review for a project will do all the following.

(1) Conduct the review for the subject project in a timely manner, according to the schedule.

(2) Follow the "Charge," but when deemed appropriate by the team lead, request other products relevant to the project and the purpose of the review.

(3) Receive from USACE and consider any public written and oral comments provided on the project.

(4) Provide timely written and oral comments throughout the development of the project, as requested.

(5) Assure the review avoids replicating an ATR and focuses on the questions in the "Charge," but the SAR panel can recommend to the RMO additional or alternate questions for consideration.

(6) Offer any lessons learned to improve the planning or design, or the review process.

(7) Submit reports consistent with the RP milestones.

(8) The team panel lead will be responsible for ensuring that all review panel comments entered into the report as team comments represent the group, are non-attributable to individuals and, when there is lack of consensus, note the nature of non- concurrence and reasons for it.

o. Record of Review. The review team will prepare a review report. A suggested report outline is: an introduction; the composition of the review team; a summary of the review during design; a summary of the review during construction; any lessons learned in both the process and/or design and construction; and appendices for conflict of disclosure forms, comments to include any appendices for supporting analyses, and assessments of the adequacy and acceptability of the methods, models, and analyses used. All comments in the report will be finalized by the panel prior to their release to USACE for each RP milestone.

p. District Responsibilities to Complete the SAR Report.

(1) The home district Chief of Engineering is responsible for coordinating with the RMO, attending review meetings with the SAR review panel, communicating with the agency or contractor selecting the panel members, and coordinating the approval of the final report with the MSC Chief of Business Technical Division.

(2) After receiving a report on a project from the peer review panel, the district Chief of Engineering, with full coordination with the district Chiefs of Construction and Operations, will consider all comments contained in the report and prepare a written response for all comments and note concurrence and subsequent action or non-concurrence with an explanation. The district Chief of Engineering will submit each panel's report and the district's responses to the RMO and MSC Chief of Business Technical Division for their review and concurrence. However, only the final phase panel report is presented to the MSC Commander for approval. After MSC Commander approval, the final report and responses will be made available to the public on the district's website within 60 days of the district receiving the report.

13. Special Cases.

a. Non-Federal Activities. Special cases exist where non-Federal interests undertake the study, design or construction of a USACE authorized project or a modification to an existing USACE project. Authorities for such actions include, but are not limited to, 33 USC 408, Sections 203 and 204 of WRDA 1986, Section 206 of WRDA 1992, and Section 211 of WRDA 1996. All non-Federal activities must meet current USACE design and construction standards.

(1) The district will review these activities to define the review requirements as outlined in this Circular in order to obtain USACE approval for the non-Federal activity.

(a) For alterations to existing USACE projects per 33 USC 408, see EC 1165-2-216 (or latest guidance) for review requirements.

(b) For other non-Federal activities that do not have specific guidance for review requirements, the home district should evaluate the activity, the authority for which the activity is authorized, and any USACE decision requirements to determine the appropriate review requirements. The resulting RP will be developed by the home district and approved by the home MSC Commander. When a non-Federal interest undertakes a study, design, or implementation of a Federal project, or requests permission to alter a Federal project, the non-Federal interest is required to undertake, at its own expense, any IEPR that the Government determines would have been required if the Government were doing the work. The district Chief of Engineering must determine whether the safety threat is significant and document the determination in the RP. Note that the designer of record cannot select reviewers.

b. Continuing Authorities Program (CAP). CAP is a group of legislative authorities under which USACE can plan, design, and implement certain types of water resources projects without additional project-specific congressional authorization. The individual authorities known collectively as the CAP are: Section 14, Flood Control Act of 1946 (PL 79-526), as amended, for emergency streambank and shoreline erosion protection for public facilities and services; Section 103, River and Harbor Act of 1962 (PL 87-874), as amended, amends PL 727, an Act approved August 13, 1946 which authorized Federal participation in the cost of protecting the shores of publicly owned property from hurricane and storm damage; Section 107, River and Harbor Act of 1960 (PL 86-645), as amended, for navigation; Section 111, River and Harbor Act of 1968 (PL 90-483), as amended, for mitigation of shoreline erosion damage caused by Federal navigation projects; Section 204, Water Resources Development Act of 1992 (PL 102-580), as amended, for beneficial uses of dredged material; Section 205, Flood Control Act of 1948 (PL 80-858), as amended, for flood control; Section 206, Water Resources Development Act of 1996 (PL 104-303), as amended, for aquatic ecosystem restoration; Section 208, Flood Control Act of 1954 (PL 83-780), as amended, originally Section 2, Flood Control Act of August 28, 1937 (PL 75-406) for snagging and clearing for flood control; and Section 1135, Water Resources Development Act of 1986 (PL 99-662), as amended, project modifications for improvement of the environment.

(1) RPs are required for all CAP projects. As an exception to Paragraph 7.b, Programmatic RPs for CAP may be developed and approved by the MSC Commander.

(2) All CAP projects are excluded from Type I IEPR except those conducted under Section 205 and Section 103, or those projects that include an EIS or meet the mandatory triggers for Type I IEPR as stated in Paragraph 11.

(3) Exclusions from Type I IEPR for Section 205 and Section 103 projects will be approved on a case-by-case basis by the MSC Commander, based upon a risk-informed decision process as outlined in Paragraph 11; this approval may not be delegated.

(4) Type II IEPR is still required for those CAP projects where life safety risk is significant as documented in the approved RP.

(5) The RMO for CAP projects is the home MSC in lieu of a PCX, except for CAP projects involving modification of dams or levee systems. The RMC will serve as the RMO for Section 103, Section 205 or Section 206 projects involving the modification of dams or levee systems. The PCXs or RMC will serve in their roles of providing advice and may serve as the RMO under appropriate agreements with the MSC. The ATR Team Lead is to be outside the home MSC unless the RP justifies an exception and is explicitly approved by the MSC Commander.

(6) For CAP projects, ATR of the cost estimate can be conducted by the MCX or by pre-certified district cost personnel within the region as designated by the Walla Walla Cost MCX. The district planner will coordinate with the Cost MCX for a qualified cost reviewer and MCX execution of the cost certification.

c. Work for Other Entities. When USACE performs planning, design or construction work for others, such as work for local, state, other agencies, or foreign Governments, the peer review requirements in this EC should be followed. The need for IEPR should be determined on an individual basis in consultation with the requesting entity. The RP will be developed by the home district and the appropriate RMO and then approved by the home MSC Commander.

14. Policy and Legal Compliance Reviews. All decision documents will be reviewed throughout the study process for their compliance with law and policy. Guidance for policy and legal compliance reviews of decision documents is addressed in Appendix H, ER 1105-2-100. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority. The technical review efforts addressed in this Circular, i.e., DQC and ATR, are to augment and complement the policy review processes by addressing compliance with pertinent published Army policies, particularly policies on analytical methods and the presentation of findings in decision documents.

15. Risk-Informed Reviews. Risk-informed reviews are predicated on an assessment of risks and expected consequences to establish the appropriate level of review. A risk register is a tool that can be used during the life of a project for making decisions on risk-informed reviews.

a. Appropriate Reviews. All work products must undergo DQC. Beyond DQC, however, there is some level of judgment involved in determining whether ATR and/or IEPR levels of review are appropriate for any work product. Therefore, the RP for all work products must include documentation of risk-informed decisions on those levels of review. Additional details on the various levels of review are provided below.

b. ATR. All decision and implementation documents are required to undergo ATR, regardless of the originating organization (Planning, Engineering, Construction, or Operations). In deciding whether to undertake ATR for other work products, answering a series of questions will aid the PDT to help identify work products as decision or implementation documents, even if they are not identified as such. This process provides a basis for making a recommendation whether undertaking ATR is appropriate for products that are not either a decision or implementation document. A "yes" answer does not necessarily indicate ATR is required; rather, it indicates an area where reasoned thought and judgment should be applied and documented in the recommendation. The following questions, and any appropriate additional questions, will be explicitly considered:

(1) Does it include any design (structural, mechanical, hydraulic, etc.)?

(2) Does it evaluate alternatives?

(3) Does it include a recommendation?

(4) Does it have a formal cost estimate?

(5) Does it have or will it require a NEPA document?

(6) Does it impact a structure or feature of a structure whose performance involves potential life safety risks?

(7) What are the consequences of non-performance?

(8) Does it support a significant investment of public monies?

(9) Does it support a budget request?

(10) Does it change the operation of the project?

(11) Does it involve excavation, subsurface investigations (drilling or sampling or both), or placement of soil?

(12) Does it affect any special features, such as cultural resources, historic properties, survey markers, etc., that should be protected or avoided?

(13) Does it involve activities that trigger regulatory permitting; for example: activities covered by Section 404 of the Clean Water Act or stormwater-related actions requiring a National Pollution Discharge Elimination System (NPDES) permit?

(14) Does it involve activities that could potentially generate hazardous wastes and/or disposal of materials such as lead based paints or asbestos?

(15) Does it reference use of or reliance on manufacturers' engineers and specifications for items such as prefabricated buildings, playground equipment, etc.?

(16) Does it reference reliance on local authorities for inspection/certification of utility systems like wastewater, storm water, electrical, etc.?

(17) Is there or is there expected to be any controversy surrounding the Federal action associated with the work product?

c. IEPR. Any work product that undergoes ATR may also be required to undergo Type I and /or Type II IEPR. Meeting the specific conditions identified for possible exclusions is not, in and of itself, sufficient grounds for recommending exclusion. A deliberate, risk-informed recommendation whether to undertake IEPR will be made and documented by the PDT, in coordination with the RMO, as discussed below. The recommendation will be submitted to the MSC along with the endorsement of the RMO. The MSC Commander has approval authority to undertake IEPR. However, if the MSC concurs with a recommendation to exclude the project from Type I IEPR, the MSC will forward the recommendation with its endorsement to the appropriate RIT for coordination in HQ and appropriate action. Once the DCW's or the Chief's decision is rendered, the recommendation and decision will be documented in the RP.

d. Type I IEPR is mandatory under the circumstances described in Paragraph 11. When a decision document does not trigger a mandatory Type I IEPR (as discussed in Paragraph 11.d.(1)), a risk-informed recommendation will be developed. This process will explicitly consider the consequences of non-performance on project economics, the environment, and social well-being (public safety and social justice), as well as indicate whether the product is likely to contain influential scientific information or be a highly influential scientific assessment; or involve any other issues that provide a rationale for determining the appropriate level of review. Furthermore, the recommendation must make a case that the study is so limited in scope or impact that it would not significantly benefit from a Type I IEPR.

e. Type II IEPR. A Type II IEPR is required to insure public health, safety, and welfare. The circumstances requiring a Type II IEPR are described in Paragraph 12. Each of those circumstances must be explicitly considered in developing a risk-informed rationale for determining the appropriate level of review, including the need for a safety assurance review.

16. Administration.

a. Judicial Review. This Circular is intended to improve the internal management of the USACE Civil Works Program, and is not intended to, and does not create any right or benefit, substantive or procedural, enforceable at law or in equity, against the United States, its agencies or other entities, its officers or employees, or any other person.

b. This Circular also does not apply to information that is:

(1) Related to certain national security, foreign affairs, or negotiations involving international trade or treaties where compliance with this Circular would interfere with the need for secrecy or promptness.

(2) Disseminated in the course of an individual agency adjudication or permit proceeding (including a registration, approval, licensing, site-specific determination), unless USACE determines that review is practical and appropriate and that the influential dissemination is

scientifically or technically novel or likely to have precedent setting influence on future adjudications and/or permit proceedings.

(3) A health or safety dissemination where USACE determines that the dissemination is time-sensitive.

(4) A USACE regulatory impact analysis or regulatory flexibility analysis subject to interagency review under Executive Order 12866, except for underlying data and analytical models used.

(5) Routine statistical information released by Federal statistical agencies (e.g., periodic demographic and economic statistics) and analyses of these data to compute standard indicators and trends (e.g., unemployment and poverty rates).

(6) Accounting, budget, actuarial, and financial information, including that which is generated or used by agencies that focus on interest rates, banking, currency, securities, commodities, futures, or taxes.

(7) Information disseminated in connection with routine rules that materially alter entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof.

(8) Responses to letters of inquiry, responses to Freedom of Information Act (FOIA) requests, and internal disseminations.

17. Implementation.

a. Decision Documents. This guidance is effective immediately and must be applied to all studies and reports regardless of the date the FCSA was signed. The costs associated with DQC and ATR will be shared according to the project purpose(s) and the phase of work. The costs associated with Type I IEPR, excluding the costs of contracts for panels, are cost shared in the same manner as other costs. The costs of contracts for Type I IEPR panels will be a Federal expense. For studies conducted by non-Federal interests Type I IEPR costs will initially be borne by the non-Federal sponsor and, if the project is implemented at some later date, these costs may be eligible for credit.

b. Implementation Documents. This guidance applies to any projects subject to Type II IEPR in PED or under construction as of 8 November 2007. All costs associated with Type II IEPR, will be shared according to the project purpose(s) and the phase of work. In planning for a Type II review, estimates will need to include the cost for the RMO to administer and manage the Type II review and the cost of the independent panel. The cost of a Type II review through completion of construction should be reasonable, scalable and a function of the complexity and duration of the project.

c. Guidance for Additional Funding. Normal budgetary procedures will be used to seek funds where IEPR funds have not been appropriated. The costs for any anticipated IEPR will be requested by study (or project) as part of the normal budget development process.

FOR THE COMMANDER:

JAMES C. DALTON, P.E.
Director of Civil Works

APPENDIX A

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APPENDIX B

Acronyms

A-E	architecture and engineering
ASA(CW)	Assistant Secretary of the Army for Civil Works
ATR	Agency Technical Review
BCOES	Biddability, Constructability, Operability, Environmental, and Sustainability
CAP	Continuing Authorities Program
CERCAP	Corps of Engineers Reviewer Certification and Access Program
CoP	Community of Practice
CSRM	Coastal Storm Risk Management
CX	center of expertise
DCG-CEO	Deputy Commanding General of Civil and Environmental Operations
DCW	Director of Civil Works
DDR	Design Documentation Report
DQC	District Quality Control
E&C	Engineering and Construction
EC	Engineering Circular
EDR	Engineering Documentation Report
EIS	Environmental Impact Statement
ER	Engineering Regulation
FCSA	Feasibility Cost Sharing Agreement
FOIA	Freedom of Information Act
FRM	Flood Risk Management
HQUSACE	Headquarters, U. S. Army Corps of Engineers
IEPR	Independent External Peer Review
IPR	In-Progress Review
LERRD	Lands, Easements, Rights of Way, Relocations, and Disposal Areas
MCX	Mandatory Center of Expertise
MSC	Major Subordinate Command
NAS	National Academy of Sciences
NED	National Economic Development
NEPA	National Environmental Protection Act
NER	National Ecosystem Restoration
NRC	National Research Council
OEO	Outside Eligible Organization
O&M	Operations and Maintenance
OMB	Office of Management and Budget
OMRRR	Operations, Maintenance, Repair, Replacement and Rehabilitation
PCoP	Planning Community of Practice
PCX	Planning Center of Expertise
PED	pre-construction engineering and design

PDT	Project Delivery Team
PgMP	Program Management Plan
P.L.	Public Law
PM	project manager
PMP	Project Management Plan
QA	Quality Assurance
QC	Quality Control
QCP	quality control plan
RIT	Regional Integration Team (HQUSACE)
RMC	Risk Management Center
RMO	Review Management Organization
RP	Review Plan
SAR	Safety Assurance Review
SME	Subject Matter Expert
TL	Technical Lead
USACE	U. S. Army Corps of Engineers
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act

APPENDIX C

Roles and Responsibilities

DISTRICT:
- Prepare RP, as part of PMP, to include scope of review, necessary data and models, etc.
- Post/publish RP on website with RMO endorsement and MSC approval memo.
- Obtain ATR Team agreement on key data such as hydraulic and geotechnical parameters early in design process.
- Assign DQC Review Lead.
- Conduct and document DQC seamlessly.
- PDT is responsible for a complete reading of the report prior to District Commander approval.
- Complete all peer reviews prior to signature from District Commander.
- Seek issue resolution support from MSC.
- Update RP to include review strategy for PED and Construction phases.
- Draft proposed response to IEPR review report and coordinate with RMO.
- When USACE response to IEPR is issued, the district will disseminate final Review Report, USACE response, and other materials to post on website and include in Decision Document.
- Support RMO in providing necessary effort to manage and coordinate review effort, including preparing draft documents.
- Assist RMO to prepare the Charge questions for the ATR and IEPR.

MSC:
- Establish Quality Management Plan (to include discussion of how DQC will be conducted and documented in districts) and execute procedures.
- Approve all RPs (and updates), assuring RMO has provided an endorsement letter, and vertical team concurrence.
- Support the district for ATR issue resolution.
- Coordinate and provide input to Type I IEPR annual report.
- Approve final Agency Response to Type II IEPR review reports.
- Provide QA process to include the adequacy and capability of the DQC teams and supplementing the team members from outside the district when necessary.
- Execute QA role and responsibility.

RMO (applicability varies by product under review):
- Coordinate all RPs, including reaching agreement on scope and details of effort.
- Endorse RPs and Updates.
- Assign ATR Team and ensure that ATR Team Lead is outside home MSC.
- Obtain services of the Cost Engineering MCX for review and certification of cost estimates.

• Work with ATR Team Lead to manage the ATR: for Type I IEPR, contract with Outside Eligible Organization (OEO); for Type II IEPR, contract with an A/E contractor or arrange with another government agency to manage Type II IEPRs.
• Assist district with preparing written responses to the IEPR review report for Type I IEPR; participate in Agency Decision Milestone.
• Participate in all planning milestone meetings and in IPR meetings relevant to product development and review work.
• Prepare Charge questions for reviewers.
• Coordinate model review and prepare recommendations for model certification or approval.
• Develop and maintain Standard Operating Procedures for the conduct of ATR and IEPR and model reviews.

HQUSACE:
• Complete policy reviews.
• Participate in issue resolution.
•
• For feasibility studies, release draft Chief's Report and decision documents for State and Agency Review as required by the 1944 Flood Control Act, as amended.
• Approve or deny requests for exclusions from Type I IEPR.
• Review requests to use NAS for Type I IEPR.
• Consider the district's proposed response to the Type I IEPR review report.
• Determine appropriate command level for issuing formal USACE response to Type I IEPR review report.
• Complete Congressional notification requirements.
• Web-postings with links to RPs on District's websites.

ALL:
• Conduct Quality Assurance.
• Uphold professional standards.
• Communicate well and often.
• Learn from prior reviews.
• Share lessons learned with the Community of Practice.

GLOSSARY

Terms and Abbreviations

Agency Technical Review – ATR is a seamless independent review by a qualified person or team not involved in the day-to-day production of a project/product, confirming quality control; confirming the technical competency and risk-informed decision making for proper application of clearly established criteria, models, regulations, laws, codes, principles and professional practices; confirming that appropriate solutions and implementation risks are considered; and ensuring the quality and credibility of the government's scientific and budgetary information. ATR is verified through a certification process at the completion of the product.

Conflict of Interest – The National Academy of Sciences defines “conflict of interest” as any financial or other interest that conflicts with the service of an individual on the review panel because it could impair the individual’s objectivity or could create an unfair competitive advantage for a person or organization.

Decision Document – As used in this Circular, a "decision document” is any Planning product that provides analysis and recommendations for an Agency decision to obtain project authorization to commit Federal funds for project implementation or project modification. A decision document is the basis for approval to send/receive funds as a result of entering into agreements with other agencies or organizations including those to obtain Congressional authorization.

District Quality Control – DQC is an integrated review approach that includes a Quality Management Plan providing for seamless review, Quality Checks (supervisory reviews, PDT reviews), a detailed peer review/checking of the documents, computations, and graphics, etc. DQC is the trigger to identify both the key risk-informed decisions and timing of reviews for high risk items/features that warrant additional evaluation by the ATR Team. DQC is verified through a certification process at the completion of the product.

Engineering Technical Lead – The Technical Lead (TL), formerly called Lead Engineer/Architect or Engineer-in-Charge, serves as the proponent for the project’s technical quality on the PDT. While the TL serves as the proponent for technical quality on all Engineering and Construction (E&C) deliverables, each member of the PDT retains their responsibility for technical quality.

Implementation Document – As used in this Circular, an “implementation document” is defined as a document, generally prepared subsequent to the decision document, which supports project implementation or project modification consistent with the decision document and its authorization. A Plans and Specifications package is one example of an implementation document.

Independence – In its narrowest sense, independence in a reviewer means that the reviewer was not involved in producing the draft or final document to be reviewed. Peer reviewers must not have participated in development of the work product. However, for IEPR, a broader view of independence is necessary to assure credibility of the process, and IEPR reviewers are generally not employed by the agency or office producing the document. The National Academy of Sciences has stated, "external experts often can be more open, frank, and challenging to the status quo than internal reviewers, who may feel constrained by organizational concerns."

Information Quality Act – Congress directed OMB to issue guidelines to "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility and integrity of information" disseminated by Federal agencies. P. L. No. 106-554, § 515(a).

Lead Planner – The Lead Planner serves as the proponent for planning studies in project development on the PDT. This role includes facilitating and guiding formulation, ensuring utilization and application of risk-informed decision making and ensuring policy and statutory compliance.

Outside Eligible Organization – An organization that:
(1) Is described in section 501(c)(3), and exempt from Federal tax under Section 501(a), of the Internal Revenue Code of 1986;
(2) Is independent;
(3) Is free from conflicts of interest;
(4) Does not carry out or advocate for or against Federal water resources projects; and
(5) Has experience in establishing and administering peer review panels.

Peer Review – One of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. It is a form of deliberation involving an exchange of judgments about the appropriateness of methods and the strength of the author's inferences. Peer review involves the review of a draft product for quality by specialists in the field who were not involved in producing the draft.

Quality Assurance – That part of quality management focused on providing confidence that quality requirements of a project, product, service, or process will be fulfilled. QA includes those processes employed to ensure that QC activities are being accomplished consistent with planned activities and that those QC activities are effective in producing a product that meets the desired end quality.

Quality Control – That part of quality management focused on fulfilling quality requirements of a project, product, service, or process. It includes those processes used to ensure performance meets agreed upon customer requirements that are consistent with law, regulations, policies, sound technical criteria, schedules, and budget.

Risk Register – The Risk Register (RR), an important risk management tool, is a log (spreadsheet) in which you record the relevant details of the risks that could result from actions taken or not taken during each stage of a project's life cycle. The PDT and all levels of the vertical team have input and joint ownership of the RR. The risk register should be used as a guide for decision-making in a timely manner, making and accepting decisions based on information available to the PDT at that time.

Scientific Information – Factual inputs, data, models, analyses, technical information, or scientific assessments based on the behavioral and social sciences, public health and medical sciences, life and earth sciences, engineering, or physical sciences. This includes any communication or representation of knowledge such as facts or data, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual forms.

Uncertainty – Uncertainty is inherent in science, and many individual studies do not produce conclusive evidence. Thus, when an agency generates a scientific assessment, it is presenting its scientific judgment about the accumulated evidence rather than scientific fact. Specialists attempt to reach a consensus by weighing the accumulated evidence. Peer reviewers can make an important contribution by distinguishing scientific facts from professional judgments. Furthermore, where appropriate, reviewers should be asked to provide advice on the reasonableness of their judgments made from the scientific evidence.

Vertical Team – Includes members from district, MSC, RMO, and HQUSACE.

From: [redacted] (b)(6)
To:
Date: Thursday, May 31, 2018 1:21:00 PM

SECTION 2.0 CURRENT AND FUTURE CONDITIONS

2.1. General Setting

Mobile Harbor is located in the southwestern part of Alabama at the confluence of the Mobile River and the head of Mobile Bay. The harbor is approximately 28 nautical miles north of the Bay entrance from the Gulf of Mexico and 170 nautical miles east of New Orleans, Louisiana. The Mobile Bay Ship Channel provides access to numerous private and public docks and berthing areas. The current dimensions of the ship channel are 47 feet by 600 feet wide across the Mobile Bar and 45 feet deep by 400 feet wide in the bay and 45 feet deep by 730 feet wide in the Mobile River to a point about one mile below the Interstate 10 highway tunnels. The channel then becomes 40 feet deep and proceeds north over the Interstate 10 and U.S. 90 Highway tunnels to the Cochrane Bridge. In the southern region of Mobile Bay, access can be gained to the Gulf Intracoastal Waterway which stretches from St. Marks, Florida to Brownsville, Texas. The Theodore Industrial Canal provides for a 40 feet deep, 400 feet wide channel, branching from the main ship channel in Mobile Bay at a point about 2.8 miles north of Mobile Bay Light House and extending northwesterly about 5.3 miles to the shore of Mobile Bay. Figure 1 1 illustrates the study area.

Mobile Harbor is comprised of both public and private port facilities located in Mobile, Alabama. Due to the nature of the cargo, vessel types and sailing drafts, the Port facilities are segmented into three areas for economic analysis purposes; the Mobile Bay Ship Channel (MBSC), the Mobile River Channel (MRC) and the Theodore Ship Channel (TSC). The Mobile Bay Ship Channel has 45 foot depth and serves the public terminals of the ASPA: Pinto Steel; ASPA McDuffie Coal; ASPA Intermodal Container Terminal; and, the Cruise Terminal. The Mobile River Channel has a 40 foot draft and serves public and private terminals. The Theodore Ship Channel serves privately owned and operated facilities.

2.2. Port Facilities

2.2.1. Facilities and Infrastructure

The ASPA has a total of 41 berths; the channel depth is 45 feet to the tunnels and 40 feet in the River Harbor. The facilities include the main complex, McDuffie Island, Choctaw Point and other sites. According to ASPA, the port's economic impact in Alabama is approximately 127,590 direct and indirect jobs, over $506 million in direct and indirect tax impact and a total economic impact of more than $18.7 billion. The main imports are heavy lift and oversized cargo, containers, coal, aluminum, iron, steel, copper, lumber, wood pulp, plywood, fence posts, veneers, toll and cut paper, cement and chemicals. Main exports are heavy lift and oversized cargo, containers, coal, lumber, plywood, wood pulp, laminate, flooring, roll and cut paper, iron, steel, frozen poultry, soybeans and chemicals.

2.2.1.1. Mobile Ship Channel Terminals

The Mobile Ship Channel terminals are located south of the Bankhead and Wallace vehicular tunnels. The facilities located on this segment of the river are the Alabama Cruise Terminal, McDuffie Coal Terminal, Pinto Island Terminal and APM Terminals Mobile.

The Alabama Cruise Terminal offers a two-story 66,000 square foot terminal that is located within 0.5 miles of I-10 and 6 miles from I-65, and offers a close proximity to numerous hotels, restaurants and attractions. A Carnival Cruise Line Fantasy-class cruise ship began calling Mobile Harbor in November of 2016.

APM Terminals Mobile (an independent division within the A.P. Moller-Maersk Group) is located at Choctaw Point near the mouth of the Mobile River and opened in 2008. The APM Terminal's investment combined with the ASPA extended capacity of the container terminal to 800,000 Twenty Equivalent Units (TEUs) when land and rail are considered. Phase three expansion of the terminal will bring the landside throughput capacity to 650,000 TEUs and is expected to be complete in 2018. Combined with rail, the total throughput capacity will be 950,000 annual TEUs. The inland trade region includes the southeast, in particular, Atlanta, Birmingham and Knoxville, but extends as far as Chicago. The terminal improves capability in the U.S. Gulf for reaching Midwest markets as well as Alabama and neighboring states. The 95-acre terminal has a 45 foot channel and 2,000 feet of deep water berth to handle post Panamax vessels. In 2016, the ASPA completed construction of a $32-million 80-acre rail terminal that permits direct and fluid transfer of containers between vessels and rail cars. The dock has a depth of 45 feet MLLW and equipped with two ship-to-shore (STS) cranes capable of a 19-row reach. In addition, two super post panama cranes that span 22-rows of containers were delivered in June 2017.

Distribution Center Development: In 2016, it was announced that Walmart will be building an import distribution center (DC) in Mobile County, AL. The DC will be approximately 2,500,000 square feet on 400 acres of land in

Irvington, AL. The DC will be Walmart's sixth import facility in the Unites States. The purpose of the DC is to receive containers from Asia to distribute the products to Walmart stores across the southeast. The containers will come through APM Terminals located approximately 15 miles from the DC site. The Walmart distribution center will be a mecca for the south east region of the US serving around 800 stores and several regional distribution centers in Alabama, Mississippi and other areas to the north. This is the fourth Walmart DC in the state. It's expected to become operational in May 2018. The capacity of the DC is around 160,000 TEUs.

The terminal has nine current lines that customers can utilize in Mobile. The regions served are North Europe, Asia and Gulf of Mexico. Two additional services are expected by 2019. In 2018, a South America to Gulf service is expected and in 2019, a West Coast South America to Gulf of Mexico service is expected.

McDuffie Coal Terminal is the largest coal import terminal in the nation with an annual throughput capacity of 23 million tons. McDuffie Island offers two bulk operations capable of receiving vessels that draft 45 feet. McDuffie Coal Terminal has two ship loaders at 1,900-feet of berth space and one ship unloader at a third berth with a length of 1,000 feet with and double stacker and conveyor system that handles both iron ore and coal. McDuffie has three stacker-reclaimers, both tandem and single railcar dumps, and three loop tracks around the facility for easy coal car handling, as well as a barge loader and unloaders.

Pinto Island Terminal, located near the mouth of the Mobile River, is capable of handling annually in excess of five million tons of semi-finished steel slabs. The 20-acre terminal provides 1,000 feet of deep-water dock dredged to 45 feet, as well as an automated barge loading system position between the ship berth and the shoreline. The terminal is equipped with three gantry cranes that are able to unload steel from ships to waiting barges or to the terminal storage yard possessing 150,000 metric tons of storage capacity.

2.2.1.2. Mobile River Channel Terminals

ASPA Main Dock Complex extends approximately 2.2 miles along the west bank of the Mobile River and is bordered by the Terminal Railway tracks to the west and Three-Mile Creek to the north. The 570 acre terminal includes approximately 1.9 million square feet of warehouse space within the main port area and a 22-acre Bulk Handling Plant at the north end. The Terminal Railway, which is owned by ASPA, interchanges with five Class 1 Railroads and has immediate access to I-65 and I-10. The primary commodities handled within the main dock complex are forest products, iron and steel products, aluminum, and Ro-Ro cargoes. The facility is capable of handling 75,000 TEUs.

Blakely Terminal is located on the eastern shore of the Mobile River across from the northern end of the ASPA facilities and has a berth length of 700 feet. On the property is a 153,000 square foot warehouse. The terminal handles crude oil, asphalts and fuel oil.

Plains Marketing is a private terminal whose purpose is to receive and ship crude oil. It has an 800 foot dock with a 40 foot depth.

Vehicle Processing Roll On/Roll Off Facility is a new facility that will allow vehicles to be driven on and off ships at Mobile. The ASPA is partnering with a joint venture out of South America to build and operate the facility. The new processing and logistics terminal will be built from a former bulk material handling facility expanding approximately 57 acres.

2.2.1.3. Theodore Ship Channel

The Theodore Industrial Canal is situated on 400 acres at the mouth of a deep water industrial canal. There are two docking facilities, one 1700 feet and another 1300 feet. The port's heavy lift capabilities allow essentially any cargo to off loaded and/or loaded. The port services vessels any length and breadth through the Panamax class. There are on-berth and off-berth open and covered storage areas.

From: [redacted]
To:
Cc:
Subject: RE: GRR ? (UNCLASSIFIED)
Date: Thursday, May 31, 2018 1:44:00 PM

Noted. Thanks, [redacted]!

-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 1:41 PM
To: [redacted]
Cc:
Subject: RE: GRR ? (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Yeah. We are good to go. I back checked [redacted] and it looks like she got the references and comments cleaned up.

As and FYI I had [redacted] rerun some volumes and acres on our open water sites as the numbers did not look right to me. He found the error and corrected it. I was going to update these numbers, but that would impact others sections in the main report an appendices. Not worth messing with this go around. I will correct these numbers after the review as it does not impact the conclusion of the analysis.

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 1:24 PM
To: [redacted]
Subject: RE: GRR ? (UNCLASSIFIED)

[redacted]
Can I post the Engineering Appendices now?

[redacted]

-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 10:04 AM
To: [redacted]
Subject: RE: GRR ? (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

It will be a push, but as you can see with us completing the EN appendix and write-up over the weekend if I am told that is the schedule I find a way. My focus next two weeks will be to finish up the water quality stuff to support the upcoming ADEM/EPA meeting and the write up for OP on SIBUA.

[redacted]
-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 9:46 AM
To: [redacted]
Subject: RE: GRR ? (UNCLASSIFIED)

[redacted] and Col. DeLapp are pushing very hard for us to release 28 June which means that we have to be done by June 19. Not feeling confident right now but better than last week at this time.

Does this sound possible from your persective? [redacted] is really concerned.

-----Original Message-----
From: [redacted]
Sent: Thursday, May 31, 2018 9:39 AM
To: [redacted]
Subject: GRR ? (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

How are we looking schedule wise on Mobile Harbor GRR?

[redacted]

CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED